

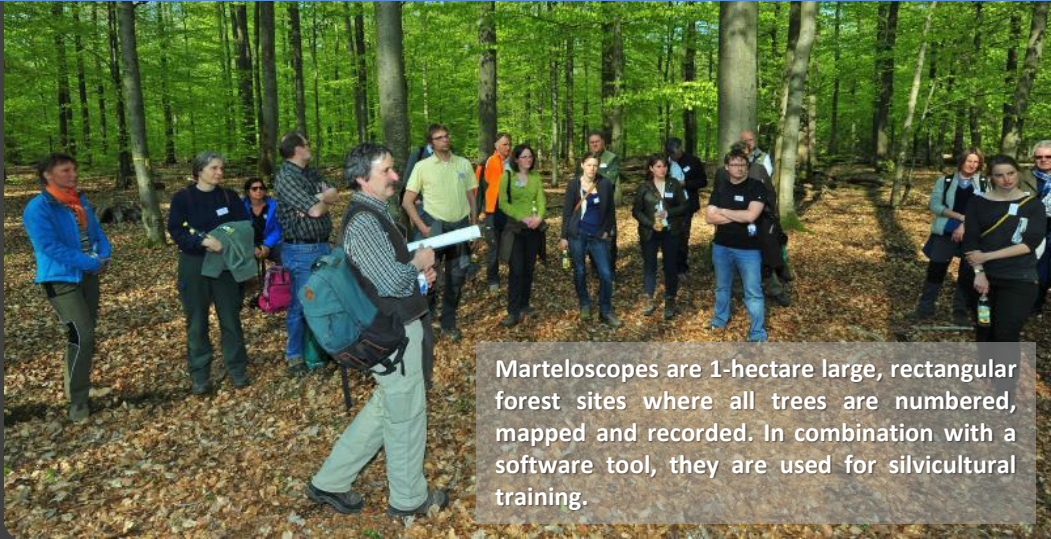
Integrate+

Marteloscopes

Calibrating silvicultural decision making



Marteloscopes



Marteloscopes are 1-hectare large, rectangular forest sites where all trees are numbered, mapped and recorded. In combination with a software tool, they are used for silvicultural training.

What are Marteloscopes?

A main task in forest management is to decide where, when and what kind of forest interventions are applied. Key factors influencing silvicultural decisions that practitioners make are their understanding of forest dynamics and their level of experience. Further, the presence of a wide range of theoretical strategies and concepts in forestry results in differences when implementing certain silvicultural practices. This may apply even when clear forest management guidelines are in place. Therefore it is of importance to ask how substantial are the consequences of different silvicultural approaches and to what extent do they affect forest biodiversity?

Experimental silviculture (“trial and error”) will not provide answers to this question. Nonetheless simulating interventions applied by individual practitioners within the same stand provide such insights.

This is exactly what *‘Marteloscopes’* do: the term is derived from French and describes a more detailed examination of tree selections and their consequences for a stand.

Marteloscopes (*M-scopes*) are the centerpiece of the Integrate+ demonstration site network which includes various sites throughout Europe . They serve the Integrate+ project and its partners as tool for implementing virtual tree selection exercises and build showcases for field visits. One main goal is to train and eventually improve decision making capacities related to integrating biodiversity aspects into forest management.

The development of a software ("*I+*") that is run on mobile devices can display tree selection results directly in the field. That means participants can immediately visualize the outcomes of their silvicultural decisions and related ecological and economic consequences.

M-scopes in combination with the I+ software thus allow forest practitioners, decision makers, scientists and other interested groups to objectively discuss different management strategies and their consequences directly on site. So called 'conflict trees' can be identified and management options exchanged in terms of economic return and ecological values (expressed through habitat structures).



Habitat structures

Integrate+ gives particular attention to habitat structures in its M-scopes. Large quantities of deadwood and a high density of old microhabitat-bearing trees are characteristic elements of natural forests, in particular in old-growth phases. These phases are often absent or rare in managed forests, even in forests under close-to-nature management. In selective harvests and thinnings, 'defective' trees displaying or potentially developing old-growth habitat structures are often removed.

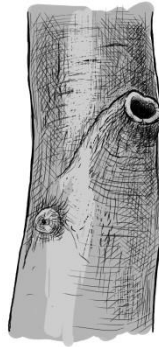
Yet, an important share of forest biodiversity is strictly or primarily dependent on such elements for their survival, especially *saproxyllic* species, being species depending on deadwood.

Most species dependent of old-growth phases and corresponding habitat structures have become rare. Conservation of biodiversity in commercial forest stands is thus linked to retaining such microhabitat structures.

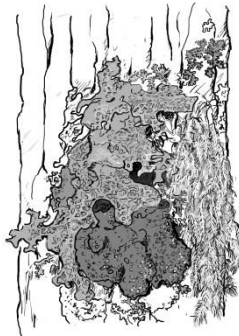
Splintered trunk



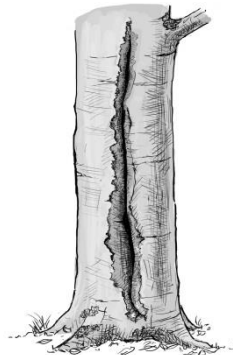
Branch cavities



Epixylic lichens



Cracks and scars



...and biodiversity



Aegolius funereus



Phellinus pini



Hericium corralloides



Lobaria pulmonaria



Limax cinereoniger



Limoniscus violaceus

Evaluation of habitat value

The standardized evaluation of the habitat value is based on a comprehensive catalogue of **tree microhabitats** and has been developed with biodiversity experts. It comprises 23 saproxylic and epixylic features such as cavities, large dead branches, cracks and loose bark, epiphytes, sap runs, or trunk rot characteristics. Fig. 1 shows exemplarily several associated species living in mould cavities.



The **habitat value** (in points) is assessed for each tree based on the recorded tree microhabitats, taking into account rarity of a habitat and duration for it to develop.

Saproxylic Microhabitats	Cavities	CV1	Woodpecker cavities
		CV2	Trunk and mould cavities
		CV3	Branch holes
		CV4	Dendrotelms and water-filled holes
	Injuries and Wounds	CV5	Insect galleries and bore holes
		IN1	Bark loss / Exposed sapwood
	Bark	IN2	Exposed heartwood / Stem and crown breakage
		IN3	Cracks and scars
	Deadwood	BA1	Bark pockets
		DW1	Dead branches and limbs / crown deadwood
Epixylic Microhabitats	Growth form related microhabitats	GF1	Root buttress cavities
		GF2	Witch broom
		GF3	Cankers and burrs
	Epiphytic crypto- and phanerogams	EP1	Fruiting bodies fungi
		EP2	Myxomycetes
		EP3	Bryophytes
			Foliose lichens
	Nests and aeries	NE1	Nests / aeries
		OT1	Sap and resin run
		Other microhabitats	OT2

Tab.1: Extract from Integrate+ tree microhabitat catalogue

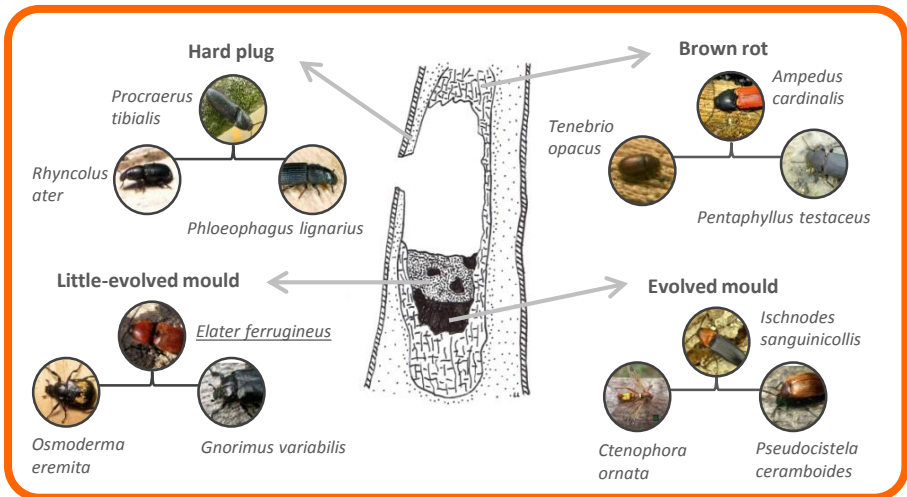


Fig.1: View into a mould cavity (adapted from Larrieu, 2014)

...and economic value

Integrative forest management is meant to combine ecological and economic aspects alike. Sound silvicultural concepts aim to produce, harvest and market timber assortments of high value. The better the economic performance, the less severe are potential trade-offs resulting from biodiversity conservation. Therefore an economic evaluation is equally important.

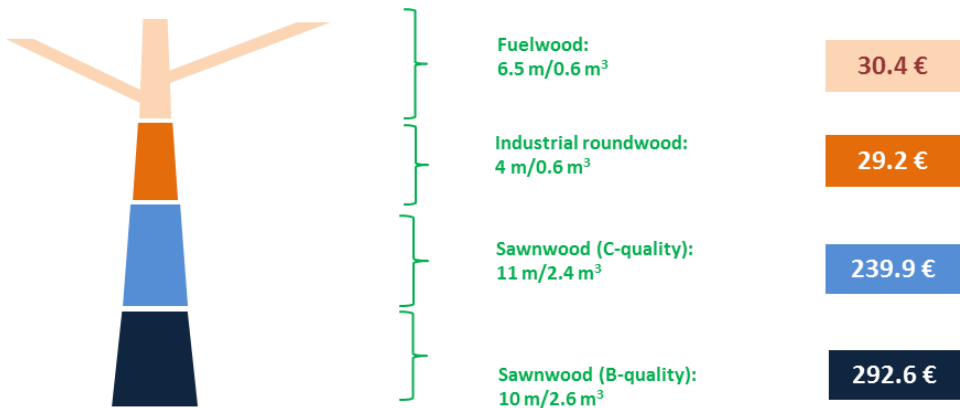


Fig. 2: Example timber assortments of one stem

The **economic value** (in €) is estimated for each tree based on volume, stem quality and corresponding local timber price lists. Trees can contain several assortments of different quality.

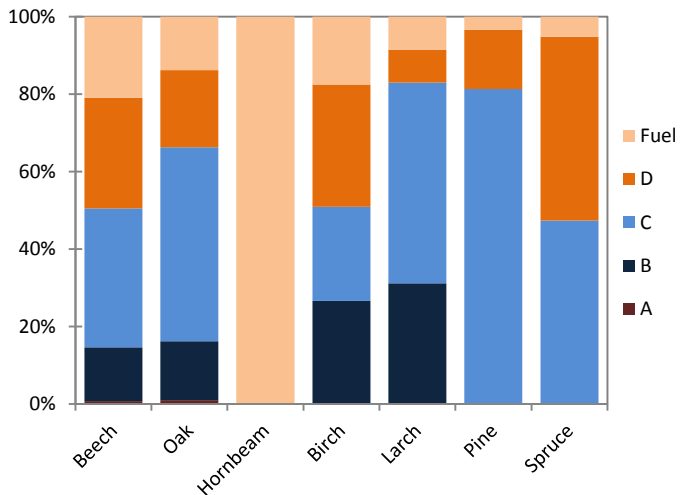
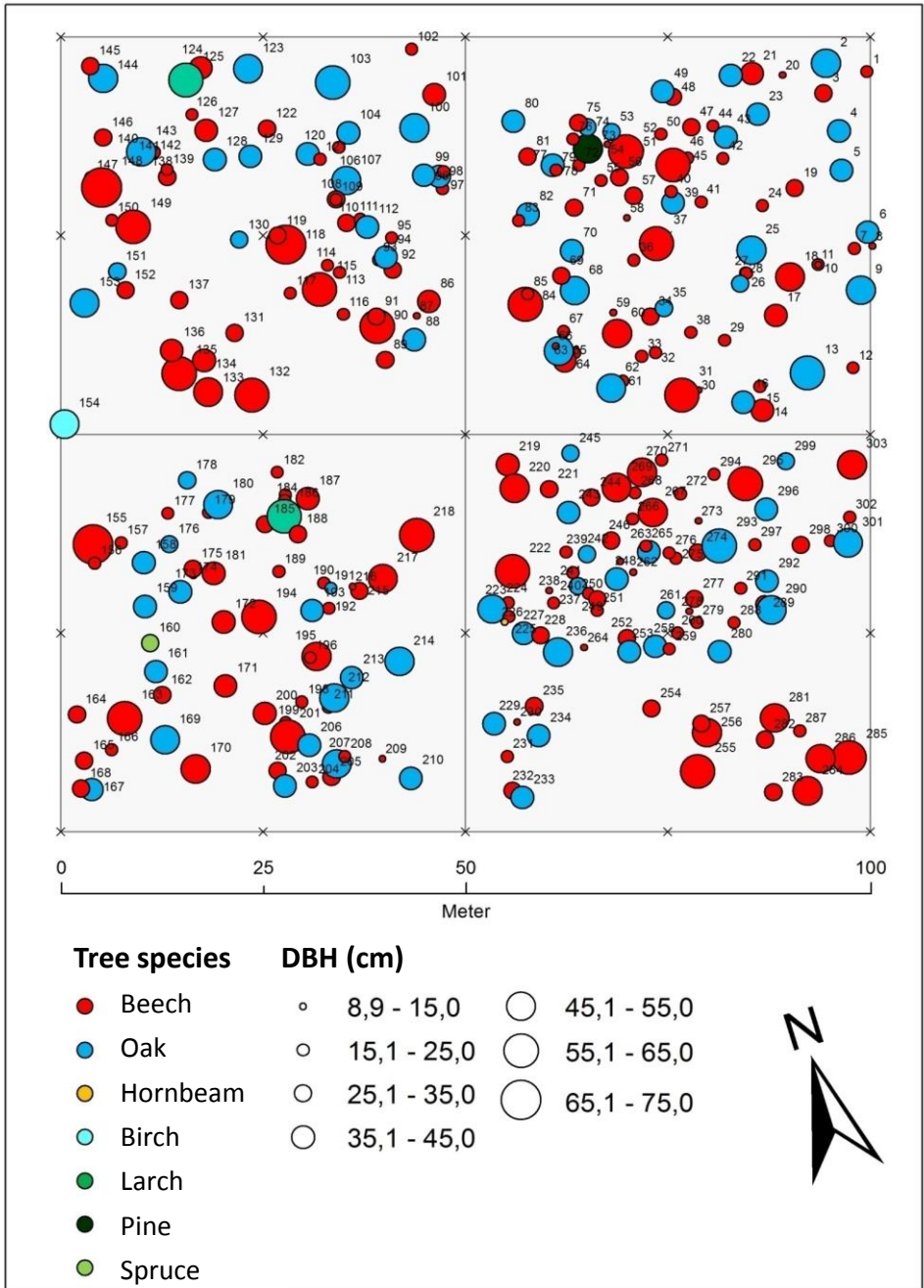


Fig.3: Example M-Scope quality distribution per tree species

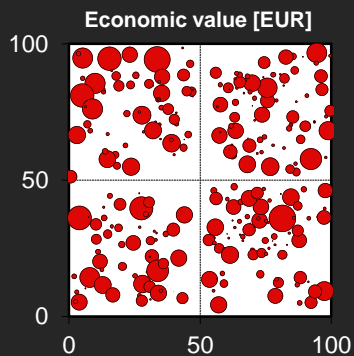
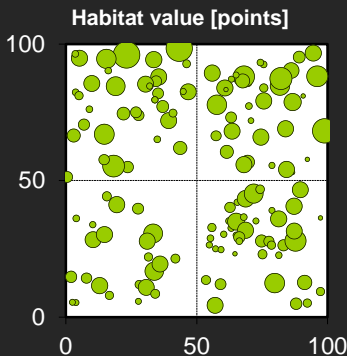
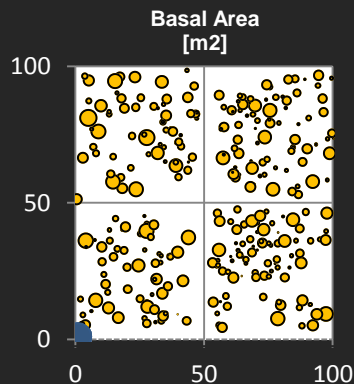
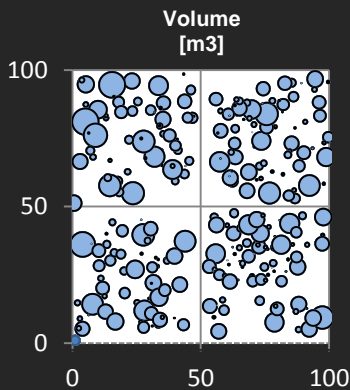
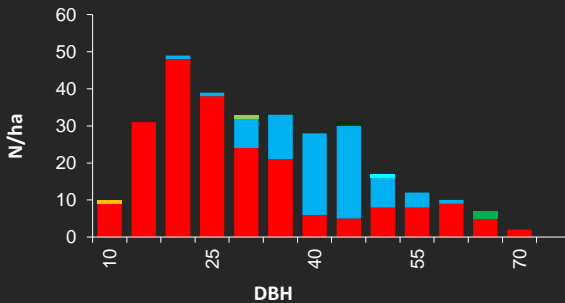
M-scope tree map



Example stand characteristics

Stand data

N [stems/ha]	303	Habitat value [points]	3,803
BA [m ² /ha]	30.06	Economic value [Euros]	30,774.-
Volume [m ³ /ha]	327.2		



I+ software

Integrate+ uses a software tool running on mobile devices (tablets). They are used directly on the Marteloscope sites and allow to apply a broad range of silvicultural training exercises.

In advance of a virtual tree selection exercise the software is pre-set for the training purpose in the field. During a training exercise, users are able to retrieve all relevant information on the stand and each individual tree. They receive direct feedback on all silvicultural decisions they have taken during the exercise.

The outputs of the exercise can then be used for self- or group evaluation, comparison of results and education. They allow to discuss different silvicultural concepts and consequences of their implementation in terms of their ecological and economic impacts.

The I+ software also allows to display detailed descriptions of all individual tree microhabitats and their relevance for different biomes and species.



...and virtual interventions

A comparison of two interventions is shown as a result of a virtual tree selection exercise. They highlight the different outcomes regarding economic and habitat values and their effects on the forest structure (basal area).

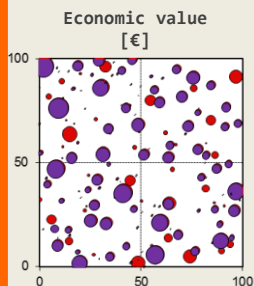
Scenario 1: - Positive selection of habitat trees, harvesting high quality trees

Scenario 2: - Strict removal of competitors to high quality trees, harvest of target diameter trees

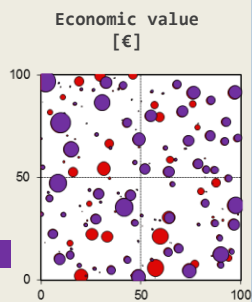
Interventions

Scenario 1

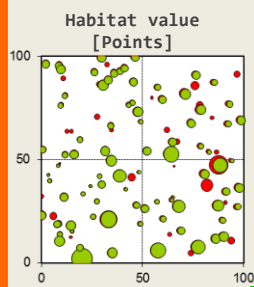
Scenario 2



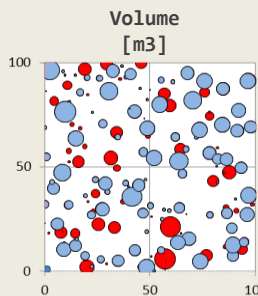
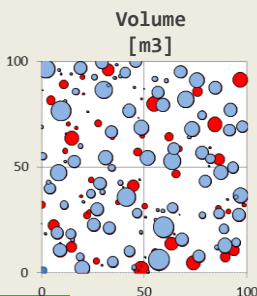
6,116 €



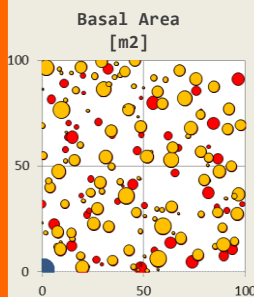
7,649 €



3630



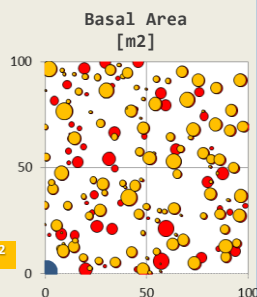
2485



22.6 m²

Removal
98.6 m³

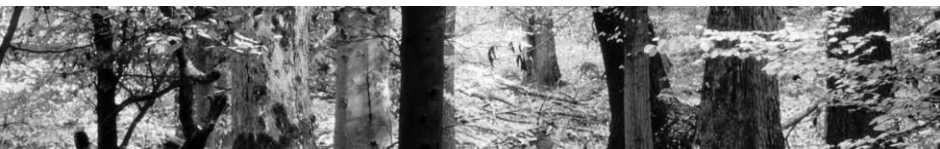
Removal
116.2 m³



21.8 m²

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.



Schuck, A., Kraus, D., Krumm, F., Schmitt, H., 2015. Integrate+ Martelloscopes – calibrating silvicultural decision making. Integrate+ Technical Paper No 1. 12 p.

Illustrations: Lisa Apfelbacher

European Forest Institute, 2015

www.integrateplus.org