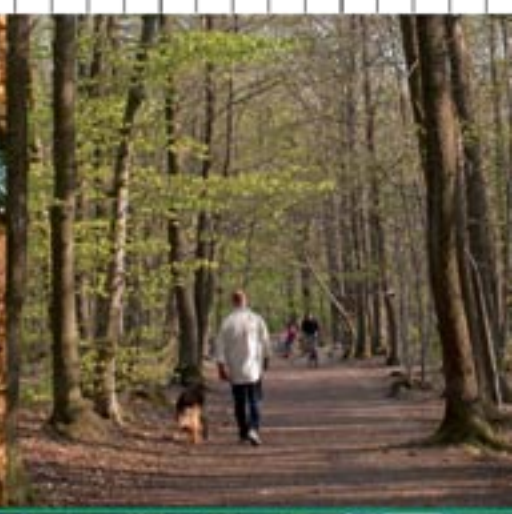
2010 Edition

Indicators for the sustainable management

of French metropolitan forests






Inventaire Forestier National

Foreword

This is the fourth enhanced and updated edition of the report *Indicators for the Sustainable Management of French Forests*, which was previously published in 1995, 2000 and 2005.

It is an essential reference to gain further insight into our forests, which cover almost 30% of metropolitan France. It pools the knowledge of managers, ecologists researchers, statisticians, administrators and other stakeholders who are all striving to ensure the sustainable management of French forests, where economic, environmental, landscape and society aspects are crucial in addressing the current challenges facing our country.

French forest policies are formulated on the basis of knowledge and characterization of the country's forests. It is thus essential to have access to regularly updated, reliable and comprehensive data.

The new inventory method that the French National Forest Inventory (NFI) has been implementing since 2005 provides access to comprehensive synchronous inventory data for the entire country, including homogenous annual data, which facilitates monitoring of many indicators.

This report also makes effective use of the new redistribution of forest regions, which makes it easier to account for the ecological conditions in forest ecosystems and to assess the impact of climate change. This new division includes 86 silvoecoregions (SER) grouped in 12 large ecoregions (GRECO).

I would like to thank everyone who contributed to this report. In addition to their enthusiastic interest in forests and their diversity, this active participation reflects a remarkable capacity to adapt to new working methods.

Director General for Agricultural, Agrifood
and Regional Policies

Eric ALLAIN

Production

French National Forest Inventory

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Preface

The United Nations Conference on the Environment and Development (UNCED, Rio de Janeiro, 1992) outlined the main principles for sustainable development. The Pan-European Forest Process (or so-called Helsinki Process) was launched as a follow-up to the Second Ministerial Conference on the Protection of Forests in Europe (Helsinki, 1993) with the aim of applying UNCED principles to European forests. The Third Conference (Lisbon, 1998) defined criteria and indicators for sustainable forest management in Europe that the signatory countries are committed to update and enhance on a regular basis. This commitment was confirmed in the Fourth Conference (Vienna, 2003), which also recommended that the criteria and indicators be integrated in national forest programmes. The Fifth and Sixth Conferences (Warsaw, 2008, and Oslo, 2011) validated the indicators as European forest policy instruments.

France has been publishing *Indicators for the Sustainable Management of French Forests* every 5 years since 1995 to review the progress. This is the fourth edition. It consists of 35 quantitative indicators that were adopted at the Vienna Conference in 2003 and which are classified under the six sustainable management criteria delineated at the Helsinki Conference. The six criteria are key sustainable management topics: forest resources, forest health, production and harvesting, biodiversity, forest protective functions and other services of forests. These key topics are classified by indicators, i.e. quantitative, qualitative or descriptive tools which, when measured and monitored periodically, highlight change trends. With every new edition, this pan-European list has been supplemented with other, sometimes novel, so-called national indicators that are used to assess features specific to French forests. For clarity, the so-called Vienna indicators are presented separately from those specific to the French forest setting: code numbers referring to the French indicators have three digits, whereas those pertaining to European indicators have two digits. Within the current pan-European setting, the present document is focused only on metropolitan French forests, as in the previous editions.

The Direction générale des politiques agricole, agroalimentaire et des territoires (DGPAAT) of the French Ministry of Agriculture, Food, Fisheries, Rural Affairs and Spatial Planning (MAAPRAT) assigned the French National Forest Inventory (NFI) with the task of producing this document. It was coordinated by a steering committee of members from organizations and institutions in the forest-wood sector, and it benefited from the contribution and suggestions of various other stakeholders in this sector and relevant associations.

Cautionary note

European and French indicators

The indicator headings outlined in the 2003 Vienna Conference were copied entirely, even in cases where tables do not fully mesh with the topics, and then a subtitle specifies the scope of the indicator. The codes for indicators defined in the Vienna Conference have two digits, while the specific French indicator codes have three. These latter indicators are attached, where possible, to the most relevant Vienna Conference topics.

French National Forest Inventory (NFI) data

The NFI data presented in this document only refer to forests available for wood supply (FAWS) in metropolitan France. They were calculated with data collected using two different inventory methods* depending on whether they were collected prior to or after 2005.

The adoption of the international definition of forests in 2005 and the national streamlining of inventory implementation conditions during the switch to this new inventory method caused a break in the series of forest area data. This in turn led to a break in all other data series. The 2010 data should thus be considered as a new baseline for the indicators developed on the basis of NFI data. It should also be kept in mind that all comparisons between the 2005 edition of this ISFM report and the new data were affected to different extents. The commentaries generally do not highlight variations between data in the 2005 and present editions. In addition to these changes concerning the entire French forest, there were changes in the definition of some distribution variables. These changes are explained in the text under the concerned indicators.

Data from the 2005 edition of the Indicators for the sustainable management of French forests report

Data indicated under 'retrieval year' 1989, 1994, 1999 and 2004 were calculated using data collected by the former inventory method. These were the most recent data available on 1st January of the corresponding year. Given the frequency of the inventories undertaken in each department with the former method (12 years on average), they correspond to the mean years 1981, 1986, 1991 and 1996, respectively**. These mean inventory years are noted in the tables under the data retrieval years. The impact of the storms of December 1999 was thus only partially taken into account in the 2004 NFI data based on the mean year of 1996.

Data from the 2010 edition of the Indicators for the sustainable management of French forests report

The 2010 data were calculated using data collected under the new NFI inventory method described in Appendix II. These data were pooled from the annual inventory surveys of 2006 to 2009, spanning the period from November 2005 to October 2009. The 2005 inventory data were disregarded since some distribution variables were not available for this inventory. The mean date associated with these results was around late 2007. Moreover, the impact of cyclone Klaus in January 2009 (high volumes of damaged trees were culled) was taken into account for some of these data.

The definition of terms for the NFI data used in this report are summarised in Appendix III. A table summarising the areas calculated by NFI is presented in Appendix IV. These NFI results concern the FAWS area, which includes poplar plantations but not thickets, in compliance with the international forest definition. **Data for the 2005 edition (years 1989 to 2004) do not include poplar plantations, but they take thickets into account**.

The statistical data are presented with a 95% confidence interval***. These were considered significant when the variation coefficient was not over 30% of the estimated value for area data, and 80% of the estimated value for other data (when the first condition on the area was confirmed).

* See Appendix II for a description of the new inventory method.

**Appendix I provides a list of French departments and survey dates used by NFI for the four mentioned dates.

*** Out of 100 samples collected, 95 would have values within this confidence interval while 5 would have values outside of it.

Contents

Criterion 1

MAINTENANCE AND APPROPRIATE ENHANCEMENT OF FOREST RESOURCES AND THEIR CONTRIBUTION TO GLOBAL CARBON CYCLES

Indicator 1.1

Area of forest and other wooded land, classified by forest type and by availability for wood supply

The French Service de la statistique et de la prospective (SSP, formerly SCEES) of the French ministry responsible for forests (MAAPRAT) has been conducting annual surveys since 1982 on landuse patterns. The landmark sampling changes that took place in 1991 and 2005 gave rise to three series of survey results, i.e. Teruti 1 between 1982 and 1990, Teruti 2 between 1992 and 2003 and Teruti-Lucas since 2006. The forest area presented here was estimated on the basis of the Teruti 2 surveys for the ISFM 2005 edition and the Teruti-Lucas surveys for more recent data.

All data on forests available for wood supply are NFI statistics. Definitions for each category are given in Appendix III.

Sustainable Forest Management Indicator (ISFM) 2005 Edition

Landuse		1993		1998		2003*	
		1 000 ha	*%*	*1 000 ha*	*%*	*1 000 ha*	*%*
Forest (incl. poplar plantations)		14 811	27	15 220	28	15 408	28
	Broadleaved	9 466	64	9 715	64	9 852	64
	Conifers	4 052	27	4 122	27	4 090	27
	Mixed	1 292	9	1 384	9	1 466	10
Other wooded land***		1 935	4	1 825	3	1 743	3
Thickets, hedges and scattered trees		1 664	3	1 563	3	1 517	3
Total wooded lands and other lands with tree cover		**18 410**	**34**	**18 608**	**34**	**18 668**	**34**
Others		36 509	66	36 311	66	36 251	66
Total France		**54 919**	**100**	**54 919**	**100**	**54 919**	**100**

Source: SCEES-Teruti 1993, 1998 and 2003; forests excluding poplar plantations correspond to physical nomenclature codes 18-21, poplar plantations to codes 24 and 25; FAO's other wooded land category** corresponds to heathland-maquis-garrigues in the Teruti study, code 70; thickets, hedges and scattered trees correspond to codes 22, 72, 23 and 26.

ISFM 2010 Edition

Landuse		2006*		2007		2008		2009		2010	
		1000 ha	*%*	*1000 ha*	*%*	*1000 ha*	*%*	*1000 ha*	*%*	*1000 ha*	*%*
Forest (incl. poplar plantations)		15 095	27	15 128	28	15 115	28	15 125	28	15 137	28
	Broadleaved	9 206	17	9 303	17	9 243	17	9 281	17	9 300	17
	Conifers	3 293	6	3 272	6	3 283	6	3 244	6	3 227	6
	Mixed	2 530	5	2 492	5	2 530	5	2 548	5	2 556	5
	Temporarily unstocked	65	0	61	0	59	0	52	0	54	0
Other wooded land***		2 442	4	2 456	4	2 499	5	2 510	5	2 499	5
Thickets, hedges and scattered trees		1 947	4	1 909	3	1 898	3	1 872	3	1 863	3
Total wooded lands and other lands with tree cover		**19 484**	**35**	**19 493**	**35**	**19 512**	**36**	**19 508**	**36**	**19 499**	**36**
Others		35 436	65	35 426	65	35 407	64	35 411	64	35 420	64
Total France		**54 919**	**100**	**54 919**	**100**	**54 919**	**100**	**54 919**	**100**	**54 919**	**100**

Source: SSP-Teruti-Lucas. Forests excluding poplar plantations correspond to physical nomenclature codes 31100, 31200 and 31300, poplar plantations to code 31400, clearcuts to code 34000. Thickets and hedges or rows respectively correspond to codes 32000 and 33000. Other wooded lands correspond to heathlands, fallows, maquis and garrigues in the Teruti-Lucas survey (code 40000).

* The decline in the forest area estimates between 2003 and 2006 is associated with the sampling and nomenclature changes between the Teruti and Teruti-Lucas surveys. Note that the confidence interval for the forest area data is ± 0.2 Mha.

** cf. Appendix III

*** Other wooded lands correspond to heathlands, fallows, maquis and garrigues.

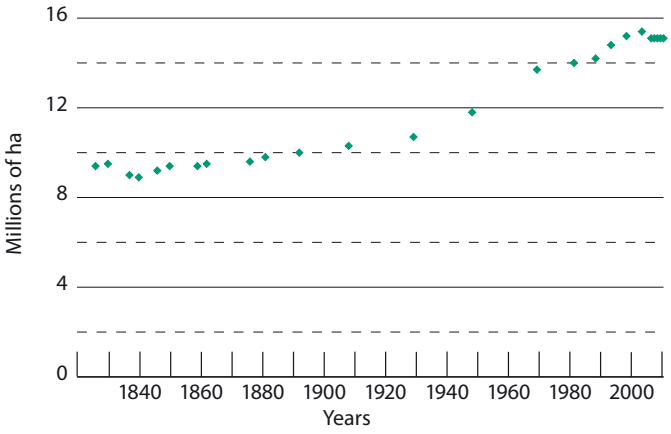


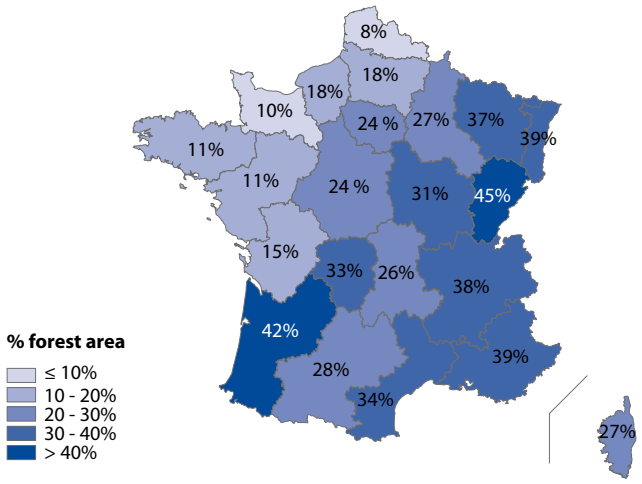
Figure 1: Variation in forest area over the last 2 centuries.

Source: Cinotti, based on a multi-source compilation for the pre-1980 period, SCEES.
Teruti until 2003 and SSP-Teruti-Lucas from 2006.

Box 1: Variations in forest area over the last 2 centuries

The area of land under forest has increased markedly since the early 19th century—it seems to have virtually expanded by two-thirds in nearly 2 centuries.

This situation, which is common to most European countries, is especially the upshot of higher agricultural yields and the reduced need for land for food production in the 19th and 20th centuries. It has also led to planned and natural reforestation of marginal land that had been cleared and cultivated as a result of population pressure. This has simplified erosion and flood control initiatives within the framework of national policies. This sharp rise in forest area over 2 centuries is, however, uneven and disguises the fact that land is still being cleared as a result of urban growth and infrastructural development, particularly around large built-up areas and also that some unique forest environments, such as alluvial forests, are dwindling because of major projects undertaken to modify the course of large rivers.



Map 1: Percentage of forest area by administrative region in 2010.
Source: SSP – Teruti-Lucas.

Due to the switch from the Teruti survey to the Teruti-Lucas survey, it is not possible to make direct comparisons between annual forest areas. **The decline in forest area between the 2003 and 2006 surveys was due to the sampling and nomenclature changes***. The increase in other wooded land area is due to the fact that fallows were not distinguished from heathlands in the Teruti-Lucas survey, while the increase in hedge area could be explained by the change in the hedge definition.
Even though the direction of the trend is beyond doubt, the different values plotted on the graph should be considered with caution since, until 1960, they were based on estimates from varied sources, often drawn from the land register. This register is above all a fiscal instrument that often underestimates forest areas. From certain surveys, it can be estimated that in slack periods of afforestation the land register's underestimate is usually around 20%, but that in periods of intense afforestation the underestimate may be as much as 50% for some localities. The land register figures have nevertheless become much more reliable in recent years.
From the 1980s, new statistical methods using aerial photography and field studies (Teruti survey of the SSP) and the permanent inventory of forest resources conducted by the French National Forest Inventory (NFI) have improved the assessment of forest areas.

France ranks 4th amongst EU countries in terms of forest area, surpassed by Sweden with 28 million ha (Mha), Finland with 22 Mha and Spain with 18 Mha (FAO, 2010). The forest area in France has expanded to the current level of 15.1 Mha (SSP, 2010), i.e. 27.6% of the total area. The total forest area has been relatively stable since 2006, with an increase only concerning a few tens of thousands of hectares overall. As compared to the clear increase in forest area that has taken place to date, this downturn is due to a decline in the afforestation of heathland, fallows and farmland. It is also associated with the decrease in agricultural abandonment and in subsidies that were provided to promote farmland afforestation.
The distribution of the different stand types remained stable, around 17% for metropolitan France for broadleaved stands, 6% for conifer stands and slightly less than 5% for mixed stands.
Other wooded lands increased slightly between 2006 and 2010. However, thickets, hedges and scattered trees declined by around 80,000 ha in 5 years.

* The 2003 data are from the Teruti survey, which included around 550,000 sampling points clustered around 36 landmarks. The 2006 data are from the Teruti-Lucas survey, which included around 309,000 sampling points clustered around 10 landmarks. Note also that the 'Low density afforestation' category had been omitted in the Teruti-Lucas survey.

Forests available for wood supply (FAWS)

Data from the new NFI inventory method
(see Cautionary note p. 4)

Data retrieval year Survey years	2010 2006 to 2009	
Forest area	*1000 ha*	*% eligible for inventory*
Poplar plantations	196 ± 20	87
Broadleaved	9 950 ± 113	94
Conifers	3 488 ± 83	93
Mixed	1 641 ± 65	95
Temporarily unstocked stands	44 ± 13	0
Total FAWS	**15 319 ± 104**	**91**

Source: NFI.
Relevant domain: FAWS.

These percentages were calculated solely on the basis of NFI data, but not with the SSP data presented above.

The French National Forest Inventory (NFI) data used for this indicator are from the annual 2006 to 2009 surveys. Despite the fact that their definitions are identical, a comparison with Teruti-Lucas survey data highlights certain differences, especially in regions of the Mediterranean Basin. In these regions, borders between the forest and maquis or garrigues depend on factors that are hard to assess (ground cover rates and potential stand heights). A comparison of the procedures is under way (in 2011).

Percentage of the forest area available for wood supply

Data retrieval year Survey years	2010 2006 to 2009
Forest area	*Percentage forests available for wood supply in the total forest area*
Poplar plantations	100
Broadleaved	96
Conifers	94
Mixed	94
Temporarily unstocked stands	100
Total FAWS	**95**

Source: NFI.
Relevant domain: FAWS.

These percentages were calculated solely on the basis of NFI data, but not with the SSP data presented above.

According to NFI, the forest available for wood supply (FAWS) area (cf. definition in Appendix III) has currently reached 15.3 Mha (± 0.1). The percentage of FAWS area relative to the entire forest area has remained steady (95%, as in the 2005 report). On average, the FAWS area consists of 91% stands eligible for inventory (cf. definition in Appendix III).
Private forests* cover an area of over 11.5 Mha (± 0.1), which means they represent 75% of the FAWS area. The remaining quarter includes state-owned forests (10% of the total) and other public forests (15%).

* NFI assigns a legal property category to each sampling point (state-owned forest, other public forest, private forest). NFI uses ancillary information for this classification: field maps based on forestry regulations provided by the Office National des Forêts (ONF). These maps sometimes compile information that is not recent (1987 to 2002), but they are currently the only available and usable references.

Indicator 1.1.1

Forest area gains and losses

Forest and poplar plantation area gains and losses and during three periods

Origin and allocation of forested area		1992 to 1997			1997 to 2003			2006 to 2010		
		Forested area gains	*Forested area losses*	*Balance*	*Forested area gains*	*Forested area losses*	*Balance*	*Forested area gains*	*Forested area losses*	*Balance*
		Variation in ha/year								
Man-made areas	Areas with structures	300	900	-600	100	1 100	-1 000	300	1 400	-1 100
	Coated or stabilised areas	1 800	3 100	-1 300	1 400	2 900	-1 500	4 200	10 300	-6 100
	Other man-made areas	2 800	3 600	-800	2 000	3 300	-1 300	4 200	5 600	-1 400
	Sub-total	4 900	7 600	-2 700	3 500	7 300	-3 800	8 700	17 300	-8 600
Farmland	Arable land	10 400	5 700	4 700	6 100	5 500	600	5 700	7 700	-2 000
	Permanent crops	1 800	1 000	800	1 100	1 200	-100	2 200	2 500	-300
	Other cropland associated with agricultural production	800	500	300	300	500	-200	600	600	0
	Permanent grassland	26 900	4 800	22 100	16 000	5 400	10 600	14 200	12 500	1 700
	Sub-total farmland	39 900	12 000	27 900	23 500	12 600	10 900	22 700	23 300	-600
Natural areas	Other woodland*	30 400	14 300	16 100	14 800	8 800	6 000	37 600	22 000	15 600
	Heathland, fallows, maquis, garrigues**	78 000	15 800	62 200	38 800	13 500	25 300	53 300	52 500	800
	Natural bare areas	3 900	1 200	2 700	2 900	1 200	1 700	1 800	3 800	-2 000
	Wetlands and underwater areas	1 300	1 200	100	1 100	1 100	0	1 600	1 700	-100
	Sub-total natural areas	113 600	32 500	81 100	57 600	24 600	33 000	94 300	80 000	14 300
Prohibited araes		100	300	-200	100	200	-100	5 100	0	5 100
Total		**158 500**	**52 400**	**106 100**	**84 700**	**44 700**	**40 000**	**130 800**	**120 600**	**10 200**
Percentage of total in France		**0.29**	**0.10**	**0.19**	**0.15**	**0.08**	**0.07**	**0.24**	**0.22**	**0.02**

Source: SSP - Teruti-Lucas. Annual mean in ha.

The landuse changes noted in the landuse surveys were minor phenomena and the associated confidence interval was often in the same range as the measured change. Moreover, changes in samples and nomenclature could have biased the comparison of patterns between periods, with the accuracy declining as the comparison becomes more detailed.

Beyond the main trends showing gradual stabilisation of the forest area as of the mid-2000s, and the permeability of the limits between forests, other woodland, heathland, fallows and farmland, these figures should be considered with caution.

* Other woodland includes hedges, thickets and scattered trees.

**Heathland, fallows, maquis, garrigues:

These areas are characterised by the presence of shrubs and low woody or semi-woody plants (generally less than 5 m tall) on more than 20% of the area. Scattered trees can account for less than 10% of the cover (projection of crowns on the ground).

Transfer matrices (Teruti 1 between 1982 and 1990, Teruti 2 between 1992 and 2003 and Teruti-Lucas since 2006) based on these three data series can shed light on landuse changes between two years provided that the sample is identical between the first and last year of the survey. Moreover, the period has to be long enough to eliminate bias due to 'noise' caused by temporary changes (e.g. a forest sampling point affected by windfalls is recorded in a heathland until reforestation occurs). Conversely, the period should not be too long in order to be able to detect trend variations over time. We therefore considered the three following periods which showed significant trend variations: 1992-1997, 1997-2003 and 2006-2010.

The forest area (including poplar plantations) increased by 106,000 ha/year during the first period, 40,000 ha/year during the second, and 10,000 ha/year during the third. The marked increase in forest area which was still under way in the early 1990s gradually levelled off around the end of the decade. Currently, considering the confidence interval attached to these values, it could be reasonably concluded that the forest area is now steady.

This net balance noted in the above paragraph is the result of two contrary patterns. The gains in forest area, i.e. 159, 85 and 131 thousand ha/year, were offset by losses of 52, 45 and 121 thousand ha/year, respectively. Gains slowed down substantially between the first and second period, whereas losses only moderately declined. There seemed to be a new acceleration in this change pattern over the 2006-2010 period. This latter point should be balanced against the fact that the adoption of a new sampling procedure always leads to monitoring errors during the initial years, but the situation is then gradually stabilised by correction.

Gains in forest coverage mainly concern heathland, fallows, maquis and garrigues, then farmland and finally other forested lands, mainly thickets. Over the periods, there is very little change in the proportions when taking the deviations induced by the change in sampling and nomenclature in 2005 into account:

– heathland and fallows: 49% from 1992 to 1997, 46% from 1997 to 2003, 41% from 2006 to 2010,
– farmland: 25% from 1992 to 1997, 28% from 1997 to 2003, 17% from 2006 to 2010,
– other forested lands: 19% from 1992 to 1997, 17% from 1997 to 2003, 29% from 2006 to 2010.

Forest area losses are also concentrated within these three categories:

– heathland and fallows: 30% from 1992 to 1997, 30% from 1997 to 2003, 44% from 2006 to 2010,
– farmland: 23% from 1992 to 1997, 28% from 1997 to 2003, 19% from 2006 to 2010,
– other forested lands: 27% from 1992 to 1997, 20% from 1997 to 2003, 18% from 2006 to 2010.

The net balance in exchanges between the forest, on one hand, and heathland, fallows, farmland and other forested lands, on the other, decreased substantially over time but still remained positive for the forest: + 106,000 ha/year from 1992 to 1997, + 42,000 ha/year from 1997 to 2003, and + 16,000 ha/year from 2006 to 2010. The main category in which exchanges were negative concerned man-made areas (areas with structures, coated or stabilised areas and other man-made areas) where the negative, yet limited, balance expanded over time: - 3,000 ha/year from 1992 to 1997, - 4,000 ha/year from 1997 to 2003, and – 9,000 ha/year from 2006 to 2010.

A detailed analysis of landuse transition matrices during the three periods sheds greater light on these trends (cf. Appendix IX) :

– the variations in heathland and fallows are in line with typical transitions that occur in periods of agricultural abandonment: farmland —> fallows —> heathland —> forest. The result of these transitions shows that:
• farmlands turned into heathlands and fallow lands at a rate of 32,000 ha/year from 1992 to 1997, 11,000 ha/year from 1997 to 2003, 29,000 ha/year from 2006 to 2010.
• heathlands and fallows were transformed into forest at a rate of 62,000 ha/year from 1992 to 1997, 25,000 ha/year from 1997 to 2003, 1,000 ha/year from 2006 to 2010.

– other forested lands generally turned into forest at a rate of 16,000 ha/year from 1992 to 1997, 6,000 ha/year from 1997 to 2003, 16,000 ha/year from 2006 to 2010. This positive shift is due to two contrasting trends:
• thickets gradually expanded to more than 50 ares, i.e. the threshold of the forest classification, at a rate of 30,000 ha/year from 1992 to 1997, 15,000 ha/year from 1997 to 2003, 38,000 ha/year from 2006 to 2010.
• compact forests over 50 ares were fragmented into thickets at a rate of 14,000 ha/year from 1992 to 1997, 9,000 ha/year from 1997 to 2003, 22,000 ha/year from 2006 to 2010.

Indicator 1.1.2

Forest area and afforestation rate by large ecoregion

Box 2: Large ecoregions and silvoecoregions

The 11 large ecoregions (GRECO) were delineated on the basis of a combination of macroclimatic, geological and topographical data for France and they correspond to the European ecoregion division for France. These GRECO are subdivided into 86 silvoecoregions (SER). Five recent azonal alluvia SER were also determined (NFI, 2011).

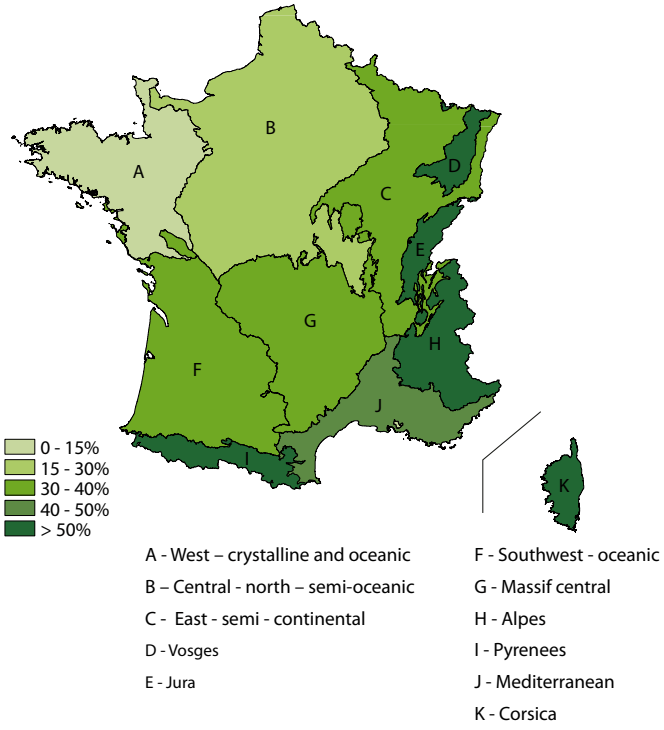
One silvoecoregion is the largest geographical zone within which factors that determine forest production, or the distribution of large types of forest habitat, fluctuate uniformly between accurate values according to a combination of factors that differ from combinations that characterize adjacent SERs.

SER and GRECO represent geographical divisions of the country based on ecological factors. They serve as a national reference for forest management framework documents. They are also useful for drawing up guidelines for selecting tree species, and thus are suitable for use by forest managers.

Forests available for wood supply

Large ecoregion	1 000 ha	Percentage forest area
A - West – crystalline and oceanic	597 ± 23	10
B - Central-north – semi-oceanic	2 840 ± 50	20
C - East - semi-continental	2 135 ± 49	31
D - Vosges	573 ± 26	63
E - Jura	484 ± 25	53
F - Southwest-oceanic	2 428 ± 47	31
G - Massif central	2 712 ± 54	38
H - Alps	1 151 ± 40	52
I - Pyrenees	742 ± 31	51
J - Mediterranean	1 267 ± 48	41
K - Corsica	390 ± 31	54
Total	**15 319 ± 104**	**30**

Source: NFI, survey years 2006 to 2009.
Relevant domain: FAWS.



Map 2: Percentage forest area by GRECO.
Source: NFI.

The highest percentages forest areas were noted in medium and high mountain regions (Vosges, Jura, Alps and Pyrenees) and in the Mediterranean region (Corsica, Mediterranean). In contrast, the large northwestern French region is less wooded with more farmland.

Vosges, Jura, Alps and Pyrenees GRECOs account for 19% of the French forest area, while Corsica and Mediterranean regions represent 11%, with the remaining 70% found in the other, mainly lowland, regions.

Indicator 1.1.3

Area by forest structure

Forests available for wood supply

ISFM 2005 Edition

Data retrieval year		1989		1994		1999		2004	
Average year		1981		1986		1991		1996	
Forest structure		*1000 ha*	*%*	*1000 ha*	*%*	*1000 ha*	*%*	*1000 ha*	*%*
Poplar plantations	Regular high forest	202	1	202	1	207	1	220	2
Forests	Regular high forest	5 753	42	6 021	44	6 423	46	6 768	47
	Irregular high forest	729	5	707	5	671	5	639	4
	Coppice	2 393	18	2 258	16	2 124	15	2 098	15
	Mixed coppice/high forest	4 368	32	4 322	31	4 241	30	4 201	29
	Temporarily unstocked*	93	1	137	1	139	1	115	1
	Unspecified	0	0	127	1	269	2	269	2
Total		**13 538**	**100**	**13 774**	**100**	**14 074**	**100**	**14 310**	**100**

* clear cutting or accident less than 5 years previously

Stands with unspecified structures correspond to stands not inventoried in the Mediterranean region.
Source: NFI.
Relevant domain: FAWS, including thickets.

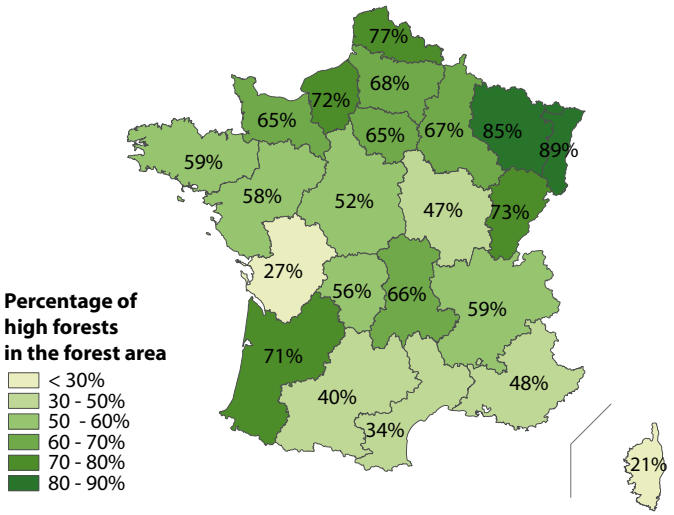
ISFM 2010 Edition

Data retrieval year		2010	
Survey years		2006 to 2009	
Forest structure		*1000 ha*	*%*
Poplar plantations	Regular high forest	196 ± 20	1
Forests	Regular high forest	7 556 ± 104	49
	Irregular high forest	638 ± 40	4
	Coppice	1 736 ± 65	11
	Mixed coppice/high forest	4 304 ± 93	28
	Temporarily unstocked	42 ± 12	0
	Open forest	848 ± 56	6
Total		**15 319 ± 104**	**100**

Source: NFI.
Relevant domain: FAWS.

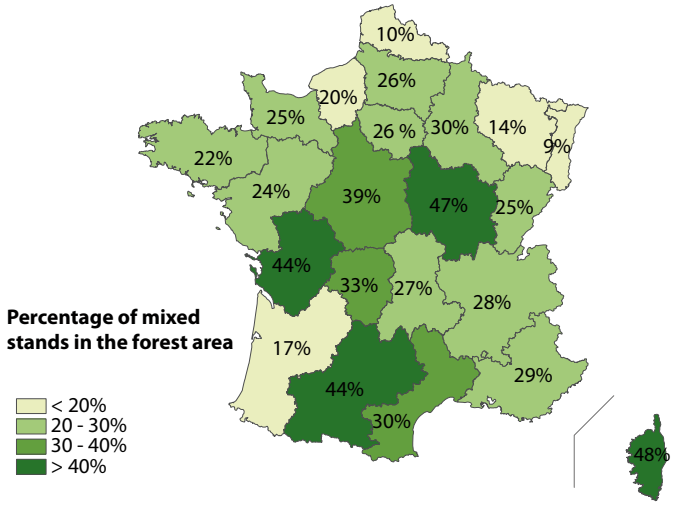
The forest structure (cf. definition in Appendix III) includes the vertical organisation of the stand, the origin of the trees within the structure and their size. It no longer includes any silvicultural considerations, which concern management or intended management.

Temporarily unstocked stands, as defined by NFI, are henceforth considered as completely nil forest areas with tree canopy, regardless of whether the focus is on trees eligible or not for inventory. This definition differs slightly from that used in the ISFM 2005 edition, where a temporarily unstocked area corresponded to a forest area that had undergone clear cutting or accident less than 5 years previously, and on which live trees eligible for inventory had a total absolute cover of less than 10%, with regeneration being nil or uncertain.



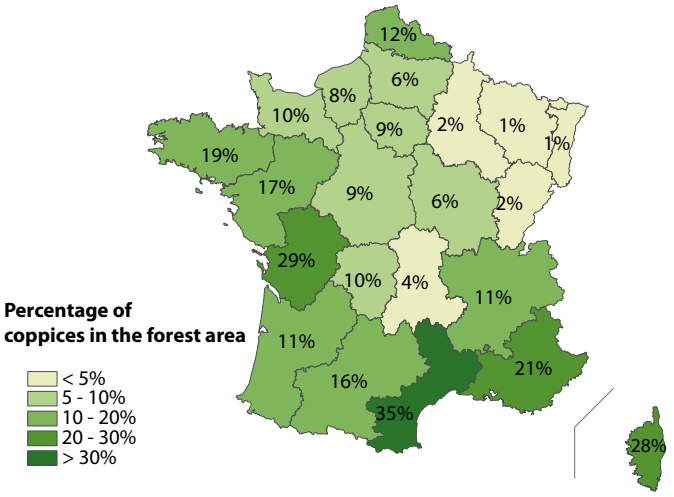
Map 3: Percentage of regular and irregular high forests in the closed* FAWS area.

Source: NFI, survey years 2006 to 2009.



Map 4: Percentage of mixed coppice/high forests in the closed* FAWS area.

Source: NFI, survey years 2006 to 2009.



Map 5: Percentage of coppices in the closed* FAWS area.

Source: NFI, survey years 2006 to 2009.

High forest accounts for most of the French FAWS: regular high forests (forest or poplar plantations) represent half of the area while irregular high forests represent 4% of this area.

The increase in **regular high forest** noted in previous editions is still under way. However, caution is needed because the real pattern cannot be distinguished from the impact of methodological changes. This increase is likely the result of natural growth and ageing of coppices and mixed coppice/high forest stands. Pedunculate oak is the most common tree species in coppice, covering an area of slightly over 1 Mha, followed by sessile oak, maritime pine and beech, each of which covers over 900,000 ha.

The two French regions with the largest irregular high forest area are Rhône-Alpes with 201,000 ha ± 22,000 (14% closed FAWS* in this region) and Provence-Alpes-Côte d'Azur with 133,000 ha ± 18,000 (12%). Midi-Pyrénées, Aquitaine, Languedoc-Roussillon and Franche-Comté regions also have substantial regular high forest areas, ranging from 44,000 ha ± 10,000 for Franche-Comté to 53,000 ha ± 11,000 for Midi-Pyrénées.

The region with the largest regular high forest area (excluding poplar plantations) is Aquitaine, with 1.2 Mha. Regular high forest accounts for 68% of the closed FAWS area in this region (excluding poplar plantations). The percentage of regular high forest (excluding poplar plantations) in the closed FAWS area varies markedly depending on the region, ranging from 85% in Alsace to only 15% in Corsica. Generally, all regions in most of northern France, from Nord-Pas-de-Calais to Centre, have over 50% of regular high forest (including two-thirds of broadleaved stands). Conversely, most regions with a low percentage of regular high forest are in the vicinity of the Mediterranean, including Provence-Alpes-Côte d'Azur, Midi-Pyrénées, Languedoc-Roussillon and Corsica, as already mentioned. Poitou-Charentes region also has one of the lowest percentages of regular high forest.

Mixed coppice/high forest stands represent over a quarter of the FAWS stands, a pattern that is specific to France, in contrast with most other European forests. Coppices account for over 10% of the FAWS area. Open forests* represent 6% of all FAWS.

The regions with the highest percentage of mixed coppice/high forest stands are Corsica, Bourgogne, Poitou-Charentes and Midi-Pyrénées, while the lowest percentage is in Alsace and Nord-Pas-de-Calais.

The most common tree species in **coppice stands** are pubescent oak with 410,000 ha (± 33,000), holm oak with 360,000 ha (± 32 000) and chestnut with 239,000 ha (± 24 000). The following tree species are also found in high forest stands: pedunculate oak with over 115,000 ha, sessile oak, birch, beech, willow and false acacia, which cover an area ranging from 50,000 to 80,000 ha, respectively, as well as ash, hornbeam and large alder, covering an area of 30,000 to 50,000 ha.

* definition in Appendix III

Regions with the most coppices are mainly in the Mediterranean area: Languedoc-Roussillon (334,000 ha ± 27,000 or 35% of the closed FAWS area), Corsica (28% - 80,000 ha ± 18 000) and Provence-Alpes-Côte d'Azur (227,000 ha ± 25,000 – 21%). Poitou-Charentes region also has a high percentage of coppices (29%).

The total popular plantation area in France is 196,000 ha (± 20 000), including 28,000 ha (± 7,000) in Picardie, 22,000 ha (± 6,000) in Champagne-Ardenne and almost 20,000 ha (± 6,000) in Pays-de-la-Loire. The Garonne River basin (Midi-Pyrénées and Aquitaine) accounts for around 33,000 ha of poplar plantations. The statistical data for all other regions are not significant.

Temporarily unstocked areas only represent a low percentage of the FAWS area. These areas are mainly found in Aquitaine, Limousin, Lorraine and Poitou-Charentes regions.

Oak coppice at Lamastre (Ardèche region) in autumn 2008.

Regeneration cut in a high forest in Indre department.

Indicator 1.1.4

Forest area by main tree species and composition

Forest area by main tree species

ISFM 2005 Edition

Data retrieval year	1989		1994		1999		2004	
Average year	1981		1986		1991		1996	
Main tree species	*1 000 ha*	*% of total area*	*1 000 ha*	*% of total area*	*1 000 ha*	*% of total area*	*1 000 ha*	*% of total area*
Pedunculate oak	2 382	18	2 424	18	2 333	17	2 200	16
Sessile oak	1 762	13	1 777	13	1 868	14	1 835	13
Undifferentiated oak*	-	-	-	-	-	-	148	1
Beech	1 231	9	1 255	9	1 291	9	1 301	9
Pubescent oak**	846	6	860	6	920	7	981	7
Chestnut**	515	4	488	4	492	4	496	4
Holm oak**	367	3	390	3	432	3	432	3
Common ash	271	2	309	2	359	3	398	3
Hornbeam	202	2	197	1	198	1	204	1
Birch	199	1	163	1	156	1	164	1
False acacia	136	1	134	1	131	1	131	1
Large alder	94	1	85	1	82	1	83	1
Willow	57	0	52	0	61	0	71	1
Large maple	27	0	33	0	38	0	57	0
Aspen	60	0	60	0	61	0	63	0
Cork oak**	72	1	79	1	79	1	79	1
Other broadleaved species	264	2	245	2	268	2	290	2
Total broadleaved**	**8 484**	**64**	**8 552**	**63**	**8 769**	**64**	**8 935**	**64**
Maritime pine**	1 398	10	1 383	10	1 381	10	1 365	10
Scots pine	1 179	9	1 154	9	1 122	8	1 127	8
Common spruce	717	5	744	6	740	5	718	5
Silver fir	544	4	554	4	566	4	572	4
Douglas fir	231	2	296	2	332	2	368	3
Aleppo pine	232	2	236	2	241	2	254	2
Austrian pine	183	1	188	1	179	1	194	1
Corsican pine	92	1	109	1	133	1	153	1
Larch	95	1	94	1	96	1	109	1
Mountain pine	55	0	56	0	55	0	56	0
Other conifer species	118	1	139	1	153	1	148	1
Total conifers**	**4 845**	**36**	**4 953**	**37**	**4 999**	**36**	**5 063**	**36**
Subtotal	**13 329**	**100**	**13 505**	**100**	**13 768**	**100**	**13 998**	**100**
Unspecified	8		66		99		93	
Total**	**13 337**		**13 571**		**13 867**		**14 091**	

* pedunculate, sessile and pubescent oak.

** including estimated area in different formations of the Mediterranean region not inventoried in 1994, 1999 and 2004.

Source: NFI.

Relevant domain: FAWS excluding poplar plantations and including thickets, criterion determined only for forests available for wood production and for which a main species could be specified.

The variation rate of the area under pedunculate, sessile and pubescent oak could not be calculated because these three oaks were aggregated in 2004 when doubt was raised as to the species determination.

ISFM 2010 Edition

Data retrieval year	**2010**			
Survey years	**2006 to 2009**			
Main tree species	*1000 ha*			*% of total area*
Pedunculate oak	1 975	±	67	13
Sessile oak	1 639	±	56	11
Beech	1 418	±	55	9
Pubescent oak	1 370	±	56	9
Chestnut	739	±	42	5
Holm oak	706	±	45	5
Common ash	576	±	39	4
Hornbeam	561	±	35	4
Birch	308	±	28	2
Cultivated poplar	224	±	22	1
False acacia	191	±	23	1
Large alder	139	±	20	1
Willow	121	±	18	1
Large maple	111	±	17	1
Aspen	105	±	16	1
Cork oak	89	±	17	1
Other broadleaved species	553	±	42	4
Total broadleaved	**10 826**	**±**	**115**	**71**
Maritime pine	1 106	±	48	7
Scots pine	896	±	46	6
Common spruce	590	±	37	4
Silver fir	565	±	35	4
Douglas fir	404	±	32	3
Aleppo pine	213	±	26	1
Austrian pine	197	±	23	1
Corsican pine	184	±	22	1
Larch	102	±	15	1
Mountain pine	56	±	12	0
Other conifer species	134	±	19	1
Total conifers	**4 448**	**±**	**93**	**29**
Subtotal	**15 274**	**±**	**104**	**100**
Temporarily unstocked	45	±	13	0
Total	**15 319**	**±**	**104**	**100**

Source: NFI.
Relevant domain: FAWS.

Since the adoption of the new inventory method, the main tree species is considered to be the species with the greatest cover eligible for inventory in the stand (noted within an area of 25 m around a sampling point) or, when there is no cover eligible for inventory, the tree species with the greatest cover not eligible for inventory (noted within an area of 15 m around a sampling point). This definition coincides with that used until 2004, except in reference to mixed coppice/high forest stands where the main species was the one with the greatest cover in the high forest layer (i.e. the reserve). This change could help to explain the increase in the areas of high forest species, such as hornbeam, that are commonly found in mixed coppice/high forest stands. However, changes concerning holm oak and, to a lesser extent, pubescent oak, are due to a real increase in area, as well as adaptations to the international definitions mentioned in the Cautionary Note which, in particular, modified the minimal height thresholds that trees must reach *in situ* (cf. Appendix III).

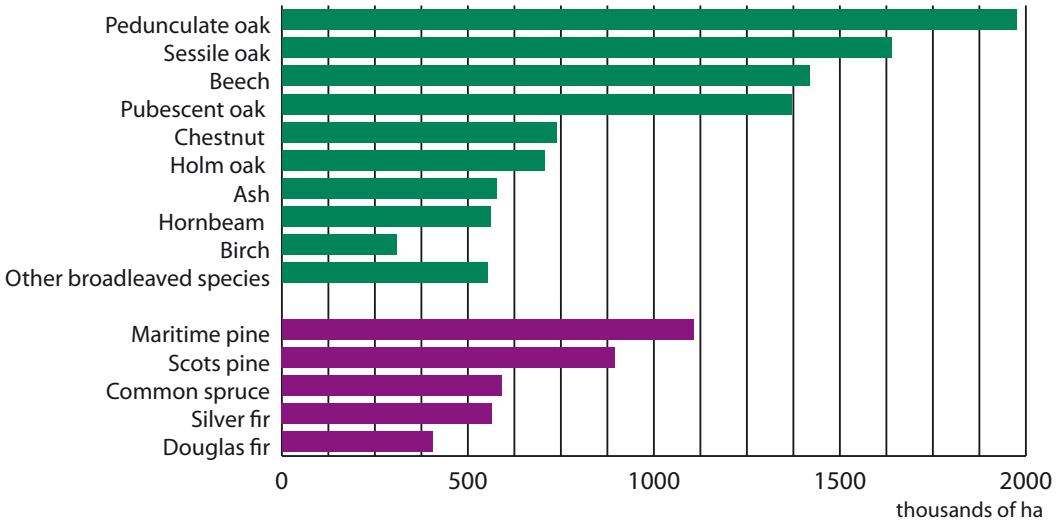


Figure 2: Forest area of the main broadleaved and conifer species.
Source: NFI, survey years 2006 to 2009.

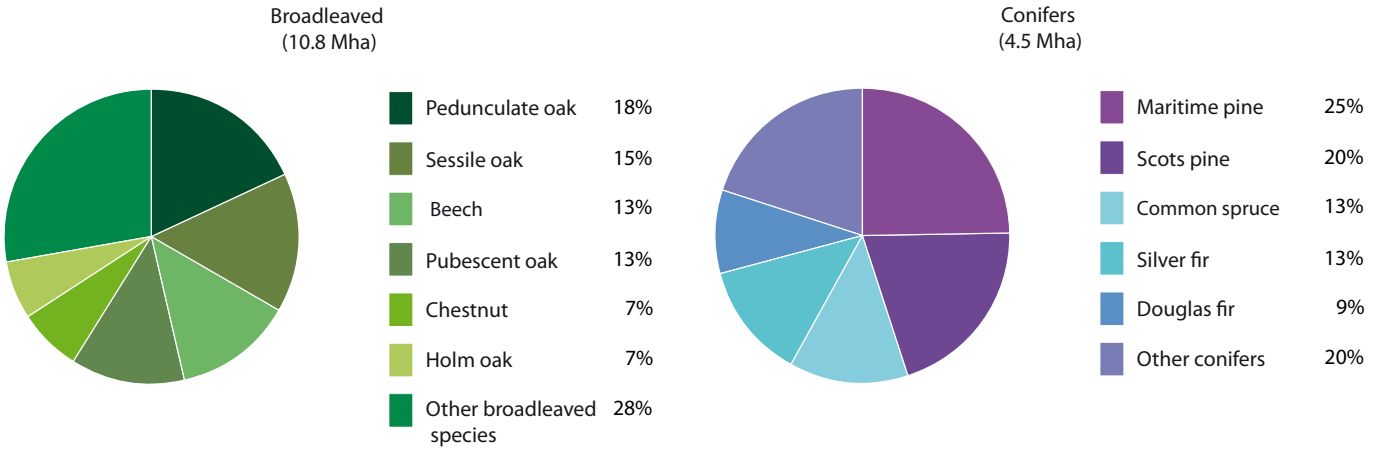


Figure 3: Forest area per main tree species.
Source: NFI, survey years 2006 to 2009.

Predominantly broadleaved stands are in the majority, covering 71% of the FAWS area, or 10.8 Mha. Pedunculate and sessile oaks are the two most represented tree species in metropolitan France, with an area of more than 3.6 Mha. Beech covers 1.4 Mha and is the third ranking species in terms of forest area (9%).

In conifers, maritime pine is the most common species with 1.1 Mha (7% of the French FAWS area), despite a decrease that could partly be due to the storms of December 1999 and January 2009. The forest area remained constant overall on the Landes massif between the 2004 and 2010 surveys, but the area of the main broadleaved species increased whereas the maritime pine surface area declined (Colin, 2010). The explanation for this phenomenon is the substitution of the main species in stands in which a broadleaved sublayer existed in a mixed stand with maritime pine prior to the storm. In these stands, pine tree windfalls caused by the storm were common, whereas the broadleaved trees remained standing, subsequently becoming the main species at the sampling point.

Scots pine is the second ranking conifer species, covering an area of 896 thousand ha, followed by fir and spruce, with each representing 4% of the FAWS area. The spruce forest area continues to decrease, reflecting the process of gradual substitution of spruce by other reforestation species. There has been a very marked twofold increase in the Douglas fir area over the last 25 years. This increase is the result of the very high demand for this species for reforestation in Bourgogne, Limousin and Auvergne regions.

The change in the main species determination method could explain some land classification changes, such as the decline in the area of stands classified as main conifer species, and the conversion of these areas in favour of main broadleaved species, especially coppices.

Detailed composition-oriented forest area calculation

Data retrieval year Survey years			2010 2006 to 2009	
Stand type		*Composition*	*1000 ha*	*% of total area*
Stands available for inventory	Pure broadleaved	Pure oak stand	2 282 ± 71	15
		Pure beech stand	618 ± 38	4
		Pure holm oak stand	366 ± 32	2
		Pure chestnut stand	326 ± 29	2
		Cultivated poplar plantation	171 ± 19	1
		Pure ash stand	149 ± 20	1
		Pure indigenous broadleaved stand	274 ± 28	2
		Other pure broadleaved stand	214 ± 23	1
	Pure conifers	Pure pine stand	1 722 ± 63	11
		Pure spruce stand	333 ± 29	2
		Pure fir stand	284 ± 25	2
		Pure Douglas fir stand	258 ± 25	2
		Other pure conifer stands	135 ± 18	1
	Mixed broadleaved	Beech-oak stand	736 ± 40	5
		Oak-hornbeam stand	720 ± 40	5
		Oak-ash stand	501 ± 36	3
		Mixed oak stand	476 ± 35	3
		Oak-chestnut stand	406 ± 32	3
		Mixed ash stand	284 ± 27	2
		Mixed holm oak stand	263 ± 28	2
		Mixed oak stand	241 ± 24	2
		Oak-birch stand	162 ± 20	1
		Other mixed broadleaved stand	807 ± 45	5
	Mixed broadleaved- conifers	Pine-oak stand	456 ± 36	3
		Mixed pine stand	414 ± 33	3
		Beech-fir stand	209 ± 22	1
		Other beech and conifer stands	177 ± 21	1
		Other mixed stands	598 ± 40	4
	Mixed conifers	Mixed pine stand	158 ± 20	1
		Other mixed conifer stands	259 ± 26	2
Subtotal			**13 999 ± 107**	**91**
Stands ineligible for inventory	Broadleaved not available for inventory		812 ± 43	5
	Conifers not available for inventory		373 ± 29	2
	Mixed stands not available for inventory		90 ± 22	1
Temporarily unstocked stands			45 ± 13	0
Total			**15 319 ± 104**	**100**

Source: NFI.
Relevant domain: FAWS.

N.B.: in this table, 'pure' is used for simplification, but actually refers to stands in which a species is pure or predominant (cf. definitions in Appendix V).

The composition-oriented stand classification is based on the cover calculations described in Appendix V. The main species has the greatest free cover in the stand, whereas the composition is determined by the species predominance or balance within the stand in terms of cover. The species diversity of the stand is first determined on the basis of the cover in order to distinguish stands of pure species or with one predominant species from mixed stands with two, three or more species. Then the single species or several species present, ranked in decreasing order of their importance in the cover, are associated with this diversity, thus highlighting the composition type.

N.B.: the so-called 'pure' compositions in this table are stands in which one species has a relative free cover rate of over 75%, as well as stands in which a species has a relative free cover rate of over 50%, whereas no other species has more than 15%.

Pure and mixed stands are almost equally distributed over the forest area, with 7 Mha for pure or predominant stands and 6.9 Mha for mixed stands. Mixed broadleaved stands are more numerous, accounting for 33% of the area of stands available for wood supply and eligible for inventory. They are followed by pure broadleaved stands (31%), and pure or predominantly conifer stands (20%). Mixed species or mixed conifer stands only represent 13 and 3% of the eligible for inventory FAWS area.

Pure or predominantly oak stands are the most widespread (2.2 Mha ± 71,000 ha), followed by pure or predominantly pine stands (1.7 Mha ± 63,000 ha), immediately followed by mixed oak-beech and oak-hornbeam stands, each with over 700,000 ha ± 40 000.

These data may be compared with those presented under Indicator 4.1.1.

Example of a mixed stand.

Indicator 1.2

Growing stock on forest and other wooded land, classified by forest type and by availability for wood supply

Forests available for wood supply

The volume presented here is the NFI stem volume (7 cm top diameter), excluding branches (cf. Appendix III).

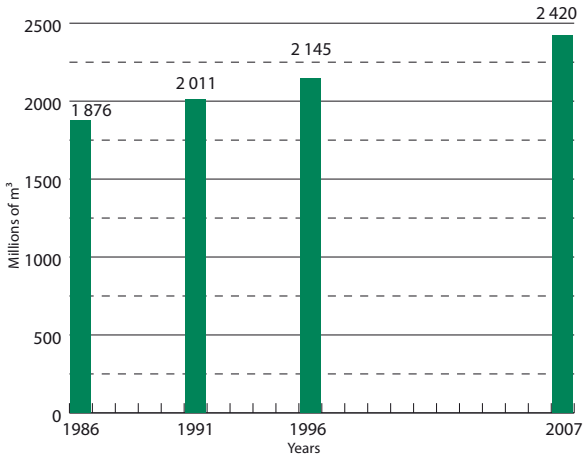


Figure 4: Growing stock patterns in FAWS.

Source: NFI, data for 1986 to 1996 obtained by former method, while the 2007 data were from the 2006 to 2009 surveys (new method). Relevant domain: FAWS (including poplar plantations). Note that thickets were included until 1996, but excluded in 2007.

The total growing stock in forests and poplar stands continues to regularly increase. This could be explained by the expansion of forest areas, as well as by the capitalisation of current stands. This latter phenomenon is noted in many forested European countries and is the result of the increase in forest area throughout the 20th century following agricultural abandonment, the capitalisation of stands due to the decline in coppice felling and generally to the lower felling rate relative to the increment. The increase in forest area affects the growing stock several decades later, when the stands have reached maturity (NFI, 2011). Another potential cause of the increase in growing stock is the rise in forest stand productivity (Bontemps, 2006). This growing stock increase is very marked in private forests, whereas it has levelled off in public forests, except in small and medium woodlands which are becoming more numerous in communal forests.

The growing stock in poplar plantations was 25.9 Mm^3 (± 6.9) in 2007, including 23.7 Mm^3 (± 6.2) poplars. The remaining 2.3 Mm^3 were other species that were growing in these plantations, such as ash, large alder and willow.

The per-hectare growing stock in closed forests reached 167 m^3/ha (± 2.5), but only 19 m^3/ha (± 3.8) in open forests. This difference could be explained by the much lower absolute coverage for open forests (less than 40%) as compared to closed forests. It thus clearly makes sense that this difference would be reflected in the growing stock.

Data retrieval year	**2010**		
Survey years	**2006 to 2009**		
	Mm³	*%*	*m³/ha*
State-owned forests	264 ± 15	11	182 ± 9
Other public forests	425 ± 16	18	180 ± 7
Private forests	1 731 ± 35	72	150 ± 3
Total	**2 420 ± 41**	**100**	**158 ± 2**

Source: NFI.
Relevant domain: FAWS.

The growing stock distribution differs slightly from the area distribution: private forests account for slightly under 75% of the growing stock. Its per-hectare average growing stock is therefore lower than the average for all FAWS. These private forests are mainly the result of recent natural and human induced afforestation.

ISFM 2005 Edition

Data retrieval year Average year	1989 1981		1994 1986		1999 1991		2004 1996	
Composition	*Mm³*	*%*	*Mm³*	*%*	*Mm³*	*%*	*Mm³*	*%*
Broadleaved stands	1 004	58	1 070	58	1 148	58	1 219	57
Conifer stands	559	32	612	33	649	33	697	33
Mixed stands	160	9	171	9	194	10	211	10
Total	**1 723**	**100**	**1 854**	**100**	**1 991**	**100**	**2 127**	**100**
Composition	*m³/ha*		*m³/ha*		*m³/ha*		*m³/ha*	
Broadleaved stands	119		126		133		139	
Conifer stands	150		163		172		184	
Mixed stands	137		145		158		164	
Total	**129**		**138**		**146**		**154**	

Source: NFI.
Relevant domain: FAWS excluding poplar plantations and including thickets.

The total growing stock of FAWS in metropolitan France is one of the highest in Europe (excluding Russia), along with Germany and Sweden (Forest Europe, 2011). However, the growing stock per ha (158 m^3/ha) is much lower than the average values for Switzerland (over 300 m^3/ha), Austria, Slovenia, Germany and Czech Republic (250 to 350 m^3/ha), whereas it is higher than average in Mediterranean countries (Italy 151 m^3/ha, Spain 50 m^3/ha, Greece 47 m^3/ha) and Scandinavian countries (Norway 98 m^3/ha, Sweden 119 m^3/ha, Finland 99 m^3/ha - Peyron, pers. com. and FAO, 2010). France's intermediate position could be explained especially by its position at a biogeographical crossroads, with marked interregional heterogeneity and the nationwide predominance of broadleaved stands (contrary to countries with a high growing stock per ha). On a European scale, the most capitalised forests are in Central Europe, mainly in mountainous areas (Gallaun et al., 2010), while the least capitalised are in the Iberian Peninsula (50 m^3/ha for Spain and 54 m^3/ha for Portugal – FAO, 2010).

In France, Alsace is the only region where the growing stock is above 250 m^3/ha. Overall, the northeastern regions (Alsace, Franche-Comté, Lorraine, Rhône-Alpes) and Massif Central regions (Auvergne, Limousin) have the highest average per-hectare growing stock (over 185 m^3/ha).

In metropolitan France, broadleaved stands (including poplar stands) account for over 60% of the total growing stock. However, these stands have the lowest average growing stock per ha, especially due to the fact that the production potential for broadleaved species is lower than that of conifers, and because silviculture recommendations favour higher conifer densities. The per-hectare growing stock is higher for conifers, which represent slightly over 25% of the total growing stock.

The increase in growing stock is due to the overall capitalisation of existing stands that are newly considered as forest.

ISFM 2010 Edition

Data retrieval year Survey years	2010 2006 to 2009	
Composition	*Mm³*	*%*
Broadleaved stands	1 471 ± 31	61
Conifer stands	658 ± 30	27
Mixed stands	291 ± 19	12
Total	**2 420 ± 41**	**100**
Composition	*m³/ha*	*IC (%)*
Broadleaved stands	145	nd
Conifer stands	189	nd
Mixed stands	177	nd
Total	**158 ± 2**	

Source: NFI.
Relevant domain: FAWS.

Although it is hard to accurately assess, there is clearly a long-term increase in growing stock in mixed and conifer stands. This increase is the result of the increase in areas for these categories and high capitalisation in these stands, especially in medium and high mountain areas. The highest growing stock is noted for conifer stands located between 600 and 1,000 m elevation, followed by stands between 400 and 600 m elevation and between 1,000 and 1,400 m elevation. For mixed stands, the highest growing stock is found between 1,000 and 1,400 m elevation, then at over 1,400 m elevation, and subsequently between 600 and 1,000 m elevation. Highland stands are generally harder to log because of physical factors such as steep slopes and a lack of roads that hamper access to the resource.

The per-hectare growing stock of broadleaved stands is much lower than that of conifer and mixed stands. Here again the highest growing stock per ha values are recorded in highland stands (1,000 to 1,400 m), which are usually less accessible. However, under 1,000 m elevation, there is a decrease in growing stock in broadleaved stands as the elevation increases, likely due to the harsher growing conditions.

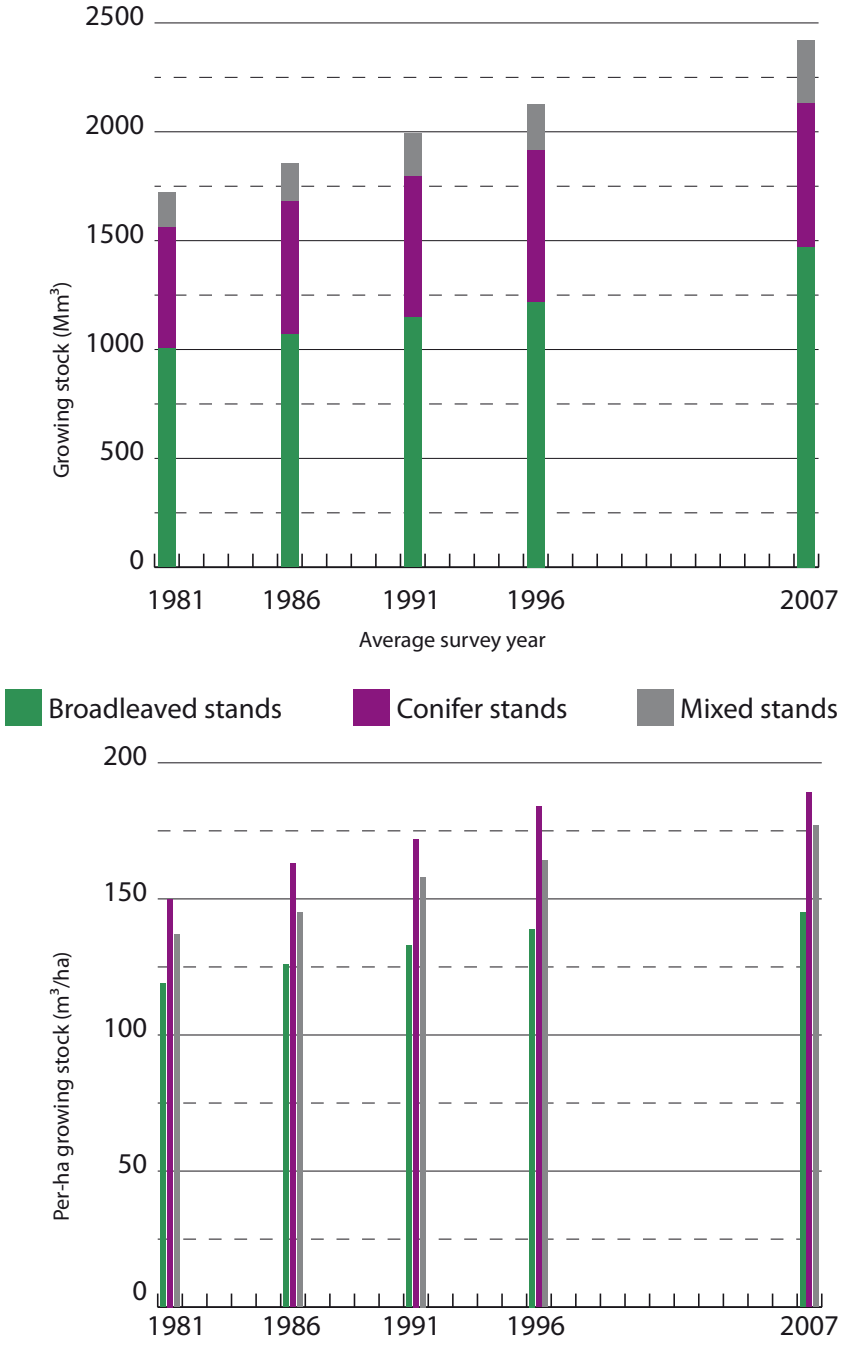


Figure 5: Growing stock and per-hectare growing stock per forest type.

Source: NFI. Note: poplar plantations excluded and thickets included until 1996, the opposite in 2007. Survey years 2006 to 2009 used to determine the average year 2007.

Indicator 1.2.1

Growing stock by NFI forest structure

Forests available for wood supply

The volume presented here is the NFI stem volume (7 cm top diameter), excluding branches (cf. Appendix III).

ISFM 2005 Edition

Data retrieval year		1989			1994			1999			2004		
Average year		1981			1986			1991			1996		
Forest structure		*Mm³*	*%*	*m³/ha*	*Mm³*	*%*	*m³/ha*	*Mm³*	*%*	*m³/ha*	*Mm³*	*%*	*m³/ha*
Forests	Regular high forest	932	54	162	1 046	56	174	1 164	58	181	1 285	60	190
	Irregular high forest	109	6	149	109	6	154	112	6	167	107	5	168
	Coppice	138	8	58	137	7	61	138	7	65	140	7	67
	Mixed coppice-high forest	543	32	125	561	30	131	577	29	137	595	28	143
Total forests		**1 723**	**100**	**129**	**1 854**	**100**	**138**	**1 991**	**100**	**146**	**2 127**	**100**	**154**
Poplar plantations	Regular high forest				23		149	21		137	18		121

Source: NFI.
Relevant domain: FAWS excluding poplar plantations and including thickets.

ISFM 2010 Edition

Data retrieval year		2010		
Survey years		2006 to 2009		
Forest structure		*Volume (Mm³)*	*% of the volume*	*m³/ha*
Poplar plantations	Regular high forest	26 ± 7	1	133
Forests	Regular high forest	1 540 ± 37	64	204
	Irregular high forest	109 ± 11	4	169
	Coppice	115 ± 9	5	66
	Mixed coppice-high forest	613 ± 20	25	143
	Open forest	16 ± 3	1	19
Total		**2 420 ± 41**	**100**	**158**

Source: NFI, survey years 2006 to 2009.
Relevant domain: FAWS, excluding temporarily unstocked stands.

The changes made in the 'forest structure' variable are pointed out for Indicator 1.1.3. Note that, here again, differences between the 2004 and 2010 data should not be interpreted as actual variations in the growing stock as they could also be the result of the definition changes that were applied.

Regular high forests, excluding poplar plantations, had the highest growing stock. These structures pooled 64% of the growing stock, whereas they only accounted for 49% of the forest area. This high growing stock value, which increased in recent years, is the result of a shift in growing stock derived from mixed coppice-high forest conversion stands, and the increment potential of conifer afforestation and reafforestation.

Rhône-Alpes region alone accounted for 35% of the regular high forest growing stock.

Concerning poplar plantations, Picardie accounted for 14% of the total growing stock of these stands, Pays-de-la-Loire 11% and Champagne-Ardenne 10%. Moreover, Aquitaine, Poitou-Charentes, Centre and Nord-Pas-de-Calais regions had a relatively high percentage of poplar plantation growing stock.

Most of the coppice growing stock is found in the South of France: Languedoc-Roussillon, Aquitaine, Midi-Pyrénées and PACA regions, as well as in Poitou-Charentes and Rhône-Alpes regions.

Indicator 1.2.2

Growing stock by tree species

Forests available for wood supply

Growing stock

The volume presented here is the NFI stem volume (7 cm top diameter), excluding branches (cf. Appendix III).

ISFM 2005 Edition

Data retrieval year	1989		1994		1999		2004	
Average year	1981		1986		1991		1996	
Tree species	*Mm³*	*%*	*Mm³*	*%*	*Mm³*	*%*	*Mm³*	*%*
Pedunculate oak	230	13	249	13	249	12	257	12
Sessile oak	204	12	219	12	251	13	267	12
Undifferentiated oaks	-	-	-	-	-	-	2	0
Beech	214	12	223	12	235	12	242	11
Chestnut**	86	5	90	5	98	5	101	5
Pubescent oak**	41	2	46	2	54	3	68	3
Hornbeam	62	4	68	4	76	4	82	4
Common ash	41	2	46	2	52	3	58	3
Birch	39	2	39	2	40	2	39	2
False acacia	17	1	18	1	18	1	20	1
Holm oak**	11	1	13	1	14	1	16	1
Aspen	21	1	22	1	22	1	22	1
Large alder	17	1	17	1	17	1	19	1
Large maple	10	1	11	1	13	1	16	1
Small maple	11	1	11	1	13	1	15	1
Cherry or wild cherry	11	1	12	1	14	1	16	1
Linden	10	1	11	1	12	1	13	1
Other broadleaved	39	2	39	2	42	2	45	2
Total broadleaved**	**1 062**	**62**	**1 133**	**61**	**1 221**	**61**	**1 297**	**61**
Common spruce	124	7	138	7	152	8	164	8
Silver fir	145	8	148	8	157	8	165	8
Scots pine	136	8	138	7	140	7	143	7
Maritime pine**	165	10	186	10	189	9	200	9
Douglas fir	15	1	28	2	41	2	54	3
Corsican pine	12	1	15	1	19	1	22	1
Austrian pine	22	1	23	1	24	1	26	1
Larch	16	1	15	1	15	1	20	1
Aleppo pine	10	1	11	1	11	1	14	1
Other conifers	14	1	21	1	27	1	30	1
Total conifers**	**660**	**38**	**723**	**39**	**776**	**39**	**836**	**39**
Total	**1 723**	**100**	**1 857**	**100**	**1 996**	**100**	**2 133**	**100**

** including estimated growing stock in the types of formations not inventoried in 1994 and 1999.
Source: NFI.
Relevant domain: FAWS excluding poplar plantations and including thickets.

Data retrieval year Survey years	2010 2006 to 2009	
Tree species	*Mm³*	*%*
Pedunculate oak	289 ± 11	12
Sessile oak	277 ± 12	11
Beech	262 ± 13	11
Chestnut	122 ± 9	5
Pubescent oak	97 ± 6	4
Hornbeam	93 ± 5	4
Common ash	89 ± 6	4
Birch	40 ± 3	2
Cultivated poplar	31 ± 6	1
False acacia	26 ± 4	1
Holm oak	26 ± 3	1
Aspen	26 ± 3	1
Large alder	25 ± 4	1
Large alder	24 ± 3	1
Small maple	21 ± 2	1
Cherry or wild cherry	20 ± 2	1
Linden	15 ± 2	1
Other broadleaved	68 ± 4	3
Total broadleaved	**1 550 ± 32**	**64**
Common spruce	185 ± 16	8
Silver fir	181 ± 15	7
Scots pine	143 ± 9	6
Maritime pine	139 ± 11	6
Douglas fir	94 ± 12	4
Corsican pine	33 ± 7	1
Austrian pine	25 ± 5	1
Larch	21 ± 5	1
Aleppo pine	16 ± 3	1
Other conifers	34 ± 6	1
Total conifers	**870 ± 30**	**36**
Total	**2 420 ± 41**	**100**

Source: NFI.
Relevant domain: FAWS, excluding temporarily unstocked stands.

The growing stock considered here is calculated for each individual tree and not only for the main tree species of the stand. For instance, at a sampling point where sessile oak is the species with the greatest cover (main species), other species may also be present. The growing stock of each tree of these other species is allocated to the considered species.

The top 10 species in terms of growing stock represent 74% of the total growing stock, or around 1.8 billion m^3. An increase in growing stock was noted for all species, except maritime pine, whose growing stock suddenly dropped as a result of cyclone Klaus (cf. also Indicator 2.4 on storm damage). The increase in growing stock was greater in broadleaved stands (NFI, 2011). For pubescent oak, the increase reached +3.5%/year as a result of a spontaneous increase in the area of this species in the South of France, as also was the case with holm oak (NFI, 2011). In conifers, the greatest increase was noted in Douglas fir (+ 7.25%/year). This was due to the massive use of this species in afforestation initiatives within the framework of the Fond forestier national. Douglas fir and spruce together account for 70% of the increase in conifer growing stock (NFI, 2011).

Broadleaved species account for a major part of the growing stock, i.e. 64% of the total volume. The three main broadleaved species, pedunculate oak, sessile oak and beech, represent 34% of the total growing stock, with around 830 Mm^3. Broadleaved species were found to be in majority in most French regions, except in Auvergne, Rhône-Alpes and PACA regions. The growing stock in Île-de-France and Picardie regions is almost exclusively broadleaved (94 and 93%, respectively, of their growing stock is broadleaved). Nord-Pas-de-Calais, Champagne-Ardenne, Poitou-Charentes, Haute-Normandie, Centre and Bourgogne have over 80% broadleaved growing stock.

Maritime pine, the main conifer species in terms of growing stock in prior ISFM editions, now has a lower growing stock than that of spruce, fir and Scots pine, which account for 8%, 7% and 6% of the total growing stock, respectively. As already mentioned, this decline was due to the impact of the 1999 and 2009 storms.

The storms had an immediate impact on the growing stock, via windfalls, in addition to a delayed impact. The presence of windfalls leads to a drop in felling in stands unaffected by the storms, while sapling stand growth might be influenced in the short and medium term by storm damage.

The conifer growing stock in Rhône-Alpes region is over 150 Mm^3, followed by Aquitaine with 94 Mm^3, and then Auvergne with around 87 Mm^3.

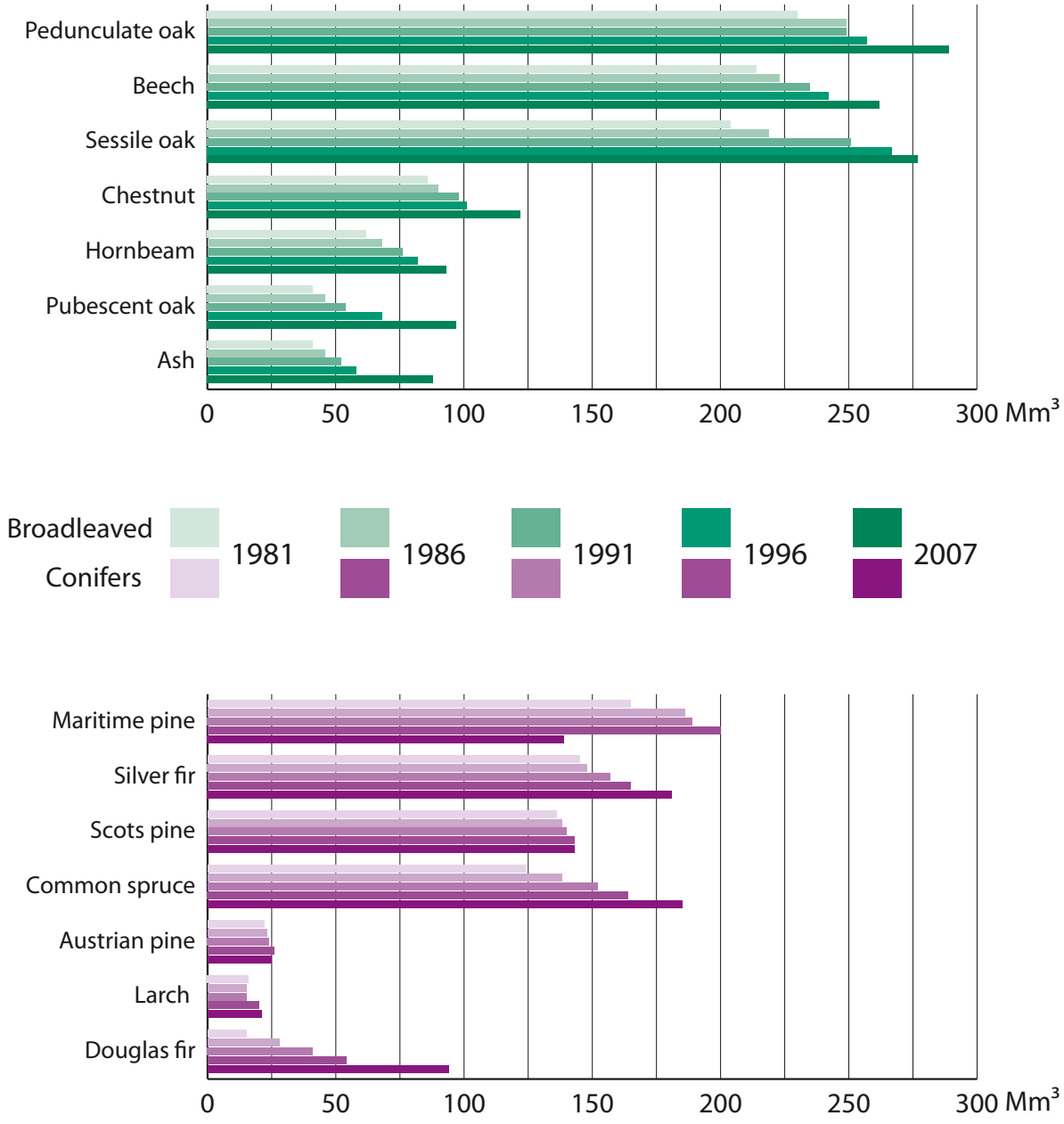
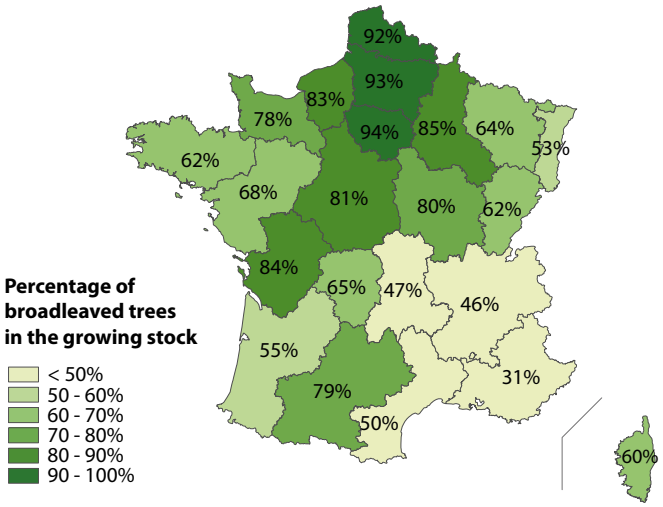
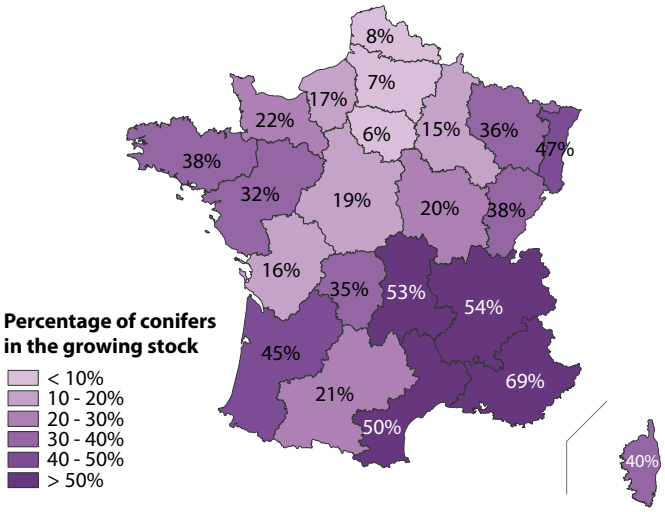


Figure 6: Growing stock of the main broadleaved and conifer species.
Source: NFI.



Map 6: Percentage of broadleaved trees in the growing stock by administrative region.



Map 7: Percentage of conifers in the growing stock by administrative region.

Source: NFI, survey years 2006 to 2009.

Growing stock per hectare

Average growing stock per hectare of a species in stands where it represents the main species (m^3/ha).

ISFM 2005 Edition

Data retrieval year	1989	1994	1999	2004
Average year	1981	1986	1991	1996
Main tree species	*m^3/ha*			
Pedunculate oak	90	96	102	103
Sessile oak				
Beech	130	131	134	136
Chestnut	87	89	99	100
Pubescent oak	41	46	50	56
Hornbeam	55	57	64	67
Common ash	73	75	76	76
Birch	46	47	49	51
False acacia	64	71	73	78
Holm oak	23	26	28	30
Aspen	64	65	69	68
Large alder	95	98	104	115
Large maple	53	56	60	66
Small maple	30	28	28	27
Cherry or wild cherry	35	37	35	38
Linden	71	74	75	83
Other broadleaved	45	48	48	48
Total broadleaved	**83**	**88**	**93**	**94**
Common spruce	141	152	170	187
Silver fir	228	226	230	239
Scots pine	99	101	105	105
Maritime pine	113	130	132	142
Douglas fir	54	82	109	129
Corsican pine	119	124	127	129
Austrian pine	108	110	116	117
Larch	129	128	127	146
Aleppo pine	42	44	44	51
Other conifers	63	84	104	116
Total conifers	**119**	**128**	**135**	**143**
Total	**96**	**102**	**108**	**112**

Source: NFI.
Relevant domain: FAWS excluding poplar plantations and including thickets.

Only the growing stock of the main tree species relative to the inventoried area of this species was taken into account in the data presented in the previous editions. The growing stock of other species was not included, whereas in the 2010 edition it is included in the column 'Growing stock per hectare for all species'.

In broadleaved species, the average growing stock per ha for all species combined is highest in stands having beech, sessile oak or linden as main species. In contrast, holm oak stands are amongst the least capitalised stands.

ISFM 2010 Edition

Data retrieval year	**2010**	
Survey years	**2006 to 2009**	
Main tree species	*Growing stock of species per ha (m^3/ha)*	*Total growing stock per ha (m^3/ha)*
Pedunculate oak	105 ± 4	164 ± 6
Sessile oak	136 ± 5	195 ± 7
Beech	136 ± 7	204 ± 9
Chestnut	115 ± 11	171 ± 13
Pubescent oak	59 ± 4	79 ± 5
Common ash	85 ± 10	162 ± 16
Hornbeam	66 ± 6	152 ± 10
Cultivated poplar	122 ± 27	143 ± 32
Holm oak	32 ± 4	44 ± 5
Birch	42 ± 8	88 ± 16
False acacia	85 ± 19	135 ± 25
Large alder	108 ± 28	164 ± 39
Large maple	68 ± 25	151 ± 44
Aspen	74 ± 24	144 ± 40
Linden	83 ± 31	187 ± 65
Small maple	32 ± 24	68 ± 25
Cherry or wild cherry	35 ± 33	66 ± 44
Other broadleaved	47 ± 8	73 ± 10
Total broadleaved	**94 nd**	**146 ± 3**
Common spruce	250 ± 20	306 ± 23
Silver fir	253 ± 20	321 ± 23
Scots pine	118 ± 9	147 ± 11
Maritime pine	111 ± 10	120 ± 10
Douglas fir	199 ± 26	232 ± 28
Corsican pine	156 ± 38	178 ± 40
Austrian pine	110 ± 28	129 ± 30
Larch	162 ± 37	193 ± 41
Aleppo pine	58 ± 12	63 ± 13
Other conifers	135 ± 32	163 ± 37
Total conifers	**158 nd**	**189 ± 6**
Total	**113 nd**	**158 ± 2**

Source: NFI.
Relevant domain: FAWS, excluding temporarily unstocked stands.

Stands in which the main species is a conifer have the highest average growing stock per hectare. Of these, fir and spruce stands are the most capitalised, with over 300 m^3/ha on average. This could be explained by the management recommendations for these stands, which are often kept very dense, but also partly by the lower level of logging due to the locations of these stands, i.e. often in mountainous regions. Sixty-nine percent of the spruce area and 78% of the fir area are above 600 m elevation, which corresponds to 72% and 81%, respectively, in terms of growing stock. The highest per-hectare growing stock is found at this elevation, i.e. over 290 m^3/ha for spruce and 310 m^3/ha for fir.

Conversely, Aleppo pine has a very low growing stock, i.e. 63 m^3/ha. In broadleaved species, the highest average per-hectare growing stock is found in beech or sessile oak stands, with around 200 m^3/ha.

The per-hectare growing stock of the main species represents 71% of the total stand growing stock on average. This average is 65% for broadleaved species and 84% for conifers.

Growing stock per detailed stand type

Data retrieval year			2010		
Survey years			2006 to 2009		
Stand type			*Mm³*	*%*	*m³/ha*
Stands eligible for inventory	Pure broadleaved	Pure oak stand	336 ± 16	14	147
		Pure beech stand	131 ± 12	5	212
		Pure chestnut stand	59 ± 8	2	181
		Pure ash stand	25 ± 7	1	166
		Cultivated poplar plantation	26 ± 7	1	151
		Pure indigenous broadleaved	29 ± 6	1	105
		Other pure broadleaved	42 ± 6	2	73
	Pure conifers	Pure pine stand	244 ± 16	10	142
		Pure spruce stand	110 ± 15	5	330
		Pure fir stand	101 ± 13	4	357
		Pure Douglas fir stand	72 ± 12	3	275
		Other pure conifers	29 ± 8	1	214
	Mixed broadleaved	Beech-oak stand	156 ± 11	6	212
		Oak-hornbeam stand	129 ± 9	5	179
		Oak-ash stand	92 ± 10	4	182
		Oak-chestnut stand	72 ± 8	3	178
		Mixed oak stand	61 ± 8	3	128
		Mixed ash stand	45 ± 7	2	159
		Mixed oaks	44 ± 6	2	182
		Oak-birch stand	23 ± 5	1	141
		Other mixed broadleaved	136 ± 11	6	127
	Mixed broadleaved-conifers	Mixed pine stand	68 ± 9	3	164
		Pine-chestnut stand	55 ± 8	2	121
		Beech-fir stand	55 ± 8	2	263
		Beech-spruce stand	34 ± 7	1	286
		Beech-fir-spruce stand	18 ± 5	1	324
		Other mixed stand	111 ± 13	5	186
	Mixed conifers	Fir-spruce stand	41 ± 10	2	335
		Mixed pine stand	31 ± 7	1	198
		Other mixed conifers	37 ± 8	2	273
Subtotal			**2 412 ± 38**	**100**	**172**
Stands not eligible for inventory			7 ± 2	0	6
Total			**2 420 ± 41**	**100**	**158**

Source: NFI
Relevant domain: FAWS, excluding temporarily unstocked stands.

Stands in which one species is pure or predominant represent half of the total growing stock. Pure or predominantly broadleaved stands account for 27% of the total growing stock, while pure and predominantly conifer stands represent 23%. Mixed broadleaved stands represent 31% of the total growing stock.

N.B.: in this table, 'pure' is used for simplification, but actually refers to stands in which a species is pure or predominant (cf. definitions in Appendix V).

The two stand types that pool the greatest growing stock are pure or predominantly oak stands (14% of the total growing stock) and pure or predominantly pine stands (10% of the total growing stock).

Indicator 1.2.3

Basal area per tree species

Average basal area for all tree species in stands where the species is the main one

ISFM 2005 Edition

Data retrieval year Average year	1989 1981	1994 1986	1999 1991	2004 1996
Main tree species	*Basal area for all species in stands where the species is the main one (m^2/ha)*			
Pedunculate oak Sessile oak	18.5	19.6	20.8	21.4
Beech	22.4	22.9	24.0	24.4
Chestnut	20.8	21.2	23.0	23.1
Pubescent oak	11.5	12.7	13.7	14.6
Hornbeam	16.6	17.1	19.2	19.8
Common ash	18.5	18.9	18.9	18.9
Birch	13.0	13.4	14.0	14.6
False acacia	13.5	14.5	15.5	16.4
Holm oak	8.8	9.9	10.8	11.4
Aspen	16.7	17.1	17.6	18.0
Large alder	19.5	19.7	20.4	21.9
Large maple	17.3	18.2	18.1	19.9
Small maple	12.9	12.7	13.0	12.4
Cherry or wild cherry	13.4	13.6	13.2	13.8
Linden	20.9	21.0	22.1	22.8
Other broadleaved	13.0	13.7	13.8	13.8
Total broadleaved	**17.6**	**18.5**	**19.6**	**20.1**
Common spruce	21.4	23.5	26.2	28.2
Silver fir	28.1	28.4	30.3	31.3
Scots pine	20.1	20.9	22.1	22.4
Maritime pine	16.5	18.1	18.4	20.3
Douglas fir	10.8	14.6	18.2	20.4
Corsican pine	17.1	19.6	20.7	21.0
Austrian pine	19.3	20.0	21.4	21.7
Larch	20.2	20.1	19.9	22.9
Aleppo pine	11.4	11.9	12.0	13.9
Other conifers	14.2	17.6	20.5	21.9
Total conifers	**19.0**	**20.3**	**21.7**	**23.0**
Total	**18.1**	**19.2**	**20.4**	**21.2**

Source: NFI.
Relevant domain: FAWS excluding poplar plantations and including thickets.

Data retrieval year Survey years	2010 2006 to 2009
Main tree species	*Basal area for all species in stands where the species is the main one (m^2/ha)*
Pedunculate oak	21.7 ± 0.7
Sessile oak	23.4 ± 0.6
Beech	25.5 ± 0.9
Chestnut	27.0 ± 1.5
Pubescent oak	15.8 ± 0.8
Common ash	21.2 ± 1.6
Hornbeam	21.0 ± 1.2
Cultivated poplar	15.3 ± 2.3
Holm oak	13.4 ± 1.4
Birch	14.3 ± 2.0
False acacia	19.7 ± 3.0
Large alder	22.9 ± 4.4
Large maple	20.2 ± 4.6
Aspen	19.8 ± 4.2
Linden	25.8 ± 7.5
Small maple	13.8 ± 4.3
Cherry or wild cherry	11.2 ± 5.7
Other broadleaved	14.2 ± 1.6
Total broadleaved	**20.6 ± 0.3**
Common spruce	33.7 ± 1.9
Silver fir	33.6 ± 1.8
Scots pine	23.0 ± 1.3
Maritime pine	16.2 ± 1.1
Douglas fir	25.5 ± 2.1
Corsican pine	24.4 ± 4.1
Austrian pine	20.1 ± 3.5
Larch	24.6 ± 3.9
Aleppo pine	12.5 ± 2.2
Other conifers	23.2 ± 3.8
Total conifers	**23.8 ± 0.6**
Total	**21.5 ± 0.3**

Source: NFI.
Relevant domain: FAWS, excluding temporarily unstocked stands.

Trends highlighted in the per-hectare growing stock are also noted in the basal area data. On average, stands of main broadleaved species have a basal area of 21 m^2/ha. This average basal area is higher in conifers (24 m^2/ha). Moreover, stands with the highest basal area (all main species combined) are spruce and fir.

In broadleaved stands, Auvergne and Limousin regions have the highest average basal areas, with 26 and 24 m^2/ha, respectively. In contrast, the lowest average basal areas are in Mediterranean regions (PACA, Languedoc-Roussillon, Corsica). The most common species in these regions (especially holm oak and pubescent oak) seldom have large stem diameters because they are often found in coppices or the growing conditions are harsh.

In conifer stands, Alsace, Auvergne, Franche-Comté and Rhône-Alpes regions have the highest basal areas, i.e. over 30 m^2/ha. Aquitaine is the region with the lowest conifer basal area, with 14 m^2/ha. This could be explained by the lower plantation densities for maritime pine than for other conifer species, but also by the impact of the 1999 and 2009 storms which, in particular, opened gaps in the oldest stands.

Basal area by main tree species and holding type

Data retrieval year	2010		
Survey years	2006 to 2009		
Holding type	**State-owned forest**	**Other public forest**	**Private forest**
Main tree species	*m²/ha*	*m²/ha*	*m²/ha*
Pedunculate oak	20 ± 4	21 ± 2	22 ± 1
Sessile oak	23 ± 2	23 ± 1	24 ± 1
Pubescent oak	17 ± 6	14 ± 4	16 ± 1
Holm oak	n. s.	14 ± 4	13 ± 1
Beech	22 ± 2	25 ± 1	28 ± 2
Common ash	n. s.	18 ± 6	22 ± 2
Hornbeam	18 ± 4	20 ± 2	22 ± 2
Other broadleaved	16 ± 5	16 ± 3	20 ± 1
Total broadleaved	**21 ± 1**	**21 ± 1**	**21 ± 0**
Maritime pine	22 ± 6	16 ± 5	16 ± 1
Scots pine	22 ± 4	26 ± 4	23 ± 1
Corsican pine	26 ± 14	n. s.	23 ± 4
Austrian pine	22 ± 5	n. s.	19 ± 6
Common spruce	31 ± 4	34 ± 3	34 ± 3
Silver fir	30 ± 5	33 ± 2	36 ± 3
Douglas pine	n. s.	25 ± 8	26 ± 2
Other conifers	21 ± 8	21 ± 3	18 ± 2
Total conifers	**25 ± 2**	**28 ± 1**	**23 ± 1**
Total	**22 ± 1**	**23 ± 1**	**21 ± 0**

Source: NFI.
Relevant domain: FAWS excluding temporarily unstocked stands.

The average basal area in main broadleaved species stands is relatively steady, irrespective of the regime of the considered holding, except for beech, which has a much higher average basal area in private forests than in public forests. The reverse pattern applies to conifers, where the average basal area in private forests is lower than the average values in public forests. This average for all combined conifers disguises the high between species heterogeneity.

Indicator 1.3

Age structure or diameter distribution of forests and other wooded land, classified by forest type and by availability for wood supply

Forests available for wood supply

Age distribution of regular high forest stands

ISFM 2005 Edition

Data retrieval year	1989		1994		1999		2004	
Average year	1981		1986		1991		1996	
Age class (years)	*1000 ha*	*%*	*1000 ha*	*%*	*1000 ha*	*%*	*1000 ha*	*%*
0-19	1 163	20	1 133	19	1 105	17	1 118	17
20-39	1 152	20	1 190	20	1 356	21	1 351	20
40-59	881	15	930	15	1 001	16	1 134	17
60-79	753	13	817	14	882	14	956	14
80-99	585	10	644	11	715	11	779	12
100-119	397	7	432	7	468	7	519	8
120-139	330	6	363	6	383	6	395	6
140-159	292	5	309	5	308	5	313	5
160-179	61	1	69	1	76	1	71	1
180-199	47	1	48	1	48	1	46	1
200-219	36	1	34	1	33	1	35	1
220-239	36	1	34	1	33	1	35	1
240 and over	18	0	18	0	15	0	16	0
Total	**5 753**	**100**	**6 021**	**100**	**6 423**	**100**	**6 768**	**100**

Source: NFI.
Relevant domain: FAWS excluding poplar plantations, including only stands whose age could be determined. Regular high forests excluding poplar plantations and including thickets.

With the new inventory method, the age assigned to the stand is determined on the basis of the ages of two trees selected from the six largest trees in the stand overstorey, and the two most representative species of these six trees (or the species most represented, if its cover surpasses 75% of the cover of the six trees). When the two measured trees are different species, it is the age of the most representative species that is used, otherwise it is the average of the two ages. Trees growing on the edge of the stand that differ from trees within the stand are excluded. When two stands of different generations are overlapped (regeneration phase of regular treatments), the age of the future stand is taken into account, without considering potential residual trees from the previous stand.

Tree age is measured by core sampling using an increment borer at 1.3 m height. Calculated ages are corrected to determine the age at the trunk base (baseline age).

The age assigned to the stand can thus generally be interpreted as the age of the main species in the stand overstorey.

Regular high forest oak stand in Vienne department.

Regular high forest stands currently cover almost 7.8 Mha in France, representing half of the FAWS area. Only 31% of broadleaved high forests are under 60 years of age. In contrast, this percentage is 69% of the area for conifer high forests. Only 12% of conifer regular high forests are over 100 years of age, whereas broadleaved regular high forest stands of this age represent 36% of the total broadleaved regular high forest area.

Variations from one age class to the next cannot alone be explained by the ageing of existing stands. Areas newly considered as being regular high forest areas, e.g. natural growth or areas resulting from the conversion of coppice or coppice with standards stands, or even areas now taken into account following the change in inventory method, have been added to the areas already present. These new areas are not necessarily young, so the variations noted between the ISFM 2005 and 2010 editions cannot be considered as only being due to the evolution in stand age.

ISFM 2010 Edition

Data retrieval year Survey years	2010 2006 to 2009	
Age class (years)	*1000 ha*	*%*
0-19	1 136 ± 53	15
20-39	1 220 ± 56	16
40-59	1 363 ± 58	17
60-79	1 153 ± 53	15
80-99	956 ± 48	12
100-119	760 ± 43	10
120-139	530 ± 35	7
140-159	312 ± 27	4
160-179	167 ± 20	2
180-199	96 ± 15	1
200-239	62 ± 12	1
240 and over	38 ± 10	0
Total	**7 793 ± 104**	**100**

Source: NFI.
Relevant domain: regular high forest (including poplar plantations) and temporarily unstocked stands in closed forest (considered as regular since these areas are totally unstocked).

Forest age classes (all forest structures combined)

Data retrieval year Survey years	2010 2006 to 2009	
Age class(years)	*1000 ha*	*%*
0-19	2 245 ± 79	15
20-39	2 415 ± 77	16
40-59	2 896 ± 83	19
60-79	2 611 ± 78	17
80-99	1 833 ± 66	12
100-119	1 359 ± 57	9
120-139	886 ± 47	6
140-159	484 ± 34	3
160-179	264 ± 26	2
180-199	154 ± 20	1
200-239	98 ± 16	1
240 and over	74 ± 14	0
Total	**15 319 ± 104**	**100**

Source: NFI.
Relevant domain: FAWS

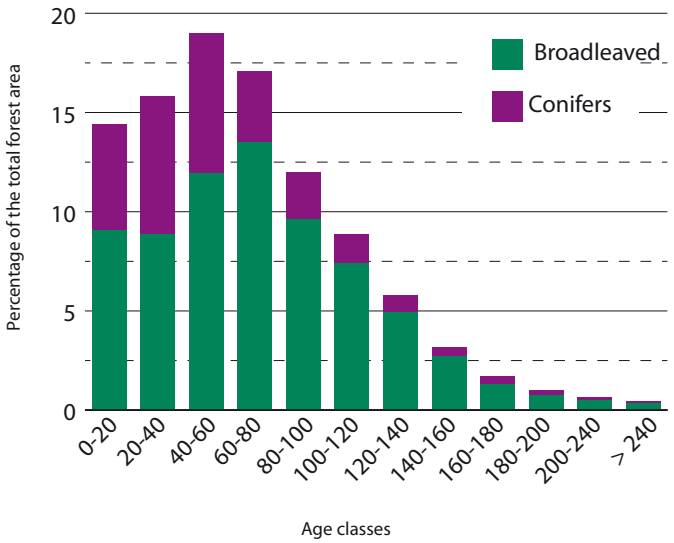


Figure 7: Forest area per age class.
Source: NFI, survey years 2006 to 2009.

By assessing age class distributions throughout the entire forest area, it is possible to determine whether or not the entire French forest is affected by an ageing phenomenon, without having to separate areas converted from one forest structure to another from the analysis.

Forty-nine percent of the FAWS is under 60 years old and 22% is over 100 years old. This distribution includes 42% of the area under 60 years old and 25% over 100 years old for broadleaved stands, and 66% and 13%, respectively, for conifer stands. For broadleaved stands, the 60–80 year age class is the most represented and it accounts for 19% of the forest area, while for conifer stands it is the 40–60 year age class, which covers 24% of the area.

It should be noted that interpretation of the area distribution by age class (all species combined) has some shortcomings. This approach can overlook marked differences depending on the species. It is nevertheless possible to interpret the low forest area of the first age classes relative to conventional distributions as being the result of a regeneration and plantation defect and of coppice and mixed coppice-high forest ageing.

Tree diameter classes (for all structures combined)

The diameter classes used are:

- Small diameter trees: 7.5 ≤ d < 22.5 cm
- Medium diameter trees: 22.5 ≤ d < 47.5 cm
- Large diameter trees: 47.5 ≤ d < 67.5 cm
- Very large diameter trees: 67.5 ≤ d

ISFM 2005 Edition

Data retrieval year		1989		1994		1999		2004	
Average year		1981		1986		1991		1996	
Composition	*Diameter class*	*Mm³*	*%*	*Mm³*	*%*	*Mm³*	*%*	*Mm³*	*%*
Broadleaved stands	Small diameter trees	370	37	381	36	397	35	406	33
	Medium diameter trees	424	42	462	43	500	44	537	44
	Large diameter trees	161	16	175	16	192	17	211	17
	Very large diameter trees	48	5	51	5	59	5	65	5
Total broadleaved		**1 004**	**100**	**1 070**	**100**	**1 148**	**100**	**1 219**	**100**
Conifer stands	Small diameter trees	139	25	154	25	164	25	163	23
	Medium diameter trees	324	58	356	58	380	59	413	59
	Large diameter trees	80	14	86	14	87	13	102	15
	Very large diameter trees	15	3	17	3	17	3	19	3
Total conifers		**559**	**100**	**612**	**100**	**649**	**100**	**697**	**100**
Mixed stands	Small diameter trees	44	28	47	28	53	27	56	27
	Medium diameter trees	84	52	88	52	100	51	109	51
	Large diameter trees	25	16	29	17	33	17	37	17
	Very large diameter trees	6	4	7	4	8	4	10	5
Total mixed		**160**	**100**	**171**	**100**	**194**	**100**	**211**	**100**
All stand types	Small diameter trees	554	32	582	31	614	31	626	29
	Medium diameter trees	832	48	906	49	979	49	1 059	50
	Large diameter trees	267	15	290	16	312	16	349	16
	Very large diameter trees	70	4	75	4	84	4	94	4
Subtotal		**1 722**	**100**	**1 853**	**100**	**1 990**	**100**	**2 127**	**100**
Unspecified (not tallied)		0		1		1		0	
Total		**1 723**		**1 854**		**1 991**		**2 127**	

Source: NFI.
Relevant domain: FAWS excluding poplar plantations and including thickets.

ISFM 2010 Edition

Data retrieval year		2010			
Survey years		2006 to 2009			
Composition	*Diameter class*	*Mm³*			*%*
Broadleaved stand	Small diameter trees	422	±	11	29
	Medium diameter trees	690	±	16	47
	Large diameter trees	266	±	8	18
	Very large diameter trees	93	±	5	6
Total broadleaved		**1 471**	**±**	**31**	**100**
Conifer stands	Small diameter trees	120	±	7	18
	Medium diameter trees	408	±	19	62
	Large diameter trees	107	±	8	16
	Very large diameter trees	22	±	4	3
Total conifers		**658**	**±**	**30**	**100**
Mixed stands	Small diameter trees	65	±	5	22
	Medium diameter trees	162	±	11	56
	Large diameter trees	51	±	5	18
	Very large diameter trees	13	±	2	4
Total mixed		**291**	**±**	**19**	**100**
All stand types	Small diameter trees	608	±	12	25
	Medium diameter trees	1 260	±	22	52
	Large diameter trees	425	±	11	18
	Very large diameter trees	127	±	6	5
Total		**2 420**	**±**	**41**	**100**

Source: NFI
Relevant domain: FAWS, excluding temporarily unstocked stands.

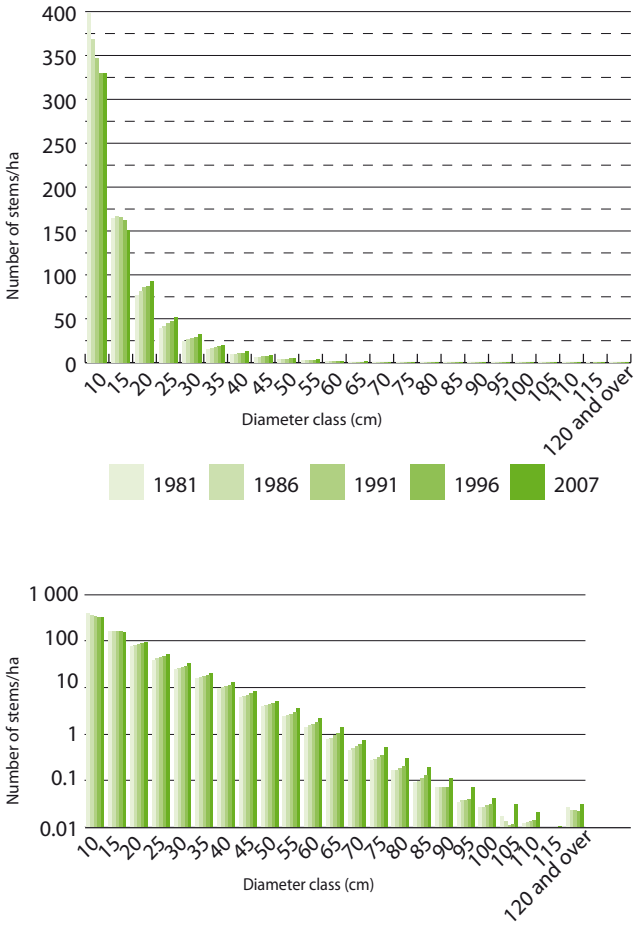


Figure 8: Variations in the number of stems per ha and diameter class. Logarithmic scale for the second graph

Source: NFI, survey years 2006 to 2009.

The medium diameter tree class has the highest growing stock regardless of the forest type considered. It accounts for 52% on average. This average is lower for broadleaved stands (47%), but is higher when the stand contains more conifer species.

Large and very large diameter trees account for 23% of the growing stock on average (all stand types combined). Medium and large diameter trees together have pooled most of the growing stock increase over the last two decades (61% and 22%, respectively - NFI, 2011).

In pedunculate and sessile oaks, small diameter growing stock represents no more than 15% of the growing stock of the species, whereas medium diameter trees represent almost half of this stock. Almost 10% of the growing stock of these two species comes under the very large diameter tree class.

For some broadleaved species, such as holm oak and pubescent oak, the small diameter tree class accounts for the greatest percentage of the growing stock (75% and 54% of the growing stock of the species). Trees of these species are seldom ranked in large stem diameter classes.

The cultivated poplar growing stock is very irregularly distributed in the diameter categories, with only 7% of the growing stock in the small diameter class, while medium diameter trees account for 64% of the total poplar growing stock.

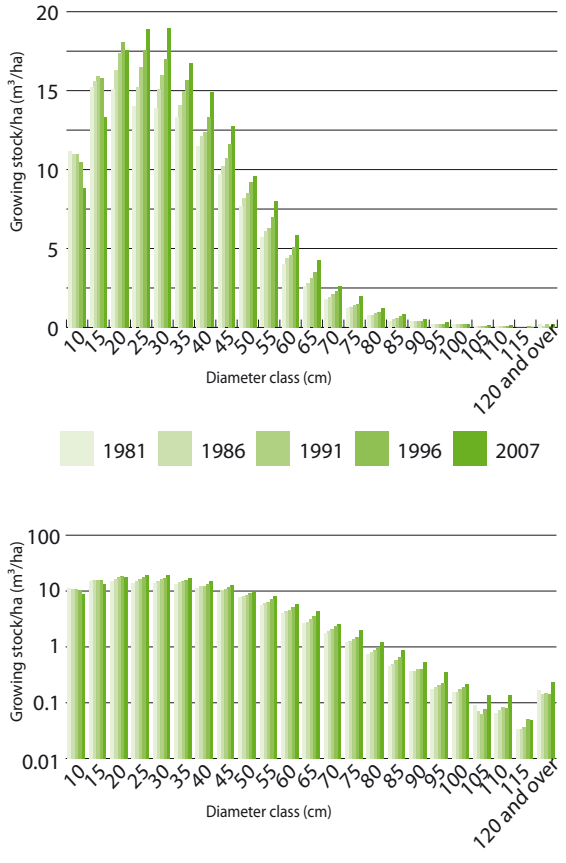


Figure 9: Variations in the growing stock per ha and diameter class. Logarithmic scale for the second graph.

Source: NFI, survey years 2006 to 2009.

Conifer species such as maritime pine, Scots pine, Aleppo pine, spruce, Douglas fir and larch generally have 15 to 20% of their growing stock in the small diameter tree category, with over 60% in the medium diameter category.

Overall, there seems to have been a shift in small diameter growing stock towards larger diameters–the growing stock of first three diameter classes declined, whereas it increased in all other classes. This decline in growing stock in the first classes could be explained by the reduction in trees observed in these classes. In conifers, the growing stock decreased after cyclone Klaus, so the growing stock distribution by diameter class reflects more the impact of the storm than indicating a general trend.

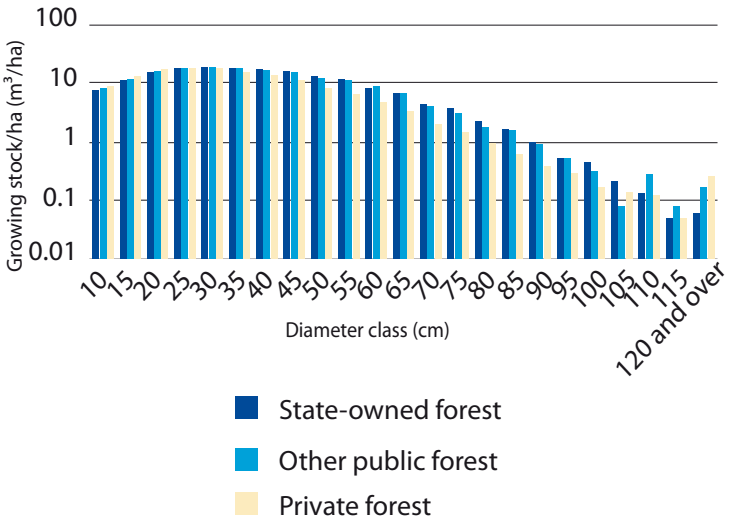


Figure 10: Growing stock per ha and holding type (logarithmic scale).

Source: NFI, survey years 2006 to 2009.

Growing stock per tree species and holding type

Broadleaved

Data retrieval year	2010					
Survey years	2006 to 2009					
Holding type	**State-owned forest**		**Other public forest**		**Private forest**	
Diameter class (in cm)	*Mm³*	*m³/ha*	*Mm³*	*m³/ha*	*Mm³*	*m³/ha*
Small diameter trees	34 ± 3	24	62 ± 4	26	370 ± 10	32
Medium diameter trees	69 ± 5	47	114 ± 5	48	542 ± 13	47
Large diameter trees	38 ± 4	26	55 ± 3	23	174 ± 6	15
Very large diameter trees	16 ± 2	11	19 ± 2	8	57 ± 4	5
Total	**156 ± 12**	**108**	**251 ± 12**	**106**	**1 143 ± 28**	**99**

Source: NFI.
Relevant domain: FAWS, excluding temporarily unstocked stands.

Conifers

Data retrieval year	2010					
Survey years	2006 to 2009					
Holding type	**State-owned forest**		**Other public forest**		**Private forest**	
Diameter class (in cm)	*Mm³*	*m³/ha*	*Mm³*	*m³/ha*	*Mm³*	*m³/ha*
Small diameter trees	18 ± 3	12	25 ± 3	11	98 ± 5	9
Medium diameter trees	62 ± 6	43	98 ± 8	42	374 ± 15	33
Large diameter trees	22 ± 3	15	39 ± 4	17	97 ± 6	8
Very large diameter trees	6 ± 2	4	12 ± 2	5	18 ± 3	2
Total	**107 ± 11**	**74**	**174 ± 14**	**74**	**588 ± 25**	**51**

Source: NFI.
Relevant domain: FAWS, excluding temporarily unstocked stands.

Indicator 1.4

Carbon stock of woody biomass and of soils on forest and other wooded land

Forests available for wood supply excluding poplar plantations

ISFM 2005 Edition

Data retrieval year	Carbon stock (million t)								Carbon sink (million t/year)
	1989		1994		1999		2004		1994-2004
Average year	1981		1986		1991		1996		1986-1996
Compartment	*MtC*	*tC/ha*	*MtC*	*tC/ha*	*MtC*	*tC/ha*	*MtC*	*tC/ha*	*MtC/an*
Tree above-ground biomass	603	45	654	49	714	52	765	55	11
Tree below-ground biomass	172	13	187	14	204	15	219	16	3
Subtotal forest tree biomass	775	58	841	63	917	67	984	71	14
Forest soils (including litter)		NA		NA	1 074	79		NA	NA
Total		**NA**		**NA**	**1 991**	**146**		**NA**	**NA**

ISFM 2010 Edition

Data retrieval year	Carbon stock (million t)		Carbon sink (million t/year)
	2010		1999-2010
Survey years	2006 to 2009		1996-2007
Compartment	*MtC*	*tC/ha*	*MtC/an*
Tree above-ground biomass	885	62	11
Tree below-ground biomass	252	18	3
Subtotal forest tree biomass	1 137	80	14
Forest soils (including litter)	NA	NA	NA
Total	**NA**	**NA**	**NA**

Source: NFI, results from the old inventory method for years 1986 to 1996 and survey years 2006 to 2009 for the average year 2007. DSF 1993-94 was used to estimate carbon stocks in forest soils from the European network for forest damage monitoring (540 plots).

Relevant domain: FAWS excluding poplar plantations. The estimate of the carbon stock in forest soils includes carbon in the litter and in the 0-30 cm horizon; as the update was not available at the time of publication, the 1999 value is given.

The tree above- and below-ground biomass was calculated using volume tables that consider the total above-ground biomass so as to include branches (Vallet, 2006) and 'root expansion factor' coefficients to include roots, and the 'wood density' and 'carbon levels' noted in the final report of the CARBOFOR research project, published in 2004 (Loustau, 2010). The carbon sink was calculated as the difference in carbon stocks over the number of lapsed years.

N.B.: These data are not comparable to those presented in France's official responses to the UN Framework Convention on Climate Change and the Kyoto Protocol, which were prepared by CITEPA.

Forests represent the most important carbon storage ecosystem in the world and are thus a key lever in policies designed to reduce greenhouse gas emissions. In forests, carbon is mainly stored in soilborne organic matter and tree biomass.

Stock analysis

Living biomass

Carbon contained in tree biomass amounts now to 1.1 billion t in forests available for wood supply (excluding poplar plantations), or 80 t/ha. Below-ground tree biomass accounts for 22% of this total amount. These estimations are based on the conclusions of the final report of the CARBOFOR project, published in 2004, which improved the quantification of branches and roots allocated to the NFI volumes (Box 3).

The highest carbon stocks are found in eastern France (Alsace, Franche-Comté), in Auvergne and in the north (Picardie, Haute-Normandie, Nord-Pas-de-Calais, Île-de-France), with stocks exceeding 90 tC/ha, and even 100 tC/ha for the eastern regions. The lowest values, less than 50 tC/ha, are found in the Mediterranean region (PACA, Languedoc-Roussillon). These results are linked with the tree dimensions and the proportion of branches. Broadleaved stands thus have a higher per-hectare carbon stock than conifers (78 tC/ha for broadleaved versus 69 tC/ha for conifers), even though their per-hectare NFI volume is lower (cf. Indicator 1.2).

The proportion of living biomass in the woody or nonwoody understorey and foliage could not be taken into account for this indicator due to a lack of reliable elements to calculate the carbon stock in this compartment. Moreover, other forest formations, poplar plantations and other wooded lands (heathland) and trees not eligible for inventory were not counted.

Deadwood

NFI now inventories lying or standing deadwood, but the corresponding carbon stock is not currently calculated.

Soils and ground litter

In 1993-94, the carbon stock in forest soils was assessed in 540 plots of the European network for forest damage monitoring (cf. Indicator 2.3). This soil carbon stock was estimated to be 79 t/ha, or 54% of the total forest carbon stock in 1999. As these data have not been updated, temporal variations in this stock are still unknown. It seems certain that soilborne carbon increases with the tree age in new stands (natural colonisation or afforestation of farmland and heathland), but the patterns are less clear in long-established forests. This stock has not been determined in poplar plantations or other wooded lands (heathlands).

The net annual carbon storage, or 'sink' in the tree biomass is estimated at 14.3 million t per year for the 1986-1996 period (data retrieval years 1994-2004). This sink represents 13% of national gross carbon emissions, without taking land-use, land-use changes and forestry into account. An update of the sink evaluation is presented for the 1996-2007 period (data retrieval years 2004-2010). The storage remained stable over the period.

Forests contribute to curbing the greenhouse effect, but this contribution not only involves their carbon stock. The use of timber produced by forests from atmospheric CO_2 increases the carbon sustainably stored in forest products (buildings, constructions), while also reducing fossil fuel consumption. In addition to using fuelwood as an alternative to fossil fuel, timber use—at equivalent performance—consumes less energy than other competing raw materials (steel, concrete, PVC, etc.). This contribution is, however, hard to quantify.

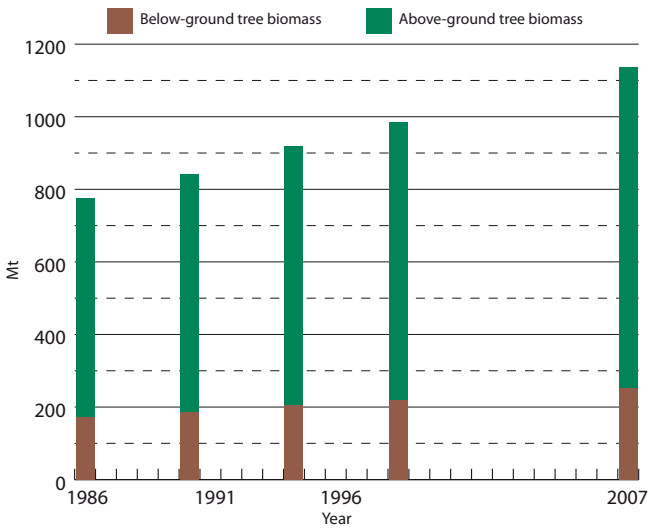


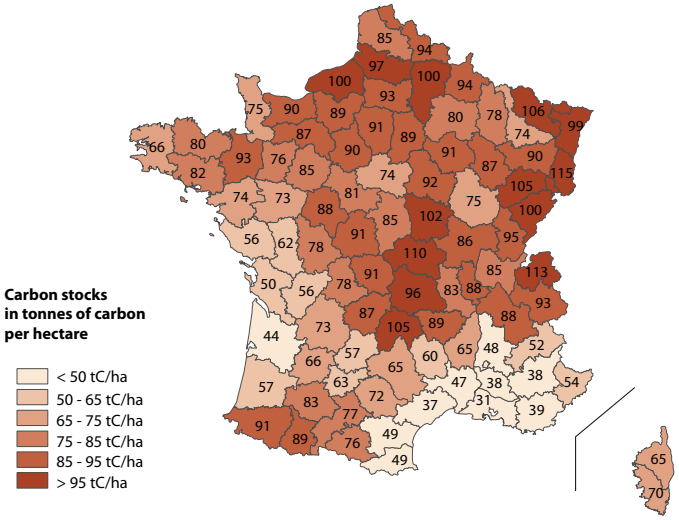
Figure 11: Variations in the carbon stock of forest trees.

Source: NFI, survey years 2006 to 2009.

Box 3: CARBOFOR research project

The CARBOFOR project on carbon sequestration in large-scale forest ecosystems in France was jointly conducted from 2002 to 2004 by many partners and funded by the French Ministry of Ecology and Sustainable Development and the Forestry Ministry via the ECOFOR public interest group. This research project compared ecosystem responses to a regionalised climatic scenario (1960-2100) with respect to the carbon cycle, biogeography and susceptibility to major pests and diseases.
The French National Institute for Agricultural Research (INRA), the French National Forest Inventory (NFI) and the Laboratoire d'études des ressources forêt-bois (LERFOB) have developed a new method for calculating carbon stocks in tree biomass on a national scale:
– the total above-ground carbon volume of trees is based on volume tables drawn up by LERFOB from French forest research archival data, so the mean branch biomass expansion factor is 1.61 for broadleaved species and 1.33 for conifers;
– the root biomass expansion factor, wood density and carbon content were evaluated on the basis of a bibliographical analysis. The root biomass expansion factors were evaluated at 1.28 for broadleaved species and 1.30 for conifers. The wood density was estimated at 0.55 tDM/m^3 fresh material for broadleaved species and 0.44 tDM /m^3 fresh material for conifers. Finally, the carbon content in dry matter was determined at 0.475 tC/tDM.

These estimations resulted in an overall ratio (tC/m^3 NFI) of 0.53 for broadleaved species and 0.36 for conifers. The difference generally concerns the use of the LERFOB volume tables per main species types.
The EMERGE research project, underway in 2011, should result in an update of volume tables that can be used with NFI data for different tree diameters and for a broader range of species and stand types.



Map 8: Above- and below-ground carbon stocks in forest trees (excluding poplar plantations).

Source: NFI, survey years 2006 to 2009.

Criterion 2

MAINTENANCE OF FOREST ECOSYSTEM HEALTH AND VITALITY

Indicator 2.1

Deposition of air pollutants on forest and other wooded land, classified by elements: nitrogen (N), sulphur (S) and base cations

The deposition of air pollutants is one of the factors responsible for forest damage. Sulphur dioxide (SO_2) is an acidification agent (sulphuric acid). Nitrogen oxides (NOx) are ecosystem inputs that induce acidification (nitric acid) and are responsible for the formation of ozone (O_3) through a reaction involving non-methane volatile organic compounds (NMVOC). Ammonium (NH_3) contributes to the atmospheric nitrogen input and to soil acidification.

Air pollutant depositions in forests are obviously directly dependent on emissions. Although the declining rate over the last 3 decades is encouraging (cf. table below)—because of the shutdown of thermal power plants, the desulphurization of industrial emissions, the use of low-sulphur fuels and the increase in vehicles equipped with catalytic converters—the trend varies depending on the pollutants concerned. Ammonium emission (NH_3) has not markedly decreased. Variations in this pollutant, which was mostly (98%) of agricultural origin in 2008, are mainly due to livestock production changes (76%) and the use of synthetic fertilizers (21%).

	1980	1985	1990	1995	2000	2005	2007	2008	2009 estimate	Variation 1980-2008[1]
	Volume (1000 t)									
SO_2	3 157	1 491	1 335	976	621	471	415	358	324	-89
NO_x	2 009	1 794	1 922	1 775	1 642	1 489	1 362	1 272	1 215	-37
NH_3	793	790	791	773	797	746	740	754	746	-5
COVNM			2 726	2 320	1 865	1 386	1 179	1 086	1 002	-60
	in acid equivalents (Aeq)									
acidification and eutrophication (SO_2, NO_x and NH_3)	189	132	130	115	102	91	86	83	80	-56

(1) 1990-2008 for NMVOC.
Source: CITEPA/SECTEN format - April 2010.

The acid equivalent index is designed to assess the overall amount of substances emitted into the atmosphere. At different spatiotemporal scales, these substances contribute to the acidification and eutrophication of soil, air and the aquatic environment. Its level has declined by over 50% since 1980 due to the marked reduction in SO_2 emissions. Ammonium currently represents 53% of the contribution to this index, as compared to 25% in 1980.

Estimate of atmospheric deposition under the forest canopy (throughfall) in the CATAENAT sub-network stations - 2004-2007 averages*

	H+	Cl	$S\text{-}SO_4$	$N\text{-}NO_3$	Na	$N\text{-}NH_4$	K	Mg	Ca	Fe	Al	Mn	Mean precipitation under the forest canopy
Placette	*g/ha*	*kg/ha*	*kg/ha*	*kg/ha*	*kg/ha*	*kg/ha*	*kg/ha*	*kg/ha*	*kg/ha*	*g/ha*	*g/ha*	*g/ha*	*mm*
CHP 40	11.5	47.8	7.3	2.7	23.1	3.2	41.7	5.1	9.5	54.9	96.0	658.8	615.8
CHP 59	28.7	24.5	7.7	2.5	11.9	6.6	37.2	4.1	8.9	77.3	108.8	1 320.3	720.4
CHS 35	10.5	32.2	4.3	2.8	14.9	7.7	29.1	3.6	4.7	58.0	63.7	2 033.6	533.1
CHS 41	12.1	15.3	2.9	2.0	6.5	4.3	19.2	2.6	6.1	33.9	54.7	1 504.4	433.4
CPS 77	11.1	13.9	3.4	2.9	5.9	3.8	13.7	2.9	8.5	52.3	70.4	1 313.7	397.0
DOU 71	107.1	21.4	5.5	8.3	12.7	4.4	12.5	3.0	7.2	36.8	233.4	704.0	959.5
EPC 08	107.3	30.5	11.3	7.3	16.1	7.9	25.0	2.9	8.0	85.6	372.7	1 524.3	1 016.6
EPC 63	39.6	16.3	4.1	4.7	8.7	2.8	16.4	2.6	8.1	84.7	241.1	610.9	686.5
EPC 74	64.0	7.8	4.5	6.9	3.3	6.7	15.6	1.6	10.9	108.1	192.1	262.4	984.6
EPC 87	53.0	25.5	5.2	5.8	13.1	3.3	22.4	3.0	6.6	58.6	239.7	400.1	836.1
HET 30	60.5	26.5	10.9	8.0	15.4	6.4	17.2	3.0	22.3	45.4	219.0	516.5	1 669.8
HET 64	22.0	27.2	8.4	4.9	13.9	4.0	19.5	2.8	10.0	21.5	94.0	505.3	853.5
PL 20	46.8	106.1	9.9	4.0	58.4	0.8	14.5	9.1	19.6	121.5	749.6	388.5	845.0
PM 17	76.4	141.3	9.6	4.7	77.7	2.8	8.0	10.8	11.8	40.1	101.1	142.8	576.1
PM 40c	76.6	36.2	4.4	3.0	16.5	2.7	13.9	4.8	9.7	57.7	299.8	91.1	589.8
PM 72	16.3	36.9	4.8	6.1	18.7	9.2	12.7	3.3	6.3	57.2	191.5	497.8	542.0
PM 85	68.1	204.9	12.8	4.6	120.7	2.7	13.0	15.4	10.8	58.1	77.2	69.1	488.1
PS 44	46.4	70.8	6.9	4.3	37.6	9.3	13.5	4.5	4.9	59.0	203.1	159.1	558.4
PS 67a	65.6	9.1	4.1	4.9	4.8	5.5	8.0	1.4	4.9	30.3	329.3	809.5	507.0
PS 76	164.9	63.6	14.2	5.6	34.4	7.6	15.7	5.3	9.6	51.3	262.9	1 507.3	593.1
SP 05	1.3	4.5	2.4	0.5	1.1	0.4	27.0	1.7	11.4	70.6	195.7	154.3	386.1
SP 11	19.0	26.7	7.4	3.6	12.9	1.9	43.7	2.8	12.4	120.6	314.5	245.2	863.5
SP 25	40.2	14.5	5.5	6.1	7.3	4.1	21.6	2.2	12.2	65.6	185.9	438.9	1 317.5
SP 38	28.2	5.8	4.3	2.1	2.2	2.3	18.0	1.6	7.9	47.1	218.9	1 117.3	981.0
SP 57	85.5	14.0	6.1	4.6	6.8	2.2	20.1	1.9	6.2	74.8	186.3	2 428.4	715.9
SP 68	45.8	9.6	3.9	5.6	4.7	4.0	21.8	1.6	5.4	46.6	176.7	314.2	709.0
Mean 2004-2007	50.3	39.7	6.6	4.6	21.1	4.5	20.0	4.0	9.4	62.2	210.7	758.4	745.3
Mean 1999-2003*	63.6	41.9	8.0	4.8	22.3	5.0	20.1	4.1	10.3	96.4	190.6	733.1	857.8
Mean 1993-1998	113.0	43.6	11.0	4.8	23.0	4.8	21.5	4.2	11.3	62.7	234.9	853.8	812.5
Variation since 1999-2003	-0.2	-0.1	-0.2	-0.1	-0.1	-0.1	-0.0	-0.0	-0.1	-0.4	0.1	0.0	-0.1
Variation since 1993-1998	-0.6	-0.1	-0.4	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.0	-0.1	-0.1	-0.1

*Because of incomplete measurements, year 2000 is excluded from the calculations for PS 67a, as well as year 2003 for SP 11.

Source: ONF, manager of the French RENECOFOR network (Réseau National de suivi à long terme des Écosystèmes Forestiers) and the CATAENAT sub-network (Charge Acide Totale d'origine Atmosphérique dans les Écosystèmes Naturels Terrestres); the plots are identified by their predominant species - CHS for sessile oak, CHP for pedunculate oak, CPS for pedunculate and sessile oak combined, HET for beech, EPC for Norway spruce, PS for Scots pine, PM for maritime pine, PL for Corsican pine, DOU for Douglas fir, SP for silver fir – followed by the department number of the plot.

The main purpose of the CATAENAT sub-network, set up by the French Office national des forêts (ONF) in late 1992, is to analyse the impact of atmospheric deposition on forest ecosystems. The network consists of 27 sites in open fields and 26 sites within forests located throughout metropolitan France, varying in terms of both the predominant species in the stand and its geographical location, without claiming to be statistically representative. A time-series of 15 years of measurements of annual precipitation and atmospheric deposition in the open field and under the forest canopy (throughfall deposition) is now available for the 1993-2007 period. As an in-depth specialised analysis of these results will soon be published, only the main trends reported in the ONF scientific reports are discussed here.
Details on the 2004-2007 comparisons with the previous 1993-1998 and 1999-2003 periods are given in Appendix XIV.

Throughfall deposition differs clearly from open field deposition levels (not under forest cover). This is firstly due to aerosols and mist and cloud droplets deposited on the tree crowns, as well as precipitation deposition. There is also ion exchange between the precipitation and foliage—trees are thus able to take up certain elements, such as nitrogen, via leaf absorption while discharging others via canopy leaching, especially potassium, calcium and magnesium. Throughfall deposition is generally higher than open field deposition for most elements, except for nitrogen which is sometimes taken up by the foliage, and protons.
Furthermore, throughfall deposition is often greater under conifers—except for larch—than under broadleaved species in the same forest area owing to the persistence of conifer foliage in winter:

a) Acid deposition induced by protons (direct acidity, H^+) in open field precipitation and throughfall is mostly low, i.e. in all plots they are under 1 kg (Keq)/ha/year. It had already greatly decreased on average between 1993 and 1998, and between 1999 and 2003 (-43.7%) and further decreased between 1999-2003 and 2004-2007 (-20.8%). Sites with the greatest throughfall values over the 1993-1998 period were those where the decrease was most marked over the 15 year period: -75.9 % in Seine-Maritime (PS 76), -72.4% in Ardennes (EPC 08) and -79.1% on Mont Aigoual (HET 30). This drop in proton deposition is mainly linked to sulphur fallout.

b) Sulphur deposition ($S\text{-}SO_4$) is from two main sources. Part is ocean-derived, which is much greater in coastal areas and has no acidification impact because these depositions are associated with alkaline cations (calcium, magnesium, potassium). Secondly, human-induced emissions of SO_2 are responsible for acidic sulphur fallout as they are partially associated with protons. Over the last 15 years, apart from coastal sites (PM 17 and PM 85), atmospheric sulphur depositions have dropped sharply (-39.8% on average), concomitantly with proton depositions (direct acidity). Sites initially most affected by this pollution are also where the greatest decreases are noted, i.e. especially -59.4% in Seine-Maritime (PS 76), -54.3 % in Ardennes (EPC 08) and -41.1% on Mont Aigoual (HET 30). The policy to reduce SO_2 emissions that was imposed in 1980 thus seems to be yielding encouraging results, even though the decline slowed down between 1999-2003 and 2004-2007. Nitrogen ($N\text{-}NO_3$ and $N\text{-}NH_4$) is gradually surpassing sulphur as the main acidifying compound since its deposition levels have been declining at a much slower rate.

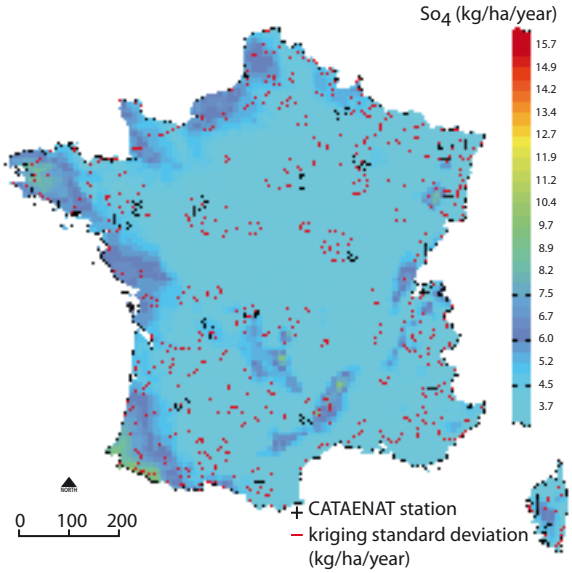
c) Nitrogen deposition (in the form of ammonium and nitrates) has a fertilisation impact on trees, but can also have negative ecosystem acidification (as these compounds are associated with protons) and eutrophication impacts. These depositions are highly spatially variable and mainly derived from agricultural activities (livestock production and fertilisation) for ammonium and vehicle emissions for nitrates. However, depositions sometimes occur very far from the emission site, especially on mountain ranges (e.g. in Vosges and Jura regions) where precipitation is more substantial than in lowland areas.
Total average nitrogen ($N\text{-}NO_3$+$N\text{-}NH_4$) throughfall was 9 kg/ha/year over the 2004-2007 period. As compared to the 1999-2003 period, there was a relatively marked 8% decrease in this average but with contrasting trends, i.e. declining at 15 sites (2-42%), increasing at eight other sites (2-36%) and steady at three other sites.

d) Calcium, magnesium and potassium are major nutrient cations and their atmospheric deposition is an important nutrient source for barren soils. These depositions are from different sources. Magnesium (Mg), which is mainly derived from the marine environment, shows a very marked gradient between the coast and inland areas, with no average throughfall deposition noted since 1993. Calcium (Ca) is mainly borne by Saharan wind currents, but depositions are also partly from industrial emissions. On average, there has been a relatively marked decrease in throughfall depositions since 1993 (-16.9%), but this trend is noted especially at sites where declines in sulphur deposition are sharpest: -44.8% in Seine Maritime (PS 76), - 46.7% in Ardennes (EPC 08) and -47.3% in the vicinity of Strasbourg (PS 67a). Hence, although the reduction in sulphur pollution has led to a considerable reduction in the direct acidity of atmospheric deposition in forests, it also seems to have led to a considerable reduction in calcium inputs.

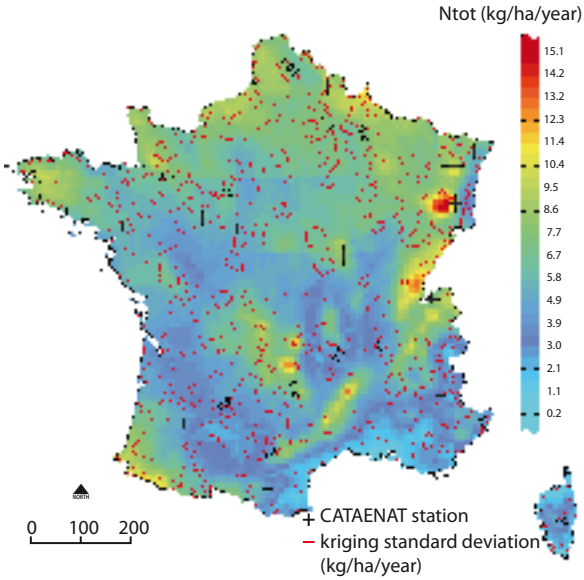
e) Sodium (Na) and chloride (Cl) depositions are essentially derived from the oceans. When elevated (PM 17, PM 85), trees may be subject to extreme salinity conditions.

The overall marked decrease in acidifying depositions of sulphur and protons is beneficial for ecosystems and evidence of the efficiency of the proactive policies imposed in 1980 to reduce SO_2 emissions. However, the deposition acidity still sometimes surpasses the critical load for the most barren soils. Decreasing atmospheric pollution is still a major challenge, especially with respect to nitrogen deposition levels, which have remained relatively steady in the last 15 years and whose accumulation in ecosystems can have negative effects in terms of both acidification and eutrophication.
The findings of the soil analysis study under way (2009-2012) on plots in the RENECOFOR network (cf. p.47) should enable a more accurate assessment of the real impact of these depositions on forest ecosystems.

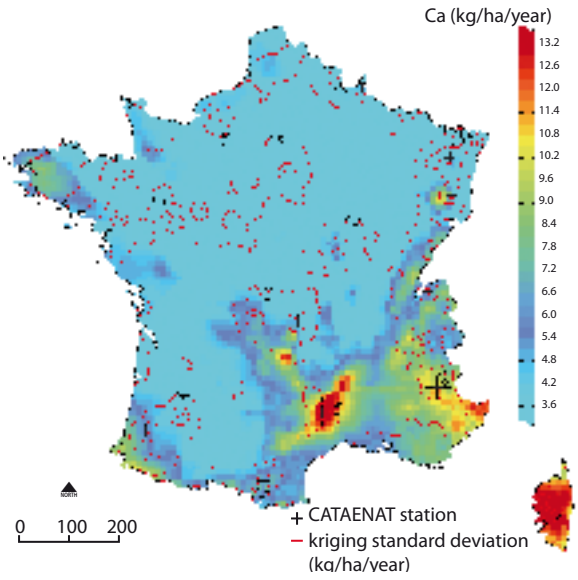
RENECOFOR - CATAENAT
Spatialization of annual atmospheric open field deposition of sulfate ($S\text{-}SO_4$) over the 1999-2004 period.



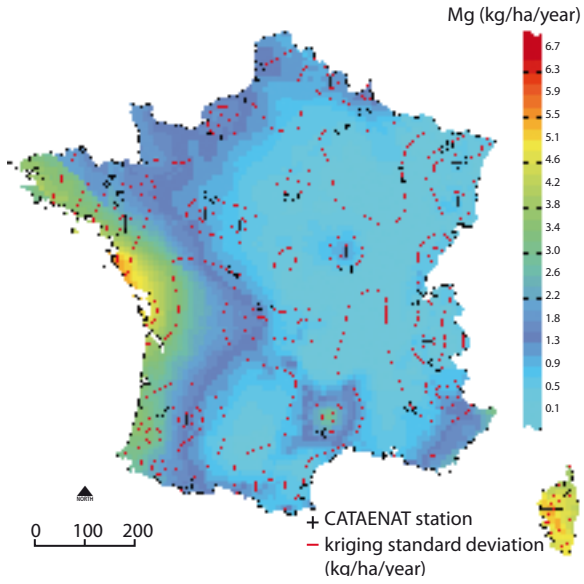
RENECOFOR - CATAENAT
Spatialization of annual atmospheric open field deposition of total nitrogen ($N\text{-}NO_3 + N\text{-}NH_4$) over the 1999-2004 period.



RENECOFOR - CATAENAT
Spatialization of annual atmospheric open field deposition of calcium (Ca) over the 1999-2004 period.



RENECOFOR - CATAENAT
Spatialization of annual atmospheric open field deposition of magnesium (Mg) over the 1999-2004 period.



Map 9: Spatialization of annual atmospheric open field deposition of sulfate, total nitrogen, calcium and magnesium in precipitation from 1999 to 2004 at 27 sites in the CATAENAT sub-network.

Source: ONF. Method developed by Croisé et al. (2005).

Variations in overall precipitation quality in open fields in the CATAENAT sub-network from 1993 to 2007 (mean national concentrations weighed by precipitations)

Indicators of the mean overall precipitation quality in France can be calculated simply by dividing the sum of annual depositions at all sites by the sum of their precipitations. The result is the mean annual concentration per mm of precipitation for all 27 sites located in the open field. From a scientific standpoint, this is the only national indicator for monitoring long-term precipitation quality trends.

The direct precipitation acidity has decreased over the last 15 years: the mean pH has generally increased since 1993 despite a stagnation since 2000. This could be partially explained by the 37% decrease in sulfate concentrations during the same period. Nitrate concentrations have been highly stable, along with ammonium levels, apart from an initial peak in 1993. With respect to alkaline cations (calcium, magnesium, sodium), magnesium levels closely match sodium patterns, clearly reflecting its main oceanic origin. However their annual variations are too marked to be able to determine the trends.

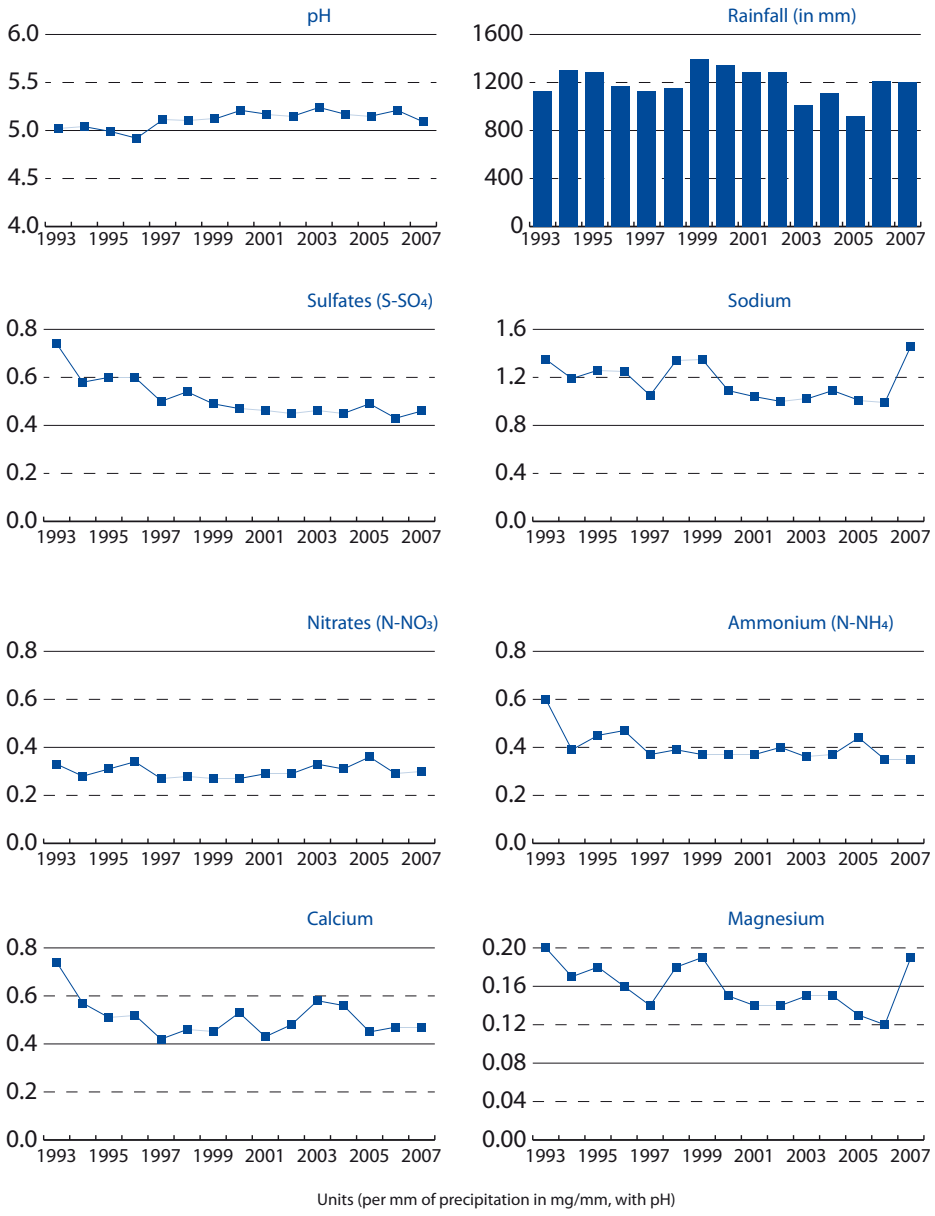


Figure 12: Variations in overall precipitation quality in open fields in the CATAENAT sub-network from 1993 to 2007.

Source: ONF.

Reference:

Croisé L., Ulrich E., Duplat P., Jaquet O., 2005
Two independent methods for mapping bulk deposition in France. Atmospheric Environment, 39: 3923-3941.

Indicator 2.2

Chemical soil properties of forest and other wooded land (pH, CEC, C/N, organic C, base saturation) related to soil acidity and eutrophication, by main soil types

ISFM 2005 Edition: 508 plots monitored

Soil type		Water pH	Cation exchange capacity (CEC=T)	Base saturation rate (S/T)	Organic carbon content	Carbon/ nitrogen ratio (C/N)
WRB classification	*Number of plots monitored*		*meg/100 g*	*%*	*%*	*%*
Cambisol	222	5.5	11.5	57.6	36.0	14.9
Leptosol	123	7.0	27.0	93.5	47.1	14.1
Luvisol	72	4.8	5.6	47.6	27.5	16.5
Podzol	47	4.7	3.3	32.6	26.5	24.5
Arenosol	2	5.3	1.4	60.1	12.5	25.5
Gleysol	10	5.8	19.2	75.4	41.2	13.0
Regosol	3	6.7	13.6	82.6	37.3	17.8
Others	29	5.8	8.7	70.2	34.8	16.3

Source: Département de la santé des forêts - Inventaire des sols forestiers européens (16 km x 16 km). Means for 1993-94 in the 0-20 cm horizon.
WRB: World Reference Base of Soil Resources

ISFM 2010 Edition: 543 plots monitored

Soil type		Water pH		Cation exchange capacity (CEC=T)		Base saturation rate (S/T)		Organic carbon content		Carbon/ nitrogen ratio (C/N)	
WRB classification	*Number of plots monitored*			*meg/100 g*		*%*		*%*		*%*	
		cm									
		0-10	*0-20*	*0-10*	*0-20*	*0-10*	*0-20*	*0-10*	*0-20*	*0-10*	*0-20*
Cambisol	288	5.6	5.7	17.9	16.0	71.9	68.7	54.3	42.3	16.4	16.0
Leptosol	37	7.0	7.0	35.0	32.3	97.1	96.4	72.7	59.3	16.8	16.2
Luvisol	48	4.8	4.8	6.1	5.3	56.1	49.1	32.8	24.1	17.5	17.4
Podzol	27	4.3	4.3	3.9	3.2	39.6	32.3	37.8	30.7	29.9	30.5
Arenosol	27	4.6	4.6	2.7	2.2	51.4	47.1	23.9	18.1	25.5	25.0
Stagnosol	28	4.9	5.0	8.3	7.4	58.0	52.4	36.3	26.5	17.8	17.5
Phaeozem	28	7.3	7.4	42.3	39.0	99.5	99.4	88.1	74.0	16.8	16.0
Umbrisol	25	4.6	4.6	8.8	7.1	34.6	30.7	83.7	69.2	18.1	18.1
Others	35	5.3	5.4	13.1	11.9	71.2	66.7	43.2	32.1	17.9	17.6

Source: Département de la santé des forêts – Programme BioSoil: Inventaire des sols et de la biodiversité pour le réseau européen de surveillance des forêts (16 km × 16 km), 2007; means in the 0-10 and 0-20 cm horizons.
WRB: World Reference Base of Soil Resources

Forest soils were first analysed in 1994-1995 in French plots of the European network for forest damage monitoring (European network level 1) that were set up in 1989 on the basis of a 16 x 16 km square grid. In France, this network is extended to non-forest areas through a soil quality measurement network (RMQS) with plots set up as of 2001 according to the same square grid and managed by the 'Gis Sol' scientific interest group. Variations in soil quality, according to 2000 assessment points, are thus being monitored throughout metropolitan France via these networks. A second analysis of soils in plots of the European network for forest damage monitoring (level 1) was carried out in 2007 within the framework of the BioSoil programme (cf. below).

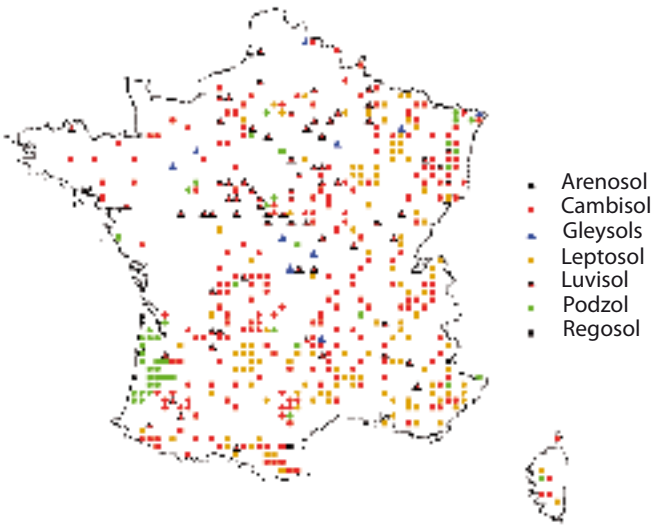
Another French forest network, i.e. the RÉseau National de suivi à long terme des ÉCOsystèmes FORestiers (RENECOFOR), managed by the French Office national des forêts, aims to gain insight into changes in forest ecosystems induced by environmental changes (air pollution, meteorological events). This network is not based on a systematic square grid but on 102 study areas distributed throughout metropolitan France and covering a wide range of FAWS ecosystems (sessile oak, pedunculate oak, Douglas fir, spruce, beech, larch, Scots pine, maritime pine, Corsican pine and silver fir). The physicochemical properties of soils at these 102 sites are monitored using a comparable procedure over time, with five analytical repetitions per layer to 40 cm depth. The first surveys were conducted in 1993-95, while the second is currently under way. The first temporal variations will be analysed in 2013.

Since late 2006, NFI, the INRA InfoSol research unit at Orléans and Laboratoire d'analyse des sols (LAS) at Arras have been jointly addressing a request from the Joint Research Centre (JRC) of the European Commission (Ispra, Italy) within the framework of the European BioSoil programme. This programme is designed to produce a soil and biodiversity inventory for the European forest monitoring network. BioSoil involves 22 European countries and around 4,500 sites, including 548 in France, with Europe partitioned systematically over a 16 x 16 km grid.

Unfortunately it is not possible just to present a comparison between the 2006-2007 (BioSoil) and the previous (1994-1995) surveys because:

- The 1994 procedure was not tailored for a comparison between successive surveys with respect to the plots (a single sample per plot, whereas the BioSoil survey involved a composite sample from five samplings);
- The soil classification differs, according to the French soil reference base for the 1994-1995 survey and the World Reference Base for Soil Resources (WRB) classification for the BioSoil survey—hence Umbrisols are Organosols, Stagnosols correspond to Reductisols, etc.;
- Apart from this difference in nomenclature, identical profiles were classified differently in the two surveys;
- The number of plots increased and some of them were moved.

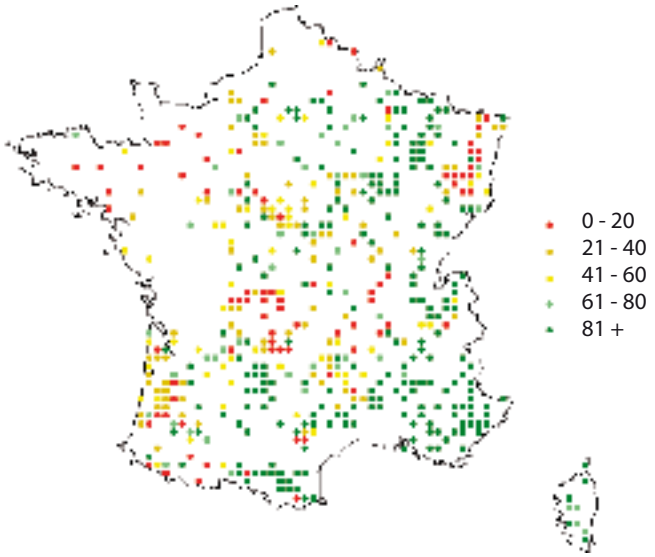
A comparison by plot groups would therefore not be an easy task. In-depth studies on this issue are under way or planned.



Map 10: Types of soils found in the plots of the European monitoring network over a 16 ×16 km grid.
Source: DSF, 1994-95 and 2007.

Forest soils are much more acidic and unsaturated (low proportion of base cations in the cation exchange complex) than agricultural soils. The differences could be explained by the fact that forest stands often grow on barren soils (mountain, hydromorphic and superficial soils, etc.), without any inputs (fertilisers and other soil conditioners). Moreover, mineral losses regularly occur as a result of silvicultural nutrient export without subsequent mineral restoration, litter extraction and increased leaching of minerals by acidic atmospheric depositions.

Within the European network, 45% of soils have a base saturation rate (S/T) of the nutrient cationic complex (calcium, magnesium, potassium) in the 0-20 cm horizon of over 80%, whereas 16% of soils have a low S/T, less than 20%. No precise minimum thresholds have been set, below which forest trees would have mineral nutrition problems, but it is known that the risks increase considerably when the base saturation rate is under 10% (6% of soils). The most unsaturated soils are mainly found in Vosges, the northwestern regions (Normandie, Bretagne), Massif Central and the Landes massif.



Map 11: Base saturation rates recorded in plots of the European monitoring network over a 16 × 16 km grid.

Source: DSF, 1994-95 and 2007.

Indicator 2.3

Defoliation of one or more main tree species on forest and other wooded land in each of the defoliation classes: 'moderate', 'severe' and 'dead'

Data prior to 1994 could not be compared to those collected after 1997 because of the change of method that took place during the 1995-1997 period. Hence, defoliation of a tree is assessed relative to a reference tree (zero defoliation), and references are delineated for each species, region and stand. For this reason it is hard to make comparisons between trees or general categories (broadleaved, conifers). It is therefore necessary to assess variations in this defoliation criterion rather than its absolute value during a given year.

The defoliation status generally reflects the vitality of the tree, and is the result of various factors: tree age, silvicultural history, pathogenic presence, climatic stress, atmospheric pollution, mineral deficiency, etc. The great number of defoliation factors and their difficult interpretation generally complicate determination of the symptom cause.

The climate was marked by a long-term drought from 2003 to 2006 (and until 2007 in the southeastern Mediterranean region) and by cyclone Klaus in January 2009 which, although it did not affect France overall, caused severe damage in the Landes massif. This climatic event did not, however, upset the network nearly as much as the storms of Christmas 1999 since only a few monitoring plots were shut down or moved.

Over the 2005-2010 period, for many forest species there was an improvement in the extent of their defoliation and thus in their health status. This trend tends to indicate that the situation is returning to normal after two major successive crises that affected the French forests, i.e. the Christmas 1999 storms and the 2003 drought. This improvement was further enhanced by cool summers with considerable precipitation in 2007 and 2008, which was highly beneficial for forest vegetation growth.

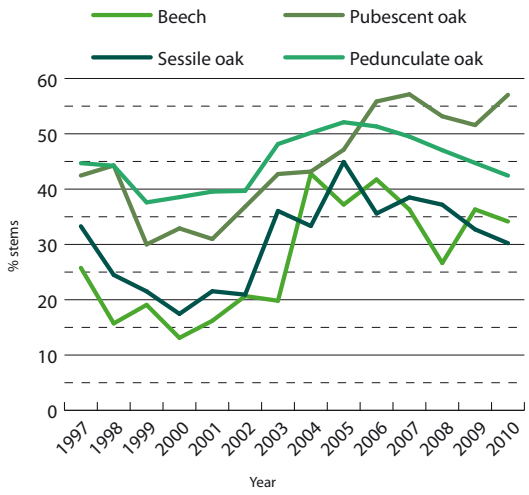


Figure 13: Variation in the percentage of stems of the main broadleaved species with a defoliation rate above 25%.

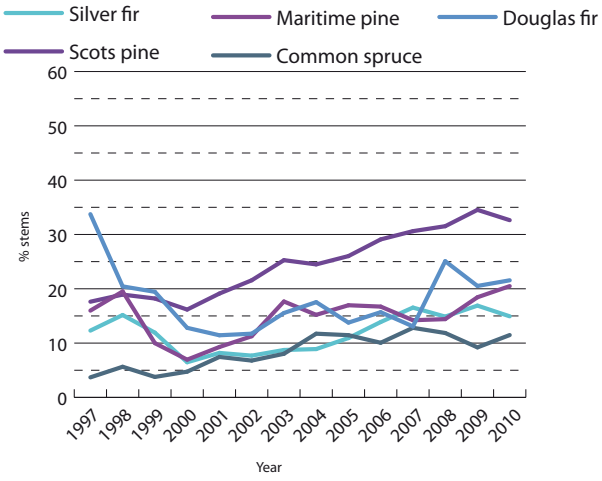


Figure 14: Variation in the percentage of stems of some conifer species with a defoliation rate above 25%.

Source : Département de la santé des forêts – Réseau systématique de suivi des dommages forestiers.

Maritime pine tree windbreaks resulting from cyclone Klaus in January 2009.

This trend was especially marked for broadleaved species (sessile oak, pedunculate oak and beech, with the exception of pubescent oak). However, it was not for conifers, i.e. there was little change, a slight increase (maritime pine, common spruce, silver fir), or even a very sharp increase for Scots pine for which the defoliation situation worsened, generally resulting in the deterioration of its health status in southeastern France.

The level of trees with moderate to average defoliation has been high since 2003 as compared to previous years. The poor health of broadleaved trees is the result of the high defoliation rates of oaks (especially pedunculate oak) and also of more marginal species such as wild cherry, which is susceptible to cylindrosporiosis, elm, which is chronically affected by Dutch elm disease, alder and birch, or trees with little commercial value, such as holm oak or pubescent oak.
After the peak in conifer mortality in 2004, mainly only affecting spruce trees weakened by the 2003 drought and bark beetle infestations, the percentage of deadwood in the grid network returned to a more normal level for both broadleaved and conifer species.

Dead chestnut stand.

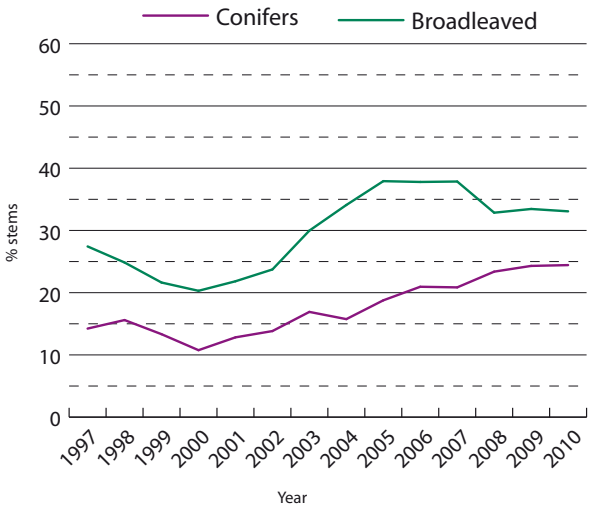


Figure 15: Percentage of trees affected by moderate defoliation (25 to 60%).

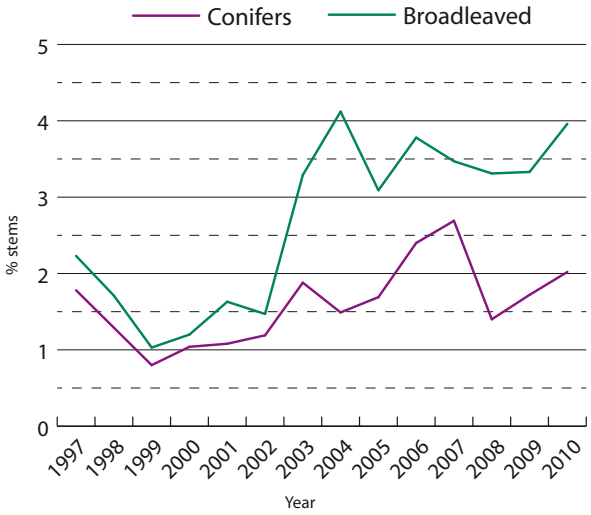


Figure 16: Percentage of trees affected by severe defoliation (more than 60%).

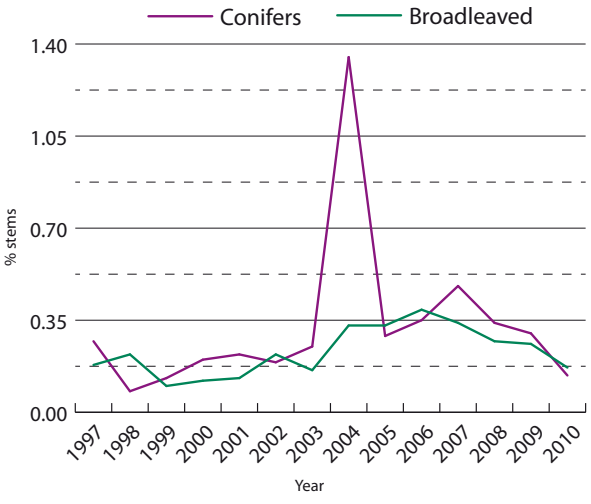


Figure 17: Percentage of dead trees.

Indicator 2.4

Forest and other wooded land with damage, classified by primary damaging agents (abiotic, biotic and human induced) and by forest type

Cause of damage	Main species	% of damaged plots			% of damaged trees		
		1995-1999	2000-2004	2005-2009	1995-1999	2000-2004	2005-2009
Pest insects	Broadleaved	40.3	39.9	39.9	17.9	18.0	16.6
	Conifers	9.5	8.6	11.2	3.4	1.8	4.1
	All species	34.7	34.2	34.7	12.8	12.3	12.2
Fungal diseases	Broadleaved	13.4	13.0	19.4	3.7	3.6	6.4
	Conifers	9.3	14.6	12.9	4.5	7.3	8.4
	All species	14.2	16.0	20.4	4.0	4.9	7.0
Climatic stress	Broadleaved	15.4	10.3	16.5	5.6	3.8	9.7
	Conifers	8.2	8.1	11.2	4.5	2.3	6.3
	All species	15.1	10.5	16.2	5.2	3.3	8.5

Source: Département Santé des Forêts (DSF).

National data are available on damage caused by pest insects, fungal diseases, climatic stress, fires and storms. For the first three factors, the reliable data can only be expressed according to the number of plots and trees affected, but not in terms of area, contrary to the fire and storm damage data. An in-depth analysis of this damage is provided hereafter.

Damage caused by pest insects, fungal diseases and abiotic stress

An assessment of the concerned area has been conducted for the first two editions of the present report (1995 and 2000), based on the main pest and disease events reported during the 5 previous years and by using a multiplicative correction factor to account for non-inventoried situations. However, considering the error level, it was decided to not record the estimations previously carried out. It is not possible to clearly determine exactly how the areas would have changed relative to the previous period.

It is hard to set up a reliable system for monitoring this indicator because of several factors:

– damage symptoms due to pest insects (e.g. defoliators) and fungal diseases are often temporally limited and thus a suitable statistical system has to be available to be able to quantify the damage at the right time;

– some pathogenic fungi (e.g. conifer polypores) are very hard to detect if there is no mortality in the affected trees or if they are not logged;

– relations between the extent of symptoms and the extent of increment losses are often unknown;

– trees can die several months or even years after being damaged by pest insects or fungal diseases. These trees are often scattered throughout the stands and the mortality threshold beyond which the stand may be rehabilitated can vary markedly depending on the forest manager's priorities.

Stand damaged by cyclone Klaus in Aquitaine region.

Damage caused by pest insects, fungal diseases and abiotic stress, such as spring frost and summer drought, varies widely from year to year: it can be limited to 1 year or fluctuate over several years, depending on the specific dynamics of these pest populations, and in interaction with the climatic stress factors (particularly water stress). Mortality is often the ultimate stage of progressive weakening (ageing, root rot fungi, etc.). Tree death can occasionally become more frequent due to a combination of unfavourable factors (e.g. drought and insect defoliators) or outbreaks of bark beetles after storms or droughts.

Because of the lack of an operational measurement instrument capable of supplying reliable quantitative data at the national level on the impact of different biotic and abiotic factors, the question is covered here from two complementary angles:

– **the proportion of trees and plots in the European network affected by 'known causes'**: the sampling density is sufficient to reflect major health problems, but probably not more localised problems. Moreover, the summer rating underestimates the damage symptoms and causes because the factors of spring stress (insects, frosts, etc.) are not always identifiable in summer and certain problems (e.g. root problems) are difficult to diagnose;

– **assessment of the severity of serious pest and disease problems on the basis of observations made by the correspondents-observers of the Département santé des forêts** (several thousands observations per year): these problems have been documented, but the proportion of stands affected in a given region is unknown. The observations collected enable us to monitor fluctuations in the main pests affecting French forests.

NB: Recent data cannot be compared to those of the initial 1990-1994 period because the training level of the observers has considerably improved.

Damage of known origin in the European network for forest damage monitoring (mean frequency of problems linked with attacks by pest insects and fungal diseases and with abiotic factors)

For all species, the three most frequent stress factors during the 2005-2009 period are:

– pest insect attacks: 35% of plots and 12% of trees;

– attacks by pathogenic fungi: 20% of plots and 7% of trees;

– abiotic stress (climatic and silvicultural damage, mineral deficiencies, etc.): 16% of plots and 8% of trees.

Photo: S. Latherade - NFI

A dead pine tree as a result of heavy bark beetle attacks.

Species	Number of plots with at least one tree of the species	Number of plots in which were reported					
		Insect pests		Pathogenic fungi (and related)		Damage due to an abiotic factor	
	mean 2005-2009	*mean 2005-2009*	*%*	*mean 2005-2009*	*%*	*mean 2005-2009*	*%*
Sessile oak	130.4	44.8	34.4	14.6	11.2	7.0	5.4
Pedunculate oak	148.2	48.0	32.4	34.6	23.3	11.6	7.8
Holm oak	27.2	9.8	36.0	3.0	11.0	10.2	37.5
Pubescent oak	68.2	35.8	52.5	9.0	13.2	16.6	24.3
Beech	131.8	30.0	22.8	2.8	2.1	11.4	8.6
Maple	59.6	4.8	8.1	1.6	2.7	3.0	5.0
Birch	36.8	1.5	4.1	0.0	0.0	3.2	8.7
Hornbeam	53.8	5.2	9.7	1.3	2.3	4.0	7.4
Chestnut	52.6	2.0	3.8	10.4	19.8	6.8	12.9
Common ash	62.4	6.8	10.9	1.4	2.2	4.4	7.1
Poplar	30.2	1.8	6.0	2.4	7.9	4.0	13.2
Wild cherry	37.8	4.0	10.6	4.0	10.6	2.2	5.8
Other broadleaved	84.4	10.0	11.8	3.6	4.3	7.8	9.2
Total broadleaved	**380.8**	**151.8**	**39.9**	**74.0**	**19.4**	**62.4**	**16.5**
Common spruce	48.0	1.3	2.6	1.0	2.1	1.8	3.6
Silver fir	49.2	2.0	4.1	11.0	22.4	4.4	8.9
Scots pine	66.2	5.2	7.9	9.4	14.2	6.4	9.7
Maritime pine	51.4	10.2	19.8	1.0	1.9	4.0	7.8
Austrian pine	22.4	1.8	8.0	1.3	5.6	4.3	19.0
Aleppo pine	14.4	2.3	16.2	5.6	38.9	3.2	22.2
Douglas fir	20.0	1.6	8.0	2.2	11.0	2.0	10.0
Larch	13.6	2.8	20.2	1.0	7.4	2.4	17.6
Other conifers	10.8	1.0	9.3	1.0	9.3	1.3	11.6
Total conifers	**231.2**	**25.8**	**11.2**	**30.0**	**12.9**	**26.2**	**11.2**
Total all species	**503.8**	**174.8**	**34.7**	**103.0**	**20.4**	**81.4**	**16.2**

Source: DSF.

The degree of damage is difficult to interpret, as it can be over- and under-estimated, and it is very hard to differentiate their respective impacts. The above table only presents the various tree damage factors without accounting for the extent of damage caused. Finally, very spatially large phenomena can be monitored via the square grid network, but it is not tailored for assessing localised and temporarily heavy damage or for detecting emerging pests such as *Chalara fraxinea*, which was first identified in eastern France in 2008.

However, the hierarchy of the different types of problem and the percentage of trees damaged has generally remained unchanged in recent years. The variations could be readily explained, e.g. by the recrudescence of pests and diseases on oaks and by more virulent powdery mildew attacks in recent years.

Species	Number of stems	Number of stems in which were reported					
		Insect pests		Pathogenic fungi (and related)		Damage due to an abiotic factor	
	mean 2005-2009	*mean 2005-2009*	*%*	*mean 2005-2009*	*%*	*mean 2005-2009*	*%*
Sessile oak	1 225.0	213.4	17.4	40.6	3.3	23.6	1.9
Pedunculate oak	1 128.0	240.8	21.3	170.0	15.1	34.8	3.1
Holm oak	368.6	64.6	17.5	38.0	10.3	160.6	43.6
Pubescent oak	852.6	199.0	23.3	28.0	3.3	157.4	18.5
Beech	1 086.6	261.6	24.1	16.6	1.5	90.0	8.3
Maple	149.4	7.2	4.8	4.2	2.8	6.8	4.5
Birch	146.8	2.0	1.4	0.0	0.0	40.0	27.2
Hornbeam	222.0	14.0	6.3	2.0	0.9	11.8	5.3
Chestnut	431.6	9.0	2.1	83.0	19.2	40.8	9.5
Common ash	281.4	31.4	11.2	6.0	2.1	6.4	2.3
Poplar	149.0	3.6	2.4	37.2	25.0	25.8	17.3
Wild cherry	92.0	6.6	7.2	8.5	9.2	3.8	4.1
Other broadleaved	415.8	44.2	10.6	9.0	2.2	35.0	8.4
Total broadleaved	**6 548.8**	**1 089.0**	**16.6**	**418.2**	**6.4**	**635.4**	**9.7**
Common spruce	482.6	10.3	2.1	1.0	0.2	3.8	0.8
Silver fir	498.8	5.8	1.2	35.6	7.1	54.6	10.9
Scots pine	664.8	10.2	1.5	105.0	15.8	70.6	10.6
Maritime pine	844.8	35.8	4.2	2.0	0.2	19.2	2.3
Austrian pine	227.4	20.4	9.0	8.3	3.6	14.0	6.2
Aleppo pine	225.2	9.0	4.0	123.4	54.8	31.8	14.1
Douglas fir	306.2	9.8	3.2	20.2	6.6	14.3	4.7
Larch	149.4	56.5	37.8	3.0	2.0	17.2	11.5
Other conifers	95.4	3.0	3.1	1.0	1.0	4.0	4.2
Total conifers	**3 494.6**	**143.2**	**4.1**	**292.4**	**8.4**	**219.4**	**6.3**
Total all species	**10 100.4**	**1 232.2**	**12.2**	**710.6**	**7.0**	**854.8**	**8.5**

Source: DSF.

The usual trends are noted and they depend on the characteristics of the species and pests:

– oaks and larch are more affected by insects, especially defoliating caterpillars;

– poplars and chestnut for broadleaved species, Aleppo pine for conifers have recurrent fungal disease problems;

– mistletoe is the main problem affecting Scots pine;

– some species show symptoms that can be interpreted as being due to drought: holm oak and pubescent oak, birch, Scots pine and Aleppo pine, etc.

Severity of the 10 major pest and disease problems affecting French forests from 1989 to 2009

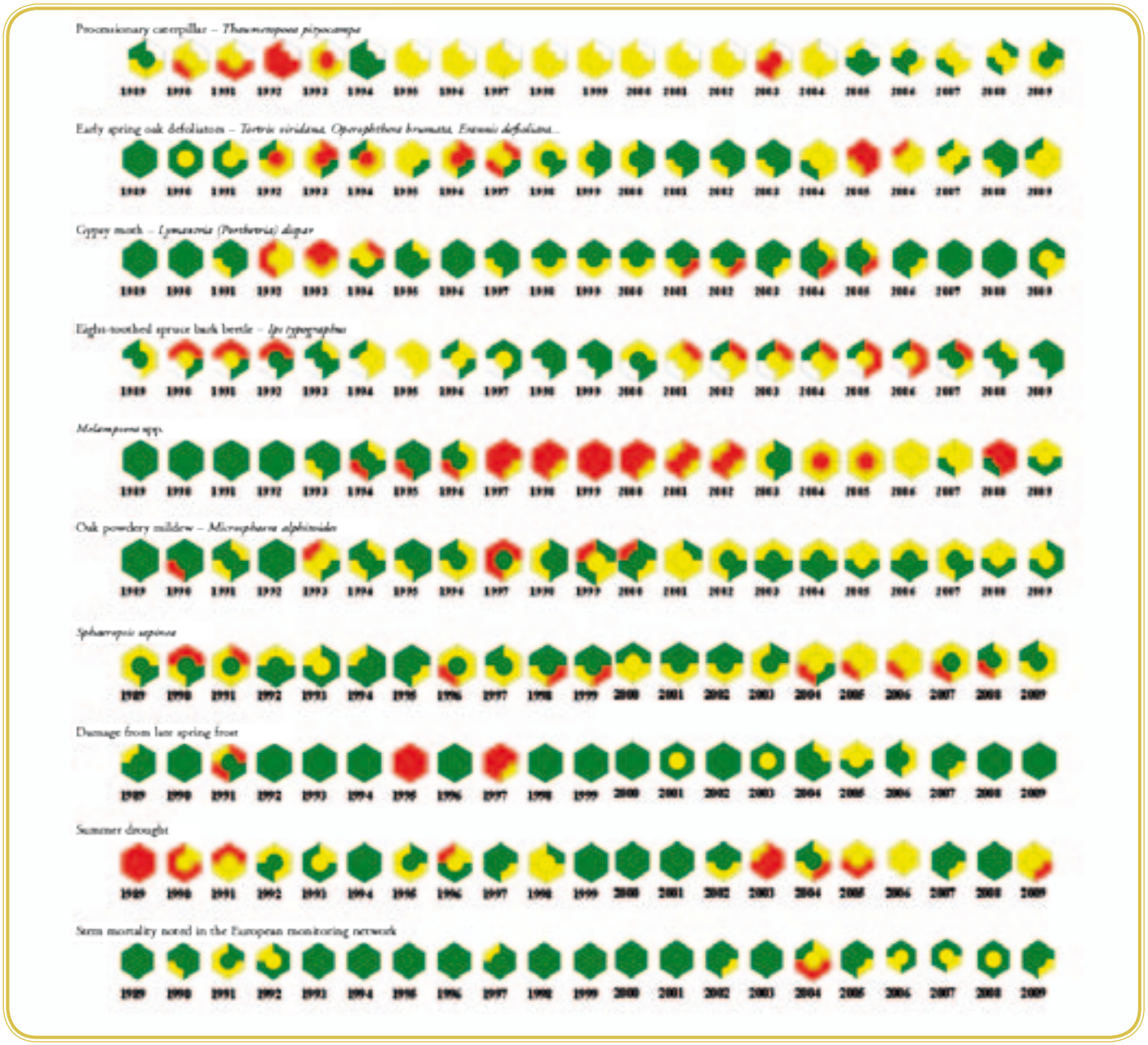
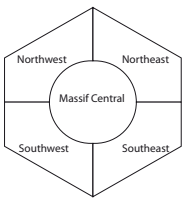


Figure 18: Severity of the 10 major pest and disease problems affecting French forests from 1989 to 2009.
Source: DSF.

The hexagons represent France:
Northwest
Northeast
Massif Central
Southwest
Southeast



Severity of problems:
green: absence, trace, slight, endemic
yellow: moderate
red: marked, epidemic

The white part of some hexagons indicate that the pest mentioned is (or was) absent from the concerned regions.

The 2005-2009 period was marked by continued bark beetle infestations on spruce trees following outbreaks initiated by windfalls caused by the Christmas 1999 storm and the 2003 drought-heat wave. These infestations gradually diminished in the Alps and eastern France in 2008 as a result of the heavy precipitation in 2007 and 2008 and the introduction of bark beetle parasitoids. Despite this, several hundreds of thousands of cubic metres of spruce were still destroyed by bark beetle outbreaks.
Epidemics of broadleaved defoliating caterpillars occurred in 2005, without major consequences, and then the situation very quickly returned to endemic levels. In 2008, *Melampsora* spp. benefitted from mild humid climatic conditions, leading to their proliferation.

Fires observed in forests and other wooded lands

Year	Area destroyed by fire (ha)				Number of fires
	Outside of Mediterranean region	Mediterranean region [1]		Total	
			%		
1979	6 376	53 351	89	59 727	5 507
1980	5 988	16 188	73	22 176	5 040
1981	4 233	23 478	85	27 711	5 173
1982	6 486	48 659	88	55 145	5 308
1983	5 239	48 490	90	53 729	4 659
1984	12 507	14 696	54	27 203	5 672
1985	9 861	47 507	83	57 368	6 249
1986	4 460	47 400	91	51 860	4 353
1987	3 714	10 395	74	14 109	3 043
1988	1 494	5 208	78	6 702	2 837
1989	18 695	56 871	75	75 566	6 743
1990	18 728	53 897	74	72 625	5 881
1991	3 581	6 549	65	10 130	3 888
1992	3 828	12 765	77	16 593	4 002
1993	4 797	11 901	71	16 698	4 769
1994	2 390	22 605	90	24 995	4 618
1995	8 149	9 988	55	18 137	6 563
1996	8 281	3 119	27	11 400	6 401
1997	9 331	12 250	57	21 581	8 005
1998	7 837	11 243	59	19 080	6 288
1999	3 123	12 782	80	15 905	4 960
2000	5 162	18 864	79	24 026	4 553
2001	2 502	17 970	88	20 472	4 260
2002	23 860	6 299	21	30 159	4 097
2003	11 771	61 507	84	73 278	7 023
2004	3 114	10 596	77	13 710	3 767
2005	4 779	17 356	78	22 135	4 698
2006	2 410	5 483	69	7 893	4 608
2007	2 086	6 486	76	8 572	3 382
2008	2 260	3 746	62	6 006	2 793
2009	5 888	11 112	65	17 000	4 870
(1) Languedoc-Roussillon, Provence-Alpes-Côte d'Azur, Corsica, Drôme, Ardèche					
Mean 1980-84 (ha/year)	6 891	30 302	81	37 193	5 170
% total forest area	nd	nd		0.23	
Mean 1985-89 (ha/year)	7 645	33 476	81	41 121	4 645
% total forest area	nd	nd		0.25	
Mean 1990-94 (ha/year)	6 665	21 543	76	28 208	4 632
% total forest area	0.05	0.63		0.18	
Mean 1995-99 (ha/year)	7 344	9876	57	17 221	6 443
% total forest area	0.06	0.24		0.10	
Mean 2000-2004 (ha/year)	9 282	23 047	71	32 329	4 740
% total forest area	0.07	0.54		0.19	
Mean 2005-2009 (ha/year)	3 485	8 837	72	12 321	4 070
% total forest area	0.02	0.20		0.08	

Source: MAAPRAT and the French Ministry of the Interior, based on the Prométhée files for the Mediterranean region, the Association régionale DFCI for the Aquitaine region and DRAAF statements for the other regions. Burnt areas are relative to forest areas and other wooded lands from the Teruti-Lucas survey of SSP: Indicator 1.1.

From 1991 to 2002, the areas affected by fires in France ranged from 10,000 to 30,000 ha per year, which differed markedly from the trend of the previous decade.
These encouraging results were upset by the drought-heat wave of 2003, when there was a record number of more than 7,000 fires with 73,300 ha burnt. The Mediterranean region was especially affected, with more than 60,000 ha burnt in 2003, including 27,400 ha in Corsica and 18,800 in the Var region, thus surpassing the losses of 1989 and 1990. The mean burnt area per fire was more than 10 ha throughout France, as was also the case in 1989 and 1990. These mean results conceal the marked variations between regions, with the largest forest fires recorded in the Mediterranean region.
Another unique feature in recent years concerns the peak in burnt areas recorded in 2002 outside of the Mediterranean area, corresponding to very large forest fires that occurred in the Aquitaine and Midi-Pyrénées regions. The situation returned to normal in 2004, with less than 14,000 ha burnt throughout France.
Despite the peaks in 2005 and 2009 associated with the hot dry summer climatic conditions, destroyed areas decreased substantially between 2006 and 2008 to under 10,000 ha, with a historical minimum of 6,000 ha and less than 3,000 fires ignited in 2008.

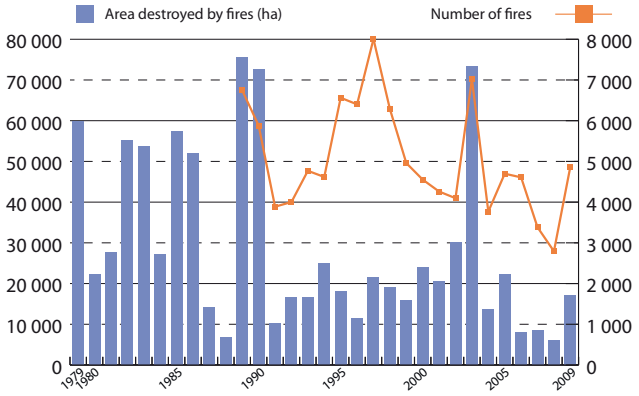


Figure 19: Variations in the number of fires and burnt areas in forests and other wooded lands from 1979 to 2009.

Source: MAAPRAT and Ministry of the Interior.

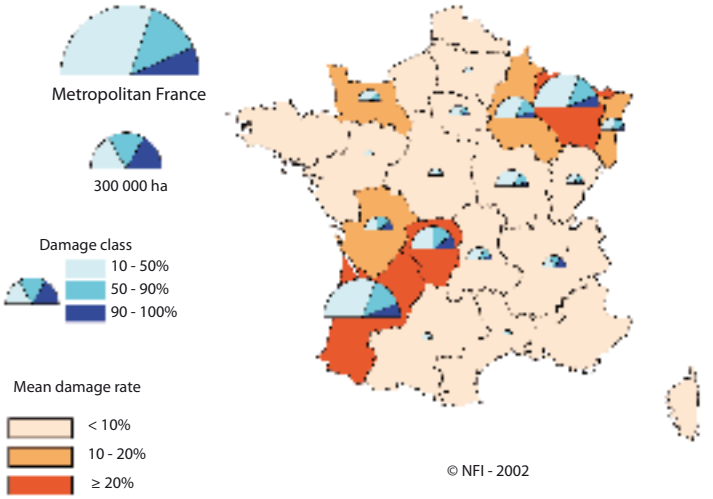
This improvement is the result of several factors, including:
– better adaptation of the system to extreme climatic conditions;
– better control of urbanisation in forest areas and better self-protection of homes;
– regular clearing maintenance in collaboration with crop and livestock farmers when possible;
– more effective coordination of stakeholders;
– enhanced public awareness on forest fire prevention.

Storms

	1965-1974	1975-1984	1985-1994	1995-2004	2005-2009**
Volume in state-owned forest (Mm^3)	3.0	3.6	9.7	61.7	2.3
Volume in private forest (Mm^3)	0.7	12.0	6.5	115.4	41.0
Total volume (Mm^3)	**3.7**	**15.6**	**16.2**	**177.1**	**43.3**
% of growing stock	0.2	1.0	0.9	8.3	1.8
% of production of the corresponding period	-	2.6	2.2	20.0	nd
Mean volume per ha of metropolitan forest per year	0.0	0.1	0.1	1.1	0.6
Destroyed stands (in ha)*	about 2 500	about 9 800	about 9 300	about 115 300	about 70 000

*From 1965 to 1998: area-equivalent of volumes destroyed; 1999: NFI estimation of stand areas in which more than 10% of the cover is destroyed; 2005-2009: NFI estimation of stand areas in which more than 20% of the cover is destroyed.
** As these figures just account for cyclone Klaus in 2009, they are presented for information only, while awaiting a relevant supplement to this table for the 2005-2014 period.
Source: from 1965 to 1998: ONF and French Ministry of Agriculture and Fisheries, only for exceptional windfalls, thus not taking into account windfall volumes regularly removed in mountains at the end of winter; for private forests, most of the figures come from M. Doll's thesis `Disastrous Meteorological Events in Forests´ 1988; the area-equivalent of the volumes destroyed per year is calculated from the mean volume per hectare of regular high forest, the type of stand most often affected by windfalls. For the 1999 and 2009 storms, NFI estimations were based on analyses of aerial photos and field surveys after the storms (see details below); the exceptional windfall volume between year 2000 and 2008 was zero.

Following the December 1999 storms, which caused considerable damage to a large part of the French forest (176 Mm^3 destroyed, Map 12), the 2005-2009 period was only affected by the exceptionally severe storm of January 2009 in southwestern France (cf. below).



Map 12: Area of stands damaged by more than 10%, ranked by damage class and mean damage rate per administrative region.

Source: NFI, 2002.

The January 2009 storm

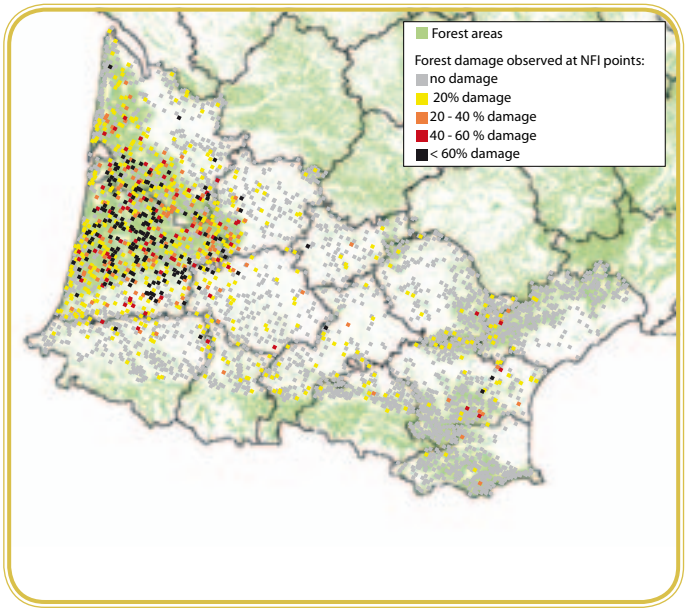
Cyclone Klaus of 24 January 2009 had a major impact on the Aquitaine forest massif and on scattered parts of other massifs in southwestern France. The damage was assessed in Aquitaine, Midi-Pyrénées and Languedoc-Roussillon regions by the National forest inventory using two complementary methods:

– mapping of storm damage to the Aquitaine massif from cloud-free SPOT satellite images at decametric accuracy—these images were acquired in February 2009, spanning almost the entire damaged area (except for the southwestern tip of the Landes massif);

– joint estimation of forest areas and stem volumes affected, based on:

• monitoring of over 3,000 points already inventoried during the four previous annual inventories by all field staff during February 2009;

• photo-interpretation of aerial photographs acquired directly over the sampling points. Low altitude aerial photographs guided the survey teams when they assessed the damage in Pyrénées-Orientales region.



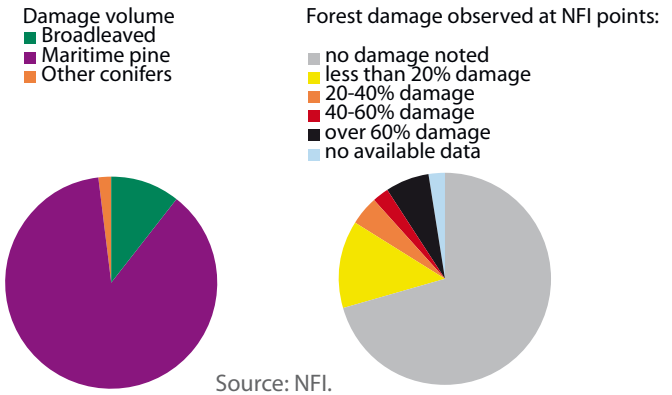
Map 13: Evaluation of forest damage by surveys and photo-interpretation at NFI sampling points during the last four inventories.

Source: NFI, 2009.

The total area monitored in the zone was 7.3 Mha, with forests available for wood supply (FAWS) covering 35% of this area (2.5 Mha).

A total of 690,000 ha was damaged by the storm, representing 29% of the total forest area.

	Forest available for wood supply area (ha)	Area concerned (%)
No damage noted	1 788 000	71
Less than 20% damage	338 000	13
20-40% damage	117 000	5
40-60% damage	63 000	3
Over 60% damage	170 000	7
No available data	58 000	2
Total	**2 535 000**	**100**



Source: NFI.

	Damage volume (Mm^3)	Volume concerned (%)
Broadleaved	4.6	11
Conifers	38.7	89
including maritime pine	37.9	87
including other conifers	0.8	2
Total	**43.3**	**100**

Indicator 2.4.1

Simultaneous presence of several ungulate species

The following graph shows the joint presence of several wild ungulates (red deer, roe deer, wild boar, fallow deer, sika deer, chamois, Cantabrian chamois, ibex and mountain sheep) in the French forest in 2005.

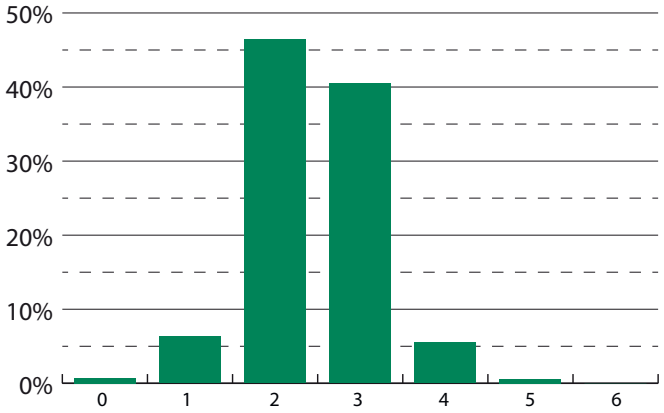


Figure 20: Distribution of ungulate species, in terms of numbers, throughout the French forest area (including Corsica) in 2005 (including wild boar).

Source: Réseau ongulés sauvages ONCFS-FNC-FDC.

	Area (1 000 ha)	% of the French forest
0 species	111.6	0.7
1 species	952.9	6.3
2 species	7 024.7	46.4
3 species	6 123.4	40.5
4 species	836.2	5.5
5 species	83.4	0.6
6 species	0.2	0.0
French forest	15 132.4	100.0

Source: Réseau ongulés sauvages ONCFS-FNC-FDC, SSP for the reference forest area.

Note: The calculations were based on data from the 5-year 'red deer massif' survey (2010 data currently being processed) and the 5-year mountain ungulate survey (latest conducted in 2011). The roe deer data are from the 5-year 'communal roe deer hunting bag' survey (latest conducted in 2007). The wild boar data are from the annual 'communal wild boar hunting bag' survey. Data on two marginal species, i.e. fallow deer and sika deer, are from the 5-year survey of 2006.

Red deer have expanded their distribution range mostly in mountain regions. Numbers of mountain ungulates have also increased to a similar extent (chamois and ibex numbers have almost doubled in 10 years), but they have colonised lowland areas. Roe deer and wild boar are also increasing in highland areas, even at elevations of over 2,500 m. Situations in which different species are living in the same area are thus becoming very common, especially in forest environments, with forests representing 40% of the area occupied by these animals on average.

Red deer (*Cervus elaphus*) with growing antlers (June 2010 in Alsace region).

Indicator 2.4.2

Progression of wild ungulates in forest areas

Big game is a key component of forest ecosystems. As part of its activities, ONCFS has been monitoring big game populations for over 30 years. The Réseau ongulés sauvages ONCFS-FNC-FDC currently monitors all wild ungulate species inhabiting lowland and mountain regions in France. Hunting bag samples of all hunted species per department are collected annually. Red deer, fallow deer, sika deer, chamois, Cantabrian chamois, mountain sheep and ibex are the focus of periodic surveys on the basis of which their spatial distribution ranges are mapped and numbers estimated. Roe deer and wild boar numbers are estimated on the basis of hunting bag data.
Variations noted in the hunting bags of all hunted ungulates in France highlight the major increase in these species over the last 20 years. This increase is more marked for lowland ungulates as compared to those inhabiting mountain regions.

	2009-2010 survey numbers	Progress over 20 years
Red deer	49 075	× 3.8
Roe deer	507 148	3.2
Wild boar	491 762	4.7
Chamois	14 066	2.8
Cantabrian chamois	3 388	1.6
Mountain sheep	4 322	3.8
Fallow deer	2 334	6.1
Sika deer	164	6.6

Source: Réseau ongulés sauvages ONCFS-FNC-FDC.

Ungulate hunting bag patterns over 20 years in France

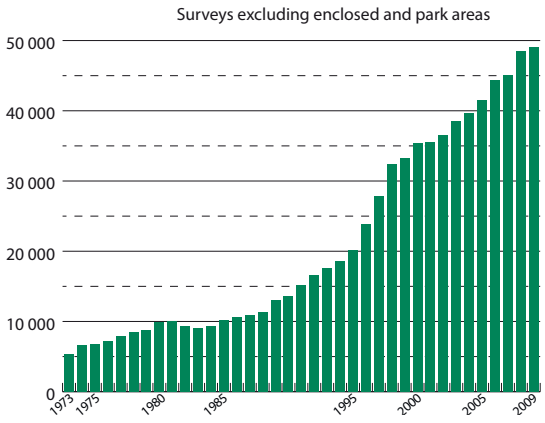


Figure 21: Annual red deer sampling patterns from 1973 to 2009 in France.

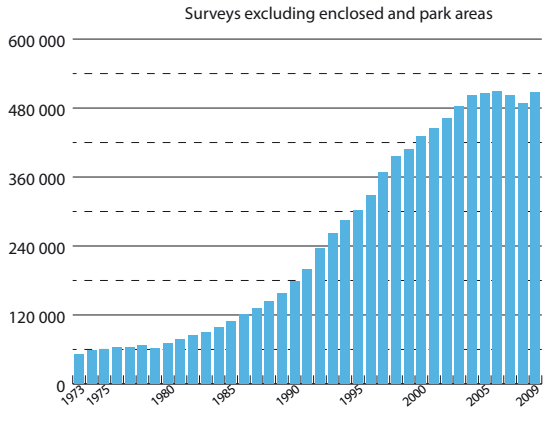


Figure 22: Annual roe deer sampling patterns from 1973 to 2009 in France.

Source: Réseau ongulés sauvages ONCFS-FNC-FDC.

The area colonised by red deer has doubled in 20 years and the estimated numbers have quadrupled.
In contrast, the rise in roe deer numbers has clearly slowed down in recent years, with density-dependence phenomena noted in some areas.

Red deer

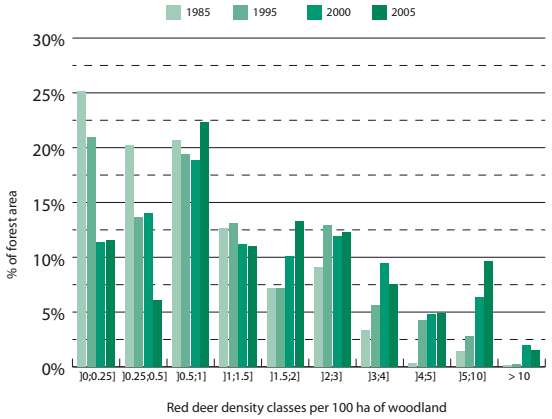


Figure 23: Distribution of forest areas inhabited by red deer in France (excluding Corsica) according to red deer density classes per 100 ha of woodland.

In 1985, red deer inhabited 26% of the French forest area, 31% in 1995, 39% in 2000 and 45% in 2005. Over a 20 year period, there has been a clear reduction in forest area with low red deer densities, whereas forest massifs with very high red deer densities are now being noted.

Note: As the ONCFS surveys are carried out every 5 years, the 2010 data were not available for this edition but, as of late 2011, they can be accessed on the ONCFS website at: www.oncfs.gouv.fr.

Forest area inhabited by red deer in France

	1985		1995		2000		2005	
Red deer density classes	*Inhabited forest area*	*% forêt*	*Inhabited forest area*	*% forêt*	*Inhabited forest area*	*% forêt*	*Inhabited forest area*	*% forêt*
]0;0.25]	985.6	25.1	979.9	20.9	663.4	11.4	782.1	11.5
]0.25;0.5]	791.3	20.2	637.2	13.6	818.9	14.0	417.1	6.1
]0.5;1]	813.4	20.7	908.4	19.4	1094.8	18.8	1509.9	22.3
]1;1.5]	495.4	12.6	612.5	13.1	652.9	11.2	745.0	11.0
]1.5;2]	281.1	7.2	338.6	7.2	589.8	10.1	901.8	13.3
]2;3]	354.9	9.1	603.4	12.9	690.9	11.9	833.4	12.3
]3;4]	128.8	3.3	262.0	5.6	549.9	9.4	507.5	7.5
]4;5]	10.9	0.3	197.2	4.2	282.0	4.8	334.4	4.9
]5;10]	56.2	1.4	133.1	2.8	369.7	6.3	654.4	9.6
> 10	4.0	0.1	10.8	0.2	117.8	2.0	99.4	1.5
Total	**3921.6**	**100.0**	**4683.1**	**100.0**	**5830.1**	**100.0**	**6785.0**	**100.0**

Source : Réseau ongulés sauvages ONCFS-FNC-FDC.

Roe deer

In 1985, roe deer inhabited 94% of the French forest area, and 99% since 1995. It is not found in Corsica.
Over a 20 year period, there has been a clear reduction in the percentage of forest area with low roe deer densities, whereas areas with high density classes have been increasing.
Estimated roe deer densities per 100 ha of woodland are, however, a less relevant indicator than for red deer because roe deer are present to an increasing extent in all types of habitat (hedgerows, large grasslands, etc.).

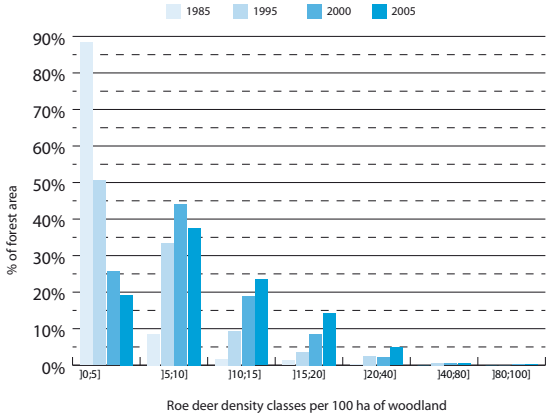


Figure 24: Distribution of forest areas inhabited by red deer in France (excluding Corsica) according to red deer density classes per 100 ha of woodland estimated on the basis of the number of hunting kills.
Source : Réseau ongulés sauvages ONCFS-FNC-FDC.

Note: As the ONCFS surveys are carried out every 5 years, the 2010 data were not available for this edition but, as of late 2011, they can be accessed on the ONCFS website at: www.oncfs.gouv.fr.

Forest area inhabited by roe deer in France

	1985		1995		2000		2005	
Roe deer density classes	*Inhabited forest area*	*% forêt*	*Inhabited forest area*	*% forêt*	*Inhabited forest area*	*% forêt*	*Inhabited forest area*	*% forêt*
]0 ; 5]	12 568.5	88.4	7 533.6	50.5	3 823.4	25.6	2 862.3	19.2
]5 ; 10]	1 203.2	8.5	4 990.7	33.4	6 586.7	44.1	5 596.5	37.5
]10 ; 15]	236.5	1.7	1 400.5	9.4	2 824.4	18.9	3 492.4	23.4
]15 ; 20]	180.3	1.3	540.6	3.6	1 273.5	8.5	2 139.0	14.3
]20 ; 40]	32.6	0.2	368.7	2.5	326.0	2.2	733.1	4.9
]40 ; 80]	0.0	0.0	91.5	0.6	60.9	0.4	71.6	0.5
]80 ; 100]	0.0	0.0	0.0	0.0	30.7	0.2	30.7	0.2
Total	**14 221.2**	**100.0**	**14 925.6**	**100.0**	**14 925.6**	**100.0**	**14 925.6**	**100.0**

Source: Réseau ongulés sauvages ONCFS-FNC-FDC.

Criterion 3

MAINTENANCE AND ENCOURAGEMENT OF PRODUCTIVE FUNCTIONS OF FORESTS (WOOD AND NON-WOOD)

Indicator 3.1

Balance between net annual increment and annual fellings of wood on forest available for wood supply

Since the 2010 inventory, NFI is reviewing points inventoried 5 years previously with the aim of estimating felling that occurred over the period. A uniform estimation that is compatible with the NFI biological production estimation will therefore soon be available.
The fellings and biological production calculations and associated data are currently being validated and will soon be officially published. This represents a major enhancement to this indicator because until now comparisons between production and fellings have been based on data from surveys with different definitions. This indicator will be updated with new data for the next ISFM edition.

Indicator 3.1.1

Logging of forests

National results

Forests available for wood supply

ISFM 2005 Edition

Area

Data retrieval year	1989		1994		1999		2004	
Average year	1981		1986		1991		1996	
Logging class	*1 000 ha*	*%*	*1 000 ha*	*%*	*1 000 ha*	*%*	*1 000 ha*	*%*
Easy	8 174	61	8 253	61	8 366	62	8 541	62
Average	1 516	11	1 469	11	1 464	11	1 426	10
Difficult	3 330	25	3 483	26	3 587	26	3 671	27
Very difficult	313	2	239	2	180	1	183	1
Subtotal	**13 333**	**100**	**13 444**	**100**	**13 597**	**100**	**13 821**	**100**
Unspecified	4		127		270		270	
Total	**13 337**		**13 571**		**13 867**		**14 091**	

Source: NFI
Relevant domain: FAWS excluding poplar plantations and including thickets.

Volume

Data retrieval year	1989		1994		1999		2004	
Average year	1981		1986		1991		1996	
Logging class	*Mm^3*	*%*	*Mm^3*	*%*	*Mm^3*	*%*	*Mm^3*	*%*
Easy	1 067	62	1 146	62	1 228	62	1 312	62
Average	193	11	200	11	207	10	216	10
Difficult	428	25	477	26	530	27	568	27
Very difficult	35	2	31	2	26	1	31	1
Total	**1 723**	**100**	**1 854**	**100**	**1 991**	**100**	**2 127**	**100**

Source: NFI.
Relevant domain: FAWS excluding poplar plantations and including thickets.

ISFM 2010 Edition

Area

Data retrieval year	2010		
Survey years	2006 to 2009		
Logging class	*1000 ha*		*%*
Easy	8 916	± 104	58
Average	1 369	± 58	9
Difficult	4 926	± 95	32
Very difficult	108	± 17	1
Total	**15 319**	**± 104**	**100**

Source: NFI
Relevant domain: FAWS.

Volume

Data retrieval year	2010		
Survey years	2006 to 2009		
Logging class	*Volume (Mm^3)*		*%*
Easy	1 414	± 33	58
Average	230	± 17	10
Difficult	760	± 27	31
Very difficult	15	± 5	1
Total	**2 420**	**± 41**	**100**

Source: NFI
Relevant domain: FAWS.

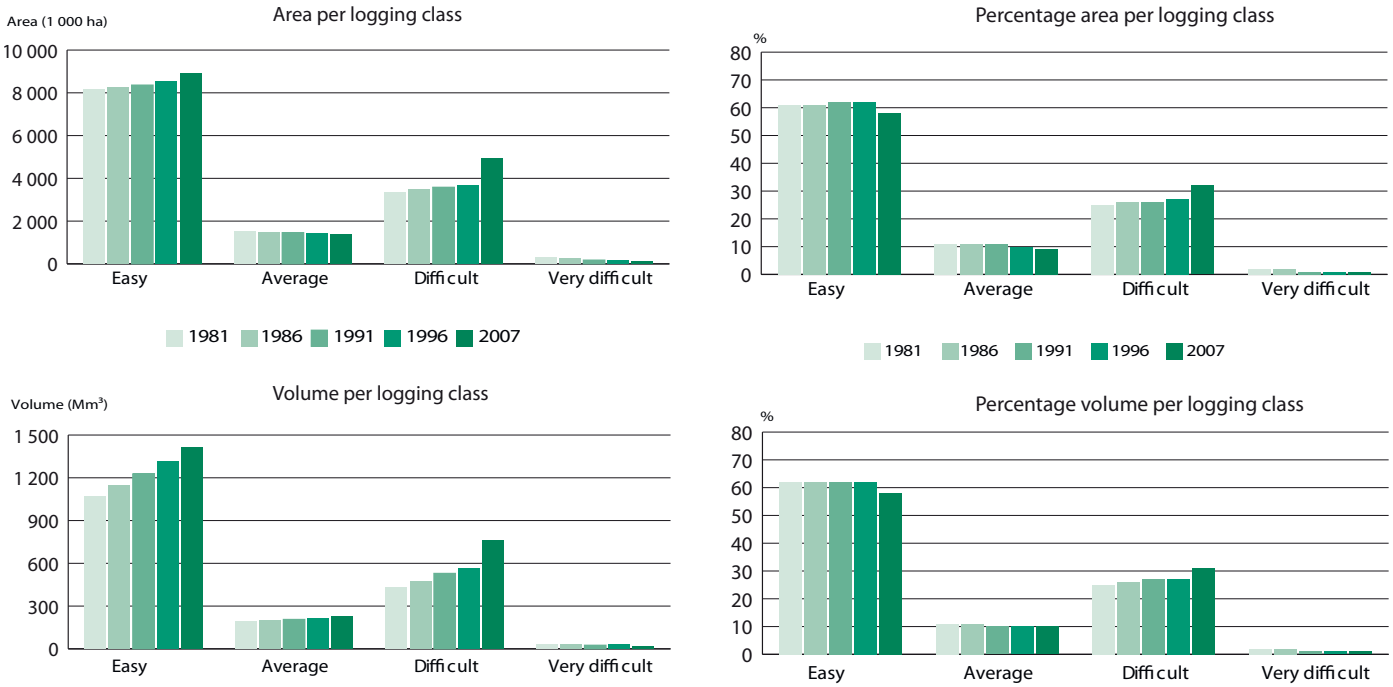


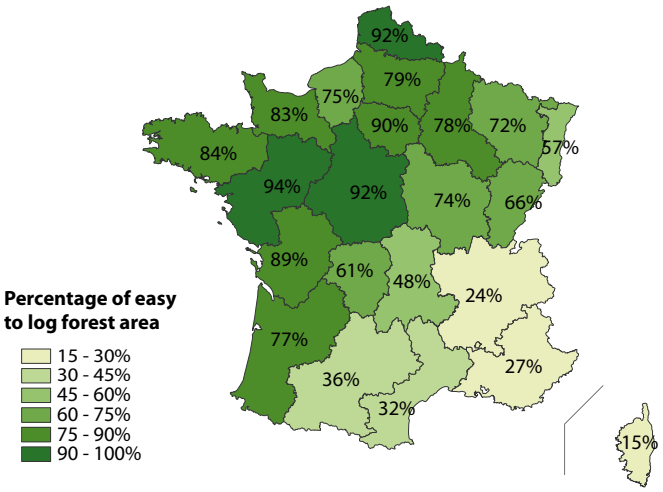
Figure 25: Variations in area and volume by logging class.

Source: NFI.

Logging is based only on physical criteria concerning the immediate stand environment: the existence or the possibility of developing a hauling route, the hauling distance, the ground structure and relief and the hauling slope class (cf. definition in Appendix III). The ecological or economic setting or the forest road system are not taken into account.

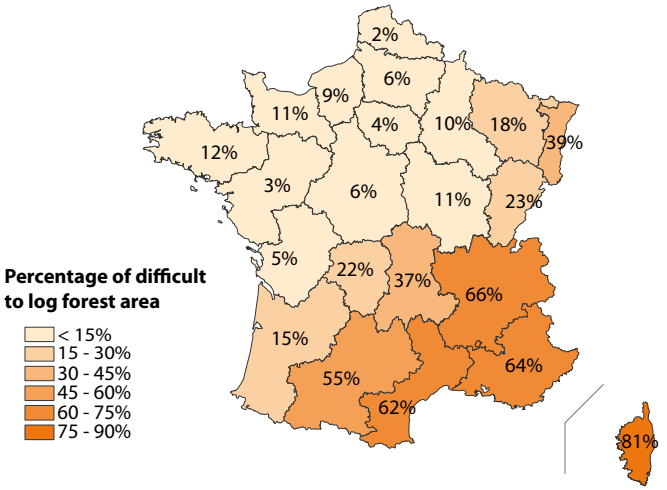
Conditions in nearly 60% of the forest area and growing stock are currently easy for logging. However, a third of the forest area or growing stock is difficult to very difficult to log.

The very clear increase in difficult to log volume could be partially explained by the capitalisation in the hardest to reach stands, as well as by new afforestations in this category. These new afforestations concern newly afforested areas in agricultural abandonment zones, or the colonisation of heathland or fallows. They also concern areas newly considered as forest due the change in definition, areas located especially in southeastern France which are often difficult to log because access routes are insufficient for these stands, which are not considered to be very productive.



Map 14: Percentage of easy to log forest area.

Source: NFI, survey years 2006 to 2009.



Map 15: Percentage of difficult to log forest area.

Source: NFI, survey years 2006 to 2009.

There are marked differences between regions associated with the local topographical features. Corsica is the region where the area of difficult to very difficult to log area is greatest, i.e. 81% of the forest area and 86% of the growing stock. At least half of the forest area is difficult to log in Rhône-Alpes, PACA, Languedoc-Roussillon and Midi-Pyrénées regions.

In contrast, over 80% of the area is easy to log in lowland regions of western and northern France, i.e. 80-90% of the area in Bretagne, Basse-Normandie and Poitou-Charentes regions, and 90% in Centre, Île-de-France, Nord-Pas-de-Calais and Pays-de-la-Loire.

It should be kept in mind, however, that the national approach adopted for this report is based on identical classification criteria regardless of the considered region. It is therefore not tailored for assessing local difficulties. For instance, in mountain regions where the techniques and equipment are adapted for harsh conditions, in some cases loggers might consider that an area which would be classified as average or difficult to log in a lowland region would be suitable for logging.
In Rhône-Alpes region, access to 36,000 ha (± 10 000) is very difficult, which represents 2% of the total forest area in this region. The corresponding stem volume is 6.7 Mm^3 (± 4.0), or 2% of the total growing stock in this region.

Note: Maps 14 and 15 do not account for stands with an average logging difficulty, so the totals per region do not add up to 100%.

Logging by administrative region

Area

2010	Easy	Average	Rather difficult	Total
Administrative region	*1 000 ha*	*1 000 ha*	*1 000 ha*	*1 000 ha*
Alsace	182 ± 15	n.s.	125 ± 14	320 ± 11
Aquitaine	1 389 ± 36	135 ± 20	270 ± 23	1 794 ± 29
Auvergne	333 ± 23	110 ± 16	256 ± 21	699 ± 22
Basse-Normandie	142 ± 9	n.s.	n.s.	171 ± 8
Bourgogne	727 ± 26	138 ± 17	111 ± 15	977 ± 20
Bretagne	298 ± 17	n.s.	43 ± 9	355 ± 16
Centre	862 ± 23	n.s.	54 ± 10	933 ± 21
Champagne-Ardenne	535 ± 22	85 ± 14	67 ± 12	687 ± 18
Corse	59 ± 16	n.s.	315 ± 32	390 ± 31
Franche-Comté	464 ± 22	81 ± 13	159 ± 18	704 ± 18
Haute-Normandie	161 ± 14	35 ± 8	n.s.	216 ± 13
Île-de-France	234 ± 12	n.s.	n.s.	260 ± 11
Languedoc-Roussillon	368 ± 31	65 ± 14	711 ± 34	1 144 ± 31
Limousin	342 ± 21	97 ± 14	122 ± 15	560 ± 18
Lorraine	620 ± 24	83 ± 14	158 ± 17	861 ± 19
Midi-Pyrénées	476 ± 32	108 ± 17	724 ± 34	1 308 ± 33
Nord-Pas-de-Calais	95 ± 11	n.s.	n.s.	104 ± 11
Pays de la Loire	304 ± 14	n.s.	n.s.	323 ± 13
Picardie	248 ± 16	44 ± 10	n.s.	312 ± 16
Poitou-Charentes	354 ± 19	n.s.	n.s.	396 ± 19
Provence-Alpes-Côte d'Azur	356 ± 30	115 ± 19	830 ± 38	1 301 ± 37
Rhône-Alpes	365 ± 28	149 ± 19	990 ± 37	1 504 ± 35
France	**8 916 ± 104**	**1 369 ± 58**	**5 033 ± 94**	**15 319 ± 104**

The 'rather difficult' category includes areas that are difficult to very difficult to log, since very few areas fall into this latter class and it therefore cannot be differentiated.
Source: NFI, survey years 2006 to 2009.
Relevant domain: FAWS.

Volume

2010	Easy	Average	Rather difficult	Total
Administrative region	*(Mm^3)*	*(Mm^3)*	*(Mm^3)*	*(Mm^3)*
Alsace	42 ± 7	n.s.	37 ± 6	82 ± 8
Aquitaine	152 ± 11	17 ± 4	41 ± 5	210 ± 12
Auvergne	82 ± 10	26 ± 6	56 ± 7	164 ± 11
Basse-Normandie	26 ± 4	n.s.	n.s.	31 ± 4
Bourgogne	130 ± 8	26 ± 5	20 ± 4	176 ± 9
Bretagne	52 ± 6	n.s.	8 ± 3	63 ± 7
Centre	144 ± 8	n.s.	10 ± 2	157 ± 8
Champagne-Ardenne	94 ± 8	16 ± 4	12 ± 4	123 ± 8
Corse	4 ± 2	n.s.	31 ± 6	36 ± 6
Franche-Comté	103 ± 9	19 ± 4	40 ± 7	161 ± 10
Haute-Normandie	30 ± 4	7 ± 2	n.s.	40 ± 4
Île-de-France	42 ± 5	n.s.	n.s.	47 ± 5
Languedoc-Roussillon	33 ± 6	8 ± 4	68 ± 7	109 ± 9
Limousin	63 ± 7	18 ± 5	26 ± 5	107 ± 9
Lorraine	113 ± 9	17 ± 6	37 ± 7	167 ± 11
Midi-Pyrénées	62 ± 7	15 ± 4	102 ± 9	179 ± 10
Nord-Pas-de-Calais	17 ± 4	n.s.	n.s.	18 ± 4
Pays de la Loire	50 ± 6	n.s.	n.s.	53 ± 6
Picardie	46 ± 6	9 ± 3	n.s.	58 ± 6
Poitou-Charentes	42 ± 5	n.s.	n.s.	48 ± 5
Provence-Alpes-Côte d'Azur	26 ± 4	7 ± 3	80 ± 7	113 ± 8
Rhône-Alpes	63 ± 9	26 ± 7	190 ± 14	279 ± 16
France	**1 414 ± 33**	**230 ± 17**	**775 ± 27**	**2 420 ± 41**

The 'rather difficult' category includes areas that are difficult to very difficult to log.
Source: NFI, survey years 2006 to 2009.
Relevant domain: FAWS.

Indicator 3.2

Value and quantity of marketed roundwood

Quantity of marketed roundwood

Usage category	Marketed volume (1 000 m³/year)						
	1983-87	1988-92	1993-97	1998-2002	2003-2007	2008	2009
Marketed construction timber	19 118	22 729	20 794	24 345	21 305	21 135	22 444
Marketed industrial wood	10 004	10 909	10 883	11 575	11 990	11 368	12 347
Marketed fuelwood	1 968	2 669	2 646	2 608	2 664	3 034	3 779
Total	**31 090**	**36 307**	**34 323**	**38 528**	**35 959**	**35 537**	**38 570**

Source: SSP/EAB Exploitation forestière et Scierie, raw data, 5-year means, without correction for logging losses; overbark and underbark volumes depending on the species until 2002, uniformised to overbark volumes since 2003.

The volumes are derived from annual surveys of the professional logging industry. As of 2005, only overbark volumes have been recorded. Between 1988 and 2004, both overbark and underbark volumes were declared depending on the species and category. Overbark volumes were converted to underbark volumes using a bark coefficient determined for each type of product.
Fuelwood for self-consumption from forest and non-forest trees is estimated using the French method described at the EUROSTAT forestry statistics working group meeting on 26/11/2009 (cf. EUROSTAT Doc. Forest/2009WG/05). The bark volume is not subtracted since fuelwood is never debarked.

The long-term removals trend was upset over the study period by the storms of December 1999 and January 2009. There was a very sharp increase in removals in 2000, 2001 and 2002 which is reflected in the data for 2000. Conversely, 2003, 2004 and 2005 were marked by a downturn, which is reflected in the 2005 data. It was not until 2007 that there was a return to the removals level of 1999. However, the economic crisis led to a new downturn in 2008 and 2009, but in 2009 there was an added reverse effect of cyclone Klaus, mainly with respect to maritime pine removals.

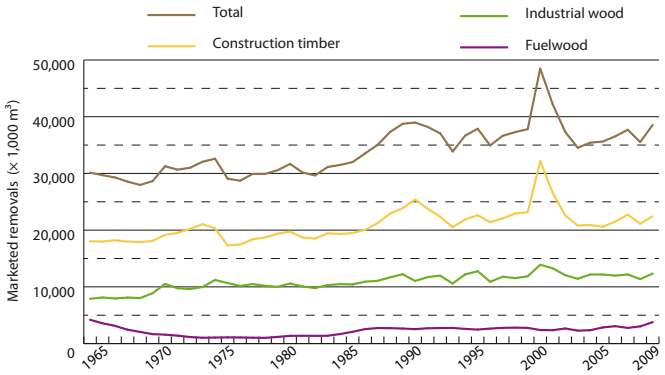


Figure 26: Variations in marketed removals declared to EAB from 1964 to 2009.
Source: SSP.

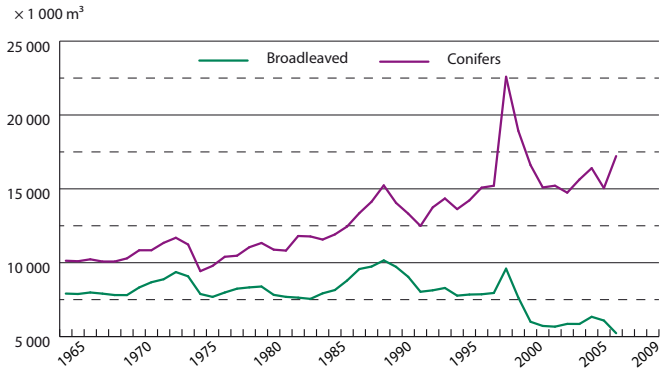


Figure 27: Variations in construction timber removal declared to EAB from 1964 to 2009.
Source: SSP.

The marketable share of fuelwood removals was very small relative to the total fuelwood removal volume. The period is characterised by a regular decline associated with the decline in the number of rural farmers, i.e. traditional fuelwood clients. Progress in the efficiency of heating units has also resulted in a drop in removals. There was an upturn at the end of the period due to the development and implementation of favourable renewable energy policies. Here again, the storms led to a sharp increase in the fuelwood removals data for the years 2000 and 2009.

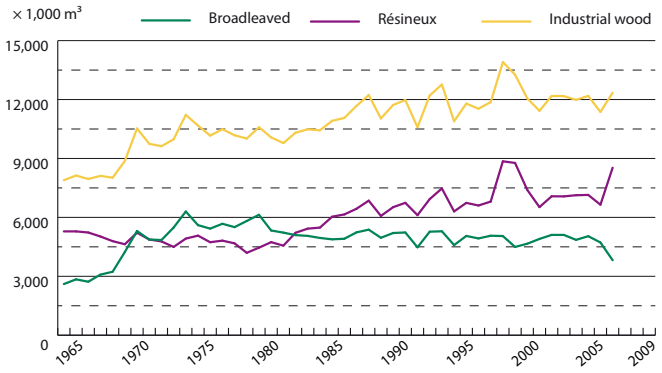


Figure 28: Variations in industrial wood removals declared to EAB from 1964 to 2009.

Source: SSP.

Value of marketed roundwood

Usage category	Wood value after logging (million euros 2002/year)				
	1991-92	1993-97	1998-2002	2003-2007	2010
Marketed construction timber	1 522	1 367	1 359	1 506	1 722
Marketed industrial wood	299	291	241		
Marketed fuelwood	107	99	84	100	159
Total	**1 929**	**1 757**	**1 685**	**1 606**	**1 881**
Wood value in euros/m³	53.7	51.2	43.7	44.7	53.5

As the euro was adopted as the currency of France in 2002, values listed in French francs for 1988 to 2001, and in euros as of 2002, were converted into euros per average year for the intervals (1990, 2000, 2005) by applying the conversion coefficient calculated by INSEE on the basis of the overall consumer price index.
Source: SSP/Agreste, survey on wood values after logging; no data available on wood values prior to 1991.

The unit values are determined from a survey on the final value of logging products. The total value of all industrial roundwood and marketed fuelwood is determined by applying these final values to volumes derived from the logging survey. The total value is identical, irrespective of whether the wood is measured in terms of underbark or overbark volumes, with only the unit value differing.
2010 prices were extrapolated from the 2005 data by applying a present value coefficient of 1.1 for all products and 0.9 for maritime pine (cyclone Klaus).
In constant currency for the considered period, wood prices regularly decreased, in line with the trend for all raw materials. This trend could begin shifting in 2010, but this is still very hypothetical. The fact that there was very little difference between industrial roundwood prices and fuelwood prices seems surprising. However, it should be kept in mind that industrial roundwood includes pulpwood whose unit value is less than that of fuelwood. The average price of industrial wood disguises very substantial price gaps between the different products, but the volumes of all products with a high unit value, i.e. mainly hardwood construction timber, are low.
Wood prices, like volumes, were affected by the storms, but in the reverse direction, thus explaining the price drop in 2000 to 2003. The sharp rise from 2006 to 2007 was quashed by the impact of the 2008 crisis and then by cyclone Klaus. There was an upturn in the situation in late 2009 and early 2010, even though windfalls have disrupted the situation concerning maritime pine.
Contrary to industrial roundwood prices, the storms and the economic crisis have had little effect on fuelwood prices.

Indicator 3.2.1

*Marketing wood felled in certified forests**

Quality	Certified marketed volume**									
	2002		2003		2004		2005		2006	
	1 000 m³	*% ***	*1 000 m³*	*% ***	*1 000 m³*	*% ***	*1 000 m³*	*% ***	*1 000 m³*	*% ***
Construction timber	401	1.8	1 599	7.7	4 300	20.6	6 026	29.3	8 594	40.0
Industrial wood	163	1.3	828	7.2	2 802	23.0	4 772	35.5	5 411	45.1
Fuelwood	98	3.7	247	10.8	492	20.9	557	19.6	886	28.9
Total	**661**	**1.8**	**2 673**	**7.7**	**7 595**	**21.4**	**10 906**	**30.6**	**14 891**	**40.8**

Quality	Certified marketed volume**						Variation 2009/2007	*Windfalls from cyclone Klaus*	% windfalls 2009/total
	2007		2008		2009				
	1 000 m³	*% ***	*1 000 m³*	*% ***	*1 000 m³*	*% ***	*%*	*1 000 m³*	*%*
Construction timber	10 201	44.8	9 614	45.5	14 015	62.4	+ 45.8	7 033	50.2
Industrial wood	5 512	45.2	5 742	50.5	7 891	63.9	+ 37.4	4 114	52.2
Fuelwood	923	33.4	913	30.1	1 522	40.3	+ 66.7	149	9.8
Total	16 636	44.1	16 269	45.8	23 427	60.7	+ 44.0	11 297	48.2

** % of the marketed total.
Source: SSP/EAB, raw data, without correction for bark or logging losses.

The volumetric proportion of certified wood in marketed removals amounts to 60% or 23.4 million m^3. The trend observed—44% increase in volumes between 2007 and 2009—highlights the vitality of the certification process implemented in France, involving forest owners, cooperatives and downstream subsectors.
Construction timber accounts for 60% of all certified wood, while industrial wood represents 33%, proportions that are very consistent with the total marketed volume shares.

These results can be directly related to the extent of certified area, which accounted for one third of the forest area in late 2010, for the two certification systems in France: PEFC (Programme for the endorsement of forest certification schemes) and FSC (Forest Stewardship Council): see Indicator 6.1.3.

* wood from certified sustainably managed forests that has been logged by certified enterprises.

Indicator 3.3

Value and quantity of marketed non-wood goods from forest and other wooded land

Non-wood goods	Quantity (t/year)			'Wholesale value' (million € 2009/year)		
	1998-99	2002-03	2008-09	1998-99	2002-03	2008-2009
Venison*	18 392	23 101	25 752	65.8	68.7	203.2
Mushrooms (including truffles)	5	25	9	17.5	12.5	16.0
Cork	5 700 to 8 200	4 700 to 5 700	1 500	1.2 to 1.8	1.4 to 2.2	0.5
Honey	NA	5 600 to 7 100	5 500 to 6 900	NA	19.8 to 30.4	25.0 to 33.9
Gathered plants	4 300 to 5 000	4 300 to 5 000	NA	5.8 to 6.1	5.8 to 6.1	NA
Tree seeds	NA	NA	98	-	-	1.3
Total	**-**	**-**	**-**	**NA**	**108.2 to 119.9**	**NA**

* including self-consumption.
Source: see detailed tables below. All values were converted into 2009 euros. Gathered plant production was considered to have remained stable between 1999 and 2003 as no updated data were available.

Forests provide a variety of different non-wood goods ranging from venison to gathered plants, including mushrooms, honey, tree seeds and even cork in Mediterranean forests. It is generally hard, due to the very marked fluctuations, to assess the quantities harvested and their value (e.g. for mushrooms, honey, gathered plants). The total mean 'wholesale' value of these products ranges from €108 to 120 million per year, which is quite substantial. Venison represents more than half of this total value, with honey representing 20-28% and mushrooms 10-11%, but harvests of these latter two goods can sometimes be very low.

The benefits of these goods go beyond their economic value as they also provide valuable services. For instance, it is now clearly established that cork oak stands are an important element in land-use management and forest fire protection. The importance of the recreational aspect of some plant gathering activities and the key role of bees in maintaining plant biodiversity via pollination are also well known.

Venison

Venison	Quantity (t)				Value (million € 2009)			
	1998-99	2002	2008	2009	1998-99	2002	2008	2009
Red deer	1 617	1 829	2 423	2 454	4.8	5.2	17.9	18.2
Roe deer	4 748	5 540	5 856	6 086	27.9	28.3	69.7	72.4
Wild boar	12 027	15 731	19 895	17 212	33.1	35.2	131.3	112.6
Total	**18 392**	**23 101**	**28 174**	**25 752**	**65.8**	**68.7**	**218.9**	**203.2**

Source: ONCFS, based on kills by multiplying the values by the mean weights estimated on the basis of expert opinion at 50 kg for a red deer, 12 kg for a roe deer and 35 kg for a wild boar. 1998-99 period: value estimated in F 1998 at F16/kg for a red deer, F32/kg for a roe deer and F15/kg for a wild boar. 2002 period: value estimated in € 2002 at €2.5/kg for a red deer, €4.5/kg for a roe deer and €2/kg for a wild boar. 2009 period: value estimated at €7.4/kg for a red deer, €11.9/kg for a roe deer and €6.6/kg for a wild boar. All values have been converted into 2009 €.

The quantity of hunted venison has sharply increased in recent years, rising from 18,000 to 25,000 t in 4 years. Wild boar accounts for two-thirds of the total and the quantity is rising faster than the trend noted for deer. The quantity of red and roe deer venison reached 7,400 t in 2009-2010, and this rise is associated with the yearly increase in kills (see Indicator 2.4.2).

Venison is usually self-consumed. Its value can only be roughly estimated on the basis of expert opinion since this type of game is no longer sold at Rungis market due to current commercial constraints and regulations. It was estimated at over 200 million € for the 2009-2010 period, including 55% for wild boar and 45% for roe deer.

Mushroom harvest

Mushroom category	Marketed quantity (t)								
	1997-98	1998-99	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
Black Périgord truffles	30	14	35	35	15	39	39	27	15
of which 1/3 harvested in forests	10	5	12	12	5	13	13	9	1
Other truffles (forests)*	NA	NA	NA	NA	NA	12	17	8	5
Boletus	2 120	NA	2 340	1 010	920	NA	NA	NA	NA
Chanterelles	1 850	NA	1 850	1 440	1 070	NA	NA	NA	NA
Other forest mushrooms	870	NA	730	910	500	NA	NA	NA	NA

* summer truffles (a few plantations since the late 1990s) and Bourgogne truffles (plantations started in the 1990s).

Mushroom category	Marketed quantity (t)				'Wholesale' value (million € 2009)		
	2006-07	2007-08	2008-09	2009-10	1997-98	2001-02	2009-10
Black Périgord truffles	28	26	58	32	11.1	6.9	6.0
of which 1/3 harvested in forests	1	1	3	2	3.7	2.3	2.0
Other truffles (forests)*	6	7	6	5	NA	NA	NA
Boletus	NA	NA	NA	NA	9.8	4.6	NA
Chanterelles	NA	NA	NA	NA	3.9	5.6	14.0
Other forest mushrooms	NA	NA	NA	NA	NA	NA	NA

Source: Fédération Nationale des Syndicats Agricoles de Cultivateurs de Champignons, Fédération Française des Trufficulteurs, Forêt Privée Française et Service des Nouvelles du Marché; in 1997, an in-depth study was conducted by FNPC on forest mushrooms. A new survey is under way but the results are not yet available. The per-kg values used are: 1) for truffles: 2,000 F 1997/kg and 400 € 2001/kg - 2001/02 estimate based on 2004-05 rates of SNM evaluated at €490 /kg; 2) for boletus: 25 F 1997/kg or 4 € 2001/kg, also retained for 2001-02 due to a lack of updated data; 3) for chanterelles and other forest mushrooms: 21 F 1997/kg or 3.4 € 2001/kg, also retained for 2001-02 due to a lack of updated data. All values were converted into 2009 euros.

Data on forest mushroom harvests are very incomplete. The last in-depth survey by the Fédération nationale des producteurs de champignons was conducted in 1997 and an update is not yet available.
Harvests fluctuate yearly because mushrooms are very sensitive to climatic variations. Truffle production is relatively steady, or even increasing, mainly due to the gradual set up of productive plantations in recent decades, whereas boletus and chanterelle harvests dropped from 4,000 to 2,000 t between 1997-1998 and 2001-2002. Since then, there have been no records of forest mushroom harvests due to the high self-consumption levels and unauthorised picking.

The main producing regions are the Massif Central, Périgord and northeastern and southwestern France. The total value of the marketed harvest is estimated at €15-20 million per year. This should be supplemented with the production for self-consumption but this is very hard to evaluate.

The economic weight of forest mushrooms is far from insignificant, especially in certain regions. French consumption is much higher than the harvest and this gap, currently filled by imports (particularly from eastern Europe), represents a potential market for the cultivation of forest mushrooms.

The positive role of mycorrhizal mushrooms in the functioning and productivity of forest ecosystems has been known for many years. Continued research on the production of mycorrhizan mushrooms (boletus, saffron milk cap, etc.) and on optimisation of forest management should eventually strike a balance between timber production and edible mushroom production. The latter could provide extra income for forest owners in certain regions, provided that the problem of unauthorized picking can be solved locally.

Cork production

Location	Annual harvest (t/year)			Stumpage (thousand € 2009)		
	1999	2004	2009	1999	2004	2009
Corsica	3 000 to 5 000	2 000 to 2 500	1 200	670 to 1 090	440 to 880	360
Var	2 000 to 2 500	2 000 to 2 500	220	440 to 550	550 to 880	77
Pyrénées-Orientales	700	700	70	110	440	56
Landes	-	-	10	-	-	1
Total	**5 700 to 8 200**	**4 700 to 5 700**	**1 500**	**1 220 to 1 750**	**1 430 to 2 200**	**494**

Sources: Institut Méditerranéen du Liège, based on numbers supplied by ASLGF de la Suberaie Catalane, Le Liège Gascon, l'ASL Suberaie Varoise, l'ONF du Var, l'ODARC, les sociétés Lièges Mélior et À Fleur de Liège, completed by estimates based on expert opinion.

French cork oak production stands are mainly found in four regions: Corsica, Var, Pyrénées-Orientales and Landes. In the latter, the cork sector is being restructured with the support of local enterprises. Harvested cork quantities, which have been evaluated at around 1,500 t/year in France, have declined considerably in the last 6 years due to cyclical (disease and pest problems in Var region, private land issues in Corsica, etc.) and economic (decline in cork demand, excessive stocks, too low purchase prices for refuse corkwood) factors. The trend is currently towards an abandonment of cork resources because of the lack of land investment by professional organizations.

Stumpage of cork has decreased to the same extent as the harvested volumes. Total sales for this sector must now therefore be under €500,000/year but this is hard to evaluate because average prices estimated on the basis of expert opinion integrate a broad range of qualities and situations.

In Corsica, there is no organised market for cork. Commercial stakeholders, who are mostly Sardinians, purchase cork from local producers who negotiate with owners. Purchase prices, which were artificially high 5-6 years ago, have dropped considerably in the last 2 years. This has resulted in a decline in forest cork sales and many stockpiles have not been sold and producers are having difficulty disposing of this cork. The ODARC technical service estimates that 1,200 t were harvested in 2009 (but the figures were lower for 2010), with a mean stumpage price of around €0.30/kg. A forestry cooperative (Corsica furesta) was founded in 2010 especially to enhance cork market management.

In private forests in Var region, following the emergence of problems in the Maure massif caused by Platypus cylindrus, a wood-eating pest insect, the cork oak producers' association ASL Suberaie Varoise (120 owners; 4,580 ha) and CRPF PACA decided in 2003 to freeze cork sales. Sixteen tonnes were still harvested by ASL Suberaie Varoise in 2009. In public forests, and under the supervision of ONF Var, around 30 t of cork were harvested in the communal forest of Muy in 2008 and sold to a Sardinian stakeholder for a price ranging from €0.20 to 0.65/kg depending on the quality.

In addition to these two one-off operations, a regular quantity (evaluated at 170 to 250 t), is harvested annually in Maure massif and purchased by two local commercial stakeholders.

In Pyrénées-Orientales region, the main operator is ASLGF de la Suberaie Catalane (60 owners; 2,000 ha), whose harvested tonnage has been sharply dropping since 2009, due to:

– a silviculture-related factor because, after several substantial harvest years of over 30 t, there were 2 years of slump, with very little sufficiently thick reproduction cork available for harvesting (note however the first harvests of PEFC certified cork in 2009 and 2010);

– a more worrisome economic factor due to the increased difficulty in marketing average to low quality cork to cork stopper dealers.

In addition to these organised sales, a few independent cork harvesters are working in the department, with an annual harvest volume of around 50 t. The average stumpage price is €0.80/kg, with a maximum of €1.10.

In addition, unproductive cork (virgin or burnt) is harvested yearly by ASLGF de la Suberaie Catalane (90 ha since 2007). However, this cork, for which there are currently no local market outlets, is left in the forest unmarketed. There is hope that these rehabilitated cork plots will generate better cork harvests in the future. These unprofitable harvests are conducted using funds obtained for cork oak production stand rehabilitation, through credits obtained within the framework of DFCI development plans, supplemented by self-financing by owners.

In Landes region, slightly less than 10 t of cork (low quality due to a lack of harvesting in the last 40 years, i.e. virgin or over-thick) is harvested by the association Le Liège Gascon, and used locally by member companies. This cork is sold at a token stumpage price of €0.10/kg, and this price has remained constant since 2006.

The slump in the world cork stopper market in the last 20 years has resulted in an overtonnage market worldwide, leading to a severe drop in cork prices over the last 5 years. As commercial stakeholders have high cork stocks, considerable quantities of unsold cork are stockpiled in warehouses and in forests in all producing countries.

However, as the market for high quality cork stoppers is thriving, it is essential to enhance the cork production quality in forests. It is especially crucial to carry out research on the cork worm (*Corœbus undatus*), the larval form of a beetle that has been widely identified as one of the main damaging pests of cork (note however that Corsican cork is worm-free).

Moreover, the popular trend in favour of cork as an environment-friendly material in the building industry, and more generally in sectors other than the cork stopper sector, is promising for the future development of a market for non-stopper grade cork, but this is yet to be the case in France considering the complete absence of this type of industry to date.

Forest honey production

Species	Mean quantity marketed (t)				Mean price (€/kg)				'Wholesale' value (k€)			
	2004		2010		2004		2010		2004		2010	
	low	high	low	high	low	high	low	high	low	high	low	high
Acacia	3 000 to 4 000		2 500 to 3 000		3.50 to 4.50		4.50 to 5.00		10 500 to 18 000		11 250 to 15 000	
Chestnut	1 500 to 2 000		1 500 to 2 000		3.00 to 3.50		4.50 to 4.50		4 500 to 7 000		6 750 to 9 000	
Linden	500 to 500		600 to 700		3.00 to 3.60		4.00 to 4.20		1 500 to 1 800		2 400 to 2 940	
Fir	600 to 600		400 to 500		5.50 to 6.00		6.00 to 7.00		3 300 to 3 600		2 400 to 3 500	
Heather	NA		100 to 150		NA		6.00 to 7.00		NA		600 to 1 050	
Heath	NA		100 to 150		NA		4.50 to 5.00		NA		450 to 750	
Strawberry tree	NA		50 to 100		NA		4.50 to 5.00		NA		225 to 500	
Honeydew and forest plants	NA		250 to 300		NA		3.50 to 4.00		NA		875 to 1 200	
Total	**5 600 to 7 100**		**5 500 to 6 900**		**-**		**-**		**19 800 to 30 400**		**24 950 to 33 940**	

Source: Coopérative France Miel 2004 and 2010; mean current production estimated on the basis of expert opinion due to a lack of more accurate statistical data.

The quantity of marketed forest honey ranges from 5,500 to 6,900 t per average year. Acacia honey accounts for nearly half of this volume and chestnut honey represents a little less than 30% of the marketed quantities. This production, although relatively stable over 5 year intervals, can fluctuate substantially, particularly as a result of weather conditions: production can sometimes be null, especially for fir honey. Forest honey accounts for 30% of the total honey production in France, which amounts to 20,000 t in 2010, versus 30,000 to 40,000 t in 2004. The marked decrease in total production over the last 5 years could be due to the abnormally high rate of bee mortality noted in recent years. However, this has had relatively little impact on forest honey production.
The total value of forest honey ranged from €25 to 34 million in 2010 and has increased with the rise in the unit price, which is due to the general decline in honey production for all honey types. Fir and heather honey are the most sought-after types, with a 'wholesale' value of €6-7/kg.

Forest seed production

Nature	Marketed quantity (batches or kg)						Value* (en k€)					
	2005	2006	2007	2008	2009	2010	2005	2005	2007	2008	2009	2010
Number of batches	970	1 070	-	-	-	-	907	907	1 275	1 265	932	983
Conifer seeds	NA	NA	1 087	1 935	1 619	840						
Acorns and chestnuts	NA	NA	72 168	94 153	44 877	60 933						
Other broadleaved seeds	NA	NA	3 348	2 196	1 596	2 415						

* total sales for the activity in public forests, including transportation and auxiliary services.
Source: ONF, 2010.

Public forests represent a key source of forest seeds in France. They therefore contribute significantly to supplying public and private nurseries with forest breeding material of high genetic value collected in a diverse range of sites and seed orchards.

Gathered plants

Plant type	1997 production (t/year)	2005 production (t/year)	Value (million € 2005)
Lichen (perfumery and cosmetics)	2 000 to 2 500	NA	0.3 to 0.4
Butcher's broom leaves	200	NA	0.4
Butcher's broom rhizomes (pharmacy)	150 to 200	NA	0.3 to 0.5
Rock-rose leaves and branches (perfumery)	800	NA	1.1
Bilberries (cosmetics and pharmacy)	1 000	NA	2.6
Linden leafy bracts and flowers	80	NA	0.5
Ash leaves	100	NA	0.2
Total	**4 330 to 4 880**	**4 605**	**5.3 to 5.6**

Source: ONIPPAM (Office national interprofessionnel des plantes à parfum, aromatiques et médicinales) 1997 production data, except for butcher's broom leaves, i.e. 1989 data, due to a lack of available updated data for 2004; 1997 values converted into 2005 euros, due to number inaccuracies (no recent data available).

The gathered plant harvest estimated in 1997 was 4,000 to 5,000 t, for a value of €5 to 6 million, mainly taking place in the French mountain massifs, i.e. Vosges, Alpes, Pyrénées and especially the Massif Central (Cévennes, Auvergne, Limousin). According to the Office national interprofessionnel des plantes à parfum, aromatiques et médicinales (ONIPPAM), most of these harvests are declining, except for lichens for perfumery and cosmetics, where production has remained stable.
However, the annual gathered plant harvest is hard to estimate because this sector is loosely organised and the activity is often marginal. No updated data is currently available to distinguish between gathered forest plants and crops. The Comité des plantes à parfum, aromatiques et médicinales (CPPARM) nevertheless has accurate data on quantities harvested by cooperatives located in Corsica, Ardèche and Puy-de-Dôme regions which obtain supplies from independent gatherers of plants throughout France depending on the seasons (cf. table below). However, no data is available on the value of these harvests.

Species	Harvested parts	Fresh weight (kg)	Dry weight (kg)
Sweet woodruff	whole plant	NA	3
Hawthorn	flowers and leaves	2 062	3 080
White birch	leaves, bark, sap	1 815	1 702
Box tree	leafed branchlets	NA	470
Bearberry	leafed branchlets	898	NA
Chestnut	leaves and fruit (especially)	5 516	2 281
Meadow saffron	bulbs	23	NA
Douglas fir	leafed branchlets	400	NA
Ash	leaves	6 000	1 603
Scotch broom	leafed and flowered branchlets	NA	130
Juniper	leafed branchlets	3	NA
Beech	buds	4 871	1
Ivy	leafed branchlets	23	NA
Lily of the valley	whole flowered plant	113	NA
Common European myrtle	leafed branchlets	15 013	NA
Bilberry	tips and berries	9 892	3 034
Hazelnut tree	bark	10	52
Corsican pine	needles	2 006	NA
Scots pine	buds and branchlets	2 470	NA
Mastic tree	leafed and flowered branchlets	3 005	NA
Primrose	whole plant	NA	4
Silver fir	buds	6	NA
Common elder	flowered tops	1 946	416
Total		**56 072**	**12 776**

Source: CPPARM, 2009; values for cooperatives located in Corsica, Ardèche and Puy-de-Dôme.

Indicator 3.4

Value of marketed services on forest and other wooded land

Marketed services	Ownership category	Value (million € 2008)				
		1993	1998	2003	2005	2008
Hunting licences	state-owned forest	32.2	32.8	34.6	43.5	42.2
	other public forest governed by forest regulations	18.2	19.6	18.9	19.0	19.5
	private forest	26.1	NA	26.5	NA	NA
Total hunting		**76.5**	**NA**	**80.0**	**NA**	**NA**
Fishing licences	state-owned forest	0.2	0.3	0.3	0.3	0.4
Royalties and rental charges (concessions)	state-owned forest	9.4	9.0	9.3	13.1	15.2
	other public forest governed by forest regulations	7.6	7.4	6.9	NA	NA
Total royalties and rental charges		**17.0**	**15.0**	**14.7**	**NA**	**NA**
All services	state-owned forest	41.8	42.1	44.2	56.9	57.8
	other public forest governed by forest regulations	25.8	24.5	25.8	NA	NA
	private forest	26.1	NA	26.5	NA	NA
Total all services		**93.7**	**NA**	**96.5**	**NA**	**NA**
		€6.3/ha	**NA**	**€6.3/ha**	**NA**	**NA**

Source: public forest: ONF, 2003 to 2008 sustainable development reports; private forest: SCEES/Enquêtes sur la structure de la forêt privée, ESSES 1976-83 and 1999 for the leased area; estimation of the mean 2003 hunting licence fee in private forests by applying the increase noted in state-owned forests during the 1993-2003 period to the 1993 value. All numbers have been converted into 2008 euros; they refer to gross income, without deducting management and maintenance expenditures.

Forests represent a setting for many services, some of which generate income for the forest owner. This includes hunting and fishing licences, as well as royalties and rental charges in public forests.

State-owned forest

Hunting licences

In metropolitan France, 1.75 million ha of state-owned forest, or 4% of the hunting area (lowlands and woodlands), hosts around 100,000 hunters (for a total of 1.3 million licences). Different hunting methods are practiced: firearm hunting, including bow hunting, individually (hunting by stalking or from a hide) or in groups (drives with or without dogs), hunting on horseback with hounds (especially in large state-owned forests), underground burrow hunting or occasionally falcon hunting.
Most hunting plots rented in state-owned forests are allocated by public tender, otherwise plots are generally allotted on a licensing or friendly basis. The increase in income from hunting as of 2005 is due to the relocation of hunting leases (for 12 years) which took place during the first half of 2004.

Concessions

Concessions, which account for barely 1% of the managed state-owned forest area, concern specific services that are generally of public interest (power transmission systems, open-pit mines, beach access plan in Aquitaine, etc.). These time-limited concessions always include clauses that the concerned ecosystems must be returned to their initial state, and may even include countervailing measures.
The increase in income from concessions since 2005 is mainly due to the rehabilitation of revenue-generating concessions (camp grounds, telephone or power facilities, etc.).

Fishing licences

ONF is responsible for the management of lakes, ponds and rivers of the State private sector in state-owned forests, while also managing fishing rights. This involves 3,350 km of shoreline and 1,610 ha of ponds and lakes. Plots are generally leased for 6 years, with fishing controlled by licence, public collective management, or in a reserve setting.

Case of the other public forests governed by public regulations

Hunting licences

The forestry code does not include a special framework for the allocation of hunting rights in community forests governed by forestry regulations. The owner community with hunting rights is solely responsible for setting the hunting conditions in its forest.
Hunting rights, which are seldom reserved, are allocated under different conditions: public auction leases, calls for tender, written or oral informal leases, incorporation into a certified communal hunting association (ACCA), etc.
Income generated by hunting licences varies depending on the selected options and is sometimes nil (free access).

Special case of Alsace-Moselle
Under local regulations, communal forest regulations incorporate communal hunting, and managed by the Mayor for all owners within the administered area. Hunting licences are generally allotted by public auction or calls for tender. A lease may also be passed on from a prior leaseholder.

Fishing licences

Owner communities, like the situation with hunting, are solely responsible for managing fishing rights.

Private forest

It is hard to estimate the value of hunting licences for private forests since conditions vary widely with respect to hunting in these forests.
A survey on private forest structures conducted by the Service central des enquêtes et études statistiques (SCEES) in 1999 revealed that more than half of the surveyed owners were voluntarily or obligatorily attached to an authorised communal and intercommunal hunting association (ACCA or AICA). This situation concerned 45% of the forest area. A quarter of these owners provide their relatives, friends or local hunting groups with free hunting access to their forests, especially in southern France.

Paid hunting leases apply to 13% of the forest area, but only 2% of private owners. This generally concerns large-scale properties (51 ha on average) belonging to corporate bodies. Only 8% of private owners (16% of the area) maintain exclusive hunting rights in their forests.

Indicator 3.5

Proportion of forest and other wooded land under a management plan or equivalent

Formal management plans

Ownership category		Units	Managed area					
			1974	1984	1994	1999	2004	2010
State-owned forest*		*ha*	1 184 400	1 421 000	1 610 100	1 704 500	1 633 000	1 669 700
		%	71.0	82.3	90.5	93.3	89.1%	98.1
Other public forest governed by forest regulations		*ha*	1 316 400	1 650 800	1 983 700	2 197 700	2 193 000	2 655 533
		%	54.4	66.1	75.0	80.9	78.9	89.7
Total all forests governed by forest regulations		**ha**	**2 500 800**	**3 071 800**	**3 593 800**	**3 902 200**	**3 826 000**	**4 325 233**
		%	**61.2**	**72.7**	**81.2**	**85.9**	**83.0**	**92.8**
Private forest	**Compulsory simple management plan****	*ha*	94 900	2 345 900	2 479 800	2 551 700	2 487 000	2 764 628
		%	2.8	71.2	73.9	75.9	73.1	80.5
	Voluntary simple management plan	*ha*	-	-	16 700	26 400	35 200	81 737
	Total	**ha**	**94 900**	**2 345 900**	**2 496 501**	**2 578 101**	**2 522 201**	**2 846 419**
		%	**-**	**23.8**	**24.0**	**24.1**	**23.4**	**27.2**
Total		**ha**	**2 595 700**	**5 417 700**	**6 090 301**	**6 480 301**	**6 348 201**	**7 171 652**
		%	**-**	**38.5**	**41.1**	**42.6**	**41.2**	**46.8**

* For 2010, excluding state-owned land managed by other ministries (79,000 ha), state-owned forests in Corsica (50,000 ha) which were transferred to the Collectivité territoriale de Corse in 2003, and the Domaine de Chambord (5,000 ha), all of which are classified under 'Other public forest governed by forest regulations'.
** presented % are relative to the area prior to implementation of a simple management plan in compliance with the law (see Box 4).
Source: ONF for state-owned forests and other public forests governed by forest regulations, based on current management plans; CNPF for private forests with an approved current simple management plan, including voluntary management plans; the percentage of all managed metropolitan forests is calculated on the basis of Teruti survey areas (headings 18 to 21, 24, 25) 1983 (old data series), 1993, 1998, 2003 and Teruti-Lucas 2008 (new data series); managed areas were established for 1st January of the concerned year.

The French forest area for which a 'formal' management plan has been drawn up is currently over 7 million ha, or 45.1% of the overall area. This area increased by 640,000 ha in 10 years, two thirds of which account for public forests. The decline noted in 2004 is due to damage incurred by the 1999 storms, which resulted in a revision of many managed areas and simple management plans. Cyclone Klaus in January 2009 also explains the low relative increase in managed area in private forests. This lack of progress also reflects the limbo-like situation in which some owners have found themselves as a result of financial and technical uncertainties encountered with respect to the rehabilitation of their forests.

A high proportion of public forests are managed, i.e. 98% of state-owned forests and 89.7% of other public forests governed by public regulations. In 2009 and 2010, the approval by the French Forestry Minister of the new Directives Nationales d'Aménagement et de Gestion (state-owned forests) and the new Orientations Nationales d'Aménagement et de Gestion (communal forests) reaffirms the multifunctional aspect of sustainable forest management, while confirming the aim to 'produce more wood while striving to enhance biodiversity preservation' and integrating the assumed potential impacts of climate change predicted in the 21st century. Forest management plans are now systematically based on assessments of issues associated with the main functions of forests managed locally: wood production, ecology, social function and natural risk protection.

For private forests, 80.5% of forests whose owners were obliged to draw up a simple forest management plan, i.e. Simple Management Records (PSG : plan simple de gestion), have an authorized PSG in 2010. Under the agriculture and fisheries modernisation law of July 2010, the conditions concerning the obligation to draw up a PSG were recently modified, which now applies when the cumulated area of the largest forest plot and isolated forest plots located in the same community and in the territory of adjacent

communities is 25 ha or more. Isolated forest plots of under 4 ha are not considered. The slight decline noted in 2004 was directly due to the storms of December 1999, which sharply increased the number of pending obligatory PSGs. Nine years later, cyclone Klaus wreaked further havoc amongst forest owners. Faced with massive stand destruction, clean-up and marketing difficulties and uncertainty with respect to obtaining reconstruction credit, many of these owners preferred to postpone their PSG renewal until the situation settled. However, voluntary PSGs are still constantly increasing, with their area expanding by more than twofold over the last 5 years.

In addition, the proportion of managed French forests is much higher than that of forests under a 'formal' management plan, especially with respect to private forests. A survey on private forest structures carried out by the Service central des enquêtes et études statistiques (SCEES) in 1999 provided an assessment of the level of involvement of owners in forest development. A quarter of private forest owners, holding around 60% of the forest area, sought information or called in external assistance to enhance management of their forest properties. These proportions increased as the forest size increased: 89% of owners with 100 ha or more were concerned (91% of the area), as compared to 19% of owners with less than 10 ha (24% of the area). Finally, 560,000 owners were active in maintaining, felling, etc., their stands, alone or with the help of their relatives. Their work time is estimated at 20 days per year and per owner, representing more than 11 million work days.

Box 4: Management records required by the French forest law of 9 July 2001

Four management record categories are stipulated under the French forest law of 9 July 2001 (Loi d'orientation forestière du 9 juillet 2001):

- management records
- simple management plans
- model management regulations
- codes of good silvicultural practices.

These records must be drawn up in compliance with regional development directives (DRA) for state-owned forests, regional management schemes (SRA) for other public forests governed by forest regulations, and regional silvicultural management schemes (SRGS) for private forests. DRA, SRA and SRGS are defined in the regional forest guidelines (ORF), which in turn are drawn up by regional commissions for forests and forest goods, with the participation of concerned partners.

For public forests, the management record is generally a detailed management record. It can be replaced by a model management regulation (RTG), i.e. a simple record, for forests with a low economic potential and ecological interest.

For private forests, a simple management plan (PSG) is compulsory for forested properties with an uninterrupted area that is equal to or higher than the threshold set for the administrative department, ranging from 10 to 25 ha. An owner with a forest area under the preset departmental threshold but equal to or above 10 ha can submit a voluntary PSG. Compulsory and voluntary PSG records are comparable to public forest management documents.

Private forest owners with properties that do not qualify under this category can concur to a model management regulation (RTG) drawn up by a common forest management and logging organisation or a forest expert. They can also comply with a code of good silvicultural practices (CBPS) drawn up by the Centre régional de la propriété forestière and approved by the prefect of the regions. The CBPS contains key sustainable forest management guidelines classified by region or group of natural regions.

Forests managed in compliance with these four management record categories are confirmed as being sustainably managed forests, conditional to a 10-year (minimum) commitment by the owner when they qualify under RTG and CBPS. These sustainable management commitments are required to obtain government subsidies.

Indicator 3.5.1

Forest area covered by a catalogue of forest stations or by a simple species guide

Coverage	Forest area covered by a catalogue of forest stations (1 000 ha)						Forest area covered by a simple guide (1 000 ha)					
	2000		2005		2010		2000		2005		2010	
	Forested	*Total*	*Forested*	*Total*	*Forested*	*Total*	*Forested*	*Total*	*Forested*	*Total*	*Forested*	*Total*
Complete	5 636	18 128	6 742	22 326	6 754	22 485	3 100	9 617	5 104	15 375	5 920	18 180
Partial	453	2 257	584	2 596	583	2 290	232	1 135	365	1 425	453	1 853
Total	**6 089**	**20 385**	**7 326**	**24 922**	**7 337**	**24 775**	**3 332**	**10 752**	**5 468**	**16 750**	**6 373**	**20 033**
% total France	**43.2 %**	**37.1 %**	**52.0 %**	**45.4 %**	**52.1 %**	**45.1 %**	**23.6 %**	**19.6 %**	**38.8 %**	**30.6 %**	**45.2 %**	**36.5 %**

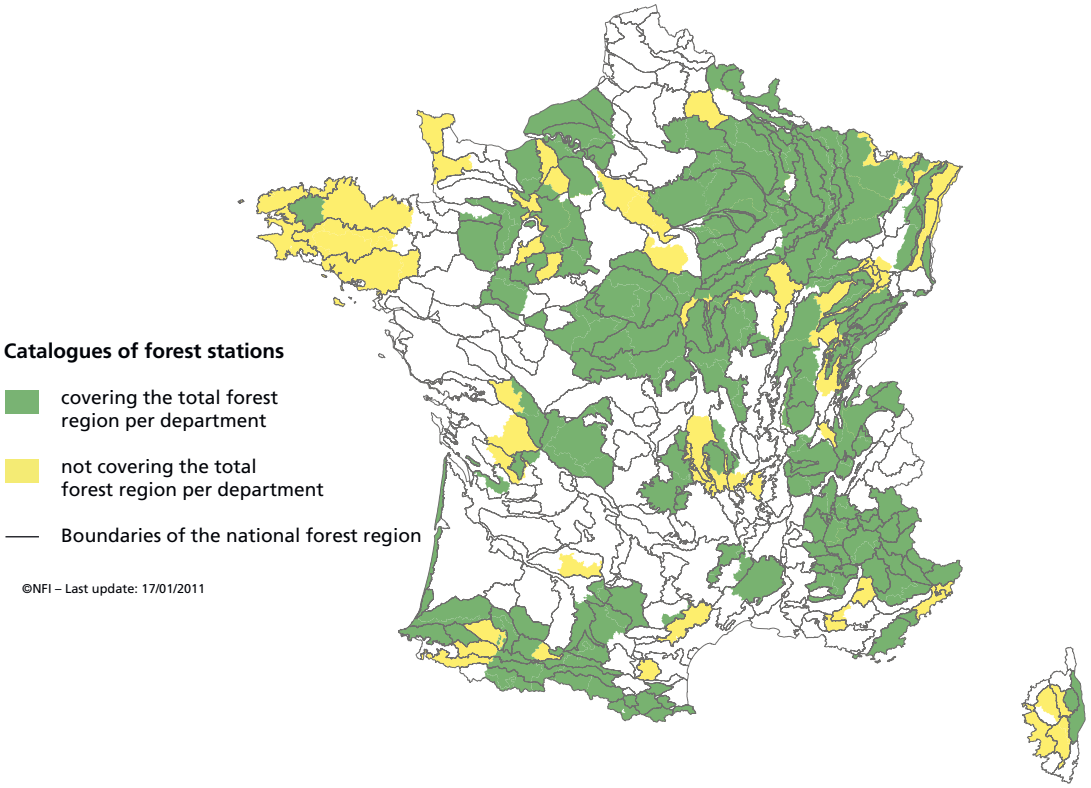
Source: NFI; calculations were done per NFI departmental forest region while only taking the area actually covered within each region into consideration; areas covered per region could be determined by this method. However, the scope of validity of the documents is usually greater.

Due to the lack of sufficient accuracy concerning the edges of the area covered by field site classification documents, especially in the oldest documents, and the absence of referencing with respect to the boundaries of forest regions defined by NFI, their incorporation into a GIS would be useless. For each document, the areas covered (forested or total) were thus assessed with respect to the compliance of the boundaries in the text with those of the forest regions.
Moreover, since 1992, NFI has been recording ecological and floristic field data. In 2002, NFI was tasked by the French Forest Ministry to permanently oversee, provide expertise and operational coordination in the field of forest station classification. Areas actually covered by a descriptive record of forest stations were thus recalculated and refined on national forest region and departmental forest region scales. Data generated by this more accurate method overrule the data series published in the year 2000 edition of the present document. The method was used to determine the status of the situation on 01/01/2000, while taking the newly published guides into consideration, which are the only documents likely to be used on a daily basis by public and private forest managers. The slight decrease in forest area covered by the catalogues between 2005 and 2010 is due to the fact that NFI's ongoing verification of the field site classification documents since 2002 has led to the recovery of some old original documents. It is thus possible to specify areas that had been overevaluated in the past. This decrease was not entirely offset by publication of the new catalogues, which in turn declining in favour of simple guides.

Catalogues of forest stations include, amongst other elements, a description and a key for identifying different forest ecosystems in a natural region. They are developed by scientists or academics, generally on the basis of the results of analyses of the topography and landforms, climatic characteristics, types of rock, soil, humus and vegetation composition. It was felt that these catalogues should be transformed into clear and easy to use tools that could help forest managers in making accurate ecological analyses of their forest stations—a prerequisite for sustainable management. Guides were thus drawn up to facilitate identification of forest stations and species—they summarise knowledge in the form of site units with known potentials for the main forest species of one or several natural regions. These practical guides (attractive presentation, small size, simple and detailed scientific concepts), can provide forest managers with access to enhanced knowledge on natural production factors concerning their forests, thus facilitating decision making on the best species to plant in their forests stands. These guides are the only reference documents available for some regions when no catalogue of forest stations has been drawn up. The findings of studies carried out before these documents were drawn up and studies on the potentials of one (or several) species have also been published. A detailed updated list is presented on the NFI website, and most of the published documents can be downloaded at:
www.ifn.fr/spip/?rubrique160

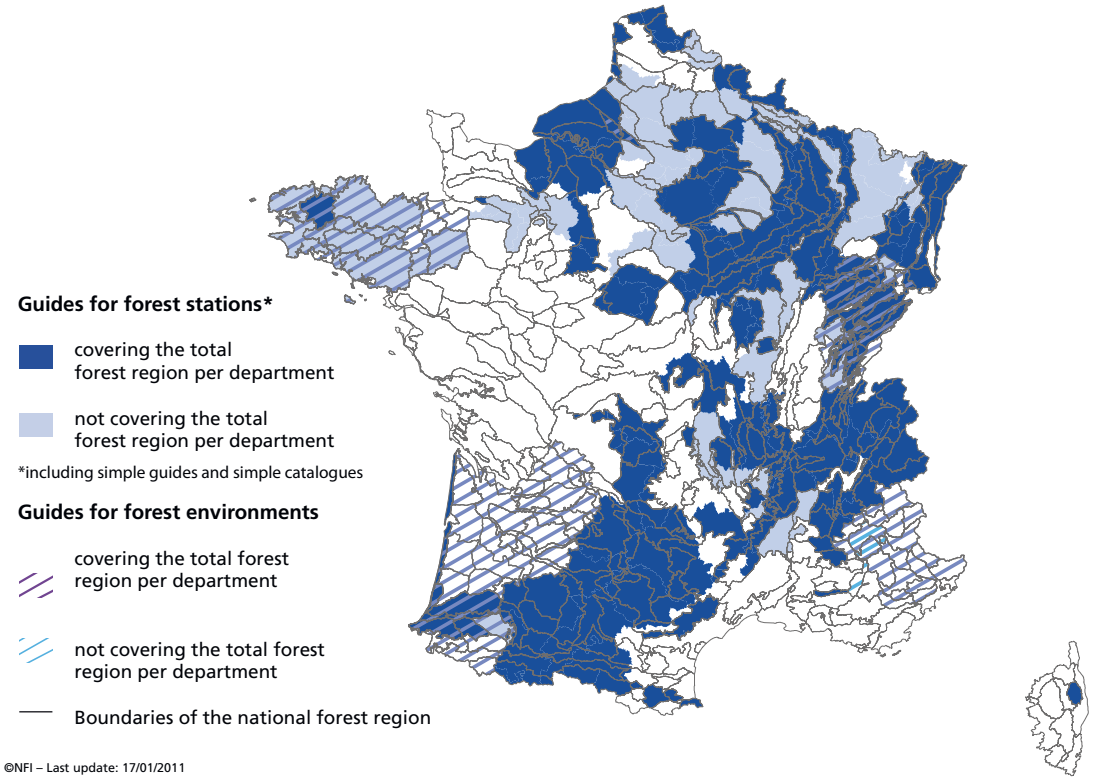
Half of the forest area in France, i.e. 7.3 million ha, is currently covered by a catalogue of forest stations (20% increase in 10 years), while more than 45% of the area is covered by a simple guide (91% increase over the same period). The guides are thus being published at a much faster pace than the catalogues, which is very encouraging with respect to applying sustainable development concepts in the field. This progress has been more substantial in regions with the harshest forest production conditions, i.e. mountain areas, the Mediterranean region, or areas with a low afforestation rate: northern France.

However, regions for which a forest station classification is available generally have a mean forest cover of 30%, which is higher than the national average. This trend indicates that—apart from the Gascogne region, for instance, for which no classification tool is available to date—the interest generated by the forest station catalogues is generally higher in the most forested regions. This clearly highlights the willingness of public and private managers to conduct ecological analyses as part of their everyday forest management activities.



Map 16: Catalogues of stations available per forest region. Situation in late 2010.

Source: NFI.



Map 17: Simple species guides available per forest region. Situation in late 2010.

Source: NFI.

Criterion 4

MAINTENANCE, CONSERVATION AND APPROPRIATE ENHANCEMENT OF BIOLOGICAL DIVERSITY IN FOREST ECOSYSTEMS

Indicator 4.1

Area of forest and other wooded land, classified by number of tree species occurring and by forest type

Forests available for wood supply (excluding stands ineligible for inventory)

Data retrieval year Survey years	2010 2006 to 2009							
	Broadleaved stand		Conifer stand		Mixed stand		Total	
Number of species eligible for inventory in the stand	*1 000 ha*	*%*	*1 000 ha*	*%*	*1 000 ha*	*%*	*1 000 ha*	*%*
1 species	520 ± 37	6	725 ± 44	23	-		1 245 ± 57	9
2 species	871 ± 48	9	669 ± 44	21	100 ± 18	6	1 640 ± 66	12
3 species	1 342 ± 58	14	600 ± 40	19	221 ± 25	14	2 162 ± 73	15
4 species	1 474 ± 61	16	451 ± 34	14	268 ± 27	17	2 193 ± 73	16
5 species	1 431 ± 59	15	302 ± 28	10	240 ± 25	15	1 974 ± 68	14
6 species	1 229 ± 55	13	189 ± 22	6	226 ± 24	15	1 643 ± 63	12
7 species	925 ± 47	10	91 ± 16	3	164 ± 21	11	1 180 ± 53	8
8 species	658 ± 40	7	49 ± 11	2	129 ± 18	8	837 ± 45	6
9 species	416 ± 33	4	n. s.		86 ± 15	6	524 ± 36	4
10 species or more	468 ± 35	5	n. s.		117 ± 18	8	602 ± 40	4
Total	**9 334 ± 110**	**100**	**3 114 ± 81**	**100**	**1 551 ± 62**	**100**	**13 999 ± 107**	**100**
Mean number of species eligible for inventory	5.0		3.1		5.6		4.7	

Source: NFI.
Relevant domain: FAWS, excluding stands ineligible for inventory.

The number of species eligible for inventory per stand is the number of species monitored in a 20 are circular plot* centred on a sampling point, while only counting trees with a stem diameter of at least 7.5 cm at breast height. All species, regardless of their number, are counted when the trees fulfil these inventory conditions.

Stands not eligible for inventory were excluded from this indicator since here the focus is only on species with final crop trees in the stand and which are not simply part of the understorey. Ineligible stands may contain a few trees that would be eligible for inventory, but the number of species calculated would not be representative of the actual diversity of the current or future final crop stand.

The data presented in the ISFM 2005 edition differed considerably from the data presented here because there were fewer classes assessed for the number of trees and also because some species were pooled to ensure consistency between inventories. Sessile, pedunculate and pubescent oaks were thus counted as a single species and equer trees were classified with fruit tree species. These groupings were discarded here so that the data presented would be more in line with the actual situation in forests.

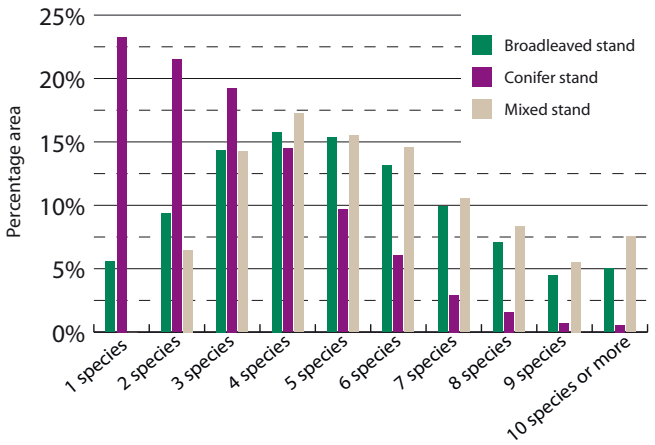
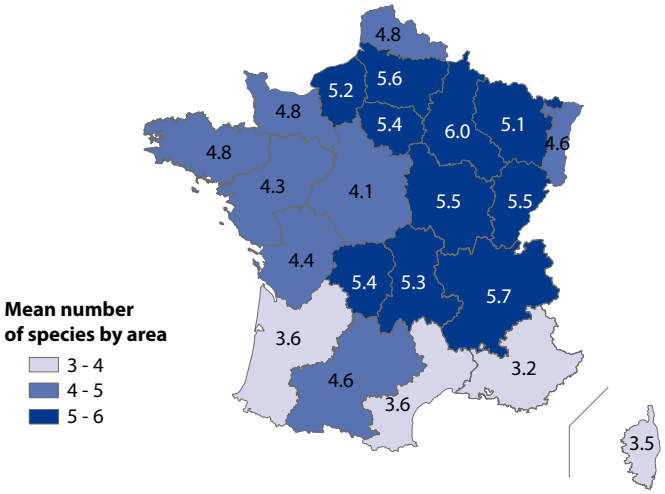


Figure 29: Proportion of FAWS area per number of species eligible for inventory present and per forest type.
Source: NFI, survey years 2006 to 2009.

* The sampling plot corresponds to a 25 m radius around each sampling point.

Over 90% of stands eligible for inventory contain at least two species that have reached the eligible stage and contain 4.7 eligible species on average. Stands with mixtures of three eligible species and more account for 79% of the area and 48% of this area has at least five eligible species. Monospecific stands represent under 10% of the eligible for inventory stand area.
Eligible stands with a broadleaved main species contain 5.0 eligible species on average, whereas stands with a conifer main species contain 3.7. This lower diversity could mainly be explained by the higher proportion of monospecific conifer stands as compared to broadleaved stands.



Map 18: Mean number of species eligible for inventory per administrative region.

Source: NFI, survey years 2006 to 2009.

Champagne-Ardenne, Bourgogne, Picardie, Rhône-Alpes and Franche-Comté regions have the highest mean number of species eligible for inventory per plot, with an average ranging from 5.5 to 6 species per plot. In contrast, Mediterranean regions (PACA, Corsica, Languedoc-Roussillon) have the lowest mean number of eligible species per plot, with fewer than four eligible species per plot on average. This lower diversity in Aquitaine could be explained by the prevalence of maritime pine monocultures in this region. However, in Mediterranean regions, this low intra-stand diversity should be analysed with caution because it is more a reflection of the lower number of eligible species in these stands than a lack of diversity. Indeed, NFI flora analyses, which are not only restricted to trees eligible for inventory, have shown that the Mediterranean is one of the regions with the highest number of tree species. Finally, it should be kept in mind that the regional differences likely mainly reflect the impact of the high soil fertility at the site on the stand diversity.

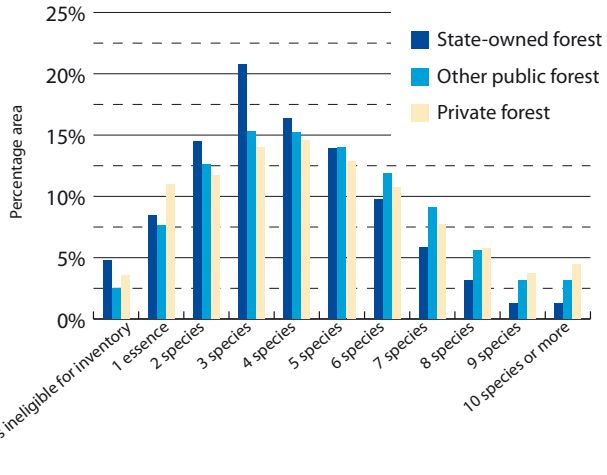
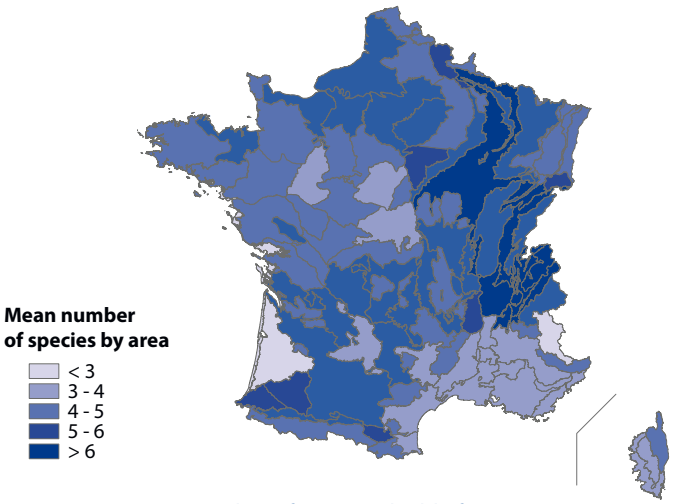


Figure 30: Proportion of FAWS area per number of species eligible for inventory present and forest ownership category.

Source: NFI, survey years 2006 to 2009.

State-owned forests have the lowest mean number of species eligible for inventory, with 4.1 eligible species per plot on average. Twenty-three percent of the state-owned forest area is located in PACA and Languedoc-Roussillon regions, where there are fewer eligible species, which could explain this average, in addition to the fact that many state-owned forests, especially protection forests, are located on relatively infertile land. However, private forests and other public forests have 4.7 eligible species on average. This relative diversity of private forests could be explained by the willingness to manage these forests, and also likely by the presence of various species in unmanaged private forests, since silviculturists do not orient species selection. These factors suggest that the forest ownership category could actually reflect the impact of other sources of variability, such as the type of site on which the stands are located.



Map 19: Mean number of species eligible for inventory per silvoecoregion.

Source: NFI, survey years 2006 to 2009.

Indicator 4.1.1

Proportion of the main species in stands

Forests available for wood supply – excluding temporarily unstocked stands

Proportion of the main species in basal area

ISFM 2005 Edition

Data retrieval year	1989	1994	1999	2004
Average year	1981	1986	1991	1996
Main tree species	*Proportion of the main species relative to the basal area for all tree species (% purity)*			
Pedunculate oak / Sessile oak	63	62	62	59
Beech	69	68	67	67
Chestnut	80	80	79	79
Pubescent oak	86	86	85	83
Hornbeam	57	57	56	55
Common ash	48	49	49	48
Birch	59	58	58	58
False acacia	71	73	71	71
Holm oak	85	86	85	84
Aspen	50	49	49	46
Large alder	75	73	74	74
Large maple	43	43	45	45
Small maple	50	49	46	47
Cherry or wild cherry	42	41	40	41
Linden	49	49	46	48
Other broadleaved	65	64	64	63
Total broadleaved	**66**	**66**	**65**	**64**
Common spruce	75	77	77	78
Silver fir	76	76	75	75
Scots pine	77	76	75	74
Maritime pine	86	87	86	87
Douglas fir	79	82	82	81
Corsican pine	82	81	82	83
Austrian pine	83	82	82	82
Larch	79	80	79	79
Aleppo pine	75	75	75	72
Other Conifers	80	80	80	80
Total conifers	**79**	**79**	**79**	**79**
Total	**71**	**71**	**71**	**70**

Source: NFI.
Relevant domain: FAWS, excluding poplar plantations and including thickets, for trees eligible for inventory.

ISFM 2010 Edition

Data retrieval year	2010
Survey years	2006 to 2009
Main tree species	*Proportion of the main tree species relative to the basal area for all tree species (% purity)*
Pedunculate oak	60
Sessile oak	65
Beech	66
Chestnut	72
Pubescent oak	75
Common ash	48
Hornbeam	50
Cultivated poplar	78
Holm oak	78
Birch	49
False acacia	62
Large alder	64
Large maple	46
Aspen	48
Linden	45
Small maple	52
Cherry or wild cherry	53
Other broadleaved	71
Total broadleaved	64
Common spruce	79
Silver fir	75
Scots pine	79
Maritime pine	89
Douglas fir	82
Corsican pine	85
Austrian pine	82
Larch	80
Aleppo pine	88
Other conifers	82
Total conifers	81
Total	70

Source: NFI.
Relevant domain: FAWS.

The main species here is the one with the greatest cover eligible for inventory within the stand (assessed within a 20 are* circular plot around a sampling point) or, when there is no eligible cover, the species with the greatest cover ineligible for inventory (assessed within a 7 are** circular plot around a sampling point). This definition is in line with that used until 2004, except in mixed coppice/high forest stands where the main species is the one with the greatest cover in the high forest layer. This change concerning the determination of the main species in mixed stands means that there is more area in which the main species is a coppice species. Classification of these areas with a main species frequently found in coppices, and no longer with a high forest species, means that there is a lower percentage of basal area for coppice species than previously (at mixed species sampling points, the presence of high forest trees decreases the percentage of basal area for coppice species trees).

Despite the fact that forest management is focused to an increasing extent on enhancing species diversity, French silviculturists still give priority to one or two main gregarious species, associated with secondary species or an understorey. This is why the percentage of basal area of the main species remains high (70 %).

In conifer stands, the main species clearly predominates in terms of basal area (81%) as compared to broadleaved stands (64% of the basal area).

Stands of valuable broadleaved species and various preponderant broadleaved species have a low percentage of the main tree species relative to the basal area, i.e. not above 53% for valuable broadleaved species (wild cherry, ash, large maple) and 50% for various broadleaved species (birch, hornbeam, aspen).

* corresponding to a circular 25 m radius plot around the sampling point.
** corresponding to a circular 15 m radius plot around the sampling point.

Percentage area of stands eligible for survey in which the main species is pure or preponderant (at least 50% of the cover for this species and less than 15% for the second most common species) in all eligible stands in which it is the main species

A stand is considered pure for a given species if the relative free cover for this species is over 75%. A species is considered preponderant if its relative free cover is over 50% and the rate of the second most common species in the stand is not higher than 15% (see Appendix V).

On average, stands in which the main species is pure or preponderant represent 51% of the area of stands eligible for survey.

Except for pubescent and holm oak stands, broadleaved stands in which the main species is preponderant represent under 50% of the total area of the main species concerned.

The lowest rate is noted for birch—stands in which this species is preponderant represent only 29% of the stands in which birch is the main species.
The trend is reversed for conifers, with the lowest rate obtained by fir and spruce. These stands, which are commonly found in mountain areas, are often mixed with beech.

Data retrieval year	**2010**		
Survey years	**2006 to 2009**		
Main tree species	*Area of stands*	*Area of eligible stands in which the tree species predominates*	*Proportion of the area in which the main tree species predominates*
	1000 ha	*1000 ha*	*%*
Pedunculate oak	1 840 ± 64	696 ± 42	38
Sessile oak	1 586 ± 55	750 ± 40	47
Beech	1 351 ± 54	618 ± 38	46
Pubescent oak	1 275 ± 54	836 ± 45	66
Chestnut	692 ± 41	326 ± 29	47
Holm oak	589 ± 40	366 ± 32	62
Common ash	539 ± 37	149 ± 20	28
Hornbeam	528 ± 34	76 ± 14	14
Birch	248 ± 25	72 ± 13	29
Cultivated poplar	198 ± 21	174 ± 19	88
False acacia	173 ± 22	65 ± 14	38
Large alder	132 ± 19	39 ± 11	30
Other broadleaved	812 ± 47	232 ± 26	29
Maritime pine	924 ± 45	782 ± 42	85
Scots pine	851 ± 45	517 ± 36	61
Common spruce	571 ± 37	333 ± 29	58
Silver fir	550 ± 34	284 ± 25	52
Douglas fir	358 ± 30	258 ± 25	72
Austrian pine	176 ± 22	117 ± 18	66
Corsican pine	173 ± 21	129 ± 18	75
Aleppo pine	168 ± 23	130 ± 20	78
Larch	98 ± 15	69 ± 13	71
Other conifers	165 ± 21	112 ± 17	68
Total	**13 999 ± 107**	**7 132 ± 110**	**51**

Source: NFI.
Relevant domain: FAWS, excluding stands ineligible for inventory.

Indicator 4.2

Area of regeneration within forest stands, classified by regeneration type and main tree species in the stand

Forests available for wood supply

The method used until 2005 to generate data for this indicator, i.e. based on aerial photo observation, is no longer applied. This technique involved overlaying field plots of the previous inventory over aerial photographs of the latest inventory. This method was not reliable as it was hard to determine the type of cutting on aerial photographs.

With the new inventory method, it is now possible to use field data for this indicator, i.e. on the presence and even type of cutting, the type of plantation and the main species in the stand. The felling details describe the type of cutting conducted at the sampling point during the 5 years prior to the inventory, with the following conditions: clearcutting with rehabilitation, clearcutting without rehabilitation, total cutting of the overstorey, intensive cutting of the overstorey, partial or no cutting.

The type of regeneration is classified as natural in the following situations:

– clearcutting noted without rehabilitation and unplanted stand;
– total cutting of the stand overstorey;
– intensive cutting of the overstorey.

Conversely, the type of regeneration is classified as artificial in the following situations:

– clearcutting noted without rehabilitation and planted stand;
– clearcutting noted with rehabilitation;
– stands temporarily unstocked and absence of recent cutting (if the cutting is not recent and the area is completely unstocked, it is presumed that planting is necessary to maintain the wooded state).

This method is quite reliable, but the data should still be carefully interpreted, i.e. some inventory data can be circumstantial. For instance, if the sampling point is inventoried right after clearcutting and there are no signs of rehabilitation, it does not necessarily mean that no rehabilitation work will take place, so this classification could turn out to be inaccurate.

Data retrieval year	**2010**			
Survey years	**2006 to 2009**			
	Main tree species		**Total**	
	Broadleaved	**Conifers**		
Regeneration type	*1000 ha/ year*	*1000 ha/ year*	*1000 ha/ year*	*%*
Artificial	12.8	14.6	27.4	29
Natural	53.0	14.5	67.6	71
Total	**65.8**	**29.2**	**95.0**	**100**

Source: NFI.
Relevant domain: FAWS.

Note: the results do not take variations of forest area into account (see 1.1.1.).

The area regenerated annually is estimated at 95,000 ha, nearly 30% of which is artificially regenerated. This area is slightly greater than that obtained based on the previous aerial photo observation method (82,800 ha in the ISFM 2005 edition).
Almost 70% of the regenerated stands are broadleaved. Most artificially regenerated stands are conifers (53%), whereas a major proportion of naturally regenerated stands are broadleaved (78%).

The main naturally regenerated species are pedunculate, pubescent and sessile oak, chestnut, beech and maritime pine. The fact that this latter species is seldom found in natural regeneration stands suggests that its presence highlights the shortcomings of the method discussed above. The main species regenerated artificially are especially maritime pine and Douglas fir, as well as pedunculate oak, beech and cultivated poplar.

Indicator 4.3

Area of forest and other wooded land, classified by 'undisturbed by man', 'semi-natural' or 'plantations', by forest type

Forests available for wood supply

The areas are classified as follows:

– Undisturbed forests were estimated at 30,000 ha due to the lack of data on this topic. By definition, these are forests that have existed since time immemorial, are composed exclusively of native species and there has been no human intervention for at least 50 years. This estimation was based on 1994 data from the Office national des forêts and the French National Forest Inventory. The value for private forests was estimated by applying the same ratio as that applied for public forests between undisturbed forest and forest not available for wood supply (estimated by NFI), this data could thus be slightly overestimated—private forests are less represented in mountain areas where most undisturbed forests are found;

– All plantations, regardless of their age, are now classified under the plantations category while differentiating planted species (broadleaved, conifer and mixed planted species). In the ISFM 2005 edition, an age limit of 40 years old was set for plantations, beyond which stands were classified under semi-natural forests by default;

– Semi-natural forests are those which, by default, do not qualify as plantations or undisturbed forests.

French metropolitan forests have been profoundly shaped by humans throughout history. Only 30,000 ha of forest area is estimated to have been undisturbed for at least 50 years—these stands are mainly located in mountain regions that are generally inaccessible. It is hard to accurately evaluate this area and the data therefore could not be updated.

Plantations account for 12% of the forest area, or over 1.9 million ha, and mainly involve conifers. Douglas fir is the top-ranking species planted, with around 350,000 ha. Indigenous species follow, with maritime pine and common spruce, followed by Corsican pine and Austrian pine. The plantation area will likely decrease in the coming years—sales of forest plants dropped sharply following the storms of 1999 and 2009 (DGPAAT/SDFB, 2011).

Pedunculate oak, sessile oak and beech plantations represent 7% of the plantation area. Less human intervention is required in these plantations as compared to others since they are logged at an advanced age.

Semi-natural forests represent 88% of the total area, with broadleaved species accounting for two-thirds of the stands, and these forests contain most of the mixed forest stands.

The naturalness concept is hard to assess. Studies carried out by the French National Institute for Agricultural Research (INRA) highlighted the advantages of the 'old forest' concept, which could be used to develop a supplementary indicator.

This indicator, which would be based on how long the area has been in a wooded state, rather than on the age of the trees or the stand structure, would be aimed at revealing the functioning and diversity of forest ecosystems. This research resulted in the identification of typical plant associations in long-standing forests.

Data retrieval year	**2010**		
Survey years	**2006 to 2009**		
Naturality degree	*Forest type*	*1000 ha*	*%*
Undisturbed forests		30	0
Semi-natural forests	Broadleaved stands	9 722	63
	Conifer stands	2 273	15
	Mixed stands	1 392	9
	Total semi-natural forests	13 387	87
Plantations	Broadleaved planted species	376	2
	Conifer planted species	1 496	10
	Mixed planted species	n. s.	
	Total plantations	1 901	12
Total		**15 319**	**100**

Source: NFI.
Relevant domain: FAWS.

Indicator 4.3.1

Area of very old regular high forests forming specific habitats

Forests available for wood supply

ISFM 2005 Edition

Data retrieval year		1989		1994		1999		2004	
Average year		1981		1986		1991		1996	
Main tree species	*age limit**	*ha*	*% total area of the species*	*ha*	*% total area of the species*	*ha*	*% total area of the species*	*ha*	*% total area of the species*
Pedunculate oak	180 years	13 800	3	14 900	3	12 800	2	10 300	1
Sessile oak	240 years	700	0	900	0	700	0	400	0
Pubescent oak	150 years	3 800	3	5 200	4	6 800	4	7 800	5
Holm oak**	200 years	1 800	13	700	6	700	6	700	6
Cork oak	120 years	4 600	8	4 200	7	4 200	7	5 100	10
Beech	180 years	30 700	5	35 800	5	29 000	4	30 800	4
Chestnut	150 years	23 900	20	17 200	15	17 800	15	16 500	14
Common ash	120 years	4 600	7	5 500	6	6 900	5	7 000	4
Large alder	70 years	3 500	25	2 500	24	2 200	23	2 600	20
Aspen	70 years	1 600	17	1 100	12	1 400	16	1 100	11
Birch	50 years	9 400	39	10 500	54	11 200	53	15 000	56
Lowland fir	160 years	0	0	0	0	100	0	0	0
Lowland spruce	160 years	0	0	200	0	200	0	100	0
Mountain fir	200 years	11 200	3	12 400	4	11 800	3	11 300	3
Mountain spruce	200 years	10 200	3	9 400	2	8 900	2	9 900	2
Maritime pine	140 years	900	0	800	0	900	0	1 400	0
Scots pine	200 years	2 000	0	1 500	0	1 300	0	1 200	0
Corsican pine	200 years	1 900	2	2 100	2	2 000	2	2 000	2
Mountain pine	150 years	7 400	15	7 400	15	7 400	15	5 800	12
Larch	200 years	9 000	11	8 700	10	8 700	10	10 700	11
Total		**141 000**	**3**	**141 000**	**3**	**135 100**	**2**	**139 800**	**2**

** area underestimated in 1994, 1999 and 2004 owing to the absence of a field inventory for certain formations in the Mediterranean region.
Source: NFI.
Relevant domain: regular high forests in FAWS, excluding poplar plantations and including thickets.

* age limit greatly exceeding the admissible age for rotation of the concerned species.

ISFM 2010 Edition

Data retrieval year		2010	
Survey years		2006 to 2009	
Main tree species	*age limit**	*ha*	*% total area of the species*
Pedunculate oak	180 years	27 000 ± 8 000	1
Sessile oak	240 years	2 000 to 9 000 ha	0
Pubescent oak	150 years	15 000 to 20 000 ha	1
Holm oak	200 years	-	0
Cork oak	120 years	< 8 000 ha	4
Beech	180 years	52 000 ± 11 000	4
Chestnut	150 years	< 10 000 ha	1
Common ash	120 years	10 000 to 25 000 ha	3
Large alder	70 years	5 000 to 15 000 ha	7
Aspen	70 years	5 000 to 15 000 ha	10
Birch	50 years	28 000 ± 8 000	9
Lowland fir	160 years	-	0
Lowland spruce	160 years	< 3 000 ha	0
Mountain fir	200 years	2 000 to 10 000 ha	1
Mountain spruce	200 years	2 000 to 12 000 ha	1
Maritime pine	140 years	< 6 000 ha	0
Scots pine	200 years	< 3 500 ha	0
Corsican pine	200 years	< 3 500 ha	0
Mountain pine	150 years	< 5 000 ha	3
Larch	200 years	1 000 to 9 000 ha	5
Total		**207 000 ± n.d.**	**3**

Source: NFI.
Relevant domain: regular high forests in FAWS, excluding poplar plantations.
The dash (-) symbol indicates that this type of stand was not identified at any NFI sampling points, but it does not necessarily mean that no stands of this type exist.

For most species, the data accuracy is too low to present (the data are claimed to be non-significant). In this case, a possible data interval is indicated. Variations between the data published in 2005 and the 2010 data cannot be precisely interpreted. A considerable part of the differences could be due to the changes in definition and uniformization of the inventory procedures in France.
As previously, we limited the evaluation of these old stand areas to regular high forests so as to ensure a certain continuum for this indicator.

Stands in a phase of advanced maturity or even senescence contain specific habitats that are host to certain animal or plant species. However, it should be noted that this 'stand' approach does not account for individual trees that are sometimes kept by foresters for their positive impact on biodiversity. Moreover, the data should be carefully interpreted since only one age limit per species, as defined on the basis of expert opinion, is considered here, without accounting for between site differences.

For 2010, the very old regular high forest area represents 3% of the total regular high forest area. The situation is still highly variable depending on the species considered. Pedunculate oak, beech and birch are the only species for which the data are significant. The abundance of birch stands of over 50 years old could be explained by the ageing of former coppices of this species that were converted into regular high forest. The old birch stand area was already increasing in the 2005 edition of this report, which was also the case for pubescent oak (non-significant for the 2010 edition).

It would be beneficial to supplement this indicator, which is currently limited to regular high forests, with an assessment of old stands in other forest structures, or at least an evaluation of the presence of very old trees in stands. More generally, the concept of specific habitats formed by old stands could be specified and enhanced. Finally, the presented data could be refined through a revision of the age limits per species according to the site conditions.

* age limit greatly exceeding the admissible age for rotation of the concerned species.

Indicator 4.4

Area of forest and other wooded land dominated by introduced tree species

ISFM 2005 Edition

Data retrieval year	1989		1994		1999		2004	
Average year	1981		1986		1991		1996	
Tree species	*1000 ha*	*%*	*1000 ha*	*%*	*1000 ha*	*%*	*1000 ha*	*%*
Indigenous	12 648	95	12 724	94	12 942	94	13 117	94
Acclimatized	582	4	663	5	696	5	754	5
Exotic	99	1	118	1	129	1	126	1
Subtotal	13 329	100	13 505	100	13 768	100	13 998	100
Unspecified	7		66		99		93	
Total	**13 337**		**13 572**		**13 867**		**14 091**	

Source: NFI.
Relevant domain: FAWS, excluding poplar plantations, including thickets.

The exotic, acclimatized or indigenous aspect of species is considered here on a national level. Species classified in each category are listed in Appendix VII.

French forests have an exceptionally diversified range of tree species due to the variety of physical environments and climates, which in turn is linked with France's geographical location in Europe at the crossroads of the Atlantic, continental and Mediterranean domains. Broadleaved species predominate in both number and area.

Although data of the 2005 and 2010 editions are not fully comparable, there seems to have been some degree of stability: supplementary forest areas mainly boosted the indigenous species (cf. species list in Appendix VII) and acclimatized species compartments, but to a lesser extent. Proportionally, the percentage of exotic species seems to have increased most, but this variation is hard to confirm due to the changes in definition.

There is a clear high proportion (92%) of stands with an **indigenous** main tree species. The area they cover increases, partly due to natural afforestation.

Acclimatized species currently occupy 6% of the forest area. These species are especially characterized by their better natural regeneration capacity, and are mainly represented by Douglas fir, Austrian pine and false acacia. This latter species alone accounts for around 191,000 ha. These species also represent 6% of the growing stock (154 Mm^3), divided as follows: 37 Mm^3 in broadleaved stands, 98 Mm^3 in conifer stands, and 19 Mm^3 in mixed stands.

Exotic species only cover 2% of the inventoried forest area. The main species concerned are cultivated poplar, Sitka spruce and Vancouver fir. The volume of exotic species represents 2% of the total growing stock, i.e. 56 Mm^3, including 33 Mm^3 in broadleaved stands, 18 Mm^3 in conifer stands, and 4 Mm^3 in mixed stands.

ISFM 2010 Edition

Data retrieval year	2010		
Survey years	2006 to 2009		
Tree species	*1000 ha*		*%*
Indigenous	14 040	± 109	92
Acclimatized	908	± 50	6
Exotic	326	± 27	2
Temporarily unstocked stand	45	± 13	0
Total	**15 319**	**± 104**	**100**

Source: NFI.
Relevant domain: FAWS.

A few exotic or acclimatized tree species are now known to be invasive in France. The box elder (*Acer negundo*) can modify the floristic species composition in relict alluvial forests. Dense black cherry (*Prunus serotina*) stands hamper regeneration of shade-intolerant tree species (oak, Scots pine), leading to a decline in vegetation diversity. Copal trees (*Ailanthus altissima*) tend to uniformize landscapes and habitats.

Indicator 4.5

Volume of standing and lying deadwood on forest and other wooded land, classified by forest type, size or decomposition stage

The previous inventory method applied at NFI until 2004 only took trees that had been dead for less than 5 years into account when the field team surveyed the plot. This only gave partial information on the total deadwood volume in forests (according to an NFI study in Haut-Rhin department, one fifth of the volume was accounted for). The new inventory method records the existing deadwood, however old (see Appendix II).

Standing deadwood per forest type and age

Data retrieval year	2010		
Forest type	*Volume of wood from standing trees dead for less than 5 years*	*Volume of wood from standing trees dead for more than 5 years*	*Total volume of standing deadwood*
	m³/ha	*m³/ha*	*m³/ha*
Broadleaved	2.2 ± 0.2	3.9 ± 0.3	6.1 ± 0.4
Conifers	3.4 ± 0.7	3.6 ± 0.7	7.0 ± 1.0
Mixed	4.3 ± 1.2	5.1 ± 1.5	9.3 ± 1.9
Total	**2.7 ± 0.2**	**3.9 ± 0.2**	**6.5 ± 0.3**

Source: NFI, survey years 2008 and 2009.
Relevant domain: FAWS excluding temporarily unstocked stands.

The death date of a standing tree is determined using different indices:

– the state of conservation of a stump log;
– the age of stem or branch shoots of broadleaved species damaged when a tree is felled;
– the period since the recovery or acceleration of diameter and/or height growth of adjacent previously competing trees (by assessing the thickness of growth rings of trees using a Pressler increment borer).

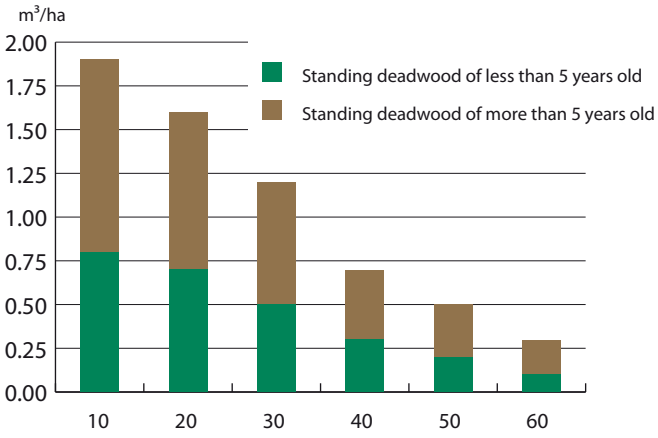
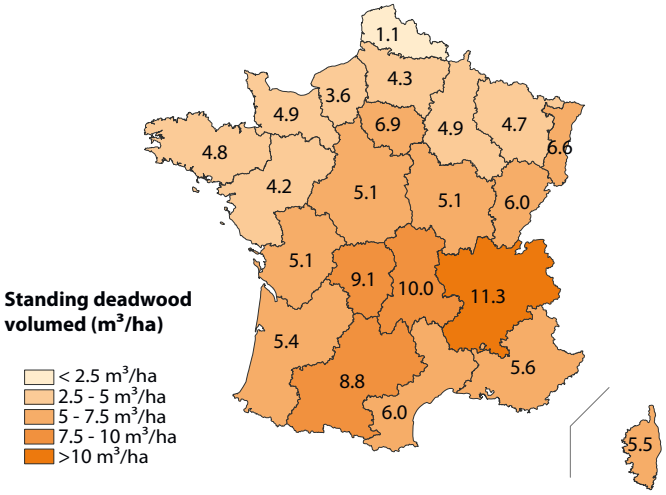


Figure 31: Standing deadwood volume per ha, diameter class and age.



Map 20: Standing deadwood volume per ha and per administrative region.

Source: NFI, survey years 2008 and 2009.

The volume of standing deadwood of all ages is around 101 Mm^3, 40% of which is less than 5 years old.

61% of this total volume is found in broadleaved stands. However, these stands have the lowest volume per hectare: 6.4 m^3/ha versus 7 m^3/ha in conifer stands and 9.3 m^3/ha in mixed stands, whereas these latter stands only account for 15% of the total standing deadwood volume.

The distribution of the standing deadwood volume per age (± 5 years old) is quite balanced in mixed and conifer stands. However, standing deadwood of over 5 years old is by far the overriding compartment in broadleaved stands (64% of the standing deadwood stock).

The situation varies markedly from region to region, ranging from 1.1 m^3/ha in Nord-Pas-de-Calais to 11.3 m^3/ha in Rhône-Alpes. The highest per-ha standing deadwood volumes occur in the Rhône-Alpes, Auvergne, Limousin or Midi-Pyrénées regions. On the other hand, the lowest per-ha stocks are found in the northern half of France (Nord-Pas-de-Calais, Haute-Normandie, Picardie, Pays-de-la-Loire, Lorraine, Bretagne or Champagne-Ardenne).

This could be mainly explained by the logging difficulties encountered in these regions. Indeed, the per-ha standing deadwood volume increases as the logging conditions get harsher: stands in easy logging conditions have on average a standing deadwood volume of 5.1 m^3/ha, as compared to 6.8 m^3/ha for stands in average difficulty conditions and 9 m^3/ha for stands considered as very difficult for logging.

The highest volume of standing deadwood is found in chestnut stands (15 m^3/ha), followed by common spruce stands (14.2 m^3/ha) and silver fir stands (13.2 m^3/ha). In contrast, holm oak, Aleppo pine, Austrian pine and pubescent oak stands have the lowest standing deadwood volumes (under 4 m^3/ha). Overall, standing deadwood volumes are 6.2 m^3/ha (± 0.4 m^3/ha) in stands mainly containing broadleaved species and 7.3 m^3/ha (± 0.9 m^3/ha) in stands mainly consisting of conifer species.

Finally, private forests have the greatest standing deadwood volumes (6.8 m^3/ha), followed by non-state-managed public forests (5.8 m^3/ha) and then state-owned forests (5.2 m^3/ha).

Standard windfalls of less than 5 years old (excluding poplar plantations)

Data retrieval year	2010	
Survey years	2006 to 2008	
Forest type	*1 000 m^3*	*Referenced to the inventoried area (m^3/ha)*
Broadleaved	4 331 ± 882	0.5
Conifers	2 364 ± 923	0.7
Mixed	1 132 ± 614	0.7
Total	**7 826 ± 1 150**	**0.5**

Source: NFI, survey years 2006 to 2008.
Relevant domain: FAWS, excluding temporarily unstocked stands and poplar plantations. Windfalls resulting from the January 2009 Klaus storm are not included in these data.

This section focuses on windfalls of less than 5 years old at the time they were assessed by field agents, while overlooking windfalls caused by cyclone Klaus (cf. Indicator 2.4 where storm damage is discussed). Older windfalls are considered as lying deadwood, a category that is covered hereafter.
The windfall date of a considered tree is determined using the same indices as those used for determining the standing deadwood date, along with the age of the vegetation growing on the clump of soil upon which an uprooted windfall tree was previously growing.

Windfalls considered here were less than 5 years old.
The per-ha windfall volume is lower in broadleaved stands (0.5 m^3/ha) than in conifer or mixed stands (0.7 m^3/ha). Per-ha volumes are identical regardless of whether the composition (broadleaved, conifer or mixed stand types) or main species (broadleaved, conifers) is taken into account.

The per-ha windfall volume is higher in Rhône-Alpes (1.1 m^3/ha), Auvergne (1.0 m^3/ha), Aquitaine, Picardie and Bretagne (0.8 m^3/ha) regions. These are mountain regions (where windfalls can be caused by locally strong winds or snow storms), or coastal regions affected by high winds and storms. In regions where windfalls are less common, it is often impossible to obtain sufficiently reliable data because of the low number of windfalls observed.

Lying deadwood

Lying deadwood is inventoried separately from standing deadwood.

Data retrieval year	2010											
Survey years	2008 - 2009											
Diameter class	*Broadleaved stand*			*Conifer stand*			*Mixed stand*			*Total*		
	m³/ha			m³/ha			m³/ha			m³/ha		
5 and 10 cm	7.5	±	0.3	8.0	±	0.6	9.2	±	1.0	7.8	±	0.2
15 and 20 cm	3.6	±	0.3	4.5	±	0.7	5.3	±	1.0	4.0	±	0.3
25 and 30 cm	2.2	±	0.4	2.7	±	0.7	4.0	±	1.5	2.5	±	0.3
More than 35 cm	2.4	±	0.6	1.5	±	1.0	3.9	±	1.7	2.4	±	0.5
Total	**15.7**	**±**	**0.7**	**16.6**	**±**	**1.6**	**22.5**	**±**	**3.3**	**16.6**	**±**	**0.6**

Source: NFI, survey years 2008 and 2009.
Relevant domain: FAWS, excluding temporarily unstocked stands.

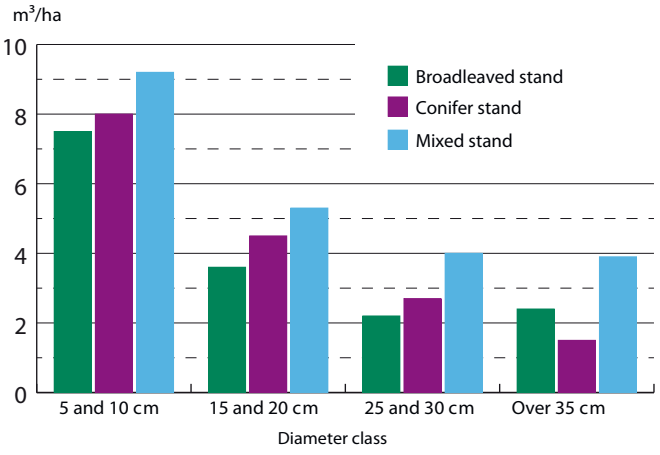
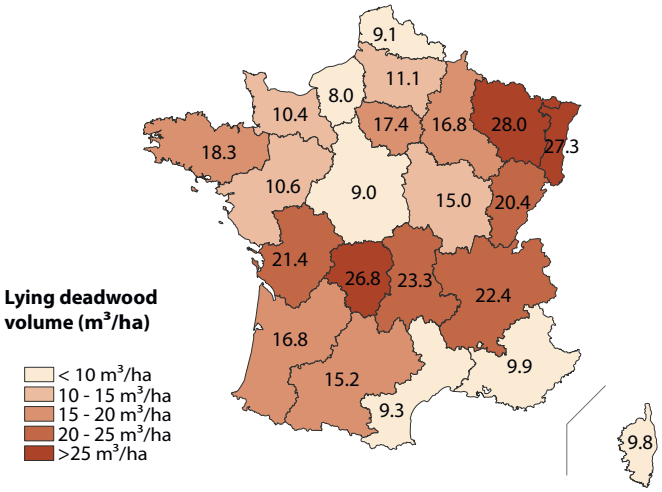


Figure 32: Per-ha lying deadwood volume per diameter class and forest type.



Map 21: Per-ha lying deadwood volume per administrative region.

Source: NFI, survey years 2008 and 2009.

Lying deadwood represents a total volume of 257 Mm³ (±10). The per-ha lying deadwood volume is highest in mixed stands (22 m³/ha), followed by conifer stands (17 m³/ha) and broadleaved stands (16 m³/ ha). As broadleaved stands account for the largest forest area, 64% of the total lying deadwood volume is found in these stands, with 21% found in conifer stands and 15% in mixed stands.

The situation varies from region to region, with per-ha lying deadwood volumes ranging from 28 m³/ha in Lorraine to 8 m³/ha in Haute-Normandie. The Alsace region comes immediately after Lorraine with 27 m³/ha, followed by mountain regions: Limousin (27 m³/ha), Auvergne (23 m³/ha), Rhône-Alpes (22 m³/ha) and Franche-Comté (20 m³/ha), and one exceptional non-mountainous region, Poitou-Charentes (21 m³/ha).

The presence of high quantities of lying deadwood in certain mountain regions may be explained by snow storms in these regions, which can induce windfalls and tree crown breakage. In regions such as Lorraine and Alsace, this abundance of lying deadwood should be interpreted with caution since there are also very high per-ha volumes of live trees in these regions. It is therefore logical that substantial quantities of lying deadwood may be found in stands with high growing stock after they have been logged. It is also likely that trees knocked down or damaged during the 1999 storms were not totally removed, which means that this wood contributes to the lying deadwood volume.

The extent of deadwood decomposition is classified in five categories on the basis of two criteria, i.e. the presence of bark and its texture:

– if bark is present and the wood is solid, not decomposed, sometimes with the presence of branches, the extent of decomposition is considered zero;

– if bark is present and its texture is partially soft, with the absence of young branches, the extent of decomposition is low;

– if the bark is fragmented and its texture is partially soft, with the absence of young branches, the extent of decomposition is average;

– if bark is absent and average to heavy rotting is noted, the extent of decomposition is high;

– if bark is absent, there is complete rotting and the shape of the log is altered, the extent of decomposition is very high.

Over three-quarters of the lying deadwood stock has an average to very high level of decomposition. This corresponds to longer time spent in these compartments than the time spent in zero to low decomposition compartments.

30% of lying deadwood is under 7.5 cm diameter, and almost 50% consists of logs with a diameter ranging from 12.5 to 22.5 cm. The two last diameter classes (22.5 to 32.5 cm and 32.5 cm and more) account for the last quarter of the lying deadwood stock to an equal extent.

The extents of lying deadwood decomposition are relatively identical irrespective of the log diameter.

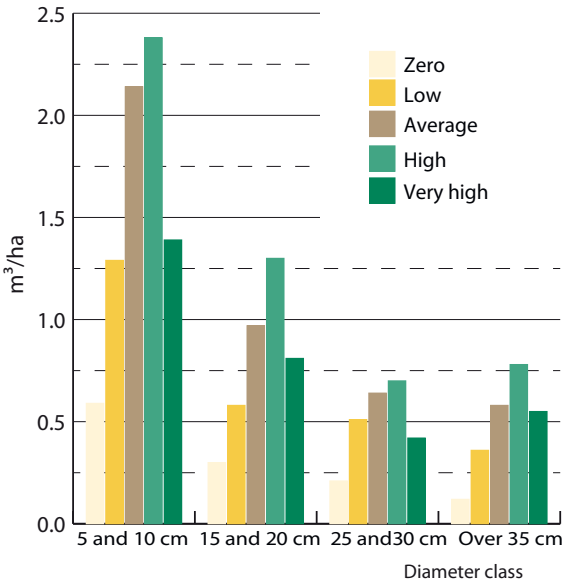
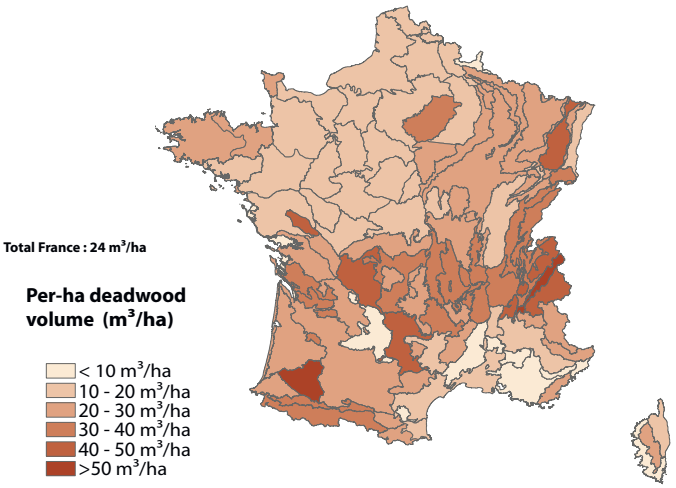


Figure 33: Per-ha lying deadwood volume, per diameter class and decomposition stage.

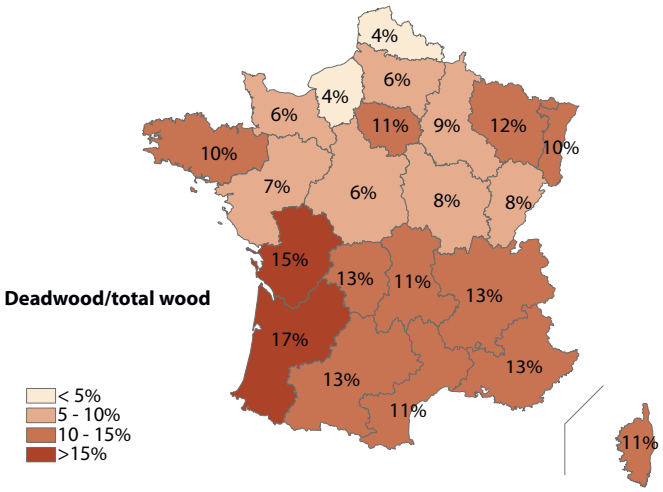
Source: NFI, survey years 2008 to 2009.

Total deadwood volume per-ha for all deadwood types

Proportion of deadwood in the wood volume per-ha



Map 22: Per-ha deadwood volume, for all types of deadwood combined, per SER.



Map 23: Deadwood/total wood ratio by administrative region.

Source: NFI, survey years 2008 to 2009.

There are marked differences between regions: Aquitaine has the highest per-ha deadwood rate, with deadwood accounting for 17% of the per-ha wood volume. This abundance of deadwood—windfalls, standing and lying deadwood—highlights the effect of cyclone Klaus in 2009 (windfalls represent 24% of the per-ha deadwood volume in this region), while also indicating that the damaged trees have not all been removed. Conversely, Nord-Pas-de-Calais and Haute-Normandie have the lowest per-ha deadwood rate (4%).

Indicator 4.6

*Area and number of genetic entities managed for conservation and utilisation of forest tree genetic resources (*in situ *and* ex situ *gene conservation) and for forest tree seed and plant production*

Production of forest tree seeds and plants for artificial regeneration

Selected or tested stands	Broadleaved		Conifers		Total		2004-10 variation
	2004	2010	2004	2010	2004	2010	
Number of species	8	8	12	13	20	21	5.0 %
Number of species with indigenous resources	7	7	8	8	15	15	-
Number of regions of provenance (RP)	53	59	57	59	110	118	7.3 %
Number of RP with indigenous stands	51	56	43	41	94	97	3.2 %
Number of stands	773	807	936	850	1 709	1 657	- 3.0 %
Number of indigenous stands	625	661	555	480	1180	1141	- 3.3 %
Total area (ha) of indigenous stands	21 819	23 142	28 713	32 035	50 532	55 177	9.2 %
Total area (ha)	22 455	23 788	37 058	39 929	59 513	63 863	7.3 %
Qualified or tested seed orchards	**Broadleaved**		**Conifers**		**Total**		
	2004	**2010**	**2004**	**2010**	**2004**	**2010**	
Number	1	5	13	22	14	27	93.0 %
Area (ha)	1	4	321	433	322	437	35.7 %
Qualified 'clone mixture' varieties (black poplar)	**Broadleaved**		**Conifers**		**Total**		
	2004	**2010**	**2004**	**2010**	**2004**	**2010**	
Number	0	3	0	0	0	3	-
Tested clones	**Broadleaved**		**Conifers**		**Total**		
	2004	**2010**	**2004**	**2010**	**2004**	**2010**	
Number	44	44	10	10	54	54	-

Source: CEMAGREF, 2010.

Marketing of forest reproductive material for the main French tree species is governed by regulations set down in an EU Council Directive. The aim of this directive is to allow foresters to trace the characteristics and qualities of forest genetic resources used for plantation. It involves prohibiting the use of seeds and plants derived from stands considered to be of poor genetic quality and obliging suppliers to give reliable and standardised information on the identity of seed and plant batches.
Following signature of this new EU directive in December 1999, the French forest code texts concerning these regulations were fully updated. These regulations became effective in October 2003 after the adoption in July 2002 of a new system of redistribution of regions of origin and continuously evolve to adapt to new needs. All information on these regulations is available online at: http://agriculture.gouv.fr/graines-et-plants-forestiers.

The objectives of the regulations adopted in 2003 are wide ranging:

– to broaden the regulation scope, especially by increasing the number of species controlled (58). In 2010, besides hybrid poplar cultivars and black poplar varieties which are only propagated vegetatively, metropolitan France now has genetic resources for 48 species, that can be generatively propagated using seeds that are harvested in authorised seed stands in France: 19 conifer and 29 broadleaved species, with 35 of them being indigenous species;
– to enhance monitoring of the forest reproductive material identity from seed harvest to plant dissemination. Seed lots are now certified at harvest with a Master Certificate giving a reference appearing in the document supplied upon delivery to foresters. This reference is the keystone of this traceability system;
– to set up four marketing categories, including 'identified', 'selected', 'qualified', 'tested' (see Box 5) meeting the diversity of forester needs;
– to better account for new varieties from genetic improvement programmes.

For material in the identified and selected categories, seed sources and selected stands are grouped in regions of origin, which serve as a reference for marketing this material to foresters. These regions of origin were defined on the basis of the importance of species, their distribution, their diversity as assessed in tests or by biochemical analysis, or environmental variations. The number of regions of origin ranges from 1 to 19 depending on the species.

Stand area selection is based on a tradeoff between finding a stand of good genetic quality and its potential for fulfilling the need for plants suitable for current and future situations, while also accounting for new constraints arising as a result of climate change.

Seed orchard areas and the number of clones and 'mixed clonal' varieties are increasing in association with the results of genetic improvement and genetic diversity research programmes.

Since 2004, there has been:
– a slight increase in the number of broadleaved stands resulting from the selection of new stands (sycamore maple, chestnut and sessile oak);
– a decrease in the number of conifer stands, offset by the development of seed orchards. This change follows the disappearance of stands undergoing regeneration, affected by windfalls or pest infestations (maritime pine, Scots pine, Douglas fir, common spruce, etc.);
– an increase in the mean stand area (from 35 to 38 ha), mainly concerning conifers, in order to enhance genetic diversity;
– selection of new stands or varieties to address current needs, either for environment-friendly plantations focused on indigenous material (new 'mixed clonal' varieties of black poplar) or for wood-production oriented plantations with species substitution (loblolly pine stands);
– an increase in the number of seed orchards (both broadleaved and conifers) and wild cherry clones resulting from genetic improvement programmes.

Box 5: Marketing categories for forest seeds and plants

The geographical origin is the only information available for materials classified as identified. These are harvested in a seed source, i.e. a set of trees of undetermined size, located in a known harvest zone, corresponding to a single region of origin. There is no preselection of these resources.
Selected material is from stands chosen mainly on the basis of phenotypic traits (vigour, tree shape, disease resistance). Most trees in these stands must be true-to-type.
Material classified under the qualified category is artificial, contrary to that from most species. This material is issued from seed orchards or 'mixed clonal' varieties (plantations of family clones or parental stock) set up specifically to produce seeds or plants of superior genetic quality. To this end, the raw material components previously undergo individual phenotypic selection in the forest or under test conditions on the basis of criteria such as vigour, tree shape, disease resistance or wood quality.
The highest amount of information is available for tested material. The superiority of this material, relative to one or several reference materials for the species, is demonstrated through comparative tests or component assessments with respect to at least one trait of silvicultural interest. Stands, seed orchards and clones that have been the focus of comparative provenance or clonal tests qualify under this category.

National genetic resource conservation programme

Following the first Ministerial Conference on the protection of forests in Europe (Strasbourg, 1990), France pledged to implement a conservation policy for forest genetic resources. The French Forestry Ministry thus subsequently set down the main national policy guidelines in this area, in line with the strategy followed since 1986. Priority was given to *in situ* conservation (in field stands) of forest genetic resources, as recommended in Resolution 2 of the Strasbourg Conference.

A national body was set up, i.e. the Commission des Ressources Génétiques Forestières, to ensure that the national forest genetic resource conservation policy is harmoniously implemented. This committee is responsible for defining how the policy should be implemented, so a national network for the management and conservation of genetic resources of the main forest species was set up. This national network is organised by species and combines *in situ* and *ex situ* methods (cultivation from harvested seed or cuttings taken from in the field stands). It currently concerns 14 species or species groups and covers:
- *in situ* conservation stands, already registered in the Registre des Matériels de Base set up for the *in situ* conservation of forest genetic resources of national interest, for beech, silver fir, sessile oak and maritime pine, in the process of registration for common spruce, black poplar, European white elm, common ash, wild cherry and European black pine and in the process of selection for wild service tree and Scots pine;
- *ex situ* conservation plantations, already registered in the Registre des Matériels de Base set up for the *ex situ* conservation of forest genetic resources of national interest, for wild cherry and silver fir;
- *ex situ* collections of clones registered in the Registre des Matériels de Base set up for the *ex situ* conservation of forest genetic resources of national interest for elm, black poplar, service tree, walnut and wild cherry; these collections are fully maintained in clone plots and some clones are also cryopreserved.
N.B.: clones registered in the Registre and preserved in the five national collections are a representative subset of the private collections (INRA, CEMAGREF, IDF) from which they originate.

France also participates in EUFORGEN (European Forest Genetic Resources Programme), a cooperative programme that is geared towards promoting the exchange of information and experience on forest genetic resource conservation, and it focuses especially on ensuring consistency in the work undertaken at the species level.
With the support of participating countries, EUFORGEN has set up and updates a georeferenced database (EUFGIS) on all conservation units that fulfil the dynamic conservation criteria defined and accepted by all EUFORGEN members (http://portal.eufgis.org). Ultimately, a selection carried out by EUFORGEN within this group will make it possible to set up, for each species, sustainable conservation networks that are validated on a pan-European scale.
Further information is available online at: http://agriculture.gouv.fr/conservation-des-ressources.

Species	Natural populations conserved *in situ*				*Ex situ* conservation plantations				*Ex situ* conserved collections			
	2004		2010		2004		2010		2004		2010	
	Nb	*Area (ha)*	*Nb*	*Area (ha)*	*Nb*	*Area (ha)*	*Nb*	*Area (ha)*	*Total number of clones*	*Within national collections*	*Total number of clones*	*Within national collections*
Wild service tree	under discussion		on-going EUFORGEN selection									
Sessile oak	20	2 593	20	2 619								
Service tree			no *in situ* network						140	60	140	60
Common ash			(5)	ongoing review								
Beech	27	3 875	27	3 875								
Wild cherry	under discussion		(2)	ongoing review	2	4	2	4	332	251	332	251
Common walnut			no *in situ* network						90	58	90	58
Elm species	in preparation								426	417	> 430	417
European white elm			(2)	ongoing review								
Black poplar	12 (ongoing selection)		(6)	ongoing review					367	260	> 400	260
Common spruce	in preparation		(24)	ongoing review								
Silver fir	22	3 506	21	3 391	4	28	4	28				
Maritime pine	in preparation		4	900								
Scots pine			ongoing selection									
European black pine			(1)	ongoing review								
Total	**81**	**10 343**	**71 (+40)**	**10 628**	**6**	**32**	**6**	**32**	**1 355**	**1 046**	**> 1 392**	**1 046**

Source: Commission des ressources génétiques forestières (CRGF), CEMAGREF, INRA and ONF; 2004, 2010.
Numbers of populations planned in the ongoing reviews are in brackets.

Indicator 4.7

Fragmentation of forest area in basic units

The data used to calculate this indicator are, for the French departments where it is available, from the NFI forest cartographic database version 2 (v2) (cf. Appendix XII), but version 1 (v1) is used for the rest of France.

In its native form, the v2 database represents forests of over 50 ares, whereas v1 has 2.25 ha thresholding. For the needs of this indicator, the two versions were made to be consistent by eliminating all wooded areas (and non-wooded enclaves within forests) of less than 2.25 ha. There are still three main differences between these versions that may have an impact on the results:

– first, the minimum width for the representation of mapped objects is 20 m for v2 and 75 m for v1, which can result in breaks (or, conversely, new continuities) because of the change in specifications and not a real change in forest masses;

– secondly, the geometric accuracy of objects is significantly greater in v2 because of the mapping method, as automatic segmentation of aerial photos produces entities bearing many more peaks than manual plotting of contours;

– finally, the data used for indicators in the 2000 and 2005 editions had a representation threshold of 4 ha, as compared to 2.25 ha for the present 2010 indicator.

Since forest massif area calculations assume that a break of 200 m does not disturb the continuity overall, the differences specified above only have a minor effect on the results. However, they make it impossible to interpret an indicator of a boundary length per hectare or the gross area of forest massifs (without 200 m buffer zone), since changes in the accuracy of limits are significant.

Fragmentation of forest area is an important factor in evaluating the capacity of forest ranges to host animals or plants requiring special habitats. NFI data are not sufficiently accurate to be able to assess very small forest units. The proposed method thus mainly concerns large animals.

It has been estimated that a break of 200 m would not interrupt the continuity of a forest unit. This option is designed to account for the mobile behaviour of some animals and their circulation between forest units linked by forest or subforest corridors. This approach should ultimately be enhanced by taking potential impassable barriers (highways without special animal crossings, rivers, etc.) into account, but it already offers a preliminary estimation of the spatial distribution of forest units.

However, it would be risky to interpret the spatial distribution patterns of forest units because of the methodological modifications. It is still noteworthy that the class distribution remains similar despite these variations, with over 70% of the forest species being part of large units of over 10,000 ha. These large units could correspond to large uninterrupted forests like the Landes forest with few unstocked areas, or to a mosaic of small tightly clustered massifs as in the western Massif Central region.

The current situation reflects the landholding structure and the heritage from the history of the last centuries, which man cannot modify quickly despite his intentions and his convictions on the desirable state of forest spatial configuration. Moreover, it is hard to interpret the fragmentation of the national forest area because of the high diversity between regions: in many cases, increased fragmentation can threaten certain plant and animal species, while in others the opening of clearings in very compact units can benefit other species.

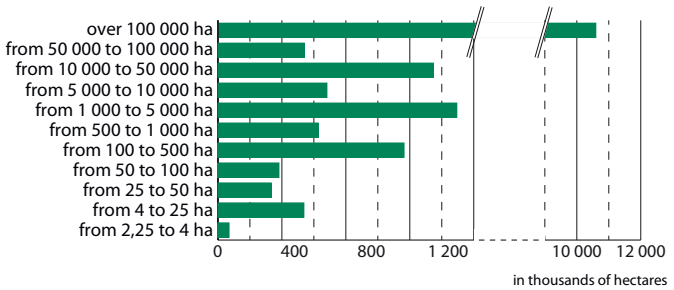


Figure 34: Forest area per range size.

Source: NFI

Area class	Data retrieval year for the cartographic database											
	1999				2004				2010			
	Number of forest units	*Mean area mapped per forest unit*	*Total mapped area*		*Number of forest units*	*Mean area mapped per forest unit*	*Total mapped area*		*Number of forest units*	*Mean area mapped per forest unit*	*Total mapped area*	
		1 000 ha		*%*		*1 000 ha*		*%*		*1 000 ha*		*%*
2.25-4 ha	-	-	-	-	-	-	-	-	18 938	3	58	0
4-25 ha	42 308	10	431	3	45 230	10	449	3	44 777	10	448	3
25-50 ha	7 827	35	275	2	7 962	35	280	2	7 858	35	277	2
50-100 ha	4 766	70	332	2	4 743	70	331	2	4 554	70	318	2
100-500 ha	4 908	209	1 028	7	4 876	208	1 014	6	4 654	208	970	6
500-1,000 ha	787	698	549	4	801	701	561	4	744	701	522	3
1,000-5,000 ha	646	2 096	1 354	9	645	2 080	1 341	8	605	2 058	1 245	8
5,000-10,000 ha	99	6 906	684	4	94	6 825	642	4	81	7 011	568	3
10,000-50,000 ha	71	19 054	1 353	9	92	123 960	11 404	71	57	19 683	1 122	7
50,000-100,000 ha	6	77 648	466	3					6	74 918	450	3
over 100,000 ha	13	705 809	9 175	59					12	882 857	10 594	64
Total	**61 431**	**255**	**15 659**	**100**	**64 443**	**249**	**16 023**	**100**	**82 286**	**201**	**16 571**	**100**

Source: NFI 1999, 2004 and 2010, for all forests and poplar stands of over 4 ha, based on the NFI cartographic database, considering that a 200 m break does not interrupt the continuity of a forest unit.

Indicator 4.8

Number of threatened forest species, classified according to IUCN Red List categories in relation to the total number of forest species

Assigning a forest species status is complicated since many species live both in forest areas and different highly varied environments where they seek similar living conditions. Many of them actually live in fringe areas, in plant structures and formations at the forest interface or in changing forest areas: forest edges and premantles, clearings, felled areas, etc. Finally, some species are not considered as forest species, but the forest is essential to them for part of their biological development, e.g. anthophilous insects whose larvae develop in wood, or vertebrates that inhabit trees but can feed in any other type of habitat. The revision of the IUCN Red List of animals after 2005 and the progress in knowledge has led to a discontinuity with respect to previous data and those of 2010, including data on the number of species considered as being forest species. Appendix XIII describes those that were retained so as to facilitate accurate comparisons in 2015.

A global approach to land management, rather than strict forest management measures, is thus required to ensure the protection of most threatened species. Moreover, forest species with the highest populations are invertebrates, lower plants (lichens, bryophytes) and micro-organisms, for which no accurate information is available.

The need to develop a European biodiversity preservation policy has now been fulfilled. The EU Birds directive (1979) and Habitats, Fauna and Flora directive (1992) gave rise to the European ecological network Natura 2000, which is aimed at preserving biodiversity by maintaining or reestablishing, in a suitable conservation state, natural habitats and habitats of fauna and flora species of community interest. They led to a modification in regulations on the French protection of concerned species, with the publication, in 2007 and 2010, of new lists of protected species, including the protection of roosting areas and breeding sites, to account for the need to integrate habitats partially in taxon conservation.

The publication Cahiers d'habitat, derived from the above mentioned EU directive, with two volumes devoted to the forest that were published in 2001 by the French Ministry of Ecology and Sustainable Development under the auspices of the Muséum national d'histoire naturelle, specify the ecological requirements and recommendations for the management of each type of habitat.

Concerning forest management as such, the 'Gestion forestière et diversité biologique' files now enable forest managers to take biodiversity challenges into better account in their day-to-day practices. These documents, which were written for educational purposes by experts from the École nationale du génie rural des eaux et forêts, the Office national des forêts and the Institut pour le développement forestier, specifically examine forest and associated habitats (mosaic habitats in forest environments or dynamically linked habitats) and, in addition to descriptions of how to recognise species, put forward a series of recommendations on management methods that promote biodiversity preservation.

Our selection of forest species whose status required changing is based on the IUCN Red List of Threatened Species in France, mainly selecting those considered as threatened. The species status terms used in the former editions are out of line with those used by IUCN, for which the rareness concept is not a vulnerability criterion (cf. Box 6).

In an attempt to make a comparison with the 2005 data, CR and EN species were thus placed in the 'endangered' category, VU species in the 'vulnerable' category, and finally NT species in the 'rare' category, which are actually 'near threatened'. For instance, Bechstein's bat is not at all rare, but the trends concerning its situation are negative, which prompted IUCN experts to consider it as near threatened (so there is a risk that its status will worsen if nothing is done to safeguard its habitats).

The results highlight an increase in the number of threatened species, especially birds, amphibians and reptiles. Mammals seem to be less affected, which could be explained by the fact that knowledge has been enhanced on these species—few studies had been focused on these species before 2000 due to difficulties in monitoring them in forest areas. For instance, inventories and studies on Chiroptera species (bats) were very difficult until the advent of sophisticated techniques such as ultrasonic detection, which has improved their accuracy.

	Species living in a strictly forest-type habitat or often present in a forest environment		Species with mixed behaviour distributed fairly evenly between forests and open environments		Total		Variation 2005-2010
	2005	2010	2005	2010	2005	2010	
Vascular plants *							
Number of species	**271**	**329**	**435**	**609**	**706**	**938**	**n.s.**
- endangered	1	n.s.	3	n.s.	4	n.s.	n.s.
- vulnerable	3	n.s.	5	n.s.	8	n.s.	n.s.
- rare	0	n.s.	2	n.s.	2	n.s.	n.s.
Total threatened	**4**	**20**	**10**	**29**	**14**	**49**	**n.s.**
% threatened species	1%	6%	2%	5%	2%	5%	-
Mammals							
Number of species	**39**	**13**	**34**	**38**	**73**	**51**	**n.s.**
- endangered	2	2	1	0	3	2	- 33%
- vulnerable	10	0	1	1	11	1	- 91%
- rare	2	2	2	7	4	9	+ 125%
Total threatened	**14**	**4**	**4**	**8**	**18**	**12**	**- 33%**
% threatened species	36%	31%	12%	21%	25%	24%	-
Birds							
Number of species	**55**	**28**	**65**	**45**	**120**	**73**	**n.s.**
- endangered	0	1	1	3	1	4	+ 300%
- vulnerable	2	8	5	5	7	13	+ 86%
- rare	4	4	4	3	8	7	- 12.5%
Total threatened	**6**	**13**	**10**	**11**	**16**	**24**	**+ 50%**
% threatened species	11%	46%	15%	24%	13%	33%	-
Reptiles							
Number of species	**0**	**0**	**11**	**7**	**11**	**7**	**n.s.**
- endangered	0	0	0	1	0	1	+ 100%
- vulnerable	0	0	1	1	1	1	=
- rare	0	0	1	1	1	1	=
Total threatened	**0**	**0**	**2**	**3**	**2**	**3**	**+ 50%**
% threatened species	0%	0%	18%	43%	18%	43%	-
Amphibians							
Number of species	**4**	**0**	**9**	**9**	**13**	**9**	**n.s.**
- endangered	0	0	0	1	0	1	+ 100%
- vulnerable	0	0	5	1	5	1	- 80%
- rare	0	0	0	1	0	1	+ 100%
Total threatened	**0**	**0**	**5**	**3**	**5**	**3**	**- 40%**
% threatened species	0%	0	56%	33%	38%	33%	-

Sources: Flore forestière française, IDF, 1989, 1993, 2008; IUCN Red List of Threatened Species in France:
Chapter: Orchidées de France métropolitaine, IUCN France, MNHN, FCBN & SFO (2010);
Chapter: Mammifères de France métropolitaine, IUCN France, MNHN, SFEPM & ONCFS (2009);
Chapter: Oiseaux nicheurs de France métropolitaine, IUCN France, MNHN, LPO, SEOF & ONCFS (2008);
Chapter: Reptiles et Amphibiens de France métropolitaine, IUCN France, MNHN & SHF (2009).
*protection status in France in 2010. The list of threatened forest animal and plant species is given in Appendix XIII.

Note: Three categories of threatened species are generally defined:
- category 1: Species living in a strictly forest-type habitat or species commonly present in a forest environment; the fauna usually concerned are arboreal species and/or species requiring considerable tree cover: forest, but also sometimes parks, plantations, orchards, etc.
- category 2: Species with mixed behaviour, with a home range divided more or less equally between forest and open environments (grassland, heathland, marshes). This category includes species of fauna seeking or tolerating tree cover of over 10%.
- category 3: Plant species occasionally found in a forest environment but usually observed in an open environment. Animal species from non-forest environments that may still be found in environments on the fringe of forest areas, especially most aquatic species which become arboreal during the breeding season (e.g. grey heron).

Only the first two categories are regarded as 'forest species'.

The groups included in the above table are thus as follows:

– **Flora**: plant species capable of developing in a forest environment were selected on the basis of the three volumes of the Flore forestière française (Rameau et al., 1989,1993 and 2008) in addition to other works. The 2005 figures did not include Mediterranean species, of which many are threatened, since volume 3 was published after this date. No conclusions can thus be drawn from the figure on variations between 2005 and 2010. Non-vascular plants are not included. The selection of forest species, involving about 13,000 species of bryophytes and 5,000 species of lichens, would require a long-term programme by a team of experts. As the only redlist currently available concerns orchids, we only focused on species with a protection status, even though this concept only partially coincides with the IUCN criteria (cf. box).

– **Mammals**: aquatic species were not included when the presence of a riparian environment is not essential to them, even though they can sometimes commonly be observed in forest ponds, streams or ditches (e.g. *Neomys fodiens, Ondatra zibethicus*). They are however included when they particularly seek riversides with tree cover (e.g. *Mustela lutreola, Castor fiber*). Two species (*Rattus rattus* and *Mus musculus*) are included because they live wild in forest environments in the Mediterranean region (not because they may occupy buildings in forests).

– **Birds** : only nesting birds are included, migratory and wintering birds are omitted. While category 1 of the species living in a strictly forest-type habitat is relatively well defined, the same cannot be said of the other categories. As explained above, aquatic species which become arboreal during the breeding season, shifted to category 3, are not included in the table. In contrast, species that occupy bushy environments, preforest areas and heathland are included in category 2 (e.g. warblers, shrikes, etc.).

– **Reptiles** : aquatic (or semi-aquatic) species are not included as none of them seek riparian environments, even though they can be observed in forest ponds, streams or drains (e.g. *Natrix natrix*).

– **Amphibians** : species which do not absolutely require a riparian environment were excluded, although they are sometimes commonly observed in forest ponds, streams or drains (e.g. *Rana kl. esculenta*). However, amphibians are included when the presence of riverside tree cover (or in the vicinity for seasonally migrating species) is especially sought (e.g. *Triturus marmoratus*).

Box 6: Threatened species and their protection

European directives and ministerial decrees on species protection are complemented by the IUCN Red Lists of Threatened Species. These lists highlight risks that a species is endangered in a given region, based solely on biological criteria and facts (change in distribution range, population dynamics, population changes, risk of alteration or disappearance of certain habitats that are essential for the species' survival, etc.). They reflect the extinction risk of each taxon at time t, and are therefore regularly updated (every 10-20 years depending on the species group). Contrary to certain common beliefs, they do not correspond to rareness indices, nor do they warrant a protection classification, even though they can encourage enhanced protection. The most recent lists for vertebrates were published on 26 March 2008 for reptiles and amphibians, on 3 December 2008 for birds, and on 13 February 2009 for mammals.

Species are classified according to different criteria:
EW: extinct in the wild
Threatened species:
CR: critically endangered
EN: endangered
VU: vulnerable
Other species categories, considered as not threatened:
NT: near threatened (close to the threatened species limit)
LC: least concern (little risk of extinction)
DD: data deficient (insufficient data for evaluation)
NA and NE for species for which the method is not applicable or those that have not been evaluated.

A taxon can therefore evolve, depending on the success of the conservation measures, from a threatened category to a more favourable category.

Indicator 4.9

Area of forest and other wooded land protected to conserve biodiversity, landscapes and specific natural elements, according to MCPFE Assessment Guidelines

The use of geographical information systems has substantially improved the estimation of protected forest area and other wooded lands since the ISFM 2005 edition. Cartographic data of the French National Forest Inventory (NFI) can thus now be intersected with the digitised protected area edge data supplied by the Museum national d'histoire naturelle, after deletion of overlapping areas. This includes 'other wooded lands' as defined by FAO (NFI heathlands). The Natura 2000 network was dealt with separately (cf. below) for legibility purposes; the proposed sites of community importance and the designated special protection areas overlap different protection classes.

In metropolitan forests, biodiversity is highly protected in an area of 195,000 ha, or 1.3% of the forest area (categories I, II and IV of the World Conservation Union - IUCN). These protected areas occur in the centre of national parks, nature reserves and strict and managed biological reserves located in public forests. This very low protected area rate in comparison to rates in Scandinavian countries and North America could be historically explained by the landholding structure and the high population density of France, which have made it difficult to form large-scale strict biological reserves. Scientific discussions are still ongoing concerning the best solution that should be adopted to preserve forest biodiversity: imitation of natural disturbance regimes, maintenance of natural forest structuring elements during cutting operations (large trees, deadwood, etc.) or setting up of strict biological reserves—these three possibilities are not mutually exclusive.

The Office national des forêts (ONF) initiated a programme to form a network of strict biological reserves covering a broad range of forest ecosystems, consisting of reserves with a unit area of around 50 ha in lowland regions and 100 ha in mountain regions. It has been enhanced at the end of 2005 by the creation of a large-scale strict biological reserve of 2,600 ha in Chizé forest (Deux-Sèvres), supported by the current national hunting and wildlife reserve. This partly explains the marked increase in strict biological reserves.

Moreover, it is estimated that the 'protection of landscapes and specific natural elements' concerns 4.8 million ha of metropolitan forests, or almost a quarter of the forest area. This classification corresponds to IUCN category V (inhabited protected areas). These areas consist mainly of regional natural parks (PNR) and zones on the periphery of the seven metropolitan national parks. The marked increase in these protected areas (almost 1 million ha in 6 years) mainly corresponds to the creation of four new regional natural parks (PNR) in that period, since metropolitan France now has 46 PNR.
Finally, there are also other protection statuses in France, including the landuse planning classification 'woodlands to be preserved'. This status prohibits any change in classification or landuse strategy that could jeopardise woodland conservation, protection or creation.

MCPFE protection class		Type of protected area	2001	2004			2010			2004 2010
			Area (ha)							Proportion of protected forests (%)
			Forests	Forests	Heathlands*	Total	Forests	Heathlands*	Total	
1	Biodiversity protection									
1.1	No human intervention	Strict biological reserves	1 300	4 300		4 300	14 478	841	15 369	0,03 0,09
		Strict natural reserves	4 000	4 000	4 000	8 000	NA	NA	NA	NA NA
Subtotal 1.1			**5 300**	**8 300**	**4 000**	**12 300**	**NA**	**NA**	**NA**	**NA NA**
1.2	Minimal intervention	National parks: central areas	94 600	94 600	125 600	220 200	122 119	153 985	276 104	0.60 0.70
1.3	Conservation via active management	Natural reserves, excluding strict nature reserves**	57 500	53 200	25 200	78 400	63 746	34 974	98 720	0.30 0.40
		National database Protected areas (ex voluntary nature reserves)		8 700	4 000	12 700	9 661	4 155	13 816	0.10 0.06
		Managed biological reserves	17 400	22 100		22 100	20 495	2 630	23 125	0.10 0.10
Subtotal 1.3			**74 900**	**84 000**	**29 200**	**113 200**	**93 902**	**41 759**	**135 661**	**0.50 0.60**
Subtotal 1 (after deletion of multiple counts)			**174 800**	**186 900**	**158 800**	**345 700**	**225 960**	**194 914**	**420 874**	**1.20 1.30**
2	Protection of landscapes and specific natural elements									
		National parks: peripheral areas	403 800	403 800	287 500	691 300	540 997	299 818	840 815	2.50 3.20
		Regional natural parks	2 547 400	2 724 400	378 500	3 102 900	3 306 957	520 303	3 827 260	17.00 19.50
		Biotope protection prefectoral orders	62 300	55 200	11 500	66 700	81 793	13 660	95 453	0.30 0.50
		Alluvial protection forests	6 200	6 200		6 200	6 201		6 201	0.04 0.04
		Periurban protection forests	10 600	44 600		44 600	80 459		80 459	0.30 0.50
		Conservation of coastal and lacustrine shoreline areas	8 900	10 200	18 800	29 000	19 844	35 467	55 311	0.10 0.10
		National hunting and wildlife reserves	17 000	17 100	4 900	22 000	14 857	4 573	19 430	0.10 0.10
Subtotal 2 (after deletion of multiple counts)			**2 984 300**	**3 170 500**	**689 500**	**3 859 900**	**3 997 507**	**855 003**	**4 852 510**	**19.80 23.60**
Total (after deletion of multiple counts)			**3 159 100**	**3 297 400**	**835 100**	**4 132 500**	**4 081 087**	**1 026 102**	**5 107 189**	**20.60 24.10**
Natura 2000										
Bird Directive		Notified Special protection areas (SPA)	NA	221 300	192 700	414 000	1 878 641	570 958	2 449 598	1.30 12.40
Habitats Directive		Proposed Special areas of conservation (SAC)	NA	NA	NA	NA	2 182 627	777 254	2 959 882	NA 14.40
Total		Total of proposed or designated Natura 2000 sites (after deletion of overlapping areas)	NA	NA	NA	NA	3 178 091	952 850	4 130 942	NA 21.00

*'other wooded lands' as defined by FAO

** The 2010 data were obtained via GIS, which is more accurate, but induces interruptions in data series. In particular, strictly protected parts of natural reserves, whose boundaries are not clearly defined, could not be taken into account and are thus classified with natural reserves, excluding strict nature reserves.

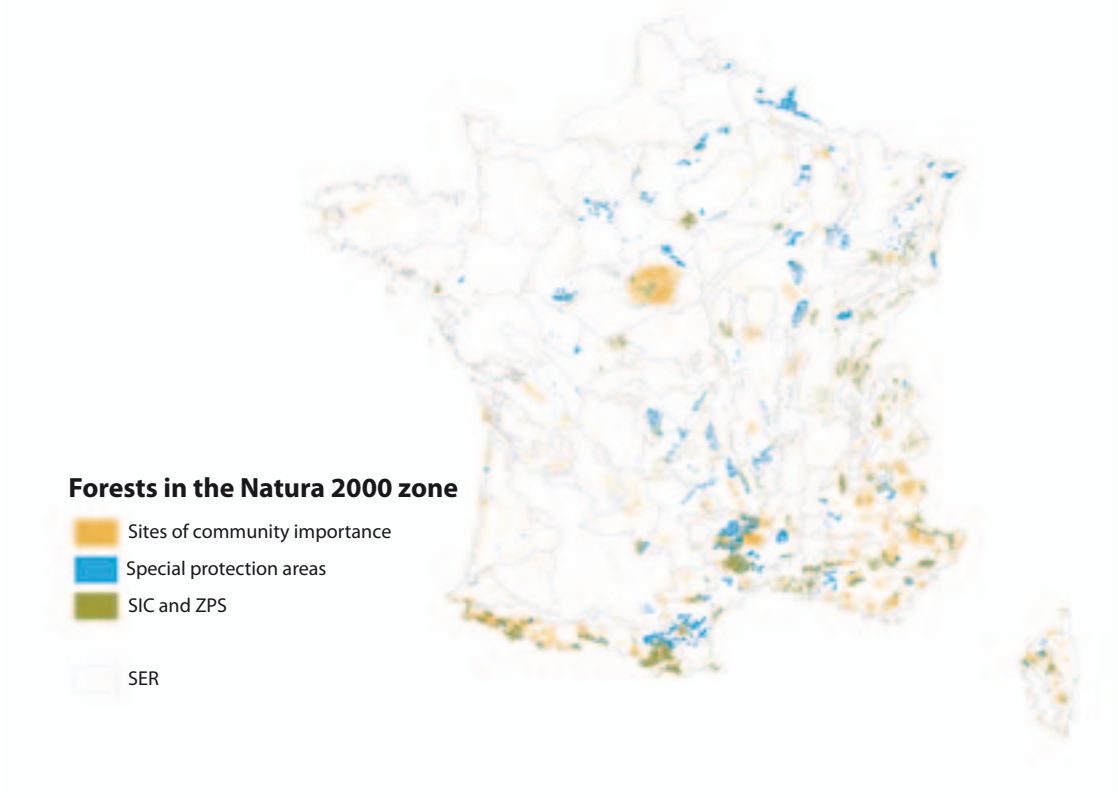
Source: MNHN 2001 and 2004, INPN 2010 and NFI 2010, by intersection of maps and deletion of overlapping areas, Teruti-Lucas for the 2010 %. INPN 2010, http://inpn.mnhn.fr/isb/download/fr/maps.jsp for natural areas; MAAPRAT, 2010, http://agriculture.gouv.fr/les-forets-de-protection,10806 for protection forests.

Woodland type	Special protection area		Special area of conservation		Natura 2000	
	2003	2010	2003	2010	2003	2010
High broadleaved forest	NA	431 465	NA	443 950	NA	674 292
High conifer forest	NA	404 135	NA	474 460	NA	694 971
Mixed high forest	NA	139 875	NA	143 779	NA	208 913
Mixed high broadleaved forest and coppice	NA	282 242	NA	335 834	NA	507 021
Mixed high conifer forest and coppice	NA	111 036	NA	136 779	NA	209 958
Coppice	NA	230 964	NA	292 164	NA	411 810
Open forest	NA	256 686	NA	332 008	NA	436 305
Poplar plantation	NA	22 238	NA	23 654	NA	34 823
Subtotal forest	**221 300**	**1 878 641**	**NA**	**2 182 627**	**1 418 500**	**3 178 091**
Heathland	192 700	570 958	NA	777 254	NA	952 850
Total	**414 000**	**2 449 598**	**NA**	**2 959 881**	**NA**	**4 130 942**

Source: MNHN 2003, INPN 2010 and NFI 2010, by intersection of maps and deletion of overlapping areas.

The Natura 2000 network was set up to foster biodiversity conservation throughout the European Union. The aim is to maintain or rehabilitate natural habitats and habitats of flora and wildlife species of community importance so as to ensure their conservation. It consist of sites that have been specially designated by each Member State in application of the so-called EU Bird (special protection areas) and Habitats (special areas of conservation) directives of 1979 and 1992. To date, France has designated over 4 million ha of heathlands and forests as sites of community importance under these two directives.

The site management conditions are defined in 'objective documents' that specify measures required to ensure species and habitat conservation. These measures are implemented through contracts drawn up by the state with different suppliers (farmers, forest owners, forest managers, etc.).



Map 24: Forest locations in the Natura 2000 sites (special areas of conservation and special protection areas).

Source: INPN, 2010.

Criterion 5

MAINTENANCE AND APPROPRIATE ENHANCEMENT OF PROTECTIVE FUNCTIONS IN FOREST MANAGEMENT (NOTABLY SOIL AND WATER)

Indicator 5.1

Areas of forest and other wooded land designated to prevent soil erosion, to preserve water resources, or to maintain other forest ecosystem functions, part of the MCPFE Class 'Protective Functions'

A relatively high number of private forests fulfil protective functions, but no specific data are available on this topic. However, only a part of public forests fulfil this role, as a principal function or jointly with production.

Physical protection (soil and water) in public forests

State-owned areas (including allocated state-owned areas)

	Total area (1,000 ha)						*Forest area (1,000 ha)*						*Percentage forest 2004*
	*1990**	*1994**	*1999**	*2004*	*2005*	*2009*	*1990***	*1994*	*1999*	*2004*	*2005*	*2009*	
Production and protection	233	238	238	241	247	253	198	202	202	205	207	211	0.85
Protection	132	136	142	144	146	152	78	80	84	85	89	88	0.59
Total	276	373	380	385	393	405	276	282	286	290	296	299	

Areas governed by local communities

	Total area (1,000 ha)						*Forest area (1,000 ha)*						*Percentage forest 2004*
	*1990**	*1994**	*1999**	*2004*	*2005*	*2009*	*1990***	*1994*	*1999*	*2004*	*2005*	*2009*	
Production and protection	440	461	507	564	568	581	387	406	446	495	499	495	0.88
Protection	144	161	212	236	248	252	95	106	140	156	166	169	0.66
Total	584	622	719	800	816	833	482	512	586	651	665	664	

Total areas governed by forestry regulations

	Total area (1,000 ha)						*Forest area (1,000 ha)*						*Percentage forest 2004*
	*1990***	*1994**	*1999**	*2004*	*2005*	*2009*	*1990***	*1994*	*1999*	*2004*	*2005*	*2009*	
Production and protection	673	699	744	805	815	834	585	608	648	700	706	706	0.87
Protection	276	296	354	380	394	404	173	186	224	241	255	258	0.63
Total	949	995	1 099	1 185	1 209	1 238	758	794	872	941	961	964	

Data rounded off to thousand ha, extrapolated by ONF agency before consolidation.
* including state-owned forests allocated to various ministries; application of the afforestation rate in the area of the two concerned series in 2004.
** data obtained by linear extrapolation
Source: ONF, for all wooded land governed by forestry regulations; the percentage of wooded land in the total area for 2004 was applied to the total areas for 1994 and 1999. Data FRT/SER, late March 2010 (2005 data for three agencies in state-owned lands and two agencies in local community lands), revised 2004 data (ex-Corsican state-owned forests accounted for in the forests of local communities and state-owned Chambord establishment accounted for with forests of the local communities from 2010).

Public forests, whose key function is to protect the physical environment, now cover an area of nearly 260,000 wooded ha, two-thirds of which is found on non-state-owned property. These are mainly mountain and coastal forests. This area has increased by 34,000 ha in 10 years, currently accounting for 6.4% of the total wooded area within public forests. The total protection area (wooded and non-wooded) currently covers close to 400,000 ha. It also has a partial role in the protection of infrastructures and inhabitants against natural hazards, but it is impossible to differentiate these different functions—data presented in Indicator 5.1 thus partially overlap those of Indicator 5.2, for which no detailed data is available.

Public forests also include over 700,000 ha that serve a dual role as a source of wood supply while providing physical protection.

The French government has been rehabilitating mountain land since 1860. Under this policy it has been acquiring highly degraded areas and subsequently reforesting and developing them in order to boost their protective role. The Office national des forêts has set up mountain landscape rehabilitating services (RTMs) in 11 departments located in mountainous regions (Alps and Pyrenees). These RTMs conduct prevention activities in all public forests. They also provide support for local communities (expertise, work planning, technical assistance) and public security authorities.

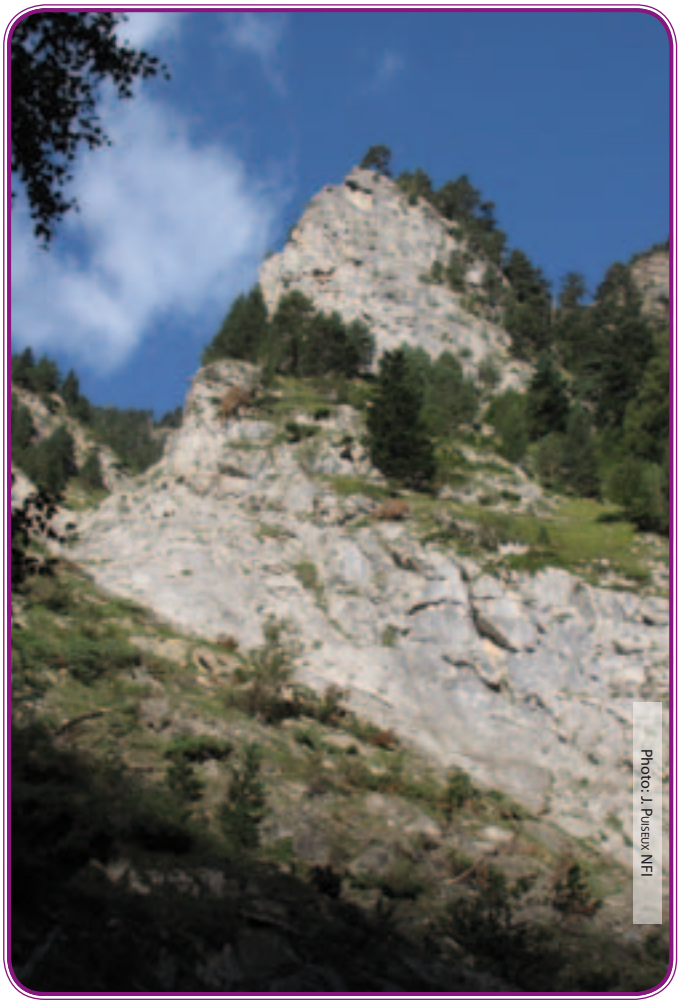
A major programme to stabilise coastal dunes was also undertaken by the state in the 19th century, through afforestation, plant cover and civil engineering works. This large coastal area is currently managed by the Office national des forêts and includes 380 km of coastal dunes and 120 km of rocky coast.
Coastal environments are subject to very rapid natural dynamics (erosion, vegetation successions, etc.) and to considerable human pressure (urbanisation, tourism, etc.). Their management is no longer solely focused on dune protection, it also includes biodiversity and landscape protection initiatives.
Since 1975, the Conservatoire de l'espace littoral et des rivages lacustres has been actively acquiring highly threatened coastal sites.

Note: The steady increase in area managed with a focus on protection illustrates that the protection of inhabitants and infrastructures against natural hazards is being accounted for to an increasing extent. However, the 'protection' or 'protection and production' series do not solely concern physical protection, they also include forests classified as protection forests with respect to landscape and inhabitants' well-being (data cannot be differentiated), thus leading to a slight overestimation of this increase over the 1990-2009 period.

Drinking and mineral water quality protection

In 1994, around 200,000 ha of forest were found in drinking water reservoir protection zones that are clearly delineated in the landscape and have special easements. Moreover, almost 600,000 ha of forest are located within mineral water spring protection zones and thus have a specific role in water quality protection, without any special forest management requirements.

In December 2010, 60.5% of water extraction facilities at around 34,000 water reservoirs have protection areas that were delineated by a public utility declaration decree, representing 68.9% of the extracted water volume (18.5 Mm^3 of water is extracted per day).



Mountain pine and Scots pine stands in Moudang valley (Hautes-Pyrénées region) serving to preserve water quality.

Indicator 5.2

Area of forest and other wooded land designated to protect infrastructure and managed natural resources against natural hazards, part of MCPFE Class 'Protective Functions'

The proportion of forests specifically designated for the protection of infrastructures and managed natural resources against natural hazards is currently unknown. These forests are partially accounted for in Indicator 5.1 since erosion control, especially in mountain regions, also provides protection for infrastructures and inhabitants against potential floods and landslides, etc.

Since 1995, the French Ministry of the Environment has been drawing up predictable natural hazard prevention plans (PPRN). Under these PPRNs, natural hazard zones are mapped and regulations are enforced for all existing and future urbanism, construction and management initiatives: 'red zones' where new constructions are prohibited and 'blue zones' where they are allowed subject to special requirements. Prevention, protection and safety measures to be taken by inhabitants and territorial communities are also drawn up. Although flooding is the most prevalent natural hazard in France, PPRNs can take all potential hazards into account (including landslides, avalanches, earthquakes, forest fires, etc.).

On 1 January 2010, 7,500 PPRNs were approved in France, including 80% for flood hazards, for 12,000 set out.
In addition, the French Ministry of the Environment is coordinating the development of mountain hazard databases along with permanent avalanche monitoring systems.

A forest stand in the Alps with a natural hazard protection role.

Criterion 6

MAINTENANCE OF OTHER SOCIOECONOMIC FUNCTIONS AND CONDITIONS

Indicator 6.1

Number of forest holdings, classified by ownership categories and size classes

Public forests managed by the Office national des forêts (ONF)

Number of forest holdings and area of public forests by size class

Area class	State-owned forests			Allocated state-owned lands			Other forests governed by forest regulations			Total			
	Nb	*Area (ha)*	*% (Area)*	*Nb*	*Area (ha)*	*% (Area)*	*Nb*	*Area (ha)*	*% (Area)*	*Nb*	*Area (ha)*	*% (Area)*	*Aver. Area*
0-1 ha	1	1	0.0	0	0	0.0	61	43	0.0	62	44	0.0	0.7
1-4 ha	2	6	0.0	0	0	0.0	474	1 230	0.0	476	1 236	0.0	2.6
4-10 ha	5	30	0.0	1	7	0.0	1 002	7 000	0.2	1 008	7 037	0.2	7.0
10-25 ha	28	510	0.0	6	100	0.1	2 084	35 500	1.2	2 118	36 110	0.8	17.0
25-50 ha	57	2 100	0.1	7	300	0.4	2 212	81 400	2.8	2 276	83 800	1.8	36.8
50-100 ha	74	5 700	0.3	10	700	0.9	2 637	192 100	6.7	2 721	198 500	4.3	73.0
100-500 ha	424	120 200	7.1	23	5 100	6.5	5 507	1 226 500	42.5	5 954	1 351 800	28.9	227.0
500-1,000 ha	257	183 600	10.8	8	5 100	6.5	869	590 700	20.5	1 134	779 400	16.7	687.3
1,000-10,000 ha	465	1 178 200	69.2	12	39 500	50.0	421	741 100	25.7	898	1 958 800	41.9	2 181.3
10,000 ha and over	15	212 100	12.5	1	28 300	35.8	1	12 400	0.4	17	252 800	5.4	14 870.6
Total	**1 328**	**1 702 400**	**100.0**	**68**	**79 000**	**100.0**	**15 268**	**2 887 900**	**100.0**	**16 664**	**4 669 527**	**100.0**	**276.6**

Source: Office national des forêts (ONF) 2010, managed area repository.

The ONF currently manages nearly 16,700 different forest units, including 15,268 non-state-owned forests, mainly owned by local authorities. The mean unit size varies markedly according to the public forest category, i.e. estimated at 1,282 ha for state-owned forests, but only 189 ha for other forests governed by forest regulations. Thus 92.5% of the state-owned forest area is occupied by units of over 500 ha, while most other public forest area (53.4%) contain units of less than 500 ha. State-owned forests include 15 very large forest ranges of more than 10,000 ha (12.5% of the area) with the largest being the Orléans state-owned forest which is almost 35,000 ha. Small units of less than 100 ha account for only 7% of the public forest area but represent over half of the units managed by ONF.

State-owned forests in Corsica were transferred to the Collectivité Territoriale de Corse (in compliance with Article 21 of the law of 22 January 2002). This freehold transfer took effect on 1 January 2004. In contrast, the state-owned forest area increased by around 3,000 ha between 2005 and 2010 following a range of different land transactions.

Note: Public forests refer to all wooded and unwooded land governed by forest regulations, i.e. belonging to the State, public authorities and certain public institutions. Unwooded land represents around 15% of state-owned forests and 10% of forests owned by public authorities. The 79,000 ha of rezoned state-owned land concerned is mainly military land. Other forests governed by forest regulations are mainly forests owned by public authorities (communal and sectional), as well as forests belonging to public institutions, public utility institutions, mutual companies and savings banks.

Regional distribution

State-owned forests

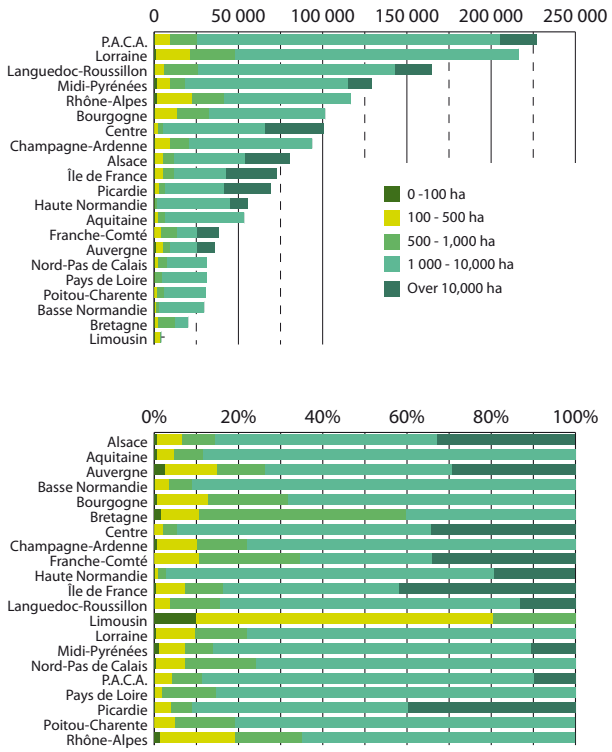


Figure 35: Percentage of the state-owned forest area (excluding rezoned state-owned land) ranked by size class and region, and total area of state-owned forests (excluding rezoned state-owned land) by size class and region.

Others forests governed by forestry regulations

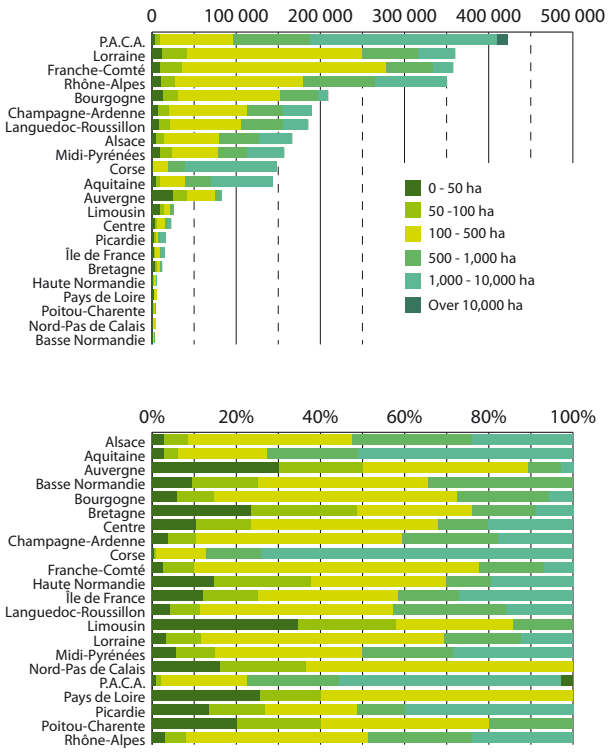


Figure 36: Percentage of other forests governed by forestry regulations ranked by size class and region, and total area by size class and region.

Source: Office national des forêts (ONF) 2010, managed area repository.

Note: The breakdown by state-owned forest region excludes rezoned state-owned land, which can bias the public forest distribution at some locations (e.g. concerning the Canjuers military station in Var region, the Centre d'Essais des Landes in Aquitaine and La Courtine military station in Limousin).

The largest state-owned forest areas are found in Provence-Alpes-Côte d'Azur (PACA) (227,000 ha), Lorraine (216,000 ha), Languedoc-Roussillon (165,000 ha) and Midi-Pyrénées (129,000 ha). The most extended areas of very large state-owned forests (more than 10,000 ha) are in central France: 34,000 ha in the Centre region, 30,700 ha in Île-de-France and 27,600 ha in Picardie. Conversely, eastern France contains the largest areas of small state-owned forests (less than 1,000 ha): Lorraine has 47,600 ha, Rhône-Alpes 41,000 ha and Bourgogne 32,000 ha.

In terms of relative forest area, large state-owned forests (over 10,000 ha) account for a substantial relative area (over a third of the state-owned forest area) in Île-de-France (42% of the state-owned forest area), Picardie (40%), Centre (35%), Franche-Comté (34%) and Alsace (33%). The smallest state-owned forests (under 1,000 ha) account for a substantial relative area (over a third of the state-owned forest area in Limousin (100% of the state-owned forest area, but the overall area concerned is very small), Bretagne (60%), Franche-Comté (35%) and Rhône-Alpes (35%).

The highest total areas of other forests governed by forest regulations are in PACA (423,000 ha), Lorraine (360,000 ha), Franche-Comté (360,000 ha) and Rhône-Alpes (350,000 ha). Regions with the greatest area of large forests owned by public authorities (over 1,000 ha) are PACA (235,000 ha), Corsica (110,000 ha)—where state-owned forests were transferred to the Collectivité Territoriale de Corse—and Rhône-Alpes (84,000 ha). In contrast, regions with the highest area of small forests owned by public authorities (under 100 ha) are Lorraine (42,000 ha), Auvergne (41,000 ha) and Franche-Comté (36,000 ha).

Large forests owned by public authorities (over 1,000 ha) represent a high relative forest area in Corsica (74% of the forests owned by public authorities), PACA (56%), Aquitaine (51%) and Picardie (40%). The smallest forests owned by public authorities (under 100 ha) account for a high relative area in Limousin (58% of the area of forests owned by public authorities), Auvergne (50%), Bretagne (48%), Pays-de-la-Loire (40%) and Poitou-Charentes (40%).

Private forests

Number of properties and private forest area by size class

Size class	1976-83					1999					2002				
	Number of owners		Area			Number of owners		Area			Number of owners		Area		
	total (x 1,000)	%	total (x 1,000 ha)	%	av. (ha)	total (x 1,000)	%	total (x 1,000 ha)	%	av. (ha)	total (x 1,000)	%	total (x 1,000 ha)	%	av. (ha)
0-1 ha	2 360	64.2	773	7.9	0.3	2 361	67.8	745	7.0	3.0	2 111	65.8	667	7.1	0.3
1-4 ha	1 165	31.7	3 188	32.7	2.7	934	26.8	2 975	28.0	3.2	724	22.5	1 454	15.5	2.0
4-10 ha											229	7.1	1 414	15.1	6.2
10-25 ha	100	2.7	1 464	15.0	14.6	120	3.4	1 761	16.6	14.7	95	3.0	1 448	15.4	15.2
25-50 ha	42	1.1	1 905	19.6	45.4	58	1.7	2 641	24.9	45.5	28	0.9	977	10.4	34.5
50-100 ha											13	0.4	890	9.5	69.1
100-500 ha	9	0.2	2 410	24.7	267.8	11	0.3	2 498	23.5	227.1	8	0.3	1 580	16.8	187.5
500-1,000 ha											1	0.0	387	4.1	670.1
1,000- 10,000 ha											0	0.0	499	5.3	2 089.3
10,000 ha and over											0	0.0	67	0.7	13 357.3
Total	**3 676**	**100.0**	**9 740**	**100.0**	**2.6**	**3 484**	**100.0**	**10 620**	**100.0**	**3.0**	**3 210**	**100.0**	**9 385**	**100.0**	**2.9**

Sources:
1976-83: survey on economic structures in silviculture conducted by the Service central des enquêtes et études statistiques (SCEES), now the Service de la statistique et de la prospective (SSP);
1999: survey on the structure of private forest properties conducted by SCEES (now SSP) for properties of 1 ha and over, and based on the land register for properties of less than 1 ha.
2002: land register.

Note: caution is required when making comparisons of any of the data presented here, since:

– data for the 0-1 ha class between 1976-83 and 1999 cannot be compared since the 1976-83 survey was focused on woodland areas of over 0.5 ha and based on the Enquête annuelle sur l'utilisation du territoire (Teruti), whereas the 1999 data were derived from the land register due to the lack of available elements in the 1999 survey of SCEES (now SSP).

– the SCEES 1976-83 survey was based on the sampling points from the Teruti survey in which the landowners were identified, thus explaining why the total area was underestimated (9.7 Mha out of 10.4 Mha recorded).

– finally, the 2002 data were from the land register since no new surveys had been carried out on the private property structure, thus explaining why the area was underestimated (as a guide, the 1999 SCEES survey estimated the area of private properties of over 1 ha at 9.9 Mha, as compared to 8.3 Mha estimated via the land register at the same date). The land register actually overestimates land that is not very taxed (fallows and heathland) to the detriment of more taxed land (utilised farmland, grasslands and forests). It is biased by under-reporting and by the slowness of the updating process (Koerner et al., 2000).

More than half of the private forest area consists of units of less than 25 ha. The mean size of private forest properties is now estimated at nearly 3 ha, whereas it was 2.6 ha 20 years ago. The number of private owners is still very high (3.2 million according to the land register in 2002), which puts France in pole position amongst European countries. Very small forest units of less than 1 ha are owned by 2.1 million private owners, or two-thirds of all private owners in France.
A survey conducted by SCEES (now SSP) in 1999 on forest properties of over 1 ha revealed the legal status of private forest owners. Individual forest owners are the most numerous, i.e. 96% of the total for around 83% of the area. They are represented by individuals, communal matrimonial estates, joint- and co-owners. There are not many legal entities (4%) but they account for more than 17% of the area. Their units are quite large, i.e. 43 ha on average. These include forest management groups that own the largest units (mean 110 ha).

These figures reflect the high level of private land parcelling in France, which is a major economic handicap that is hampering operational competitiveness while locally promoting 'non-management'. Very small properties are underlogged, while also being enclaves that may hamper logging on neighbouring properties (Puech, 2009). Land restructuring, grouping of land owners and providing expert management advice to land owners could help offset this land parcelling problem. The French forest law of 9 July 2001 created a fiscal incentive (in the form of a tax reduction) to encourage investment in forests (DEFI), to:

– combat the problem of forest land parcelling: concerning the acquisition of land (woodland, forests, cleared land to be planted) and subscription for shares of forest management groups or Sociétés d'épargne forestière (SEF);
– stimulate forestry work: concerning forestry work undertaken by the owner, a forestry group or an SEF for which taxpayers are shareholders;
– develop forest management and promote economic organization of the sector: concerning compensation for carrying out a contract for woodland and forest management with a forest expert, a forest cooperative, a producers' organization or with ONF.

Box 7: Forest cooperation

French forestry cooperation is a young movement in comparison to that of other European countries. It began gaining momentum in the 1980s (UCFF, 2004). The cooperatives are involved to an increasing extent in logging, logistics and marketing activities, as well as in the development of services concerning forest management and forestry project management. The following table presents statistical data on cooperative group members of the Union de la coopération forestière française (UCFF). A review of 23 cooperatives on the basis of 1999 data showed that 70% of UCFF members owned at least 10 ha (source: UCFF).

	2009
Number of cooperatives and members' groups	27
Number of member producers	99 843
Number of member producers with PEFC certification	28 350
Concerned area	1 965 000 ha
Number of salaried staff	907
Volume marketed/year	5 971 000 m^3

Source: Union de la coopération forestière française (UCFF), statistical data on 31/12/2009.

Regional distribution of the different property sizes

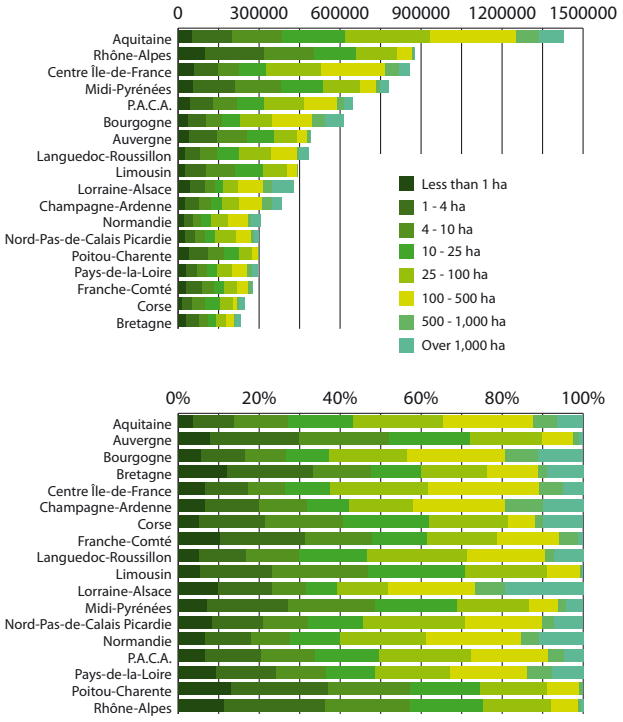


Figure 37: Percentage of private forest area ranked by size class and region, and total private forest area by size class and region.

Source: Land register 2002.

With 1.4 Mha of private forests, Aquitaine is by far the region in which private forests are most represented, followed by Rhône-Alpes (0.9 Mha), Centre-Île-de-France (0.9 Mha) and Midi-Pyrénées (0.8 Mha).

In Poitou-Charentes, Bretagne, Rhône-Alpes and Franche-Comté, over 10% of the private forest area contains properties of at least 1 ha (10-13%). Conversely, the lowest rate of private wooded area covered by these small properties is in Aquitaine (3%).
Rhône-Alpes, Auvergne and Limousin regions have the highest rates of private wooded area covered by 1-25 ha properties (62-65%), contrary to Lorraine-Alsace, Centre-Île-de-France and Bourgogne regions (29-32%).
The highest rates of private wooded area covered by 25-100 ha properties are found in Centre-Île-de-France, Languedoc-Roussillon and Nord-Pas-de-Calais Picardie (24-25%).
There are high regional differences with respect to properties of over 100 ha. They represent more than 40% of the private wooded area in Lorraine-Alsace, Bourgogne and Champagne-Ardenne (42-48%). In contrast, they account for less than 10% of this area in Rhône-Alpes, Poitou-Charentes and Limousin.

All properties

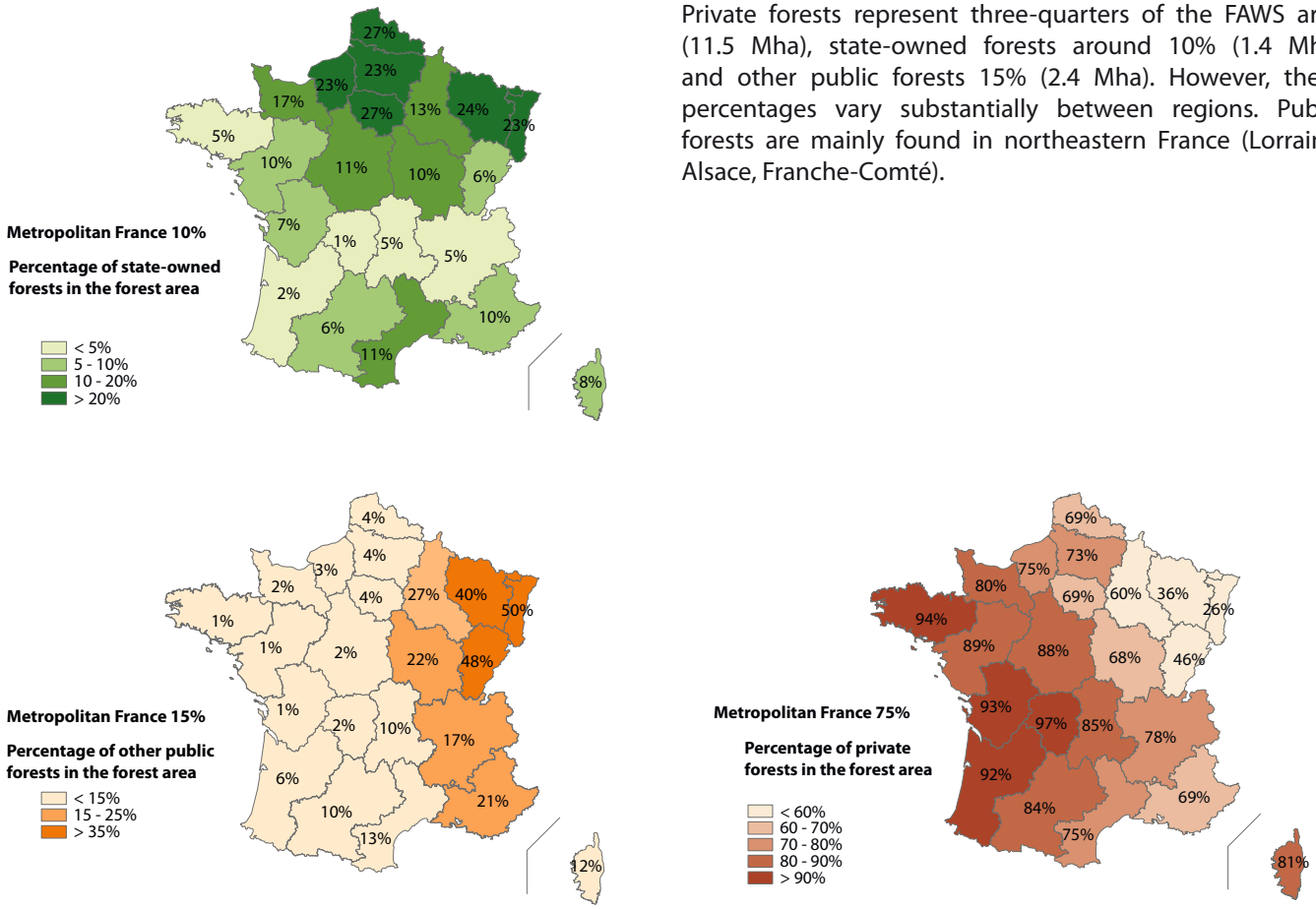
Forest available for wood supply area (including poplar plantations) by property category.

Property category	FAWS area	%	Total area
	1 000 ha		*1 000 ha*
State-owned	1 450 ± 33	9.5	1 797 ± 28
Other public land	2 360 ± 35	15.4	2 741 ± 24
Private	11 510 ± 99	75.1	50 405 ± 23
All property categories	**15 319 ± 104**	**100.0**	**54 944**

Source: French National Forest Inventory (NFI), survey years 2006 to 2009.

Note: the data presented here are from NFI, which inventories metropolitan French forests regardless of the property status. The forest definition used here is in line with that given by the Food and Agriculture Organization of the United Nations (FAO). These figures only concern FAWS (cf. definitions in Appendix III). NFI assigns a legal property category to each sampling point on the basis of information provided by ONF. The cartographic layer used for this breakdown by property is from before 2004, the year when state-owned forests in Corsica were transferred to the Collectivité Territoriale de Corse (art. 21 of the law of 22 January 2002). Consequently, in the 'all property' category on the table, Corsican state-owned forests are still attached to state-owned forests.

Private forests represent three-quarters of the FAWS area (11.5 Mha), state-owned forests around 10% (1.4 Mha) and other public forests 15% (2.4 Mha). However, these percentages vary substantially between regions. Public forests are mainly found in northeastern France (Lorraine, Alsace, Franche-Comté).



Map 25: Percentage of state-owned forests, other public and private forests in the FAWS area.

Source: French National Forest Inventory (NFI), survey years 2006 to 2009, forests available for wood supply.

Mixed beech-fir stand in Pyrénées-Atlantiques region.

Indicator 6.1.1

Integration of forests in local initiatives

Article 64 of law n° 2010-874 of 27 July 2010 for the modernization of agriculture and fisheries modifies Article L12 of the French forest code concerning the establishment of a local forest development strategy (SLDF) in local areas relevant to the outlined objectives. The SLDF:

– is a locally oriented approach that was established upon the initiative of local stakeholders: local authorities, producers' organizations, the Centre régional de la propriété forestière (CRPF), the Office national des forêts (ONF) or the Chamber of Agriculture;

– involves developing, on the basis of an economic, environmental and social assessment, an operational multi-year action programme geared towards the development of sustainable forest management. This programme gives rise to agreements that could be eligible for public support funding;

– is managed jointly by a committee headed by an elected local authority;

– defines the objectives, indicators concerning actions to be carried out and impact indicators. An annual report on the progress achieved is drawn up and addressed to the Commission régionale de la forêt et des produits forestiers (CRFPF).

The action programme aims to:

– mobilise wood by promoting dynamic and sustainable stewardship;

– ensure that environmental and social demands are fulfilled;

– contribute to employment and rural development;

– promote technical and economic grouping of forest property owners, land restructuring and grouped management on a forest massif scale;

– strengthen the competitiveness of the wood industry.

Territorial forest charters (CFT) and massif development plans (PDM) are the two main territorial management instruments used to implement SLDFs and mentioned in the law of July 2010 for the modernization of agriculture and fisheries. They are described in the memorandum DGPAAT/SDFB/C2010-3079 of 9 August 2010, of the French Ministry of Agriculture, Food, Fisheries, Rural Affairs and Spatial Planning (MAAPRAT).

Territorial forest charters

Number of CFTs and areas concerned, all progress stages combined

Number of CFTs	CFT areas (ha)	Number of CFT districts	Forest area (ha)	Percentage forest (%)
118	10 133 812	5 341	4 159 736	41%

Source: Réseau national des Chartes forestières de territoire (CFT), Fédération nationale des communes forestières (FNCoFor)/Institut de Formation Forestière Communale (IFFC), 2011.

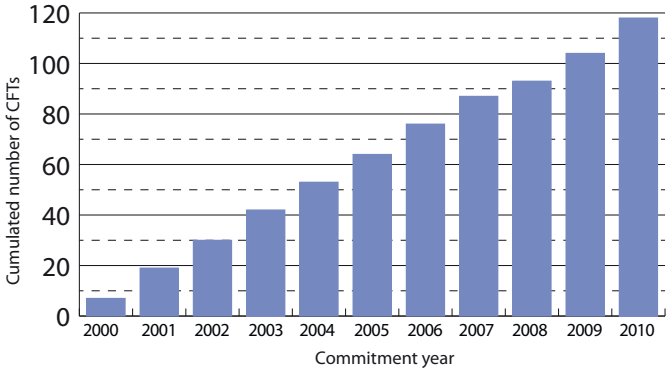


Figure 38: Cumulated number of territorial forest charters (CFT) according to the commitment date.

Source: Réseau national des Chartes forestières de territoire (CFT), Fédération nationale des communes forestières (FNCoFor)/Institut de Formation Forestière Communale (IFFC), 2011.

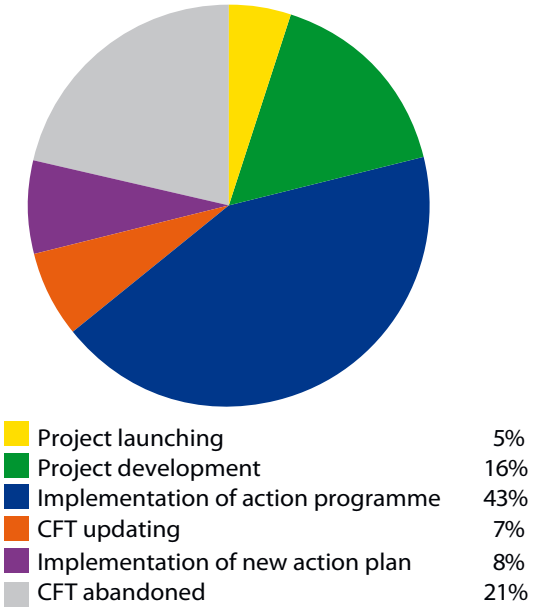


Figure 39: Distribution of the cumulated number of territorial forest charters (CFT) in 2011 according to the progress stage.

Source: Réseau national des Chartes forestières de territoire (CFT), Fédération nationale des communes forestières (FNCoFor)/Institut de Formation Forestière Communale (IFFC), 2011.

CFTs were launched via the first article of the French forest law of 9 July 2001 and are now attached to SLDFs via the French agriculture and fisheries modernization law of 27 July 2010.

CFTs are instruments for sustainable management and development of rural areas. The aim is to further the development of forests in their economic, social and environmental setting, thus promoting the multifunctional role of forests on a local level. It also aims to fulfil specific local expectations (economic, ecological, social and cultural), while taking the objectives and constraints of public and private forest owners into account.

CFTs are the result of local initiatives, whether they be communal or intercommunal. They are based on a collaborative approach between different local stakeholders focusing the development of shared collective projects. The approach fosters encounters between stakeholders offering goods and services, i.e. public or private foresters, and requestors (local authorities, various economic operators, public establishments, forest users' or environmental protection associations, the State) requiring these goods and services.

CFT monitoring and networking were initiated by FNCoFor. There were 118 CFTs in early 2011 (all stages combined) for an area of 10.1 Mha, or 18% of the area of metropolitan France. CFTs are distributed throughout France. However, there is a higher concentration in the southeast along a diagonal line between Ardennes and Gironde regions, an accurate reflection of the extent of forests in the different regions (FNCoFor/IFFC, 2009). The mean CFT afforestation rate is 41%. The CFT forest area is 4.16 Mha, with 66% private forests, 17% forests owned by public authorities and 12% state-owned forests. The 118 CFTs are at different progress stages (cf. diagram): 58% in the operational phase (implementation or updating of the multi-year action programme), 21% in the starting and design phase (launching of the approach, project development, validation) and 21% abandoned (the CFT action programme was not carried out or not renewed).

Massif development plans

Number of massif development plans (PDM) and their areas

Cumulated number of PDM	Total PDM area (ha)	Public forest area (ha)	Private forest area (ha)	Total forest area (ha)	Percentage forest (%)
307	6 852 000	735 000	1 826 000	2 561 000	37%

Source: CEMAGREF, situation on 01/01/2011.

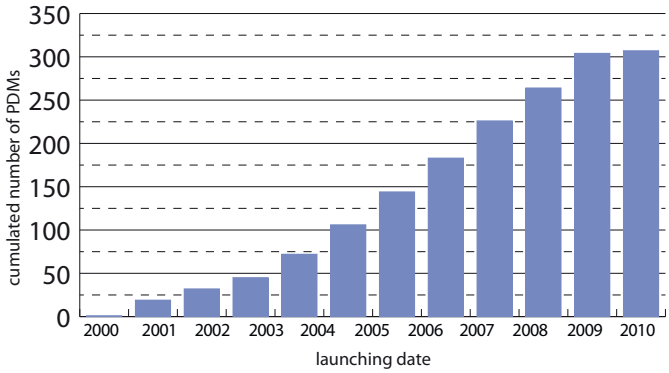


Figure 40: Cumulated number of massif development plans (PDM) according to the launching date.
Source: CEMAGREF, situation on 01/01/2011.

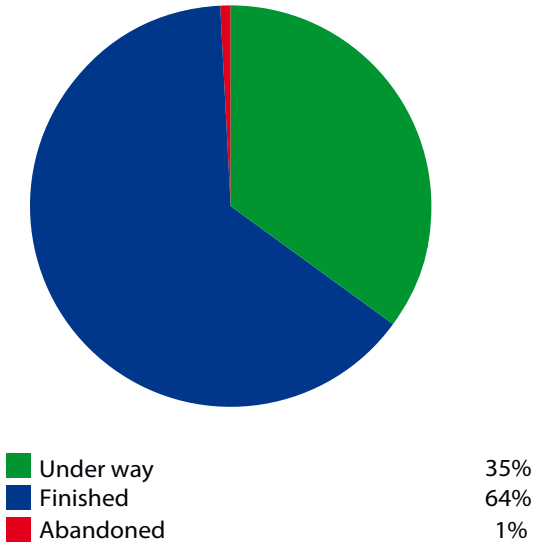


Figure 41: Distribution of the cumulated number of massif development plans (PDM) in 2011 according to the progress stage.

Source: CEMAGREF, situation on 01/01/2011.

Private forest institutions have been setting up PDMs since 2000. These plans are mainly group development project instruments that enhance the organization of the silviculture sector, while improving supplies to primary wood manufacturing industries.

These territorial development instruments promote the development of new production activities and services (development of non-wood products and ecological and services, conservation of certain exceptional ecological environments, water protection) and contribute to supporting rural employment.

The PDM approach involves assessment and discussions with owners and other local stakeholders so as to carry out operations tailored to the specific features of each massif and consistent actions in different properties. A PDM includes:

– An assessment of the massif: social, economic and environmental analysis of the massif and drawing up of a report that includes guidelines for management of the massif, and management proposals.

– Action and coordination proposals:

• a collective approach to the massif: coordination phase with silviculturists, development of forest area management projects;

• an individual approach: individual assessments, development of work programmes, silviculturists' choices of self or group management.

– PDM implementation:

• formalization of projects planned in individual management documents (simple management plans) or collective sustainable management documents so as to promote long-term actions and ensure their follow-up;

• on the basis of individual commitments of silviculturists, coordinating work to be carried out by different stakeholders on the massif (cooperatives, forest experts, forestry work contractors, etc.).

Indicator 6.1.2

Information and training of forest owners and managers on sustainable forest management

Number of trained public forest managers

	2009	2010
Number of training days benefitting ONF staff on the topic 'Consolidate sustainable management of public forests'	12 000	11 000

Source: Office national des forêts (ONF).

Note: ONF staff spend a considerable amount of their time informing owners (forests owned by public authorities)—meetings, dissemination of informative documents, field meetings—but this time is hard to quantify.

ONF training is organized along the three main lines of the ONF establishment project:

– line 1: consolidating sustainable public forest management (25% of the training package);
– line 2: creating added value in wood, work and service activities (35%);
– line 3: promoting human relations and enhancing the efficiency of the organization (40%).

The 'consolidating sustainable public forest management' line includes many training courses on various aspects of sustainable forest management (recognition and management of forest habitats, fauna, flora, tailoring management to climate change, hunting management, etc.). In 2009, ONF staff benefitted from 12,000 training days on this line. The slight decrease noted in 2010 was mainly due to a cyclical increase in lines 2 and 3 (implementation of large computer projects) and the renewal of statutory training.

Training forest-owning communities

Elected representatives make the most important decisions concerning community-owned forests, e.g. decisions to sell or not sell, selling options, withdrawal price setting, adoption of required work programs. They participate in drawing up management programmes that must comply with guidelines set by elected representatives with respect to the role that they assign to forests. They institute policies concerning the development of forest areas.

The extent of responsibilities of municipal representatives with respect to sustainable management of their forests highlights the need to train mayors, elected representatives and community staff so as to enable elected representatives to make the most suitable decisions in terms of the development, conservation and enhancement of community forest heritage.

IFFC—an association under 'Law 1901'—was founded in July 1990. IFFC serves as a specialised instrument for FNCoFor in the fields of training and forest development. It edits regularly updated educational documents that are disseminated to all forest-owning communities and ONF foresters. It also offers:

– national training courses on topics requested by mayors;
– educational and financial training assistance organized by departmental associations and regional unions;
– educational trips, meetings, conferences on topical issues concerning community-owned forests and on topics to meet future needs.

The training courses are focused especially on the following topics: mobilization and marketing of wood, forest management, hunting, forestry work, fuelwood, timber and estovers.

Year	Number of training days provided by IFFC and regional forest community unions	Number of trainees
2007	129 (75 days on community-owned forests, 45 topic training courses and 9 educational trips)	3 700 (2,627 elected representatives and 1,035 ONF staff members and others)
2008	101	3 002
2009	135	2 976
2010	150	2 851

Source: Fédération nationale des communes forestières (FNCoFor)/ Institut de Formation Forestière Communale (IFFC).

Private forests: number of trained and informed silviculturists and managers

Summary of trained and informed silviculturists and managers

Items	2007	2009	Notes
	Nb	*Nb*	
Informed silviculturists and managers (Details in table below)	419 915	468 978	Increase in connections to regional delegation websites (Centres régionaux de la propriété forestière - CRPF) of CNPF.
Trained silviculturists and managers (Details in table below)	25 074	22 133	Decrease in the number of extension meetings organized by regional delegations (CRPF) of CNPF.
Total before reduction	**444 989**	**491 111**	
10% reduction for duplicates	- 44 499	- 49 111	Correction of overestimations associated with duplicate counts for 'informed' and 'trained'.
Overall total 'Informed + Trained'	**400 490**	**442 000**	
Rate of informed and trained silviculturists and managers	36%	40%	Calculated on the basis of 1,100,000 forest owners, considered unchanged between 2007 and 2010.

Source: Centre national de la propriété forestière (CNPF).

Informed silviculturists and managers

Items	2007	2009	Notes
	Nb	*Nb*	
Recipients of regional information magazines* and newsletters published by CNPF	216 665	165 825	Increase in the area threshold for the dissemination of magazines in certain regions (e.g. from 4 to 10 ha).
Sale of CNPF-Institut pour le développement forestier (IDF)* documents	4 431	5 000	High demand for Flore forestière méditerranéenne, following its publication in 2008.
Connections to CNPF-managed websites and intranet sites*	238 673	343 427	Increase in connections to existing sites and set up of new sites in several regions.
Individual technical support (technical visits by CNPF agents at the request of silviculturists)	6 803	6 834	Stability.
Total before reduction	**466 572**	**521 086**	
10% reduction for duplicates	- 46 657	- 52 108	Correction of overestimations associated with duplicate counts for all items.
Total 'informed'	**419 915**	**468 978**	

*a specific allowance is applied so as to only account for silviculturists and managers.
Source: Centre national de la propriété forestière (CNPF).

The French forest code law (Article L.221.1) assigned the Centre national de la propriété forestière (CNPF) with the mission of developing, orienting and improving the sustainable management of woodlands and forests of private owners. CNPF thus carries out forest development activities focused especially on informing and training silviculturists and forest managers.

The rate of informed and trained private silviculturists increased from 36 to 40% between 2007 and 2009.

The websites explain this positive trend. These sites, along with regional magazines, are by far the most important information outlets. They enable the dissemination of general fundamental information that all forest owners require.

Website visits are increasing steadily from year to year. Almost all regions now have a dedicated website, developed and managed by CNPF.

In certain regions, the increase in the area threshold considered for dissemination of newsletters to owners explains the decline in the number of recipients. These newsletters are nevertheless still essential for boosting awareness. They are the only source of forest information for many silviculturists. Several regional surveys (Centre, Normandie, Poitou-Charentes, etc.) indicate that the newsletters are read, appreciated and used as reference documents.

There is also an increase in purchases of books from the Institut pour le développement forestier (IDF) by silviculturists, especially due to the popularity of the handbook *Flore forestière méditerranéenne* following its publication in 2008.

Trained silviculturists and managers

Items	2007	2009	Notes
	Nb	*Nb*	
Participants in extension meetings coordinated by CNPF*	26 168	22 395	Tightening of meetings on priorities outlined in regional policies (sustainable forest management certification, etc.).
Participants in IDF training courses of CNPF*	437	657	Development of customized training courses, as a complement to those proposed in the standard catalogue.
Participants in courses of the Association de formation à la gestion forestière (FOGEFOR) coordinated by CNPF	1 255	1 540	Progression of training to enhance knowledge and perfect skills.
Total before reduction	**27 860**	**24 592**	
10% reduction for duplicates	- 2 786	- 2 459	Correction of overestimations associated with duplicate counts for all items.
Total 'trained'	**25 074**	**22 133**	

* a specific allowance is applied so as to only account for silviculturists and managers.
Source: Centre national de la propriété forestière (CNPF).

Note: This indicator, which was established by CNPF in 2007, accounts for information and training initiatives of this establishment to the benefit of silviculturists and forest managers.

The number of technical visits (4th row on the above table) by regional delegations (Centre régionaux de la propriété forestière - CRPF) of CNPF has remained steady. They concern all regions and mainly target 'new' owners individually wishing to get informed with the help of a technician. An increasing number of requests concern stand health assessments and information pertaining to sustainable forest management documents.

The 'training' component is more contrasted. The indicator 'participants on extension meetings' is decreasing due to the decline in the number of extension meetings organized by CRPF. These meetings represent a first step in the training of forest owners, enabling them to discover and become familiar with forest management practices. They offer targeted and detailed contributions on all aspects of sustainable silviculture management (economics, techniques, regulations, taxation, etc.). The most efficient concern small sectors (townships or even smaller) with a reasonable number of participants (30-40 maximum), thus making it possible to alternate theoretical presentations with practical demonstrations. The drawback is that the meeting preparation and coordination are time consuming (minimum 3-4 days per meeting). In several regions the trend is towards a decrease in these meetings due to a lack of resources.

Training courses of the Association de formation à la gestion forestière (FOGEFOR) and those organized by IDF work well, even though in 2010 there was a sharp decline in these courses likely due to a lag effect of the economic crisis. These different training courses serve as educational support for silviculturists concerning implementation of forest management strategies and mastering top-notch methods and techniques (drawing up simple management plans, mastering the cartography of forest sites, using forest classifications to describe stands, etc.). FOGEFOR training courses designed for 'advanced' silviculturists (skill development, professionalization, reference groups) are a follow up to basic courses for beginners, for which new participants are scarce.

Indicator 6.1.3

Sustainable forest management certification

Certification aims to provide an objective impartial proof of the implementation of sustainable forest management practices. The quality of forest management practices can be assessed on the basis of:

– the forest area certified by PEFC (Programme for the Endorsement of Forest Certification schemes) or FSC (Forest Stewardship Council) with respect to sustainable forest management;
– the number of logging companies with PEFC or FSC certification.

These data enable estimation of the forest area and the minimum number of companies concerned by sustainable forest management. Other areas and companies may also comply with sustainable management criteria, but it is impossible to measure this.

Program for the Endorsement of Forest Certification Schemes (PEFC)

Area and number of owners and companies with PEFC certification (in December of the concerned year)

	2005	2006	2007	2008	2009	2010
PEFC-certified area (ha)	4 067 688	4 401 200	4 577 105	5 066 619	5 089 378	5 151 484
Number of PEFC-certified owners	16 452	20 440	23 214	43 202	47 196	48 175
Number of PEFC-certified loggers	290	306	301	317	310	319
Number of PEFC-certified sawyers and loggers-sawyers	365	440	485	511	530	563

Source: Programme for the Endorsement of Forest Certification schemes (PEFC).

Note: The PEFC statistics group sawyers and loggers-sawyers. It is therefore not possible to exclude sawyers whose activity is not directly associated with forests. However, most sawyers are also loggers.

PEFC certification is a guarantee of compliance with the sustainable forest management criteria defined in the Ministerial Conferences on the Protection of Forests in Europe held in Helsinki and Lisbonne. Foresters, through their commitment to comply with these criteria, demonstrate their management of the economic, social and environmental impact of their activity. PEFC certification, which is voluntary, thus encourages forest owners to enhance their training on sustainable management practices. Foresters are regularly subject to unannounced checks and visits from a representative of an accredited certification body as part of annual audits of regional entities and monitoring of their members. PEFC certification was designed especially according to the specific features that prevail in Europe, which are quite marked in France, especially with respect to the predominance of private forests, which are often highly fragmented, alongside state-owned and community-owned forests. The PEFC system, which is based on the continuous improvement principle, sets objectives that are revised on a 5-year basis. The PEFC-France association pools three categories of stakeholders in the sector (producers, manufacturers and forest users). The distinct regional features are a major focus of the PEFC benchmarks. PEFC-France is thus represented throughout France by around 15 regional (or interregional) associations responsible for managing forest certification on a local scale. They are responsible for setting forest management rules in line with the constraints of all forest owners and managers within the same region based on assessments.

The area and number of certified owners have been steadily increasing since 2005. Currently, 5.2 Mha of forests have PEFC certification for 48,175 members. The marked increase in the number of certified owners between 2007 and 2008 could be explained by the introduction, by forest cooperatives, of the 'porting' concept. Through their PEFC sustainable management certification, they guarantee interventions in members' properties in compliance with PEFC sustainable forest management principles. They offer members the possibility of 'porting', in their name, the PEFC certification of their forests assigned to the cooperative. The owner's commitment is individual and voluntary. This certification 'porting' is tailored to the fragmentation of French private forests and simplifies the commitment of silviculturists in the sustainable management of their forests.

A 5-year PEFC membership of a forest logger is a commitment to comply with the national logging specifications. The aim of the specification document is to promote harmonization and improve the clarity of PEFC requirements applied to logging in France. This document was drawn up by an ad-hoc working group, mandated by PEFC-France, in collaboration with concerned stakeholders. All specifications available when the document was drawn up were taken into account. It includes national requirements supplemented by local requirements applicable in certain regions, while being focused especially on the removal of nutrients from forest ecosystems. Potential modifications to the national logging specifications must be applied by loggers as soon as possible and at the latest within 12 months following their notification. Loggers, as specified in the membership documents, accept to be monitored internally by the regional PEFC body and externally by the certification institution.

Like the trend with forest owners, the number of PEFC-certified forest companies has been increasing since 2005, and currently 319 forest loggers and 563 sawyers have PEFC certification.

Forest Stewardship Council (FSC)

Area, number of forest owners and groups and number of FSC-certified loggers (February 2011)

	2011
FSC-certified area (ha)	15 847
Number of FSC-certified forest owners and groups	17
Number of FSC-certified loggers (chain of control)	10

Source: Forest Stewardship Council (FSC).

Note: FSC statistics concerning the number of loggers pool all companies having logging activities, including sawyers and pulp and paper manufacturers.

FSC is an international not-for-profit NGO. It was established in 1993 to promote responsible forest management worldwide. By responsible management, FSC means management that takes preservation of the natural environment into account, while being socially beneficial and economically viable. The association, which consists of an environmental bureau, a social bureau and an economic bureau, has participatively developed a set of 10 principles and criteria (FSC, 2000). Each FSC-certified forest is audited by an independent certification organization, which checks compliance with the principles and criteria. An initial audit is carried out, followed by yearly audits. A certificate renewal audit is carried out in each certified forest on a 5-year basis. The FSC system, which is tailored for both tropical and temperate forests, has developed instruments to facilitate proper application of the system in fragmented private forests in Europe. There are currently 15,847 ha of certified forests in France, for 17 forest owners and groups. In addition, 10 companies with logging activities are certified.

Indicator 6.2

Contribution of forestry and manufacturing of wood and paper products to gross domestic product

Value added per sector and contribution of forestry and wood and paper products to added value and gross domestic product (GDP) (in billion € 2008)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Silviculture and logging	4.3	3.5	4.5	4.0	2.8	3.1	3.1	3.8	4.4	3.4
Woodworking and wood product manufacturing	4.1	4.2	4.0	4.0	4.3	3.7	3.4	3.4	3.7	3.7
Paper pulp, paper and cardboard manufacturing	2.2	2.5	2.8	2.5	2.2	2.0	1.8	1.6	1.5	1.2
Paper and cardboard product manufacturing	3.7	3.7	4.0	3.8	3.7	3.7	3.4	3.1	3.3	3.3
Furniture making (wood and non-wood)	5.0	5.0	5.2	5.0	4.9	4.7	4.5	4.3	4.0	3.6
Total added value	**19.3**	**18.9**	**20.4**	**19.4**	**17.8**	**17.1**	**16.2**	**16.2**	**17.0**	**15.2**
Total added value France	1447.0	1505.5	1542.7	1568.1	1582.6	1609.4	1640.6	1683.8	1746.0	1750.5
Total added value France excluding service industry	377.7	387.5	390.1	384.3	375.3	376.0	376.8	379.6	396.7	390.8
% added value France	1.3%	1.3%	1.3%	1.2%	1.1%	1.1%	1.0%	1.0%	1.0%	0.9%
% added value France excluding service industry	5.1%	4.9%	5.2%	5.0%	4.7%	4.5%	4.3%	4.3%	4.3%	3.9%
Gross domestic product (production approach)	1622.5	1681.2	1717.7	1743.7	1759.1	1793.0	1829.6	1884.1	1948.4	1948.5
Gross domestic product (production approach) excluding service industries	753.8	777.8	794.8	790.5	788.1	800.2	802.8	823.2	850.5	836.6
% Gross domestic product (production approach)	1.2%	1.1%	1.2%	1.1%	1.0%	1.0%	0.9%	0.9%	0.9%	0.8%
% Gross domestic product (production approach) excluding service industries	2.6%	2.4%	2.6%	2.5%	2.3%	2.1%	2.0%	2.0%	2.0%	1.8%

Source: Institut national de la statistique et des études économiques (INSEE), Comptes Nationaux –2000 basis, according to the Nomenclature économique de synthèse (NES).

Note: Added value is the total production value. It is equal to the production value minus the intermediary consumption. The gross domestic product (GDP) is the aggregate representing the final result of the production activity of resident production units. It can be defined as the sum of gross added values of different institutional sectors or different branches of activity, plus taxes but minus subsidies on the products (which are not allocated to sectors and activity branches).

The data used are from the INSEE Comptes Nationaux (2000 basis), contrary to the ISFM 2005 edition. This source has the advantage of being uniform and continuous over time. However, it does not enable a detailed breakdown by activity. The nomenclature used is from the Nomenclature économique de synthèse (NES) adopted by INSEE in 1994. This nomenclature is associated with the Nomenclature d'activités française (NAF) rev. 1. The activities included in each sector are as follows:

– 'silviculture and logging' (A02 in NES): silviculture, logging, associated services;
– 'woodworking and wood product manufacturing' (F31 in NES): wood sawing and planing; wood impregnation; wood panel manufacturing; framework and joinery manufacturing; wood package manufacturing; manufacturing of various wooden items; manufacturing of cork items, basketry or wicker work;
– 'paper and cardboard product manufacturing' (F33 in NES): corrugated cardboard industry; manufacturing of cartons, paper wrappings, paper articles for sanitary or domestic use, stationery articles, wallpaper and other paper or cardboard articles;
– 'furniture making' (C41 in NES): manufacturing of chairs, office and shop furniture, kitchen furniture, accessory furniture, garden and other outside furniture; associate upholstery industries; mattress manufacturing;
– 'paper pulp, paper and cardboard manufacturing' (F31 in NES).

Considering the sharp rise in services, two ratios are given, the contribution of all branches studied for added value (and respectively GDP) for all of France, but also their contribution to the added value (and respectively to GDP) excluding service industries (i.e. only retaining agriculture, silviculture and fisheries sectors; industry, energy and construction).

Sectors completely or partially associated with wood (silviculture, logging, associated services; woodworking and wood product manufacturing; paper pulp, paper and cardboard manufacturing; paper and cardboard product manufacturing; furniture making) currently generate added value that is estimated at €15 billion/year, or 0.9% of the national added value. The contribution of the wood industry overall to the added value dropped from 1.3% in 1999 to 0.9% in 2008. It had already decreased slightly between 1990 and 2000.

There were 34 logging companies employing 20 salaried workers or more or achieving sales exceeding €5 million in 2007 (SSP, annual firm survey (EAE)). That same year, there were 4,135 logging companies overall (SSP-EAE and income tax return on business profits (BIC) of INSEE-Direction générale des impôts (DGI)). The sector is becoming increasingly concentrated from year to year: there was a total of 6,353 logging companies in 2000.

The timber and paper industry consists of three main sectors: woodworking (including sawmills), wooden furniture making and the paper industry. Each of these sectors has its own specific characteristics, which differ between sectors. Except for the pulp and paper industry and the wood-based panel industry, which are highly capitalistic and globalised, the other sectors are more dispersed and their performance varies substantially.

Wood sawing and planing activities have increased considerably in recent years, mainly due to an upswing in the building industry that started in 1997. This sector still consists of many small units but the trend is now towards corporate concentration, i.e. there were 2,065 in 2007 (Source: SSP (EAE) and INSEE-DGI (BIC)) as compared to 6,800 in 1970.

Mechanised woodworking, excluding sawmills, mainly involves wood-based panel making, framework, joinery and wooden package manufacturing. The French wood-based panel industry is a highly concentrated sector consisting of a small number of mainly medium-sized companies. The framework and joinery sector is, however, very dispersed and the wooden package making companies are also quite dispersed.

The relative share of the added value of sawing and planing within the mechanical woodworking sector is not available. It was previously determined by the Service des études et des statistiques industrielles (SESSI) of the Industry Ministry, which has now been transferred to INSEE. As a guide, this percentage was evaluated at 23% in 1997 and 28% in 2001.

The paper and cardboard product manufacturing industry consists of 75 companies, while the paper pulp manufacturing industry consists of 12 (Confédération française de l'industrie des papiers, cartons et celluloses (COPACEL), 2009 data). France is the 10th ranking world paper and cardboard producer, the 5th ranking European producer, and the 24th ranking world per-capita consumer of these products (COPACEL, 2008 data).

The relative share of the added value of wooden furniture in the furniture manufacturing sector is no longer available. It was previously determined by SESSI. As a guide, this share had been evaluated at 61% in 1997 and 64% in 2001. Wooden furniture therefore represents a major share of the global furniture manufacturing sector. Most of these companies have a salaried staff of under 50.

Indicator 6.3

Net revenue of forest enterprises

Gross added value, mixed income and net enterprise revenue of forest enterprises (in million € 2008)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Description	*euros 2008*								
Production	6 470	6 563	5 873	5 469	5 634	5 863	6 217	6 910	6 265
Service input	3 351	3 538	2 839	2 763	2 878	2 717	3 301	3 814	3 429
Proportion for standing wood	1 667	1 932	1 313	1 074	1 105	1 160	1 494	1 849	1 466
Gross added value	**3 119**	**3 024**	**3 034**	**2 706**	**2 756**	**3 146**	**2 916**	**3 095**	**2 836**
Fixed capital consumption	689	680	667	650	634	619	606	522	519
Taxes	150	140	141	146	141	137	132	140	139
Production subsidies	112	176	279	131	98	107	103	35	33
Employee compensation	810	809	813	820	816	749	776	796	776
Mixed income	**1 581**	**1 570**	**1 693**	**1 222**	**1 263**	**1 748**	**1 505**	**1 672**	**1 434**
Outstanding interests	30	32	29	29	28	28	27	27	26
Enterprise revenue	**1 551**	**1 538**	**1 664**	**1 194**	**1 235**	**1 720**	**1 478**	**1 646**	**1 408**

Source: LEF, Integrated Environmental and Economic Accounting for Forests (IEEAF).

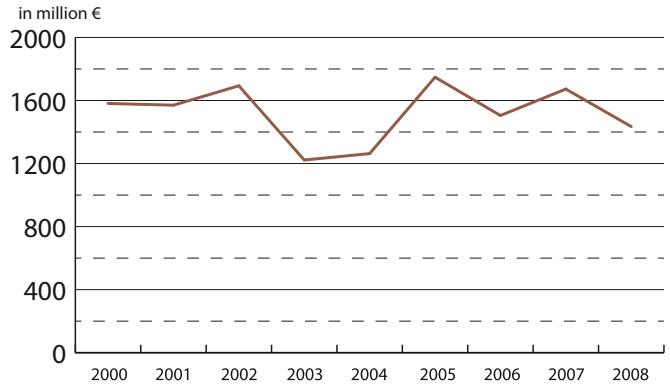


Figure 42: Mixed income variations (in million € 2008).

Source: cf. table.

Forest enterprise mixed income was estimated at €1.43 billion in 2008. Excluding inflation, there were substantial variations in added value and associated aggregates over the 2000-2008 period. These variations are primarily due to the impact of the 1999 storms. Logging of the enormous volumes of windfalls generated a high added value from 2000 to 2002, combined with an increase in subsidies, which were not maintained thereafter (2003-2004) because of the decline in removal volumes and the low prices. It was only in 2005 that net logging revenues improved because of the market recovery and a slight increase in removals. Mean stumpage prices rose from €19/m^3 in 2002 to €22/m^3 in 2008, as estimated within the framework of Integrated Environmental and Economic Accounting for Forests (IEEAF) and this includes the fuelwood self-consumption value. The payable interest is relatively steady and enterprise revenues to be paid are close to the mixed income level (€1.41 billion in 2008).

Note: IEEAF in France are developed by the Laboratoire d'économie forestière (LEF) on the basis of data of the Institut national de la statistique et des études économiques (INSEE), the French National Forest Inventory (NFI), the Office national des forêts (ONF) and the French Ministry of Agriculture, Food, Fisheries, Rural Affairs and Spatial Planning (MAAPRAT). These figures concern both silviculture and logging.

Mixed income is the sum of the gross added value (difference between production and service inputs) and production subsidies after deduction of employee salaries, taxes and consumption of fixed capital. The elements involved in this calculation are as follows (Niedzwiedz et al., 2010) :

– production: including net wood supply, mortality deducted (derived from the silviculture sector); production of construction timber, industrial timber and fuelwood (derived from the logging sector); other forest products (cork and forest plants); services (afforestation and reafforestation, forest inventories, fire and dune protection, rehabilitation of mountain areas and services provided by companies).

– service input: this mainly includes seeds and plants, energy, fertilizer, small equipment, services, as well as standing wood consumption by the logging sector (removals plus logging losses).

– production subsidies, employee compensation, taxes and consumption of fixed capital: these data are provided by INSEE and mainly derived from Les comptes nationaux.

The net enterprise revenue is the mixed income after deduction of rents and interest.

Indicator 6.4

Total expenditures for long-term sustainable services from forests

Total expenditures for long-term sustainable services from forests

Long-term sustainable services		Amount in million € 2010											
		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Forest fire protection	Prevention	34.0	34.3	34.8	36.7	30.7	31.9	31.0	30.5	29.8	29.7	28.8	26.9
	Control	84.5	86.1	93.0	107.1	200.6	129.5	133.9	145.2	117.0	100.6	116.7	98.0
Subtotal forest fire protection		**118.5**	**120.4**	**127.8**	**143.8**	**231.2**	**161.4**	**164.8**	**175.7**	**146.7**	**130.2**	**145.6**	**124.9**
Mountain landscape rehabilitation		9.7	12.6	7.4	20.5	18.3	14.3	15.2	18.8	17.7	17.6	17.7	16.5
Coastal dune protection		0.6	0.0	1.0	1.3	1.4	1.3	0.9	0.8	0.8	0.8	0.8	0.8
Subtotal mountain and dunes		**10.2**	**12.6**	**8.4**	**21.8**	**19.6**	**15.6**	**16.1**	**19.7**	**18.6**	**18.5**	**18.5**	**17.3**
Natura 2000 contracts, forest dispositions		0.0	0.0	0.0	NA	NA	NA	NA	NA	0.2	0.5	0.6	0.5
Biological reserves		0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.3

Sources: French Ministry of the Interior, Overseas Territories and Local Authorities, and the Ministry of Immigration, for fire control
French Ministry of Agriculture, Food, Fisheries, Rural Affairs and Spatial Planning (MAAPRAT) for fire prevention, mountain landscape rehabilitation and coastal dune protection.
French Ministry of Ecology, Sustainable Development, Transportation and Housing (MEDDTL) for Natura 2000 contracts and biological reserves.

Note:

Forest fire control

– The French Ministry of the Interior provides national funding for forest fire control, while managing most of the airborne fire fighting operations in France. A small share of these expenses concern prevention. Until 2009, 60% of the military training costs for civil protection was allocated to forest fire control. This percentage decreased to 38% in 2010 due to major operational involvement in other areas. At these rates, this cost represented €49 million in 2009 and €35 million in 2010.

– Expenditures of the Services départementaux d'incendie et de secours (SDIS) for forest fire fighting is not included since joint SDIS cost accounting and complementary expertise would be necessary to determine the exact figures, but they were estimated at €231 million (Chatry et al., 2010).

Fire prevention

– Forest fire prevention expenses only concern MAAPRAT credits and, since 2007, the self-financing share of the Office national des forêts (ONF) for general interest missions (in compliance with the State-ONF 2007-2011 contract).

– MEDDTL expenditures are not included (currently estimated at €1-2 million/year) for fire prevention, essentially for implementing natural forest fire hazard prevention plans (PPR). The share of their cost relative to all PPRs is not available.

– European funds mobilized in implementing rural development plans (European Agricultural Fund for Rural Development (EAFRD)) are also not included.

Other forest fire protection initiatives (prevention and control)

– The table does not include indirect costs of various other administrations for fire control and prevention, estimated at €13 million, those of local authorities (excluding SDIS), estimated at €98.5 million, and those for network managers, individuals and private owners, estimated at €13 million (Chatry et al., 2010).

Forest ecosystem protection

– For management of the European Natura 2000 network, amounts invested by the State for forest measures from 2007 to 2009 (there was no distinction between the different measures before this date) are indicated.

– European EAFRD credits are not included, nor are expenditures associated with drawing up and implementing documents of objectives, despite their high number. As a guide, the percentage concerning forests of costs for drawing up and implementing documents of objectives was roughly estimated by MEDDTL—on a pro rata basis with respect to the forest area at Natura 2000 sites—at €7.3 million in 2010 (an amount that has remained relatively steady in recent years).

– Expenses associated with biological reserves concerning MEDDTL funding, as of 2002, for biological reserves in public forests (as part of a State-ONF contract).

Public accommodation

– Expenditures for tourism-related work by ONF were estimated at €20 million in 2008, while ecological work was estimated at €25 million, but these estimations are only partial. They include expenditures devoted entirely to these services, in addition to a low estimate of the lump sum for regular work (tree marking, development projects, etc.) devoted to these services.

The main long-term sustainable services from metropolitan forests are forest fire protection (prevention and control), mountain land rehabilitation, coastal dune protection, expenditures for the Natura 2000 network and biological reserves. Total expenditures for these services in 2010 are estimated at €143 million. The sharp rise in 2003 is linked with the many forest fires that occurred during the summer drought-heat wave period: forest fire control expenditures incurred by the French Ministry of the Interior thus reached €200 million that year. There is always a greater proportion of expenditures for forest fire protection, even in average years.

The French Ministry of the Interior is generally responsible for implementing forest fire control policies (Chatry et al., 2010), i.e. defining certain prevention guidelines, standards for equipment involved and control strategies based on quick intervention to extinguish fire starts. Fire control expenditures are divided between airborne and military civil protection deployment and subsidies (including support groups). Over the last two decades, the heavy airborne fire fighting equipment capacity (Trackers, Canadairs, Dash) has remained steady, but the costs have increased with the efficiency of the aircraft. Over the same period, the staff and the availability of civil protection intervention units decreased slightly, but staff training and equipment improved, so their capacity generally remained stable. However, their cost increased sharply. Forest fire control expenditures may vary between years depending on the extent of interventions, which can in turn influence the aircraft deployment conditions, and potential acquisitions of air tankers to replace wrecked aircraft.

Forest fire prevention policies are implemented by MAAPRAT, in conjunction with the Ministry of the Interior, MEDDTL, territorial communities and forest owners (authorized union associations (ASA) of Aquitaine). These policies focus on four issues:

- hazard forecasting;
- forest fire monitoring for fire start detection and quick intervention on incipient fires;
- equipment and maintenance of forest fire protection structures (DFCI), development and management of forest areas;
- public awareness and professional training.

Forestry Ministry expenditures concern forest labour staff specialized in DFCI work, forest fire monitoring and fire start control teams, subsidies for investments and DFCI activities, in compliance with departmental and regional forest fire protection plans (PPFCI), eligible for development plans (Plan de développement rural hexagonal (PDRH) and Plan de développement rural de Corse (PDRC) for metropolitan France). These credits are decreasing for at least three reasons: the decline or maintenance of numbers of certain specialized DFCI staff, the decrease in State subsidies to French departments for forest fire fighters and the decrease in annual zonal credit allocations for the 'Prometheus' zone in 15 Mediterranean departments (ex-Mediterranean forest conservatory).

Mountain landscape rehabilitation and coastal dune protection are undertaken by ONF for MAAPRAT.

Mountain landscape rehabilitation activities of ONF concern:

- active protection: torrent control, drainage of waterlogged soils, biological engineering work;
- close protection to complement active protection: containment or deviation of dangerous material flows.

ONF is also involved in various mountain hazard prevention operations for the French Ministry of the Environment. It is in particular responsible for the management of databases on mountain hazards, permanent avalanche monitoring in partnership with the Institut de recherche pour l'ingénierie de l'agriculture et de l'environnement (CEMAGREF), and the development of hazard prevention guidelines.

In addition, ONF stabilises and maintains dunes on the edge of state-owned forests by planting vegetation (arenaceous plants) and installing windbreaks, safety fences and walking paths. Most of these operations are focused on dunes along the Atlantic coast. ONF outlined initiatives to be implemented on the basis of three key objectives: controlling erosion in the dune environment and preserving or enhancing its biodiversity, providing public access without disturbing natural balances, and renewing forest stands essential for the management of coastal areas.

The aim of the Natura 2000 network is to contribute to preserving biodiversity throughout Europe. It consists of special sites designated by Member States. In France, the Natura 2000 network currently covers over 6.9 Mha, or around 12.5% of the total area. Management measures outlined in documents of objectives drawn up for each site can be implemented through a Natura 2000 contract and benefit from both State and European funding. The first contracts were signed in 2003. The initiatives implemented most in forest areas correspond to projects that promote the development of senescent woodlands, the creation or rehabilitation of clearings or heathlands, and unwanted species control operations (ASP, 2010).

Indicator 6.5

Number of persons employed and labour input in the forest sector, classified by gender and age group, education and job characteristics

Employment in the wood sector (thousands of persons in full-time equivalents (FTE)).

		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Silviculture and logging	Total employment FTE	39.9	38.3	38.3	35.5	32.4	31.0	30.8	30.9	30.5	29.4
	Salaried employment FTE	30.5	29.0	29.1	26.5	23.6	22.4	22.3	22.6	22.5	21.8
	Independent employment	9.4	9.3	9.2	9.0	8.8	8.7	8.5	8.3	8.0	7.7
	% independent	23.6%	24.3%	24.1%	25.4%	27.3%	28.0%	27.7%	26.8%	26.2%	26.1%
Woodworking and wood product manufacturing	Total employment FTE	91.4	91.2	90.9	90.6	90.8	89.1	85.8	85.6	85.5	85.2
	Salaried employment FTE	85.0	84.7	84.5	84.1	84.4	82.8	79.4	79.1	79.0	78.6
	Independent employment	6.4	6.4	6.4	6.5	6.4	6.3	6.3	6.5	6.5	6.5
	% independent	7.0%	7.1%	7.1%	7.1%	7.0%	7.0%	7.4%	7.6%	7.6%	7.7%
Paper pulp, paper and cardboard manufacturing	Total employment FTE	26.1	25.9	25.7	25.4	25.1	25.3	24.4	24.3	23.4	22.2
	Salaried employment FTE	25.9	25.7	25.6	25.3	25.0	25.2	24.3	24.2	23.2	22.1
	Independent employment	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	% independent	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.6%
Paper and cardboard product manufacturing	Total employment FTE	60.2	59.4	60.3	58.9	57.6	56.2	53.8	49.5	48.2	47.4
	Salaried employment FTE	59.4	58.6	59.5	58.1	56.8	55.4	53.1	48.7	47.5	46.6
	Independent employment	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	% independent	1.3%	1.3%	1.3%	1.3%	1.3%	1.4%	1.4%	1.6%	1.6%	1.7%
Furniture making (wood and non-wood)	Total employment FTE	123.7	125.5	128.1	124.3	121.1	116.5	112.9	108.3	104.8	101.5
	Salaried employment FTE	106.6	108.3	110.9	107.2	104.3	100.0	96.4	91.6	88.3	85.0
	Independent employment	17.1	17.2	17.2	17.2	16.8	16.5	16.5	16.7	16.6	16.5
	% independent	13.8%	13.7%	13.4%	13.8%	13.9%	14.2%	14.6%	15.4%	15.8%	16.3%
Total all sectors	Total employment FTE	341.2	340.1	343.4	334.8	327.0	318.2	307.7	298.6	292.4	285.7
	Salaried employment FTE	307.4	306.3	309.7	301.2	294.1	285.9	275.5	266.2	260.4	254.1
	Independent employment	33.8	33.8	33.8	33.6	32.9	32.3	32.2	32.4	32.0	31.6
	% independent	9.9%	9.9%	9.8%	10.0%	10.1%	10.2%	10.5%	10.8%	10.9%	11.1%
Total France	Total employment FTE	23 204.6	23 867.2	24 369.3	24 577.4	24 599.5	24 628.6	24 774.9	25 031.2	25 431.7	25 617.1
	Salaried employment FTE	20 673.3	21 340.7	21 863.8	22 084.1	22 117.3	22 125.6	22 246.6	22 476.2	22 852.5	23 021.9
	Independent employment	2 531.3	2 526.5	2 505.5	2 493.3	2 482.1	2 503.0	2 528.3	2 555.1	2 579.1	2 595.2
	% independent	10.9%	10.6%	10.3%	10.1%	10.1%	10.2%	10.2%	10.2%	10.1%	10.1%

Source: Institut national de la statistique et des études économiques (INSEE), Comptes Nationaux – basis 2000, according to the Nomenclature économique de synthèse (NES).

Note: As for Indicator 6.2, the data used are from the INSEE Comptes Nationaux (2000 basis), contrary to the ISFM 2005 edition. This source has the advantage of being uniform and continuous over time. However, it does not enable a detailed breakdown by activity. Activities in each sector are described in Indicator 6.2. Work accomplished in the silviculture sector is especially hard to quantify because forest owners carry out much of the work themselves, and this is not accurately monitored by regular statistical surveys. However, the last survey of the Service central des enquêtes et études statistiques (SCEES, now the Service de la statistique et de la prospective (SSP)) in 1999 on the private forest property structure enabled an estimate of silviculturist forest owner labour input at 11 million days per year, or 49,000 full-time equivalents (FTE).

The data used underestimates employment in the forest-wood sector. This sector also employs personnel for upstream activities (ministries, French National Forest Inventory (NFI), forest development organizations, staff of the Office national des forêts (ONF), research and technical institutions, professional organizations, education and training, hunting) and downstream activities (machinery and equipment manufacturing, construction, wood marketing, chemistry of forest products). However, specific analyses would be required to be able to determine the number of people solely involved in the forest-wood sector, otherwise the breakdown is not possible (INSEE, 2006).

The forest-wood sector employs around 286,000 full-time equivalents, or 1.1% of the total employed labour force. The distribution per sector clearly shows that the furniture making sector predominates, with 36% of the workforce, followed by woodworking and wood product manufacturing (30%), paper and cardboard product manufacturing (17%), silviculture and logging (10%) and finally by paper pulp, paper and cardboard manufacturing. However, as mentioned in the note, taking the work carried out by silviculturist forest owners into account (estimated at 49,000 FTE by SCEES in 1999) would increase the share of the silviculture-logging sector to 22% of the total, i.e. 335,000 FTE.

Many independent employees work in the silviculture and logging field, representing 26.1% of all employment in 2008, whereas they only account for 0.6% of jobs in the paper pulp, paper and cardboard manufacturing sector. Throughout the industry, independent employees represent 11.1% of the jobs, a rate close to that of the entire workforce in France.

In addition, according to a study carried out in 1998 (Association forêt-cellulose, Serge Lochu Consultant, 2001), 235,000 jobs have been indirectly induced by the forest-wood sector, especially in the construction, intermediate goods, energy and financial sectors.

The Agence de l'Environnement et de la maîtrise de l'énergie (ADEME) commissioned a study to assess employment in the biofuel sector, ranging from biofuel production (wooden logs, chips, pellets, by-products, straw, fuel crops), to their storage (storage platform) and use (stoves and fireplaces, wood boilers, collective boilers and cogeneration units). In this study (Algoé and Blézat Consulting, 2007), it was estimated that there were 60,000 direct and indirect jobs in the biofuel sector in 2006, including 40% informal jobs. According to this study, 90% of the employment in the sector are associated with wooden logs and individual heating equipment (individual wood stoves, fireplaces and inserts; 55% and 35% of these jobs, respectively). 74% of the jobs associated with wooden logs are informal.

The employed labour force involved in the forest-wood sector has been declining in a trend-setting way for several decades. The total full-time equivalent employment has thus decreased from 341,000 in 1999 to 286,000 in 2008.

On the basis of the Comptes nationaux data, it is not possible to know the job distribution by gender, age and educational level. Otherwise, data from the statistical office of the European Union (EUROSTAT) Labour Force Survey (LFS), and the INSEE employment survey give an indication of this distribution. It should, however, be kept in mind that the sample concerning the wood sector is too small to be representative, so the data accuracy is poor. The LFS indicates that male employment largely prevails in the wood sector, with the proportion of female employees roughly around:

- 10% in the silviculture, logging and associated services sector;
- 20% for the woodworking and wood product manufacturing sector;
- 30% for the paper and cardboard manufacturing sector.

The proportion of employees over 50 years old is around 20% in these sectors. Finally, there seem to be fewer unqualified jobs than in the workforce, whereas there seem to be more midrange jobs. The training level seems to have progressed in all sectors. The paper and cardboard manufacturing sector has the highest percentage of high level jobs. Irrespective of the sector, 75-85% of all employees have not attended university.

Indicator 6.6

Frequency of occupational accidents and occupational diseases in forestry

Frequency of occupational accidents and occupational diseases of self-employed workers (excluding 'child victims' and 'solidary contributors') in the forest sector in metropolitan France, excluding Alsace-Moselle

	2004	2005	2006	2007	2008	2009
Affiliated during the period	6 807	6 730	6 726	6 749	6 719	6 501
Occupational accident, with work stoppage	699	721	671	634	605	517
Occupational accident, fatal	4	3	5	12	8	6
Occupational disease, with work stoppage	16	12	16	20	14	14

Source: Mutualité sociale agricole (MSA).

Occupational accidents and occupational diseases of salaried workers in the forest sector in Alsace-Moselle

	2007	2008	2009
Occupational accident, with work stoppage	500	442	413
Occupational accident, fatal	1	1	2
Occupational disease, with work stoppage	31	31	32

Source: Statistical statements on occupational accidents and diseases supplied by the Caisses d'Assurance-Accident Agricoles (CAAA).

After a marked decrease from 1979 to 1988, the occupational accident frequency rate in the forestry sector levelled off until 2001, with a slight improvement beginning in 2002 (see Table p. 144). The trends varied in the different subsectors. Logging is traditionally the worst subsector for accidents, even though the frequency rate has decreased as in other sectors. Silviculture ranked second in terms of occupational accident frequency. The pattern for the resin tapping sector is highly variable because of the low hourly volume concerned (0 to 10,000 h since 1992).

The increase in occupational diseases is generally linked to periarticular diseases, which were first taken into account in 1984. There is usually a rather long period between the exposure to a risk and detection of the disease. Several explanations for this phenomenon are possible but the fact that employees declare their health problems more systematically seems to play an important role, thus suggesting that this is mainly an 'administrative follow-up' indicator rather than an indicator reflecting an increase in occupational hazards.

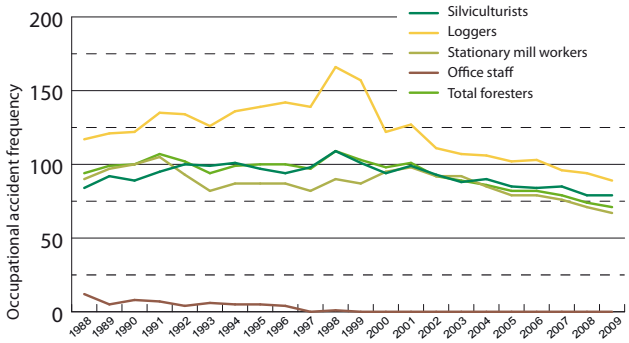


Figure 43: Variations in the frequency of occupational accidents (number of accidents with work stoppage per million work hours declared) for salaried employees in the forest sector (excluding resin tapping).

Source: Mutualité sociale agricole (MSA).

Frequency of occupational accidents and occupational diseases of salaried workers in the forest sector in metropolitan France, excluding Alsace-Moselle

		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Salaried workers																							
Number of work hours (x 1,000)		70 558	69 707	69 439	62 934	65 771	61 926	58 618	61 173	60 512	59 120	55 043	53 365	58 616	54 418	50 854	48 822	45 939	44 235	44 152	43 880	42 958	40 094
Accidents with work stoppage																							
Number	total	6 620	6 908	6 957	6 716	6 712	5 843	5 816	6 105	6 049	5 748	6 019	5 520	5 753	5 508	4 654	4 362	3 962	3 608	3 612	3 453	3 187	2 839
Number	serious fatal	15	11	10	14	12	25	12	14	18	13	13	15	20	19	8	13	3	10	7	10	11	8
Frequency rate	total	93.8	99.1	100.2	106.7	102.1	94.4	99.2	99.8	100.0	97.2	109.4	103.4	98.1	101.2	91.5	89.3	86.2	81.6	81.8	78.7	74.2	70.8
Frequency rate	fatal	0.2	0.2	0.1	0.2	0.2	0.4	0.2	0.2	0.3	0.2	0.2	0.3	0.3	0.3	0.2	0.3	0.1	0.2	0.2	0.2	0.3	0.2
Occupational diseases with work stoppage																							
Total number	total	14	16	22	16	25	26	34	33	52	63	64	84	89	130	127	142	109	161	143	130	137	137

Source: Mutualité sociale agricole (MSA).

Note: As Alsace and Moselle have a different system for occupational accidents, the sources and data used differ.
Data on salaried workers concern those involved in silviculture, resin tapping, logging, stationary mills and associated offices.
For self-employed workers, since 1 April 2002, the 'occupational accidents and professional diseases' insurance plan for farm operators has become an obligatory social protection branch. Members may obtain insurance through MSA or the Association des Assureurs (which has delegated the Réunion de sociétés d'assurances). Since that date, MSA utilizes statistical data for occupational accidents and professional diseases derived from agencies of MSA agencies and the insurance provider group. Data on self-employed workers concern those involved in silviculture, logging and stationary mills.
Only occupational accidents per-se are recorded. Commuting accidents which, according to the French labour code, are classified as occupational accidents for salaried worker entitlements, are not included here since they are not hazards associated with the type of professional activity.
The accident frequency rate represents the number of accidents with work stoppage per million declared work hours. It is irrelevant to calculate this frequency rate for professional diseases since the period between an exposure to a hazard and detection of a professional disease can be quite long. Moreover, the extent to which these diseases are accounted for varies highly depending on the type of disease and the geographical area where the individual is located, so it is more an administrative monitoring indicator. For self-employed workers, this frequency rate cannot be calculated because the work hours are not recorded.

Indicator 6.7

Per capita consumption of wood and products derived from wood

Apparent consumption of wood and products derived from wood in France

Apparent consumption of wood and wood-derived products	1990	1995	2000	2005	2006	2007	2008	2009
Total (million m^3 roundwood equivalents)	113	113	122	121	120	117	114	115
Per capita (m^3 roundwood equivalents/capita)	1.99	1.95	2.06	1.98	1.95	1.90	1.83	1.85

Sources: United Nations Economic Commission for Europe (UNECE)/Food and Agriculture Organization of the United Nations (FAO) (French data transmitted for the Joint Forestry Sector Questionnaire (JFSQ), published in the ForesStat database) for data related to wood and wood-derived products; United Nations population division (data published in the PopStat database) for population.

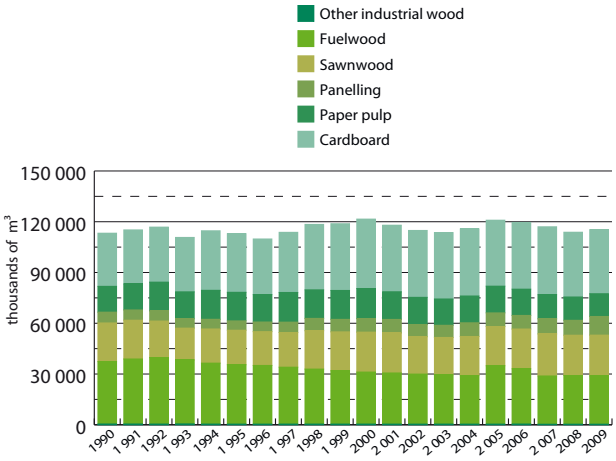


Figure 44: Variations in apparent consumption of wood and wood-derived products per product type, in roundwood equivalents (EQ) (1,000 m^3).

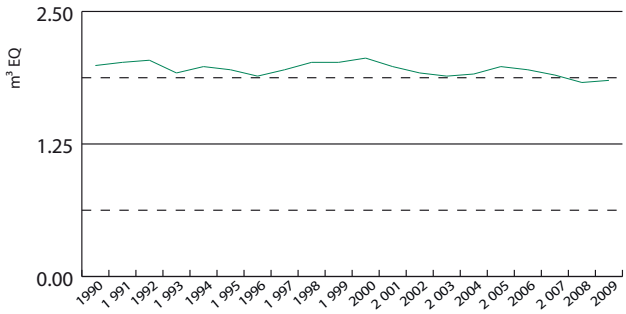


Figure 45: Variations in per capita apparent consumption of wood and wood-derived products, in roundwood equivalents (EQ).

Source: cf table.

Note: The method used is recommended by FAO for the JFSQ. The apparent consumption is defined as the sum of produced and imported quantities. Processed product volumes are converted to 'roundwood equivalents' (EQ) using technical coefficients, i.e. raw wood volumes required to manufacture these processed products, including production losses. The total wood and derivative consumption in EQ is calculated as the sum of apparent consumption of sawnwood, wooden veneer and panelling, paper pulp, cardboard, other industrial roundwood and fuelwood (marketed and self-consumed). By only considering these products, double counts are avoided (consumed construction timber is counted as sawnwood, as is pulpwood used by panelling manufacturers and pulp).
The data used are what the French Service de la statistique et de la prospective (SSP) provides to FAP for the JFSQ. They are estimated on the basis of French national statistical sources: branch surveys, professional federations, Service de l'observation et des statistiques (SOeS)-Observatoire de l'Energie and the French customs service. Since 2006, the quantities supplied by the customs service are incomplete due the lack of obligation to transmit the information, so the estimations are done by SSP within the framework of the JFSQ. Wood self-consumption estimates are provided to FAO by SSP within the framework of the JFSQ. It is calculated on the basis of the latest data from the Service de l'observation et des statistiques (SOeS) and studies (Arthur Andersen and Associates, 2000), indicating that 70% of total fuelwood consumption involves wood from forest trees, with 25% from non-forest trees and 5% recycled wood.

Total apparent consumption of wood and wood-derived products in metropolitan France was over 115 Mm^3 EQ in 2009, or 1.85 m^3 EQ/capita. Per-capita consumption declined slightly over the 1990-2009 period (-0.4%/year on average). This decrease could be partially explained by the population growth, which increased faster than wood consumption (+0.5%/year on average versus +0.1%/year, respectively), and also by the decrease in fuelwood consumption, especially self-consumption (-1.6%/year on average over the 1990-2009 period), which represents 90% of the total fuelwood consumption. However, consumption of marketed fuelwood increased (+2.0%).

Panelling consumption increased by 2.9%/year on average between 1990 and 2009. This is the result of an increasingly greater diversified supply of wood-based panelling, to fulfil the demand from construction, furniture and wooden package manufacturing industries and DIY stores. Paper and cardboard consumption has also increased since the 1990s, especially in conjunction with the marked increase in graphic paper consumption.

Wood-derived products benefit from the 'green' label trend, promoting the consumption of natural, environment-friendly products, especially fuelwood, wooden packaging, wood products used in construction and various other wooden items (useful and decorative articles). Technological improvements and the promotion of wood materials, especially for construction, seems to be starting to pay off. Wood and derivatives are being showcased as competitive, modern ecological products thanks to innovations by the Institut technologique forêt cellulose bois-construction ameublement (FCBA) and national and regional interprofessional promotion. Wood combines technical and environmental performance, and contributes to combating the greenhouse effect by sequestering carbon. It is likely that the trend towards increased certification of wood products has an impact on end consumption, but it is currently impossible to measure the apparent consumption of certified wood in France due to the lack of data.

Indicator 6.7.1

Salvaging and recycling cellulose fibres–upgraded related products

Salvaging and recycling papers and cardboards

Variation in the consumption and salvaging of papers and cardboards

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Consumption (kt)	4 163	4 192	4 468	4 930	5 276	5 775	5 566	5 705	5 781	5 942	5 953	6 050	5 947	5 677	4 998
Utilization rate (%)	48.3	49.1	48.9	53.8	55.0	57.7	57.8	58.2	58.2	57.9	57.6	60.5	60.4	60.4	60.0
Apparent salvaging (kt)	3 705	3 857	4 220	4 669	5 037	5 299	5 350	5 581	5 938	6 417	6 568	6 951	7 091	6 885	6 907
Salvaging rate (%)	38.5	41.1	40.9	43.8	46.2	46.5	49.2	51.3	54.7	58.1	60.6	63.7	63.8	64.4	72.5

kt: 1,000 t
Source: Confédération française de l'industrie des papiers, cartons et celluloses (COPACEL).

Note: The salvaged paper and cardboard utilization rate is the consumption of paper and cardboard salvaged during the new paper and cardboard manufacturing process. It reflects variations in the percentage reuse of recycled fibre relative to total utilized fibre resources.
The salvaging rate represents the salvaging of used paper over the apparent paper and cardboard consumption. It reflects variations in the percentage consumption of paper and cardboard salvaged after utilization, and the development of the salvaging system or the increase in its efficiency.
Apparent salvaging is the consumption of salvaged paper and cardboard, plus exports and variations in stocks, minus imports.

Salvaged paper and cardboard are obtained via collections from manufacturers, households and merchants, process scrap and unsold material. They are used for manufacturing paper and cardboard instead of virgin cellulose fibre derived from wood. The salvaged paper and cardboard utilization rate has been increasing over the last 15 years. Salvaged fibre is the main source of fibre in the French paper manufacturing industry (60% utilization rate in 2009).

Paper and cardboard salvaging has developed substantially via the development of selective collection and promotion of collection, sorting and recycling to encourage the involvement of the paper manufacturing industry and all stakeholders in the recycling system. Material from almost two-thirds of all paper and cardboard products is reutilized for manufacturing new products. There is still scope for improvement with respect to paper from offices—the awareness of these stakeholders requires boosting. The objective salvaging rate for 2010 was set at 66% through a joint European statement to partners of the Confederation of European Paper Industries (CEPI)/European Recovered Paper Association (ERPA) network. France is currently well positioned in terms of its salvaging rate relative to the average rate for all European countries (72.2% in 2009 according to the European Declaration on Paper Recycling follow-up report). However, the high salvaging rate in 2009 was circumstantial, as it was associated with the marked reduction in global paper and cardboard consumption due to the global economic situation.

The development of old paper recycling is more a response to an industrial strategy (cost reduction in the paper manufacturing industry) and waste management than a forest protection strategy, considering the moderate removal rate in France. Material salvaging transforms used products (waste) into resources, extends their service life, reduces the environmental impact of paper and cardboard products, while also reducing the quantity of waste that has to be disposed.

By-product processing

Variations in the quantity of processed sawmill by-products

	Units	1988	1993	1998	2004	2005	2006	2007	2008	2009
Processed sawmill by-products	*1000 t*	5 298	6 263	7 583	7 876	8 117	8 705	9 186	8 706	7 785
including by-products for pulping	*1000 t*	3 240	3 623	4 312	4 286	4 511	4 694	4 823	4 417	3 925
Production of sawnwood, cask wood and railway ties	*1000 m³*	10 269	9 319	10 220	9 980	9 932	10 157	10 206	9 596	8 074
Sawmill by-products/production of sawnwood, cask wood and railway ties	*t /m³*	0.52	0.67	0.74	0.79	0.82	0.86	0.90	0.91	0.96

Source: SSP – Wood removals and sawnwood production.

Sawmill by-products are derived from the first stage of industrial silvicultural timber processing. There are different types of these products depending on the operations from which they are derived (debarking, log milling, rip sawing, etc.): chips and shavings, sawdust, bark and short offcuts. Their use enhances the cost-effectiveness of saw mills and reduces pulp industry supply costs, while improving the efficiency of wood material utilization. These by-products are also used to supply urban and industrial boiler plants, thus generating conflicts of use with cellulose pulp and panelling manufacturers.

The quantity of processed sawmill by-products reached 7.8 million t in 2009. Following a steady increase for over 20 years, it stalled in 2008 and 2009 due to the economic crisis. Relative to the production of sawnwood, cask wood and railway ties, it was 0.96 t/m³ in 2009. The share targeted for pulping (chips and offcuts) has been decreasing over time, i.e. from 61% in 1998, but it was still around 50% in 2008 and 2009.

The volume of unmarketed waste was 0.4 million t in 2009. 568,000 t of by-products used for energy production were marketed in 2009 (sharply increasing trend), whereas 256,000 t were self-consumed by the manufacturing companies (also sharply increasing trend).

Indicator 6.8

Imports and exports of wood and products derived from wood

Trade balance in volume (in roundwood equivalents)

Restricted range (European requirement): excluding secondary manufactured products (except for paper and cardboard) (see Note)

Trade balance in roundwood equivalents (EQ), based on the method used for the Joint Forestry Sector Questionnaire (JFSQ) survey conducted for the Food and Agriculture Organization of the United Nations (FAO).

	Quantities (million m^3 roundwood equivalents)						
	1990	1995	2000	2005	2006	2007	2008
Exports	13.1	19.0	25.2	31.0	31.2	29.8	27.7
Imports	28.1	29.1	40.4	41.2	42.2	43.4	41.0
Balance	-15.0	-10.1	-15.1	-10.1	-11.0	-13.7	-13.4

Sources: United Nations Economic Commission for Europe (UNECE)/Food and Agriculture Organization of the United Nations (FAO) (French data transmitted for the Joint Forestry Sector Questionnaire (JFSQ), published in the ForesStat database). FAO for conversion coefficients.

Expanded range (national adaptation): including all secondary manufactured products (see Note)

Trade balance in roundwood equivalents, based on the method used by the Laboratoire d'économie forestière (LEF).

	Quantities (millions m^3 roundwood equivalents)						
	1990	1995	2000	2005	2006	2007	2008
Exports	23.4	27.9	41.2	47.6	48.4	48.7	46.6
Imports	37.0	42.3	57.3	58.7	59.8	62.9	59.5
Balance	-13.6	-14.3	-16.1	-11.2	-11.5	-14.2	-12.9

Sources: Laboratoire d'économie forestière (LEF) – Trend chart for the wood industry. According to data from the French customs service published by AGRESTE and estimates of the Service de la statistique et de la prospective (SSP) for the missing data. LEF for conversion coefficients in roundwood equivalents (EQ) (including coefficients for secondary manufactured products) and SSP for the other coefficients.

Note: Processed product volumes were converted into roundwood equivalents (EQ – cf. Indicator 6.7) using technical coefficients.
The method implemented in the 'restricted range' table is that used for the JFSQ survey conducted by SSP for FAO, as for Indicator 6.7. This questionnaire also serves as a reference for the report on forest sustainable management indicators in Europe, which was filled in during the Forest Europe Ministerial Conference. The following products are taken into account: fuelwood, other industrial roundwoods, sawnwood, wood-based veneers and panelling, paper pulp and paper and cardboard.
The method used in the 'expanded range' table is that of LEF, which covers a broader range than the 'restricted range' table since it includes all roundwoods, wood and paper waste and secondary manufactured products. The following products are taken into account: rough timber, sawnwood, sawnwood by-products, veneers and plywood, reconstituted wooden panels (particle and fibre panels), pulp, rough paper and cardboard, old paper and secondary manufactured products (furniture, packaging, construction timber, various wooden items).
SSP, the French FAO correspondent for the JFSQ, uses French customs data. However, since 2006, quantities provided by the French customs service are incomplete due to the lack of obligation to transmit data. The estimates are thus done by SSP within the framework of the JFSQ.

The French trade balance in volume, regardless of the method used, is negative.
In 2008, France imported 28 Mm^3 EQ of wood and derivative products (60 Mm^3 EQ when including all rough timber, waste and secondary manufactured products) while exporting 41 Mm^3 EQ (47 Mm^3 EQ in the expanded range). The trade balance deficit in volume is thus almost 13 Mm^3 EQ.
The trade deficit declined between 2003 and 2006, with an export volume that increased faster than the import volume, but it began increasing again in 2007, and this trend worsened in 2008 with the economic crisis which stalled trade.

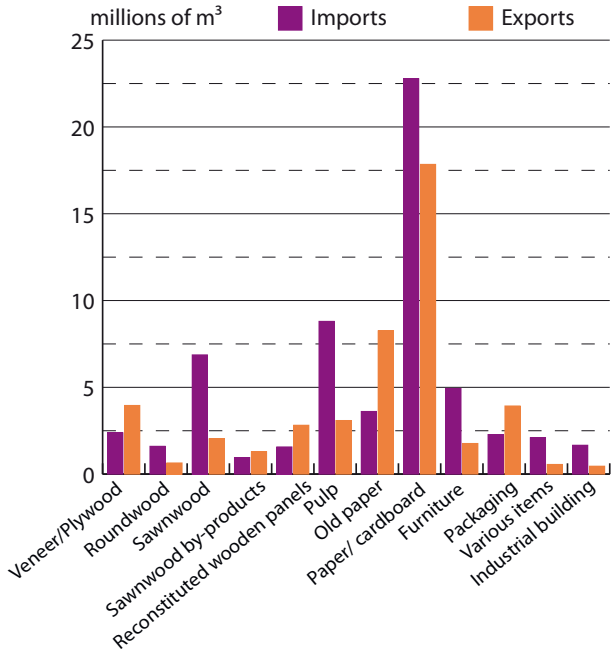


Figure 46: Imports and exports in roundwood equivalents and derived products by product type in 2008.
Source: Laboratoire d'économie forestière (LEF).

The main imported products (cf. Figure 46) are paper and cardboard (38%) sawnwood (12%) and paper pulp (15%), whereas the top export volumes concern paper and cardboard (38%), old paper (18%), roundwood (18%) and packaging (18%).
France has a high deficit with respect to paper pulp (-5.7 Mm^3 EQ), rough paper and cardboard (-4.9 Mm^3 EQ), sawnwood (-4.8 Mm^3 EQ) and wooden furniture (-3.2 Mm^3 EQ). However, our trade balance is positive for old paper, roundwood and packaging (+4.6 Mm^3 EQ, +1,6 Mm^3 EQ and +1,6 Mm^3 EQ, respectively).
The main partners of France are generally other European countries. For imports, its main partners are Germany, Belgium, Luxembourg, Finland, and Congo and Gabon for tropical wood, whereas for exports Spain, Belgium, Luxembourg, Germany and Italy top the list.

Trade balance in value (in million € 2008)

The European indicator (for the Forest Europe Ministerial Conference) just requires the volume calculation, so only the trade balance in value determined by the LED method (national method) is presented here.

Trade balance in value based on Laboratoire d'économie forestière (LEF) data

	Values (million € 2008)						
	1990	1995	2000	2005	2006	2007	2008
Exports	5 785	6 734	8 980	8 166	8 351	8 554	7 955
Imports	10 607	9 548	13 164	11 934	12 301	13 504	12 859
Balance	-4 823	-2 814	-4 183	-3 768	-3 950	-4 950	-4 904

Sources: Laboratoire d'économie forestière (LEF) – Trend chart for the wood industry. According to French customs data published in Agreste. The transaction amount is expressed for imports in terms of CIF (cost, insurance, freight) and for exports in FOB (free on board). 8-figure Combined Nomenclature is used.

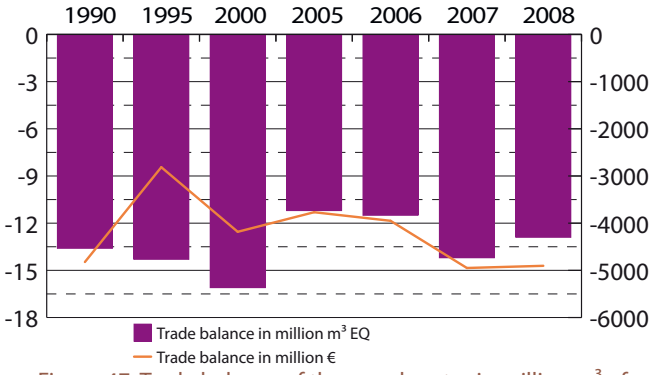


Figure 47: Trade balance of the wood sector in million m^3 of roundwood equivalents and constant million € 2008.

Source: Laboratoire d'économie forestière (LEF).

Note: The data are derived from LEF studies and in line with the 'expanded range' table for the trade balance in volume.
The products taken into account are: rough timber, sawnwood, sawnwood by-products, veneers and plywood, reconstituted wooden panels (particle and fibre panels), pulp, rough paper and cardboard, old paper and secondary manufactured products (furniture, packaging, construction timber, various wooden items).

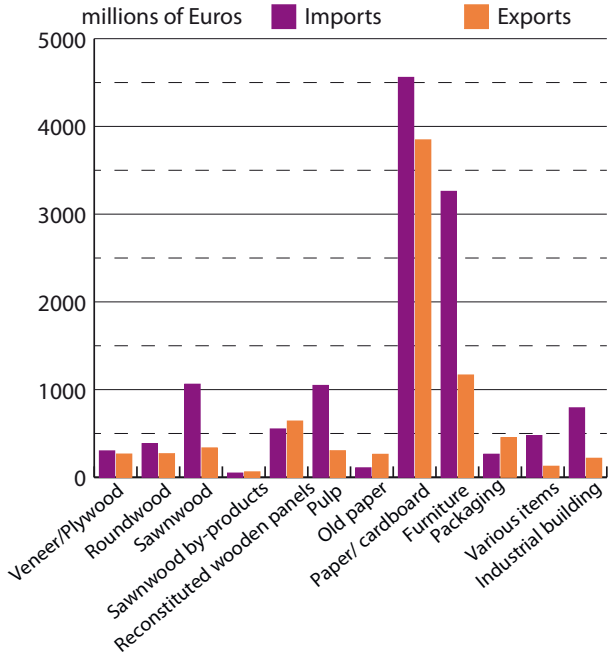


Figure 48: Imports and exports in million € of wood and derived products by product type in 2008.

Source: Laboratoire d'économie forestière (LEF).

France had a negative foreign trade balance of nearly €5 billion for the entire wood sector in 2008. In relative value, exports increased faster than imports between 1990 and 2008 (+1.8% per year versus +1.1% per year, and the 2008 deficit level is equivalent to the 1990 level.

There were still clear variations over the period, with an improvement in the trade balance in the mid-1990s, which was halted by the impact of the storms in 1999 and in the 2000s, with a decline at the end of the period, likely due to the international economic crisis in 2008.

As for the trade balance in volume, the main partners of France are other European countries, in addition to China for processed wood products.

In 2008, 43% of the deficit could be explained by the poor trade balance for furniture (wooden furniture and chairs). The deficit for sawnwood, paper pulp and paper and cardboard are equal, with each representing around 15% of the overall deficit. Although the trade balance deficit for sawnwood tended to increase, that of paper pulp and paper and cardboard improved markedly (an almost twofold decrease between 1990 and 2008).

The main excess products are packaging, old paper and reconstituted wooden panels (particle and fibre panels).

In 2008, although the roundwood trade balance was positive (1.6 million m^3 EQ), it was slightly negative in value (-€36 million). This shows that imported woods have a much higher unit price than exported wood (€127 versus €67 on average in 2008). This could be explained by two factors: the mean unit price for imported construction timber is 49% higher than the unit price of imported pulpwood, whereas in exports the same ratio is only 18%, and the percentage of pulpwood is higher in exports.

The wood industry deficit represents 9% of the French trade balance deficit and 0.3% of the national gross domestic product (GDP). Better wood mobilization, especially in private forests, and better supply structuring via strengthening of interprofessional organizations are potential ways to reduce the deficit in the forest wood sector.

Share of wood energy in total energy consumption for metropolitan France

Period	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010 provisoire
Primary production in KTOE – all renewable energies	15 932	16 797	15 150	15 786	16 106	15 764	16 329	17 163	19 690	20 399	22 745
1.1 Primary production in KTOE – all electrical renewable energies	5 823	6 468	5 272	5 153	5 233	4 568	5 049	5 375	6 008	5 636	6 299
1.2 Primary production in KTOE – all thermal renewable energies	10 109	10 329	9 878	10 633	10 873	11 197	11 281	11 789	13 682	14 764	16 446
proportion of primary production in KTOE – wood energy	8 281	8 424	7 852	8 456	8 521	8 572	8 294	8 104	8 726	8 997	10 100
share of wood energy in the primary production of renewable energies	52.0%	50.1%	51.8%	53.6%	52.9%	54.4%	50.8%	47.2%	44.3%	44.1%	44.4%
Gross renewable electrical energy production standardized in GWh	-	-	-	-	-	70 537	71 497	72 633	74 946	76 323	78 679
proportion of wood energy	1 090	1 044	1 109	1 132	1 129	1 254	1 250	1 364	1 409	1 234	1 360
share of wood energy in standardized gross renewable electrical energy production	-	-	-	-	-	1.8%	1.7%	1.9%	1.9%	1.6%	1.7%
Final renewable thermal energy consumption based on the RE Directive	-	-	-	-	-	9 280	9 246	8 970	9 937	10 773	12 216
proportion of wood energy	8 125	8 285	7 705	8 306	8 372	8 371	8 099	7 656	8 198	8 648	9 724
share of wood energy in final renewable thermal energy consumption	-	-	-	-	-	90.2%	87.6%	85.3%	82.5%	80.3%	79.6%
Final consumption in transport in KTOE	-	-	-	-	-	547	855	1 578	2 446	2 620	2 863
proportion of biofuel	334	334	332	336	340	403	710	1 430	2 284	2 463	2 642
Final consumption all renewable energies in KTOE	-	-	-	-	-	15 749	16 105	16 646	18 666	19 800	21 690
proportion of wood energy	-	-	-	-	-	8 479	8 206	7 773	8 320	8 754	9 841
share of wood energy in final consumption of all renewable energies in KTOE	-	-	-	-	-	53.8%	51.0%	46.7%	44.6%	44.2%	45.4%
Consumption of primary energy by form of energy, with corrections for climate, in MTOE	267.0	268.2	271.7	270.7	274.2	275.1	273.9	273.9	273.2	261.4	265.8
Charcoal	14.2	12.4	12.8	13.6	12.9	13.4	12.4	12.9	12.1	10.7	11.4
Oil	95.0	95.1	93.3	91.3	92.5	91.4	91.3	90.9	88.4	85.0	82.0
Gas	37.4	38.3	40.0	39.1	39.8	40.7	40.1	40.3	40.4	38.7	40.1
Primary electricity (nuclear, hydraulic, wind-generated and photovoltaic)	108.9	110.9	113.5	114.9	117.1	117.4	117.6	116.1	117.0	110.7	115.1
Renewable energies	11.6	11.6	11.7	11.8	11.9	12.3	12.5	13.8	15.3	16.3	17.1
Final energy consumption, with corrections for climate, in MTOE	157.3	159.4	160.5	159.4	160.3	160.3	161.3	161.2	161.4	155.5	157.7

Source: Service de l'observation et des statistiques (SOeS). KTOE: thousands of tonnes of oil equivalents, MTOE: millions of tonnes of oil equivalents, GWh: giga-Watt-hour, RE Directive: Renewable Energy Directive

Distribution of the total energy production based on wood origin

	TJ/year	KTOE/year
Energy directly drawn from fuelwood	306 109	7 306
drawn from forest and other wooded lands	218 163	5 207
drawn from trees outside forests	87 946	2 099
Energy produced by related products and wood industry residue	92 181	2 200
solid related products (offcuts, sawdust, bark, excluding transformed products listed below)	50 711	1 210
liquid residue of pulp and paper industry (mainly black liquor)	41 470	990
Energy drawn from wood products transformed for energy purposes (charcoal, pellets, briquettes, chips, etc.)	5 662	135
Energy drawn from salvaged wood (from building construction or demolition, pallets, etc.)	20 717	494
Total energy production from wood	**424 669**	**10 135**

Source: SSP (based on the Joint Wood Energy Enquiry 2007 filled for FAO). TJ: terajoule (1012 joules), KTOE: thousands of tonnes of oil equivalents

Note:

– Primary energy is that contained in energy products extracted from the natural environment. This energy is used as-is by the end user, or processed into another form of energy (e.g. electricity), or consumed in the transformation process or during transit to the user, or used for non-energy purposes. Primary energy is recorded as early as possible upstream. Primary energy production is calculated by multiplying the quantities by the heating value.
– Total final energy consumption is the quantity of energy available for the end user. It is the primary energy consumption minus the internal consumption of the energy branch.
– Primary energy production in KTOE (thousands of tonnes of oil equivalents) for all renewable energies is equal to the total primary renewable electrical and thermal energies:
– renewable electrical energies: renewable hydraulic wind and photovoltaic energy production.
– renewable thermal energies: thermal solar, geothermal, heat pumps, biomass (fuelwood, renewable incinerated urban waste, agricultural and agrifood residue, biogas, biofuel).
– Final consumption of all renewable energies in KTOE for the RE Directive (2009/28/EC) is equal to:
– standardized (to eliminate meteorological variations) renewable electrical production: standardized gross hydraulic and wind energy production, gross photovoltaic and electrical energy production from biomass;
– final renewable thermal energy consumption according to the RE Directive: final real consumption relative to thermal solar, geothermal, heat pumps in compliance with the Directive, biomass (incinerated urban waste, fuelwood, agricultural and agrifood residue, biogas);
– biofuel consumption.
– Data in the table on p.152 are from SOeS, while those on the table on p.153 are from SSP. The differences between these data could be explained by differences in the methods used.

France is rich in renewable energy resources. In 2009, it was the second-ranking producer and also the second-ranking consumer of renewable energy in Europe (SOeS). Primary production of all renewable energies (electrical and thermal) was 20 MTOE (millions of tonnes of oil equivalents), or 15.3% of the total national energy production.

Since 2007 and the Grenelle Environment Forum, France has been developing and implementing an ambitious renewable energy development strategy throughout the country. Renewable energy production, according to the Grenelle Environment, is one of the two key energy strategies, with the second being to enhance energy efficiency in buildings.

A French national renewable energy action plan was drawn up in application of the European RE Directive 2009/28/EC and submitted to the European Commission in mid-2010. It outlines the contributions of each form of renewable energy and charts a tentative annual course for the 2010-2020 period for each form, so as to be able to reach, by 2020, the objective set by this directive of 23% renewable energy in the total final energy consumption.

Energy generated from biomass for heat and electricity production must be substantially developed in the coming years. In addition to small-scale facilities to generate heat for residences, biomass can also provide fuel for heating systems and electrical energy or cogeneration plants. In 2006, heat production by the biomass sector was 8.8 MTOE (excluding biogas). The heat production objectives for 2012 and 2020 are 12.2 and 19.7 MTOE, respectively.

The Grenelle Environment Forum set the objective to produce a supplementary 21 Mm^3 of wood by 2020, more than half of which is targeted for energy production. In 2008, ADEME (Agence de l'environnement et de la maîtrise de l'énergie) therefore assigned the French National Forest Inventory (NFI) the task of conducting a national assessment of woody biomass that should be available for energy production by 2020 (NFI, 2010). On the basis of an innovative assessment method and the most recent resource data, the study evaluated the mobilizable supplement in the light of the actual silvicultural, technical, economic and environmental situation. The sustainable supplementary stock of wood available for energy production in forests, poplar plantations and hedges was thus estimated at 12 Mm^3/year (2.7 MTOE), plus 7.2 Mm^3/year of other minor forest wood products (1.6 MTOE). A major management effort will nevertheless be required to rehabilitate currently abandoned stands so as to be able to mobilize these volumes.

Indicator 6.10

Area of forest and other wooded land where public has a right of access for recreational purposes and indication of intensity of use

Total per-capita forest area

ISFM 2005 Edition

	1993	1998	2003
Population (x1,000 inhabitants)	57 369	58 299	60 102
Forest area, including poplar plantations (1,000 ha)	14 811	15 220	15 408
Per-capita forest area (ha)	0.26	0.26	0.26

Sources: Service central des enquêtes et études statistiques (SCEES, now Service de la statistique et de la prospective (SSP)) /Enquête annuelle sur l'utilisation du territoire (Teruti) (1993 to 2003); Institut national de la statistique et des études économiques (INSEE)/General population census, estimations on 1st January of the year.

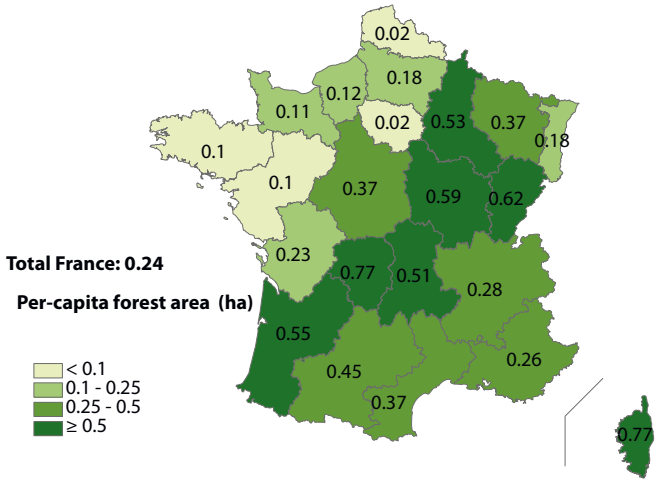
ISFM 2010 Edition

	2010
Population (x1,000 inhabitants)	62 135
Forest area, including poplar plantations (x1,000 ha)	15 137
Per-capita forest area (ha)	0.24

Sources: SSP - Teruti-Lucas (2010). Institut national de la statistique et des études économiques (INSEE) (2008 census, cumulation of data collected in the five census surveys from 2006 to 2010).

The per-capita forest area is 0.24 ha on average in France. The situation varies in different French regions because of differences in percentage forest cover and population densities. Corsica and Limousin have the highest per-capita forest area (0.77). The lowest ratios occur in Île-de-France and Nord-Pas-de-Calais (0.02).

This first approach to the 'forest supply' should be improved by including a property parameter since there is no public access to some private forests. Moreover, the distance between the population and the closest forest is a key factor with respect to accessibility. Forest access is also to an increasing extent governed by different, and sometimes competing, forest uses, especially on week-ends (hunting, hiking, etc.): a rigorous spatiotemporal understanding of activity sharing in forests could enhance the concept of public access to forests.



Map 26: Per-capita forest area by region.

Source: Institut national de la statistique et des études économiques (INSEE) (2008 census, cumulation of data collected in the five census surveys from 2006 to 2010) and SSP - Teruti-Lucas 2010 (forest area including poplar plantations and excluding other wooded land).

Note: Because of the switch from the Teruti survey to the Teruti-Lucas survey, it is impossible to make direct comparisons between the survey data (cf. Indicator 1.1). The decline in forest area between the 2003 and 2010 surveys is due to the sampling change. The data apply to metropolitan France.

Public forests

		Forest area devoted mainly to public access in ha (proportion of wooded area)			
		1994	1999	2004	2009
State-owned forests	Area	19 500	30 000	27 000	25 000
	proportion of wooded area	17 300	26 700	24 000	23 000
Other public forests governed by forest regulations	Area	24 000	33 500	35 000	44 000
	proportion of wooded area	19 900	27 800	29 000	36 000
Total public forest	Area	**43 500**	**63 500**	**62 000**	**69 000**
	proportion of wooded area	**37 200**	**54 500**	**53 000**	**59 000**

Source: Office national des forêts (ONF), management plan datasets on public access. Areas include wooded and non-wooded lands.

Note: The National Estate of Chambord is counted with forests owned by public authorities. The public access datasets concern parts of forests with priority public access. However, their area is only a partial indicator of the extent of public use of public forests. Most of these forests are open to the public and many public forests managed chiefly for wood supply have a high level of public facilities. As of 1 January 2010, and in compliance with the new ONF Directives nationales d'aménagement et de gestion, the public access dataset concept has been dropped and new public forest development plans will specify the classifications of forests (or parts of forests) according to the social demand (low, average, high). This classification will be developed on the basis of the extent of public use and in the light of regulations concerning landscape (e.g. classified site), public hosting or cultural facilities (e.g. forest charter focused especially on social and cultural aspects). The new database on public facilities will enable monitoring of areas by social demand class (integration of state-owned forests in 2011 and other public forests governed by forest regulations as the public facilities are upgraded).

For all public forests combined, the area in the public access datasets has increased considerably over the last 15 years, reflecting the fact that the social demand is being taken into consideration to an increasing extent in development projects. These stands, which are mainly located in the vicinity of large towns or famous tourist sites, benefit from specific equipment and tailored management, which is aimed at reconciling the high public use of certain sites with stand rehabilitation and preservation of ecologically sensitive environments.

The ONF has installed a considerable amount of equipment to meet the recreational demand in state-owned forests, especially (ONF, 2008):

– 15,600 km of hiking trails
– 7,200 km of cycling trails
– 3,200 km of horseback riding trails
– 1,100 km of cross-country ski trails
– 1,980 equipped reception areas
– 49 campgrounds
– 20 hiking trails with reception areas specially equipped for disabled persons.

Social expectations of French people concerning the forest area are complex and ever-changing. This situation prompted ONF, in partnership with scientific organizations, to undertake a large-scale assessment on social demand relative to forests. This work is aimed at clearly identifying and analysing expectations so that forest management can ultimately be tailored to meet these needs. A preliminary assessment, carried out in partnership with the Institut de recherche pour l'ingénierie de l'agriculture et de l'environnement (CEMAGREF, Bordeaux), showed that public expectations extended far beyond the recreational aspect of forests and could not be solely fulfilled by installing equipment associated with public accommodation. In 2004, a national survey on different images of forests in the public eye, conducted by ONF and the Université de Caen, concluded that the forest's role as a "heritage to pass on to future generations" is the top concern of French people (87%).

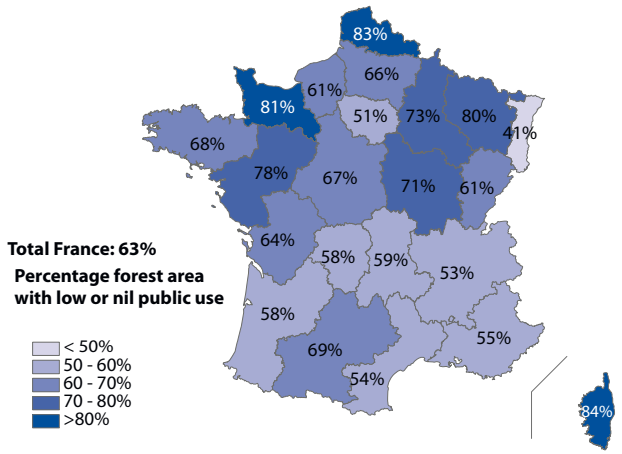
Public use of private forests of over 1 ha

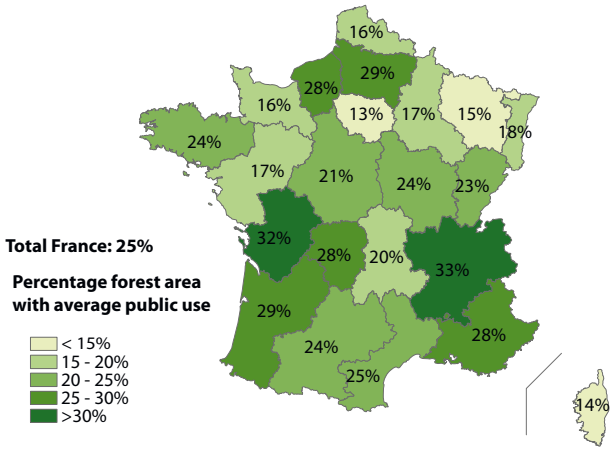
Public use of private forests of over 1 ha

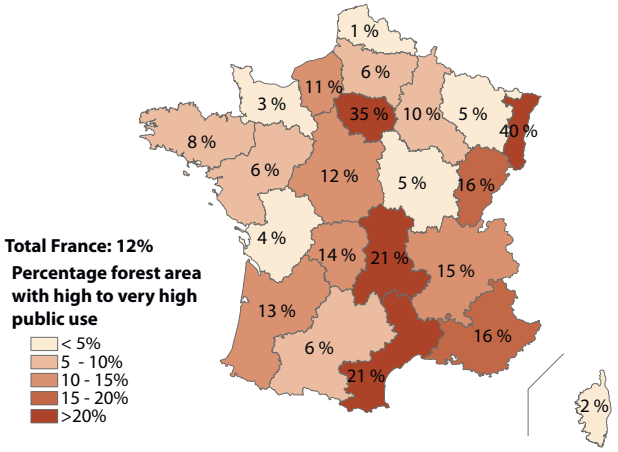
	Number of owners (1,000)	Forest area (1,000 ha)
Total	**1 118**	**9 848**
including %		
providing free public access to their forests	86%	72%
where the forest is visited by the public	75%	84%
- low public use	51%	46%
- medium public use	19%	25%
- high to very high public use	5%	12%
considering that the public causes no annoyance	87%	67%
tolerating picking of small products	88%	78%

Source: Service central des enquêtes et études statistiques (SCEES, now Service de la statistique et de la prospective (SSP), 1999, survey on private forest property structures; only forests of over 1 ha were monitored.

According to the 1999 SCEES survey, most owners of private forests of over 1 ha (86%) declare that they provide free access to their forests, i.e. 72% of the total forest area. Prohibited access is usually enforced by legal bodies, as displayed by warning signs (21% of areas) or by physical barriers (7%). A very large proportion of private forests is actually used by the public (84%) but the visiting rate is only high to very high in 12% of the area and limited to 5% of owners. The results vary from region to region (Map 27): the most visited private forests are located around large urban centres (Île-de-France) or in regions where tourism is high (Alsace, Languedoc-Roussillon, Auvergne, Provence-Alpes-Côte d'Azur). Finally, according to the same survey, many private owners consider that the public does not cause any annoyance and they tolerate picking of mushrooms, berries and other small products in their forests.







Map 27: Private forest areas with high to very high, average and low or nil public use per administrative region.

Source: Service central des enquêtes et études statistiques (SCEES), now Service de la statistique et de la prospective (SSP), 1999

Number of visits in forests

Total number of visits in forests

Public activities	Total number of household visits	Mean number of visitors per household	Total number of individual visits	Proportion of visits of 2 h and more	Number of visits per person and per year
2001	*1,000,000*	*units*	*1,000,000*	*%*	*unit/pers./year*
Walking	287	2.5	716	72%	12.5
Sports	51	2.1	109	65%	1.9
Animal walking	44	1.6	69	30%	1.2
Picking	21	2.5	51	88%	0.9
Hunting	10	1.7	18	74%	0.3
Fauna/flora	9	1.5	14	82%	0.2
Firewood	7	1.4	10	83%	0.2
Other activities	12	1.9	23	99%	0.4
Total	**441**	**2.3**	**1 010**	**70%**	**17.7**

Source: Survey of the Laboratoire d'économie forestière (LEF).

According to a LEF study conducted in 2002 in a sample of 2,575 French households representative of telephone subscribers, and concerning the year 2001, 56% of French households had visited a forest at least once in 2001. There was a total of 441 million visits, two-thirds of which involved walks. Each household was composed of 2.3 members on average, which means there was a total of a billion visits by French people in 2001. Walking is most often associated with picking, usually in family groups, more than nature watching, rural activities (hunting, firewood collecting) or walking a dog. Excluding the time it takes to reach the forest (mainly by car, bicycle or on foot), the visiting time is often over 2 h, and 2.5 h on average. Recreational activities in the forest are thus extremely important for French people, who pay around €2 billion per year just to gain access to forests by car.

Frequency of visits

Frequency of visits in forests during the 12 last months	% 1995	% 2004
Every day or almost		3
Once a week		12
Subtotal: at least once a week (2004)/very often (1995)	**22**	**15**
Once every 2 weeks		11
Once a month		16
Subtotal: at least once a month (2004)/often (1995)	**33**	**42**
Several times a year (2004)/rarely (1995)	26	29
Subtotal: at least once a year	**81**	**71**
Never	19	29

Sources:
2004: 'Forests and society' survey of the Office national des forêts (ONF)–Université de Caen/Laboratoire d'analyse secondaire et de méthodes appliquées à la sociologie (LASMAS), 2004.
1995: Survey of the Institut français de l'Environnement (IFEN, now the Service de l'observation et des statistiques (SOeS))/former Directorate of Rural Areas and Forest of the French Ministry of Agriculture/Centre de recherche pour l'étude et l'observation des conditions de vie (CRÉDOC).

According to the 2004 'Forests and society' survey (ONF–Université de Caen/LASMAS), French forests receive around 35 million visitors a year, for a total of 500 million visits, and 71% of French people visited a forest at least once. There seems to have been a slight decrease in forest visits between 1995 and 2004: in 1995, 19% of French people never visited forests (IFEN/DERF/CRÉDOC, 1996), whereas this rate increased to 29% in 2004. When comparing forest visits to common French cultural practices such as going to the movies (52% of the population had gone to the movies at least once over a 1 year period – INSEE, 2002), visiting forests still seems to be one of the most widespread recreational activities (ONF, 2005).

The 2004 survey is currently being renewed. Initial results of the 2010 survey (ONF/Université de Caen 'Forests and society' survey, 2010) nevertheless confirmed the increase between 2004 and 2010 in the percentage of people who had not visited a forest in the year. In 2010, forest outings did not last more than half a day in 92% of cases. The most common way of visiting the forest is in a car, but a third of the people interviewed stated that they visited forests without any vehicle. Forest visits are, to an increasing extent, a privileged time for having fun with the family or friends. Only 14% were alone when last visiting a forest.

Duration of forest visits

Last time you visited a forest, you stayed...	%
All day	8
Half a day	33
Around 2 h	42
Less than 2 h	17

Source: Office national des forêts (ONF)/Université de Caen 'Forests and society' survey, 2010.

Means of transport to get to the forest

Last time you visited a forest, you went…	%
By car	61
On foot	31
By bicycle	4
Other	4

Source: Office national des forêts (ONF)/Université de Caen 'Forests and society' survey, 2010.

Indicator 6.10.1

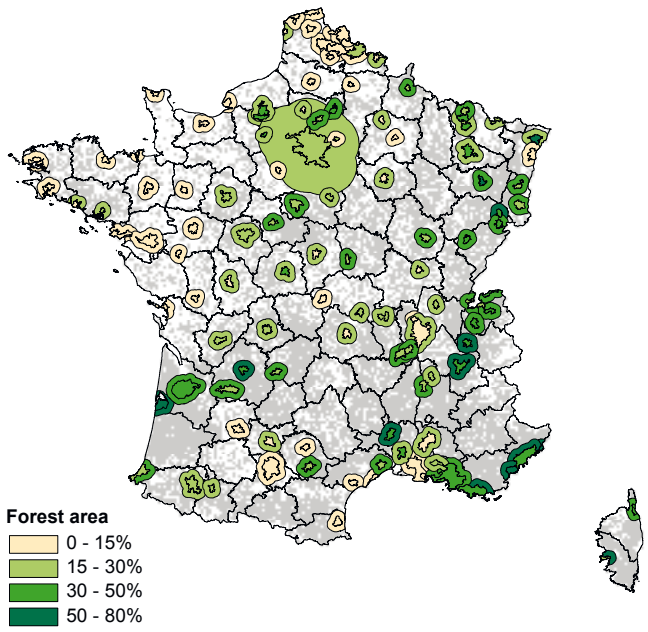
Forests under urban influence

Area of forests under urban influence and per-capita forest area

	Urban unit	Extended area
Number	114	
Forest area (in ha)	606 000	3 110 000
Mean afforestation rate	21.7%	25.2%
Number of inhabitants	32.4 millions	
Forest area/inhabitant (m^2/ha)	187	958

Source: French National Forest Inventory (NFI) forest cartographic database for the forest area (latest version available in 2011 for each department) and the Institut national de la statistique et des études économiques (INSEE) for the number of inhabitants (2008 census and the 1999 delineation of urban unit boundaries).

Note: forests under urban influence (NFI, 2006) are defined on the basis of the NFI forest cartographic database combined with the municipal boundaries of urban units of over 50,000 inhabitants and their extended area (10 km beyond the municipal boundaries of the urban unit, 50 km for Paris). The NFI forest cartographic database, based on aerial photographs, contains all wooded areas (zones with over 10% forest tree cover at the time of the photograph, or which could reach this threshold) of over 2.25 ha and over 75 m wide. For INSEE, an urban unit is a municipality or a set of municipalities that includes, within its area, a built-up zone with at least 2,000 inhabitants and where no dwelling is separated from the nearest neighbour's dwelling by more than 200 m. Moreover, over half of the inhabitants of each concerned municipality must live in this built up zone.



Map 28: Forests under urban influence.
Source: French National Forest Inventory (NFI) forest cartographic database for the forest area (latest version available in 2011 for each department) and the Institut national de la statistique et des études économiques (INSEE) for the number of inhabitants (2008 census and the 1999 delineation of urban unit boundaries).

A fifth of the forest area in France is 'under urban influence', including 606,000 ha in 114 urban units of over 50,000 inhabitants and 3,110,000 ha in the extended areas of these units. These forest areas may be used by urban inhabitants for recreational purposes.

The urban unit of Paris and its extended area covers a total area of 2.4 Mha with 524,000 ha of forest, including large state-owned forests (e.g. Rambouillet, Fontainebleau, Compiègne).

The forest area within the 114 urban units with over 50,000 inhabitants is 22% on average. It is slightly lower than that of the extended areas (25%). However, the mean values mask marked differences. Around a third of urban units and their extended areas (41 urban units) have a forest area of under 15%. These are mostly located in regions without much woodland: northern tip, northwest (from Havre to La Rochelle), the western Mediterranean coastal region, central part of the Midi-Pyrénées region (Toulouse, Agen, Albi). This is also the case for a few urban centres such as Strasbourg, Châlons-en-Champagne and Montluçon. In contrast, around a third of urban units and their extended areas (39 urban units) have a forest area of 30% or more. These are located in areas with a substantial forest area: Alps, Vosges, Jura, Aquitaine and the eastern Mediterranean region.

With 32.4 million inhabitants, the 114 urban units of over 50,000 ha pool over half of the French population. Within each urban unit, this population has access to 187 m^2/inhabitant of forest on average. This average masks contrasting situations. 29% of the urban units (33) have a per-capita forest area of less than 100 m^2. This could be explained by the low afforestation rate (under 15%), except for Paris which has a higher rate, but also a high population density. Conversely, the inhabitants of seven urban units have access to over 1,000 m^2 (Alès, Arcachon, Elbeuf, Épinal, Fréjus, Haguenau, Périgueux). Urban units with the highest populations generally have a lower per-capita forest area.

Indicator 6.11

Number of sites within forest and other wooded land designated as having cultural or spiritual value

Type of site	Number	Observations	Source
Classified sites with wooded areas	275	*with 6 sites labelled 'Grand Site de France' including forest: Sainte-Victoire (2004); Pont du Gard (2004); Bibracte – Mont Beuvray (2007); Puy de Dôme (2008); Marais Poitevin (2010); Saint-Guilhem-le-Désert - Gorges de l'Hérault (2010)*	1
Arboretums in public forests	144	with 15 of national interest	2
Forest biosphere reserves	6	Vallée du Fango (1977), Cévennes (1985), Vosges du Nord (1988), Mont Ventoux (1990), Lubéron (1997), Pays de Fontainebleau (1998)	3
World Heritage sites	3	Réserve naturelle de Scandola en Corse (maquis) (1983) Pyrénées - Mont Perdu (1997) Vallée de la Loire (Domaine de Chambord) (2000)	3
Unusual trees and tree groups in public forests	2 100	with 290 of national interest	4
Unusual stands and tree rows in public forests	280		4
Periurban protection forests	14	Bois d'Epinoy (1984), Bois des Dames (1984), Bois d'Holnon (1987), Massifs de St-Avold et de la Houve (1989), Forêts de St-Aubin-de-Médoc et le Taillan-Médoc (1991), Massif du Rouvray (1993), Forêt de Sénart (1995), Forêt de Fontainebleau (2002), Forêt de Dreux (2004), Forêt de Nonnenbruch (2004), Forêt d'Evreux (2007), Forêt de Fausses-Reposes (2007), Forêt de Rambouillet (2009), Forêt de Bouconne (2009).	5

Source: 1 French Ministry of Ecology, Sustainable Development, Transportation and Housing (MEDDTL).
2 Office national des forêts (ONF).
3 United Nations Educational, Scientific and Cultural Organization (UNESCO) 2010.
4 Office national des forêts (ONF) 2008, based on the 'Arbres remarquables' database.
5 French Ministry of Agriculture, Food, Fisheries, Rural Affairs and Spatial Planning (MAAPRAT)

Note: some sites, already mentioned in Indicator 4.9, can also have a cultural or spiritual value.

The forest has an important cultural and symbolic status in the French imagination. This is reflected in the main images that the forest brings to mind for people, as a "heritage to pass down to future generations" and a "nature reservoir", as revealed in a survey undertaken by the ONF and the Université de Caen in 2004 (ONF, 2006). Forest areas with a high cultural and symbolic value include sites that are classified as being partially wooded, arboretums with public access, biosphere reserves, World Heritage sites, unusual trees and tree stands and periurban protection forests.

Classified sites are legally designated as sites whose conservation or preservation is of public interest from an artistic, historical, scientific, legendary or scenic standpoint. Some sites come under several criteria. All forestry work that could modify the state or aspect of a classified site requires an authorisation from the minister responsible for these sites. Around 275 sites are classified as being partially wooded, representing a total area of 74,000 ha (figures from the Environment Ministry 2004). Two-thirds of them are classified with respect to all of the criteria mentioned above, with 20% considered as being 'scenic'. Most of them are located in Île-de-France (21%), Bretagne (13%), Pays-de-la-Loire (12%), the Centre region (11%) and Provence-Alpes-Côte d'Azur (8%). The most famous and used classified sites—'Major sites'—benefit from special policies aimed at restoring sites that are highly visited and at developing projects to enable long-term management. The two main tools proposed by the State to achieve these objectives are the 'Opérations Grands Sites' and the Grand Site de France® label. The Opérations Grands Sites are initiatives geared towards addressing problems encountered in hosting visitors and in maintaining the sites, and they give rise to a study programme and work operations implemented by the site manager. Eight sites have been granted the Grand Site de France® label since 2004, six of which include a forest area: Sainte-Victoire, Pont du Gard, Bibracte – Mont Beuvray, Puy de Dôme, Marais Poitevin and Saint-Guilhem-le-Désert - Gorges de l'Hérault.

French **arboretums** are relatively untapped biological heritage resources. They contain very high diversity (taxa and individual plants), rare species (endangered, vulnerable or symbolic) and very unique ecosystems. 144 of these arboretums are located in public forests and managed by ONF. Their size, origin and design varies, so they present different features. An analysis of all arboretums was carried out in 2006-2007. They have been rated on the basis of three criteria, which are considered to be essential in the identification of sites of national interest:

– conservation interest (containing at least 10 wild species that are on the Red Lists of the International Union for Conservation of Nature (IUCN), species that are rare or endangered, with each being represented by at least 10 individuals);

– scientific interest (the presence, with a population of a minimum of 10 individuals, of at least one known native species that is represented in at least one other arboretum and whose traits, with respect to future climate change, are considered interesting);

– heritage interest: an interest associated with the variety of the collection, the history, the presence of unusual individuals or a landscape attraction.

In state-owned forests, this assessment led to the identification of 15 arboretums that could be considered of national interest, thus warranting a special management policy.

UNESCO launched a scientific programme entitled Man and the Biosphere (MAB) in 1971, with the aim of gaining further insight into the relationship between man and the environment. Within the framework of this programme, UNESCO developed the '**biosphere reserve**' concept-sites where natural resource-friendly human developments are showcased and applied. In 2011, there are 564 biosphere reserves worldwide, located in 109 countries. France has 10 reserves, 7 of which are in metropolitan France. Six of these metropolitan reserves are forested, i.e. the biosphere reserves of Pays de Fontainebleau, Vosges du Nord, Cévennes, Mont Ventoux, Luberon and Vallée du Fango in Corsica.

The UNESCO World Heritage Convention was adopted in 1972. Its aim is to globally promote the identification, protection and preservation of cultural and natural heritage considered as having an outstanding value for humanity. **Natural heritage sites** have an outstanding universal value from scientific, conservation or natural beauty standpoints. There are 35 World Heritage sites in France, 3 of which are in metropolitan France and include forests or maquis ('other wooded lands' according to the Food and Agriculture Organization of the United Nations (FAO)). These are the 'Val de Loire between Sully-sur-Loire and Chalonnes' site, including the Domaine de Chambord (classified since 1981, it was included in the Val de Loire site in 2000); the 'Golfe de Porto: calanche de Piana, golfe de Girolata, réserve de Scandola' site which includes the Scandola nature reserve in Corsica, a remarkable example of Mediterranean maquis; and the 'Pyrénées - Mont Perdu' site which includes forest.

In 1996, the ONF undertook an inventory of **unusual trees** in public forests. They were defined according to dendrological (size, age), aesthetic (stem shape, foliation, roots) or cultural (historical, religious, ethnographic value) criteria. These trees are generally not legally protected but they are taken into account in forest management plans. ONF thus conducted local inventories with regional and national harmonization and four interest levels. Around 2,100 trees and tree groups were classified as unusual, 290 of which were considered as being of national interest. In addition, 280 unusual stands and tree rows were recorded.

The protection forest classification is the oldest forest protection tool. This status was created in 1922 with the aim of preserving mountain lands and providing protection against natural hazards. In 1976, it was expanded through a nature protection law to include **periurban forests** and forests requiring preservation for ecological reasons or for the well-being of the population. The protection forest classification, which is the most legally binding forest protection tool, is reserved for massifs of major environmental and social importance. There are currently 14 periurban protection forests. The classification restricts property rights: all forest clearing operations are prohibited, as well as any infrastructure building. It also enables public traffic and motor vehicle control.

Conclusion

The analysis of the 54 indicators proposed in this new version of Indicators for the sustainable management of French metropolitan forests reviews the current sustainable forest management situation in France. The broad range of topics covered under the six criteria set down in the Helsinki Conference clearly highlights the complexity of situations encountered and the need for a global approach to sustainable forest management. This regularly improved and updated set of indicators should provide and effective French forest landscape monitoring tool.

This study was also an opportunity to use the new inventory method to update indicators based on French National Forest Inventory (NFI) data, with the exception of Indicator 3.1 which is focused on increment and fellings (no available data when the present document was drawn up). Data was available for all of the other indicators, but the low level of accuracy of the data for some of them reflects the fact that too much detail is required for the indicator. This observation will provide an opportunity to improve the concerned indicators through the collection of more relevant data by adopting new methodological approaches or by reorienting the indicators so that they will be more in line with current issues—the need to conduct studies in this direction before the next edition in 2015 is one of the priorities put forward by the project steering committee. However, as substantial and broad ranging data are available in France, most of the indicators proposed at the Vienna Conference could be addressed, and these were supplemented with around 20 other new indicators.

The data presented here—in addition to those from NFI—were supplied by over 30 different organisations, administrations and associations. The main problems concerned methodological issues, the absence of certain data and information recovery.

As a follow up to the assessment carried out in 2006 on biodiversity indicators, a conference on forest indicators will be jointly organised by CEMAGREF, NFI and GIP-ECOFOR and held in late 2011. The aim will be to review the current situation, while providing an opportunity to continue the sustainable forest management debate with all concerned stakeholders.

Appendices

List of acronyms, symbols and abbreviations

ACCA	Association Communale de Chasse Agréée
ADEME	Agence de l'Environnement et de la Maîtrise de l'Énergie
AFOCEL	Association Forêt-Cellulose (now FCBA)
Agreste	Agreste: la statistique, l'évaluation et la prospective agricole
AICA	Association Intercommunale de Chasse Agréée
ASA	Association Syndicale Autorisée
ASL	Association Syndicale Libre
ASLGF	Association Syndicale Libre de Gestion Forestière
ASP	Agence de Services et de Paiement
BIC	Bénéfices Industriels et Commerciaux
CAAA	Caisse d'Assurance-Accident Agricole
CATAENAT	Charge Acide Totale d'origine Atmosphérique dans les Écosystèmes Naturels Terrestres
CBPS	Code des Bonnes Pratiques Sylvicoles
CCMSA	Caisse Centrale de la Mutualité Sociale Agricole
CCR	Centre Commun de Recherche
CEMAGREF	Institut de Recherche pour l'Ingénierie de l'Agriculture et de l'Environnement (ex Centre National du Machinisme Agricole, du Génie Rural, des Eaux et des Forêts)
CEPI	Confederation of European Paper Industries
CEREN	Centre d'Étude et de Recherche Économique sur l'Énergie
CFT	Charte Forestière de Territoire
CGAF	Conservatoire Génétique des Arbres Forestiers
CI	confidence interval
CIF	cost, insurance and freight
CITEPA	Centre Interprofessionnel Technique d'Études de la Pollution Atmosphérique
CMPFE	Conférence Ministérielle pour la Protection des Forêts en Europe
CNPF	Centre National de la Propriété Forestière
CNPMAI	Conservatoire National des Plantes à parfum, Médicinales, Aromatiques et Industrielles
COPACEL	Confédération française de l'industrie des Papiers, Cartons et Celluloses
CPPARM	Comité des Plantes à Parfum Aromatiques et Médicinales
CRÉDOC	Centre de Recherche pour l'Étude et l'Observation des Conditions de vie
CRFPF	Commission Régionale de la Forêt et des Produits Forestiers
CRGF	Commission des Ressources Génétiques Forestières
CRPF	Centre Régional de la Propriété Forestière
CTBA	Centre Technique du Bois et de l'Ameublement (now FCBA)
DDAF	Direction Départementale de l'Agriculture et de la Forêt
DEFI	Dispositif d'Encouragement Fiscal à l'Investissement en forêt
DFCI	Défense de la Forêt Contre les Incendies
DGI	Direction Générale des Impôts
DGPAAT	Direction générale des Politiques Agricole, Agroalimentaire et des Territoires
DOM	Département d'Outre-Mer
DRA	Directive Régionale d'Aménagement
DRAAF	Direction Régionale de l'Agriculture, de l'Alimentation et de la Forêt
DSF	Département Santé des Forêts
EAB	Enquête Annuelle de Branche
EAE	Enquête Annuelle d'Entreprise
EFI	European Forest Institute
ENGREF	École Nationale du Génie Rural, des Eaux et des Forêts, intégrée à AgroParisTech
ENR	renewable energy
EPEI	Enquête sur les Petites Entreprises Industrielles
ERPA	European Recovered Paper Association
ESSES	Enquête Statistique sur les Structures Économiques de la Sylviculture
EUFGIS	European Information System on Forest Genetic Resources / Système européen d'information sur les ressources génétiques forestières
EUFORGEN	European Forest Genetic Resources Programme / Programme européen de ressources génétiques forestières
EUROSTAT	Statistical Office of the European Communities
FAO	Food and Agriculture Organization of the United Nations / Organisation des Nations Unies pour l'Alimentation et l'Agriculture

FCBA	Institut Technologique Forêt Cellulose Bois-construction Ameublement (ex AFOCEL et CTBA)
FDC	Fédération Départementale des Chasseurs
FEADER	European Agricultural Fund for Rural Development
FNB	Fédération Nationale du Bois
FNC	Fédération Nationale des Chasseurs
FNCoFor	Fédération Nationale des Communes Forestières
FNE	France Nature Environnement
FNPC	Fédération Nationale des Producteurs de Champignons
FNSPFS	Fédération Nationale des Syndicats de Propriétaires Forestiers Sylviculteurs
FOB	free on board
FOGEFOR	FOrmation à la GEstion FORestière
FranceAgriMer	Établissement national des produits de l'Agriculture et de la Mer
FSC	Forest Stewardship Council
GDP	gross domestic product
GFRA	Global Forest Resources Assessment
GIP	ECOFOR ÉCOsystèmes FORestiers public interest group
GIS SOL	Scientific interest group - Soil (INRA)
GRECO	large ecoregion
IDF	Institut pour le Développement Forestier
IFEN	Institut Français de l'Environnement (now SOeS)
IFFC	Institut de Formation Forestière Communale
IFN	Inventaire Forestier National
IGN	Institut Géographique National
IML	Institut Méditerranéen du Liège
INPN	Inventaire National du Patrimoine Naturel
INRA	Institut National de la Recherche Agronomique
INSEE	Institut National de la Statistique et des Études Économiques
ITSAP	Institut Technique et Scientifique de l'Apiculture et de la Pollinisation
IUCN	World Conservation Union
JFSQ	Joint Forest Sector Questionnaire
JWEE	Joint Wood Energy Enquiry
LAS	Laboratoire d'Analyse des Sols (INRA, Arras)
LASMAS	Laboratoire d'Analyse Secondaire et de Méthodes Appliquées à la Sociologie/Université de Caen
LEF	Laboratoire d'Économie Forestière (joint research unit with AgroParisTech-ENGREF and INRA)
LERFOB	Laboratoire d'Études des Ressources Forêt-Bois
LFS	Labour Force Survey /EUROSTAT
LPO	Ligue pour la Protection des Oiseaux
LUCAS	Land Use Cover Area frame statistical Survey / Enquête européenne sur l'utilisation des terres
MAAPRAT	Ministère de l'Agriculture, de l'Alimentation, de la Pêche, de la Ruralité et de l'Aménagement du Territoire
MAB	Man and Biosphere / L'homme et la biosphère
MEDDTL	Ministère de l'Écologie, du Développement Durable, des Transports et du Logement
MNHN	Muséum National d'Histoire Naturelle
MSA	Mutualité Sociale Agricole
NAF	Nomenclature d'Activités Française
NES	Nomenclature Économique de Synthèse
ODARC	Office de Développement Agricole et Rural de la Corse
ONCFS	Office National de la Chasse et de la Faune Sauvage
ONF	Office National des Forêts
ONIPPAM	Office National Interprofessionnel des Plantes à Parfum, Aromatiques et Médicinales
ORF	Orientations Régionales Forestières
PACA	Provence-Alpes-Côte d'Azur
PDM	Plan de Développement de Massif
PDRC	Plan de Développement Rural de Corse
PDRH	Plan de Développement Rural Hexagonal
PEFC	Programme for the Endorsement of Forest Certification schemes / Programme de reconnaissance des certifications forestières
PNR	Parc Naturel Régional
PPFCI	Plan de Protection des Forêts Contre l'Incendie
PPR	Plan de Prévention des Risques
PSG	Plan Simple de Gestion
RBD	Réserve Biologique Dirigée
RBI	Réserve Biologique Intégrale
RENECOFOR	Réseau National de suivi à long terme des Écosystèmes Forestiers
RF	forest region (IFN)

RMQS	Réseau de Mesure de la Qualité des Sols
RN	natural reserve
RP	region of origin
RTG	Règlement Type de Gestion
RTM	Restauration des Terrains en Montagne
SAC	Special area of conservation (Habitat directive)
SCEES	Service Central des Enquêtes et Études Statistiques (aujourd'hui SSP)
SDFB	Sous-Direction de la Forêt et du Bois
SDIS	Service Départemental d'Incendie et de Secours
SEF	Société d'Épargne Forestière
SEOF	Société d'Études Ornithologiques de France
SER	silvoecoregion
SESSI	Service des Études et des Statistiques Industrielles
SFEPM	Société Française pour l'Étude et la Protection des Mammifères
SHF	Société Herpétologique de France
SLDF	Stratégie Locale de Développement Forestier
SMI	sustainable management indicator
SNM	Service des Nouvelles du Marché
SoeS	Service de l'Observation et des Statistiques (ex IFEN)
SPA	special protection area (Bird directive)
SRA	Schéma Régional d'Aménagement
SRGS	Schéma Régional de Gestion Sylvicole
SSP	Service de la Statistique et de la Prospective (ex SCEES)
Teruti	Enquête annuelle sur l'Utilisation du Territoire (until 2004)
Teruti-Lucas	Enquête annuelle sur l'Utilisation du Territoire (georeferenced since 2005)
UCFF	Union de la Coopération Forestière Française
UNECE	United Nations Economic Commission for Europe / Commission Économique des Nations Unies pour l'Europe
UNESCO	United Nations Educational, Scientific and Cultural Organization / Organisation des Nations Unies pour l'Éducation, la Science et la Culture
VA	added value
WRB	World Reference Base for Soil Ressources / Système international de classification des sols
WWF	World Wildlife Fund / Fonds mondial pour la nature

Symbols and abbreviations

§	paragraph	m	meter
>	more than	m^2	square meter
µg	microgramme	m^3	cubic meter
Aeq	acid equivalent	mg	milligramme
CEC	cation exchange capacity	cm	centimeter
mm	millimeter	cm^2	square centimeter
Mtoe	million tons oil equivalent	C/N	carbon/nitrogen ratio
CO_2	carbon dioxide	NA	not available
NMVOC	non-methane volatile organic compound	NH_3	ammoniac
€	euro	NH_4	ammonium
EQ	roundwood equivalent	NO_3	nitrate
FTE	full-time equivalent	F	franc
NO_x	nitrogen oxide	g	gramme
p	part	ha	hectare
Mha	million hectares	Mm^3	million cubic meters
p.	page	CI	confidence interval
FR	for the record	Keq	kg-equivalent
PVC	polyvinylchloride	kg	kilogramme
SO_2	sulfur dioxide	SP	saturation percentage
km	kilometer	t	tonne
KTOE	kilotonne oil equivalents	T	cation exchange capacity (CEC)
l	liter	t C	tonnes of carbon
TJ	terajoul	n.s.	non-significant
tC/tDM	tonnes of carbon per tonne of dry matter	tMS/m^3	fresh tonnes of dry matter per m^3 of fresh matter

List of boxes, maps and figures

Boxes

Maps

Figures

Websites queried

Organization	Site
Agence de l'environnement et de la maîtrise de l'énergie	www.ademe.fr
Agreste: la statistique, l'évaluation et la prospective agricole	www.agreste.agriculture.gouv.fr
CEMAGREF (l'Institut de recherche en sciences et technologies pour l'environnement)	www.cemagref.fr
Centre technique interprofessionnel d'études de la pollution atmosphérique	www.citepa.org
Comité national pour le développement du bois	www.bois-construction.org
Comité des Plantes à Parfum, Aromatiques et Médicinales	www.cpparm.org
Confédération française de l'industrie des papiers, cartons et celluloses	www.copacel.fr
Direction générale de l'énergie et des matières premières	www.industrie.gouv.fr/energie
European Information System on Forest Genetic Resources (EUFGIS)	http://portal.eufgis.org
Fédération nationale des communes forestières de France	www.fncofor.fr
FCBA (Forêt Cellulose Bois-Construction Ameublement)	http://www.fcba.fr
Food and Agriculture Organization of the United Nations – Forestry	www.fao.org/forestry
Forest Europe (Conférence ministérielle pour la protection des forêts en Europe)	www.foresteurope.org
Forest Stewardship Council	www.fsc.org
Forêts de protection	http://agriculture.gouv.fr/les-forets-de-protection,10806
French National Forest Inventory (Inventaire forestier national)	www.ifn.fr
Groupement d'intérêt public Écosystèmes Forestiers	www.gip-ecofor.org
Institut de l'abeille (ITSAP)	www.cnda.asso.fr
Institut méditerranéen du liège (IML)	www.institutduliege.com
Institut national de la statistique et des études économiques	www.insee.fr
Inventaire national du patrimoine naturel	http://inpn.mnhn.fr/isb/accueil/index
Man and Biosphere – France (UNESCO)	www.mab-france.org
Ministère de l'agriculture, de l'alimentation, de la pêche, de la ruralité et de l'aménagement du territoire	www.agriculture.gouv.fr
Ministère de l'écologie, du développement durable des transports et du logement	www.developpement-durable.gouv.fr
Mutualité sociale agricole	www.msa.fr
Observatoire de la forêt méditerranéenne	www.ofme.org
Office national de la chasse et de la faune sauvage	www.oncfs.gouv.fr
Office national des forêts	www.onf.fr
Office national interprofessionnel des plantes à parfum, aromatiques et médicinales	www.onippam.fr
Office statistique des communautés européennes (EUROSTAT)	europa.eu.int/comm/eurostat
Programme for the endorsement of forest certification schemes	
- PEFC International	www.pefc.org
- PEFC France	www.pefc-france.org
Service de l'observation et des statistiques (SOeS)	*http://www.stats.environnement.developpement-durable.gouv.fr/*
Service des nouvelles du marché	www.snm.agriculture.gouv.fr
Union de la coopération forestière française	www.ucff.asso.fr
United Nations Economic Commission for Europe	www.unece.org
World Conservation Union – French Committee	www.uicn.fr
World Heritage Committee (UNESCO)	www.whc.unesco.org
World Wildlife Fund – France	www.wwf.fr

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Appendix I

Administrative region	Department		Dates of field surveys to record data available on 1st January			
			1989	1994	1999	2004
ALSACE	67	BAS-RHIN	1979	1989	1989	2002
	68	HAUT-RHIN	1978	1988	1988	1999
AQUITAINE	24	DORDOGNE	1982	1992	1992	1992
	33	GIRONDE	1977	1987	1987	1998
	40	LANDES	1978	1988	1988	1999
	47	LOT-ET-GARONNE	1979	1989	1989	2000
	64	PYRÉNÉES-ATLANTIQUES	1985	1985	1995	1995
AUVERGNE	3	ALLIER	1987	1987	1987	2001
	15	CANTAL	1977	1989	1989	1989
	43	HAUTE-LOIRE	1979	1991	1991	2002
	63	PUY-DE-DÔME	1976	1988	1988	1988
BASSE-NORMANDIE	14	CALVADOS	1987	1987	1987	2001
	50	MANCHE	1975	1987	1987	2001
	61	ORNE	1975	1988	1988	2001
BOURGOGNE	21	CÔTE-D'OR	1980	1990	1990	1990
	58	NIÈVRE	1985	1985	1996	1996
	71	SAONE-ET-LOIRE	1980	1989	1989	1989
	89	YONNE	1986	1986	1986	1999
BRETAGNE	22	CÔTES-D'ARMOR	1981	1981	1995	1995
	29	FINISTÈRE	1981	1981	1996	1996
	35	ILLE-ET-VILAINE	1980	1980	1995	1995
	56	MORBIHAN	1980	1980	1998	1998
CENTRE	18	CHER	1986	1986	1986	1999
	28	EURE-ET-LOIR	1977	1992	1992	1992
	36	INDRE	1973	1988	1997	1997
	37	INDRE-ET-LOIRE	1985	1985	1985	1999
	41	LOIR-ET-CHER	1982	1982	1982	1998
	45	LOIRET	1979	1979	1992	1992
CHAMPAGNE-ARDENNE	8	ARDENNES	1987	1987	1987	1998
	10	AUBE	1983	1983	1994	1994
	51	MARNE	1986	1986	1986	1997
	52	HAUTE-MARNE	1985	1985	1997	1997
CORSE	2A	CORSE-DU-SUD	1977	1988	1988	1988
	2B	HAUTE-CORSE	1977	1988	1988	1988
FRANCHE-COMTÉ	25	DOUBS	1982	1982	1994	1994
	39	JURA	1980	1980	1992	1992
	70	HAUTE-SAÔNE	1984	1984	1996	1996
	90	TERRITOIRE DE BELFORT	1984	1984	1984	1996
HAUTE-NORMANDIE	27	EURE	1975	1988	1988	2003
	76	SEINE-MARITIME	1976	1989	1989	2002

ÎLE-DE-FRANCE	75	PARIS ET SA ZONE PÉRIPHÉRIQUE	1979	1979	1994	1994
	77	SEINE-ET-MARNE	1978	1978	1993	1993
LANGUEDOC-ROUSSILLON	11	AUDE	1978	1989	1989	1989
	30	GARD	1982	1982	1993	1993
	34	HÉRAULT	1983	1983	1997	1997
	48	LOZÈRE	1979	1979	1992	1992
	66	PYRÉNÉES-ORIENTALES	1980	1991	1991	1991
LIMOUSIN	19	CORRÈZE	1980	1990	1990	2003
	23	CREUSE	1981	1991	1991	1991
	87	HAUTE-VIENNE	1981	1991	1991	1991
LORRAINE	54	MEURTHE-ET-MOSELLE	1980	1990	1990	1990
	55	MEUSE	1980	1980	1991	1991
	57	MOSELLE	1982	1982	1993	1993
	88	VOSGES	1981	1981	1992	1992
MIDI-PYRÉNÉES	9	ARIEGE	1978	1990	1990	1990
	12	AVEYRON	1981	1981	1994	1994
	31	HAUTE-GARONNE	1975	1987	1987	2000
	32	GERS	1979	1989	1989	2001
	46	LOT	1980	1990	1990	2002
	65	HAUTES-PYRÉNÉES	1974	1986	1997	1997
	81	TARN	1979	1992	1992	1992
	82	TARN-ET-GARONNE	1979	1989	1989	2001
NORD-PAS-DE-CALAIS	59	NORD	1986	1986	1986	2000
	62	PAS-DE-CALAIS	1986	1986	1986	2000
PAYS DE LA LOIRE	44	LOIRE-ATLANTIQUE	1985	1985	1985	2000
	49	MAINE-ET-LOIRE	1983	1983	1997	1997
	53	MAYENNE	1983	1983	1983	1999
	72	SARTHE	1984	1984	1984	1999
	85	VENDÉE	1984	1984	1994	1994
PICARDIE	2	AISNE	1977	1991	1991	1991
	60	OISE	1976	1990	1990	2001
	80	SOMME	1976	1989	1989	2002
POITOU-CHARENTES	16	CHARENTE	1983	1983	1993	1993
	17	CHARENTE-MARITIME	1984	1984	1993	1993
	79	DEUX-SÈVRES	1985	1985	1995	1995
	86	VIENNE	1986	1986	1996	1996
PROVENCE-ALPES-CÔTE D'AZUR	4	ALPES-DE-HAUTE-PROVENCE	1984	1984	1984	1999
	5	HAUTES-ALPES	1983	1983	1983	1997
	6	ALPES-MARITIMES	1985	1985	1985	2002
	13	BOUCHES-DU-RHÔNE	1977	1988	1988	1988
	83	VAR	1986	1986	1986	1999
	84	VAUCLUSE	1986	1986	1986	2001
RHÔNE-ALPES	1	AIN	1983	1983	1995	1995
	7	ARDÈCHE	1981	1981	1995	1995
	26	DROME	1982	1982	1996	1996
	38	ISÈRE	1984	1984	1997	1997
	42	LOIRE	1981	1981	1993	1993
	69	RHÔNE	1982	1982	1994	1994
	73	SAVOIE	1985	1985	1985	2000
	74	HAUTE-SAVOIE	1975	1987	1987	1998

Appendix II

Principles of the new NFI inventory method

Since November 2004, the French National Forest Inventory (NFI) has been conducting annual national inventory data collection surveys, with each covering a vegetation period. They begin in the middle of the last quarter of the year (October or November) and continue until the same period the following year.

The NFI method is based on systematic sampling. Each sampling point is attached to a node on a 1 km^2 grid, thus with a 1 km^2 area, set up for a 10 year period throughout metropolitan France. Every year a tenth of the network of nodes, selected so as to form a 10 km^2 grid, is used.

The first survey level corresponds to inventory work carried out yearly by photo-interpretation of the sampling point involving around 80,000 sampling points. Based on a reference departmental orthophotography (BD Ortho®) of the Institut géographique national (IGN), information on land cover, its use and the size of massifs (woodland, spinneys, thickets) are recorded on 25 m radius plots located around sampling points. Intersections of the plot with linear tree formations on a randomly oriented 1 km long transect are also counted.

The second inventory survey level involves monitoring and measuring the situation in the field in a subsample of around 8,000 sampling points per year. Data is first collected on the cover and landuse patterns. Field teams visit sampling points located in forests available for wood supply (FAWS). Many features are monitored concerning the forest stand (structure, cover, soil, etc.), vegetation (floristic survey), site conditions (slope, exposure, etc.) and many tree measurements are obtained (height, diameter, etc.).

Lying deadwood is inventoried along a randomly oriented 12 m transect centred on the sampling point, at all points in the forest. All deadwood logs lying along the transect and that fulfil the definition of lying deadwood (cf. Appendix III) is taken into account.

Statistical data published by NFI are generally derived from a combination of information obtained in the last five available annual surveys, apart from exceptions (in such cases, exceptions are noted and the survey data used is specified). Data from five surveys is required to form a large enough sample to generate relevant regional results. The accuracy of all data is measured with a confidence interval. If the variation coefficient associated with the area data is more than 30% over the estimated value, these results are considered as non-significant ('n.s.' noted in the tables). Other results (especially volume and basal area) are considered to be significant when their variation coefficient is not more than 80% over the estimated value and the area data are also significant. This difference in thresholds is due to the survey scale used, i.e. the plot for area measurements, and the tree for other data.

Appendix III

Main indicator definitions used for NFI inventories

The age assigned to a stand is determined on the basis of the age of two trees selected from amongst the six largest overstorey trees in the stand on the plot, and of the two species the most represented in these six trees (or the species the most represented if it represents over 75% of the cover of the six trees). When the two measured trees are of different species, it is the age of the most represented species in the cover that is recorded, otherwise it is the mean of the two ages. Boundary trees of different types than those in the core of the stand are excluded, while also, in cases where two stands of different generations (regeneration phase of regular treatments) are overlapping, accounting for the age of the future stand, without considering residual trees from the previous stand.
The tree age is measured by core sampling with an increment borer at breast height. The calculated ages are adjusted with a correction factor to determine the baseline tree age (original age).
The age attributed to the stand can thus generally be interpreted as representing the age of the main overstorey species of the stand.

The basal area of a tree is defined as its section at breast height, bark included. This section is calculated on the basis of the circumference measurement of the tree at breast height. The calculated values are then used to estimate unit area values according to the plot dimensions and the weight of the sampling points.

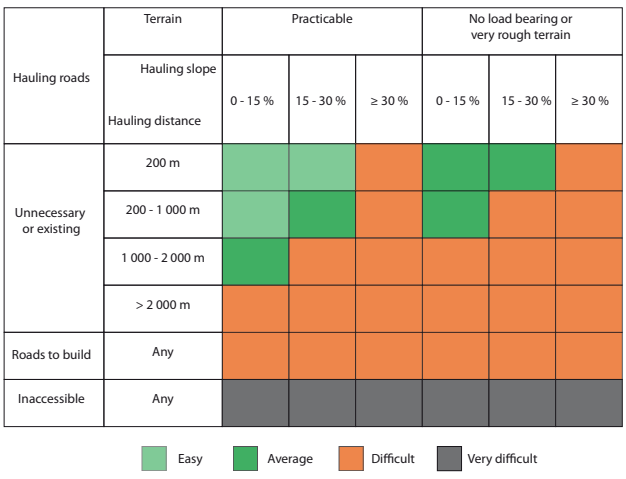
Closed forest corresponds to forest with an absolute tree cover rate of over 40%.

Lying deadwood includes windfalls of over 5 years old, residue of branches or wood logs scattered around a felling area that has been lying on the ground for over a year, residue from pruning or forestry operations (clearing) regardless of the date of these operations, and crown branches lying on the ground for more than a year after a logging operation or following an accident. More generally, lying deadwood involves wooden logs that will certainly be left on the ground. Logs gathered in windrows or piles are not taken into account. The minimum diameter of logs lying on the ground for inventory is 2.5 cm. There is no length limit. The log diameter is noted, along with the species and decomposition status (in five classes ranging from 'zero' to 'very high' decomposition).

Standing deadwood is a tree showing no sign of life above breast height but which is still standing. By convention, it is considered that all deadwood standing at a tilt angle of over 30° relative to the ground surface (due to an accident) can be classified in this category. The presumed death date is categorized as under 5 years or over 5 years.

Forest corresponds to lands covering an area of over 0.5 ha with a width of over 20 m, containing trees that can reach a height of over 5 m at maturity in situ, with over 10% tree cover. Lands predominantly used for agricultural or urban development purposes are excluded. The forest definition used until 2005 included thickets, excluded poplar plantations and specified that lands considered as forest had to be at least 25 m wide, with a minimum tree height of 7 m.

Forests available for wood supply are forests where logging is possible (without consideration for the economic viability margin), while being compatible for other possible functions. Poplar plantations (the relative free cover rate of cultivated poplar stands is over 75%) are classified amongst FAWS.



The logging potential of a stand is determined on the basis of five criteria concerning the conditions in which woodlands can or cannot be logged: the hauling distance, the presence of hauling roads, the maximum hauling slope, the bearing capacity of the ground and the extent of relief (these latter two variables are combined in one row under the heading 'terrain' in the table). These criteria are recorded directly in the field and combined in order to rank the logging potential of sites throughout France in four general classes: easy, average, difficult and very difficult.

Open forest corresponds to forest with an absolute tree cover rate of 10 to 40%.

Other wooded lands correspond to lands that do not qualify under the 'forest' category which cover an area of over 0.5 ha and are over 20 m wide, and contain trees of over 5 m height with 5-10% tree cover, or trees capable of reaching these levels in situ, or mixed cover with over 10% shrubs, saplings or trees. Lands predominantly used for agricultural or urban development purposes are excluded.

Poplar plantations are defined as stands with an absolute cover rate of 10% or more on an area of 5 ares or more and having a width of 20 m or more. The relative free cover rate of obviously cultivated poplar stands (derived from improvement programmes) should be 75% or more, at least in the stand overstorey.
Plantations are stands in which plants account for over 75% of the free cover. Plantations with a density of over 50 plants/ha are considered as forest. Wide-spaced plantations (density of 300 to 500 plants/ha), very wide-spaced plantations (maple, maple for wood supply, wild cherry, European pine, etc.) and poplar plantations are also considered as forest.

A silvoecoregion is the largest geographical zone within which factors that determine forest production or the distribution of large types of forest habitat vary uniformly between specific values according to a combination of values that differ from those that characterize adjacent silvoecoregions.

The main species at a sampling point is considered to be the main species in the layer eligible for inventory, when it is described, or otherwise the main species in the layer ineligible for inventory. The main species of each of these layers is considered to be the species with the highest relative*** free cover** in the layer. This rate may be very high (e.g. 100% in a maritime pine plantation) or relatively low (e.g. 20% in a mixed stand with several species).

The number of species eligible for inventory in a stand is calculated by NFI counts of the number of eligible species within a 25 m radius of a sampling point, regardless of the tree cover rate.

The species diversity at a sampling point (used for Indicator 4.1.1) is calculated on the basis of the relative free cover*** of the most represented species in the stand. If the relative free cover rate of the most present species in the stand is over 50% and the rate of the second most represented species is under 15%, then it is classified as a stand with one predominant species. In other cases, it is concluded that the stand contains at least two species with a relatively high percentage of cover.

Detailed stand types (e.g. pure oak stand, mixed oak stand, etc.) are defined as follows:

– pure stands are those in which the species considered as pure has a relative free cover rate of over 75%;
– mixed stands are those in which at least two species have a relative free cover rate of trees eligible for inventory of over 15%, i.e. if two species both have a relative free cover rate of 15%, the sum of their covers is 30%, and no species can alone account for 75% of the relative free cover.

A stand eligible for inventory has an absolute cover rate in the layer of trees eligible for inventory (trees with a circumference of 23.5 cm or higher at breast height = 7.5 cm or greater diameter) of over 15%. Stands not fulfilling these conditions are considered as 'ineligible' for inventory.

The forest structure of a stand is determined in the field from the rates of living relative high forest and coppice substands and, in cases in which there is less than 25% coppice, the vertical distribution of the high forest. The classification rules are as follows:

– coppices with less than 25% relative cover:
  • the relative free cover rate of tall stems* in the stem layer is under 2/3 => the stand has an irregular high forest structure;
  • the relative free cover rate of tall stems in the stem layer is 2/3 or higher => the stand has a regular high forest structure;
– coppices with at least 25% relative cover:
  • the relative cover rate of the high forest is under 25 % => the stand has a coppice structure;
  • the relative cover rate of the high forest is 25% or higher => the stand has a mixed high forest/coppice structure.

Temporarily unstocked stands are stands in which no live trees, eligible for inventory or not, have been observed at the sampling point following a human intervention (felling) or accident (fire, windfall) leading to an unstocked state. If the site is likely to have cover in the near future (within 5 years) and shows no signs of short-term ground cover changes, then it is still considered as forest.

Thickets are stands with an absolute tree cover rate* of over 40%, on an area ranging from 0.05 to 0.5 ha and a width of over 20 m**.**

*Here it is considered that the substand is made up of high forest stems with a total height that is 2/3 or more the height of the reference stand.

** The free cover rate of a substand is the sum of the crown covers of trees growing in this substand that have direct access to light relative to the area of the site (always 10).

***The relative free cover rate of a substand is the sum of free covers in this substand relative to the absolute tree cover in the entire stand.

Types of broadleaved, conifer and mixed stands are defined according to their relative free cover rate in broadleaved species in a stand eligible for inventory:

- if the relative free cover rate of broadleaved species is between 25% and 75% , it is a mixed stand;
- if the relative free cover rate of broadleaved species is less than 25%, it is a conifer stand;
- if the relative free cover rate of broadleaved species is over 75%, it is a broadleaved stand.

The volume, as measured by NFI, is an 'overbark stem volume' calculated on a volume table. It encompasses the main stem from ground level up to a 7 cm top diameter. For each tree, a percentage of rejected wood (rotted, broken, worm eaten, unusable even for fuelwood, or even absent, e.g. hollow trees, non-convex stems) is estimated. This percentage is systematically deducted from the published data, unless otherwise mentioned.

A windfall is a living or dead tree that is no longer standing following an accident that occurred less than 5 years previously. By convention, it is considered that any living or dead tree standing at a tilt angle of less than 30° relative to the ground surface (due to an accident) is classified in this category. Logged windfalls, and by extension stumps, are excluded from the inventory.

* The absolute tree cover rate in a stand is the sum of the covers of trees growing in the stand relative to the area of the site.

Appendix IV

Summary table of forest areas (in Kha)

			Closed forest	Open forest	TOTAL
			1000 ha	*1000 ha*	*1000 ha*
Forests available for wood supply (excluding poplar plantations)	Wooded stands	Stands eligible for inventory	13 335 ± 107	494 ± 40	13 828 ± 107
		Stands ineligible for inventory	899 ± 51	351 ± 40	1 251 ± 64
		Subtotal	**14 234 ± 103**	**845 ± 56**	**15 079 ± 105**
	Temporarily unstocked stands		42 ± 12	n. s.	44 ± 13
	Subtotal		**14 276 ± 103**	**848 ± 56**	**15 123 ± 104**
Poplar plantations			196 ± 20	-	196 ± 20
Forests available for wood supply			14 472 ± nd	848 ± 56	15 319 ± 104
Other forests			546 ± 39	208 ± 29	754 ± 48
Forest			**15 017 ± 99**	**1 056 ± 62**	**16 073 ± 100**

Source: NFI, survey years 2006 to 2009. The confidence interval at 95% (CI) is expressed in kha.

Appendix V

Detailed composition calculation method

Detailed compositions (or detailed stand types) presented in Indicators 1.1.4 and 1.2.2 are determined on the basis of the species diversity of the stand and the most represented species.

The species diversity of the stand is determined as follows:

– A stand is pure if:
- a single species is recorded in the plot,
- the relative free cover rate of the most represented species is over 75%;

– A stand is considered to have 'one predominant species' if the relative free cover rate of the most represented species is over 50% and the rate of the second most represented species is not over 15%;

– A stand is a two-species mix if:
- only two species have been recorded in the plot,
- the sum of the relative free cover rates of the two most represented species is over 75% and that of the third species the most represented is not over 15%,
- the sum of the relative free cover rates of the three most represented species is over 75%, and that of the fourth most represented species is not over 15% and the rate differs from that of the third most represented species;

– A stand is a three-species mix if:
- only three species have been recorded in the plot,
- the sum of the relative free cover rates of the three most represented species is over 75%, and that of the third most represented species is over 15% and that of the fourth most represented species is not over 15%,
- the sum of the relative free cover rates of the four most represented species is over 75%, and that of the fourth most represented species is not over 15% and the rate differs from that of the third most represented species;

– A stand is a four-species mix if:
- only four species have been recorded in the plot,
- the sum of the relative free cover rates of the four most represented species is over 75%, and that of the fourth most represented species is over 15% and that of the fifth most represented species is not over 15%;

– In other cases, the stand is classified as a varied mixed stand.

Once the species diversity has been determined, NFI uses the most represented species (one or more) to determine the type of stand composition.
For instance, a pure stand or a stand with one predominant species in which the most represented species is beech is called a 'pure beech stand' and classified as such in Indicators 1.1.4 and 1.2.2.
A two-species mixed stand in which the two concerned species are ash and pedunculate oak is called a 'mixed ash-pedunculate oak stand' and classified under the 'oak-ash stand' category in Indicators 1.1.4 and 1.2.2.
A mixed stand with two oak species (e.g. pedunculate and sessile oak) is called a 'two-species oak stand', whereas a mixture of one oak and another broadleaved species is called a 'mixed oak stand'.

Appendix VI

Survey year in poplar plantations

Department	Cycle	Reference year	Survey of volume
GIRONDE	1	1961	NON
LANDES	1	1961	NON
GERS	1	1962	NON
LOT-ET-GARONNE	1	1962	NON
LOT	1	1963	NON
TARN-ET-GARONNE	1	1963	NON
DORDOGNE	1	1964	NON
MEUSE	1	1964	NON
PUY-DE-DÔME	1	1966	NON
CHARENTE	1	1967	NON
CHARENTE-MARITIME	1	1968	NON
LOIRE	1	1968	NON
LOIR-ET-CHER	1	1969	NON
SAÔNE-ET-LOIRE	1	1969	NON
JURA	1	1970	NON
MEURTHE-ET-MOSELLE	1	1970	NON
TARN	1	1970	NON
VENDÉE	1	1970	NON
CÔTE-D'OR	1	1971	NON
PYRÉNÉES-ATLANTIQUES	1	1971	NON
DEUX-SÈVRES	1	1972	NON
MAYENNE	1	1972	NON
RHÔNE	1	1972	NON
SARTHE	1	1972	NON
AIN	1	1973	NON
INDRE	1	1973	NON
ISÈRE	1	1973	NON
LOIRE-ATLANTIQUE	1	1973	NON
MAINE-ET-LOIRE	1	1973	NON
MOSELLE	1	1973	NON
AUBE	1	1974	NON
CALVADOS	1	1974	NON
DRÔME	1	1974	NON
NORD	1	1974	NON
PAS-DE-CALAIS	1	1974	NON
VIENNE	1	1974	NON
EURE	1	1975	NON
HAUTE-GARONNE	1	1975	NON
HAUTE-MARNE	1	1975	NON
MANCHE	1	1975	NON
ORNE	1	1975	NON
SAVOIE	1	1975	OUI
YONNE	1	1975	NON
CHER	1	1976	OUI
HAUTE-SAÔNE	1	1976	OUI
INDRE-ET-LOIRE	1	1976	OUI
SEINE-ET-MARNE	1	1978	OUI
BAS-RHIN	1	1979	OUI
GERS	2	1979	OUI
LOIRET	1	1979	OUI
LOT-ET-GARONNE	2	1979	OUI
PARIS	1	1979	OUI
TARN	2	1979	OUI
TARN-ET-GARONNE	2	1979	OUI
CÔTE-D'OR	2	1980	OUI
ILLE-ET-VILAINE	1	1980	OUI
JURA	2	1980	OUI
LOT	2	1980	OUI
MEURTHE-ET-MOSELLE	2	1980	OUI
MEUSE	2	1980	OUI
SAÔNE-ET-LOIRE	2	1980	OUI
AVEYRON	2	1981	OUI
CÔTES-D'ARMOR	2	1981	OUI
LOIRE	2	1981	OUI
DORDOGNE	2	1982	OUI
DROME	2	1982	OUI
LOIR-ET-CHER	2	1982	OUI
MOSELLE	2	1982	OUI
RHÔNE	2	1982	OUI
AIN	2	1983	OUI
AUBE	2	1983	OUI
CHARENTE	2	1983	OUI
MAINE-ET-LOIRE	2	1983	OUI
MAYENNE	2	1983	OUI
CHARENTE-MARITIME	2	1984	OUI
HAUTE-SAÔNE	2	1984	OUI
ISERE	2	1984	OUI
SARTHE	2	1984	OUI
TERRITOIRE DE BELFORT	2	1984	OUI
VENDÉE	2	1984	OUI
CHER	2	1985	OUI
DEUX-SÈVRES	2	1985	OUI
HAUTE-MARNE	2	1985	OUI
INDRE-ET-LOIRE	2	1985	OUI
LOIRE-ATLANTIQUE	2	1985	OUI
PYRÉNÉES-ATLANTIQUES	2	1985	OUI
SAVOIE	2	1985	OUI
NORD	2	1986	OUI
PAS-DE-CALAIS	2	1986	OUI
VIENNE	2	1986	OUI
YONNE	2	1986	OUI
ALLIER	3	1987	OUI

Department	Cycle	Reference year	Survey of volume
OISE	1	1976	OUI
PUY-DE-DOME	2	1976	OUI
SEINE-MARITIME	1	1976	NON
SOMME	1	1976	OUI
TERRITOIRE DE BELFORT	1	1976	NON
AISNE	1	1977	OUI
GIRONDE	2	1977	OUI
MARNE	1	1977	OUI
ALLIER	2	1978	OUI
ARDENNES	1	1978	OUI
ARIÈGE	2	1978	OUI
HAUT-RHIN	1	1978	NON
LANDES	2	1978	OUI
GERS	3	1989	OUI
LOT-ET-GARONNE	3	1989	OUI
SAÔNE-ET-LOIRE	3	1989	OUI
SEINE-MARITIME	2	1989	OUI
SOMME	2	1989	OUI
TARN-ET-GARONNE	3	1989	OUI
ARIÈGE	3	1990	OUI
CÔTE-D'OR	3	1990	OUI
LOT	3	1990	OUI
OISE	2	1990	OUI
AISNE	2	1991	OUI
MEUSE	3	1991	OUI
DORDOGNE	3	1992	OUI
JURA	3	1992	OUI
LOIRET	2	1992	OUI
TARN	3	1992	OUI
CHARENTE	3	1993	OUI
CHARENTE-MARITIME	3	1993	OUI
SEINE-ET-MARNE	2	1993	OUI
AUBE	3	1994	OUI
VENDÉE	3	1994	OUI
AIN	3	1995	OUI
CÔTES-D'ARMOR	3	1995	NON
DEUX-SÈVRES	3	1995	OUI
HAUTE-SAÔNE	3	1995	OUI
PYRENEES-ATLANTIQUES	3	1995	OUI
DRÔME	3	1996	OUI
ARDENNES	2	1987	OUI
CALVADOS	2	1987	OUI
GIRONDE	3	1987	OUI
HAUTE-GARONNE	2	1987	OUI
MANCHE	2	1987	OUI
MARNE	2	1987	OUI
EURE	2	1988	OUI
HAUT-RHIN	2	1988	OUI
INDRE	2	1988	OUI
LANDES	3	1988	OUI
ORNE	2	1988	OUI
PUY-DE-DÔME	3	1988	OUI
BAS-RHIN	2	1989	OUI
HAUTE-MARNE	3	1996	OUI
VIENNE	3	1996	OUI
INDRE	3	1997	OUI
ISÈRE	3	1997	OUI
MAINE-ET-LOIRE	3	1997	OUI
MARNE	3	1997	OUI
ARDENNES	3	1998	OUI
GIRONDE	4	1998	OUI
LOIR-ET-CHER	3	1998	OUI
CHER	3	1999	OUI
INDRE-ET-LOIRE	3	1999	OUI
LANDES	4	1999	OUI
SARTHE	3	1999	OUI
YONNE	3	1999	OUI
BAS-RHIN	3	2000	OUI
CALVADOS	3	2000	OUI
HAUTE-GARONNE	3	2000	OUI
LOIRE-ATLANTIQUE	3	2000	OUI
LOT-ET-GARONNE	4	2000	OUI
MAYENNE	3	2000	OUI
NORD	3	2000	OUI
PAS-DE-CALAIS	3	2000	OUI
SAVOIE	3	2000	OUI
ALLIER	4	2001	OUI
GERS	4	2001	OUI
MANCHE	3	2001	OUI
OISE	3	2001	OUI
ORNE	3	2001	OUI
EURE	3	2002	OUI
SEINE-MARITIME	3	2002	OUI
SOMME	3	2002	OUI
TARN-ET-GARONNE	4	2002	OUI
AISNE	3	2003	OUI
PUY-DE-DÔME	4	2003	OUI
SAÔNE-ET-LOIRE	4	2003	OUI
CÔTE-D'OR	4	2004	OUI
PARIS	3	2004	OUI
SEINE-ET-MARNE	3	2004	OUI

Appendix VII

List of trees found in French forests

Note: this list was drawn up with the help of Mr Jean-Claude Rameau (ENGREF), based on two sources, i.e. lists of the French National Forest Inventory (NFI) and the guide 'Flore forestière française, guide écologique illustré', published by IDF-CNPF. It was further supplemented by INRA and AFOCEL. This selection overlooks a certain number of exotic species that generally occur in small or less experimental areas.

List of trees indigenous to France and found in forests

BROADLEAVED

1	*Acer campestre*	field maple	29	*Pyrus amygdaliformis*	almond-leaved pear
2	*Acer monspessulanum*	Montpellier maple	30	*Pyrus pyraster*	wild pear
3	*Acer opalus*	Italian maple	31	*Quercus cerris*	Turkey oak
4	*Acer platanoides*	Norway maple	32	*Quercus ilex*	holm oak
5	*Acer pseudoplatanus*	sycamore	33	*Quercus petraea*	sessile oak
6	*Alnus cordata*	Corsican alder	34	*Quercus pubescens*	pubescent oak
7	*Alnus glutinosa*	common alder	35	*Quercus pyrenaica*	Pyrenean oak
8	*Alnus incana*	grey alder	36	*Quercus robur*	pedunculate oak
9	*Betula pendula*	silver birch	37	*Quercus suber*	cork oak
10	*Betula pubescens*	hairy birch	38	*Salix alba*	white willow
11	*Carpinus betulus*	hornbeam	39	*Salix caprea*	sallow, goat willow
12	*Castanea sativa*	sweet chestnut	40	*Salix daphnoides*	violet willow
13	*Cornus mas*	cornelian cherry	41	*Salix fragilis*	crack willow
14	*Crataegus monogyna*	common hawthorn	42	*Salix pentandra*	bay-leaved willow
15	*Fagus sylvatica*	beech	43	*Salix viminalis*	common osier
16	*Fraxinus angustifolia*	narrow-leaved ash	44	*Sambucus nigra*	elder
17	*Fraxinus excelsior*	common ash	45	*Sorbus aria*	common whitebeam
18	*Fraxinus ornus*	manna or flowering ash	46	*Sorbus aucuparia*	rowan, mountain ash
19	*Ilex aquifolium*	holly	47	*Sorbus domestica*	service tree
20	*Malus sylvestris*	crab apple	48	*Sorbus latifolia*	service tree of Fontainebleau
21	*Olea europaea*	olive	49	*Sorbus mougeotii*	Mougeot service tree
22	*Ostrya carpinifolia*	hop-hornbeam	50	*Sorbus torminalis*	wild service tree
23	*Populus alba*	white poplar	51	*Tamarix gallica*	tamarisk
24	*Populus canescens*	grey poplar	52	*Tilia argentea*	silver-leaved lime
25	*Populus nigra*	black poplar	53	*Tilia cordata*	small-leaved lime
26	*Populus tremula*	aspen	54	*Tilia platyphyllos*	broad-leaved lime
27	*Prunus avium*	wild cherry	55	*Ulmus glabra*	wych elm
28	*Prunus padus*	bird cherry	56	*Ulmus laevis*	European white elm
			57	*Ulmus minor*	lock elm

CONIFERS

1	*Abies alba*	silver fir	9	*Pinus mugo*	dwarf mountain pine
2	*Juniperus communis*	common juniper	10	*Pinus nigra laricio corsicana*	Corsican pine
3	*Juniperus oxycedrus*	prickly juniper, cade	11	*Pinus nigra clusiana*	Pinus nigra clusiana
4	*Juniperus thurifera*	Spanish juniper, savin	12	*Pinus pinaster*	maritime pine
5	*Larix decidua*	European larch	13	*Pinus pinea*	stone or umbrella pine
6	*Picea abies*	common spruce	14	*Pinus sylvestris*	Scots pine
7	*Pinus cembra*	arolla pine	15	*Pinus uncinata*	mountain pine
8	*Pinus halepensis*	Aleppo pine	16	*Taxus baccata*	yew

List of trees acclimatized in France and relatively well represented in forests

An acclimatized tree is one which:

– was introduced long enough ago to have clearly shown, over more than one generation, that it is well adapted to the environmental and climatic conditions prevailing in France;

– can reproduce naturally in forests, without human intervention.

BROADLEAVED

1	*Juglans regia*	common walnut
2	*Quercus rubra*	red oak
3	*Robinia pseudacacia*	false acacia
4	*Celtis australis*	hackberry tree

CONIFERS

1	*Abies nordmanniana*	caucasina fir
2	*Cedrus atlantica*	Atlas cedar
3	*Cupressus sempervirens*	Italian or funeral cyprus
4	*Pinus nigra nigricans*	Austrian pine
5	*Pinus nigra laricio calabrica*	Calabrian pine
6	*Pseudotsuga menziesii*	Douglas fir

List of exotic trees sometimes found in forests

BROADLEAVED

1	*Acacia dealbata*	mimosa
2	*Acer negundo*	box elder
3	*Aesculus hippocastanum*	horse chestnut
4	*Ailanthus altissima*	tree of heaven
5	*Eucalyptus sp.*	eucalyptus
6	*Juglans nigra*	black walnut
7	*Gleditschia triacanthos*	honey locust
8	*Laburnum anagyroïdes*	laburnum
9	*Liquidambar styraciflua*	liquidambar
10	*Liriodendron tulipifera*	tulip tree
11	*Platanus ×hispanica*	London plane
12	*Platanus orientalis*	oriental plane
13	*Populus deltoides*	eastern cottonwood
14	*Populus trichocarpa*	black cottonwood
15	*Prunus laurocerasus*	cherry laurel
16	*Prunus lusitanica*	Portuguese laurel
17	*Prunus serotina*	black cherry
18	*Quercus palustris*	pin oak

CONIFERS

1	*Abies bornmulleriana*	Turkish fir
2	*Abies cephalonica*	Greek fir
3	*Abies cilicica*	cilicia fir
4	*Abies concolor*	Colorado fir
5	*Abies grandis*	Vancouver fir
6	*Abies numidica*	numidian fir
7	*Abies pinsapo*	Spanish or hedgehog fir
8	*Abies procera*	noble fir
9	*Calocedrus decurrens*	California incense tree
10	*Cedrus brevifolia*	cyprus cedar
11	*Cedrus deodara*	deodar
12	*Cedrus libani*	cedar of Lebanon
13	*Chamaecyparis lawsoniana*	Lawson cypress
14	*Cryptomeria japonica*	Japanese red cedar
15	*Cupressocyparis leylandii*	Leyland cypress
16	*Cupressus arizonica*	Arizona cypress
17	*Cupressus atlantica*	Atlas cypress
18	*Cupressus macrocarpa*	Monterey cypress
19	*Larix eurolepis*	Dunkeld larch
20	*Larix kaempferi*	Japanese larch
21	*Metasequoia glyptostroboides*	dawn redwood
22	*Picea sitchensis*	sitka spruce
23	*Pinus brutia*	Turkish pine
24	*Pinus contorta*	lodgepole pine
25	*Pinus eldarica*	eldarica pine
26	*Pinus radiata*	Monterey pine
27	*Pinus rigida*	northern pitch pine
28	*Pinus taeda*	incense pine
29	*Pinus strobus*	Weymouth pine
30	*Sequoia sempervirens*	redwood
31	*Sequoiadendron giganteum*	wellingtonia, giant sequoia
32	*Taxodium distichum*	swamp or bald cypress
33	*Thuja plicata*	western red cedar
34	*Tsuga heterophylla*	western hemlock

Appendix VIII

Tree species observed by NFI and corresponding area

A species usually designates a tree species but can sometimes refer to a sub-species or variety of special interest or to several species.
Species observed by NFI are:

Broadleaved				Conifers			
Indigenous species							
	1000 ha				*1000 ha*		
Pedunculate oak	1 975	±	67	Maritime pine	1 106	±	48
Sessile oak	1 639	±	56	Scots pine	896	±	46
Pubescent oak	1 370	±	56	Corsican pine	184	±	22
Holm oak	706	±	45	Stone or umbrella pine	< 24		
Pyrenean oak	48	±	12	Aleppo pine	213	±	26
Cork oak	89	±	17	Mountain pine	56	±	12
Beech	1 418	±	55	Arolla pine	< 5		
Chestnut	739	±	42	Dwarf mountain pine	< 2		
Hornbeam	561	±	35	Silver fir	565	±	35
Birch	308	±	28	Common spruce	590	±	37
Large alder	139	±	20	Larch	102	±	15
Large maple	111	±	17	Yew	< 2		
Common ash	576	±	39	Spanish juniper, savin	< 12		
Elm	< 32			Other indigenous conifers	NA		
Linden	62	±	13				
Small maple	63	±	14				
Cherry or wild cherry	53	±	14				
Other fruit tree	< 39						
Aspen	105	±	16				
Willow	121	±	18				
Olive	< 15						
Hazel	63	±	13				
Hop-hornbeam	< 13						
Non-cultivated poplar	< 46						
Turkey oak	< 15						
Cornelian cherry	< 4						
Wild service tree	< 8						
Other indigenous broadleaved	< 48						

Acclimatized species							
Red oak	43	±	10	Austrian pine	197	±	23
False acacia	191	±	23	Douglas fir	404	±	32
Hackberry tree	nd			Atlas cedar	< 23		
Walnut	< 5			Cypress	< 5		
Stawberry tree	< 69			Caucasina fir	< 4		
Exotic species							
Cultivated poplar	224	±	22	Weymouth pine	< 7		
Plane	< 4			Mediterranean firs	nd		
Eucalyptus	< 8			Double balsam fir	< 24		
Laburnum	< 4			Sitka spruce	46	±	10
Tulip tree	nd			Exotic larch	< 20		
Other exotic broadleaved	< 10			Cedar of Lebanon	nd		
				Incense pine	< 7		
				Other exotic conifers	< 10		

Source: NFI, survey years 2006 to 2009.
Relevant domain: FAWS.

Appendix IX

Detailed land-use transition matrices

Teruti transition matrix 1992-1997

	Areas with structures	Coated or stabilized areas	Other man-made areas	Farmland	Permanent crops	Other cultivated land associated with agricultural production	Forests (incl. poplar plantations)	Other wooded lands	Heathland, fallows, maquis, garrigues	Grasslands	Natural bare land	Wetlands and underwater zones	Prohibited areas	Total 1997
Areas with structures	670 247	10 093	26 782	20 509	3 510	7 572	4 373	3 790	10 009	14 820	200	998	302	773 205
Coated or stabilized areas	12 114	1 448 355	43 268	27 097	3 415	48 650	15 660	12 739	16 456	20 209	600	2 916	1 008	1 652 487
Other man-made areas	14 031	34 923	1 132 233	65 903	11 406	35 165	18 245	24 904	59 126	77 274	990	7 128	499	1 481 827
Farmland	2 607	11 335	15 955	16 102 458	98 676	31 833	28 626	37 825	105 622	1 013 035	0	5 985	102	17 454 059
Permanent crops	905	2 010	2 707	82 822	1 299 370	5 410	5 220	4 817	22 128	24 583	195	502	0	1 450 669
Other cultivated land associated with agricultural production	6 316	15 752	16 488	33 026	7 732	482 759	2 458	5 447	9 669	22 469	0	900	101	603 117
Forests (incl. poplar plantations)	1 405	9 073	14 130	51 841	9 112	4 190	14 373 776	152 107	390 154	134 610	19 412	6 604	711	15 167 125
Other wooded lands	2 606	5 862	20 048	16 129	4 837	5 713	71 609	1 369 667	42 884	28 656	1 889	4 193	304	1 574 397
Heathland, fallows, maquis, garrigues	1 108	7 888	23 805	128 697	40 549	10 337	79 092	30 461	1 746 598	278 196	25 033	4 298	99	2 376 161
Grasslands	1 907	4 680	19 813	961 922	31 573	13 165	24 094	39 293	158 844	9 135 989	22 293	6 983	100	10 420 656
Natural bare land	196	804	302	302	99	100	6 147	2 845	15 114	16 546	829 805	1 195	0	873 455
Wetlands and underwater zones	808	2 702	7 901	11 574	507	852	6 115	7 906	11 820	22 864	3 290	891 880	0	968 219
Prohibited areas	101	202	200	793	0	0	1 322	0	403	198	0	0	120 662	123 881
Total 1992	**714 351**	**1 553 679**	**1 323 632**	**17 503 073**	**1 510 786**	**645 746**	**14 636 737**	**1 691 801**	**2 588 827**	**10 789 449**	**903 707**	**933 582**	**123 888**	**54 919 258**

Source : SSP - Teruti
Source: SSP – Teruti.
The above matrix indicates landuse patterns in France between one year (n) and another year (n+p).
- Rows indicate the landuse during year (n) at sampling points with landuse X in (n+p).
This highlights the ORIGIN of sampling points with landuse X in (n+p).
The figures at the end of the rows represent the total area of sampling points with landuse X in (n+p).
- Columns indicate the landuse in (n+p) at sampling points with landuse Y in (n).
This highlights the FATE of sampling points with landuse Y in (n).
The figures at the bottom of the columns represent the total area of sampling points with landuse Y in (n).
- The diagonal cells indicate the areas of sampling points where there was no landuse change.

Teruti-Lucas transition matrix 1997-2003

	Areas with structures	Coated or stabilized areas	Other man-made areas	Farmland	Permanent crops	Other cultivated land associated with agricultural production	Forests (incl. poplar plantations)	Other wooded lands	Heathland, fallows, maquis, garrigues	Grasslands	Natural bare land	Wetlands and underwater zones	Prohibited areas	Total 2003
Areas with structures	739 893	11 982	32 833	33 823	3 817	7 897	6 420	4 011	14 830	21 574	203	396	0	877 679
Coated or stabilized areas	8 548	1 566 362	40 171	31 144	3 456	31 006	17 224	10 799	12 461	19 554	498	2 151	0	1 743 374
Other man-made areas	11 136	25 945	1 303 248	76 488	10 980	35 436	19 864	21 956	49 647	79 863	1 299	2 903	100	1 638 865
Farmland	3 609	11 065	13 397	16 004 659	98 648	21 898	32 827	22 094	92 845	882 401	100	6 073	100	17 189 716
Permanent crops	805	1 205	3 692	86 098	1 258 245	5 655	7 339	2 993	26 686	22 867	99	101	0	1 415 785
Other cultivated land associated with agricultural production	3 054	10 236	11 734	26 937	5 786	467 708	2 852	3 497	7 365	20 006	99	202	0	559 476
Forests (incl. poplar plantations)	802	8 314	11 865	36 804	6 690	1 997	14 900 127	89 060	232 505	95 872	17 352	6 549	408	15 408 345
Other wooded lands	1 560	4 807	15 750	10 614	3 607	4 063	52 673	1 372 491	26 024	20 440	497	4 059	100	1 516 685
Heathland, fallows, maquis, garrigues	1 298	4 096	19 601	101 072	30 119	11 206	80 714	14 626	1 760 225	188 150	25 766	3 644	0	2 240 517
Grasslands	1 691	5 369	21 203	1 035 423	28 805	15 053	32 268	27 859	137 593	9 043 911	34 971	4 497	204	10 388 847
Natural bare land	99	498	300	0	101	103	7 486	492	11 368	16 071	790 876	2 798	0	830 192
Wetlands and underwater zones	101	1 601	7 539	10 979	408	995	6 328	4 209	3 698	9 838	1 694	934 838	0	982 228
Prohibited areas	605	1 009	499	0	0	101	1 012	304	902	100	0	0	122 969	127 501
Total 1997	**773 201**	**1 652 489**	**1 481 832**	**17 454 041**	**1 450 662**	**603 118**	**15 167 134**	**1 574 391**	**2 376 149**	**10 420 647**	**873 454**	**968 211**	**123 881**	**54 919 210**

Teruti-Lucas transition matrix 2006-2010

	Areas with structures	Coated or stabilized areas	Other man-made areas	Farmland	Permanent crops	Other cultivated land associated with agricultural production	Forests (incl. poplar plantations)	Other wooded lands	Heathland, fallows, maquis, garrigues	Grasslands	Natural bare land	Wetlands and underwater zones	Prohibited areas	Total 2010
Areas with structures	697 344	26 374	35 603	27 712	3 325	2 330	5 568	5 954	14 399	25 048	1 795	359	2 877	848 686
Coated or stabilized areas	31 620	1 970 116	94 644	50 618	5 943	22 763	41 331	33 275	23 562	31 896	7 984	1 976	4 680	2 320 409
Other man-made areas	25 398	56 464	1 330 828	67 583	6 473	12 577	22 232	32 737	49 034	83 160	8 822	3 152	34 823	1 733 285
Farmland	6 205	21 678	38 713	16 088 340	94 421	81 802	30 945	39 217	71 382	843 888	8 262	5 223	3 153	17 333 229
Permanent crops	901	3 060	3 332	66 345	1 077 664	18 141	9 813	3 588	11 164	19 515	902	359	539	1 215 322
Other cultivated land associated with agricultural production	537	10 428	7 374	63 841	13 862	101 047	2 337	2 881	7 639	20 243	1 619	1 079	1 445	234 330
Forests (incl. poplar plantations)	1 083	16 922	16 813	22 762	8 704	2 511	14 612 946	150 559	213 122	56 923	7 366	6 564	20 321	15 136 596
Other wooded lands	3 417	15 491	26 725	31 201	4 495	3 960	87 907	1 579 208	42 443	61 230	2 165	4 141	807	1 863 189
Heathland, fallows, maquis, garrigues	4 134	15 120	39 970	108 791	27 833	18 057	210 044	34 534	2 198 758	161 562	16 513	13 849	4 135	2 853 299
Grasslands	3 240	16 738	43 516	535 488	21 757	22 012	49 866	53 201	109 055	8 593 918	5 775	5 935	1 440	9 461 940
Natural bare land	178	3 772	7 375	10 075	4 680	3 599	15 028	3 950	22 057	14 339	876 889	3 944	1 599	967 486
Wetlands and underwater zones	1 078	3 434	8 094	10 069	1 439	1 709	6 751	7 999	24 460	14 016	4 051	817 228	718	901 046
Prohibited areas	0	0	0	2 244	0	0	0	0	0	0	0	0	48 184	50 428
Total 2006	**775 134**	**2 159 597**	**1 652 988**	**17 085 068**	**1 270 597**	**290 507**	**15 094 768**	**1 947 103**	**2 787 075**	**9 925 738**	**942 143**	**863 808**	**124 721**	**54 919 246**

Appendix X

Areas and volumes by region and forest structure

Site	Forest structure	1000 ha			1000 m³		
Alsace	High forest	279	±	13	77 011	±	7 679
	Mixed	30	±	8	4 377	±	2 189
	Coppice	1 to 7			0 to 440		
	Open forest	2 to 10			0 to 343		
	Poplar plantation	0 to 2			0 to 117		
Total Alsace		**320**	**±**	**11**	**81 672**	**±**	**7 984**
Aquitaine	High forest	1 223	±	39	147 138	±	11 249
	Mixed	327	±	29	44 664	±	5 842
	Coppice	184	±	23	15 275	±	3 345
	Open forest	40	±	12	960	±	563
	Poplar plantation	14 to 29			0 to 5 556		
Total Aquitaine		**1 794**	**±**	**29**	**210 297**	**±**	**12 165**
Auvergne	High forest	447	±	24	128 338	±	10 649
	Mixed	205	±	20	31 799	±	4 653
	Coppice	19 to 36			816 to 3 138		
	Open forest	10 to 23			89 to 1 571		
	Poplar plantation	0 to 6			0 to 1 596		
Total Auvergne		**699**	**±**	**22**	**163 563**	**±**	**11 075**
Basse-Normandie	High forest	105	±	10	21 031	±	3 946
	Mixed	40	±	8	7 153	±	1 984
	Coppice	10 to 21			226 to 2 590		
	Open forest	1 to 10			0 to 624		
	Poplar plantation	2 to 8			0 to 2 330		
Total Basse-Normandie		**171**	**±**	**8**	**30 689**	**±**	**4 386**
Bourgogne	High forest	451	±	26	93 006	±	8 596
	Mixed	456	±	26	77 707	±	6 272
	Coppice	54	±	11	4 540	±	1 651
	Open forest	2 to 11			0 to 520		
	Poplar plantation	4 to 13			192 to 1 332		
Total Bourgogne		**977**	**±**	**20**	**176 114**	**±**	**8 937**
Bretagne	High forest	192	±	16	41 149	±	5 320
	Mixed	72	±	12	13 048	±	3 109
	Coppice	62	±	11	6 519	±	3 250
	Open forest	13 to 29			136 to 774		
	Poplar plantation	4 to 12			245 to 2 444		
Total Bretagne		**355**	**±**	**16**	**62 515**	**±**	**6 718**
Centre	High forest	463	±	25	88 578	±	7 361
	Mixed	346	±	24	57 053	±	5 317
	Coppice	81	±	13	7 939	±	2 176
	Open forest	15 to 31			0 to 1 936		
	Poplar plantation	13 to 25			823 to 3 885		
Total Centre		**933**	**±**	**21**	**156 869**	**±**	**8 209**

Site	Forest structure	1000 ha			1000 m³		
Champagne-Ardenne	High forest	445	±	22	88 438	±	7 559
	Mixed	202	±	19	31 036	±	4 555
	Coppice	7 to 18			0 to 1 373		
	Open forest	1 to 9			0 to 358		
	Poplar plantation	22	±	6	2 506	±	1 721
Total Champagne-Ardenne		**687**	**±**	**18**	**122 747**	**±**	**8 191**
Corse	High forest	60	±	14	15 013	±	5 319
	Mixed	147	±	19	16 036	±	3 704
	Coppice	80	±	18	3 401	±	1 143
	Open forest	103	±	26	1 969	±	1 314
Total Corse		**390**	**±**	**31**	**36 420**	**±**	**5 924**
Franche-Comté	High forest	503	±	22	131 420	±	10 071
	Mixed	177	±	18	28 248	±	4 320
	Coppice	8 to 19			262 to 1 673		
	Open forest	4 to 13			0 to 514		
	Poplar plantation	0 to 6			0 to 2 069		
Total Franche-Comté		**704**	**±**	**18**	**161 420**	**±**	**10 375**
Haute-Normandie	High forest	154	±	14	31 548	±	4 332
	Mixed	43	±	10	6 685	±	2 229
	Coppice	10 to 24			465 to 2 651		
	Open forest	0 to 3			0 to 0		
	Poplar plantation	0 to 5			0 to 525		
Total Haute-Normandie		**216**	**±**	**13**	**39 976**	**±**	**4 488**
Île-de-France	High forest	164	±	14	32 731	±	4 325
	Mixed	67	±	11	10 920	±	2 799
	Coppice	16 to 31			1 047 to 3 210		
	Open forest	0 to 5			0 to 75		
	Poplar plantation	1 to 7			0 to 2 120		
Total Île-de-France		**260**	**±**	**11**	**46 680**	**±**	**4 654**
Languedoc-Roussillon	High forest	334	±	27	53 000	±	7 765
	Mixed	300	±	27	36 439	±	5 670
	Coppice	334	±	27	17 826	±	3 063
	Open forest	176	±	25	2 150	±	970
Total Languedoc-Roussillon		**1 144**	**±**	**31**	**109 414**	**±**	**8 754**
Limousin	High forest	312	±	21	74 714	±	7 884
	Mixed	189	±	18	27 759	±	4 329
	Coppice	53	±	10	4 004	±	1 634
	Open forest	2 to 9			0 to 526		
	Poplar plantation	0 to 3			0 to 1 470		
Total Limousin		**560**	**±**	**18**	**106 856**	**±**	**8 741**
Lorraine	High forest	718	±	23	152 430	±	10 519
	Mixed	124	±	16	13 719	±	3 366
	Coppice	2 to 10			0 to 251		
	Open forest	6 to 17			0 to 650		
	Poplar plantation	0 to 4			0 to 857		
Total Lorraine		**861**	**±**	**19**	**166 761**	**±**	**10 906**

Site	Forest structure	1000 ha			1000 m³		
Midi-Pyrénées	High forest	481	±	30	93 260	±	8 941
	Mixed	527	±	32	71 110	±	6 670
	Coppice	199	±	22	12 169	±	2 505
	Open forest	90	±	20	3 to 2 590		
	Poplar plantation	6 to 18			0 to 2 109		
Total Midi-Pyrénées		**1 308**	**±**	**33**	**178 850**	**±**	**10 444**
Nord-Pas-de-Calais	High forest	71	±	10	14 334	±	3 586
	Mixed	5 to 15			415 to 1 921		
	Coppice	6 to 17			72 to 1 493		
	Open forest	0 to 4			0 to 229		
	Poplar plantation	7 to 14			120 to 4 097		
Total Nord-Pas-de-Calais		**104**	**±**	**11**	**18 432**	**±**	**3 735**
Pays de la Loire	High forest	170	±	15	31 748	±	5 007
	Mixed	70	±	12	12 459	±	3 142
	Coppice	51	±	10	5 343	±	2 000
	Open forest	7 to 17			0 to 316		
	Poplar plantation	19	±	5	2 802	±	1 718
Total Pays de la Loire		**323**	**±**	**13**	**52 505**	**±**	**5 646**
Picardie	High forest	191	±	16	40 898	±	5 241
	Mixed	74	±	13	11 948	±	2 666
	Coppice	10 to 22			56 to 2 149		
	Open forest	0 to 6			0 to 189		
	Poplar plantation	28	±	7	3 628	±	2 280
Total Picardie		**312**	**±**	**16**	**57 622**	**±**	**5 808**
Poitou-Charentes	High forest	100	±	15	12 868	±	3 358
	Mixed	162	±	18	22 568	±	3 305
	Coppice	106	±	14	9 580	±	2 288
	Open forest	6	to	16	0	to	185
	Poplar plantation	11	to	25	744	to	4 192
Total Poitou-Charentes		**396**	**±**	**19**	**47 574**	**±**	**4 739**
Provence-Alpes-Côte d'Azur	High forest	516	±	33	72 057	±	7 044
	Mixed	332	±	29	27 926	±	4 119
	Coppice	227	±	25	8 513	±	2 070
	Open forest	226	±	27	4 748	±	1 420
Total Provence-Alpes-Côte d'Azur		**1 301**	**±**	**37**	**113 243**	**±**	**8 133**
Rhône-Alpes	High forest	840	±	36	208 305	±	14 888
	Mixed	424	±	30	59 211	±	6 480
	Coppice	159	±	19	9 206	±	2 094
	Open forest	73	±	15	0 to 3 670		
	Poplar plantation	4 to 14			0 to 2 257		
Total Rhône-Alpes		**1 504**	**±**	**35**	**279 403**	**±**	**15 643**
Total		**15 319**	**±**	**104**	**2 419 623**	**±**	**40 511**

Species	Diameter class (in cm)	1000 m³		
Pedunculate oak	Small diameter trees	39 506	±	2 747
	Medium diameter trees	140 860	±	5 759
	Large diameter trees	80 128	±	3 889
	Very large diameter trees	28 678	±	2 700
Total pedunculate oak		289 172	±	11 324
Sessile oak	Small diameter trees	42 459	±	3 219
	Medium diameter trees	133 686	±	5 973
	Large diameter trees	77 386	±	4 246
	Very large diameter trees	23 673	±	2 498
Total sessile oak		277 203	±	11 931
Pubescent oak	Small diameter trees	52 508	±	3 531
	Medium diameter trees	39 377	±	2 967
	Large diameter trees	4 393	±	759
	Very large diameter trees	791	±	310
Total pubescent oak		97 070	±	6 070
Holm oak	Small diameter trees	19 197	±	2 052
	Medium diameter trees	5 309	±	1 142
	Large diameter trees	878	±	459
	Very large diameter trees	51 to 676		
Total holm oak		25 746	±	2 969
Beech	Small diameter trees	49 443	±	3 482
	Medium diameter trees	131 096	±	6 446
	Large diameter trees	59 865	±	3 657
	Very large diameter trees	21 294	±	2 242
Total beech		261 698	±	12 710
Chestnut	Small diameter trees	51 034	±	4 460
	Medium diameter trees	54 300	±	4 266
	Large diameter trees	8 832	±	1 215
	Very large diameter trees	7 424	±	1 767
Total chestnut		121 590	±	8 762
Hornbeam	Small diameter trees	57 245	±	3 148
	Medium diameter trees	33 522	±	2 023
	Large diameter trees	2 040	±	449
	Very large diameter trees	3 to 388		
Total hornbeam		93 003	±	4 655

Species	Diameter class (in cm)	1000 m³		
Birch	Small diameter trees	21 065	±	1 842
	Medium diameter trees	17 680	±	1 447
	Large diameter trees	785	±	265
	Very large diameter trees	0 to 128		
Total birch		39 548	±	2 824
Common ash	Small diameter trees	26 662	±	2 570
	Medium diameter trees	48 432	±	3 425
	Large diameter trees	11 455	±	1 441
	Very large diameter trees	2 192	±	735
Total common ash		88 741	±	6 051
Other broadleaved	Small diameter trees	107 754	±	4 258
	Medium diameter trees	120 817	±	5 162
	Large diameter trees	20 458	±	2 432
	Very large diameter trees	7 141	±	1 792
Total other broadleaved		256 171	±	9 528
Maritime pine	Small diameter trees	20 390	±	2 623
	Medium diameter trees	84 448	±	7 112
	Large diameter trees	29 799	±	3 675
	Very large diameter trees	4 032	±	1 242
Total maritime pine		138 669	±	10 994
Scots pine	Small diameter trees	28 335	±	2 654
	Medium diameter trees	99 202	±	6 361
	Large diameter trees	14 911	±	1 821
	Very large diameter trees	766	±	415
Total Scots pine		143 214	±	9 192
Austrian or Corsican pine	Small diameter trees	13 145	±	2 246
	Medium diameter trees	35 373	±	5 279
	Large diameter trees	7 401	±	1 848
	Very large diameter trees	2 349	±	1 536
Total Austrian or Corsican pine		58 268	±	8 419
Aleppo pine	Small diameter trees	3 017	±	768
	Medium diameter trees	9 630	±	1 740
	Large diameter trees	2 708	±	727
	Very large diameter trees	69 to 645		
Total Aleppo pine		15 713	±	2 796

Species	Diameter class (in cm)	1000 m³		
Silver fir	Small diameter trees	21 056	±	2 116
	Medium diameter trees	95 328	±	7 534
	Large diameter trees	46 992	±	4 294
	Very large diameter trees	17 340	±	2 580
Total silver fir		180 715	±	15 376
Common spruce	Small diameter trees	32 315	±	3 902
	Medium diameter trees	113 489	±	9 717
	Large diameter trees	32 768	±	3 561
	Very large diameter trees	6 143	±	1 408
Total common spruce		184 716	±	15 924
Larch	Small diameter trees	2 724	±	922
	Medium diameter trees	12 680	±	2 830
	Large diameter trees	4 458	±	1 345
	Very large diameter trees	1 215	±	958
Total larch		21 077	±	4 738
Douglas fir	Small diameter trees	13 314	±	2 062
	Medium diameter trees	62 728	±	7 945
	Large diameter trees	15 229	±	3 312
	Very large diameter trees	2 313	±	1 153
Total Douglas fir		93 584	±	12 161
Other conifers	Small diameter trees	6 526	±	1 611
	Medium diameter trees	22 237	±	3 985
	Large diameter trees	4 044	±	1 315
	Very large diameter trees	0 to 2 021		
Total other conifers		33 726	±	6 312
Total		**2 419 623**	±	**40 511**

Appendix XII

Version of the NFI cartographic database on stand types used per department and the corresponding year

Site	Year	Cartographic database version	Site	Year	Cartographic database version
Aisne	1999	1	Maine-et-Loire	1994	1
Allier	1997	1	Manche	1998	1
Alpes-de-Haute-Provence	1994	1	Marne	1995	1
Ariège	2001	1	Meurthe-et-Moselle	2001	1
Aude	1999	1	Meuse	2003	1
Aveyron	1990	1	Moselle	2001	1
Bas-Rhin	1997	1	Nord	1998	1
Bouches-du-Rhône	1997	1	Oise	1999	1
Calvados	1998	1	Orne	1998	1
Cantal	2000	1	Paris	2000	1
Charente	2002	1	Pas-de-Calais	1998	1
Charente-Maritime	2003	1	Puy-de-Dôme	2000	1
Corrèze	1999	1	Pyrénées-Atlantiques	1992	1
Corse-du-Sud	2000	1	Pyrénées-Orientales	1999	1
Côte-d'Or	2000	1	Rhône	1990	1
Côtes-d'Armor	2003	1	Saône-et-Loire	1999	1
Creuse	2000	1	Seine-et-Marne	2000	1
Dordogne	2000	1	Seine-Maritime	2000	1
Doubs	2000	1	Somme	1999	1
Eure	2000	1	Tarn	1987	1
Eure-et-Loir	2001	1	Tarn-et-Garonne	1998	1
Finistère	1993	1	Territoire de Belfort	2002	1
Gard	2000	1	Var	1995	1
Gers	1998	1	Vienne	1993	1
Gironde	1995	1	Vosges	2004	1
Haute-Corse	2000	1	Yonne	1996	1
Haute-Garonne	1996	1	Ain	2005	2
Haute-Loire	1999	1	Alpes-Maritimes	2004	2
Hautes-Alpes	1993	1	Ardèche	2007	2
Haute-Saône	2003	1	Ardennes	2005	2
Haute-Savoie	1995	1	Aube	2005	2
Haute-Vienne	2000	1	Cher	2005	2
Haut-Rhin	1997	1	Deux-Sèvres	2007	2
Hérault	2002	1	Drôme	2006	2
Ille-et-Vilaine	2003	1	Haute-Marne	2006	2
Indre-et-Loire	2002	1	Hautes-Pyrénées	2006	2
Isère	1993	1	Indre	2004	2
Jura	2000	1	Loire	2006	2
Landes	1997	1	Mayenne	2006	2
Loire-Atlantique	1996	1	Morbihan	2004	2
Loiret	2001	1	Nièvre	2007	2
Loir-et-Cher	2002	1	Sarthe	2005	2
Lot	1999	1	Savoie	2006	2
Lot-et-Garonne	1997	1	Vaucluse	2005	2
Lozère	2000	1	Vendée	2006	2

Appendix XIII

List of forest species, classified according to the categories of the IUCN Red Lists

Vascular plants		
1) species exclusively or very often found in forests		
Atlantic polystichum	*Dryopteris aemula*	-
crested fern	*Dryopteris cristata*	-
holly fern	*Polystichum braunii*	-
Mauritanian grass	*Ampelodesmos mauritanica*	-
Asperula taurinus	*Asperula taurina*	-
Cardamine chelidonia	*Cardamine chelidonia*	-
Fritillaria orientalis	*Fritillaria orientalis*	-
yellow star of Bethlehem	*Gagea lutea*	-
paeony	*Paeonia officinalis*	-
bladderseed	*Physospermum cornubiense*	-
chickweed wintergreen	*Trientalis europaea*	-
Vicia laeta	*Vicia laeta*	-
dwarf mountain pine	*Pinus mugo*	-
carob tree	*Ceratonia siliqua*	-
false Spanish cork oak	*Quercus crenata*	-
service tree of Fontainebleau	*Sorbus latifolia*	-
coralroot orchid	*Corallorhiza trifida*	NT
ghost orchid	*Epipogium aphyllum*	NT
Spitzel's orchid	*Orchis spitzelii*	VU
lady's slipper	*Cypripedium calceolus*	VU
2) species with mixed behaviour, found to an equal extent in forests and open areas		
monkshood	*Aconitus napellus subsp. corsicum*	-
palmate anemone	*Anemone palmata*	-
Bertoloni's columbine	*Aquilegia bertolonii*	-
European Michaelmas daisy	*Aster amellus*	-
Campanula cervicaria	*Campanula cervicaria*	-
mountain thistle	*Cirsium montanum*	-
Requien's delphinium	*Delphinium requienii*	-
Ligurian gentian	*Gentiana ligustica*	-
Hdysarum boutignyanum	*Hedysarum boutignyanum*	-
Haller's pasque flower	*Pulsatilla halleri*	-
Senecio ruthenensis	*Senecio ruthenensis*	-
Jupiter's beard	*Anthyllis barba-jovis*	-
dwarf birch	*Betula nana*	-
Mediterranean dwarf palm	*Chamaerops humilis*	-
crispy-leaved rockrose	*Cistus crispus*	-
poplar leaved rockrose	*Cistus populifolius*	-
alpine clematis	*Clematis alpina*	-
ardoin broom	*Cytisus ardoini*	-
Cytisus sauzeanus	*Cytisus sauzeanus*	-
Echinospartum horridum	*Echinospartum horridum*	-
needle-leaved broom	*Genista linifolia subsp. linifolia*	-
Swiss willow	*Salix helvetica*	-
shrubby germander	*Teucrium fruticans*	-
wild grapevine	*Vitis vinifera subsp. sylvestris*	-
short-spurred fragrant orchid	*Gymnadenia odoratissima*	VU
early-marsh orchid	*Dactylorhiza incarnata*	VU
western-marsh orchid	*Dactylorhiza majalis*	NT
three-toothed orchid	*Neotinea tridentata*	NT
tongue orchid	*Serapias lingua*	NT

Note. While awaiting a revision of the national red lists for plant species, we focused only on species that are protected throughout France. We therefore do not specify the extent to which species are threatened since the criteria are different (cf. § 4.8), except for orchids for which a red list was published in 2010 (cf. hereafter: sources).

Mammals		
1) species exclusively or very often found in forests		
brown bear	*Ursus arctos*	CR
lynx	*Lynx lynx*	EN
Bechstein's bat	*Myotis bechsteini*	NT
lesser noctule	*Nyctalus leisleri*	NT
Brandt's bat	*Myotis brandti*	LC
Geoffrey's bat	*Myotis emarginatus*	LC
western barbastelle	*Barbastella barbastellus*	LC
large mouse-eared bat	*Myotis myotis*	LC
Alcathoe's bat	*Myotis alcathoe*	LC
Natterer's bat	*Myotis nattereri*	LC
long-eared bat	*Plecotus auritus*	LC
Eurasian red squirrel	*Sciurus vulgaris*	LC
pine marten	*Martes martes*	LC
2) species with mixed behaviour, found to an equal extent in forests and open areas		
Felten's myotis	*Myotis punicus*	VU
common noctule	*Nyctalus noctula*	NT
Mediterranean horseshoe bat	*Rhinolophus euryale*	NT
greater horseshoe bat	*Rhinolophus ferrumequinum*	NT
lesser white-toothed shrew	*Crocidura suaveolens*	NT
Pyrenean desman	*Galemys pyrenaicus*	NT
European rabbit	*Oryctolagus cuniculus*	NT
Nathusius' pipistrelle	*Pipistrellus nathusii*	NT
lesser horsesoe bat	*Rhinolophus hipposideros*	LC
northern bat	*Eptesicus nilssoni*	LC
crowned shrew	*Sorex coronatus*	LC
pygmy shrew	*Sorex minutus*	LC
Eurasian water shrew	*Neomys fodiens*	LC
Etruscan shrew	*Suncus etruscus*	LC
Eurasian beaver	*Castor fiber*	LC
garden dormouse	*Eliomys quercinus*	LC
edible dormouse	*Glis glis*	LC
hazel dormouse	*Muscardinus avellanarius*	LC
bank vole	*Clethrionomys glareolus*	LC
yellow-necked field mouse	*Apodemus flavicollis*	LC
wood mouse	*Apodemus sylvaticus*	LC
house mouse	*Mus musculus*	LC
roof rat	*Rattus rattus*	LC
European hare	*Lepus europaeus*	LC
Daubenton's bat	*Myotis daubentonii*	LC
European otter	*Lutra lutra*	LC
Eurasian badger	*Meles meles*	LC
European polecat	*Mustela putorius*	LC
common genet	*Genetta genetta*	LC
wildcat	*Felis sylvestris*	LC
common wild boar	*Sus scrofa*	LC
European roe deer	*Capreolus capreolus*	LC
red deer	*Cervus elaphus*	LC
common shrew	*Sorex araneus*	DD
Alpine shrew mouse	*Sorex alpinus*	DD
parti-coloured bat	*Vespertilio murinus*	DD
Escalera's bat	*Myotis escalerai*	DD
greater noctule	*Nyctalus lasiopterus*	DD

Birds

1) species exclusively or very often found in forests

black stork	Ciconia nigra	EN
booted eagle	Aquila pennata	VU
hazel grouse	Bonasa bonasia	VU
capercaillie	Tetrao urogallus	VU
pygmy owl	Glaucidium passerinum	VU
grey-headed woodpecker	Picus canus	VU
white-backed woodpecker	Dendrocopos leucotos	VU
wood warbler	Phylloscopus sibilatrix	VU
bullfinch	Pyrrhula pyrrhula	VU
willow warbler	Phylloscopus trochilus	NT
coal tit	Parus ater	NT
Corsican nuthatch	Sitta whiteheadi	NT
siskin	Carduelis spinus	NT
northern goshawk	Accipiter gentilis	LC
tawny owl	Strix aluco	LC
long-eared owl	Asio otus	LC
Tengmalm's owl	Aegolius funereus	LC
black woodpecker	Dryocopus martius	LC
great spotted woodpecker	Dendrocopos major	LC
middle spotted woodpecker	Dendrocopos medius	LC
lesser spotted woodpecker	Dendrocopos minor	LC
tree pipit	Anthus trivialis	LC
wren	Troglodytes troglodytes	LC
goldcrest	Regulus regulus	LC
firecrest	Regulus ignicapilla	LC
collared flycatcher	Ficedula albicollis	LC
pied flycatcher	Ficedula hypoleuca	LC
long-tailed tit	Aegithalos caudatus	LC
marsh tit	Parus palustris	LC
willow tit	Parus montanus	LC
crested tit	Parus cristatus	LC
blue tit	Parus caeruleus	LC
European nuthatch	Sitta europaea	LC
Eurasian treecreeper	Certhia familiaris	LC
golden oriole	Oriolus oriolus	LC
Eurasian jay	Garrulus glandarius	LC
nutcracker	Nucifraga caryocatactes	LC
chaffinch	Fringilla coelebs	LC
common crossbill	Loxia curvirostra	LC
three-towed woodpecker	Picoides tridactylus	DD

2) species with mixed behaviour, found to an equal extent in forests and open areas

lesser grey shrike	Lanius minor	CR
black-shouldered kite	Elanus caeruleus	EN
spectacled warbler	Sylvia conspicillata	EN
red kite	Milvus milvus	VU
osprey, bald buzzard	Pandion haliaetus	VU
Iberian chiffchaff	Phylloscopus ibericus	VU
spotted flycatcher	Muscicapa striata	VU
southern grey shrike	Lanius meridionalis	VU
great spotted cuckoo	Clamator glandarius	NT
wryneck	Jynx torquilla	NT
roller	Coracias garrulus	NT
honey buzzard	Pernis apivorus	LC
European sparrowhawk	Accipiter nisus	LC
common buzzard	Buteo buteo	LC
hobby	Falco subbuteo	LC
black grouse	Tetrao tetrix	LC
woodcock	Scolopax rusticola	LC
stock dove	Columba oenas	LC
turtle dove	Streptopelia turtur	LC
common cuckoo	Cuculus canorus	LC
scops owl	Otus scops	LC
eagle owl	Bubo bubo	LC
European nightjar	Caprimulgus europaeus	LC
hoopoe	Upupa epops	LC
green woodpecker	Picus viridis	LC
hedge accentor	Prunella modularis	LC
robin	Erithacus rubecula	LC
nightingale	Luscinia megarhynchos	LC
common redstart	Phoenicurus phoenicurus	LC
blackbird	Turdus merula	LC
song thrush	Turdus philomelos	LC
mistle thrush	Turdus viscivorus	LC
lesser whitethroat	Sylvia curruca	LC
garden warbler	Sylvia borin	LC
blackcap	Sylvia atricapilla	LC
Bonelli's warbler	Phylloscopus bonelli	LC
chiffchaff	Phylloscopus collybita	LC
great tit	Parus major	LC
short-toed treecreeper	Certhia brachydactyla	LC
red-backed shrike	Lanius collurio	LC
common starling	Sturnus vulgaris	LC
greenfinch	Carduelis chloris	LC
hawfinch	Coccothraustes coccothraustes	LC
short-toed eagle	Circaetus gallicus	LC
scarlet grosbeak	Carpodacus erythrinus	NA

Reptiles

1) species exclusively or very often found in forests: none

2) species with mixed behaviour, found to an equal extent in forests and open areas

meadow viper	Vipera ursinii	CR
Hermann's tortoise	Testudo hermanni	VU
Bedriaga's rock lizard	Archaeolacerta bedriagae	NT
sand lizard	Lacerta agilis	LC
common or viviparous lizard	Zootoca vivipara	LC
aesculapian snake	Zamenis longissimus	LC
grass snake	Natrix natrix	LC

Amphibians

1) species exclusively or very often found in forests : none

2) species with mixed behaviour, found to an equal extent in forests and open areas

Pyrenean frog	Rana pyrenaica	EN
fire-belly toad	Bombina variegata	VU
Pyrenean brook salamander	Calotriton asper	NT
European tree frog	Hyla arborea	LC
alpine newt	Ichthyosaura alpestris	LC
agile frog	Rana dalmatina	LC
European common frog	Rana temporaria	LC
fire salamander	Salamandra salamandra	LC
marbled newt	Triturus marmoratus	LC

Sources: Flore forestière française, IDF, 1989, 1993, 2008; Red list of threatened species in France:
Chapter Orchidées de France métropolitaine, IUCN France, MNHN, FCBN & SFO (2010);
Chapter Mammifères de France métropolitaine, IUCN France, MNHN, SFEPM & ONCFS (2009);
Chapter Oiseaux nicheurs de France métropolitaine, IUCN France, MNHN, LPO, SEOF & ONCFS (2008);
Chapter Reptiles et Amphibiens de France métropolitaine, IUCN France, MNHN & SHF (2009).

Appendix XIV

Appendix to Indicator 2.1 – Variations in atmospheric deposition under the forest canopy (throughfall) in the RENECOFOR network

Placette	Période	Dépôt annuel moyen												Pluviosité moyenne sous couvert
		H+	Cl	S-SO4	N-NO3	Na	N-NH4	K	Mg	Ca	Fe	Al	Mn	
		g/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	g/ha	g/ha	g/ha	mm
CHP 40	t1: 1993-1998	22.2	59.4	10.9	2.4	30.5	3.0	39.3	6.0	12.9	64	103	377	845
CHP 40	t2: 1999-2003	12.1	55.6	9.0	2.4	28.6	4.2	39.3	5.7	12.1	105	93	443	811
CHP 40	t3: 2004-2007	11.5	47.8	7.3	2.7	23.1	3.2	41.7	5.1	9.5	55	96	659	616
	variation t3-t2	-4.4%	-14.0%	-19.5%	9.2%	-19.4%	-22.4%	6.1%	-11.2%	-21.4%	-47.8%	3.5%	48.7%	-24.1%
	variation t3-t1	-48.1%	-19.5%	-33.3%	8.8%	-24.4%	7.0%	6.1%	-14.8%	-26.6%	-14.4%	-6.5%	75.0%	-27.1%
CHP 59	t1: 1993-1998	60.2	24.7	13.2	2.7	12.0	8.8	34.2	4.3	11.4	80	102	1 285	736
CHP 59	t2: 1999-2003	30.1	22.9	9.5	2.9	10.6	11.9	43.3	4.2	9.9	120	96	1 229	850
CHP 59	t3: 2004-2007	28.7	24.5	7.7	2.5	11.9	6.6	37.2	4.1	8.9	77	109	1 320	720
	variation t3-t2	-4.7%	7.4%	-19.4%	-12.7%	12.3%	-44.7%	-14.1%	-1.9%	-9.7%	-35.3%	13.7%	7.5%	-15.3%
	variation t3-t1	-52.3%	-0.7%	-41.9%	-8.5%	-0.5%	-25.4%	8.7%	-4.6%	-21.6%	-3.3%	6.7%	2.8%	-2.4%
CHS 35	t1: 1993-1998	13.1	35.7	7.4	2.8	16.9	8.1	25.8	3.4	6.1	68	73	1 611	590
CHS 35	t2: 1999-2003	8.8	32.6	5.1	2.4	15.7	7.0	24.7	3.2	6.2	95	58	1 473	637
CHS 35	t3: 2004-2007	10.5	32.2	4.3	2.8	14.9	7.7	29.1	3.6	4.7	58	64	2 034	533
	variation t3-t2	19.6%	-1.2%	-16.5%	19.1%	-5.5%	9.8%	17.5%	13.4%	-24.5%	-38.7%	10.4%	38.1%	-16.3%
	variation t3-t1	-19.5%	-9.7%	-42.9%	0.5%	-12.2%	-5.3%	12.7%	5.2%	-22.6%	-14.3%	-13.0%	26.2%	-9.7%
CHS 41	t1: 1993-1998	19.9	19.2	5.5	2.5	7.5	3.0	19.8	2.1	8.6	66	80	1 564	524
CHS 41	t2: 1999-2003	13.5	16.0	3.7	2.8	7.2	3.5	18.8	2.2	7.9	74	59	1 226	634
CHS 41	t3: 2004-2007	12.1	15.3	2.9	2.0	6.5	4.3	19.2	2.6	6.1	34	55	1 504	433
	variation t3-t2	-10.2%	-4.4%	-23.5%	-28.8%	-9.8%	21.4%	2.3%	21.0%	-22.8%	-53.9%	-7.5%	22.7%	-31.7%
	variation t3-t1	-39.4%	-20.4%	-47.8%	-19.9%	-13.2%	45.5%	-2.8%	23.7%	-26.8%	-48.5%	-31.4%	-3.8%	-17.3%
CPS 77	t1: 1993-1998	19.3	18.8	7.1	2.9	7.1	4.6	21.1	2.6	12.4	74	109	2 008	509
CPS 77	t2: 1999-2003	10.3	15.9	4.7	3.1	6.3	5.1	19.6	2.9	11.3	126	107	1 937	552
CPS 77	t3: 2004-2007	11.1	13.9	3.4	2.9	5.9	3.8	13.7	2.9	8.5	52	70	1 314	397
	variation t3-t2	7.3%	-12.5%	-28.5%	-6.3%	-6.4%	-24.6%	-30.1%	0.0%	-24.3%	-58.6%	-34.0%	-32.2%	-28.1%
	variation t3-t1	-42.5%	-26.2%	-52.4%	-2.5%	-16.1%	-17.5%	-35.1%	11.9%	-31.3%	-29.6%	-35.2%	-34.6%	-22.0%
DOU 71	t1: 1993-1998	152.7	23.3	9.5	9.3	13.9	5.2	13.0	3.1	8.8	43	168	697	1 179
DOU 71	t2: 1999-2003	76.6	22.3	6.9	9.0	12.9	5.4	12.4	3.2	8.0	77	160	827	1 122
DOU 71	t3: 2004-2007	107.1	21.4	5.5	8.3	12.7	4.4	12.5	3.0	7.2	37	233	704	959
	variation t3-t2	39.7%	-4.1%	-20.1%	-8.1%	-1.5%	-19.4%	0.8%	-7.1%	-10.8%	-52.4%	45.5%	-14.9%	-14.5%
	variation t3-t1	-29.9%	-8.2%	-42.1%	-10.2%	-8.9%	-15.7%	-4.1%	-5.5%	-18.1%	-15.3%	38.9%	1.0%	-18.6%
EPC 08	t1: 1993-1998	389.4	34.1	24.7	12.2	17.6	11.8	32.2	2.9	15.0	145	329	2 158	947
EPC 08	t2: 1999-2003	158.5	29.2	14.3	10.3	15.7	9.2	23.8	2.9	9.4	164	484	1 846	1 108
EPC 08	t3: 2004-2007	107.3	30.5	11.3	7.3	16.1	7.9	25.0	2.9	8.0	86	373	1 524	1 017
	variation t3-t2	-32.3%	4.6%	-20.8%	-29.1%	2.4%	-14.1%	5.3%	2.0%	-15.5%	-47.7%	-23.0%	-17.4%	-8.2%
	variation t3-t1	-72.4%	-10.6%	-54.3%	-40.1%	-8.7%	-32.4%	-22.3%	1.4%	-46.7%	-40.9%	13.2%	-29.4%	7.3%
EPC 63	t1: 1993-1998	46.8	16.2	6.4	4.8	7.5	2.9	13.7	2.7	9.1	74	304	655	537
EPC 63	t2: 1999-2003	29.2	16.0	4.2	4.4	8.1	2.6	12.9	2.6	6.9	103	236	570	509
EPC 63	t3: 2004-2007	39.6	16.3	4.1	4.7	8.7	2.8	16.4	2.6	8.1	85	241	611	686
	variation t3-t2	35.5%	2.0%	-3.6%	5.8%	8.1%	7.0%	26.8%	1.3%	17.3%	-17.7%	1.9%	7.3%	35.1%
	variation t3-t1	-15.3%	0.8%	-35.9%	-3.3%	15.7%	-5.0%	19.6%	-3.1%	-11.0%	13.9%	-20.8%	-6.7%	27.8%
EPC 74	t1: 1993-1998	133.3	7.7	7.2	6.0	2.9	4.4	14.6	1.4	10.9	101	201	200	961
EPC 74	t2: 1999-2003	72.6	7.5	5.0	7.3	3.0	5.3	13.2	1.5	10.8	127	201	208	1 004
EPC 74	t3: 2004-2007	64.0	7.8	4.5	6.9	3.3	6.7	15.6	1.6	10.9	106	192	252	965
	variation t3-t2	-11.8%	3.7%	-9.6%	-5.2%	7.7%	26.7%	18.0%	6.2%	0.6%	-14.7%	-4.2%	26.0%	-2.0%
	variation t3-t1	-52.0%	1.2%	-37.9%	14.1%	13.4%	52.5%	6.8%	14.1%	-0.3%	7.1%	-4.3%	31.3%	14.4%
EPC 87	t1: 1993-1998	44.5	27.8	7.0	4.6	14.1	3.2	23.0	3.0	6.5	34	195	314	809
EPC 87	t2: 1999-2003	24.6	27.7	6.2	5.3	14.0	4.4	26.5	3.1	7.0	90	212	351	784
EPC 87	t3: 2004-2007	53.0	25.5	5.2	5.8	13.1	3.3	22.4	3.0	6.6	59	240	400	836
	variation t3-t2	115.5%	-8.1%	-16.2%	8.2%	-6.0%	-25.0%	-15.5%	-4.4%	-4.6%	-34.8%	13.2%	14.0%	6.7%
	variation t3-t1	19.0%	-8.2%	-25.3%	24.9%	-6.8%	3.7%	-2.9%	-0.5%	2.9%	70.6%	23.0%	27.4%	3.4%
HET 30	t1: 1993-1998	268.8	38.1	18.4	8.6	21.9	7.0	26.5	3.9	20.6	56	399	619	2 450
HET 30	t2: 1999-2003	130.7	32.4	12.8	8.5	19.0	7.4	17.3	3.6	19.7	149	176	607	2 036
HET 30	t3: 2004-2007	60.5	26.5	10.9	8.0	15.4	6.4	17.2	3.0	22.3	45	219	517	1 670
	variation t3-t2	-53.7%	-18.2%	-15.1%	-5.5%	-18.9%	-13.5%	-0.5%	-15.9%	12.9%	-69.6%	24.6%	-14.9%	-18.0%
	variation t3-t1	-79.1%	-30.4%	-41.1%	-6.5%	-29.5%	-8.6%	-35.2%	-23.4%	8.2%	-21.6%	-45.1%	-16.5%	-31.8%
HET 64	t1: 1993-1998	43.5	33.3	11.4	5.2	17.1	4.6	20.5	3.4	13.1	20	111	356	906
HET 64	t2: 1999-2003	19.1	27.7	9.1	5.0	13.9	4.3	19.0	2.8	10.7	56	74	384	914
HET 64	t3: 2004-2007	22.0	27.2	8.4	4.9	13.9	4.0	19.5	2.8	10.0	21	94	505	853
	variation t3-t2	15.3%	-1.8%	-7.6%	-0.4%	0.2%	-5.2%	2.3%	0.5%	-6.6%	-60.0%	26.2%	31.5%	-6.6%
	variation t3-t1	-49.5%	-18.2%	-25.1%	-4.3%	-18.4%	-11.8%	-5.0%	-15.2%	-24.0%	5.0%	-15.6%	26.9%	-5.8%
PL 20	t1: 1993-1998	93.9	112.3	12.4	3.9	64.0	0.9	12.7	9.4	20.2	67	662	455	1 095
PL 20	t2: 1999-2003	51.8	99.1	10.5	3.9	56.0	0.8	12.7	8.7	21.2	124	598	340	1 059
PL 20	t3: 2004-2007	46.8	106.1	9.9	4.0	58.4	0.8	14.5	9.1	19.6	121	750	389	845
	variation t3-t2	-9.6%	7.0%	-5.9%	1.3%	4.3%	10.0%	14.4%	5.0%	-7.5%	-2.1%	25.2%	14.2%	-20.2%
	variation t3-t1	-50.1%	-5.6%	-20.3%	0.5%	-8.7%	-2.4%	13.7%	-3.8%	-2.6%	81.9%	13.2%	-14.6%	-22.8%
PM 17	t1: 1993-1998	73.0	114.1	9.2	3.7	64.7	2.1	9.8	9.1	10.3	25	85	129	574
PM 17	t2: 1999-2003	97.1	142.5	10.0	3.5	78.6	2.3	7.5	10.7	11.4	55	95	133	717
PM 17	t3: 2004-2007	76.4	141.3	9.5	4.7	77.7	2.8	9.0	10.8	11.8	40	101	143	576
	variation t3-t2	-21.3%	-0.9%	-4.1%	29.4%	-1.1%	17.8%	6.6%	1.0%	4.2%	-27.3%	6.4%	7.1%	-19.6%
	variation t3-t1	4.7%	23.9%	4.7%	25.9%	20.2%	34.4%	-18.8%	18.2%	14.8%	58.0%	18.3%	11.0%	0.4%
PM 40c	t1: 1993-1998	43.4	39.5	7.2	2.1	21.2	1.7	17.2	5.6	10.0	30	215	78	683
PM 40c	t2: 1999-2003	60.6	39.2	5.3	2.8	19.4	2.4	13.2	5.0	10.5	71	236	91	629

Placette	Période	Dépôt annuel moyen												Pluviosité moyenne sous couvert
		H+	Cl	S-SO4	N-NO3	Na	N-NH4	K	Mg	Ca	Fe	Al	Mn	
		g/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	g/ha	g/ha	g/ha	mm
PM 40c	t3: 2004-2007	76.6	36.2	4.4	3.0	16.5	2.7	13.9	4.8	9.7	56	300	91	590
	variation t3-t2	26.5%	-7.8%	-15.7%	7.2%	-15.1%	13.3%	5.3%	-4.5%	-6.9%	-18.8%	26.2%	-0.1%	-6.3%
	variation t3-t1	76.4%	-8.5%	-38.5%	45.5%	-22.3%	58.5%	-19.0%	-14.2%	-2.9%	94.7%	39.7%	17.1%	-13.7%
PM 72	t1: 1993-1998	38.3	30.6	7.0	5.3	15.8	8.4	12.1	2.9	6.9	27	97	304	611
PM 72	t2: 1999-2003	22.6	35.1	6.1	6.1	18.3	9.2	12.4	3.3	6.9	68	114	433	730
PM 72	t3: 2004-2007	16.3	36.9	4.8	6.1	18.7	9.2	12.7	3.3	6.3	57	191	498	542
	variation t3-t2	-27.6%	5.0%	-21.0%	0.1%	2.4%	0.5%	2.2%	-0.6%	-7.8%	-15.9%	67.9%	14.8%	-25.8%
	variation t3-t1	-57.3%	20.6%	-31.4%	15.4%	18.4%	9.6%	4.3%	16.6%	-7.7%	110.1%	96.5%	63.5%	-11.3%
PM 85	t1: 1993-1998	42.3	235.1	15.9	6.4	128.8	7.0	14.0	17.7	15.4	46	63	82	506
PM 85	t2: 1999-2003	66.2	230.0	15.3	4.4	133.4	3.7	15.7	17.8	12.9	77	71	112	591
PM 85	t3: 2004-2007	68.1	204.9	12.8	4.6	120.7	2.7	13.0	15.4	10.8	58	77	89	488
	variation t3-t2	2.8%	-14.3%	-16.4%	5.4%	-9.5%	-27.0%	-16.8%	-13.5%	-15.8%	-24.5%	8.7%	-38.1%	-17.4%
	variation t3-t1	60.9%	-12.8%	-19.9%	-28.0%	-6.3%	-62.1%	-7.1%	-13.1%	-29.9%	28.7%	23.0%	-16.1%	-3.9%
PS 44	t1: 1993-1998	79.6	83.4	10.5	3.9	46.2	8.0	19.2	6.4	7.2	46	246	180	594
PS 44	t2: 1999-2003	73.5	80.9	8.4	3.5	43.5	6.5	19.2	6.1	6.4	74	219	219	701
PS 44	t3: 2004-2007	46.4	70.8	6.9	4.3	37.6	9.3	13.5	4.5	4.9	59	203	159	558
	variation t3-t2	-36.9%	-12.5%	-17.6%	22.1%	-13.6%	44.0%	-29.5%	-25.1%	-23.9%	-19.9%	-7.3%	-27.5%	-20.3%
	variation t3-t1	-41.7%	-15.2%	-34.4%	8.7%	-18.8%	16.3%	-29.4%	-29.0%	-32.1%	30.8%	-17.3%	-11.4%	-6.0%
PS 67a	t1: 1993-1998	165.1	12.6	10.8	7.3	5.2	8.2	17.5	1.9	9.4	60	336	1 672	506
PS 67a	t2: 1999-2003 (sauf 2000)	95.2	12.2	6.2	6.8	5.7	10.4	11.9	1.4	6.3	68	176	868	589
PS 67a	t3: 2004-2007	65.6	9.1	4.1	4.9	4.8	5.5	8.0	1.4	4.9	30	329	810	507
	variation t3-t2	-31.1%	-25.6%	-33.3%	-28.1%	-17.2%	-47.3%	-32.7%	0.7%	-22.1%	-55.2%	86.7%	-6.7%	-14.0%
	variation t3-t1	-60.2%	-28.1%	-61.8%	-32.4%	-7.9%	-32.9%	-54.4%	-27.5%	-47.3%	-49.5%	-2.1%	-51.6%	-0.2%
PS 76	t1: 1993-1998	685.0	90.8	34.9	5.7	49.8	5.3	27.3	7.6	17.4	108	907	2 516	587
PS 76	t2: 1999-2003	282.1	63.1	17.9	6.2	35.4	7.4	14.6	5.3	10.1	84	344	1 202	692
PS 76	t3: 2004-2007	164.9	63.6	14.2	5.6	34.4	7.6	15.7	5.3	9.6	51	263	1 507	593
	variation t3-t2	-41.5%	0.8%	-21.0%	-9.0%	-3.0%	3.1%	7.1%	-0.9%	-4.7%	-39.2%	-23.5%	19.5%	-14.2%
	variation t3-t1	-75.9%	-30.0%	-59.4%	-2.0%	-30.9%	20.6%	-42.5%	-30.0%	-44.8%	-52.5%	-71.0%	-40.1%	1.1%
SP 05	t1: 1993-1998	4.3	6.0	4.5	0.3	1.6	0.4	29.8	2.0	12.9	54	249	89	622
SP 05	t2: 1999-2003	2.9	5.4	3.9	0.7	1.6	0.8	31.4	2.3	14.0	72	236	106	611
SP 05	t3: 2004-2007	1.3	4.5	2.4	0.5	1.1	0.4	27.0	1.7	11.4	71	196	154	386
	variation t3-t2	-55.6%	-16.0%	-40.2%	-29.6%	-26.6%	-52.8%	-14.1%	-24.2%	-16.5%	-1.8%	-17.2%	45.0%	-36.8%
	variation t3-t1	-70.2%	-25.5%	-48.1%	64.4%	-29.7%	-14.7%	-9.6%	-13.7%	-11.8%	31.4%	-21.5%	73.0%	-37.9%
SP 11	t1: 1993-1998	55.1	25.0	11.2	4.4	12.7	2.5	30.3	2.8	15.3	107	230	235	626
SP 11	t2: 1999-2002	27.1	26.4	9.1	3.6	13.2	2.2	36.9	2.9	13.6	137	259	255	627
SP 11	t3: 2004-2007	19.0	26.7	7.4	3.6	12.9	1.9	43.7	2.8	12.4	121	314	245	663
	variation t3-t2	-30.1%	1.1%	-19.4%	-2.1%	-2.5%	-17.3%	18.3%	-4.2%	-8.9%	-12.1%	21.5%	-3.8%	4.4%
	variation t3-t1	-65.6%	7.0%	-34.1%	-18.5%	1.2%	-26.3%	44.2%	0.6%	-18.9%	13.0%	36.9%	4.5%	4.5%
SP 25	t1: 1993-1998	100.0	14.9	9.0	6.5	6.9	5.2	24.3	2.0	12.4	74	255	407	1 229
SP 25	t2: 1999-2003	110.6	14.9	7.0	6.9	7.2	4.6	19.1	2.1	12.6	143	147	378	1 523
SP 25	t3: 2004-2007	40.2	14.5	5.5	6.1	7.3	4.1	21.6	2.2	12.2	66	186	439	1 316
	variation t3-t2	-63.6%	-2.3%	-20.6%	-11.3%	1.0%	-11.9%	13.1%	0.9%	-3.1%	-54.3%	26.9%	16.1%	-13.5%
	variation t3-t1	-59.6%	-2.9%	-38.6%	-5.7%	6.0%	-22.5%	-10.8%	7.8%	-1.3%	-11.5%	-27.0%	7.9%	7.2%
SP 38	t1: 1993-1998	71.1	6.1	6.4	1.7	1.7	1.9	19.2	0.9	7.4	57	159	828	1 003
SP 38	t2: 1999-2003	32.3	5.8	5.3	1.7	1.8	1.9	19.5	1.5	8.3	87	162	1 147	1 107
SP 38	t3: 2004-2007	28.2	5.8	4.3	2.1	2.2	2.3	18.0	1.6	7.9	47	219	1 117	981
	variation t3-t2	-12.7%	0.1%	-18.7%	24.7%	25.3%	19.4%	-7.5%	6.1%	-4.8%	-46.8%	35.2%	-2.6%	-11.4%
	variation t3-t1	-60.3%	-4.4%	-32.7%	24.1%	28.3%	21.1%	-6.3%	72.5%	7.0%	-18.8%	38.1%	34.9%	-2.2%
SP 57	t1: 1993-1998	158.8	13.8	11.2	5.4	5.5	3.7	23.1	1.1	7.8	58	207	3 147	734
SP 57	t2: 1999-2003	91.4	12.6	6.9	5.3	5.5	3.7	19.0	1.4	7.2	95	151	2 369	811
SP 57	t3: 2004-2007	85.5	14.0	6.1	4.6	6.8	2.2	20.1	1.9	6.2	75	186	2 428	716
	variation t3-t2	-6.4%	10.7%	-12.7%	-13.2%	23.3%	-41.8%	5.6%	39.1%	-13.7%	-21.4%	23.6%	2.5%	-11.8%
	variation t3-t1	-46.2%	1.2%	-46.1%	-13.8%	24.0%	-40.9%	-13.0%	68.0%	-20.5%	28.7%	-9.9%	-22.8%	-2.5%
SP 68	t1: 1993-1998	93.4	10.1	6.0	4.2	4.7	3.0	18.3	1.6	5.8	47	222	190	657
SP 68	t2: 1999-2003	53.2	8.6	4.4	6.0	4.0	3.6	17.4	1.4	5.8	69	190	247	755
SP 68	t3: 2004-2007	45.8	9.6	3.9	5.6	4.7	4.0	21.8	1.6	5.4	47	177	314	709
	variation t3-t2	-13.8%	12.0%	-11.2%	-6.1%	16.7%	9.6%	25.2%	16.8%	-7.1%	-32.2%	-7.3%	27.3%	-6.1%
	variation t3-t1	-50.9%	-4.5%	-34.6%	32.7%	-1.4%	34.4%	18.9%	1.8%	-7.4%	-0.7%	-20.4%	65.0%	8.0%
Moyenne	t1: 1993-1998	110.6	42.3	10.9	4.8	22.3	4.9	21.5	4.1	11.1	62	230	944	607
Moyenne	t2: 1999-2003	63.6	41.9	8.0	4.8	22.3	5.0	20.1	4.1	10.3	96	191	733	856
Moyenne	t3: 2004-2007	50.3	39.7	6.6	4.6	21.1	4.5	20.0	4.0	9.4	62	211	758	745
	variation t3-t2	-20.8%	-5.3%	-17.1%	-5.2%	-5.1%	-10.2%	-0.1%	-3.7%	-8.6%	-35.5%	10.5%	3.4%	-13.1%
	variation t3-t1	-54.5%	-6.2%	-39.2%	-5.9%	-5.1%	-7.8%	-7.0%	-3.1%	-15.6%	0.7%	-8.5%	-10.2%	-7.6%

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