Steigerwald
Demo sites

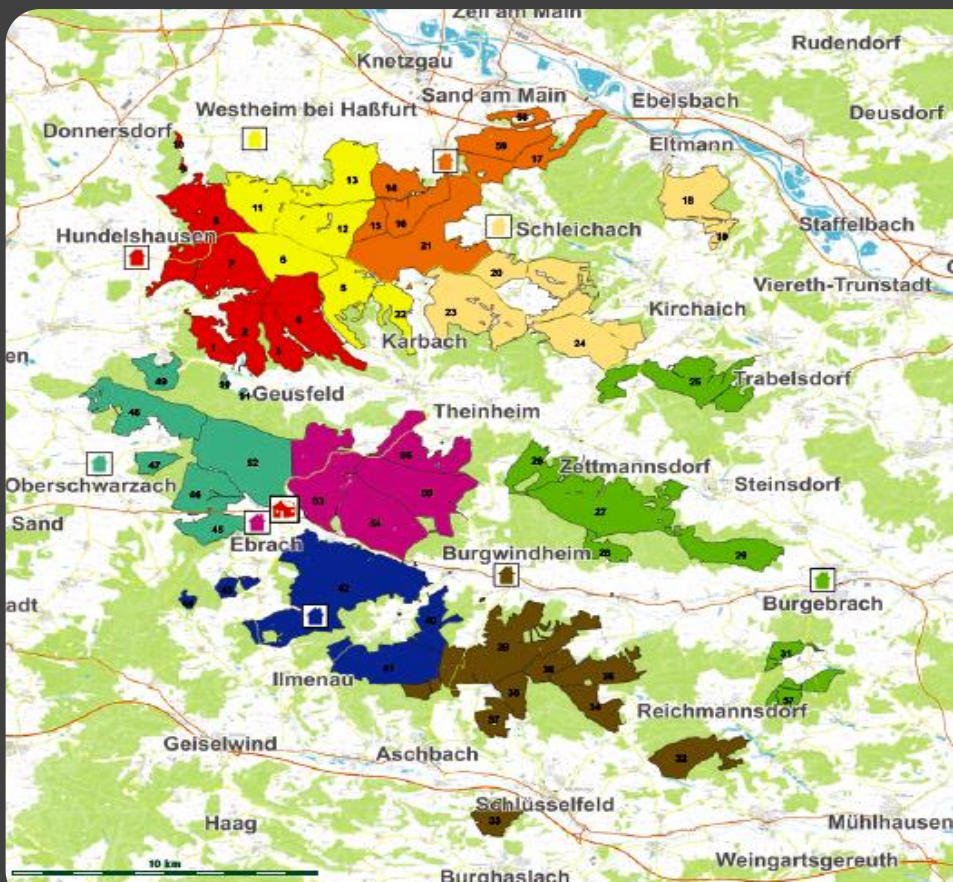
Field guide

BAYERISCHE STAATSFORSTEN
Nachhaltig Wirtschaften.

Ebrach State Forest Enterprise

Ebrach State Forest Entreprise (BaySF) manages an area of around 17,000 ha of state forest in the Steigerwald region, located between Würzburg and Nürnberg in North-Western Bavaria.

The forests are composed of 72 % broadleaved species (Beech 40 %, Oak 23 %) and 28 % coniferous species (pine being the dominant species with around 15 %). The actual average stock is 370 m^3 /ha and the annual cutting rate amounts to approximately 100,000 m^3. Around 80 % of deciduous timber is marketed in the region to more than 60 sawmills. Almost 25,000 m^3 of sold fuelwood make Ebrach one of the largest producers in Germany.



..... in figures

16,500 ha

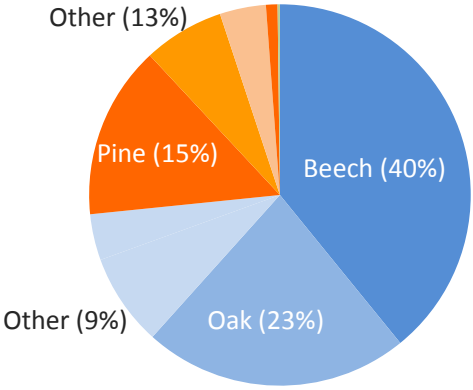
Total forest area

8.5 m^3/ha

Annual increment

370 m^3/ha

Actual average stock



140,000 m^3

is the annual increment measured over the total forest

100,000 m^3

is the annual cutting-rate

25,000 m^3

is the fuelwood production per year

20,000 m^3

are annual losses due to biodiversity measures

72 %

Broadleaves

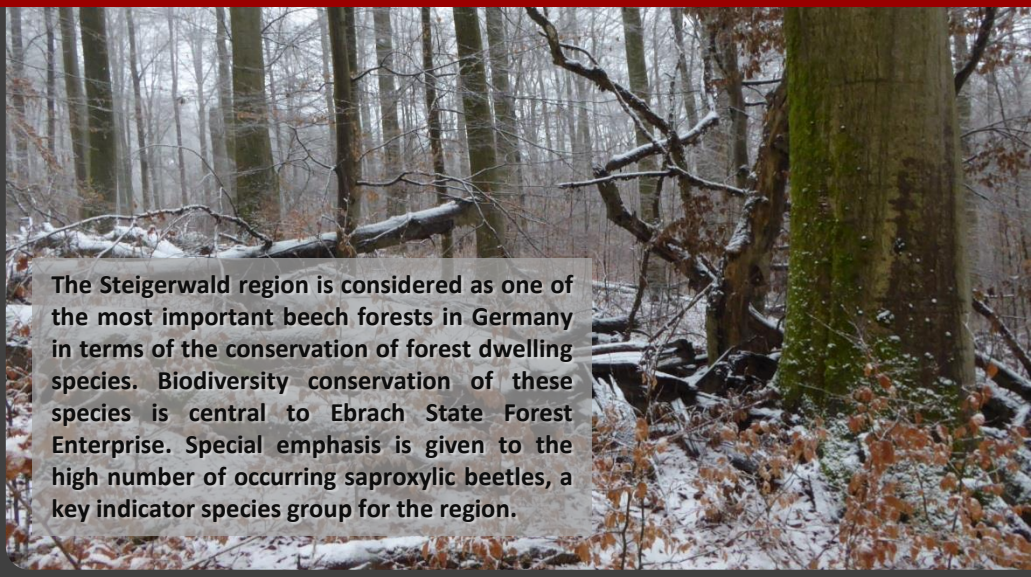
28 %

Conifers

Around **480**

different species of saproxylic beetles

Biodiversity concept



The Steigerwald region is considered as one of the most important beech forests in Germany in terms of the conservation of forest dwelling species. Biodiversity conservation of these species is central to Ebrach State Forest Enterprise. Special emphasis is given to the high number of occurring saproxylic beetles, a key indicator species group for the region.

Conservation despite utilization – The management approach implemented in Ebrach is often coined "conservation despite utilization". It can be described as an integrative approach which strives to ensure biodiversity conservation and timber production over the whole productive forest area. To ensure diversity of forest dwelling species, structural diversity and the supply of living and dead wood is crucial.

The centerpiece of Ebrach's concept is a carefully selected and cross-linked system of set-aside and extensively managed forest areas.

Stands with a high ecological value fall under set-aside forest, which contains different categories (see figures right). They can serve as the basic safeguarding of biodiversity and as donor areas for temporal colonization of habitat structures in adjacent productive forest stands. Additionally, they link dispersed habitats. Therefore the concept is often referred to as stepping stone concept.

Another important element of the enterprise's approach is an extensification of management. This is mainly realized in old stands or younger stands with a high number of remnant old trees. This leads to a systematic build-up of habitat trees and deadwood.

All other stands are managed according to legal requirements regarding nature and species conservation. For example, it is already taken care during pre-commercial thinnings to ensure the persistence of sufficient future habitat trees.

6,000 ha
Extensification of forest management

430 ha
Total area of 6 strict reserves

700 ha
210 stepping stone areas

63 ha
Forest edges

96 ha
Wet forest biotopes

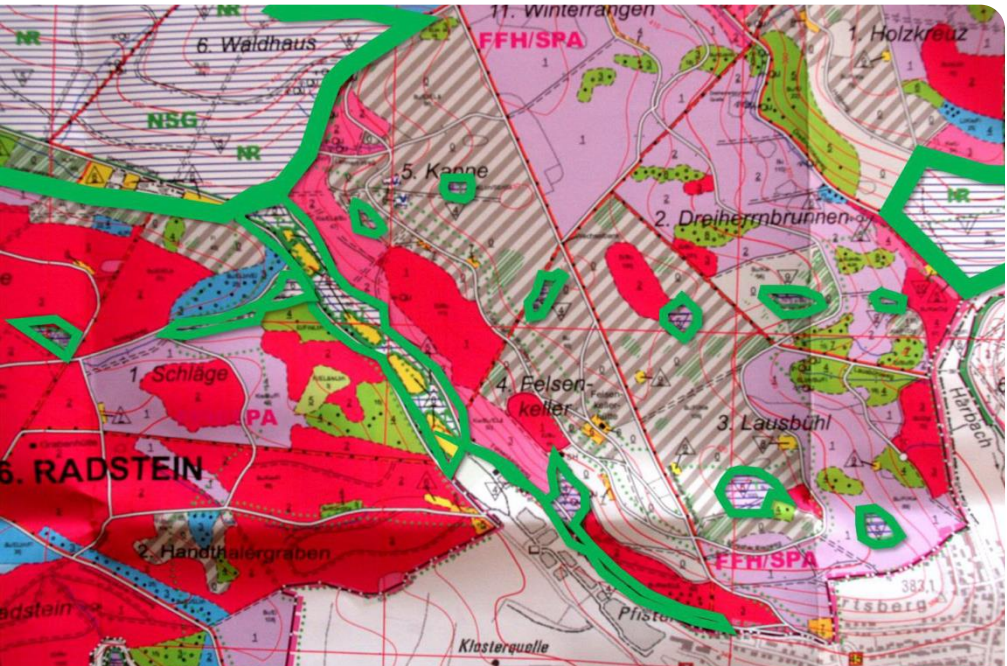
7 %
Set-aside forest areas

10 /ha
Target for habitat trees

Target for deadwood

20 m³/ha
in stands older than 100 years

40 m³/ha
in stands older than 140 years



Learning from nature

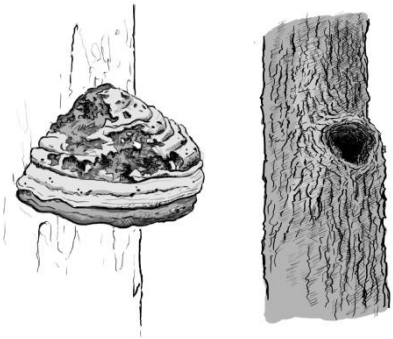
A profound understanding of natural processes in forest ecosystems is seen as a prerequisite for implementing the Ebrach biodiversity concept. The six strict reserves and more than 100 additional stepping stone habitats as smaller set-asides with longer habitat tradition accross the forest area serve as survival and reproduction sites for sensitive and highly endangered species. Dispersal- and resource-limited species are thus able to spread and establish temporarily also in managed stands from these habitat patches, provided they are evenly distributed over the entire forest area.

Learnung sites

Strict forest reserves serve as learning sites on how relevant habitat structures develop over long growing cycles. Species assemblages found in these set-aside areas serve as qualitative target definition of what should be reached on the overall forest area. The extensive research conducted in these living laboratories has produced the guidance for the management principles of the entire forest area. This is mainly reflected in the deadwood and the stepping stone concept but also in additional parameters that were included in the inventory such as habitat tree categories (trees with cavities, conks, and large innjuries). The retention of deadwood and habitat trees is fully relected in the planning cycles of the forest enterprise and is considered in the calculation of the annual cutting rate.

Microhabitat structures

Most species dependent of old-growth-elements and phases have become threatened. Conservation of biodiversity in managed forest stands is mainly a question of retention of such microhabitat structures.



Typical structures of habitat trees

Closer to nature

Main silvicultural aim in Ebrach is to maintain the beech-dominated character of the Steigerwald region. Single-tree harvesting and natural regeneration are the basis to develop structurally diverse and uneven-aged forests. Securing and improving the habitat diversity for forest species, however, has led to rethinking the management principles of the close-to-nature silviculture that was the main strategy in Ebrach for very long time. Especially the motto „ the badly formed tree is felled first“ has led to an impoverishment of microhabitat structures through the early removal of undersired over-growth in the course of thinning operations to improve quality of trees. These trees bear an important potential to become future habitat trees and thus have gained strong attention in tending and thinning.

Elite and habitat trees

Positive selection of habitat trees already takes place in thinning phases to ensure that there are sufficient individuals with microhabitat potential in later stages. The selection of elite trees is set at a maximum of 40/ha e.g. for beech in order to provide sufficient space for habitat trees to develop. In case of admixtures with different harvest span even more habitat trees per ha may be selected and permanently marked (green wave line). In total 155,000 habitat trees are the aim for the total forest area.

Deadwood

Large amounts of wood left to decay naturally are seen as crucial in Ebrach for biodiversity and nutrient sustainability. In later thinning phases and harvest the Ebrach concept requires trees to be felled away from skidding tracks so that tree crowns remain in the stand. As a general rule, the trunk is cut at the first strong branch and only the more valuable sections are removed. This helps to achieve the aim of increasing the amount of deadwood to 20 and 40 m^3/ha in forests older than 100 and 140 years respectively.

Site 1: Waldhaus

The species diversity of Waldhaus reserve resembles almost tropical forests

Waldhaus strict reserve is one of the oldest set-aside areas of Bavaria (since 1964) and among the most important beech reserves in Germany. It was extended to a total of 90 ha in 2001.

Species composition in the reserve is well documented due to many scientific investigations. Waldhaus can serve as a benchmark for assessing the species composition in managed beech forests. It represents a show case which habitat structures should be present also in managed forests in order to maintain and enhance biodiversity. Examples applied by the State Forest Enterprise Ebrach in their managed forests are to leave tree crowns of harvested trees in the forest. They are cut at the first strong limb with the aim of generating large dimensioned lying deadwood. Lying deadwood is important e.g. for many fungi species including *Herricium coralloides* (commonly often referred to as lion's mane). A second example is the retention of undesired overgrowth with strong branches in beech regeneration in the course of tending operations. Once such vital beeches have developed to mature trees some of the large branches may die off and develop into trunk and mould cavities. Such cavities are then essential habitats for saproxylic communities such as the hermit beetle (*Osmoderma eremita*).

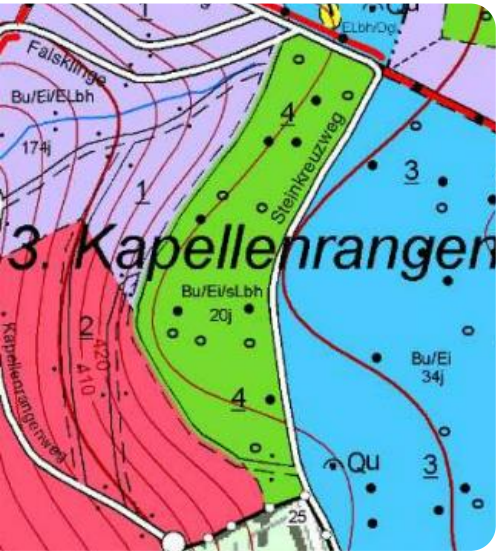
A discovery changes the management concept

In 2006 a female specimen of *Osmoderma eremita* was found accidentally in the trunk of an old beech that was destroyed during a lightning storm. The large tree (> 1m DBH) revealed a large mould cavity of more than 6 m length that remained undiscovered until then. The growth form of the tree indicated that it originated from a vital former overgrowth sapling with strong branches also sitting on the lower trunk. The branches finally died when the canopy closed but could not be completely occluded due to their thickness. These created access to a mould cavity that developed over decades in the trunk until the tree broke down. The beetles usually live on the interior wall of the cavity in symbiosis with wood-decaying fungi on which the larva feeds. As long as the tree is vital enough the slow rot from the interior is outmatched by the tree´s diameter growth. The discovery led to major changes in the management concept, especially the removal of deformed trees in early thinning operations

Extensive ecological research in the core area has revealed that on an area of only 10 ha close to 1,300 species exist in the reserve. Among the most prominent species groups are fungi (407 species), moths (349) and saproxylic beetles (289). The amount of deadwood in the core area was estimated at 107 m³/ha in 2006.

Species group	Number of species	Data quality	References
Fungi	**407**	Good	Blaschke et al. 2004
Moths	**349**	Good	Hacker & Müller, 2006
Saproxylic beetles	**289**	Good	Hacker & Müller, 2006
Vascular plants	96	Good	Seuß & Hastreiter, 2005
Flatbugs	42	Medium	Goßner, unpubl.
Birds	35	Good	Müller, 2005
Molluscs	23	Good	Rauh, 1993, Müller & Strätz, 2005
Carabid beetles	16	Medium	Rauh, 1993
Bats	15	Good	Runkel, unpubl.
Annelids	8	Medium	Rauh, 1993
Ants	7	Low	Rauh, 1993
Mosses	5	Medium	Seuß & Hastreiter, 2005
Mammals	5	Low	Rauh, 1993; Müller, unpubl.

Site 2: Deadwood management



The site at Kappellenrangen is located in a 15-25 year old beech stand with remnants of 170 year old beech and oaks and covers an area of 5.3 ha.

Harvesting in such 2-layered stands can be a challenge when the accumulation of large amounts of deadwood is a main objective during logging operations. During the last two interventions in 2007/08 and 2014/15 the harvesting was focussed on the large remnants of the previous stand. It was decided to fell the trees into the stand to be able to retain crown deadwood and not towards the skidding roads as was the practice before. Once the trees were brought down, the cut was made at the first strong branch and that part was left behind.

Active deadwood management at Kapellenrangen

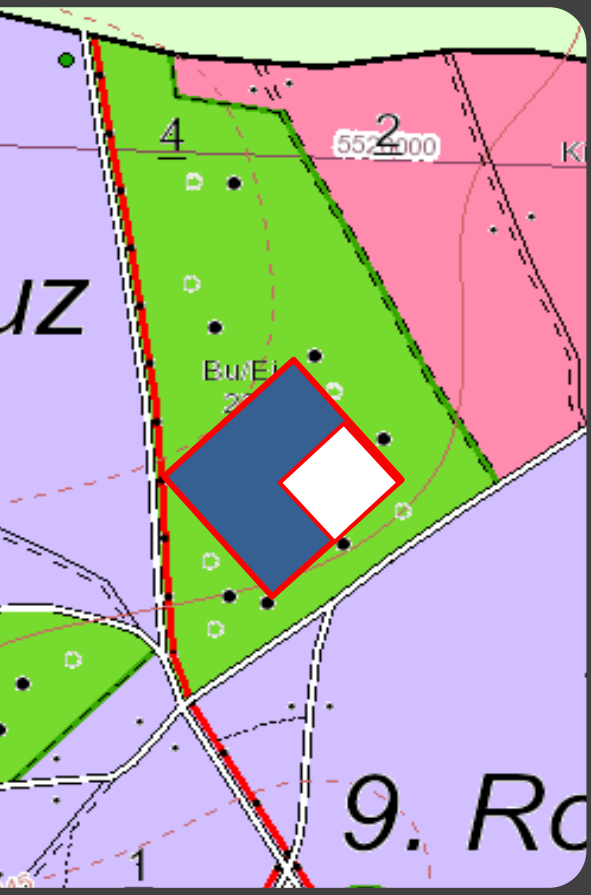
….at Kappellenrangen

In 2008 an assessment was made to investigate the damages of the new harvesting concept to the understory trees. The assessment showed that 144 potential elite trees per ha could easily be identified despite the large tree crowns. On average 21 m³ of deadwood be accumulated over a short time period based on this management measure.

Potential elite trees [N/ha]	**144**
Potential habitat trees [N/ha]	38
Ø Indifferent trees [N/ha]	1,800

	Interventions 2007-08	Interventions 2014-15
Area [ha]	4	5.3
Elite trees before harvest [N/ha]	51	41
Remaining stand [N/ha]	41	35
Removed trees [N/ha]	10	6
Harvest volume [m³/ha]	38.5	34.8
Ø volume per harvested tree [m3/ha]	3.8	5.8
Sale [m³/ha]		
High value timber	16.5	24.8
Large roundwood	11	
Residue [m³/ha]		
Lying deadwood	11	10
Remaining habitat trees [N/ha]		
With microhabitat structures		6
Veteran trees (dbh > 80 cm)		7

Site 3: Dimensioning phase



The stand comprises of 30-years old tree layer with remnant trees of up to 220 years from the previous stand on 4.7 ha. While the old stand is dominated by beech the young stand consists of a mix of oak, birch, maple, larch, spruce, etc. It can be observed at this site how a mix of tree species can be maintained through targeted interventions while relocating at an early age the increment growth to future elite trees. For demonstration purposes one section of the stand is marked based on positive and negative selection criteria.

Reference area

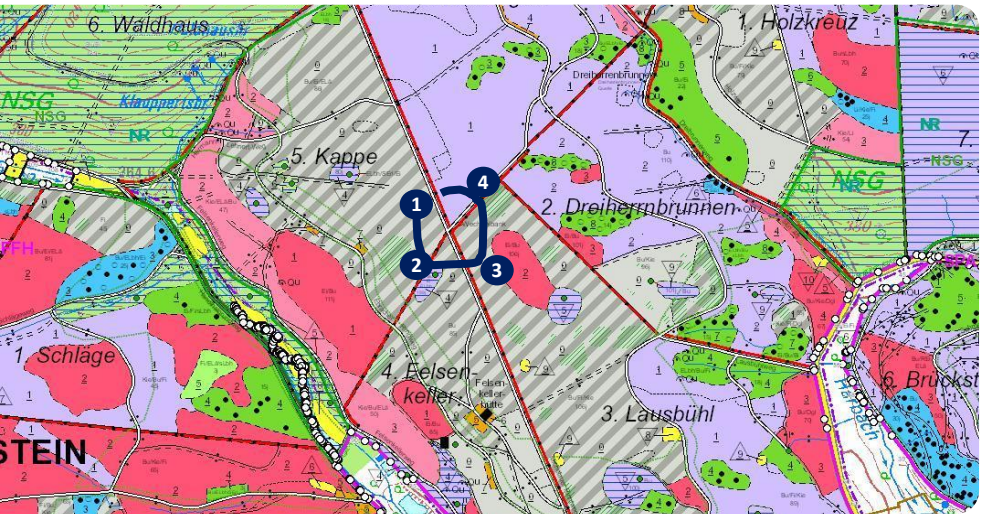
Exercise area

The site also shows how nature conservation objectives are being implemented in deciduous forests: habitat trees are already considered in the understory and not removed in the course of negative selection thinning. Large beeches from the previous stand are examined according to their habitat value: trees displaying cavities or other habitat structures are maintained. So are veteran trees with a dbh above 80 cm. The selected habitat trees usually provide a diverse set of habitat structures. Such a network of habitat trees contributes to safeguarding biodiversity over large areas of forests. The site can further highlight which trees are of high quality and available for harvesting.

… at Rotmarter

Elite and harvest trees	
Elite trees [N/ha]	89
Removed trees [N/ha]	108
Harvest volume [m³/ha]	17.0
Ø Volume per harvested tree [m³/ha]	0.16
Habitat trees	
Small habitat trees (< 30 cm)	
N [N/ha]	12
Volume [m³/ha]	4.4
Ø Volume per tree [m³/ha]	0.4
Large habitat trees (> 50 cm)	
N [N/ha]	8
Volume [m³/ha]	53.9
Ø Volume per tree [m³/ha]	6.7
Veteran trees (without microhabitat structures)	
N [N/ha]	5
Volume [m³/ha]	44.1
Ø Volume per tree [m³/ha]	8.8
Old harvest trees	
N [N/ha]	14
Volume [m³/ha]	68.1
Ø Volume per tree [m³/ha]	4.2

Site 4: Wechselbank



1. Habitat tree retention, deadwood accumulation, selection of stepping stone habitats; Natural regeneration of Sycamore maple
2. Induction of artificial cavities in trees to bridge the gap in habitat continuity
3. Target diameter harvest and artificial regeneration of Silver fir and Sycamore maple
4. Irregular forest structure and single tree selection silviculture

	Interventions 2001	Interventions 2007/08
Harvest volume [m3/ha]	39.3	33.1
Deadwood retention [m3/ha]	7	7

Elite trees	
Elite trees [N/ha] < 50 cm dbh	14
Elite trees [N/ha] >50 cm dbh	17
Habitat trees **Future habitat trees**	
N [N/ha]	65
Volume [m3/ha]	47.4
Ø Volume per tree [m3/ha]	1.4
Large habitat trees	
N [N/ha]	5
Volume [m3/ha]	14.9
Ø Volume per tree [m3/ha]	2.9

Site 5: ABC experiment

The ABC-level thinning experiment is one of the world's oldest forest research plots. It was divided into three sections each being 0.7 ha in size. The experimental plot was established 1870 in Bavaria as part of a state-wide research program. The aim was to test different thinning intensities. For more than 140 years thinning took place in a 5-10 year cycle.

In the A-level section only small dimensioned and dying trees were removed, while in the C-level even dominant trees from the overstorey were felled. The B-level was managed as an intermediate between levels A and C.

Documentation is complete and available for all interventions during the last 140 years. In addition to the information on tree growth responses to the different thinning intensities the ecological impacts are of extraordinary value especially today.

Microhabitat structures and thinning intensities

The results of the experiment show that intensive thinning prevents the establishment and development of habitat structures. Accordingly, the C-level, yet having the largest trees, displays the lowest number of species. There is a complete lack of *Fomes fomentarius* (Tinder fungus), which can be found frequently in the A-level section. The experiment illustrates very clearly that neither stand age nor tree dimensions are the drivers for maintaining biodiversity, but the variety of habitat structures on individual trees.

Integrate+ is a demonstration project funded by the German Federal Ministry for Food and Agriculture (BMEL) to establish a European network of demonstration sites for the integration of biodiversity conservation into forest management.

The Integrate+ project runs from December 2013 to December 2016 and builds on a partner network from research and practice with a focus on implementation of integrative management and enhancing transnational exchange of experiences.

Mergner, U., Kraus, D., Schuck, A., 2016. Steigerwald demo sites field guide. Integrate+ Technical Paper No. 12. 16 p.

European Forest Institute, 2016

www.integrateplus.org