REFERENCE FOREST
IN CONTINUOUS COVER FORESTRY

Grand Bois de Vielsalm

A reference forest in continuous cover forestry is a forest area which illustrates this type of management on a full scale, directly within the ecosystem. It is also used as a place of research, training and exchange. Inventories ensure it is monitored and provide knowledge on the CCF and analyse, in space and time, the forest's resistance and resilience.

The different visit formats (conferences, training, days of reflection, technical visits, etc.) make it possible to discover the dynamics and meet the different actors involved in management in continuous cover forestry (CCF).

Continuous Cover Forestry

CCF constitutes a global approach to the forest integrating its ecological, economic and social dimensions. It is based on the natural processes which govern the forest ecosystem.

CCF is based on:

1. The mix of species per tree or per group of trees (regardless of the size of the stand).

2. Natural regeneration (wherever that is possible and sufficient).

3. Continuous forest cover which avoids clearcutting and its disadvantages as much as possible.

4. Gradual irregularity of the structure (age) of the stands.

5. Management at the scale of the tree (or by group of trees), the only scale allowing the ecological and economic characteristics of each tree to be taken into account, with the aim of producing wood of different qualities, in particular large timber with high added value, and to preserve the best tree-habitats.

6. Sampling the increase in volume of stands, guaranteeing the supply of the timber industry.

7. Improving the room for biodiversity thanks to the presence of a forest understory composed of herbaceous and semi-woody plants distributed over the entire forest surface.

The Grand Bois de Vielsalm :
a forestry hotspot for several centuries

The Grand Bois is located in Belgium in the North East of the Province of Luxembourg in the municipality of Vielsalm. It is a state forest of 1811 hectares, belonging to Wallonia, and managed by the Department of Nature and Forests (DNF, cantonment of Vielsalm).

The Grand Bois is a vast and ancient forest whose management has been relatively well documented since the 18th century. A large beech forest used over time for firewood and industry, it was around 1814 that the first spruce plants were introduced. They mark the beginning of the forestation of cuttings (common spruce, Scots pine, Douglas fir) with an intensification of these plantations around 1860. In 1897, the Grand Bois became the property of the Belgian State. From 1935, Georges Turner developed a planting method (Turner cells) aimed at gradually transforming even-aged spruce stands into stands of various ages in which the spruces would be associated with beech and other softwood species. In practice, 10-acre cells planted with beech or fir are introduced into monospecific spruce stands which are around 60 years old. The method was adapted in 1975 to introduce only one cell per hectare but to increase the surface area to 20 ares. At the same time, cells of other species, the main ones being Scots pine, larch, cypress, tsuga and fir, are introduced into regular plots in order to gradually bring diversity. The Grand Bois then began its long transformation towards a balanced, productive and diversified forest.

The Grand Bois de Vielsalm has been recognized for many years for the quality of its silviculture based on a diversification of species and ages, and a continuous maintenance of the forest cover by trying to limit clearings. The mixture of species also benefits the development of biodiversity. Over the years and felling, timber harvesting operations have moved towards large mature timber. At present, forest managers work for quality woods with the best economic potential.
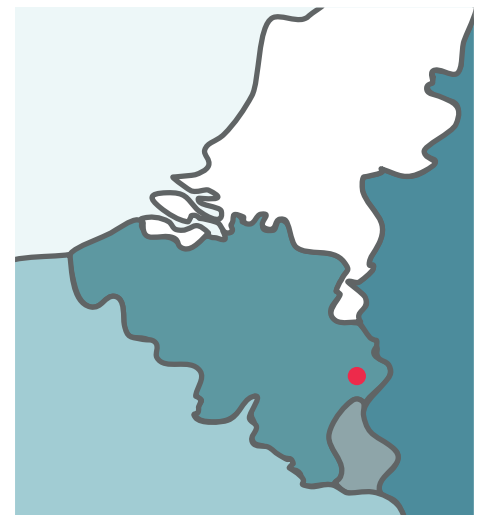
Altitude	490 – 565 meters
Bioclimatic area	Haute Ardenne and central-eastern Ardennes
Climate	Mountainous
Relief	not very uneven plain

An inventory by "permanent plots" to know the forest

Assessing the current and future state of the forest involves collecting a series of quantitative and qualitative data. To do this, the choice of an inventory by sampling by permanent plots was imposed in view of the large size of the massif for the inventory and in anticipation of future steps of re-measurement. In this way, the best balance is achieved between working time and accuracy and comparison of results over time.

The Grand Bois inventory focused on the heart of the massif, where irregular forest management is the oldest. The work was carried out jointly by the Forêt.Nature team and the DNF officers from the Vielsalm cantonment.

The protocol

The protocol for the inventory by sampling plots of the reference forest of the Grand Bois de Vielsalm was drawn up on the basis of the "Forest management inventory" (IFA) developed by the Forest Resources Management Axis of Gembloux Agro-Bio Tech (ULiège)[1]. The IFA software enables automated and customisable data processing. As part of the reference forest inventory, more in-depth ecological and health monitoring needs required the addition of several protocol points.

The IFA natively guarantees an analysis which is:

- dendrometric (number of stems, volume, basal area, species, etc.)
- sanitary (reading only)
- ecological (deadwood)

The added protocol points allow the analysis to be improved:
- sanitary, by observing the crowns thus illustrating the sanitary state by species (DECLINE protocol)[2]
- ecological, through a reading of the dendromicrohabitats (using the WSL pocket guide to dendromicrohabitats)[3].
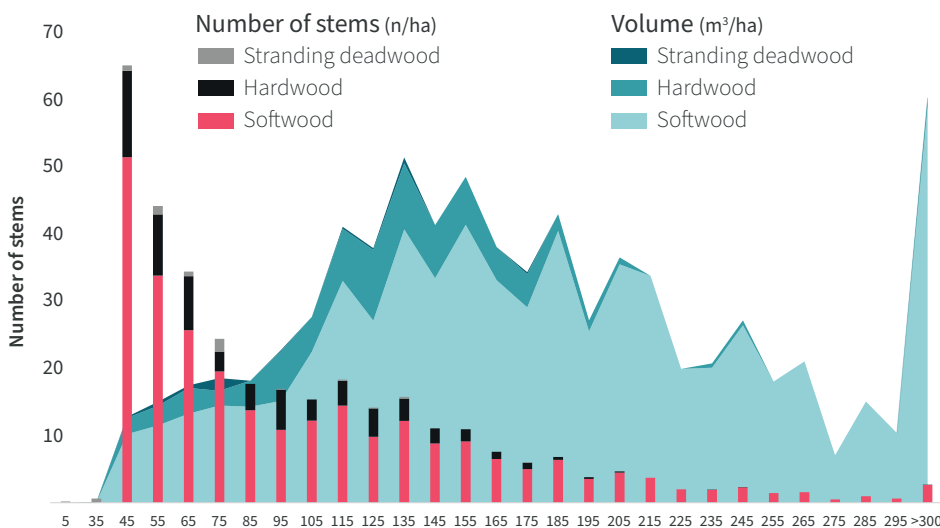

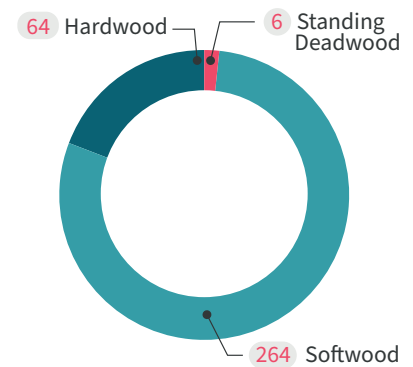*Une placette dans une régénération naturelle résineuse*

The results of the inventory

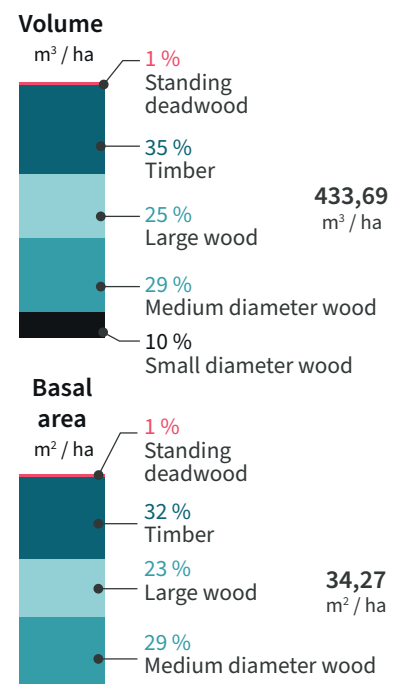### Trees and more trees, but how many?

Le Grand Bois has been managed for many years by directing wood cuts on large mature trees (harvesting) and on low quality trees which free up space for others (improvement). Clearing is avoided as much as possible to preserve the forest atmosphere and the natural dynamics underway. The distribution of the stems by circumference class illustrates a good succession in the dimensions from the youngest to the oldest tree. Even if the Grand Bois is still mostly coniferous, one in five trees is now deciduous. This proportion was achieved thanks to hardwood enrichment and the management by foresters.

64 Hardwood — 6 Standing Deadwood — 264 Softwood

Distribution of the number of stems by type of tree per hectare

Distribution of the number of stems and volume by girth class per hectare

Volume m³ / ha — **433,69** m³ / ha
- 1 % Standing deadwood
- 35 % Timber
- 25 % Large wood
- 29 % Medium diameter wood
- 10 % Small diameter wood

Basal area m² / ha — **34,27** m² / ha
- 1 % Standing deadwood
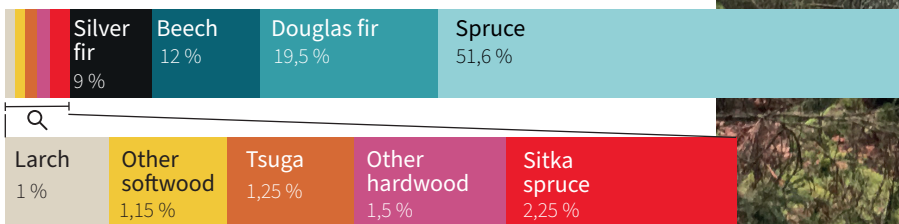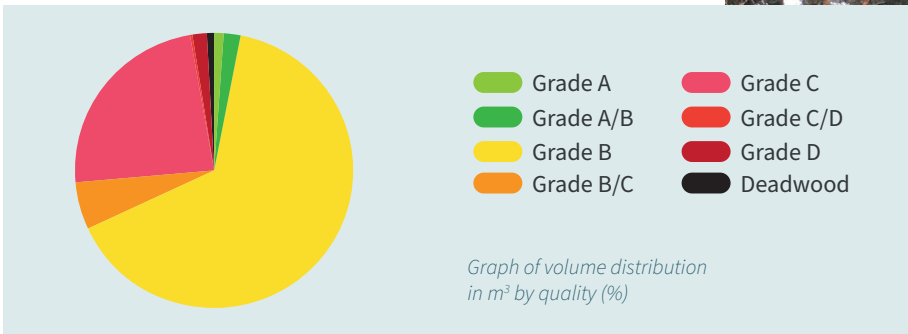- 32 % Timber
- 23 % Large wood
- 29 % Medium diameter wood

Distribution of volume and basal area by size class or status.

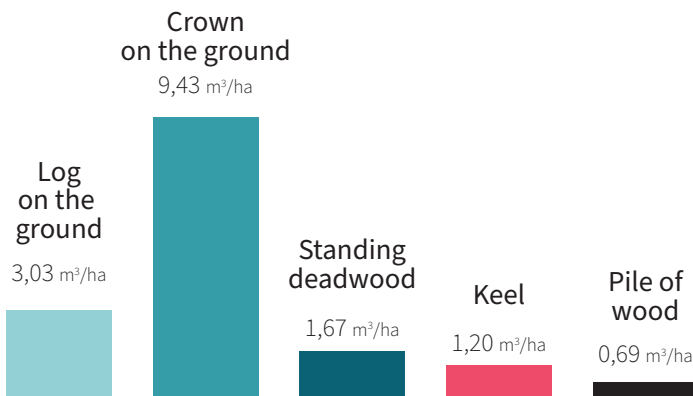# Producing quality wood without neglecting the biological heritage

Even if the majority of trees in the Grand Bois are softwoods intended for the production of wood, there are no less than 22 different species with a light but very useful leafy presence. The inventory shows that deciduous trees provide habitats for bats, woodpeckers, rodents, insects, fungi, etc., and that certain species are dependent on very specific species or structures. These dendromicrohabitats are rare and of great ecological interest, so they are of great importance for the Grand Bois.

Deadwood is also essential for hosting a multitude of animals but above all it allows the forest cycle to be completed by re-incorporating organic matter into the ecosystem. The management choices that have been made in the Grand Bois make it possible to preserve deadwood, both on the ground and standing.
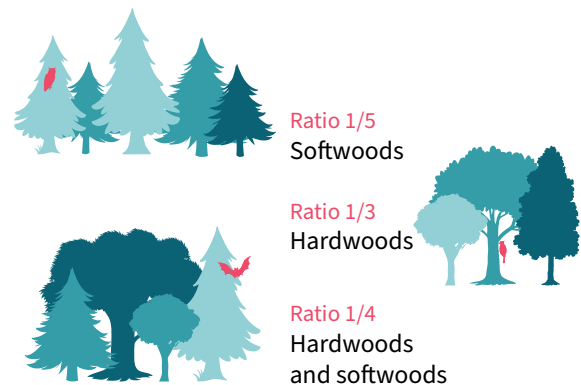
Preserving the habitat for fauna and flora while ensuring the return of organic matter to the ecosystem are two services which are completely compatible with the production of quality wood. The inventory also shows a distribution of quality trees capable of ensuring economic income.

Legend:
- Grade A
- Grade A/B
- Grade B
- Grade B/C
- Grade C
- Grade C/D
- Grade D
- Deadwood

Graph of volume distribution in m³ by quality (%)

| Silver fir 9 % | Beech 12 % | Douglas fir 19,5 % | Spruce 51,6 % |

| Larch 1 % | Other softwood 1,15 % | Tsuga 1,25 % | Other hardwood 1,5 % | Sitka spruce 2,25 % |

Distribution of basal area per hectare of living wood

Log on the ground
3,03 m³/ha

Crown on the ground
9,43 m³/ha

Standing deadwood
1,67 m³/ha

Keel
1,20 m³/ha

Pile of wood
0,69 m³/ha

Distribution of the volume of deadwood by category of deadwood

Ratio 1/5
Softwoods

Ratio 1/3
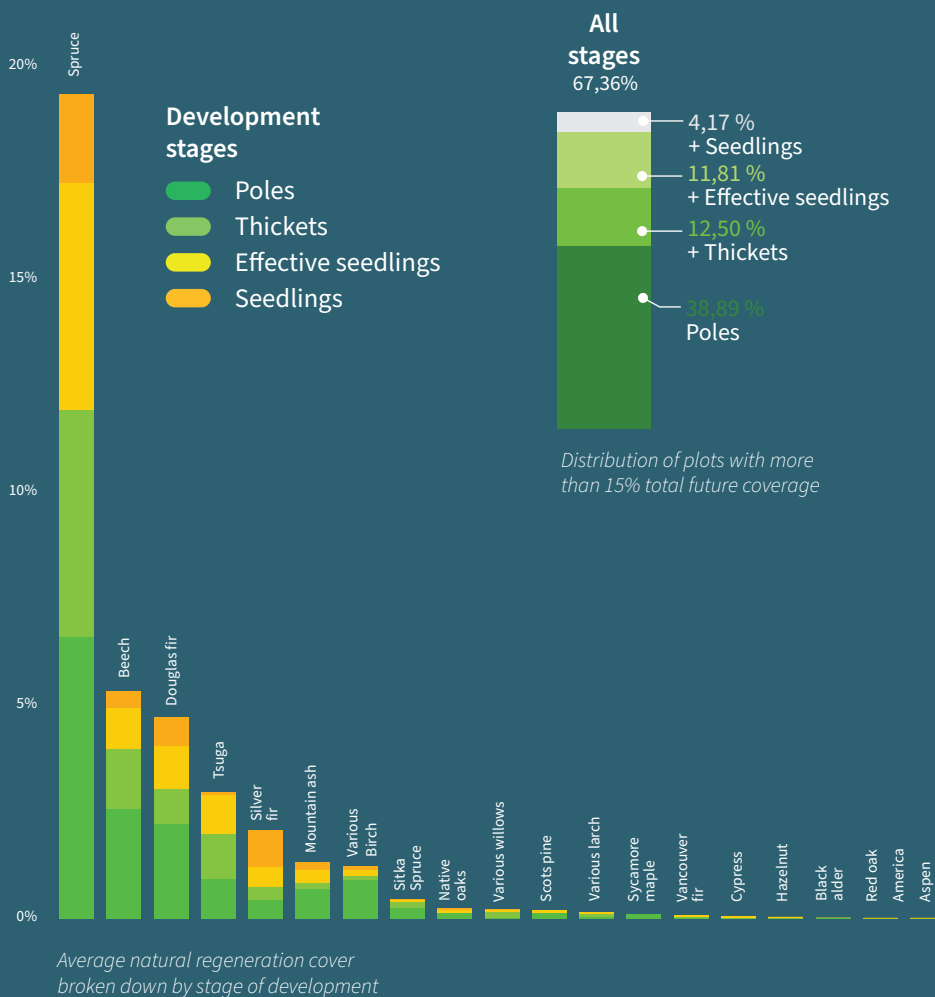Hardwoods

Ratio 1/4
Hardwoods and softwoods

Biological ratio

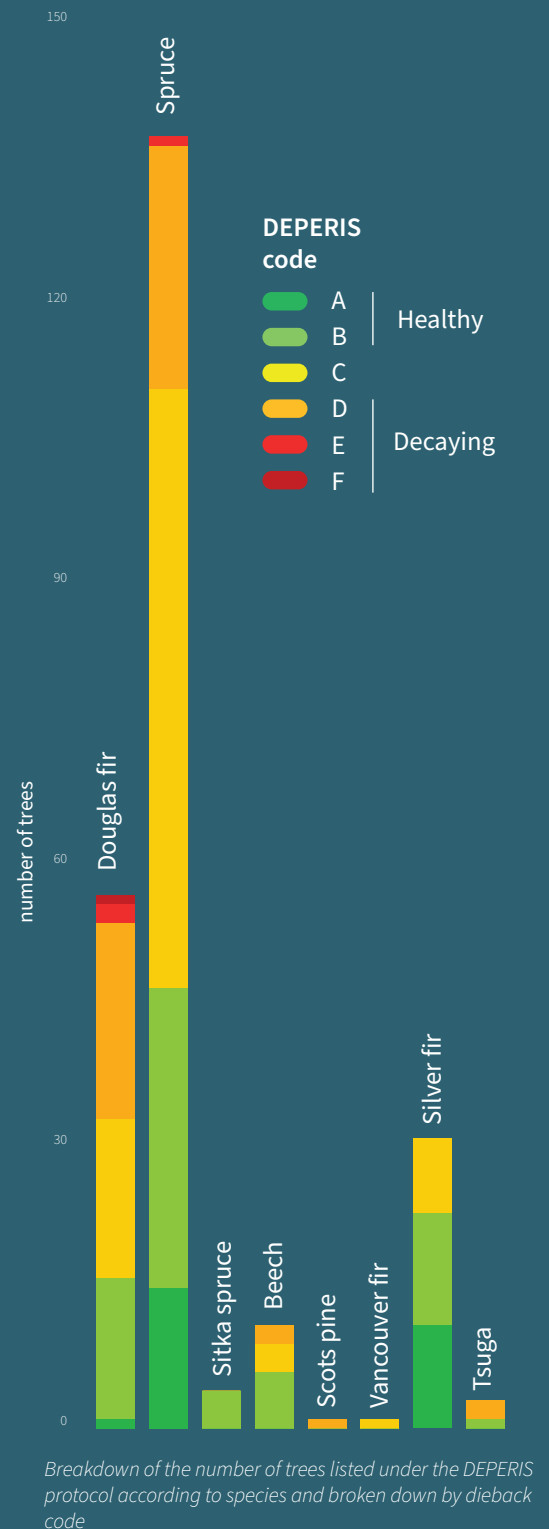# Renewing the forest naturally at first, then with careful planting

In CCF, the natural regeneration of forests is desired to maintain the forest canopy over the long term and to take advantage of the many advantages provided by the continuous forest environment. However, in practice, this type of renewal is not always possible given the diverse and specific behaviour of each species but also the constraints of soils and microclimates. So sometimes we have to supplement or modify the species by planting for many reasons: mismatch between the species and the soil, species of low market value, health risk, etc. Caution is required in the choice of the species introduced, both for the present but also for the future.

The inventory of the health status of the stands has made it possible to produce an overview whereby the interest will involve comparisons with the following inventories. The next measurement campaign will make it possible to analyse the evolution of dieback.

Number of species per plot

Minimum	1
Maximum	13
Average	5

DEPERIS code

A		Healthy
B		
C		
D		Decaying
E		
F		

Development stages

- Poles
- Thickets
- Effective seedlings
- Seedlings

All stages
67,36%

4,17 %
+ Seedlings

11,81 %
+ Effective seedlings

12,50 %
+ Thickets

38,89 %
Poles

Distribution of plots with more than 15% total future coverage

Average natural regeneration cover broken down by stage of development

number of trees

Breakdown of the number of trees listed under the DEPERIS protocol according to species and broken down by dieback code

References.
[1] GxABT. Inventaires forestiers d'aménagement, v1.094.
[2] Protocole DEPERIS d'évaluation des dépérissements forestiers. Ministère de l'Agriculture et de la Souveraineté Alimentaire, France.
[3] Ütler R., Lachat T., Krumm F., Kraus D., Larrieu L. (2020). Guide de poche des dendromicrohabitats. Description et seuils de grandeur pour leur inventaire. 58 p.