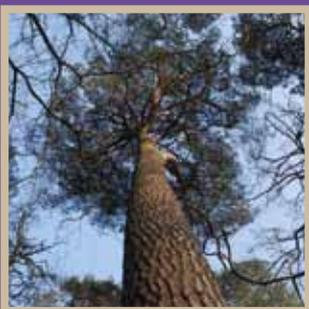


Integration of Nature Protection in Forest Policy in Flanders (Belgium)

INTEGRATE Country Report



Kris Vandekerkhove



EUROPEAN FOREST INSTITUTE
CENTRAL EUROPEAN REGIONAL OFFICE AND THE
OBSERVATORY FOR EUROPEAN FORESTS – EFICENT-OEF



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Pictures title page:

Big picture: Tree snag retained as habitat tree in a managed stand of the Sonian forest

Small pictures: Over 150 year old Scots pine stand in the Sonian forest

Large amounts of dead wood and old trees in the strict forest reserve Kersselaerspleyn (Sonian forest)

(All photos : Kris Vandekerkhove)



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CENTRAL EUROPEAN REGIONAL OFFICE AND THE
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Summary

This report gives an overview of the policy for integration of nature conservation aspects in multifunctional forestry in Flanders (Belgium).

First of all, the report shortly describes the state structure of Belgium, explaining that matters of forestry and nature conservation are the full responsibility of the regions (Flanders, Wallonia, Brussels) since 1980. No national legislation or coordinating laws are remaining. That is why the report only covers one region, being Flanders.

Chapter 2 describes the history of forests in Flanders. It shows that the low forest cover (about 11%) is not a recent phenomenon, but already dates back to the middle ages. For centuries, the remaining forests were intensively used, both for the production of firewood and construction wood, and were also used for grazing (be it often strictly regulated). Important shifts took place (deforestations and new afforestations) over the last two centuries, but the total area of forest remained quite comparable. Over the last 50 years, an important shift of paradigm took place. In the past, forests used to be mainly perceived as providers of wood (and game). Nowadays, forests are mainly perceived and managed as providers of 'socio-cultural ecosystem services' like recreation, clean air, and nature conservation. This is also translated in the main forest functions (chapter 3) and legislation.

The description of forest functions shows that the economic function is of low importance on a regional scale (although it can be important to the local economy). Recreational and conservation functions of the forest clearly have a higher importance, both in public perception and in policy.

The legal framework for forest management is quite ambitious and restrictive, both to public and private forest owners. Not only is there a strict regulation on management plans and felling permits under the forest legislation (Forest Decree), also nature conservation legislation (Nature Decree) strongly influences the operational choices of the forest owner. The 'stand-still-principle' and the 'precautionary principle' prohibits any forest operation that leads to long-term loss of natural values. Furthermore, restrictions and obligations are stricter and quality targets are more ambitious for public forests, but also for private forests within the Flemish Ecological Network, and the Natura2000 SAC's (about half of all private forests are within these categories).

In return, owners are eligible for a wide range of subsidy schemes, e.g. for public access to their forests, for reforestation and afforestation, for the production of a management plan, for conservation measures, etc. Moreover, forest owners that comply with the more ambitious legal requirements are eligible for certification under the FSC-group certificate of the Flemish government.

Finally, quite elaborate monitoring tools are put into practice in order to evaluate the performance of the forests in relation to the policy goals.

Table of Contents

Summary	I
Table of Contents	II
List of Abbreviations	IV
1 Introduction	1
1.1 Federal state structure – authority of the regions	1
1.2 Forests in Belgium: differences between Flanders and Wallonia	1
2 Forests, forest management and nature conservation	3
2.1 History of forest management and nature conservation in forests in Flanders	3
2.1.1 A long history of low forest cover	3
2.1.2 Forest management in the past	3
2.1.3 Shifting paradigms towards forests, and its effect on the significance of nature conservation in forest practice	6
2.1.4 Conclusion	8
2.2 Facts and figures about forests and biodiversity in Flanders	8
2.2.1 Forest statistics	8
2.2.2 Facts and figures about biodiversity and nature conservation in Flemish forests	15
3 Forest functions	24
3.1 Legal basis	24
3.2 Forest functions	24
3.3 Potential conflicts between nature protection and other functions	26
4 Legal framework for forest management	28
4.1 Historic legislation (before 1830)	28
4.2 National legislation (1830-1980)	28
4.3 National legislation in relation to forests and nature since 1980	30
4.4 Flemish legislation (since 1980)	31
4.4.1 Forest Decree	31
4.4.2 Nature Decree	32
4.4.3 Implementation orders derived from the forest decree and the nature decree relevant to forest management	35
4.4.4 Application of these legislations in multifunctional, integrative forest management	40

Table of Contents

4.4 International law	46
5 Financial instruments	47
5.1 Extent and development of public financing	47
5.2 Subsidy programmes to support the endorsement of the ecological targets in forest management	47
5.3 Other indirect legal, financial and market incentives	49
6 Informational instruments	50
6.1 Education	50
6.2 Advisory services	50
7 Certification	51
8 Monitoring and planning tools	52
8.1 National Forest Inventory	52
8.2 Monitoring	52
8.3 Forest planning	53
9 Discussion	55
References	56
List of Figures	64
List of Tables	65

List of Abbreviations

BVR	Besluit van de Vlaamse Regering (Decision of the Flemish Government = Executive Order))
CSFM	Criteria for Sustainable Forest Management
FSC	Forest Stewardship Council
GMO	Genetically Modified Organism
INBO	Instituut voor Natuur- en Bosonderzoek (Research Institute for Nature and Forests)
IVON	Integraal Verwevings- en Ondersteunend Netwerk (Integral Interweaving and Supportive Network)
LTER	Long Term Ecological Research
MCPFE	Ministerial Conference on the Protection of Forests in Europe
NGO	Non-Governmental Organisation ??
PEFC	Programme for the Endorsement of Forest Certification schemes
SAC	Special Area of Conservation
SFM	Sustainable Forest Management
VEN	Vlaams Ecologisch Netwerk (Flemish Ecological Network)

1 Introduction

1.1 Federal state structure – authority of the regions

Originally, Belgium was a country with national centralised administrations and legislation (e.g. national forest law of 1845). A series of institutional reforms was started in the 1970's, transforming the country into a federal state consisting of three regions (Brussels, Flanders and Wallonia; Fig. 1). Since the second Special Law on Institutional Reforms (August 8, 1980), the regions are responsible for almost all issues dealing with the environment, including forests and nature conservation.

Hence, apart from the introductory sections, all other chapters in this report describe the situation in Flanders. Where possible, additional comparisons are added for Wallonia in separate framed paragraphs. Less attention has been paid to the Brussels region since it is a very small area almost entirely dominated by the city of Brussels.

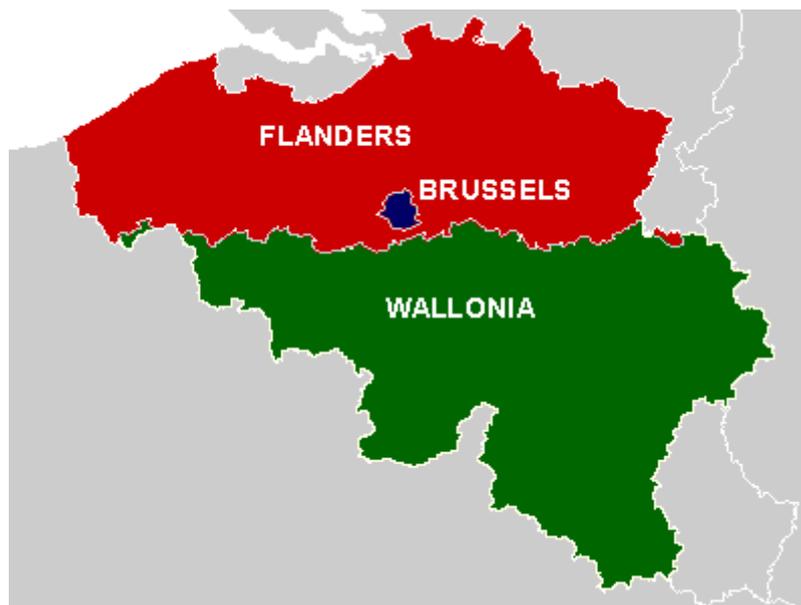


Figure 1: Belgium, with its three regions

1.2 Forests in Belgium: differences between Flanders and Wallonia

Nowadays forest covers over 600.000 ha in Belgium and almost all forests are managed as high forest. As shown in Table 1, there is a clear difference between forests in Flanders and Wallonia.

In Flanders, forest covers only about 11% of the total area. Forests are often originating from plantations on former heathlands and wet grasslands: pine and poplar plantations make up almost half of the forest area, while only $\frac{1}{3}$ of the forest area consists of broadleaved stands of indigenous species (oak (*Quercus* spp.), beech (*Fagus sylvatica* L.), mixed deciduous stands). Forests in Flanders are

clearly part of an urbanized and industrialized region. In this context, forest goods and services are mainly related to socio-cultural and ecological services. This is comparable to regions like the Netherlands, parts of Denmark and southern UK.

In Wallonia, with an average forest cover of over 30% (470.000 ha), forest is much more prominent. In the more rural environment of Wallonia, it plays an important role, also economically. Vast forested areas are found especially on the plateau of the Ardennes. Over $\frac{1}{3}$ of the area consists of Norway spruce (*Picea abies* (L.) Karst.), (while it is marginal in Flanders due to inadequate climatic conditions). It was mainly planted on former low-productive oak coppice stands. Broadleaved high forest stands of indigenous species (oak, beech, mixed deciduous stands) make up about half of the forest area.

Table 1: Major forest stand types and extent in Flanders and Wallonia (after Waterinckx and Roelandt (2001) and Lecomte et al. (2003))

National forest types	Forest types for biodiversity assessment (FTBA, BEAR)	Flanders		Wallonia	
		Area (ha)	(%)	Area (ha)	(%)
Oak forests	Mixed oak and oak hornbeam forests	11.500	8%	84.800	18%
Beech forests	Lowland and sub-montane beech forest	5.000	4%	42.300	9%
Poplar plantations	Idem	25.000	17%	9.900	2%
Mixed deciduous forests	e.g. swamp, fen and flood plain forests	33.000	25%	113.300	24%
Total Broadleaves		74.500	54%	250.300	52%
Pine plantations	Idem	40.000	30%	20.000	3%
Spruce plantations	Idem	3.000	3%	172.400	36%
Douglas fir plantations	Other plantation		-	10.800	2%
Larch plantations	Other plantation		-	8.300	2%
Mixed coniferous forests	-	19.000	13%	20.700	4%
Total Coniferous		62.000	46%	227.500	48%
Total area		136.500¹		477.800	

¹ This figure is the sum of surfaces covered by different tree species, based on the forest inventory (NFI); Total forest area, including forest roads, clearcut areas, etc... is about 145.000 ha (see below).

2 Forests, forest management and nature conservation

2.1 History of forest management and nature conservation in forests

in Flanders

2.1.1 A long history of low forest cover

Flanders is a highly industrialized, densely populated area (over 450 people per km²). Its countryside has been intensively used and altered by man over centuries. This is clearly reflected in the area and characteristics of forest cover. With a total forest cover of merely 11%, Flanders belongs to the least forested regions of Europe, together with Ireland (10%), the Netherlands (11%) and the UK (12%), (MCPFE, 2007).

This low forest index is not a recent phenomenon. As early as the first century BC, forest cover had gradually decreased to about 50% of the total land cover, followed by a slight recovery during the Dark Ages (4th-8th century AD). Especially during the Full Middle Ages (12th-13th century AD) a steep decline of woodland cover took place: demographic pressure led to woodland clearance to create more farmland. Around 1250 less than 10% of woodland cover was left (Tack and Hermy, 1998; Verhulst, 1995). Since that time, total forest cover has remained more or less similar; with a slight increase in the 18th century to about 12%, and a lowest cover of about 9% halfway the 19th century (Vandekerckhove et al., 2011).

Although total forest area remained relatively stable during the two last centuries, the spatial distribution of the forests dramatically changed; with deforestations on fertile silt loam soils (30-50% decrease) and new afforestations on heathland and alluvial meadows (De Keersmaeker et al., 2001; Vandekerckhove et al., 2005; Hermy et al., 2008). As a consequence, the actual forest is severely fragmented both in space and time.

The greater part of the actual forest cover consists of 19th and 20th century afforestations, in particular even-aged poplar and conifer plantations (primarily Scots pine). These plantations are less than 80 years old and are now gradually transformed into mixed stands (Afdeling Bos en Groen, 2001; Vandekerckhove et al., 2005). Only a small fraction (15-20%) is considered to be 'ancient woodland', meaning it remained continuously forested between the end of the 18th century and now (De Keersmaeker et al., 2001; Hermy and Verheyen, 2007; Hermy et al., 2008).

2.1.2 Forest management in the past

While the forest cover was very low, forests were used in a very intensive, be it economically sustainable way, in order to maximize the production of resources

like firewood, utensils and construction wood (Tack et al., 1993; Tallier, 2004). Until the 18th century, the whole forest area consisted of coppice forests, or coppice with standards in the larger estates of nobility and monasteries on richer soils in the south. High forest was exceptional, mainly restricted to the royal forest domain of Zoniënwood (Sonian Forest) near Brussels (Tack et al., 1993; Tack and Hermy, 1998; Tallier, 2004).

Especially in the coppiced forests, the management was very intensive. The forest provided all kinds of goods; not only firewood, charcoal and construction wood, but also acorns (for pigs), and even litter and brambles were thoroughly removed for agricultural fertilization and domestic use.

Several 'user rights' were ~~also~~ present in most of the forests, such as the right to gather dead wood and forest grazing. Forest grazing on private land (of nobilities and monasteries) was quite strictly regulated, and did not allow free-roaming. Instead, flocks herded by shepherds were used. The number of animals that was allowed in the wood, and the specific areas where they could graze, were set and controlled by forest guards. In this way, wood production and forest grazing could be well combined in closed woodland settings.

Common lands, where grazing was far less regulated, forests were gradually transformed into open land (heathlands and 'wastinas'). Due to the high population (and grazing) pressure, this transformation already took place by the beginning of the middle ages. Wood pasture systems, that were widespread in many regions of Europe, were probably rather exceptional, or even not known to occur.

From the late 18th century onwards, when coal replaced wood as the principal energy source, forest cover declined again. This trend was strengthened by several famines and the secularisation and subsequent exploitation of forests formerly owned by monasteries and nobility. Between 1775 and 1850, forest cover declined from 145.000 to 130.000 ha (De Keersmaeker et al., *subm.*).

In the 19th and 20th century, traditional forestry was replaced by production-aimed high forest management and plantation forestry. Low productive coppice forests were transformed to conifer plantations, more productive coppice with standard forests were gradually transformed to high forest of oak, or replaced by high forest of beech. In alluvial forests, poplars were planted in the traditional ash-alder coppice stands.

Especially during the 19th and the beginning of the 20th century, many heathlands were afforested with conifers, in the beginning mainly Scots pine. This resulted in an increase of the total forest area to 165.000 ha by the beginning of the 20th century.



Fig. 2: Coppicing and coppice-with-standards were the traditional management systems for woodlands from as early as the middle-ages until the beginning of the 20th century. They are now re-introduced in managed nature reserves (Nature reserve Vorte Bossen) (Photo: Kris Vandekerkhove)

During the first half of the 20th century, these heathland afforestations continued, now also with other more productive species like Japanese and Hybrid larch (*Larix kaempferi* and *Larix x marschlinsii* Mill.?), Corsican pine (*Pinus nigra* subsp. *laricio* J.F. Arnold) and Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco). From the 1950's onward, also wet valley meadows that were no longer economically profitable were planted with poplar plantations. However, over the same century, also important areas, mainly on more fertile loam soils, were deforested for urbanization, agriculture and infrastructure, especially during the two world wars and in the 1960's. This resulted in an overall decline again to the current figure of approximately 145.000 ha.

The overall average increasing and decreasing figures conceal much more dramatic shifts in the forested areas, as high levels of deforestation are partly under- or overcompensated by new afforestations. As a result, only about 15% of all forest was continuously forested over the last 200 years.

Until the 1970's, forests were mainly managed for wood production and hunting, but other forest functions like nature conservation and recreation gradually gained importance.

Over the last 30 to 40 years, multifunctionality, including ecological function of forests, and close-to-nature forestry gained importance both in forest policy and practice. The transformation of production monocultures into mixed multifunctional stands and specific elements like dead wood and veteran trees progressively gained attention in forest management. Over the last two decades the

conservation of a certain amount of dead wood and overmature trees is fully integrated in principles and practice of sustainable forest management, together with smaller scale forest operations and longer rotations (Buysse et al. 2001). This has led to a gradual increase of the average stand age and structural diversity of forest stands, more attention towards natural tree species composition and stand structure, and a significant increase of dead wood and overmature trees (Vandekerckhove et al. 2011).

The Flemish policy now has the explicit goal to further increase both quantity and quality of forest area both public and privately owned.

2.1.3 Shifting paradigms towards forests, and its effect on the significance of nature conservation in forest practice

Until the 1980's, forests (both public and private) were primarily managed to provide wood for the local economy, and income for its owner. Including aspects of nature conservation in forest management was not an issue. In the 19th and first half of the 20th century, 'conservation' in forests was merely focused on preventing deforestation and excessive cuts. Although the Forest Act (1854) prevented deforestation and former user rights that lead to degradation of the forests like forest grazing, it even took until 1931 before an act was officially voted allowing public authorities to intervene in matters of overexploitation in private forests (the so-called 'act of Cadenas').

The 'Law for Nature Protection' (1973) was the first legal instrument providing possibilities for (segregative) nature conservation in forests, in the form of the designation of Forest Reserves. They were aimed to conserve rare and threatened forest ecosystems. However, this tool remained unused. Integrative approaches of nature conservation in forest management were not provided by law, and remained marginal. Nature conservation at that time was primarily preoccupied with rapidly declining traditional agricultural systems and half-natural ecosystems like coastal areas, heathlands, grasslands, and wetlands. Forests were of little concern to conservationists at that time. The forest administration on the other hand, was mainly focused on afforestations, the struggle against legal and illegal deforestation and was in its management very much oriented towards wood production. Although more attention was paid to multiple function-forestry (with special attention to recreation) from the 1960's onward, minor interest was given to aspects of nature conservation.

Awareness for conservation aspects in forests became apparent from the 1980's onwards. Forest education at university was strongly influenced by Central European principles of close-to-nature forestry (Swiss forestry school of Leibundgut). Also within the forestry community innovative approaches were initiated by NGO's (Pro Silva movement), and forest policy was scrutinised and criticised by NGO's both within the nature conservation (NGO 'Critical Forest Management') and forestry community (the so-called 'caution committee' of the NGO Flemish Forestry Association –VBV).

Public awareness for forests was rising as well, especially when problems with forest vitality due to acid rain became apparent, and were widely covered by the media, but also through both public and private actions on forest conservation ('week of the forest' – Week van het Bos). Also education on more specific conservation aspects of forest management were initiated (e.g. a publication of the forest administration aimed at a wider public entitled 'Dead wood brings life to the forest', (Verbeke 1989)).

A 'paradigm switch' from 'forests as a source of primary production' to 'provider of multiple environmental goods and services' was taking place in the societal relation towards forests. This was also illustrated by the fact that the forest administration was 'translocated' from the Ministry of Agriculture to the newly established Ministry of the Environment in the early 1980's.

The 'Flemish Forest Decree' of 1990, was completely in line with this new paradigm.. In this law, 'sustainable multifunctional forestry' is the basic rule. A specific chapter is dedicated to the ecological function, dealing mainly with aspects of environmental protection and sustainability (e.g. nutrient cycles). A specific chapter also provides a much more practical procedure for the installation of protected areas (forest reserves). In 1995, a first series of Forest Reserves was officially established, and is still further developed (see below).

Also the *Nature Decree* (1997) had an important impact on forest management. as it also provides, for the first time, a number of specific 'principles' of conservation that are to be applied also beyond strictly protected areas. These principles proved to be very influential, especially on aspects of integrative nature conservation in forest practice.

Two basic principles are to be applied in all areas of conservation concern, including all forests:

- *stand-still-principle*: management operations (including forest operations) should not deteriorate the natural value of a site
- *precautionary principle*: all management operations (including forest operations) should be evaluated for their impact on natural values; avoidable important damage is to be excluded

Several legal instruments regulating forest management have been issued since, in order to practically implement these ambitious principles, e.g. the guidelines on Felling permits and the *Criteria for Sustainable Forest Management (CSFM)*.

They gave a strong impulse to the integration of nature conservation in managed forests (e.g. conservation of habitat trees, dead wood, ...), both in public and private forests. More details and analyses of these goals and restrictions are given in Chapter 4 (Legal Framework).

Finally, the implementation of the *EU Bird and Habitat Directives* is expected to further enhance the integration to nature conservation aspects in forests in the near future. The network of Natura2000-areas was legally established in 2002.

It includes about half of all forests in Flanders. About $\frac{1}{4}$ of all forests are considered to belong to 'actual forest habitat'. For the existing habitats, criteria for the evaluation of the 'local status of conservation' were developed (for the forest habitats: Thomaes et al. 2009). They include distinctive thresholds for 'favourable conservation status', including aspects of tree species composition, stand structure, dead wood and overmature trees.. Moreover, ambitious goals were set for habitat quality improvement, and also for habitat extension for the coming decades (see Chapter 4). These extensions include both transformation of non-habitat forest (conifer and poplar plantations) and new afforestations.

2.1.4 Conclusion

Low forest cover and intensive management over several centuries, combined with locality shifts (deforestations and afforestations) have resulted in highly fragmented, primarily young and man-made forests, with a high share of conifer and poplar plantations. Important shifts in paradigms also took place over the last 50 years. Until the 1980's, strong focus was on wood production, with recreation as an important secondary goal in public forests. Nowadays, forests are mainly perceived and managed as providers of 'socio-cultural ecosystem services' like recreation, clean air, and nature conservation. Wood production can still be important, but always within the framework of these other functions, and very much intertwined with them.

As a logic consequence of this shift in paradigm, Forestry and Nature Conservation administrations were merged in 2006, into one administration: the Agency for Nature and Forests. The agency is responsible for both management of forests and open natural areas on public land, and control and subsidies for both forestry and nature conservation initiatives on private land, including hunting and angling. At the same time, the two research institutions of the Flemish Government, dealing with Forestry (Institute for Forestry and Game Management) and nature conservation (Institute for Nature Conservation) were also merged into the Research Institute for Nature and Forests (INBO). This merge illustrates the strong integration of nature conservation and forestry in Flemish forests.

2.2 Facts and figures about forests and biodiversity in Flanders

2.2.1 Forest statistics

Total forest area. As stated before, the total forest cover in Flanders is estimated at 145.000 ha. A more recent assessment of the total forest cover based on 'high vegetation cover' using LiDar-technology revealed a total figure of over 175.000 ha, suggesting a strong increase in forest area (Boswijzer, 2013). However, this figure also includes some areas that are not legally considered as 'forest' (e.g. wooded residential areas). It is mainly developed for repeated surveys, as a tool to follow up changes over time.

Ownership. Most of the forest in Flanders is privately owned (Fig. 2), and ownership is spread over thousands of small properties. Average private properties are not larger than 1 ha. State owned forests (owned by the Flemish government, and officially called ‘Domianial forests’) cover about 18.000 ha, and other public forests (community, province) are over 25.000 ha. Very few forests are still owned by the Belgian state. They are primarily found in military training areas.

The share of forests owned by NGO’s has dramatically increased over the last decades and is now over 5% (7.600 ha). The largest nature conservation NGO in Flanders (Natuurpunt vzw.) is by far the largest private forest owner with more than 6.000 ha of forests.

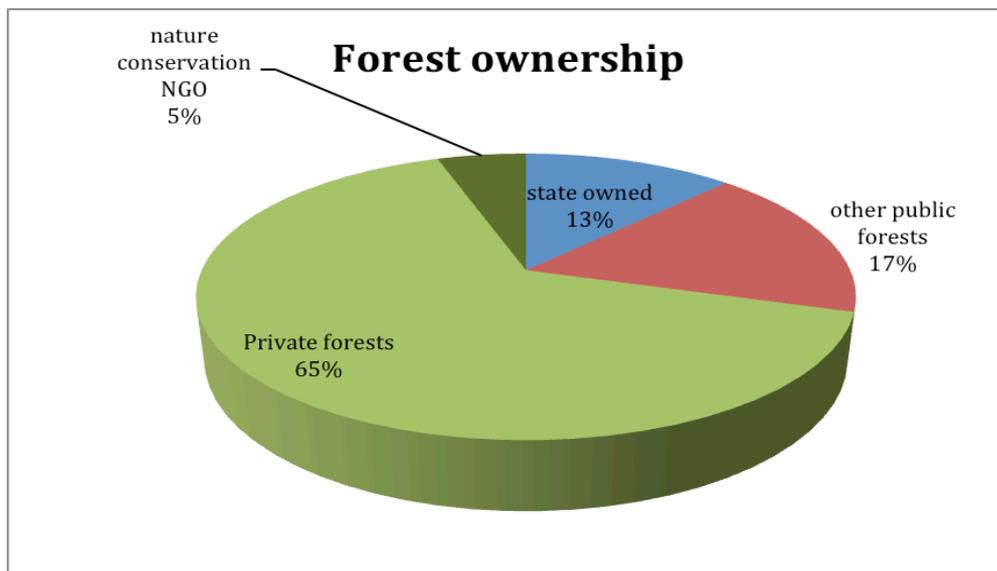


Figure 2: Forest ownership in Flanders

Tree species composition. The area of forest belonging to different stand types is based on the forest reference map (2001). About 45% of the forest consists of conifer plantations, and more than 15% are poplar plantations (Fig. 3, see also Table 1). Only 30-40% of the forest stands consist of broadleaved indigenous forest stands.

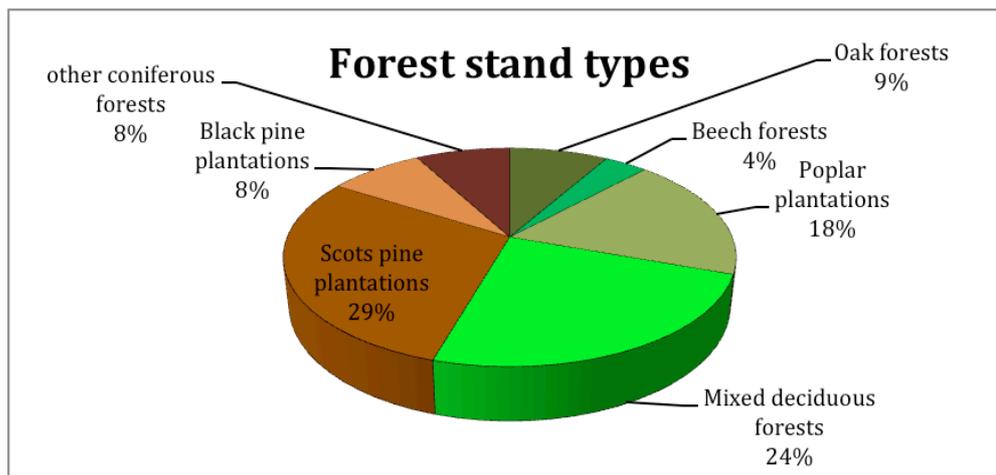


Figure 3: Surface distribution of different forest stand types in Flanders (ANB, 2001 : bosreferentielaag)

Growing stock. In 1999, the average growing stock was 31.6 million m³, or 216 m³/ha (Waterinckx & Roelandt, 2001). New figures from the second forest inventory are not available yet, still, the growing stock is expected to have further risen to about 250 m³/ha, which is a relatively high amount (Van der Aa, 2003, 2005, 2007; Laurent et al., 2005).

The distribution of this growing stock over the most important tree species is given in Figure 4. From the comparison of both graphs, one can derive that beech and oak trees have a higher relative share of the growing stock, indicating that beech and oak stands have on average higher growing stocks. For conifer trees and poplars, the shares in area and growing stock are quite comparable.

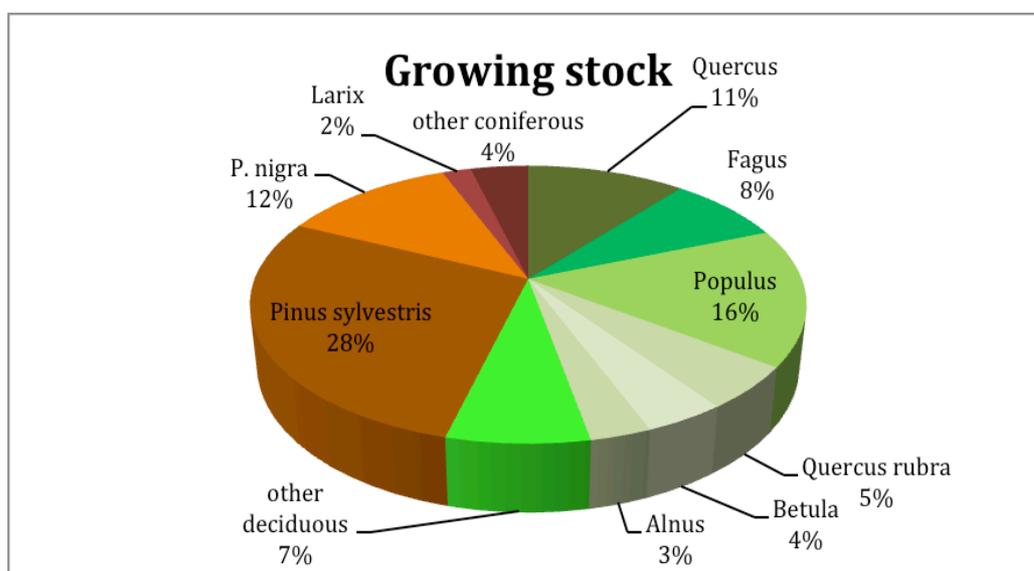


Figure 4: Distribution of the growing stock over main tree species (based on forest inventory data)

In stands younger than 20 years of age, the share of conifers and poplar has decreased dramatically: due to new visions on forest management and policy incentives (like subsidies for planting indigenous species), the emphasis is now on

natural regeneration and planting of native species. This may generate problems of supply for the wood processing industry, especially for poplar, in the future (Agneessens et al., 2003; 2008).

Harvest and economic importance. Forestry and wood harvest is of limited economic importance, not only in Flanders. For the whole of Belgium, it represents a turnover of only 50 million Euro per year. This is only about 0,01% of the GDP.

Harvest statistics are only available for public forests (both state-owned and other public forests). They show a rather steady but increasing volume of about 100.000 m³/year. This is about 3,7 m³/ha/year. That is a lower but comparable figure to harvest intensities in the surrounding countries.

For private forests, no overviews are available, and many small owners don't organize official wood sales. Their forests remain often unmanaged or are only harvested for personal use (firewood). Over the last decade however, more commercial private wood sales and harvests were organized through the so-called 'Forest Groups'(Bosgroepen). These are government supported NGO's bringing forest owners of a region together and helping them in organizing management and wood harvest (see section 6.2 : advisory services). These often are thinning and final harvest operations in neglected conifer forests. Extrapolating the results of the wood sales by the *Forest Groups*, a potential yearly harvest from private ownership can be estimated at about 150.000 m³/year. This would result in an estimated overall yearly harvest of less than 300.000 m³/year. Detailed overall figures of the annual increment are also missing but it is estimated that less than half, or even no more than 1/4 of the annual increment is harvested (Van der Aa, 2010). This extrapolation is likely to be correct for conifer and broadleaved stands. Only exception are the poplar plantations, that are still primarily intended for intensive wood production. An estimated 300.000 m³ of poplar wood is harvested every year, on a total area of less than 25.000 ha, which means an average annual harvest of over 12 m³/ha. These sales are mainly organised by the owners themselves, and are therefore missing in the overall statistics based on the wood sales from public forests and Forest Groups.

We can conclude that the overall yearly harvest in Flanders can be estimated at a mere 500-600.000 m³, representing an annual return of only 10-20 million Euro.



Fig. 5: Especially during the second half of the 20th century, many grasslands were transformed to productive even-aged poplar plantations. Poplar plantations cover more than 15% of the total forest area, and are economically seen the most important tree species. (Photo: Kris Vandekerkhove)

However, the wood processing industry is economically important, with over 25.000 employees in over 2000 companies and a turnover of over 5.700 million Euro per year (Fedustria, 2009; 2010). This wood processing industry operates in an open market with very high shares of import of basic material (raw timber and sawn wood), but also with a high export oriented market of final products and half-fabrics (e.g. hardboards, particle boards, furniture). This wood processing industry is primarily located in Flanders (Houtinfobois, s.d.), and processes over 6,2 million m³ of wood per year.

The demand for wood products is very high. Self-sufficiency of wood in Belgium is estimated at about 60% (FAO, 2012). If also import and export of woody materials (paper, sawn wood, particle boards,...) is taken into account, this self-sufficiency is estimated at 22% (Kint, 2013, based on FAO, 2010). For Flanders however, this self-sufficiency is estimated at 2-5% (Kint, 2013). The only exception is the market of poplar wood. The import and export of poplar wood is in balance; the required demand from the processing industry is approximately balanced by the local supply (De Boever and Van Acker, 2003).

Hunting. An important socio-economic factor in forests is hunting. In Flanders there are over 30.000 hunting license holders, and for many private forest owners, hunting is the most important reason why they own a forest. For the owners who don't hunt themselves, the rent of the hunting rights on their property can be an important source of income, often higher than the income from wood sale.

Moreover, it is a yearly source of income, while for small private owners, the sale of wood is an infrequent event.

TOPIC: dead wood and overmature trees in Flemish forests

Large quantities of dead wood and a high density of overmature trees are characteristic elements of the senescent or old-growth phase of natural forests. They are often referred to as 'typical' elements for natural forests, that are absent or rare, even in forests under close-to-nature commercial management (e.g. Christensen and Emborg, 1996; Bobiec, 2002). An important share of forest biodiversity is strictly or primarily dependent on these elements for their survival (e.g. Harmon et al., 1986; Heilmann-Clausen and Christensen, 2003). For instance, Siitonen (2001) calculated that a decline of the total dead wood habitat by 90-98%, may lead to the disappearance of at least 22-32%, and more probably over 50% of all saproxylic species. If this habitat loss is combined with habitat fragmentation, this proportion is expected to be even larger.

The situation in Flanders (and other regions in the Northwest-European lowlands) has been even much worse. As early as the 13th century, forests were already very fragmented and intensively used. There was virtually no overmature tree or dead wood in the traditional management regime. Except for some corner trees, marking the border between two properties, no standard trees were left to reach sizes over 60-80 cm DBH, as they were too heavy to manipulate and had higher risks of defects. Century-old user rights involved the right to remove all dead and dying trees both in private and public forests (Tack et al., 1993; Tallier, 2004). Moribund and dead trees and even dead branches on trees were promptly removed. Even the smallest branches were sought after. Older coppice stools that became less productive were entirely taken out, including the root bole. The same was done with the standard trees: they were not cut down, leaving dead stumps, but felled by digging and cutting over of the roots. The root bole was a too precious resource to be left in the forest (Tack et al., 1993; Vandekerckhove et al., 2009b).

In the 19th and 20th century, traditional management systems were replaced by high forest management and plantation forestry. These management systems also excluded dead wood and overmature trees (Branquart et al., 2004). Large dimensions were economically not desired and forest management was tailored to this. Dead wood was considered a sanitary risk and waste of resource or an indication of negligence.

Only over the last 30 to 40 years, the ecological value of dead wood and veteran trees progressively gained attention in forest management. Over the last two decades the conservation of a certain amount of dead wood and overmature trees is also fully integrated in principles and practices of sustainable forest management, together with smaller scale forest operations, longer rotations and transformation of plantations to more mixed stands (Buysse et al., 2001). This has led to a gradual increase of the average stand age and structural diversity of forest stands, and a significant increase of dead wood and overmature trees.

Regional forest policies, including the Flemish policy, frequently have the explicit goal to further increase both quantity and quality of dead wood and conserve overmature trees, through a two-way approach. In multifunctional forests, the aim is to gradually improve both quality and quantity of dead wood, by leaving some of the dead and dying trees during forest operations. For overmature trees, a number of trees per ha should be selected to be left uncut (Buysse et al. 2001). At the same time, a network of strict forest reserves (SFR) is being developed, covering 2% of the forest area. In these, a spontaneous build-up of dead wood and veteran trees to natural levels takes place (so-called 'secondary old growth'). Analyses of this process have shown for dead wood an average net accumulation of about 1,5 m³ha⁻¹.year but with wide variation (Vandekerckhove et al., 2009a). It is expected to take about one century, on average, to reach natural levels of dead wood. As most sites already contain a good number of trees over 100 years old, the same time horizon to reach natural levels of overmature trees is expected.

It is believed that the combination of these two approaches is necessary and complementary to reach the overall goal of biodiversity conservation and restoration in forests (Parviainen et al., 2000; Frank et al., 2007).

Actual figures. The average volume of dead wood (threshold diameter 7 cm) in Flemish forests derived from the first forest inventory was estimated at 7 m³/ha. As no quantitative data were available for lying dead wood, this figure involved a very conservative estimate of the lying volume (about 3.5 m³), based on the average volume of standing dead wood and the ratio of lying to total fractions derived from data in strict forest reserves. Preliminary results from the second inventory (on 400 plots) indicate that the total amount is now surpassing 12 m³/ha, with the lying fraction making up more than 70% of the volume. The estimate also indicates that trees with girth over 120 cm (= diameter of 38 cm) contribute for less than 20% in this volume, while trees smaller than 60 cm (= diameter of 19 cm) make up half of the volume.

Based on the first forest inventory, the density of trees over 80 cm DBH is estimated at 0,66 trees per ha (95% confidence interval: 0,564-0,757). Extrapolated over the total forest surface this corresponds with approximately 100.000 trees. The density of trees with DBH>95 cm is now estimated at 0,132 trees per ha (95% confidence interval: 0,094-0,181) corresponding with about 20.000 trees. About half of the registered trees (both at 80 and 95 cm DBH threshold) are beech trees, and one quarter is oaks (both *Quercus robur* L. and *Quercus petraea* (Matt.) Liebl.). This is quite remarkable, as both only make up for about 5 and 15% of the forest area, respectively. The remaining quarter is mainly poplars and northern red oaks (*Quercus rubra* L.).

Detailed full surveys of selected sites showed that the overmature trees are not equally distributed over the Flemish forest area but are mainly concentrated in a number of 'hotspot' locations. On an area of less than 5000 ha (3% of the total forest area) we registered over 8600 trees over 95 cm DBH, corresponding with

almost half of the total number estimated in the forest inventory (Vandekerkhove et al., 2011). One site, (Zoniënwood, 2500 ha) contains about $\frac{1}{3}$ of the estimated total number of monumental trees (DBH>95 cm) in Flanders.

We can conclude that the average amount of dead wood in Flemish forests (approx. 12 m³/ha) is not exceptionally high but in line with other European countries: average figures per country in Europe vary from less than 1 to 23 m³ha⁻¹ (MCPFE, 2007). Nevertheless, we can clearly state that the amount of dead wood has not been as high as it is now over at least 500 years, and probably much longer.

The recorded figure, however, is still less than 10% of the amounts to be expected in natural forests in this part of Europe (Christensen et al., 2005a; Vandekerkhove et al., 2009a). Considering that the climax vegetation in Flanders is forest for over 90% of its territory, the current amount of dead wood represents only 1% of the natural density, is very unevenly distributed, and consists mainly of small dimensions.

The same conclusion can be drawn for overmature trees: their average density is 10-50 times lower than in natural lowland forests (Nilsson et al., 2002; Bobiec, 2002), and considering the low forest cover, the density of overmature trees in forests is 100-500 times lower than in reference conditions.

Still, there are clear indications that this trend towards more dead wood and overmature trees already leads to a significant recovery of related biodiversity (Vandekerkhove et al., 2011; see section 2.2.2).

2.2.2 Facts and figures about biodiversity and nature conservation in Flemish forests

Total biodiversity. About 40-50.000 species of micro-organisms, plants, fungi and animals are known in Belgium. Approximately 80% of these species are found in Flanders (Kuijken et al., 2003). More than 75% of these are invertebrates (e.g. insects, spiders), with 4.500 species of beetles, 4.500 species of flies and mosquitoes, 2.400 species of butterflies and moths. The 'flora' (higher plants and fungi) represents 24% (about 1.400 species of vascular plants, 560 mosses, 980 lichens, 60 species of ferns, over 2500 basidiomycota and myxomycota) (Walley and Vandeven, 2006). Vertebrates represent less than 1% of the species.

These numbers are probably underestimated. Experts estimate that about 1/3 of all species present in Belgium have yet to be recorded (Kuijken et al., 2003).

Detailed monitoring and thorough comparisons of old collection and observation data with more recent ones show that many species are in decline or even have disappeared. In Flanders, at least 7% of formerly recorded species are extinct, 20% are endangered and 27% are vulnerable to near threatened; only 43% are considered safe or at low risk.

As main reasons for the decline of biodiversity are more specifically stated the destruction and fragmentation of natural habitats, pollution and eutrophication caused by agricultural and industrial practices, excessive water catchments in some areas, climate change and perturbations linked to leisure and tourism (Table 2). For forest biodiversity, acidification and eutrophication through atmospheric deposition, fragmentation and over-recreation are the main topics. Forest management itself is not mentioned as one of the main threats to biodiversity, only the spread of invasive exotic trees that were introduced in the past.

Table 2: Main threats for biodiversity in Belgium (Moreau, 2006)

Main threats	Some underlying causes
Degradation, destruction and fragmentation of natural habitats	Spread of the urbanized areas, road network and industrial areas and associated problems (noise, pollution); abandon of former agricultural practices that were favorable to biodiversity
Decrease in the capacity of the agricultural areas to host wildlife	Intensification of agricultural practices (yielding pollution and disturbance) and disappearance of landscape elements that provide food and shelter that are exploitable by wildlife (such as hedges, trees, ponds, etc.)
Pollution of soils, air and water	Excess of heavy metals (industry, roads), manure and pesticides (agriculture) and other pollutants
Invasions by alien species	International trade and transport (roads, railways, rivers), gardening practices, exotic trees in forestry, exotic pests released in the wild, climate change, etc.
Epidemics affecting wildlife	Arrivals of pathogens that are favored by the introduction of exotic species, pollution and the destruction of habitats
Climate change	Carbon emissions, deforestation and other land use changes due to human activities
Desiccation of soils and wetlands	Excess pumping of underground water tables
Recreation and leisure	Overuse of green open spaces and wild areas, little respect for nature, mountain biking and motor sports in fragile areas, dogs not on leash

Forest biodiversity. Detailed figures of the total species richness specifically for forests are not known. For beetles in Germany, it is known that over 1/3 is related to forest habitat (Köhler, 2000). Extrapolation of this figure would give an estimated 15.000 species that are considered 'forest species'. Many other species however are also often found inside forests, so it could be assumed that about half of all species (over 20.000 species) can be found in forests.

It is presumed however, that an important part of the forest biodiversity has been lost over centuries due to massive deforestation and very intensive forest use. Remaining forested areas are very fragmented (less than 10% cover more than 400 ha) and only recently re-established, and therefore often incomplete from a biological point of view. On the other hand, compared to other habitats, the current situation for forest biodiversity appears relatively positive, although based on fragmentary data. A study on invertebrates carried out in 56 wooded areas identified 932 species from 43 taxa, of which about 12% were red-listed.

However, this figure is still quite good as compared to other biotopes: overall about $\frac{1}{3}$ of all species are red-listed, and for certain habitats like heathlands, this figure is even higher (Dumortier et al., 2005).

As an effect of the shift towards more close-to-nature forestry, with more dead wood, longer rotations and the conservation of important natural elements like habitat trees and the establishment of a reserves network, a significant increase of forest biodiversity is expected. Especially species related to 'oldgrowth-characteristics' appear to be doing quite well: e.g. wood-decaying fungi, beetles, hoverflies, woodpeckers (see BOX below). Also species related to larger wilderness-areas, that recover from centuries of persecution by man are gradually recovering and regaining their forest habitats (e.g. fox, wild boar, beaver, eagle owl). Recently, even wild cat, lynx and wolf have been occasionally recorded.



Fig. 6: Snag of an old beech tree (Sonian Forest) : a typical habitat tree (Photo: Kris Vandekerkhove)

Species of the traditional rural landscape, however, are declining. Forest species with important links (e.g. for foraging) with valuable habitat in the open rural landscape (e.g. species rich grasslands, heathlands) like bullfinch, woodlark or turtle dove, have been rapidly declining over the last decades. This is also the case for species that are strongly related to the traditional forest management regimes like coppicing, litter removal, small woodland hayfields and groves. Many of these species are light-demanding and thermophilous, linked to open or half-open phases of the forest (e.g. forest butterflies), or rich internal or external forest edges. Due to the intensification of the agriculture in the countryside, and the transformation to more closed high forests in the woodlands, many of these species have lost their habitat. In some managed conservation areas, specific

efforts are made to restore these management regimes, and conserve the related species. The continued isolation of these specific sites may however jeopardize their success.

Finally, species sensitive to habitat pressures (e.g. acid and nitrogen deposition), are still decreasing. Although the deposition levels have dropped quite strongly over the last decades, critical loads are still surpassed, and cumulative effects are also present. Especially forest plants of moderately acid soils are declining (Baeten et al., 2009) while newly afforested areas are not colonized due to competition with ruderal species. This leads to an overall average degradation of forest vegetations (Baeten et al., 2010). Even more explicit is the effect on mushrooms (macrofungi), for which many forest species are currently threatened: many mycorrhizae and saprophyte species of nitrogen-poor forests suffer from eutrophication, whereas other species are sensitive to acidification. This latter factor particularly affects conifer forests, where 18% of typical mushroom species are currently extinct and another 29% are critically endangered (Kuijken et al., 2003). This problem cannot be solved by improved forest and nature policy alone. A fine tuned general environmental policy will be needed.

BOX: the recovery of species related to natural forest conditions

Considering the estimations of species loss by Siitonen (2001) it is expected that forest biodiversity, especially saproxylic communities in Flanders have been decimated in the past.

Over the last decade, there is a clear tendency towards more 'naturalness' in forests, with the establishment of a network of protected forest areas (nature and forest reserves) and more attention and efforts for the conservation of natural elements in managed forests (longer rotations, more dead wood, habitat- and veteran trees). Therefore it is expected that also species related to these natural conditions are gradually recovering. However, it is unclear how fast this recovery is going, and what fraction of the original diversity will be able to recolonise the newly available habitat.

This colonisation is the joint result of successful dispersal and successful establishment (e.g. Jonsson et al., 2005). The success is strongly dependent on the species-dependent dispersal and recruitment potential. Moreover, species recolonisation of newly established habitat might also be delayed because of lag phases in the dispersal and establishment of populations, the so-called colonization or immigration credit (Hanski, 2000; Baeten et al., 2010).

Forest birds are a well-studied group of evident good dispersers. Species from the ecological group of cavity nesting birds are expected to react promptly on the improved condition of the forest habitat in Flanders, with more diverse and older stands, and more dead and dying trees providing nesting and feeding opportunities. Especially woodpeckers have been proposed as good indicators for forest biodiversity. Secondary cavity breeders like Nuthatch and Tawny owl that are dependent on the old cavities provided by the former, are expected to quickly follow.

Trends for Flanders for the period 1990-2002 indeed indicate a significant increase. Tawny owl showed an increase between 20 and 50%, and Nuthatch, Lesser spotted and Black woodpecker increased by more than 50%. Comparing with data of 40 years ago, populations of Lesser spotted and Black woodpecker apparently have tripled, and those of Great spotted woodpecker and Nuthatch quadrupled. The most critical of this group of species is the Middle spotted woodpecker, a species that is very strongly related to old broadleaved forests (Pasinelli, 2007; Müller et al., 2009). Until 1998 this species was not breeding in Flanders. In 1999 the first two breeding pairs were registered, and by 2005 the population had reached over 50 breeding pairs and is still increasing and extending its breeding range (Vermeersch et al., 2006). More demanding species like Middle spotted woodpecker apparently take much longer to react to the improved conditions, but are now also re-establishing and are strongly increasing.

Considering saproxylic fungi, old descriptions indicate how impoverished the situation must have been in Flanders and the surrounding areas. Even a

widespread species like *Fomes fomentarius* used to be very rare or absent. The recovery of saproxylic fungi in Flanders apparently had to rely on long distance inflow of spores.

Fungi are in principle very good dispersers: they produce millions of spores, that can be spread over hundreds of kilometers. However, only a very small fraction of the spores actually spreads over a longer distance; the vast majority of spores fall within a few meters of the fruiting body (Risbeth, 1959; Kallio, 1970). Given the enormous number of spores there is still a fair chance for some spores to travel over long distances. This small fraction is crucial to establish new populations in distant localities (Stenlid and Gustafsson, 2001). In contrast to birds and insects, the spores cannot actively search for suitable substrate to germinate, thus depend on coincidence. Moreover, two compatible spores must germinate on the same substrate in order to mate and produce a dikaryotic mycelium that in its turn is able to produce fruit bodies and new spores (Stenlid and Gustafsson, 2001). This process makes the development of a reproductive new mycelium at longer distance much more unlikely than expected from its reproductive and dispersal capacity.

For Flanders however, it was shown that for many species, that are not too selective in their substrate requirements, the current density of available habitat appears sufficient to allow the steady development of new viable populations and expansion of their range. Some are now widespread in all forests, others are still expanding (Vandekerkhove et al., 2011). A number of highly selective species though, like the indicators for habitat continuity of Christensen et al. (2005b) are still rare or absent.

Sites with a high occurrence of suitable substrate like strict forest reserves, appear to be important for the establishment of these highly selective species, as they not only locally increase the chances of successful establishment, but also allow further development of larger local populations with a lower risk for local extinction. Not surprisingly, the few findings of such highly demanding species in Flanders are often concentrated in such high-density localities. These new satellites may in the future develop to become new sources for further expansion.

For saproxylic beetles, similar aspects of habitat requirements and availability are influencing possibilities for recolonisation as for saproxylic fungi (Schiegg 2000; Jonsson et al., 2005), but the process is complicated by the extreme diverse dispersal potential of the different species (Jonsell et al., 1999). Some species, often linked with highly ephemeral habitats (like bark beetles) have a high dispersal capacity, while species inhabiting stable dead wood microhabitats (like species in wood mould) have low dispersal rates. For some species dispersal over distances of as little as 200 m are even unlikely (Speight, 1989; Nilsson and Baranowski, 1997). Moreover some of these non-mobile species are very selective in their habitat. They are dependent on sites with high spatio-temporal continuity of habitat related to natural forests, and are therefore often used as indicator species for habitat continuity (Alexander, 2004; Müller et al., 2005). As

a consequence they are often rare or Red Listed in most countries where natural forests are rare or in decline.

Given the highly fragmented forest landscape and its management history in Flanders with the absence of suitable habitat, an impoverished saproxylic fauna was expected, containing the good dispersers with limited substrate requirements, but lacking the more demanding species, especially the dispersal limited species.

No extensive datasets are available in Flanders to underpin this hypothesis, but existing fragmentary information appeared to confirm it. A study on saproxylic beetles and hoverflies in the south of Belgium (Fayt et al., 2006; Dufrêne et al., 2008) indicated an impoverished fauna with less than half of the expected species number found. Signs of recovery are also fragmentary but indicate a similar long lag phase as for saproxylic fungi. A species like *Bolitophagus reticulatus* living in fruit bodies of *Fomes fomentarius* only managed to recolonise in the last decade, although suitable substrate was already available for some time.

Intensive inventory campaigns in 3 pilot test sites (forest reserves of Kolmont, Meerdaalwoud and Zoniënwood) however revealed a relatively rich fauna both in quantity and quality of species, comparable to many sites in Germany and Luxemburg: over 300 species were found in each location, with at least 1/4 of the species appearing on the German red list (Köhler et al. 2011; Köhler et al., in prep.).

Several reasons are given for this unexpectedly good result. Off course, the sites were selected for their high potential: all sites had a high actual amount of dead wood and old trees, and may also have contained higher amounts in the past than in many other forests. Moreover, resilience of species may be higher than expected, both in recolonisation and in survival in relic habitat (e.g. some deadwood that remained in remote parts of the forest). For some species, tree rows, old orchards and pollard trees in the traditional countryside landscape may have played an essential role in their survival. Speight (1989), Alexander (2004; 2008) and Dubois et al. (2009) already pointed out the importance of these alternative habitats for saproxylic species, especially dispersal limited species of wood mould in hollow trees. Over the last 50 years, these elements have been rapidly declining in the countryside. The survival of many species is expected to depend on the fact whether they managed to recolonise their restored original habitat (in the forest) before their alternative habitat is lost.

Nature and Forest Reserves. Nature reserves are installed under the nature conservation legislation (Nature Decree 1997, replacing the Law on Nature Protection, 1973). Where nature reserves used to be primarily focused on open areas (e.g. peatbogs, heathland, swamps), nowadays also forests are more and more included in the network of reserves. An estimate of the actual forest area included in nature reserves is given in Table 3.

Table 3: Overview of forest area included in nature and forest reserves

Forests in..	Area (ha)
State nature reserves	1.645
Private nature reserves	3.830
State forest reserves	2.790
Private forests reserves	240
TOTAL	8.505 (6,8%)
Not yet official reserve status	~ 6.400
Overall total	~ 15.000 (>10%)

In nature reserves there is no clear distinction between strictly unmanaged areas, and areas with conservation management. As a consequence no reliable figures are available on the area of 'non-intervention' forest in nature reserves. As a rule of the thumb, one can state that about 60% of these forests are strict reserves. The others receive a special management, focusing on rehabilitation of ancient management practices (e.g. coppice or coppice with standards) or development of half-open forest structures (grazing, restoring of gales, heathland areas etc. inside the forest).

Forest reserves in Flanders are protected according to the Flemish Forest Decree (1990). The main objective, next to conservation, is to gather scientific knowledge about forest ecosystems, forest dynamics and biodiversity conservation. The total area of forest reserve in Flanders covers over 3.000 ha (including about 100 ha of open areas like open water, grassland and heathland), subdivided over more than 70 patches in 55 forest sites. The surface ranges between 1 and 235 ha, with an average of just over 40 ha.

Both 'strict' ('Integraal bosreservaat') and 'directed' forest reserves ('Gericht bosreservaat') are possible. In the strict reserves, no management interventions are allowed, while in the directed reserves, a special management for conservation and improvement of natural values depending on human interventions is performed. About 2.500 ha are strict reserves, while the rest is subject to a special management.

Establishment of conservation networks

Nature and forest reserves (segregative approach). The establishment of strict conservation areas in forests (reserves) was a very recent development in Belgium and Flanders. Up to 30 years ago, as good as no forest areas were included in nature reserves, and the specific tool of 'forest reserves' provided by the law on nature conservation was not applied. However, over the last two decades, the area of forest in official nature and forest reserves has increased quite dramatically. If we also include the areas that were acquired by nature conservation NGO's but are still awaiting official recognition as nature reserve, than the total area of 'Forest conservation areas' can be estimated to over 15.000 ha, or more than 10% of the total forest area (Table 3).

Stimulative measures are provided in the form of subsidies for the acquisition, maintenance, public access and supervision of conservation areas by officially recognised NGO's.

Natura 2000. The Habitats Directive areas in Flanders cover about 111.000 ha, while the Birds Directive areas cover about 70.000 ha. Many overlaps between both categories are existent. Forests in Flanders are included in both Birds and Habitats Directive areas. In total more than 30% of all forest in Flanders is included in the Natura2000-network (58.000 ha), especially as Habitats Directive areas. Most Birds Directive areas are open land, marches and heathland.

About 40.000 ha of semi-natural forests in Flanders meets the criteria and descriptions of the forest habitats included in the Habitat directive (EC DG Environment, 2007) (see Table 4 in chapter 4). More than half of these semi-natural forests are actually included in the Natura-2000 network, which largely exceeds the 20% EC guideline (ETCNC, 1999a; 1999b).

Other forests included in the Natura2000-network are primarily poplar and pine plantations that are considered as buffer zones and corridors for other habitat types (e.g. heathlands, grassland types), or are foreseen to be converted towards forest habitat. Some of the rare and rich types are almost entirely included in the Natura2000-network (see Chapter 4).

Forests belonging to one of the habitats of the habitat directive or included in the official Natura2000-network may still be managed as productive woodlands, as long as they fulfil certain habitat quality requirements. Thus they can be primarily considered part of the 'integrative' conservation approach. Management restrictions and guidelines considering forests in Natura2000 will be given in section 4.4.4.

Flemish Ecological Network (VEN). Besides the Natura2000-network, it was decided to select 125.000 ha of the Flemish territory (approx. 10%) to be included in a network where nature conservation is envisaged as the predominant function (VEN). Another 150.000 ha of complementary 'connecting areas', where nature conservation is equally important to other functions (IVON), will constitute an ecologically sound networking, where all important areas are safeguarded and migration of species between them through ecological corridors is possible.

The Flemish forests will form the 'backbone' of this network: all forests are planned to be included in one of the two categories. Up to now, a first 86.000 ha of VEN have been delineated, including approx. 50.000 ha of forest. Roughly 60% of all Natura2000-forests and almost 90% of the forests in nature and forest reserves are already included in the 1st phase of VEN-delineation. Also within the Flemish Ecological Network, productive forest management is still possible, be it restricted to specific requirements. Both forests in VEN and Natura2000 are therefore part of the 'integrative approach' and will be covered in detail in section 4.4.4.

3 Forest functions

3.1 Legal basis

The legal basis for forest functions is given in the Forest Decree (1991). Basic principle is that all forests are to be submitted to a multifunctional durable management. Following forest functions are explicitly mentioned and form the basic 'chapters' of the Forest Decree:

- The economic function (productive function)
- The recreational function
- The ecological function
- The scientific function

For each of these functions, some basic principles are included in the specific articles of the law. For instance, in the chapter 'economic function', the basic legal principles on felling permits, on annual allowable cut, the legal procedures for wood sales, are stipulated.

One of the basic principles of the Forest Decree is that all forests, even all forests stands, should be managed from the principle of multifunctionality. Therefore, no 'zoning' of functions is foreseen or mapped in detail. In practice however, some functions are more important than others depending on the forest area, and also within the forest area itself.

3.2 Forest functions

Economic function.

Although the economic importance of forestry to the overall economy is quite limited, it still represents an important element for many private forest owners and for the local economy. It is presumed that also in the future, at least 80-90% of all forests in Flanders will to some extent have an economic function through wood harvest.

The harvest of wood in both state and privately owned forests is strictly regulated in the chapter on economic function in the Forest Decree. Harvests are only allowed if they are in line with an officially approved management plan, or an official felling permit. Approval of the felling application or the management plan is based on a number of criteria. Basic principles, stated in the Forest Decree, are that wood harvest is possible as long as it is not jeopardising other forest functions (social, ecological), and adheres to the basic criterion of 'sustainability', stating that the total annual harvest in one forest management unit (forest complex) should normally not exceed the annual increment. Other criteria that are taken into account in the approval procedure relate to the type of harvest (thinning, selection harvest, final cut), and focus on size, tree species, soil conditions, ... (For details see section 4.4.3). In this evaluation process, felling

applications can be refused, or specific restrictions or requirements can be imposed, in order to guarantee the sustainable conservation of the ecologic and economic value and potential of the site.

Recreational function. With a population density of over 400 inhabitants/km², it is clear that there is a high demand for public recreation areas for hiking, jogging, dog walking, cycling and other outdoor activities (e.g. horseback riding, pick-nick). After family visit, forest and parks visit is the most popular day out for people in Flanders. Over 25% of the population visits the forest at least once per month. In areas with limited public forest, this can lead to very high pressures (e.g. Palingbeek, 220 ha: 150.000 visitors/year; Bulskampveld, 300 ha: up to 500.000 visitors/year) (Van Langenhove and Spaas, 2003).

A study on recreational use in the forest complex of Meerdaalwoud and the economic value it represents (Moons et al., 2000) calculated that over 750.000 visits are made to the forest, representing a recreative value of 10 million Euro, which is more than 30 times the yearly revenue of the sale of timber.

Due to the high public pressure, public access in forests is strictly regulated. All management plans of public forests contain an access regulation. It contains a map designating hiking roads, cycling and horseback riding tracks. Off-road hiking is not allowed. Through this official network, the manager is also able to 'zonate' the recreation, concentrating the tracks close to the access points and in less sensitive areas.

Specific forest stands may also be designated as 'play-zone' where children are allowed to play freely, collect branches, make constructions, etc. Also 'free run'-zones for dogs can be installed, where dogs can be walked freely, and should not be on a leash (as is the case elsewhere in the forest). These two types of forest stands could be considered as specific zones for recreation.

Since 2008, all forests are considered open to the public, unless explicitly mentioned. In private forests, access can be forbidden by the owner. In order to prevent misunderstandings, all access tracks to the forest that are not open to the public should be marked with an official sign. Private owners who allow public access to their forests can apply for subsidies. They amount to 2 Euro/m track that is opened to the public, with a maximum of 50 Euro/ha.

Ecological function. In the Forest Decree, the ecological function concerns both aspects of nature conservation and environmental care. It contains a number of basic principles that all forests should comply with : no application of fertilizers, pesticides, ... no changes to soil and hydrologic conditions of the site, ... It also contains some specific restrictions and guidelines for the protection of fauna and flora, and states that every management plan should mention what specific natural values are present, and what measures are taken for their protection.

As mentioned in chapter 2, the ecological function is considered to be primordial in all forests within the VEN. Outside of the nature and forest reserves, this 'primary ecological function' can still be combined with commercial forestry, be it more strictly regulated than outside the network. The restrictions and incentives that are foreseen to regulate this combination of functions are stipulated in the Criteria for Sustainable Forest Management (CSFM), that are mandatory for all forests in VEN. These are explained in detail in section 4.4.4..

Anyhow, all forest operations, both inside and outside the Ecological Network, should comply with the basic principles of the Nature Decree : stand-still and precautionary principle. This means in practice that every forest operation (harvest) that is likely to be detrimental to the ecological value of the site (not the immediate, but the longer term impact of the harvest) will not be permitted.

Scientific function. The Forest Decree strongly relates the scientific function with the forest reserves: it is stipulated that in forest reserves the ecological and scientific functions are equally important and primordial. In practice, this was implemented through a detailed monitoring program for the forest reserves (Vandekerkhove, 1998; De Keersmaecker et al., 2005). Nevertheless, scientific research of course is also possible in other forest areas. Some of the highly studied sites (like Zoniënwood or the experimental forests of Gent, Antwerp and Leuven University) are being considered to be included in a European network of Long Term Ecological Research (LTER) test sites.

3.3 Potential conflicts between nature protection and other functions

Conservation measures within the forests in Flanders are indeed quite ambitious, and are sometimes to a high extent restricting the options of a forest manager. Still there are few conflicts concerning these aspects of forest management. Nature conservationists can see the progress that is being made (although sometimes 'mistakes' may still happen and lead to frustrations and tension). On the other side, the restrictions are rather well accepted by the forest owners. Different reasons can be pointed out for this:

- For many forest owners, their forest mainly has a personal social and recreational function. The restrictions on their economic possibilities is not considered problematic
- Most forest owners often have very little knowledge of forest management themselves, and have little trust in the government as such. They do have good faith in the 'Forest Groups'. Within these Forest Groups, aspects of trust and voluntariness are predominant, giving the forest owner the necessary freedom of decision. They allow forest owners to incorporate the management of their forests in a larger project. Most owners are proud to be part of a process towards better forests. Many forest owners are also quite happy with the support they receive to manage the forests in a better way. In this sense, the forest groups act as promoters and facilitators of a global forest policy, including conservation

goals in forests (Serbruyns & Luysaert, 2006; Van Gossum & De Maeyer, 2006).

- Legislation is elaborate, but there is a tradition of good consultation (through the high council of forests, and the Forest Groups) in the development process of the legislation
- The mix of legal restrictions, and supportive financial incentives also makes the concept better accepted
- Incorporation of nature conservation in forest management has been a gradual process (see section 2.1.3), also in legislation. In this sense, legislation, public awareness and public acceptance (e.g. on the conservation of dead trees in the forest) co-evolved. The concepts of integrative management have 'ripened' in the mind of people.

Conflicts with nature conservation are primarily focused on the discussion about deforestation for restoration of heathlands and valuable valley grasslands and the use of exotic tree species.

Other conflicts that may arise between forestry and other sectors are the struggle for land and space in this densely populated area, where the pressure on land is very high. There is a clear policy goal to increase the area of forest in Flanders (10.000 ha extra), but remains largely to be achieved due to high competition with other sectors (agriculture, industry, infrastructure...) and legal impediments.

For the majority of public, forests are mainly conceived as provider of public goods and services: recreation, sports, natural values, clean air, quietness. Its role as a primary producer of renewable resources (wood) is less evident. This is partly because of the low economic relevance of the wood production sector, and the open market of wood and wood products in Flanders, which makes that 'wood consumption' is not evidently related to 'wood harvest'. In this context there is high public support for forest conservation (especially in the urban population). On the other hand, there is little knowledge of forest management. The felling of trees, even if done for conservation purposes, or in the framework of a sound management plan, is to most people confronting, and often leads to controversy. Especially final cuts or felling of large avenue trees often arise emotional reactions. A lot of energy is put in public awareness and information when larger forest operations or restoration works are performed.

4 Legal framework for forest management

4.1 Historic legislation (before 1830)

The earliest formal forms of forest protection date from the 13th century, a period when forests had become relatively scarce (see section 2.1.1). At that time, the customary laws on forest use were first written down. For instance, the first version of the famous ‘Keurboeck van Soniën’, an ordinance regulating the use in the Zoniënwoud (Sonian forest) south of Brussels, dates from the end of the 13th century. Throughout the Ancien Régime these ordinances were regularly updated. Most of the ordinances had a repressive character and tried to regulate the local ‘rights of use’ like forest grazing, cutting of firewood, charcoal burning, and hunting. In summary, forest legislation in these times tried to prevent the forests from overexploitation and to safeguard the (hunting) interests of the nobility.

After the fall of the Ancien Régime (French Revolution, 1789), many forests owned by nobility and monasteries were taken over by the state, and many of them were privatised again and became the property of farmers, the new-rich and industrial companies. Many forests were cleared and transformed into farmland, infrastructure, etc.

Under French Republic rule, state forests were managed according to the ‘Code Colbert’ dating back to the 1660’s. It contained regulations on procedures for wood harvest and wood sale and control of forest operations, in order to prevent overexploitation, and provide strategically valuable wood for ship-building. After the fall of the French Empire (Waterloo, 1815) the territory of Belgium came under Dutch rule, until the Belgian independence in 1830. During these 15 years, large areas of state forest were privatised (and often deforested). Forests no longer had high national economic or strategic importance, as the wood import market was already very large.

4.2 National legislation (1830-1980)

In the first years after the foundation of the Belgian state, this privatisation was continued and large forest areas were lost. In order to stop further deforestation and degradation, the first *Belgian forest act* was passed in December 1854. This law regulated the exploitation of state forests, and included global regulations against direct deforestation and offences like poaching and theft of wood. Like most other Belgian legislation it was inspired on its French counterpart, containing typical aspects of Napoleonic law. In this law, the right of private property was very important: no right of access on private land, no strict regulations on forest management on private land, but clear regulations for state forests and for offences against private property (including game). Further, no regulations about protection of nature in forests were included and overexploitation was still

possible in private forests. The latter was solved by a *special law on private forests* in 1931.

The first legal initiative on nature protection was taken in 1957: a *Royal Decree* of April 6, 1957 states that state-owned land can be protected as nature reserves 'in order to keep their unspoilt state, protect fauna and flora, encourage scientific research, tourism and education as far as they are in compliance with nature protection'. Already in 1957, two nature reserves were created (the 'Westhoek' coastal dunes and the 'hautes fagnes' moorlands), but no forest areas were included.

The *Law on Country Planning* of 1962, defined a number of land use categories, and maps were produced delineating current and planned land use. Most existing forests were mapped as 'Forest Area' or 'Nature area'. However, some forests were also included in 'urban settlement expansion areas' or 'industry' or 'zones of residential recreation'. Small forest patches ended up in 'agriculture area'. Many forest areas in these categories were still lost or degraded (e.g. by the building of summer cottages). Still, this law was very important to stop the uncontrolled expansion of industry and urbanisation. Over the last decades, its implementation has also become much more strict.

The *National Law For Nature Protection* was voted in 1973. Next to regulations on protected species, it contained legal procedures for the delineation of both private and state nature and forest reserves. In practice however, it had little influence on forest management and policy. The delineation of nature reserves was primarily focused on open areas like coastal dunes, heathlands, grasslands, and wetlands. The instrument of *Forest Reserves* was intended to conserve rare and threatened forest ecosystems. The law stated that these reserves were to be managed to conserve the composition and the structure of the vegetation. Hunting and wood production were allowed within certain limits. Only a few forest areas in the Brussels Capital Region and Wallonia were officially designated as Forest Reserve under this law.

Within the national forest administration, there was little enthusiasm for this new legal instrument. Afforestations, the struggle against legal and illegal deforestation, wood production and recreational infrastructure were the main preoccupations. Moreover, the procedure for selection and recognition of these reserves was too complicated.

The law had little impact on regular forest management, as it had no competence on aspects of forestry, except maybe in a few cases where management had to be adapted in order to conserve legally protected species.

A series of institutional reforms was started in the 1970's transforming the country into a federal state consisting of three regions (Brussels, Flanders and Wallonia). Since the second *Special Law on Institutional Reforms* (August 8, 1980), the regions are responsible for almost all issues dealing with the environment, including forests and nature conservation. National forest administrations were

'regionalised' in 1983. The national legislation remained in vigour, until specific regional legislation was voted.

4.3 National legislation in relation to forests and nature since 1980

Very few aspects related to forests and nature conservation are still nationally organised. After regional legislation on forests and nature conservation were voted, the national laws were abolished, so overall federal legislation or policy is no longer existent. In Flanders, separate administrations were established for forests and for nature protection.

National implementation of international commitments, like the EU Birds and Habitat Directives, is most often organised by the regions, and simply compiled for compulsory national reporting.

The few national policy documents related to forest or nature are implementations of national engagements in the framework of international agreements, such as the development of a national biodiversity strategy, in line with the Convention on Biological Diversity. These policy papers are developed by the 'Belgian Biodiversity Platform' consisting of representatives of the regions, and coordinated by the Federal Public Service of Health, Food Chain Safety and Environment.

The only national policy document that is relevant to forest management is the *National Biodiversity Strategy 2006-2016* (Moreau, 2006). On forests it contains a number of policy goals, summarised below. However, this document does not impose strict regulations. It is mainly focused on aspects of genetic diversity including GMO's, on the promotion of close-to-nature forestry and forest certification :

Objective 4: ensure and promote sustainable use of components of biodiversity

4a: General

- 1) *Identify good practices involving sustainable use of biodiversity*

4f: Forestry

The forestry sector plays a multi-functional role as a producer of a renewable natural resource, provider of income and employment, biodiversity manager, guarantor of in situ conservation of local tree varieties and provider of environmental services (like soil and water protection) and of recreational activities.

Operational objectives

- 1) *Promote the conservation of forest biodiversity through independent credible forest certification systems that provide a guarantee for sustainable forest management*
- 2) *Promote nature-oriented forestry that provides a guarantee of sustainable forest management, including forest conservation*

- 3) *Protection of forest genetic diversity*
- 4) *Prevent genetically modified trees from having negative impacts on forest and general biodiversity*

4.4 Flemish legislation (since 1980)

In Flanders a new forest law, called 'Flemish Forest Decree' was voted in 1990, and a new law on nature conservation (Nature Decree) followed in 1997. These documents are extremely important for forest management as a whole, and for nature conservation in forests in particular.

4.4.1 Forest Decree

On June 13, 1990 the Belgian Forest Act of 1854 was replaced by the Flemish Decree on Forests. The Forest Decree is the 'framework' law on forest management and is valid both for state and private forests.

At the time of publication, it was a very progressive law, implementing new aspects of modern multifunctional forestry. It contains a detailed definition of the forest concept and the principles for implementation of multifunctional, sustainable forest management. It further gives detailed instructions regarding the organisation of the forest service, forest management and forest protection.

The different articles of the law are arranged according to the different forest functions: ecological, economic, social and educational, shelter and scientific functions. Of specific interest for this report are the articles on the economic and ecological function.

The chapter on economic function regulates forest harvests both in public and private forests. For private forests it states the required approvals for tree felling: felling of trees in forests is only allowed when foreseen in an officially approved forest management plan, or an official felling permit, issued by the forest service. For public forests, the Forest Decree also describes the procedures for public sale of the wood.

The ecological function is mainly preoccupied with aspects of environmental protection and sustainability (e.g. nutrient cycles). One particular article, number 18, specifically focuses on aspects of close-to-nature forestry and integration of biodiversity aspects. It states: "*The care of the conservation, development or restoration of the ecological function of the forests consists among other things of:*

- 1) *encouraging autochthonous tree and shrub species;*
- 2) *stimulating spontaneous processes;*
- 3) *promoting a varied forest structure by striving for an uneven age distribution, for dissimilarity and for sufficient amounts of dead trees and dead wood."*

A specific chapter also provides the installation of forest reserves. The former unpractical regulations on forest reserves from the National Law on Nature Protection were abolished, and a new procedure was stipulated in an *Implementation Order on Forest Reserves* in 1993. In 1995, a first series of Forest Reserves was officially established and the Forest Reserves network is still further developed.

The Forest Decree is further implemented by several of these 'implementation orders' providing detailed procedures and regulations e.g. on the content of management plans, the organisation of so-called 'Forest Groups', subsidy regulation for afforestation and reforestation, for opening of private forests for recreation and realisation of conservation goals. Those relevant to this report are described in section 4.4.3.

4.4.2 Nature Decree

In October 1997, the 'Decree relative to nature conservation and the natural environment', for easy reading further called 'Nature Decree', was voted (published in January 1998).

The main purpose of the decree is the maintenance, the restoration and the development of both nature and the natural environment through nature protection, nature development and nature management measures. It contains specific chapters on species protection, on the establishment of nature reserves (both public and private), but also contains some new revolutionary elements compared to the old law on nature conservation.

The decree indeed provides the legal base permitting the Flemish government to establish general provisions (applicable to the whole Flemish territory) to protect certain natural values (ecologically important landscape elements like trees, hedges, ponds, verges and biotopes like heathland, moorland, salt marshes, wetlands) by making the change of them subject to the granting of a license (Van Hoorick et al., 1998).

Although the decree contains provisions to guarantee a certain freedom of exploitation in agriculture and forestry (explicitly referring to the Forest Decree for forest management regulation), it also introduces some important principles and elements that indirectly have a strong impact on forest management.

Stand-still-principle. "The Flemish government takes all necessary measures, additional to existing legislation, in order to conserve over the entire territory of the Flemish Region, the environmental quality required for the conservation and to apply the stand-still principle concerning both quality and quantity of nature." In other words: the government cannot authorise or accept any management operation or plan (including forest management plan or felling permit) that will degrade both nature quality and (or) quantity.

This principle is further developed in the general guidelines for approval of forest management plans and felling permits, which are applicable to all forests (see section 4.4.4).

Precautionary principle (environmental duty). The decree lays down an environmental duty for everybody: "Everyone who commits an activity or orders someone to commit an activity and knows or reasonably has to know that the nature elements in the neighbourhood can be destroyed or seriously damaged by this activity, shall take all the reasonable measures to prevent, to control or to restore the destruction or the damage". In other words: in all operations (e.g. forestry) one should always pre-evaluate the possible impact on conservation values and exclude avoidable damage.

Flemish Ecological Network (VEN). In the chapter dealing with spatial aspects of nature conservation, the decree not only deals with nature reserves, but introduces the concept and goals for the establishment of an ecological network, this is a network of linked protected and other valuable areas, so that species can migrate over the whole network. Inspiration was found in the "Ecological Mainstructure" in the Netherlands, and in similar developments in Germany, where the network is called "Biotopverbundsystem".

The Flemish government endeavours to designate 125.000 ha in this Flemish Ecological Network. The VEN is supported by an 'Integral Interweaving and Supportive Network' (IVON) that is composed of so-called interweaving areas (150.000 ha) and of interconnecting areas between the natural areas of VEN and IVON. In the designated area of VEN, nature conservation should be the main function. In IVON other functions can be equally important (e.g. activities such as recreation, agriculture, and forestry). Although the aim of management is to preserve high-standard nature, other human activities such as agriculture, forestry, military activities or the extraction of drinking water are allowed in VEN and IVON, as long as they don't jeopardise the main (resp. interweaving) conservation function.

This network, together with the Special Areas of Conservation in the framework of Natura2000 (see below), indeed represent the integrative approach to nature conservation, as a complementary tool to the segregative approach of nature reserves. By now, over 85.000 ha of the VEN-network has been legally established, of which almost 50.000 ha is forest. This would mean that over $\frac{1}{3}$ of the total forest area should have a 'primary function nature conservation'.

Several legal instruments regulating forest management have been issued, in order to practically implement the stand still and precautionary principle, and the management of forests within the VEN :

- *Criteria for Sustainable Forest Management.* The CSFM were established by Decision of the Flemish Government in 2003. They contain a number of ambitious goals and restrictions, and are mandatory for all public forests and for all private forests within the VEN.

- *Felling permits*. Even for forests outside the VEN, basic requirements for felling permits are inspired on the stand-still principle from the Nature Decree.

- *Management Vision for Public Forests*. This management guideline was issued by the forest administration in 2001 (Buysse et al. 2001). It contains similar principles and criteria as the CSFM, but is on certain aspects more concrete (e.g. number of overmature trees per ha), or more ambitious (e.g. long term goal of at least 80% indigenous broadleaved mixed stands).

For a detailed description of the restrictions and guidelines under these three management regimes, see chapter 4.4.4.

Finally, the implementation of the *EU Birds and Habitat Directives* is also covered in the Nature Decree, and further implemented in the executive order on the implementation of the Birds and Habitat directives (see section 4.4.3). It is expected to give an important impulse to nature conservation aspects in forests in the near future. The definite network of Natura2000-areas was legally established in 2002. It includes over 70.000 ha of forest (about half of all forests in Flanders), of which 35.000 ha is overlapping with VEN. About 40.000 ha of forests are considered as belonging to 'actual forest habitat'. More than 50% of these are included in the Natura2000 network.

For the existing habitats, criteria for the evaluation of the 'local status of conservation' were developed (for the forest habitats see Thomaes et al., 2009), setting thresholds for 'favourable conservation status', including aspects of tree species composition, stand structure, dead wood and overmature trees. They are very much in line with the CSFM, but may be more restrictive on some aspects (see section 4.4.4). Most habitat types (also forest habitats) are in an unfavourable to bad conservation status (Thomaes et al., 2008).

Flanders has imposed on itself the ambitious target to reach a favourable status of conservation for 70% of all habitat types and annex-species by the year 2020 and 100% by 2050. Also on habitat extension ambitious targets have been set (in the so-called G-IHD : '*Gewestelijke Instandhoudingsdoelen*' Regional Conservation Goals). These extensions include both transformation of non-habitat forest (conifer and poplar plantations) and new afforestations. These ambitious goals are to be primarily realised within the borders of the Natura2000 network.

4.4.3 Implementation orders derived from the forest decree and the nature decree relevant to forest management

Several implementation orders to the Forest Decree and Nature Decree are determining the implementation of sustainable forest management and the integration of nature conservation in forests. They are described below.

BVR on the establishment of criteria for sustainable forest management in the Flemish Region

This regulation, voted in 2003, states that all public forests and private forests within the Flemish Ecological Network (VEN) should be managed according to the Criteria for Sustainable Forest Management. These criteria are subsequently recited and cover criteria on legal, socio-cultural, environmental and biodiversity aspects. For most of these criteria, specific indicators are included that allow the follow-up of the criterion.

Legal criteria: all forest operations should be in line with existent legislation

Socio-cultural criteria: this chapter covers several aspects (e.g. public participation in the planning, regulation of public access, legal protection and safety of forest workers). Relevant for this report is the following: forests or elements in the forest with high historical, recreational or landscape value should be conserved and managed accordingly. As examples, old woodlands, old coppice and coppice-with-standards-stands are mentioned next to archaeological sites.

The criteria and indicators on the *economic function* contain, amongst others, following restrictions and recommendations:

- Harvests should be performed with minimal damage to soil, remaining trees, fauna and flora
- Through his management, the manager aims at mixed, well-structured and balanced forest stands
- Clearcuts >1 ha are not allowed; in specific cases (e.g. transformation of homogeneous stands, poplar plantations) larger areas up to 3 ha are possible

Sustainability is a basic principle. Average yearly fellings should not surpass the increment: overall standing stock figures should at least remain balanced. Same applies to the harvest of non-woody products (e.g. mushrooms). In public forests, the harvest of non-woody products is forbidden.

Possible reduction of soil productive capacity should be minimized by minimizing the extraction of nutrients during harvest (so: no total tree use)

- Soil conditions should not be altered by artificial drainage or fertilization. Existing ditches can be maintained

Exceptions to these rules are possible if ecologically sound motivation can be given.

On *environmental aspects*, the criteria state (amongst others) that:

- All forest operations respect the carrying capacity of the ecosystem
- The use of pesticides is forbidden, except for glyphosate in the framework of eradication of invasive exotic species like *Prunus serotina*.
- No genetically modified organisms (GMO's) may be introduced

Finally, on *biodiversity aspects*, the CSFM contain following guidelines and restrictions :

- “the forest manager shall, in all cases, respect the stand-still principle and precautionary principle in respect to biological diversity. No foreseeable degradation of high natural values is allowed.” This also means in practice that rich mixed stands cannot be replaced by homogeneous plantations or other forms of land-use. The planting of invasive exotic species is forbidden. Indigenous broadleaved stands cannot be replaced by conifers, poplars or other non-native species.
- The forest and its management are checked in regard to presence and survival of rare, endangered and legally protected species, as well as indicator species of ancient woodlands. Relevant elements are inventoried and marked on management-maps. For these elements necessary measures are taken. These elements are e.g. old hollow trees, rivulets, nest trees of birds of prey, valuable permanent open spaces, well-structured fringes, ...
- No harvest operations are performed during the breeding season (April 1st- June 30th). This period can be prolonged, shortened or abolished depending on the local ecological conditions
- At least 20% of the total area of the forest should consist of, or be in transformation towards mixed stands of indigenous, site-adapted tree species. Mixed means that no species covers more than 80% of the basal area.
- The management foresees in the transformation of all homogeneous stands of poplar and non-indigenous tree species. For poplar, at least an understorey of mixed indigenous species should be present (which may be managed as coppice). For exotic stands, at least 30% (basal area) admixture of indigenous species should be realised within reasonable time.
- Natural regeneration is used wherever possible and realistic – additional planting is allowed where necessary and in new afforestations.
- At least 5% of the total area is dedicated to development of natural values. These can be rich semi-natural forest stands, or valuable open spaces and fringes. Economically valuable trees may still be selectively harvested as long as the overall value of the site is not degraded.

- The management aims at an increase of the amount of dead wood. Opportunities to do so should be recognised and used: hollow and dead trees that represent no hazard to visitors or the proliferation of diseases can be left in the forests, etc. At least 4% of the total stock should consist of dead wood, both standing and lying, in all diameter classes.
- In all stands, a number of trees per ha, preferably native species, are to be left unharvested to grow old and die naturally.

All these aspects should be included in a management plan with clear and measurable goals. Periodic evaluation of the realisation of or progress towards the goals set should be foreseen.

The manager also controls, and documents all harvests, including harvest operational guidelines and restrictions (e.g. the use of fixed harvesting tracks). Chain of custody should be possible.

BVR on forest management plans

This Decision, voted in 2003 and amended in 2007 and 2011, states that all contiguous private forest ownerships of more than 5 ha, and all public forests should have an official management plan. This can be a 'limited management plan' for private owners outside the 'Flemish Ecological Network'. Such a plan mainly contains a table of all foreseen harvest operations per forest stand for the next 20 years.

For public forests and private forests inside VEN however an 'extensive management plan' is compulsory. Such an extensive management plan should contain a detailed description of the site (including history, soil conditions, and detailed inventory of the growing stock, but also of the natural values present at the site. Furthermore it should contain detailed management goals for the site, and a list (or table) of all foreseen forest management operations for the next 20 years, in line with the Criteria for Sustainable Forest Management. These 'extensive management plans' require a strong investment of time and work, but are compensated by a subsidy (see below).

BVR on the provision of subsidies for management of public and private forests

Loss of income because of management restrictions and goals are partly balanced by subsidies. Some subsidies are also intended to stimulate forest owners to join non-mandatory policy aims, like public access to private forests. An overview of all these incentive measures is given in Chapter 5. The criteria for subsidies and the amounts paid are legally set in this executive order from 2003.

BVR on the recognition and subsidising of Forest Groups and co-operation between the forest authorities and Forest Groups

Due to the fragmented nature of forest ownership, groups of private forest owners (Forest Groups) have been established. These forest owners associations

oversee voluntary co-operation between the large number of private forest owners and public forest managers. Their objective is implementation of improved and more coherent forest management practices. The 19 active Forest Groups in Flanders cover the whole territory, and have almost 10.000 members by now (about 10% of all forest owners). This executive order sets the procedures and composition of these NGO's, and provides the subsidies for these activities. The subsidies cover the costs for at least one 'coordinator' and administrative support. The coordinator is a skilled forester who gives both coaching and technical support to the members, and helps organising joint wood sales and management plans (executive order voted in 2003).

BVR on public access to forests and nature reserves

This executive order (2008) stipulates that all forests trails are open for public access, unless the owner marks the trail with an official 'no entry' sign. All management plans should contain an 'access regulation', including maps designating hiking roads, cycling and horseback riding tracks. Off-road hiking is not allowed. Specific forest stands may also be designated as 'play-zone' where children groups with their supervisors are allowed to roam freely, collect branches, make constructions, etc.

Also 'free run'-zones for dogs can be installed, where dogs can be walked freely, and should not be on the leash.

Executive orders on the implementation of the Birds and Habitat Directives

Several executive orders have been voted in order to implement these directives, as foreseen in the Nature Decree. In the *BVR on the designation of SAC's in execution of the directive 92/43/EEG* the areas comprising the Flemish part of the 'habitat areas' in the framework the European Natura2000-network have been delineated (voted in 2002). They encompass about half of all forest in Flanders. The interpretation of European habitat types to the Flemish situation is given in Sterckx et al. (2007).

The proposed 'Sites of Community Interest' were officially adopted as 'Special Area of Conservation' (SAC) by the European Commission in 2004. In line with Article 4 of the habitats directive (see frame below), these SAC's were consequently 'designated' in Flemish legislation. Article 4 of the directive not only states that the sites are to be designated, but also points out that at the same time, priorities and targets for the maintenance of and restoration towards favourable conservation status are to be set.

The *BVR on the designation of SAC's and conservation targets* officially designated the sites as SAC's and set the procedure to be followed for the assignment of regional targets for annex I and II habitats and species of the habitat directive and annex IV species of the Birds Directive (in 2009).

Article 4: “Once a site of Community importance has been adopted in accordance with the procedure laid down in paragraph 2, the Member State concerned shall designate that site as a special area of conservation as soon as possible and within six years at most, establishing priorities in the light of the importance of the sites for the maintenance or restoration, at a favourable conservation status, of a natural habitat type in Annex I or a species in Annex II and for the coherence of Natura 2000, and in the light of the threats of degradation or destruction to which those sites are exposed.”

These have been fixed in the *BVR on the assignment of regional conservation targets for species and habitats to be protected in Europe* in July 2010. This BVR contains quite ambitious targets on the extensions of the habitats that are to be realised in the coming decades. These extensions should be realised as far as possible within the borders of the SAC's. Moreover it also states that the quality of the habitats are to be improved. For all forest habitats it is stated that this improvement is to be realised by ‘*solving problems of eutrophication, acidification, fragmentation, inappropriate use and change of vegetation*’. For the alluvial types (91E0 and 91F0) problems of ‘*natural hydrology*’ are added to this list. This quality requirement may still be rather vague, and no deadlines are set on the implementation of the quantitative goals. However, these goals are linked to one of the so-called ‘*core-indicators*’ in the framework of an ‘*overall policy target*’ that was set in the ‘*pact 2020*’ between the Flemish government and all important social players (industry, trade unions, NGO's). It states that by 2020, ‘*Flanders has designed, reassigned, improved or designated enough habitat in order to realise 70% of the conservation targets for European species and habitats*’.

An overview of forest habitats in Flanders, and the targets set, is given in Table 4. From this table, we can conclude that in the long run, about 70-100% of all forest in Natura2000-areas that is now classified ‘*no habitat*’ (e.g. conifer plantation) is to be converted to one of the forest habitat types. Moreover, it is also expected that most of the targets for extension of heathland and oligotrophic grassland types (in total 2.700-3.200 ha) are to be realised on actual non-habitat forest sites.

For forest habitats, the BVR of 2010 (annex 1) however clearly states that the establishment of new habitat by transformation of current non-habitat-forests may be spread over several decades and should be realised through management according to the Criteria for Sustainable Forest Management. In other words, ambitious targets are set to be reached, but this should not necessarily result in too hasty transformations of forest stands. However all future management goals and activities are to be in line with, and result in significant progress towards the given targets.

Table 4: Overview of actual forest habitat areas in Flanders and targets for further habitat extension

Forest Habitat type	Surface in Flanders (ha)	Surface within habitat-SAC (ha)	Targets habitat extension through afforestation (ha)	Targets habitat extension through transformation (ha)
2180	250	230	150-200*	
9110	350	300	50-100	20-40
9120	19.000	9.500	2.050-3.200	12.450-16.600
9130	3.200	2.000	950-1.260	975-1.300
9150	5	4	5-20	
9160	3.100	1.700	450-690	525-700
9190	3.200	1.300	520-890	4.800-6.400
91E0	12.000	6.000	1.800-3.000	8.775-11.700
91F0	10	8	50	0
No habitat	105.000	35.360		
Total	145.000	56.400	6.000-9.500	27.500-36.700

4.4.4 Application of these legislations in multifunctional, integrative forest management

As stated above, different target levels for integrative forest management (and related goals and restrictions) are relevant depending whether the considered forest is 'Domanial' forest (owned by the state), other public forest or private forest inside or outside the Flemish Ecological Network, in- or outside Natura2000 habitat types and SAC's (Habitat Directive areas).

Three levels of endorsement can be distinguished and are described in detail below : a 'basic level', that applies to all forests, the 'Criteria for Sustainable Forest Management', that are compulsory to all forests (both state and private) within the Flemish Ecological Network (VEN), but in principle also cover the requirements for Forest habitats outside VEN, and finally the 'Management Vision for Public Forests' that is to be applied to all public forests (and is compulsory for Domanial forests).

In Figure 5, the distribution of forests in Flanders that are included in different conservation networks is given. About half of all forests belong to VEN or SAC's of Natura2000, which implies that they should comply at least with the CSFM.

This figure does not distinguish between public and private forests, but most of the public forests are located in VEN or SAC. The figure also does not show the area of forest habitat outside official SAC, that according to the EU habitat directive, should also be kept or brought to a favourable conservation status. In practice, this means that they should also comply with the CSFM.

We can conclude that less than half of all forest in Flanders should only comply with the 'basic requirements', over 1/3 should follow the CSFM, and 1/6 to 1/3 aims to meet the highest targets set by the Vision on Public Forests (which are compulsory to all Domanial forests).

The concepts, restrictions and incentives for each of these levels is explained in detail below.

It should be mentioned that a thorough revision of these ‘levels of application’ is now underway, focussing mainly at a better integration of policy and legal statutes for forests, park areas and other natural areas. This may result in some limited revisions of thresholds and limits, additions and removal of specific elements, but will remain loyal to the current concept with different levels of integrative targets.

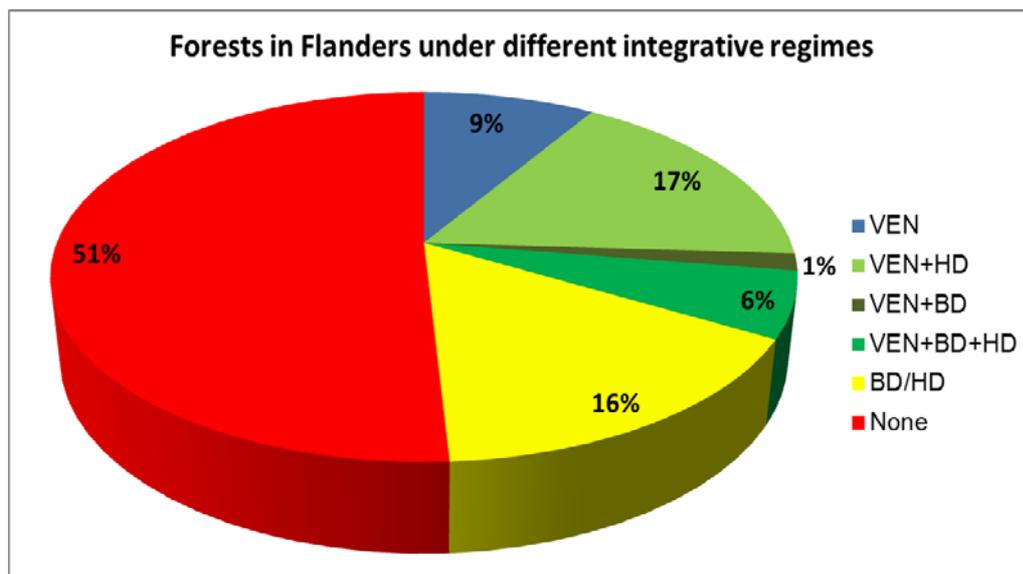


Figure 5: Different categories of integrative regimes in Flemish forests: VEN (forests within the Flemish Ecological Network); HD (forests in SAC following Habitat Directive); BD (forests in SAC following Bird Directive)

Basic level: applicable to all forests in Flanders

Mainly inspired by the ‘stand-still-principle’ of the Nature Decree and principles of sustainability in the framework of multifunctional forestry (from the Forest Decree), the following restrictions are relevant to ALL forests in Flanders, and are included in the administrative directives for the evaluation of felling permit applications and management plans:

- Deforestation is forbidden (unless with special exceptional permit and procedure – we will not cover this in detail here)
- No felling or harvest operations are allowed unless foreseen in an approved management plan or in an authorised felling permit
- Forest ownerships of >5 ha should have a (limited) management plan with a running time of 20 years
- clearcut is to be avoided. Maximum size of clearcuts for poplar and exotic tree species is 3 ha, for native broadleaved woodland, maximum

size is 1 ha, unless when transforming homogeneous stands to more mixed stands, than the area may be enlarged again to 3 ha; several clearcuts should be spread over the forests, at least 100 m apart

- No felling and harvesting from April 1 - June 30 (can be enlarged, shortened or abolished depending on local ecological conditions)
- In thinning operations, maximum thinning intensities (in % of stem number or basal area) can be imposed; thinnings leading to degradation of the stand quality or structure (removing all quality trees) will not be allowed
- Coppicing is allowed in appropriate stands and species, with a minimum rotation time of 8 years
- Specific measures to prevent soil damage may be imposed by the government in the conditions of the felling permit (e.g. fixed skidding tracks, avoiding certain areas)
- Also other preconditions can be connected to the felling permit by the forest administration such as certain valuable trees or species to be spared
- Within 5 years after final cut, successful regeneration should be established. This can be both natural or artificial regeneration (to be planted within 3 years after final cut).

All regenerations and transformations should fulfil the *stand-still-principle*:

- Native trees cannot be replaced by exotics
- Native broadleaved cannot be replaced by native coniferous forest (Scots pine)
- Mixed stands cannot be replaced by homogeneous stands

Stimulative measures:

- The owner is stimulated to keep and increase levels of dead wood and old trees (through public awareness, no strict target)
- Financial stimuli are given to switch to indigenous tree species (planting subsidies, see chapter 5)
- Possibility to join subsidy scheme for public access.

Second level: Criteria for Sustainable Forest Management

The guiding principle should be the promotion of sustainable forest management. Sustainable forest management (SFM) can be defined as "*the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems*" (MCPFE, 1993). Criteria and Indicators for SFM were developed (MCPFE, 2003).

In this context, the Flemish Government approved the executive order concerning the determination of Criteria for Sustainable Forest Management for forests in

the Flemish Region (see section 4.4.3). The requirements set in the CSFM are compulsory for all forest owners within the Flemish Ecological Network. Outside VEN, forest owners can decide to voluntarily join in. In this case, they are also eligible for the financial incentives and other opportunities (certification) related to these CSFM.

In the forests complying with the CSFM, all restrictions and targets of the basic level are also in force, but are on some points even more stringent: it no longer settles on the 'stand still' but on some points go for 'continuous improvement'.

Following requirements and restrictive measures are applied:

- An extensive management plan is required, with detailed inventory of valuable elements for nature conservation specific management implementation in order to conserve them (e.g. old habitat trees, rivulets, archaeological sites)
- Choice of tree species: idem (stand still)+ long term goal for conversion of
 - o exotic stand to mixed indigenous: 20% of surface area
 - o all homogeneous stands to mixed stands (at least 30% admixture)
- Size of clearcuts: 1 ha, unless in the frame of transformation towards more mixed stands of homogeneous exotic plantations
- Dead wood: clear target: 4% of total stock + Quality requirements: all sizes, standing and laying
- Overmature trees: a certain number of trees/ha should be selected to be left unharvested
- 5% of the forest should consist of, or being developed towards 'key-habitats'. These can be ecologically valuable open spaces and/or semi-natural stands of mixed native woodland (selective harvest of high timber value trees non detrimental to the quality is still allowed).

These SFM criteria are very demanding and for many owners obligatory, but also give the owner a certain legal security and extra possibilities. The CSFM are considered to be in accordance with the requirements for Natura2000 habitats. It is also in accordance with both FSC and PEFC²-certification standards, which makes all forests managed according to CSFM automatically eligible for individual or group-certification.

Some extra financial incentives are also provided:

- The owner is acquitted from certain taxes and succession rights
- Subsidy (per ha) for key-habitats and management of valuable open spaces
- Subsidies for the production of an extensive management plan.

² No official Flemish PEFC-standard is existent at this moment, but the CSFM is in accordance with global PEFC-standards, and the official standards of neighbouring countries or regions like the Netherlands and Wallonia.

Highest level: 'Management Vision for Public Forests'

For public forests, guidelines for management were developed (Buysse et al. 2001). They incorporate very high standards for forest management, with special attention to nature conservation aspects. They are quite comparable to the criteria for sustainable forest management (CSFM) but are on a number of elements even more ambitious. Especially on the point of tree species composition, higher targets are set.

The basic principle is close-to-nature forestry, with small-scale interventions, selective thinnings and abandoning final cuts; clearcuts (1 ha or more) are only allowed in exceptional cases.

- In the long run, the large majority of forest stands in public forests should consist of mixed, uneven aged, indigenous forest stands :

- In the long run, 80% of all stands should consist of indigenous species
- At least 30% admixture of indigenous species in the remaining exotic stands
- All stands must be mixed, meaning that no species should cover over 90% of the basal area
- New afforestations are to be done with indigenous species. Poplar clones may be used as 'pioneer' generation on maximum 50% of the area.

- Natural regeneration is used in all cases where possible.

- Special attention and appropriate management is given to valuable non-forest biotopes in the forest complex (heathland, ponds, gales, ...). These permanent open spaces, together with transient open spaces with high conservation value, should cover at least 5-15% of the total forest area.

- Special attention is also given to rare and vulnerable species (hollow trees with bat colonies, breeding areas of rare bird species, etc). Also special attention is given to rare local genotypes of trees and shrubs.

- No commercial harvesting (with heavy machinery) is allowed in valuable and vulnerable riparian forests and swamp forests.

- Changes in natural hydrology should be restricted to the absolute minimum.

- Old trees: some trees are spared to become old and die naturally. They can be spread over the stand or grouped. If spread over the stand: at least 10 trees/ha are to be spared (for very large trees and low stem numbers: at least 10% of the stand basal area). If clustered, areas of at least 5% of the stand are selected and remain unharvested.

- On dead wood, the same threshold is set as in CSFM: at least 4% of the standing stock, both standing and lying, in all decay classes, and representative for the species composition and size distribution of the stand.

As public forest management is not privatised (like in other countries), the forest administration is not eligible for any subsidies. They receive a yearly budget in order to realise these and other societal goods and services (recreational infrastructure).

Forests within the Natura2000-network

For forests within SAC's (habitat directive) there are no clear restrictions, but from the executive orders on Natura2000-targets, it is clear that forests that are adhering to a certain habitat type should at least comply with the CSFM if they want to reach the required favourable status of conservation. The conservation status of a natural habitat is "favourable" when (i) its natural range and areas it covers within that range are stable or increasing, and (ii) the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and the conservation status of its typical species is favourable as defined below.

In principle, this should be the case for all forests adhering to one of the habitat types (both within and outside SAC's), as the 6-yearly reporting towards the EU should cover all habitat within the country. The 2007 assessment clearly showed that all forest habitats were in an unfavourable status of conservation (e.g. Thomaes et al., 2008). This has led to the implementation of ambitious Regional conservation targets. These targets are considered to be required, in order to reach the long-term goal of favourable status of conservation for all habitats (as set by the EU Biodiversity Strategy 2020). In principle, these goals can be realised on the whole territory. However, in practice, the goals on habitat quality and habitat extension will be primarily concentrated in the SAC's, that cover more than 50% of the actual forest habitat area (and more than $\frac{1}{3}$ of all forests including non-habitat).

The Regional Targets for Natura2000 species and habitats are now further elaborated for every SAC. The targets for the year 2020 are also further elaborated in an implementation document (Verhaeghe, 2013). For 16 habitat types, the conservation status should be improved by 2020; for all other types, this target is to be reached by 2050. All forest habitat types (except for the marginal type 9150) are in the last category. This is logical, as a time horizon of at least 40 years is needed and reasonable to reach the regional targets, as they encompass large areas of afforestation and conversion of existent non-habitat forest stands. These transformations should be performed at a pace that is in line with the concepts of sustainability and sustainable forest management. However, also for these habitats, a substantial change in the direction of the target should be demonstrated by 2020.

As stated before, a strict application of the CSFM should be sufficient to reach the requirements for a favourable status of conservation. These are set for all forest types in Thomaes et al. (2009). In order to reach the 'conversion' goals however, the requirements surpass these of the CSFM: according to the CSFM, stands of Scots pine are considered to be 'indigenous', and should only aim for

an admixture towards mixed stands. Also stands of exotic trees should only aim for an admixture of 30% indigenous species. When these stands are selected for transformation to habitat, 'characteristic trees species' (= indigenous broadleaved species) should cover at least 70%, and exotic species can cover maximum 10% in order to reach a favourable conservation status. For poplar stands, the CSFM requirements state a subcanopy layer, covering at least 30% of the area; the favourable conservation status requires 70% coverage (Thomaes et al., 2009). A handbook gives further guidance for forest managers on the management of forest habitat types and conversion trajectories towards forest habitat (Thomaes et al., 2012).

4.4 International law

Several international agreements and commitments are related to biodiversity in forests:

- Convention on Biological Diversity
- EU Biodiversity Strategy
- MCPFE (Helsinki-process)
- EU forestry action plan
- EU Birds and Habitat directives

All these commitments have inspired, or have been adopted in regional or national legislation and policy (e.g. Belgian national biodiversity strategy), thus have been covered in the previous chapters.

5 Financial instruments

5.1 Extent and development of public financing

Unlike in many other European countries, the Flemish forest administration has not been transformed to a private or state company, but is a 'self-dependent Agency' within the public administration.

The Agency for Nature and Forests, as it is called, receives a yearly provision by the Flemish state that is to cover all expenditures.

Budgets are further subdivided in different categories, like wages of the personnel, investments in material, budgets for the acquisition of land, etc...

Also specific budgets are allocated to different forms of subsidies for private organisations and individuals (subsidies for the organisation of nature conservation NGO's, for management and acquisition of private nature and forest reserves...). Relevant for the topic of integrative forest management are :

- subsidies for the organisation of Forest Groups
- subsidies for private and public forest owners (see section 5.2)

Income from wood sales from Domanial forests, are deposited in a special fund, and are to be re-invested in acquisition and management of forests and other natural areas. They are estimated at 2 to 4 million Euros per year (FRA 2010).

The annual yearly provision amounts to over 20 million Euros (FRA 2010), From this budget, a total of over 2 million Euros is provided for different forms of subsidies to private and public forest owners.

It can be concluded that the extent of public financing, and investment of public resources into management of public and private forest and natural areas is quite high. It can be related to the high societal demands and expectations for the goods and services provided by these areas. They can be considered as a retribution of the society for the provided ecosystem services.

5.2 Subsidy programmes to support the endorsement of the ecological targets in forest management

The high requirements imposed on forest owners, are compensated by different forms of subsidies and other stimulative measures. Specific subsidies for forest owners are stipulated in the Executive Order (*BVR on the subsidies for managers of public and private forests*) from 2003. This order provides subsidies for public access, for the regeneration with native tree species, for measures supporting the ecological function and for the making of an extensive management plan.

All forest owners can apply for regenerating with native species, and for opening their forest for public access.

The subsidy for regenerating with native species amounts between 1.500 and 3.200 Euro per ha depending on the regenerated tree species, and can be further increased by 500 Euro per ha for mixed stands, and another 500 Euro/ha if also an understorey or shrub layer is provided (e.g. *Corylus*, *Cornus*, *Viburnum*). The regeneration can originate from planting or from natural regeneration.

Requirements are that the regeneration is in line with the management plan (if existent), and not contradictory to other overall goals for the area (e.g. heathland restoration). Also the minimum density of the regeneration is set, ranging from 1.600 to 2.500 plants per ha (123 per ha for *Populus canescens*). Payment is done in two parts. The first 60% is paid after approval of the application by the owner. After 5 years, the success of the regeneration is checked in the field, and if sufficient, the second part is paid.

Subsidies for public access are paid to every private owner who opens his forest to the public. After approval of the application, the owner is paid 2 Euro per m of pathway that is opened to the public, with a maximum of 50 Euro per ha.

For forest stands designated as approved official 'play zones', a subsidy of 100 Euro per ha is paid.

The subsidies for ecological function are linked to the existence of an approved extensive management plan, according to the Criteria for Sustainable Forest Management (CSFM), in which these areas are clearly designated.

Four types of areas can be designated.

- Small permanent open areas within the forest, managed for conservation purposes (ponds, small heathland patches, species-rich grasslands): 125 Euro/ha/year
- Native, broadleaved forest stands, managed for conservation and development of a 'natural forest type': 125 Euro/ha/year
- Native broadleaved stands and old Scots pine stands (over 70 years old), not specifically managed to reach a natural forest type: 50 Euro/ha/year
- Stands officially recognised as seed source for native tree and shrub species, managed in function of effective seed harvest: 50 Euro/ha/year

Finally, the production of an extensive management plan according to the principles of SFM is also subsidised: individual owners receive 200 Euro per ha for this purpose; for management plans covering several owners, this amount is raised by 20 to 50 Euro per ha. The subsidy is expected to cover about the complete cost of the management plan, making it a cost-neutral operation for the

owners. When several private owners are involved, follow-up and coordination is often done by the Forest Groups.

As stated before, the legal statutes for forests, park areas and other natural areas is under thorough revision. This may also result in some revisions of the subsidy regimes, but will remain loyal to the current concept with different levels of integrative targets.

5.3 Other indirect legal, financial and market incentives

Forest owners that are obliged to adhere to the Criteria for Sustainable Forest Management are very much restricted in their management choices. In return, they are eligible for specific subsidies (see 5.2) and also receive a certain legal security. The CSFM are considered to be in accordance with the requirements for management of Natura2000 habitats.

It is also in accordance with both FSC and PEFC-certification standards, which makes all forests managed according to CSFM automatically eligible for individual or group-certification. Forest group coordinators can also facilitate here and help with the certification procedure.

Furthermore, forest owners who manage their forests according to the CSFM, fixed in an approved management plan are exempted from succession rights.

6 Informational instruments

6.1 Education

Professional education in forest management is restricted to BSc and MSc-levels. No specific programmes are available on secondary school level.

The BSc-programmes on forest and nature management are incorporated in other training programmes on Garden and Landscape Planning, and contain little in-depth technical education on silviculture or nature conservation.

At university level, specific MSc-programmes on forest management (Forestry Engineer) have been transformed over the last years towards a broader scope of ecology, nature conservation and forest management. As a result, graduates have a better ecological basis, but may have a less elaborate knowledge of silvicultural techniques.

Specific education on forest management, ranging from one-day practical courses (e.g. on chainsaw- maintenance) up to extensive courses on forest management legislation and practice are provided by INVERDE. This is an organisation financed by a specific fund within the forest and nature administration. All non-university forest professionals need to have a 'diploma of knowledge' on forestry, issued by INVERDE after successfully finalising the extensive course and tests on forest management legislation and practice.

Publications towards a broader public are also an important source of education and information. Scientific results on forest and nature conservation management are translated to a wider public through specific journals (Bosrevue, Natuur.focus, INBO-newsletter, Bosreservatennieuws). Also the Forest Groups have a periodic for their members, where they publish new findings or ideas to a wider public. Finally, also the Centre for Nature Education (CVN) organises courses for a broad public on a wide range of natural history topics, including forests.

6.2 Advisory services

Advisory services to private forest owners are provided both by the administration itself, and the Forest Groups.

Within the forest and nature administration, a specific section of 'government officials for private forests' is operative. They deal with the applications for felling permits and management plans. Within this process, the officials can also give advise to the private owner on different aspects, such as required or acceptable felling conditions, tree species choice at replanting. Complementary to this, also Forest Groups do a lot of advisory work. Many private forest owners are reluctant to get advice directly from the government, and rely more, and often feel more confident negotiating with the Forest Group coordinators.

7 Certification

Forest certification is seen as one of the most important initiatives from the last decades to promote sustainable forest management. Since 1994, work on certification has been carried out in Belgium. Several certification schemes exist world-wide. In Belgium, both FSC and PEFC-certifications are performed.

Forests that are managed according to the Flemish Criteria for Sustainable Forest Management (CSFM), and have an approved management plan according to the guidelines automatically comply with the existent standards and are eligible for certification.

The Flemish government stimulates the FSC-certification of forests, by certification of its own forests, and offering certification possibilities to other public and private owners, associated in a common management plan that is eligible for FSC-certification. For this purpose, the administration has a FSC-group certificate.

End of 2012, about 18.600 ha of forests (mainly public forests, of which Domanial forests cover about 12.000 ha) were part of this group certificate and were officially FSC-certified. In this same year, these forests produced over 100.000 m³ of wood (Audenaert 2013).

Up to now, no forests are officially PEFC-certified in Flanders (in contrast to Wallonia, where all public forests are PEFC certified). A PEFC-standard is only available for Wallonia at this moment.

The Flemish Region also actively encourages the use of FSC-, or PEFC-certified wood in public works (so also for imported wood) (Oldenburger et al., 2009).

8 Monitoring and planning tools

8.1 National Forest Inventory

The first forest inventory of the Flemish Region was done between 1997 and 2000. This inventory uses a systematic sample grid of 1 x 0,5 km, resulting in 2665 grid points located in actual forest, presenting sample plots (Waterinckx and Haelvoet 1997). Since 2009 the second inventory is being made, switching to a continuous inventory in which every year about 1/10 of the plots is measured (Wouters et al. 2008).

The plot consists of a set of concentric circular plots. Standing trees (both alive and dead) with DBH between 7 cm and 40 cm are sampled in circular plots with a radius of 9 meter; trees with $DBH \geq 40$ cm are sampled in a larger circle ($R=18$ m). Species, status (alive/dead), DBH and height are recorded. Volume calculations for living and fresh standing dead trees use regional tariffs based on DBH and height measurements. Volumes of standing wood fragments were calculated using formulas of truncated cones. In the first forest inventory, no quantitative data for lying dead wood are available. In the second inventory, lying dead wood is sampled using Line Intersect Sampling (Warren & Olsen 1964), with 3x15 m lines sampled in every plot in 3 fixed directions from the plot centre (Wouters et al. 2008, Govaere et al. 2010). This 'fan-design' is also used in other countries (e.g. Böhl and Brändli 2007). Volumes are calculated using the formula of van Wagner (1968).

The intermediate results of the second inventory are not made available yet, so comparisons with the first inventory are not possible yet.

It is intended that this inventory will be further continued using fixed plots and a 10 year turnover.

8.2 Monitoring

Next to the NFI, also other monitoring tools are available or being developed.

In the framework of the extensive forest management plans, quite elaborate inventories of the forest stands are made : at least one sample plot is made in every stand (or one for a group of similar stands), on average 1 sample plot for every 3 ha. These plots are measured in a similar way as the NFI sample plots, allowing easy comparison, and similar data analysis.

They represent an important reference dataset, not only to underpin management decisions for the management plan itself, but also for future monitoring. Re-measurement of (a part of) these plots is possible at the end or at a mid-term-evaluation (= after 10 years) of every management plan, in order to evaluate the realisation of pre-set goals.

In the framework of the Natura2000-monitoring, a methodology is being developed for periodic evaluation of the local conservation status of every forest habitat type, using the evaluation guidelines developed by Thomaes et al (2009). For widespread types like 9120 or 9130, sample-plots locations from the NFI will be used for this purpose. For rare types (9110, 9150,...) additional field surveys will be organised. Sampling frequency will be in line with the NFI and the reporting frequency required by the EU.

Furthermore, the Agency for Nature and Forests has contracted out a study to develop a monitoring scheme for management effectiveness and performance for all its forests and natural areas.

Finally, a detailed monitoring programme is operative for the strict forest reserves (Vandekerkhove et al., 2003, 2011). For the whole network, basic measurements (comparable with other management plans) are performed at the moment a new site receives the status of strict reserve. Additional full inventories of ancient trees and large dead wood (DBH>40cm) is also performed. For a selection of sites (12 at this moment), a detailed monitoring scheme is followed using a dense grid of circular plots, combined with a full inventory of a representative core area. Data on stand characteristics and vegetation are recorded on a 10 year cycle.

8.3 Forest planning

Unlike other countries and regions, no '**national forest programmes**' are being developed for Flanders. Overall forest policy and goals are covered by the different quantitative and qualitative targets set in the policy instruments mentioned above (CSFM, Management Vision,...).

Forest conservation and forest area expansion also remain an official goal. The Flemish Environmental Policy Plan, and the Flemish Structural Plans mentioned specific goals : 10.000 ha of net forest expansion were to be realised by the year 2002. These plans proved to be unrealistic, notwithstanding the efforts of the forest administration (Van Gossum et al. 2008).

Concrete forest planning is foreseen in the **forest management plans**. Two types of forest management plans are existent, the limited management plan, and the extensive management plan. Both types have a planning horizon of 20 years.

For all contiguous private forest ownerships of more than 5 ha, and all public forests, a management plan is compulsory. This can be a 'limited management plan' for private owners outside the 'Flemish Ecological Network'. Such a plan mainly contains some basic information (cadastral data, forest stands map,...) and a table of all foreseen harvest operations per forest stand for the next 20 years.

For public forests and private forests inside VEN an 'extensive management plan' is compulsory. Such an extensive management plan should contain a detailed

description of the site (including history, soil conditions,...), a detailed inventory of the growing stock, but also of the vegetation and natural values present at the site. Furthermore it should contain detailed management goals for the site, and a list (or table) of all foreseen forest management operations for the next 20 years, in line with the Criteria for Sustainable Forest Management.

By 2008, 19.000 ha of forest had an approved extensive management plan and 29.000 ha of forests had limited management plans.

Small forest owners, who have no obligation to produce a management plan, often have an 'ad hoc' management, using felling applications and permits. They are stimulated by the Forest Groups to participate in joint management plans.

9 Discussion

Forests in Flanders are scarce and fragmented both in space as in ownership. These forests are quite productive, with high standing stock figures, but the economic importance is relatively limited, due to this scarceness and fragmented ownership.

At the same time, they have a high socio-cultural importance as an important source of recreation, well-being and nature conservation. For the majority of the population, forests are mainly conceived as a provider of such amenities and services, and not as a primary producer of goods (wood).

Due to the high societal pressures and in order to meet these expectations, legislation and policy on forest management is very strict.

Over the last decades, also aspects of nature conservation have gradually become more important and determining on forest management.

In the overall concept of durable multifunctional forest management, that is to be applied to all forests in Flanders, the integration of conservation goals is an integral part. Deterioration of natural values due to forest operations is prohibited, as the 'stand still principle' for conservation is applied everywhere. However, the Flemish forest and nature conservation policy also provides a certain 'zonation' and concentration of the efforts, with higher ambition levels and management restrictions and regulation within the Flemish Ecological Network and in Natura 2000 habitats.

The principle that the 'strongest shoulders should also carry the heaviest burden' is also reflected in the fact that many of the conservation goals are concentrated in public forests, and subsidised private nature reserves. Indeed the most ambitious targets for integrative management are set for public (domanial) forests. Many of these indeed also harbour the higher natural values.

The financial instruments in order to reach the ambitious goals for forest quantity and quality, for different goods and services, including nature conservation are indeed quite numerous, involving quite important investments.

Considering the increased participation rate (e.g. on management plans, membership of Forest Groups) and some conservation indicators in the field (higher levels of naturalness, more dead wood, expansion of highly-demanding indicator species), the policy appears quite well performing, with a high 'return on investment'.

Nevertheless, efforts are made to further improve the performance and integration of forest and nature conservation policies, working towards more integrated legal designations and statutes.

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List of Figures

FIGURE 1: BELGIUM, WITH ITS THREE REGIONS	1
FIGURE 2 COPPING AND COPPICE WITH STANDARDS	5
FIGURE 2: FOREST OWNERSHIP IN FLANDERS	9
FIGURE 3: SURFACE DISTRIBUTION OF DIFFERENT FOREST STAND TYPES IN FLANDERS (ANB, 2001 : BOSREFERENTIELAAG)	10
FIGURE 4: DISTRIBUTION OF THE GROWING STOCK OVER MAIN TREE SPECIES (BASED ON FOREST INVENTORY DATA)	10
FIGURE 5 POPLAR PLANTATION IN BELGIUM	12
FIGURE 6 HABITAT TREE - SNAG OF AN OLD BEECH TREE	17
FIGURE 5: DIFFERENT CATEGORIES OF INTEGRATIVE REGIMES IN FLEMISH FORESTS: VEN (FORESTS WITHIN THE FLEMISH ECOLOGICAL NETWORK); HD (FORESTS IN SAC FOLLOWING HABITAT DIRECTIVE); BD (FORESTS IN SAC FOLLOWING BIRD DIRECTIVE)	41

List of Tables

TABLE 1: MAJOR FOREST STAND TYPES AND EXTENT IN FLANDERS AND WALLONIA (AFTER WATERINCKX AND ROELANDT (2001) AND LECOMTE ET AL. (2003))	2
TABLE 2: MAIN THREATS FOR BIODIVERSITY IN BELGIUM (MOREAU, 2006)	16
TABLE 3: OVERVIEW OF FOREST AREA INCLUDED IN NATURE AND FOREST RESERVES	22
TABLE 4: OVERVIEW OF ACTUAL FOREST HABITAT AREAS IN FLANDERS AND TARGETS FOR FURTHER HABITAT EXTENSION	40