Auberive – The intercommunal group for the management of Auberive’s forests

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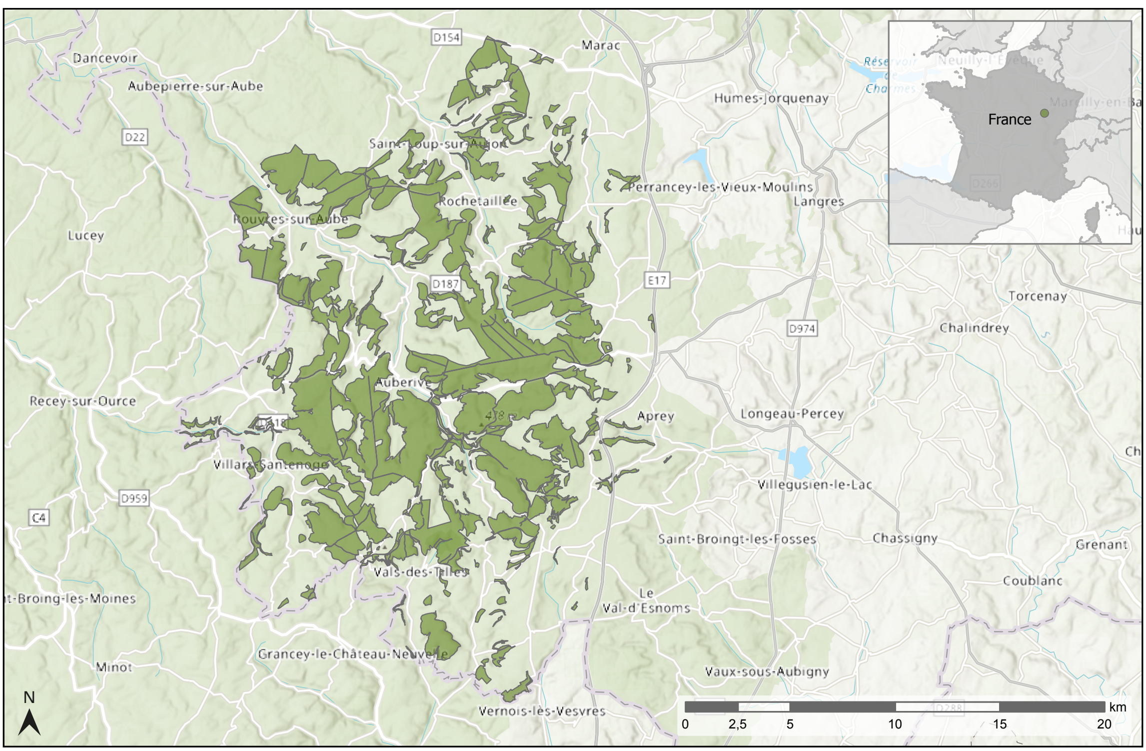
Context, legal frame and ownership structure

The public forest of Auberive comprises more than 16 500 ha of broadleaf-dominated stands. Of this, 8000 ha of the forest belong to several local communities that have decided to mutualise its management and entrust it to the ‘Office National des Forêts’ (ONF; the French national forest service). In 1974, the communities created an association named ‘Syndicat intercommunal de gestion forestière de la région d’Auberive’ (SIGFRA: Associa-



< Fig. C 1.1. Colourful autumn in Auberive. The forests are dominated by broadleaves and represent a rich species portfolio. Many forest areas have historically been managed as coppice with standards (Photo: Jean-Jacques Boutteaux).

Statement

"Continuous cover forest management integrating the economical, ecological and social functions is the main aim of Auberive's forests. Extremely diverse forest types, tree species and forest history lead us to this choice, and towards the production of high quality wood."

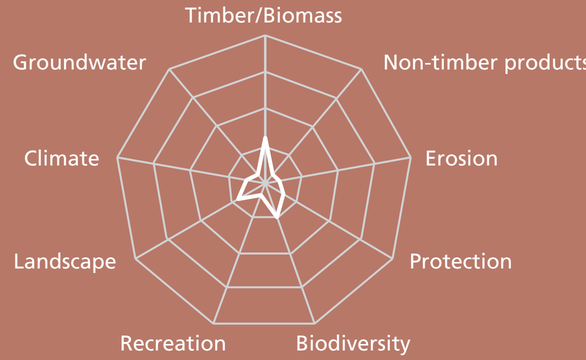


Table C 1.1. General information on the forests of the Auberive public forest.

Forest community	Mixed beech-oak-hornbeam forest, particularly rich in tree species (24 species in total)
Total forest area	16 500 ha, the SIGFRA represents 8030 ha
Main management type	Uneven-aged continuous cover (20 years conversion from coppice-with-standards)
Total volume (2008)	176 m³/ha
Annual growth	4.2 m³/ha
Annual Use (volume harvested)	3.5 m³/ha
Deadwood	
Altitude	300–500 m a.s.l.
Ownership	Local communities
Geology and substrate	Limestone and marls
Protected area (total)	123 ha special forest reserve (two reserves of 76 and 47 ha) 245 ha 'ageing' islands (85 ha set-asides, 160 ha ageing islands sensu stricto). SAC 11 465.5 ha SPA 11 528.2 ha
169 ha Special habitat protection	
Nature protection area (Natura 2000)	410 ha
Protective function	NA

tion of Auberive's municipalities for forest management). SIGFRA was the first association of its kind and is still the biggest one in France today.

The climate is semi-continental, with the average annual precipitation amounting to 900 mm, evenly throughout the year. The elevation ranges from 300 to 500 m a.s.l. Soils types are very diverse: the substrate is made of limestone and marls, but soil types vary considerably with topography, from plateaux, where soils are relatively superficial, to gullies and valleys that can sometimes be quite deep, where soils are deeper.

Historically, the forest was treated as coppice-with-standards until the 1930s. In 1960 and 1980, under the auspices of the 'Fonds Forestier National' (National Forest Fund), the forest was partially planted with conifers – mainly Norway spruce *(Picea abies),* but also silver fir *(Abies alba)* and Douglas fir *(Pseudotsuga menziesii);* currently, these species totalise an area of 700 ha. The rest of the forest is dominated by broadleaves (96 %), notably oaks (*Quercus robur* and *Q. petraea*) and beech *(Fagus sylvatica),* which altogether represent 78 % of the stands. The owners want to maintain tree species diversity, and notably the introduced conifers.

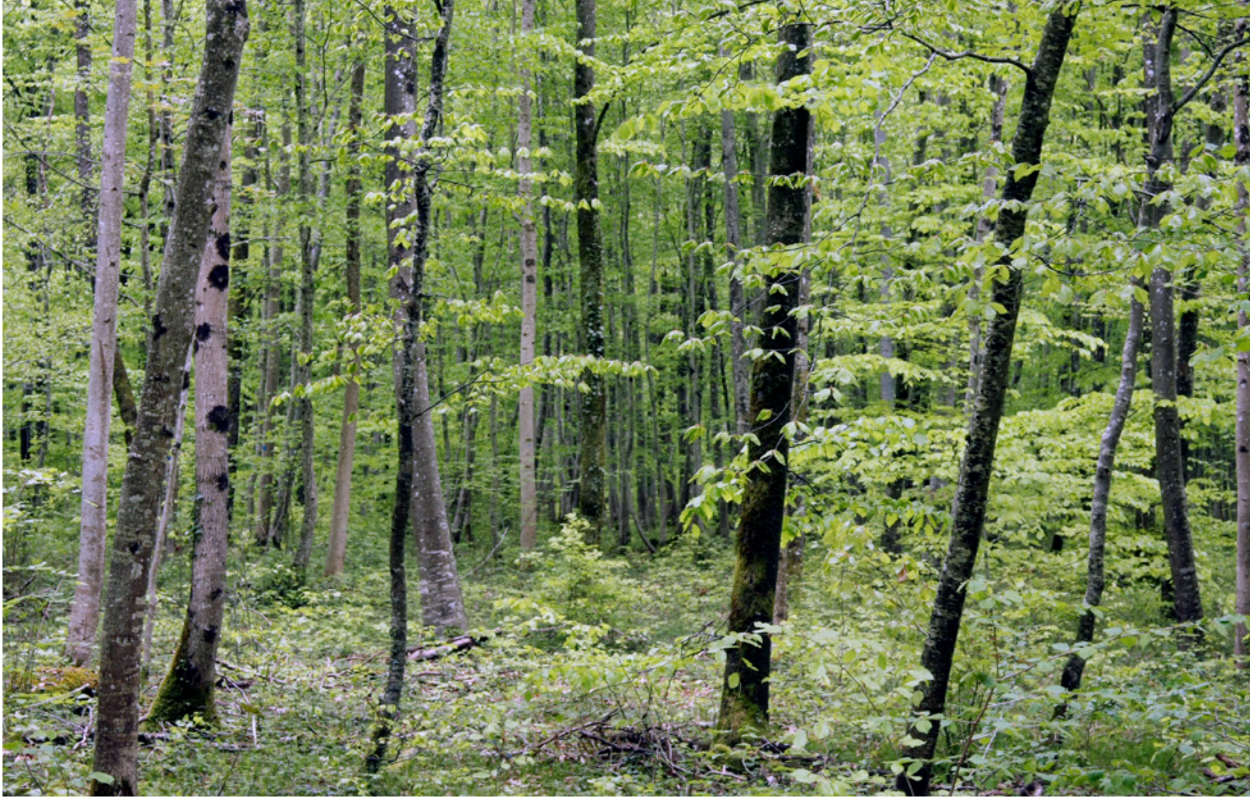


Fig. C1.2. Typical forest stand with small diameters and many different broadleaved species, such as hornbeam (*Carpinus betulus),* ash *(Fraxinus excelsior),* lime (*Tilia* spp.), oak (*Quercus* spp.), maple (*Acer* spp.), and beech *(Fagus sylvatica).*

Management

In the early 1990s, local inhabitants expressed their disapproval and negative opinions about the visible clear cuts. In addition to the aesthetic modification of the landscape, the local councillors advanced an economic argument against the harvesting of young trees with a high potential value. To solve the conflict, the ONF proposed a change in forest management. Consequently, over the last 20 years, forest management was gradually converted towards uneven-aged, continuous cover silviculture, with large and high-quality broadleaves as a main production target. Protection of ecosystems and landscapes was a joint target of the overall management scheme. More precisely, the aim is to favour the dominant indigenous tree species, namely beech, sessile oak *(Q. petraea),* pedunculate oak *(Q. robur),* hornbeam *(Carpinus betulus),* while maintaining secondary tree species that also have a production role – such as maples (*Acer* spp.), rowan *(Sorbus aucuparia),* ash *(Fraxinus excelsior),* lime (*Tilia* spp.). In total, there are at least 24 different tree species (fig. C1.2).

The uneven-aged management concept that has taken place for the last 20 years is based on four main principles:

1. Aiming towards and improving the quality, and therefore value, of individual trees individually, whatever their species, age, spatial distribution and dominance.
2. Ensuring perennial regeneration and renewal everywhere, and notably maintaining the mixture of tree species, ages and dimensions to increase the overall resilience (either ecological or economic).
3. Harvesting trees to optimise the economic return, defined as a compromise between diameter, quality and tree species; the higher the quality, the higher the harvesting diameter.
4. Ensuring optimised and regular revenues, while minimising costs of natural and artificial regeneration. This aim is a consequence of the application of the three previous principles.

The application of these general concepts maintains a continuous cover as well as a constant improvement of the overall value of the trees and timber. The total volume harvested is equivalent to the annual increment; it is assumed that the balance between production and regeneration has been reached.

The evolution of the capital is monitored, at the forest scale, through a network of 1350 permanent plots installed in 1998 and distributed over approximately half of the surface area (managed as uneven-aged). Each plot is measured once every 10 years, and to date, ¾ of the plots have been measured twice, representing more than 3000 ha. Three inventories have been performed: the first took place in 1998–1999, the second in 2007–2009, and the third began in 2016 and is about to be completed. Annual management costs are 17 €/ha while the annual cost of the inventory (including plot set-up, measurement and data management) is estimated at 4.3 €/ha. The results presented here concern only the two first inventory campaigns.

Economy

The equilibrium capital in terms of basal area has been reached and accounts for 14 to 18 m^2/ha. Mean stem density has slightly decreased from 205 stems/ha in 1998 to 191 stem/ha in 2008, while the total commercial volume has increased from 170 m^3/ha in 1998 to 176 m^3/ha in 2008. This is mainly due to an increase of 5 % in the proportion of large trees (diameter at breast height, dbh ≥47.5 cm). To date, a large majority of the harvesting has concerned coppice trees, which were considered over-abundant 20 years ago, and were detrimental for light environment (that should be diffuse and continuous). This annual harvest of coppice trees for firewood, pulpwood and industrial wood amounts to 3–5 m^2/ha (35–60 m^3/ha).

The annual increment in terms of basal area is 0.34 m^2/ha, which corresponds to an annual increase of 4.2 m^3/ha in terms of commercial volume. These values are comparable to those found in similar forest types in the area. Large trees (dbh ≥47.5 cm), mainly beech, account for the majority of the increment (fig. C1.3). This confirms the importance of favouring large high-quality trees to optimise increment, notably in the view of increases in the proportion of the best qualities (A and B) over the last years. This indicates an improvement in terms of quantity and quality (and therefore overall capital value). Between 1998 and 2008, the consumption value – that corresponds to the income theoretically obtained if all the commercial trees would be harvested and sold – has increased by 11 %, to reach 6300 €/ha. In other words, on average, the trees growing today yield a better profit than the trees which grew ten years ago.

The future value is still below the consumption value, since the initial state of the forest – formerly coppice-with-standards with over-abundant coppice – was detrimental to the overall quality and quantity of the regeneration, thus negatively affecting the future value. However, the quality of the regeneration (initial stages) is slowly, but surely, increasing and represents a potential value of 5045 €/ha.

Between 1998 and 2008, the annual mean harvested volume was 3.5 m^3/ha. Since 2003, the proportion of oaks and other broadleaves in the volume of lumber sold has consistently increased from almost 0 % in 2003 to 50 % of the income in 2015. The windstorms Lothar and Martin in 1999 have deeply affected the market for A and B-quality beech. C-quality wood is still valuable, however, and this has been the main production type over the last 10 years. Because of the collapse in beech market prices, the annual balance was sometimes negative. Harvesting targeted towards other tree species has allowed the commercial annual balance to be increased from –9 €/ha to +81 €/ha over the last six years.

Fig. C1.3. Valuable trees bigger than 47.5 cm dbh harvested in stands formerly managed as coppice trees.

Ecology and biodiversity

In total, 1235 ha of the forest are designated as 'Zones Naturelles d'intérêt Ecologique, Floristique et Faunistique') (ZNIEFF; natural areas of ecological, flora and fauna interest), 410 ha are designated as Natura 2000 areas under the European Habitats Directive, and 130 ha are designated as special reserves (mainly calcareous grasslands and marshes). Conservation-oriented management towards these habitats consists of maintenance of these open areas (grasslands and marshes) as well as biodiversity-friendly forest measures. These measures are integrated in the uneven-aged forest management and include the preservation of a multi-layered forest cover, the mixture of tree species and the conservation of habitat trees, in accordance with production objectives.

The density of inventoried and preserved habitat trees is about 1.7 stems/ha with almost half of these dead trees and snags. In addition, trees bearing black woodpecker *(Dryocopus martius)* cavities or raptor nests are mapped and identified during tree designation operations.

A total of 245 ha have recently been designated as 'ageing' islands by the ONF and the local authorities. Ageing islands consist of small areas where there is strictly no harvesting (set-asides, amounting to 85 ha), and also areas where the rotation length is increased by 20 % (ageing islands sensu stricto, amounting to 160 ha).

Finally, the forest is known as a regular nesting site for black stork *(Ciconia nigra)* and provides habitats for other rare species, such as *Hericium coralloides, Cephalanthera rubra*, *Cypripedium calceolus,* and *Lobaria pulmonaria* (fig. C 1.4).

Social and societal aspects

The forest is accessible to the public with several walking, mountain bike and horse trails. However, the frequency of visitors remains relatively low, since the population density of the area is very low

Fig. C 1.4. Many different species with high demands are found in the forest of Auberive: *Ciconia nigra* (a), *Hericium coralloides* (b), *Cephalanthera rubra* (c), *Cypripedium calceolus* (d) or *Lobaria pulmonaria* (e) (Photos: Jean-Jacques Boutteaux).

(4 inhabitants/km²). Social consideration is still quite important: it was originally the reason for the change in forest management. Because of the selective continuous cover clearings, forestry interventions have a very small visual impact and favour the acceptance of harvesting operations and cuttings. Such a cohabitation is necessary since wood production is the primary objective of the forest. Therefore, road and harvesting tracks are numerous, and care needs to be paid to ensure adequate information and notice of harvesting operations.

Resilience

Poles and small trees (dbh <22.5 cm) represent 61 % of the total stem density per hectare. This guarantees an optimal regeneration with a notable increase in the number of future coniferous stems (+82 %). Among this, the number of potential high-quality stems also increases (+2 %) which ensures the adaptation capacities of young trees to react to dedicated interventions. The decrease in the understory and coppice proportion was one of

Fig. C1.5. Different demands in Auberive's forests. Hunting is a popular forest service, represented here by a red deer (a). Habitats for species nesting in tree cavities is gaining more and more attention within society (b) and scenic beautiful spots are popular among hikers and tourists (c). Excursions for foresters but also for the interested public are promoted in the area of Auberive (d) (Photos: Jean-Jacques Boutteaux).

the main objectives over the last two decades, and resulted in a decrease of 40 % of the stem density between 1998 and 2009. The remaining coppices now serve to adjust levels of diffuse light for young future trees. Therefore, coppice and understory trees are maintained at low, but constant, levels through targeted interventions: selective harvesting of coppice, targeting larger individual trees that could be detrimental to the canopy development of standards and large trees. Such interventions allow the maintenance of diffuse light levels, and for the control of herbaceous and semi-herbaceous understory competitors, notably bramble (*Rubus* spp.). This balance between light levels and vegetation control aims at producing straight, branchless, high-quality boles.

Between 1998 and 2009, the density of 50 to 300 cm-high poles has increased by 29 %. These trees are particularly diverse in terms of species, which is reinforced by the management that favours other tree species at the expense of beech: the density of beech with height <1.5 m and height >3 m has decreased by 23 %. As a consequence, no artificial regeneration has occurred over the last 25 years; there has been no need for artificial regeneration, even after the windstorms of 1999.

Conclusion

In this forest, the capital turnover time is 38 years in terms of value and 41 years in terms of volume. This corresponds to the time needed to harvest and renew an equivalent value or standing volume at a given date. These figures show a reasonable management of the existing capital and its constant improvement, and means that the silvicultural system is economically and ecologically resilient; this is important in the face of forthcoming changes – notably climate change.

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