MARTELOSCOPE IN BISSEN

TREE MARKING EXERCISE IN A YOUNG OAK WOODLAND

FORÊT
•NATURE

OCTOBER 2022

CONTENTS

1 INTRODUCTION

1.1 OVERVIEW OF THE BISSEN MUNICIPAL FOREST

The Bissen municipal forest, with a surface area of 549.55 hectares, is managed by engineer Jeannot Jacobs and forestry manager Serge Reinardt of the central-western district of the Administration de la nature et des forêts (Luxembourg).

This continuous cover forestry managed forest is mostly located in the Central Gutland environmental region (altitude varies from about 250 to 350 metres). This forest is composed of both deciduous and coniferous trees of various ages.

The municipality has always owned this forest and it is part of a larger forest with several owners. The plot where the facility is located, at the place called "Paerchen", is a young oak forest resulting from an old coppiced wood. Birch completes the grove with some old beech trees, while hornbeam and again beech form a coppiced wood of about 15 years.

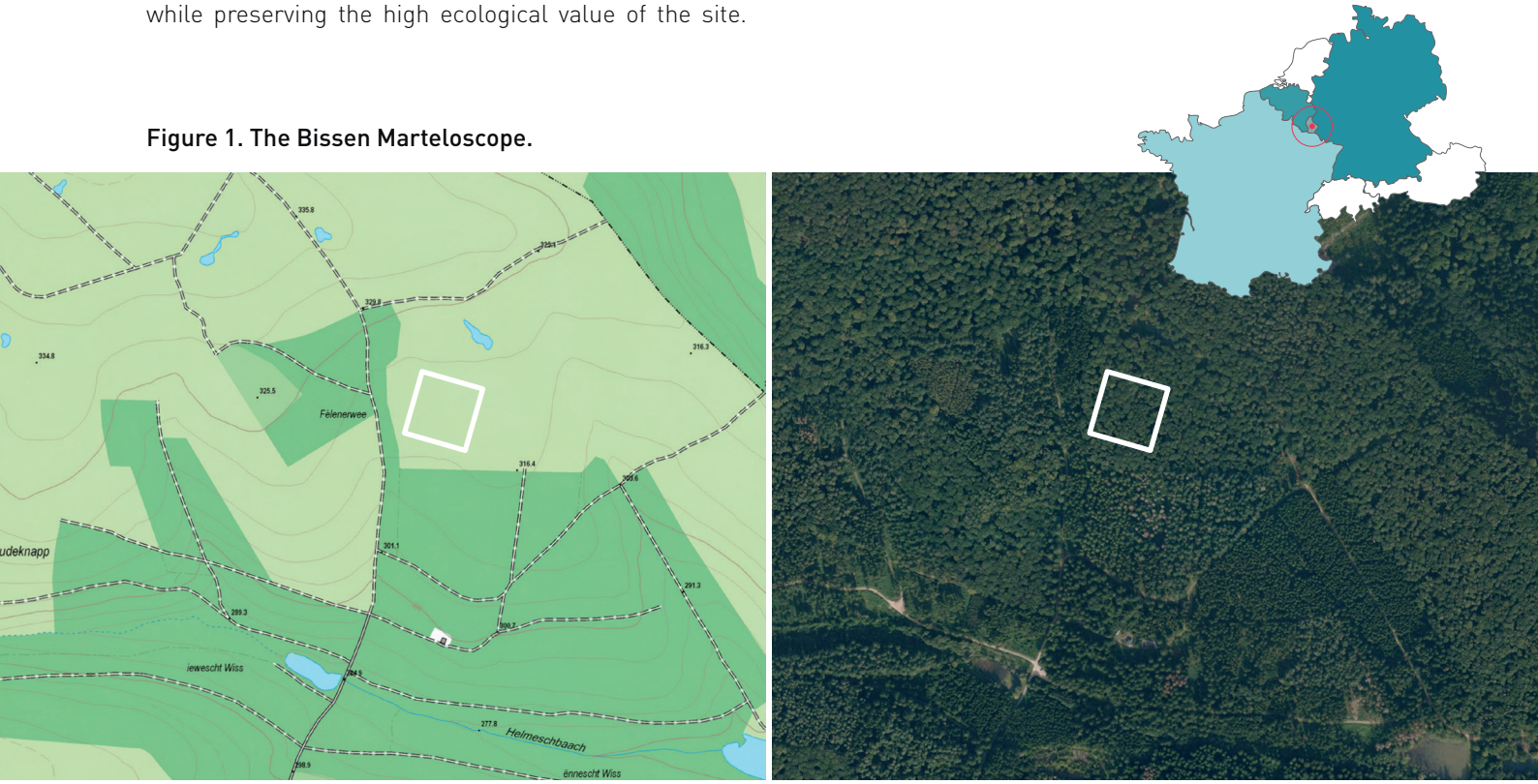
As the plot is young, the aim of the interventions is to develop the stand into a forest producing quality wood while preserving the high ecological value of the site.

The social function of the forest is not neglected and is fully developed with paths, tracks and rest areas (picnic areas, benches, ponds).

Adherence to the principles of mixed management ensures the proper development of the ecosystem and has so far led to the following results:
- the presence of a young, productive two-storey oak forest as a result of coppicing
- the maintenance of a continuous cover to preserve the forest environment
- saving on major investments in thinning, clearing, general pruning and formative pruning work (as this work is carried out in a more targeted manner).

Species such as sycamore, field maple, hawthorn and birch improve species diversity and thus provide direct biological services. Wildlife is very present with wild boar and deer and above all roe deer.

Figure 1. The Bissen Marteloscope.



1.2 THE MARTELOSCOPE

The marteloscope is an exercise area that allows the intensity and nature of each hammerer's strike to be analysed according to different criteria. It is based on a 1 hectare plot, outlined by yellow squares, where all trees are numbered and mapped. The variables taken from each tree surveyed are:

- Species.
- The circumference at 1.3 metres.
- The quality measured per log over the entire length of the log (e.g. quality B over 4 metres then quality C over 5 metres, etc.).
- Various observations (wounds, broken branches, narrow crown, health status, etc.).
- The ecological value of the trees.

All these data are encoded in analysis software produced by AgroParisTech and Pro Silva France.

In this way, the trees in the marteloscope and their numbers can be seen on a map. For the exercise, this map and a list of all the numbered trees, identified by species and circumference, are distributed. The exercise consists in marking a tree, marking on the sheet the tree you are choosing and giving the reason. There are seven possible reasons for removing a tree: improvement, renewal, health, harvest, accommodation, diversity and logging.

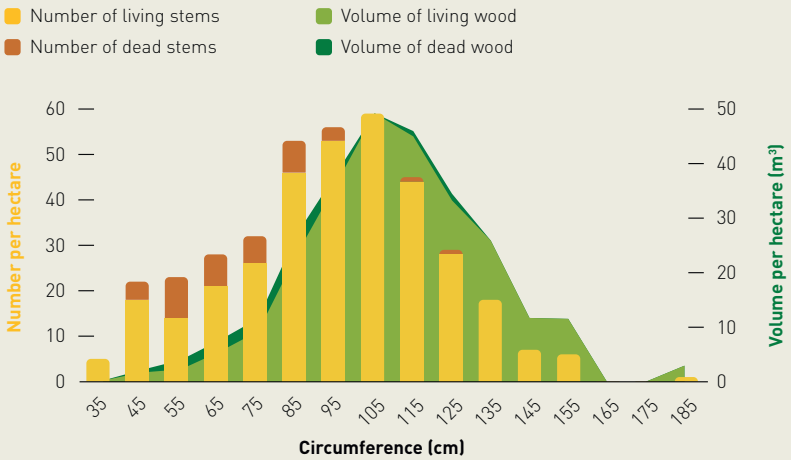
After the exercise, the hammering markings are coded and the results are analysed from a forestry, economic and ecological perspective.

1.3 OVERVIEW OF THE INITIAL STATUS OF THE BISSEN MARTELOSCOPE

Capital-structure

N/ha	G/ha	V/ha	VAM
384	**28,9 m²**	**272,6 m³**	**0,71 m³**

Distribution of number of stems and volume per circumference class (per hectare)



Class C_{130} (cm)	Nb stems	Volume (m^3)
35	5	0,26
45	22	2,20
55	23	4,00
65	28	7,62
75	32	11,63
85	53	27,11
95	56	38,06
105	59	49,22
115	45	45,96
125	29	34,48
135	18	25,89
145	7	11,70
155	6	11,54
165	0	0,00
175	0	0,00
185	1	2,95

Current growth

	Volume
European beech :	7,20 m^3/ha/an
Sessile oak :	0,46 m^3/ha/an
Others :	0,20 m^3/ha/an
Total :	7,86 m^3/ha/an

Ecological aspect

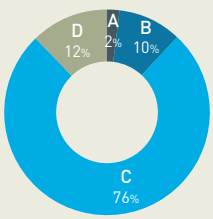
Overall score (/ha) : 494,5

Of which score > 3 : 268,5

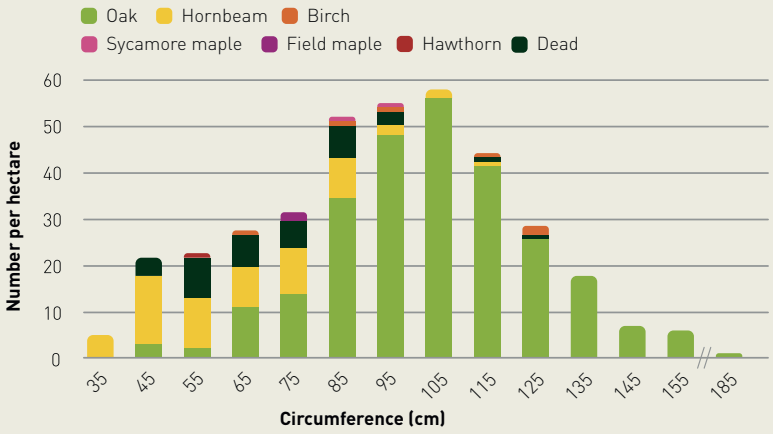
Economical aspect

Funds	6 000 €/ha
Consumption value (CV)	12 690 €/ha
Increase in value (Gain)	557 €/ha/y
Operating rate (Gain/CV)	4,4 %

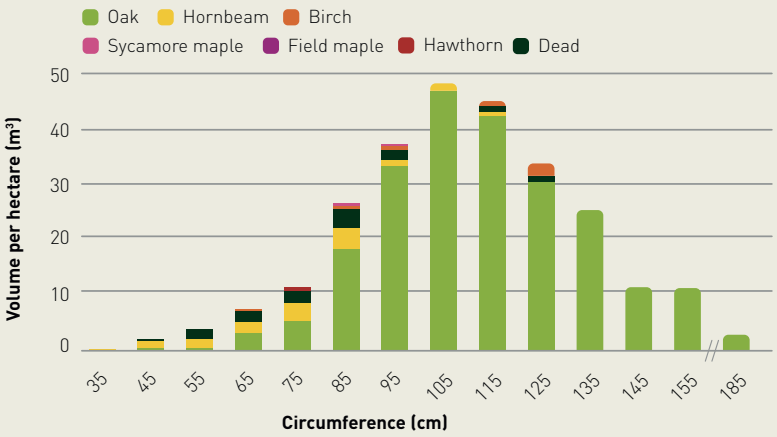
Distribution of volume by quality



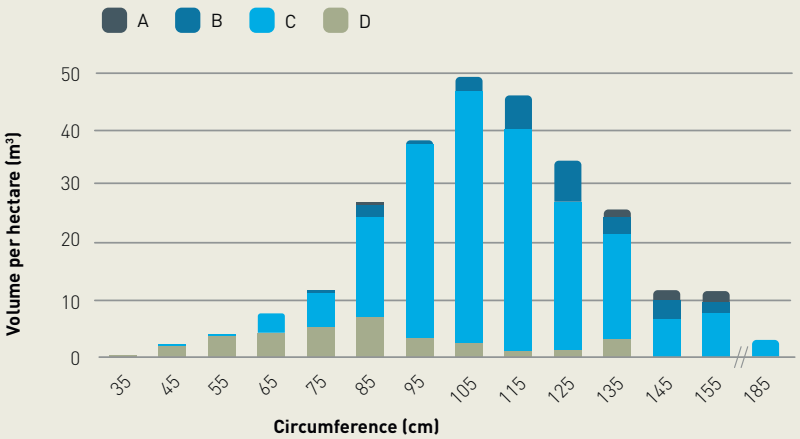
Distribution of the number of stems per species and per circumference class (per hectare)



Volume distribution by species and circumference class (per hectare)



Distribution of volume by quality and circumference class (per hectare)



2 TREE DESCRIPTIONS AND INITIAL DATA

2.1 STANDING TIMBER PRICES (€/M³) BY QUALITY

The price estimation by species, quality and circumference category was based on the standing timber prices from Forêts de France and the average standing timber price list from the Fédération nationale des experts forestiers (Belgium).

2.2 GROWTH IN TREE DIAMETER

Annual increases in circumference are estimated according to figures from the Inventaire Permanent des Ressources Forestières de Wallonie adjusted by growth measurements provided by the sorting staff.

2.3 ENVIRONMENTAL RATING

The ecological rating used in the tree inventory comes from a study in the Vosges du Nord Regional Nature Park. On this occasion, a table containing a series of criteria makes it possible to estimate the ecological value of a tree in the form of a score. This table is a key that allows a tree to be assigned one or more codes and these codes are then transformed into scores. When a tree has two or more criteria, it is given the sum of the corresponding scores by category (bats, birds, insects, plants).

2.4 TREE QUALIFICATION KEY

Species qualification keys were used to estimate tree quality by species and category. These keys are based on European standards for grading standing timber. The criteria used for wood > 90 cm are the classic defects and anomalies (fork, knots, epicormic shoots, curvature, spiral grain, frost crack, etc.). On the other hand, for poles (20-40 cm) and small wood (40-90 cm), these are potential quality criteria: straightness, dominance, well-developed crown, etc. (classic knots and defects are less important).

3 ANALYSIS TOOLS

3.1 REVIEW OF FORESTRY VALUATION INVOLVED IN THE ANALYSIS OF THE ECONOMIC ASPECT

A tree can be characterised by a number of economic criteria:

• The *consumption value* is the instantaneous market value, i.e. the revenue obtained if the wood is sold immediately. It is the product of the unit price and the volume. In the case of trees with several qualities, it corresponds to the sum of the values of each of the logs.

• The *annual gain* reflects the annual increase in value of the tree. It includes its increase in volume and the resulting increase in unit price. This calculation is made at constant quality.

• The *operating rate* is the ratio of the gain to the consumption value.

• The *potential value* is a theoretical value for estimating the future value of the stand. It is obtained by dividing the gain by a discounting rate (θ) chosen on the basis of operating rates currently observed on similar stands which are close to an optimal state.

This rate is fixed in advance (3-4% being the values commonly observed in irregular stands and allowing the balance between consumption value and potential value to be obtained). This rate is by convention the same for all trees in a plot. This notion of potential value is equivalent to the notion of future value of regular stands, except that the calculation methods differ (in the case of irregular and continuous stands, there is no notion of logging age).

• The *potential loss of value* is the difference between the potential value and the consumption value (in case of premature logging).

Calculation formulas:

• Consumption value: CV = UP. V ;

• Gain: Gain = CV. ID. (Relative change in UP and V as D increases)

i.e., Gain = d CV/dt = CV. dD/dt. (dUP/UP + dV/V) / dD;

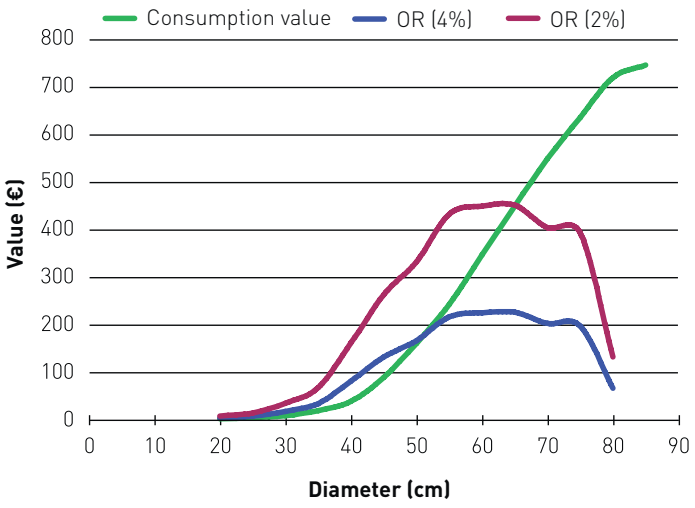
• Potential value: VP = Gain / θ

UP	*unit price*
V	*volume*
ID	*increase in diameter*
D	*diameter at 1.3 m*
θ	*discounting rate*

Estimates of potential value and consumption value can be made tree by tree. The graphic in Figure 2 gives an example of the evolution of the potential value (PV) and consumption value (CV) of an oak tree (unit price) as a function of diameter and two different discounting rates (θ) (2 and 4%).

When the potential value, i.e. the future value of the tree, is equal to the consumption value, it is more interesting to cut the tree than to leave it. The tree has, in fact, reached the end of its exploitable life. It can also be seen that the higher the discounting rate chosen, the smaller the exploitable diameter.

Figure 2. Example of the evolution of the potential value (PV) and consumption value (CV) of an oak tree (price per cubic metre) as a function of diameter and two different operating rates (θ) (2 and 4 %)



3.2 FIGURES

Figure 3. Chart of consumption value and ecological scores of trees in the Bissen Marteloscope.

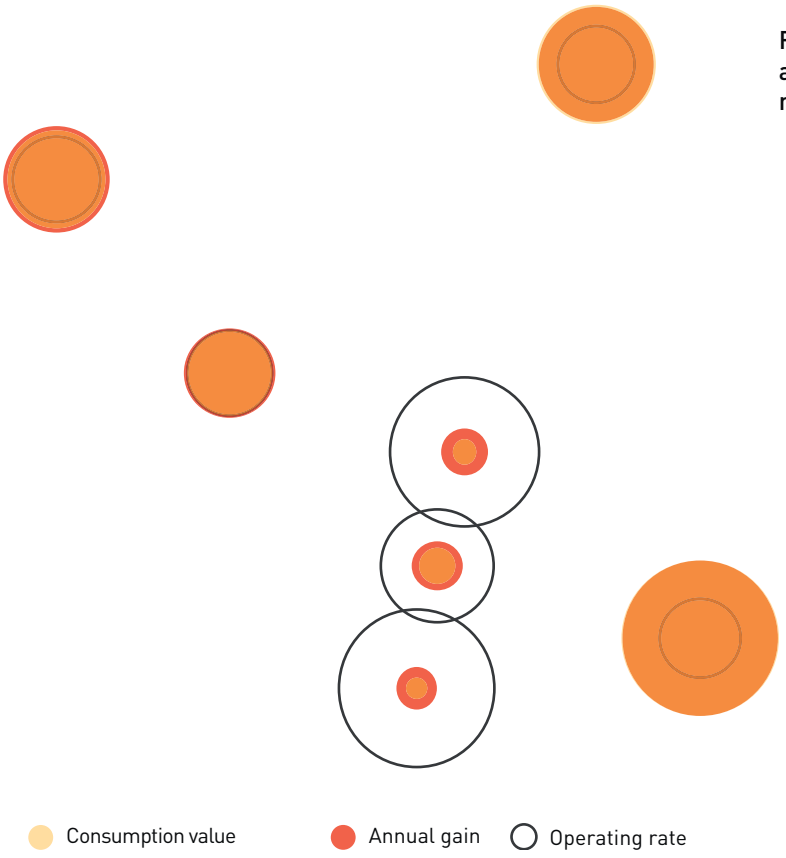


Figure 4. Chart of the consumption value, annual gain and operating rate of the Bissen marteloscope trees

4 FORESTRY

4.1 MANAGEMENT IN IRREGULAR DECIDUOUS FORESTS

The management of high-quality trees and their management up to their exploitable size must be the driving and priority principles of mixed forestry.

The occurrence and development of natural regeneration is not an objective as such but a consequence of the particular microclimate induced by proper management of the forest and understorey. If the rules of irregular forest management are respected (insert 2) and the density of game is in balance with the forest, then the seedlings of beech, oak and companion species (maple, birch, rowan, etc.) are able to appear and develop, depending on the existing seed trees. Natural seedlings will mainly grow in place of mature trees or trees that no longer have any function (utility). A logging sacrifice will never be made on a young tree that has a significant increase in value for the development of the seedling.

There is no longer any talk of regeneration methods (progressive cutting, etc.), nor of creating large gaps (> 10 acres) and even less of widening them in favour of seedlings. Maintaining an optimal level of stand capital (depending on the proportion of light sources), removing growth, controlling understorey and harvesting large mature wood, provides sufficient light for the continued development of the seedling. This management provides diffused and filtered light allowing for significant height differentiation of the dominant elites, reduction of forking problems, efficient natural pruning and limitation of competing semi-wooded vegetation.

The well-balanced treatment in continuous cover forestry creates diffuse light, which is particularly favourable to the development of seedlings, but reduces direct light, which is favourable to the growth of bramble.

In this way, regeneration (from seedlings to poles, diameter < 17.5 cm) covers 10-15% of the area (divided into small areas), ensuring sufficient sustainability of the forest.

Within the framework of the management of the diffuse and filtered light necessary for the correct development of the seedling, particular attention should be paid to maintaining the understorey situated to the east, south and west of the seedling. The sun's rays are more often oblique than vertical (Figure 5).

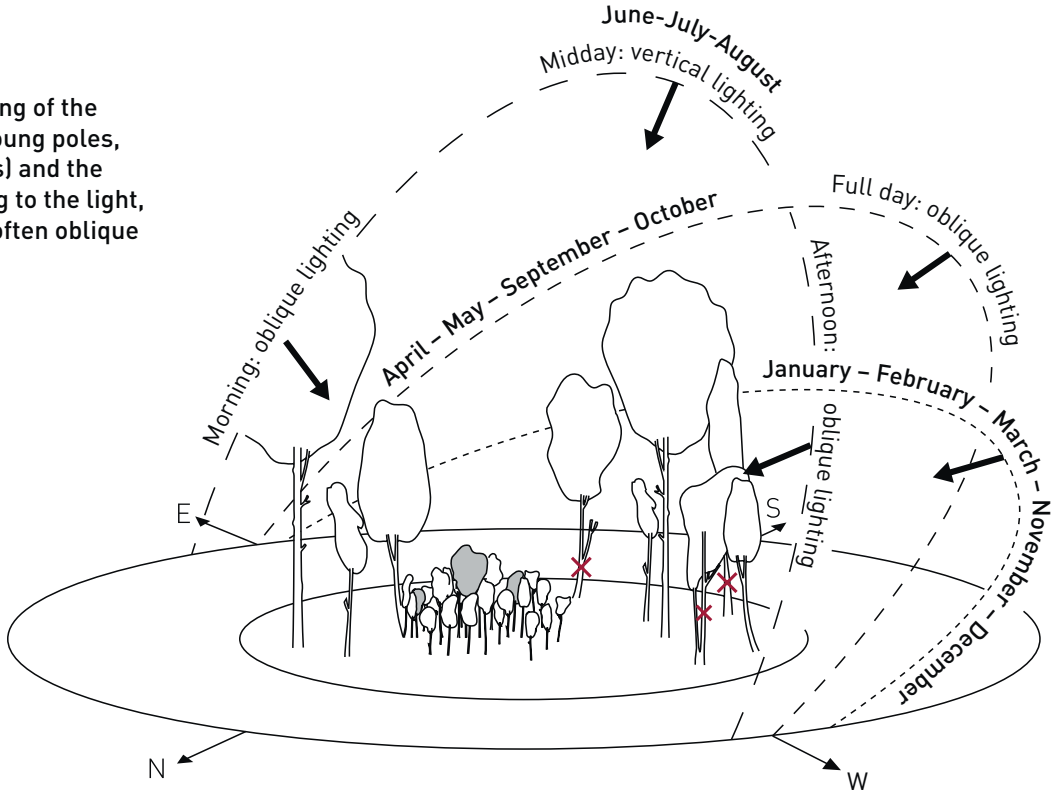


Figure 5. Marking of the understorey (young poles, coppice strands) and the forest according to the light, which is more often oblique than vertical.

In terms of frequency, the most effective way is to switch to short rotations. Today, however, management is often carried out in such a way that in Ardennes beech-oak forests the cutting rotation is fixed at 12 years. In this case, marking is carried out at quarter and three-quarter rotation for small wood and coppices and at rotation for medium and large wood. For 8-year rotations, the understorey and small woods are marked every 4 years and the rest in rotation.

Therefore, by progressively harvesting poor quality and non-functioning trees, the vitality of the stand is improved while increasing the proportion of economic and ecological quality trees and the value of the stand.

4.2 QUALITY MANAGEMENT AND TREE MARKING

OBJECTIVE OF TREE MARKING

The objective of tree marking in irregular deciduous forest is above all to manage quality. This means maximising the production of quality large wood and minimising the production of medium and small wood, without compromising the sustainability of the stand.

Managing quality also means favouring stems that fulfil other functions, such as protecting quality trees, raising seedlings, conserving biodiversity, etc.

Insert 1.
Example of lengthening:

1. In the case of beech, observing the lengthening and the general shape of the seedlings makes it possible to "quantify" the light:
- Excessive light: lengthening beyond 50/60 cm, presence of polycyclism, reduced branch insertion angle, seedlings with several heads
- Insufficient light: lengthening to 20/30 cm, seedlings bending
- Correct light: lengthening of about 40 cm, insertion of branches perpendicular to the axis

2. In the case of oak, lengthening below 20 cm seems to compromise the future and quality of young trees.

Insert 2.
The four main rules of marking in irregular deciduous forestry

1. Maintain the optimal standing capital of the forest*. Harvest valuable trees per foot and only at their harvestable size. Thinning the forest from above. Give preference to quality trees in all categories.

Growing capital levels for the establishment and development of oak and beech seedlings (given in basal area (diameter of wood measured from 17.5 cm) after pruning in irregular beech-oak stands):
- oak seedlings: 12–15 m^2/ha
- beech seedlings: 14–17 m^2/ha

2. Remove the growth at each rotation. As a general rule, per procedure, remove 15-25% of the standing capital in G and volume: 15% for short rotations (8 years), 25% for long rotations (12 years). In overcapitalised stands, where stem quality and renewal are compromised, temporary de-capitalisation should be carried out to gradually bring the capital back to its optimal level. In this case, it is recommended to switch to mid-rotation to have the most gradual decrease possible.

3. Encourage a mixture of light and shade species.

4. Lighten the understorey** to:
- Either clear the crowns of valuable trees
- Or remove the crowns of the poles and the small wood of the future
- Or provide filtered light to the seedlings.

That is, to the east, south and west of this seedling, thin the understorey from above, while maintaining tiering at all levels from the ground

In coppice stands, the "coppice selection" technique will be applied: harvesting mainly of the largest branches of the stands (1 in 2 or 1 in 3). On average, less than 4 m^2/ha of understorey (for stems between 7.5 cm and 17.5 cm in diameter) will be retained.

** The forest is made up of small wood (SW), medium wood (MW), large wood (LW) and very large wood (VLW).*
*** The understorey includes all the woody vegetation, which is smaller than the small woods: thickets, saplings, poles, shrubbery, coppices.*

TREES TO CUT

Cutting in irregular forests serves several different purposes.

Harvesting. Harvesting is the removal of mature timber at its maximum economic value, before it begins to depreciate. We harvest:
- quality trees that have reached or exceeded their exploitable circumference;
- quality trees (timber grade) that are likely to depreciate in the next rotation.

The harvesting of large trees is carried out as a priority where it brings to light seedlings or future trees.

A tree is maintained as long as its commercial value increases, i.e. it is of good quality and its vitality is strong. Trees of good quality and vitality can be reserved beyond their exploitable size if they are not likely to depreciate until the next rotation.

Enhancement (or trimming). Improvement cutting consists of removing trees that hinder the development of the crowns of high-quality target trees, which have reached the height of a knot-free log (between 6 and 10 metres depending on the species and the site). It also involves removing trees that interfere with the crown of medium and large quality trees.

Renewal (regeneration). Renewal cutting consists of removing trees of low economic or ecological value, or those that have reached the end of their life span, to allow the lighting of new growth, whose height growth, qualification and differentiation must be stimulated.

Insert 3. The best marking

Is that which:
- Returns the standing capital to its optimum (G optimum).
- Gives the owner the best return while leaving the best productive capital and the most ecologically valuable trees after the cut.

Insert 4. Avoid

- Enlarge the gaps to extend the sowing range. This is because there is a risk of harvesting wood before the end of its life. In addition, direct sunlight is increased, which is unfavourable to the development of the seedling.
- Assume that a seedling is acquired only if it is in a dense "brush" over several acres. It is therefore not only necessary to wait for the strong growths to regenerate the forest, but to take advantage of all the seedlings on a regular basis.

Insert 5. Some instructions for marking in irregular woodland

- Start to identify the finest woods, choose between them, and thin out in favour of the finest. Not just hammering out the bad ones.
- Prioritise the harvesting of large mature timber in order to harvest a large volume with little wood and provide a lot of revenue without damaging the future capital.
- Harvest valuable, injured or decaying trees before they depreciate.
- If you have a choice, start harvesting the large, mature wood that emerges from the seedling.
- Divert quality poles.
- Thin out the small and medium quality woods by cutting from the larger woods of lesser quality (do not cut a 120 cm circumference of quality B for a 180 cm of quality C but the opposite).
- Avoid harvestability sacrifices such as removing an A or B grade oak with a circumference of 120 cm in favour of a future pole or seedling.
- Avoid thinning medium and large high-quality wood between them, it is too late, they will no longer react sufficiently to the thinning. It is therefore preferable that these woods are all driven to fruition.
- Mark the tree that will thin out the most neighbouring trees.

Special cases

A quality ash tree with a circumference of 140 cm is close to an oak tree of 250 cm. Neither is hammered. Indeed, an oak at this stage does not react much to thinning, so you can choose to keep the ash for one more rotation so that it reaches a more 'saleable' 150 cm.

Comments
- A wood of 240 cm in circumference corresponds to 0.5 m^2 of basal area.
- < 100 cm circumference, firewood; > 120 cm, marketable wood

Sanitation. Sanitary cutting consists of removing diseased or dangerous trees.

Diversity. Diversity cutting consists of removing a tree in favour of an ecological niche or the diversity of shrub or tree species (mixture proportioning).

Accommodation (landscape). An accommodation cut is the removal of a tree to enhance the aesthetics of the site, to open up a view and to thin out an outstanding tree.

Harvesting. Logging is the removal of a tree to create a felling track or to facilitate felling or skidding.

TREES TO CONSERVE

Production. Medium to large quality wood that is likely to increase in value is retained.

Education. Trees that nurture young stems in the qualification phase are retained. Indeed, in semi-darkness, the differentiation between dominant and dominated stems is strengthened, plant competition is reduced and natural thinning and pruning is improved.

Environmentally friendly. Trees hosting various living creatures (birds, bats, insects, fungi) are preserved. These are decaying trees, hollow trees, trees with pecked holes or bark peeling, trees with large dead branches or cracks. This type of tree is mainly sought in those with a low potential or market value. Dead trees and rare species are also preserved.

Trees can be maintained to keep the dead wood on the ground moist to support the host micro-organisms.

Protection. Trees that protect growing production trees from windfall, haulage damage, epicormic shoots and bark burn are retained.

Seeding trees. Seeding trees are preserved, especially for rare species, to ensure their sustainability.

Aesthetics. Trees are retained for their exceptional size, shape or history.

Harvestability of species
(in circumference and cm)

The size of harvestability varies according to species and quality. This criterion does not have to be met rigidly. Each species achieves its own dimension of harvestability depending on its quality, vitality, health status or ecological value. For production purposes, the longer a tree is kept, the better its quality and the better its growth.

An injury to a quality tree can hasten its harvest. On the other hand, a quality oak, full of vitality and not at risk of depreciation, can easily be harvested beyond its term. In quality hardwoods, the larger the tree, the greater its volume and therefore its value. For example, an A-grade maple growing from 150 cm in circumference to 210 cm in circumference doubles its volume and increases in value by three times.

Example of harvestable circumference (cm)
for a tree with a developed crown: :

	Circumference by quality (cm)			
	A	B	C	D
Oak	>250	> 220	180-210	Unrestricted if useful
Sycamore maple	> 180	> 150	130-150	
Birch	140-160	120-140	100-120	
Hornbeam	140	120	90	
Field maple, hawthorn	>130	110-130	90-100	

5 TREE MARKING RECORDS

Date :

Team :

* **Reasons :**
Improvement : 1
Renewal : 2
Sanitation : 3
Harvesting : 4
Accommodation : 5
Diversity : 6
Exploitation : 7

Cutting (X)	Reasons*	Tree number	Species	Circ. (cm)	Observations
		1	Oak	102	
		2	Oak	108	
		3	Oak	92	
		4	Oak	141	
		5	Oak	130	
		6	Oak	115	
		7	Oak	92	
		8	Oak	86	
		9	Hornbeam	88	
		10	Hornbeam	46	
		11	Oak	101	
		12	Hawthorn	50	
		13	Oak	120	
		14	Oak	157	
		15	Oak	125	
		16	Oak	79	
		17	Oak	74	
		18	Oak	62	
		19	Oak	132	
		20	Oak	105	
		21	Oak	129	
		22	Oak	101	
		23	Oak	142	
		24	Oak	189	
		25	Oak	72	
		26	Oak	105	
		27	Oak	92	
		28	Oak	92	
		29	Oak	96	
		30	Oak	96	
		31	Oak	89	
		32	Oak	134	
		33	Oak	137	

* **Reasons :**
Improvement : 1
Renewal : 2
Sanitation : 3
Harvesting : 4
Accommodation : 5
Diversity : 6
Exploitation : 7

Cutting (X)	Reasons*	Tree number	Species	Circ. (cm)	Observations
		34	Oak	49	
		35	Oak	98	
		36	Oak	70	
		37	Oak	148	
		38	Oak	88	
		39	Hornbeam	91	
		40	Oak	125	
		41	Oak	114	
		42	Oak	81	
		43	Oak	64	
		44	Field maple	70	
		45	Oak	102	
		46	Oak	74	
		47	Oak	145	
		48	Oak	136	
		49	Hornbeam	65	
		50	Oak	120	
		51	Oak	68	
		52	Field maple	76	
		53	Oak	99	
		54	Oak	94	
		55	Oak	88	
		56	Oak	86	
		57	Oak	134	
		58	Oak	115	
		59	Oak	87	
		60	Oak	58	
		61	Oak	127	
		62	Oak	86	
		63	Oak	110	
		64	Oak	152	
		65	Oak	55	
		66	Oak	57	
		67	Oak	105	
		68	Oak	121	
		69	Oak	84	
		70	Sycamore maple	90	
		71	Oak	87	
		72	Oak	122	
		73	Oak	138	
		74	Oak	70	

* **Reasons :**
Improvement : 1
Renewal : 2
Sanitation : 3
Harvesting : 4
Accommodation : 5
Diversity : 6
Exploitation : 7

Cutting (X)	Reasons*	Tree number	Species	Circ. (cm)	Observations
		75	Oak	98	
		76	Oak	105	
		77	Oak	57	
		78	Oak	134	
		79	Oak	125	
		80	Oak	84	
		81	Oak	61	
		82	Oak	85	
		83	Oak	103	
		84	Oak	101	
		85	Oak	81	
		86	Oak	105	
		87	Oak	100	
		88	Oak	121	
		89	Oak	103	
		90	Oak	111	
		91	Oak	86	
		92	Oak	94	
		93	Oak	119	
		94	Oak	68	
		95	Oak	91	
		96	Oak	101	
		97	Oak	67	
		98	Oak	64	
		99	Oak	87	
		100	Oak	42	
		101	Oak	72	
		102	Oak	103	
		103	Oak	93	
		104	Oak	126	
		105	Oak	116	
		106	Oak	108	
		107	Oak	107	
		108	Oak	115	
		109	Oak	47	
		110	Oak	144	
		111	Oak	108	
		112	Oak	95	
		113	Oak	95	
		114	Oak	119	
		115	Hornbeam	51	
		116	Hornbeam	79	

* **Reasons :**
Improvement : 1
Renewal : 2
Sanitation : 3
Harvesting : 4
Accommodation : 5
Diversity : 6
Exploitation : 7

Cutting (X)	Reasons*	Tree number	Species	Circ. (cm)	Observations
		117	Hornbeam	60	
		118	Hornbeam	55	
		119	Hornbeam	75	
		120	Oak	106	
		121	Oak	99	
		122	Oak	123	
		123	Oak	131	
		124	Oak	91	
		125	Oak	67	
		126	Oak	53	
		127	Oak	98	
		128	Oak	112	
		129	Oak	117	
		130	Oak	75	
		131	Oak	120	
		132	Hornbeam	71	
		133	Oak	117	
		134	Oak	94	
		135	Oak	138	
		136	Hornbeam	45	
		137	Hornbeam	76	
		138	Hornbeam	45	
		139	Hornbeam	42	
		140	Hornbeam	31	
		141	Hornbeam	39	
		142	Hornbeam	40	
		143	Oak	88	
		144	Oak	113	
		145	Oak	106	
		146	Oak	125	
		147	Oak	110	
		148	Oak	83	
		149	Oak	93	
		150	Oak	142	
		151	Oak	112	
		152	Oak	103	
		153	Oak	68	
		154	Oak	57	
		155	Oak	124	
		156	Oak	66	
		157	Oak	117	
		158	Oak	119	

* **Reasons :**
Improvement : 1
Renewal : 2
Sanitation : 3
Harvesting : 4
Accommodation : 5
Diversity : 6
Exploitation : 7

Cutting (X)	Reasons*	Tree number	Species	Circ. (cm)	Observations
		159	Oak	122	
		160	Oak	75	
		161	Oak	97	
		162	Oak	70	
		163	Oak	99	
		164	Oak	116	
		165	Oak	117	
		166	Oak	85	
		167	Birch	86	
		168	Oak	47	
		169	Birch	117	
		170	Oak	47	
		171	Birch	125	
		172	Oak	116	
		173	Oak	117	
		174	Oak	122	
		175	Hornbeam	60	
		176	Hornbeam	70	
		177	Oak	95	
		178	Oak	106	
		179	Oak	110	
		180	Oak	67	
		181	Oak	108	
		182	Oak	120	
		183	Hornbeam	89	
		184	Oak	117	
		185	Oak	55	
		186	Oak	99	
		187	Oak	45	
		188	Oak	101	
		189	Hornbeam	70	
		190	Oak	78	
		191	Oak	133	
		192	Oak	139	
		193	Oak	135	
		194	Oak	119	
		195	Oak	94	
		196	Birch	90	
		197	Oak	116	
		198	Oak	99	
		199	Oak	79	
		200	Hornbeam	53	

* **Reasons :**
Improvement : 1
Renewal : 2
Sanitation : 3
Harvesting : 4
Accommodation : 5
Diversity : 6
Exploitation : 7

Cutting (X)	Reasons*	Tree number	Species	Circ. (cm)	Observations
		201	Oak	69	
		202	Hornbeam	45	
		203	Hornbeam	55	
		204	Hornbeam	59	
		205	Hornbeam	43	
		206	Oak	94	
		207	Oak	133	
		208	Oak	108	
		209	Oak	124	
		210	Oak	122	
		211	Hornbeam	53	
		212	Hornbeam	44	
		213	Hornbeam	42	
		214	Hornbeam	45	
		215	Birch	65	
		216	Oak	85	
		217	Hornbeam	38	
		218	Hornbeam	43	
		219	Hornbeam	35	
		220	Hornbeam	45	
		221	Oak	111	
		222	Oak	151	
		223	Oak	83	
		224	Oak	98	
		225	Hornbeam	109	
		226	Oak	81	
		227	Oak	99	
		228	Oak	89	
		229	Oak	81	
		230	Oak	106	
		231	Oak	130	
		232	Hornbeam	84	
		233	Oak	72	
		234	Oak	100	
		235	Hornbeam	82	
		236	Oak	110	
		237	Oak	125	
		238	Oak	105	
		239	Oak	83	
		240	Oak	110	
		241	Oak	99	
		242	Oak	86	

* **Reasons :**
Improvement : 1
Renewal : 2
Sanitation : 3
Harvesting : 4
Accommodation : 5
Diversity : 6
Exploitation : 7

Cutting (X)	Reasons*	Tree number	Species	Circ. (cm)	Observations
		243	Hornbeam	101	
		244	Oak	86	
		245	Hornbeam	99	
		246	Oak	107	
		247	Hornbeam	80	
		248	Hornbeam	51	
		249	Hornbeam	55	
		250	Hornbeam	44	
		251	Hornbeam	53	
		252	Oak	109	
		253	Oak	89	
		254	Oak	112	
		255	Oak	116	
		256	Oak	86	
		257	Oak	88	
		258	Oak	102	
		259	Oak	117	
		260	Oak	97	
		261	Oak	96	
		262	Oak	41	
		263	Oak	84	
		264	Oak	73	
		265	Oak	114	
		266	Oak	120	
		267	Oak	52	
		268	Oak	105	
		269	Oak	105	
		270	Oak	99	
		271	Hornbeam	75	
		272	Oak	85	
		273	Oak	113	
		274	Oak	100	
		275	Oak	114	
		276	Oak	107	
		277	Oak	83	
		278	Hornbeam	64	
		279	Oak	103	
		280	Oak	123	
		281	Hornbeam	69	
		282	Oak	89	
		283	Hornbeam	83	
		284	Oak	76	

* **Reasons :**
Improvement : 1
Renewal : 2
Sanitation : 3
Harvesting : 4
Accommodation : 5
Diversity : 6
Exploitation : 7

Cutting (X)	Reasons*	Tree number	Species	Circ. (cm)	Observations
		285	Oak	109	
		286	Sycamore maple	86	
		287	Oak	109	
		288	Oak	109	
		289	Oak	97	
		290	Hornbeam	86	
		291	Oak	126	
		292	Oak	67	
		293	Oak	109	
		294	Oak	99	
		295	Oak	70	
		296	Oak	99	
		297	Oak	112	
		298	Oak	52	
		299	Oak	148	
		300	Oak	105	
		301	Oak	84	
		302	Oak	100	
		303	Oak	99	
		304	Oak	63	
		305	Oak	101	
		306	Oak	114	
		307	Oak	106	
		308	Oak	113	
		309	Oak	119	
		310	Oak	156	
		311	Oak	56	
		312	Oak	92	
		313	Oak	74	
		314	Oak	60	
		315	Oak	99	
		316	Oak	80	
		317	Hornbeam	64	
		318	Oak	87	
		319	Oak	92	
		320	Oak	91	
		321	Oak	62	
		322	Oak	95	
		323	Oak	99	
		324	Hornbeam	74	
		325	Hornbeam	64	

* **Reasons :**
Improvement : 1
Renewal : 2
Sanitation : 3
Harvesting : 4
Accommodation : 5
Diversity : 6
Exploitation : 7

Cutting (X)	Reasons*	Tree number	Species	Circ. (cm)	Observations
		326	Oak	107	
		327	Oak	93	
		328	Oak	101	
		329	Oak	115	
		330	Oak	102	
		331	Oak	109	
		332	Oak	77	
		333	Oak	119	
		334	Oak	120	
		335	Oak	154	
		336	Hornbeam	81	
		337	Oak	139	
		338	Hornbeam	72	
		339	Oak	130	
		340	Oak	102	
		341	Oak	84	
		342	Oak	69	
		343	Oak	125	
		344	Oak	137	
		345	Oak	105	
		346	Oak	69	
		347	Oak	94	
		348	Oak	77	
		349	Oak	86	
		350	Oak	106	
		351	Oak	93	
		352	Oak	95	
		353	Oak	97	
		354	Hornbeam	57	
		355	Hornbeam	41	
		356	Hornbeam	45	
		357	Oak	87	
		358	Oak	80	
		359	Oak	54	
		360	Oak	123	
		361	Oak	102	
		362	Hornbeam	114	
		363	Oak	86	
		364	Oak	80	
		365	Hornbeam	65	
		366	Hornbeam	77	
		367	Hornbeam	34	

* **Reasons :**
Improvement : 1
Renewal : 2
Sanitation : 3
Harvesting : 4
Accommodation : 5
Diversity : 6
Exploitation : 7

Cutting (X)	Reasons*	Tree number	Species	Circ. (cm)	Observations
		368	Hornbeam	82	
		369	Oak	155	
		370	Oak	119	
		371	Hornbeam	63	
		372	Oak	116	
		373	Oak	104	
		374	Oak	109	
		375	Oak	98	
		376	Oak	109	
		377	Oak	116	
		378	Hornbeam	59	
		379	Oak	95	
		380	Oak	79	
		381	Birch	124	
		382	Oak	102	
		383	Oak	95	
		384	Oak	96	

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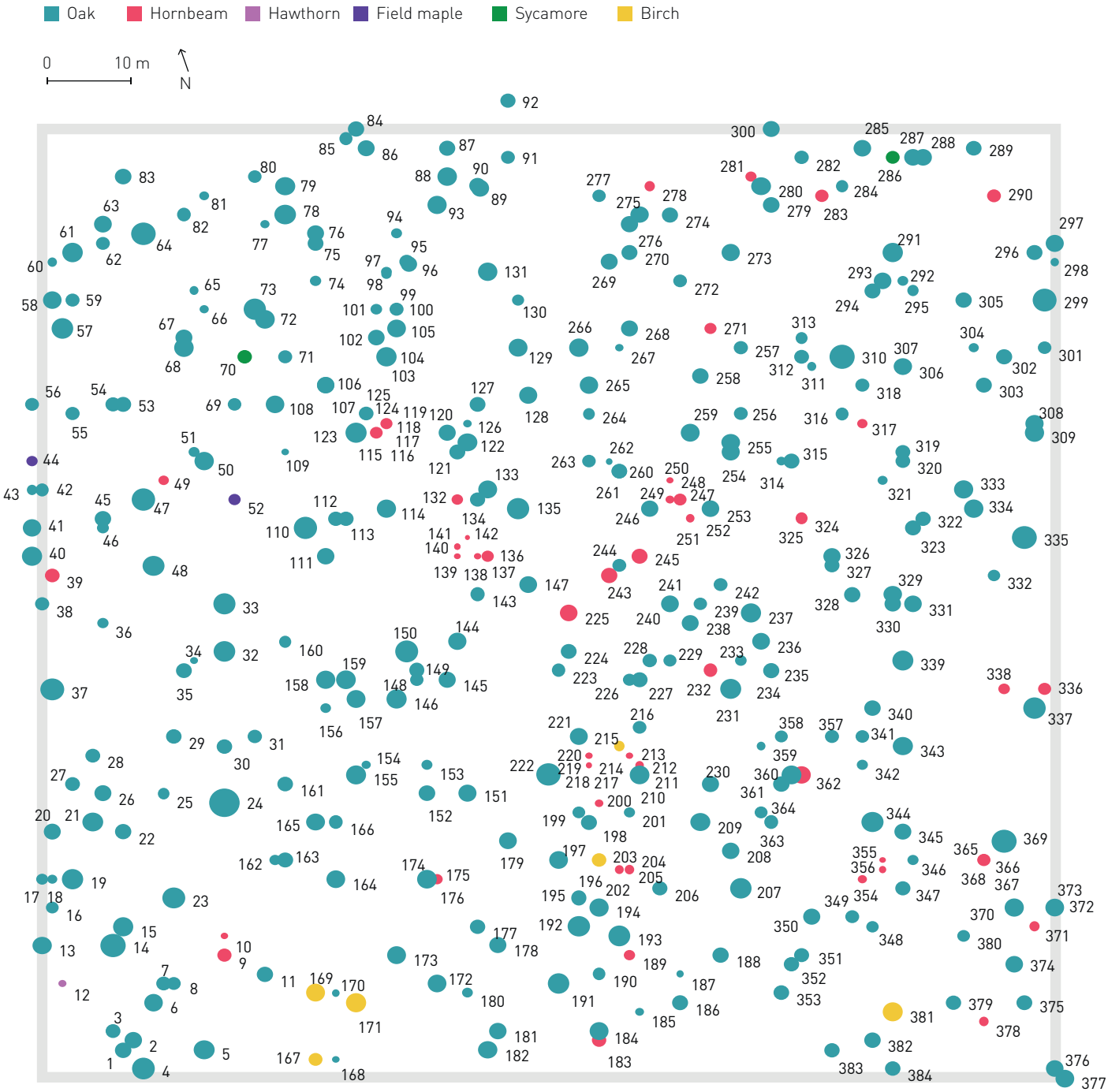
7 WORK OF THE MARTELOSCOPE



Marteloscope in Bissen

Tree marking exercise in a young oak woodland

Bastien Sante

Forêt.Nature

The marteloscope is an exercise that allows the intensity and nature of each hammerer's strike to be analysed according to dendrometric, economic and ecological criteria. It aims to present the main dynamics that govern the evolution of irregular forests.

This training is offered by Forêt.Nature with the support of Wallonia, the European Union and the Administration de la nature et des forêts du Luxembourg.

Training support document:
Marteloscope in Bissen: evaluate your hammer strike

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