

STEP-BY-STEP TUTORIAL

I+ Trainer Software

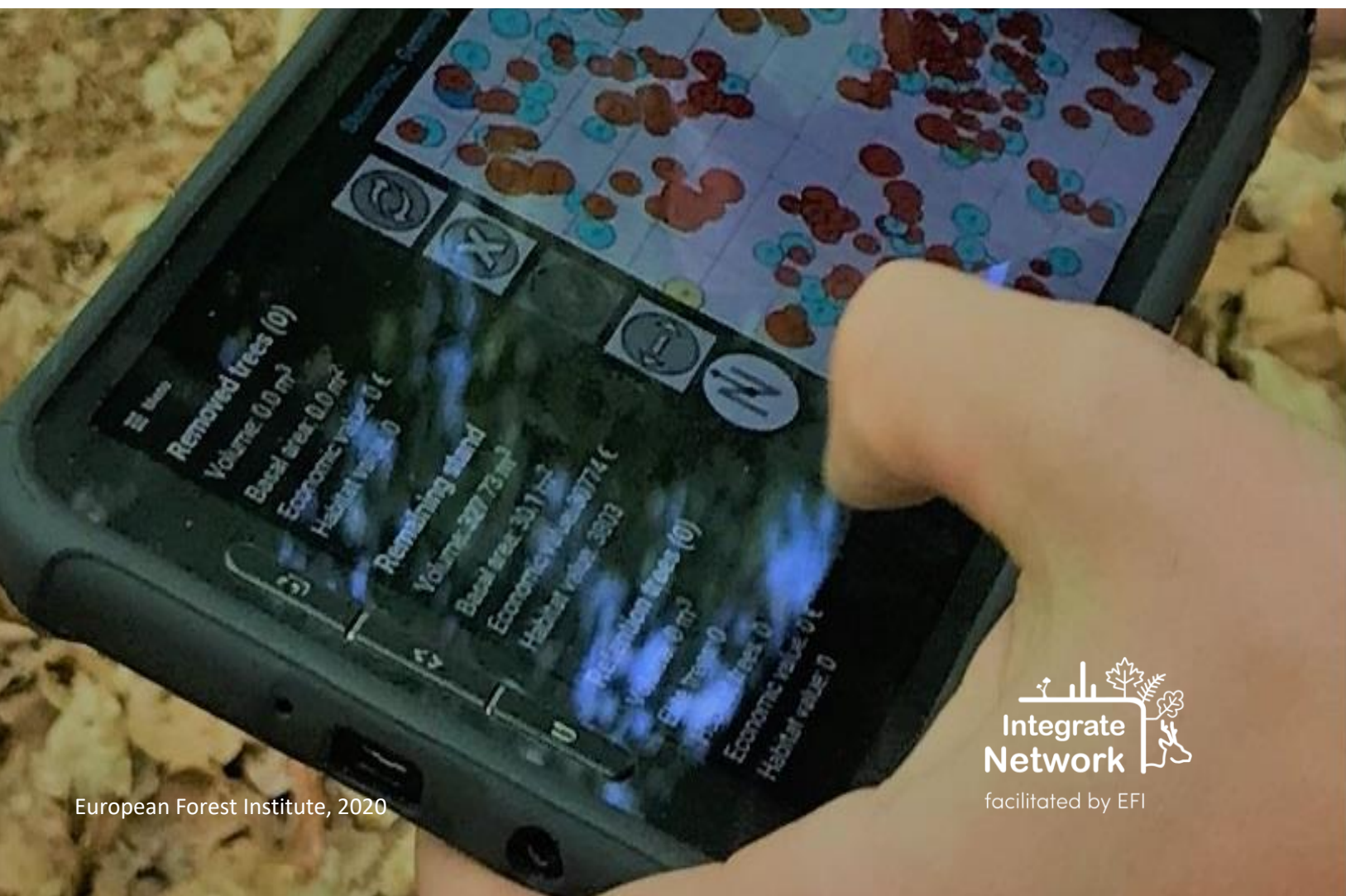


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More information: <https://integratenetwork.org/> and <http://iplus.i.int/>

Disclaimer: The I+ software was developed in the course of the projects: ‘Establishing a European network of demonstration sites for the integration of biodiversity conservation into forest management – Integrate+’ (2013 – 2016; Forst 2013-4), ‘Integrated Forest Management Learning Architecture – Informar’ (2017 – 2020; Forst 2017-1) and ‘Managing forests for resilience and biodiversity – bridging policy, practice, science and education – FoReSite’ (2020-2022; Forst 2020-1) and Metsänomistajien päätöksenteon tuki muuttuvassa toimintaympäristössä – Integrate (2021-2023). The German Federal Ministry of Food and Agriculture (BMEL) supported the first three projects, the Finnish project was supported by EU Regional development funds. The views expressed are those of the authors and do not necessarily represent those of the European Forest Institute.

1. Introduction

The I+ software is designed to run on mobile devices that can be used directly in the marteloscope sites in the forest. In advance of virtual tree selection or other exercises, the software facilitates pre-settings for the training in the field. In addition, it offers and displays a detailed description of individual tree microhabitats and their relevance for different biomes and species. During or after performing the training exercises, users receive direct feedback on all silvicultural decisions they have implemented on site both in qualitative and quantitative figures. These outputs serve for self- or group evaluation, comparison of results and education. An important aim of the software is that user groups can discuss based on objective data ecological and economic impacts of different silvicultural concepts and practical approaches on site. This way, participants can benefit from exchange with other training participants and eventually improve their own decision-making capacities. There are three software packages available and tailored for different user groups:

- **I+ Manager:** The software package '*I+ Manager*' allows plot managers to enter new marteloscope records, maintain / actualise existing marteloscope records and define marteloscope exercises. This package is reserved for software developers and will be made available to marteloscope area managers on request. For the I+ Manager software there is a separate [manual](#) (available in English only).
- **I+ Database:** There are two major datasets which are co-located in one master database. One set contains all variables that have been assessed in a marteloscope, while the second comprises of the data that is needed to conduct the tailored training sessions. The database is located on each mobile device (tablet computer, also mobile phones). When the tablet is connected to the Internet, it will synchronize its '*local*' database with that of the main server database and update with any new information. Also, training session results from the tablet are uploaded to the master database on the server. The database is managed by the **software developers**.
- **I+ Trainer:** This software package is applied when running exercises on the marteloscope sites. The I+ Trainer is the package which is relevant for the on-site user of the software. In this tutorial, we will explain how to use the I+ Trainer step by step.

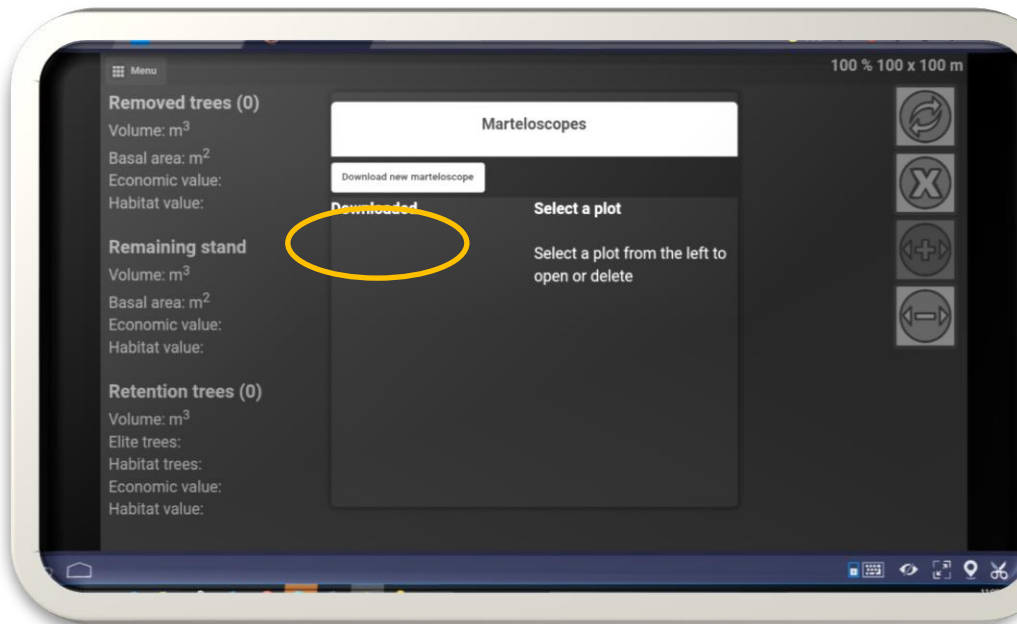
2. I+ Trainer software – user instructions

2.1. Installing the I+ Trainer software

The I+ trainer can currently only be downloaded via a link on the '[iplus website](#)'. The trainer software is not yet available in the Google Play Store. It is designed for the Android operating

system, but also runs on Windows (['emulator approach'](#)). An iOS version is not planned. There are currently three versions available: ARM for the Android operating system, an Intel version and a generic version. On the 'iplus website' there are further explanatory information for software installation.

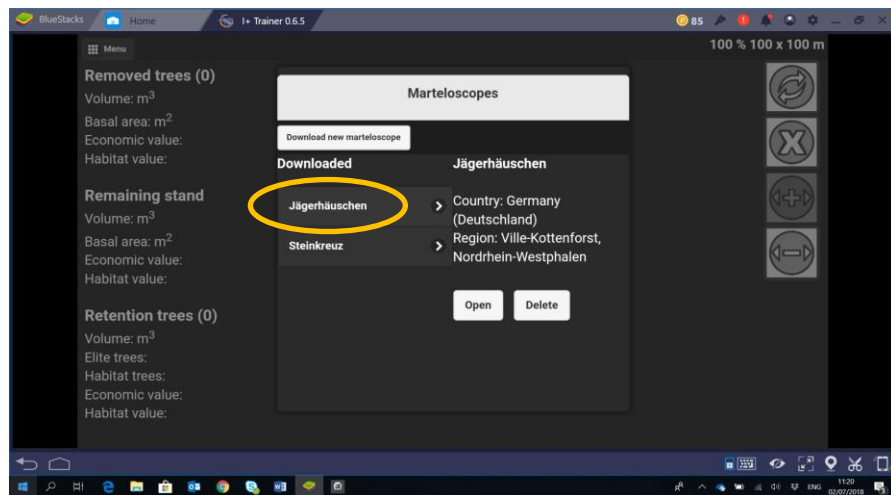
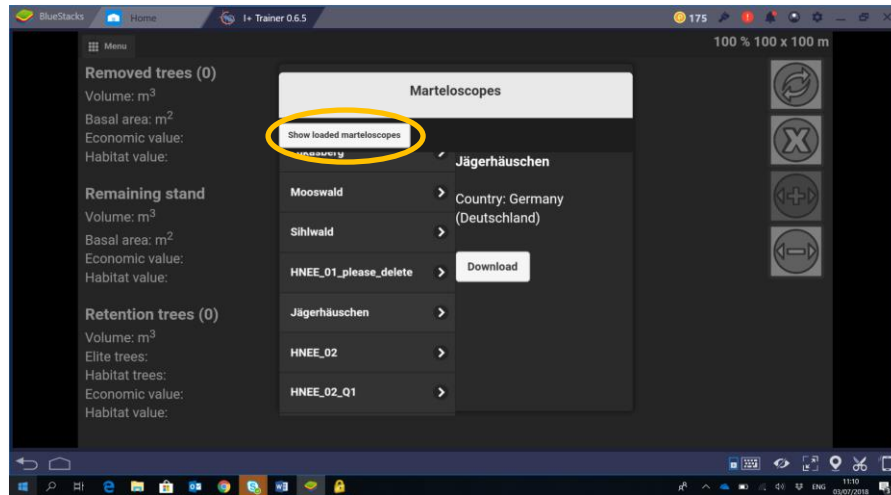
Once the software is installed, you can upload a marteloscope by clicking '*Download new marteloscope*'.



The program will ask you first for a password. You can also obtain this by contacting the I+ team. After inserting the password, scroll down to find the marteloscope you are looking for. Click '*Download*'. Note: You can only load one area per request.

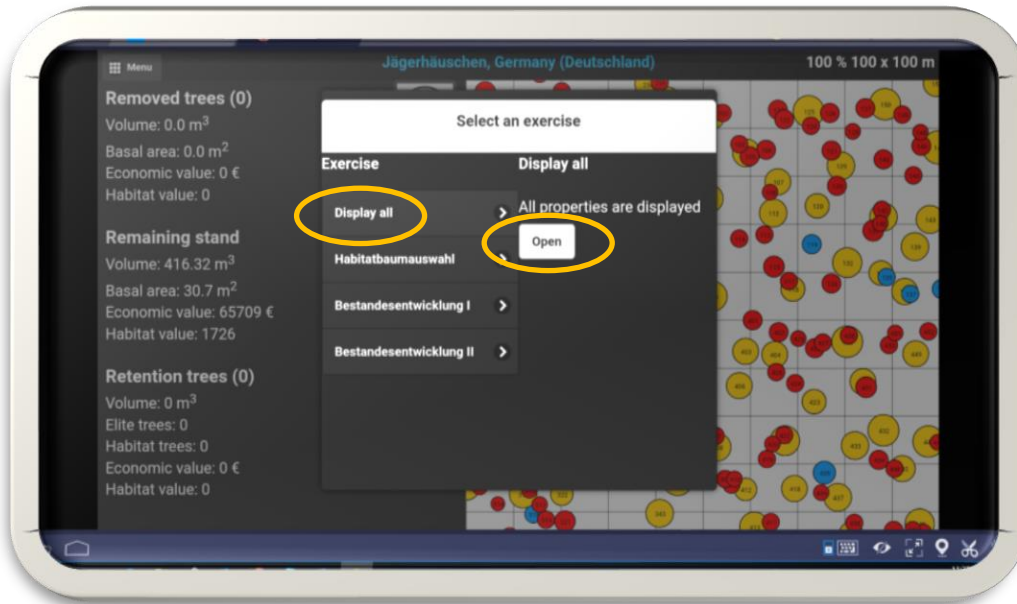
2.2. Selecting a marteloscope

Open the I+ Trainer software. The program will show you an overview of downloaded Marteloscope sites that you can select for the exercise. Additional sites from the website can be downloaded only with an administrator password. In this case we select the '*Jägerhäuschen*' Marteloscope, located in the Kottenforst near Bonn, Germany. The program will ask for confirmation; click '*yes*'.



2.3. Opening an exercise

Select the desired exercise. Some marteloscopes have a set of predefined exercises, others don't. These exercises can be prepared by the local forester with the I+ Manager software (see [I+ manager software tutorial](#)). In the latter case, or if no particular predefined exercise is planned, choose 'display all' and click 'open'. We now see a schematic areal overview of the stand, with circles representing the trees. Each individual tree has a number and a colour. The colour refers to the species. In this case, yellow is sessile oak (*Quercus petraea*), red is hornbeam (*Carpinus betulus*) and blue is beech (*Fagus sylvatica*). The diameter of a circle corresponds to the size of the tree. You can zoom in on the stand by using two fingers, as on any touch screen.



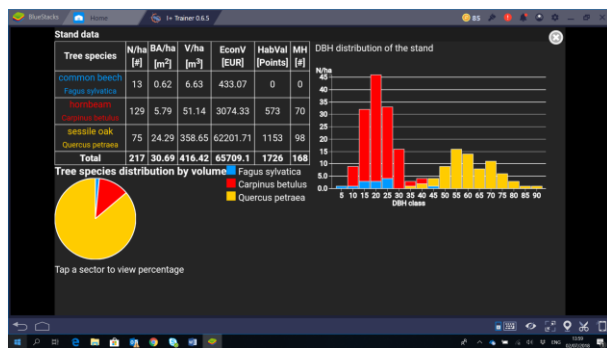
2.4. Stand information

If you click on 'Menu' in the left upper corner, you can access different types of overview information.





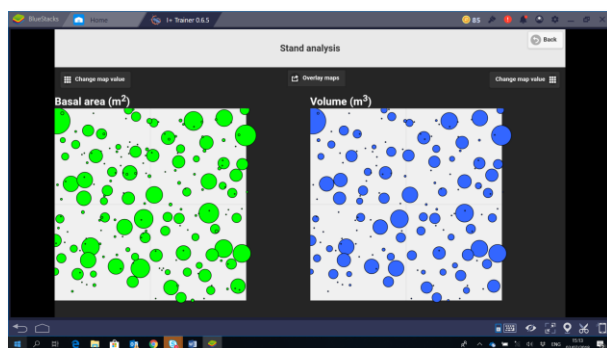
Site conditions: Information on the site can be accessed by clicking on the blue highlighted text (here: 'Jägerhäuschen, Germany') above the display of the marteloscope map.



Stand data: Overview by tree species: number of trees, basal area, growing stock, economic values, microhabitat values, DBH and volume distribution.

Tree species	Habitat value			Economic value		
	All trees [Points]	% of total	Value per tree [Points]	All trees [€]	% of total	Value per tree [€]
common beech Fagus sylvatica	0	0	0	433	0.7	33
sessile oak Quercus petraea	1153	66.8	15	62202	94.7	829
hornbeam Carpinus betulus	573	33.2	4	3074	4.7	24
Total	1726	100.0	8	65709	100.0	303

Stand value: more detailed overview of the economic and habitat value of the stand.



Compare maps: This tool allows you to get a visual view of the different attributes of the stand. The data include:

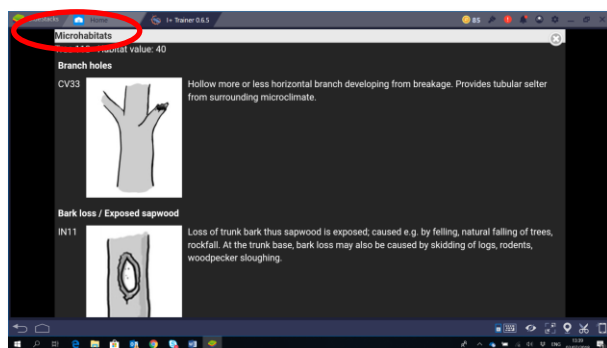
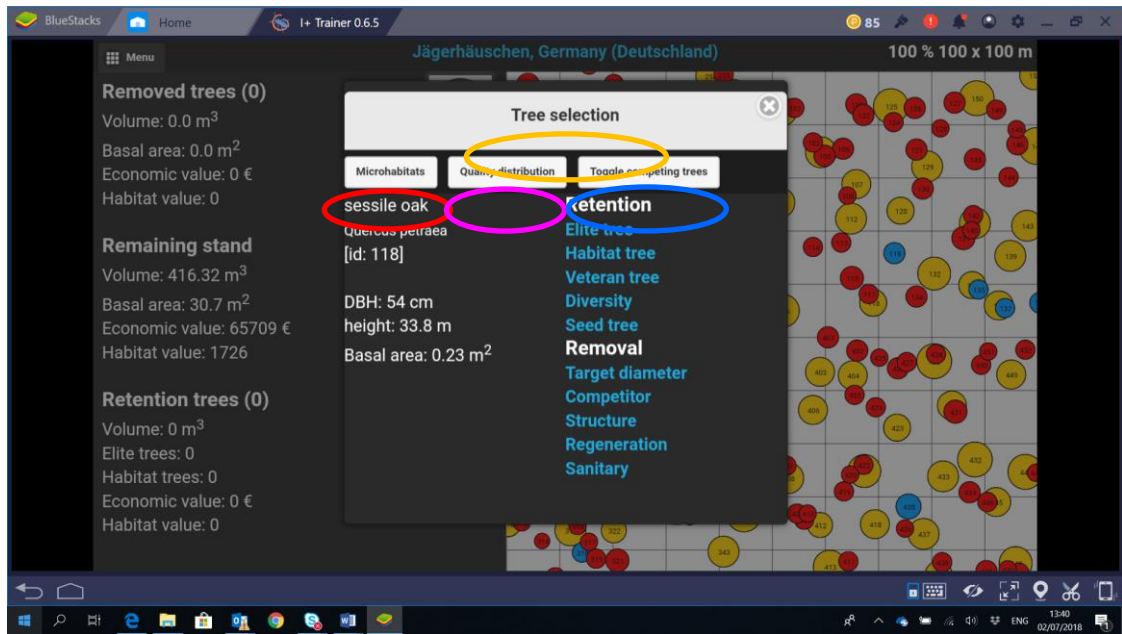
- ✓ habitat value
- ✓ volume (m³)
- ✓ economic value (€)
- ✓ basal area (m²)

Language selection: The language of the trainer software can be selected under 'Menu'. Go to the text tab 'Language' on the touch screen. The language menu appears/is listed. You can then choose between e.g. English, German, French, Spanish, Italian, Czech and Finnish. New

languages may be added as they are provided. The tab 'Martelloscopes' allows you to select and open another site (if available).

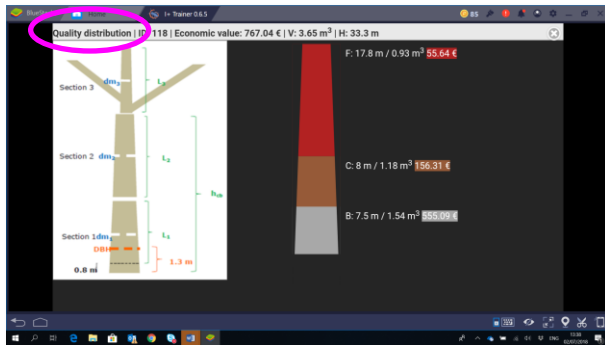
2.5. Tree information

By selecting a circle, you get a lot of information about that tree. There are four categories of information, which are shown here by the example of tree 118. Basic information is given when selecting the tree immediately and informs you of its species, ID number, height and basal area.

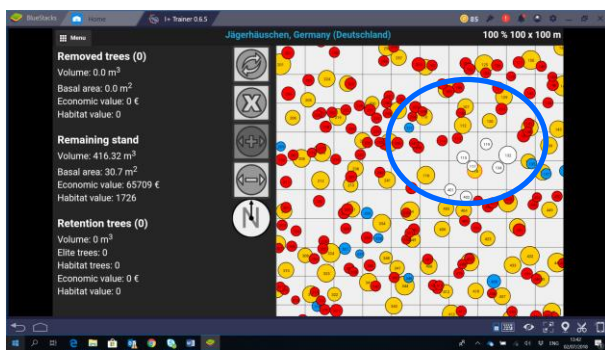


Microhabitats: overview of the recorded tree microhabitats, following the typology of the Catalogue of Tree Microhabitats¹.

¹ [Kraus, D., Bütler, R., Krumm, F., Lachat, T., Larrieu, L., Mergner, U., Paillet, Y., Rydkvist, T., Schuck, A., und Winter, S., 2016. Catalogue of tree microhabitats – Reference field list. Integrate+ Technical Paper. 16p.](#)



Quality distribution: overview of the wood quality classes of the stem. For each quality class, an estimation of the volume and the monetary value is provided.










Toggle competing trees: the competitors of the selected trees are highlighted in white.

2.6. Virtual interventions

We can choose what to do with the tree, depending on the aim of the exercise. Typically, the goal is to perform a virtual thinning. When selecting a tree, the program gives us the choice between 'Retention' and 'Removal'. If we decide to keep tree 118 in the stand because of its existing and potential future microhabitats, the tree will show up in the pane on the left (volume: 3.65 m³; habitat trees: 1). This happens to each tree that is selected for removal or retention. The trees that get no special selection are included under 'Remaining stand'. Removed tree get a yellow outline, retention trees get green outline. A white outline means that the tree was selected but no action defined under 'Removal' or 'Retention'.



In the middle of the screen there are numerous symbols that you may need while operating the program. This is what they mean:

-  Visually eliminate all the trees selected for removal
-  Reset the selection (all trees get unselected)
-  Make tree circles bigger
-  Make tree circles smaller
-  North arrow. There is no integrated compass or GPS; the north arrow relates to the image of the stand on the screen
-  Enter tree number to select target tree. Helpful when tree circles overlap strongly (*new feature!*).
-  Selection of all trees with a defined diameter range (e.g. 30-40 cm) for removal or retention (*new feature!*)

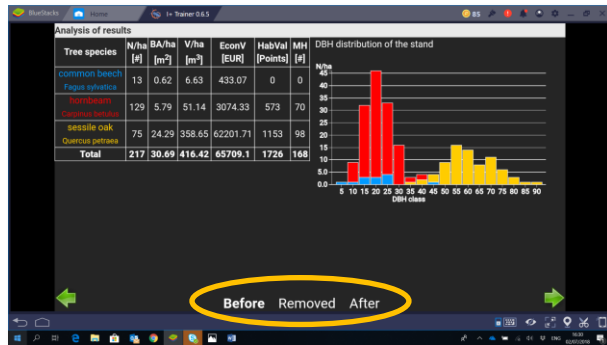
2.7. Exercise results

After selecting all the desired trees, you can see the results and a summary of your virtual forest operation. If you click on the 'menu' in the left upper corner (see chapter 2.4), you can access the 'Exercise results'. The results are sub-divided into different results windows.

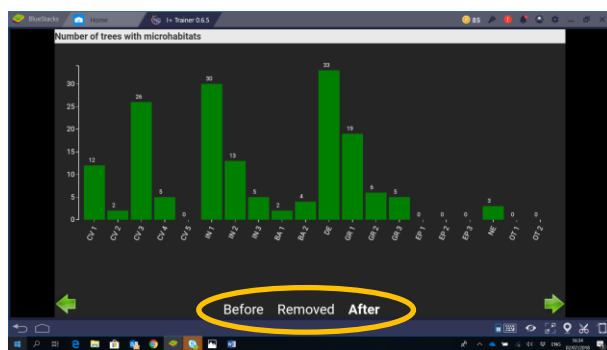


Results in numbers and maps: The first window offers exercise results in numbers (left) and illustrative 'mini maps'. You can navigate between the maps by clicking on the small map symbols or the text with a blue background. Trees selected in the exercise are coloured red in the maps. The size of the red circle symbolises their values. Map types:

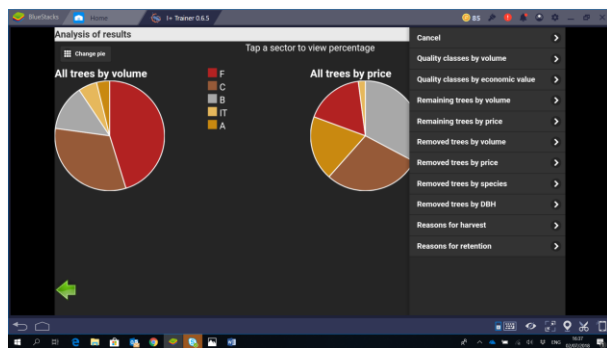
- selected habitat trees and their values
- Selected trees and their volume (m³) and basal area (m²)
- Selected trees and their economic value (€)
- Stand profile view (new feature)
- Dead wood selection (new feature)



Detailed presentation of exercise results: Tabular overview (numbers) and DBH distribution by tree species (graph). The functions 'Removed' and 'After' visualise the changes caused by the virtual intervention.



Changes in trees with microhabitats: The number of trees with microhabitats before and after thinning, classified according to the typology presented in the Catalogue of Tree Microhabitats.

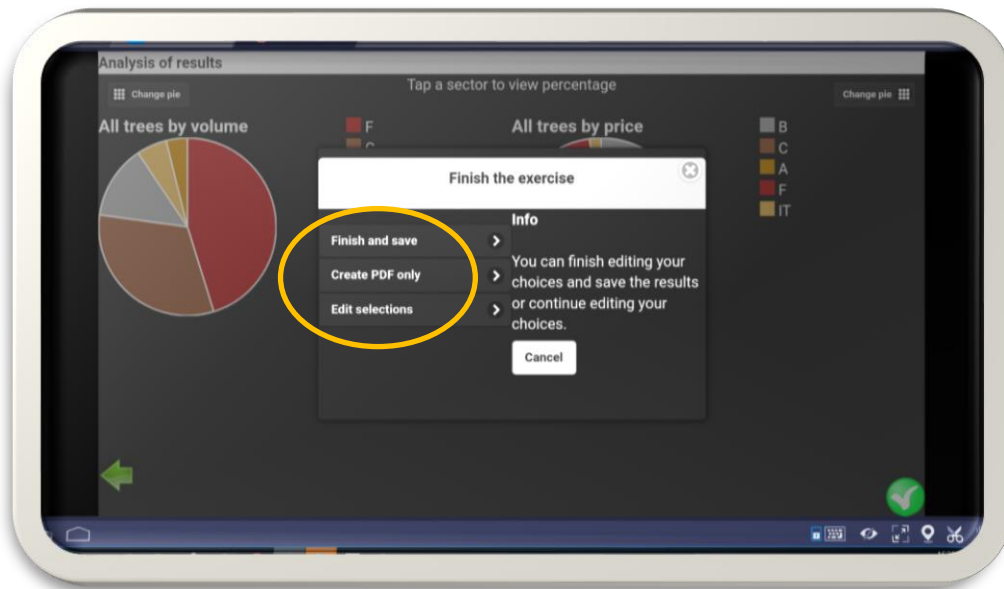


Pie charts: graphic summaries of the results, with ten different variable that can be selected

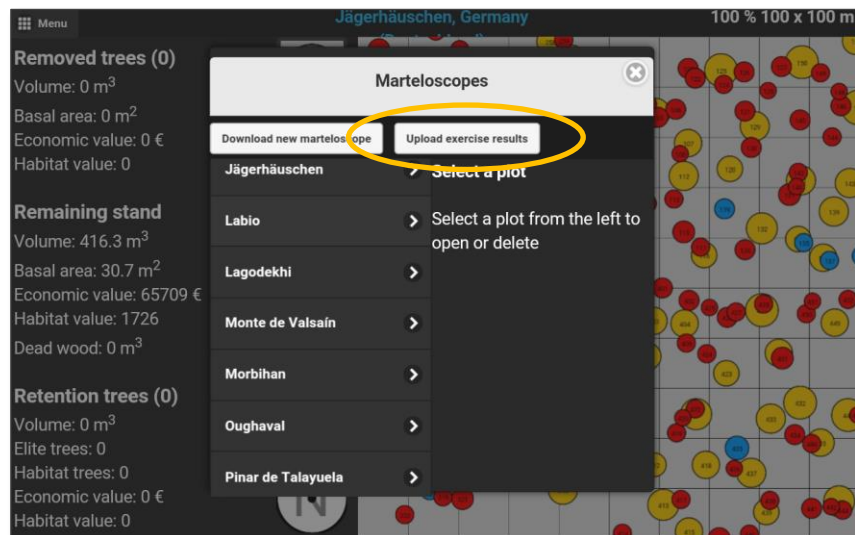
2.8. Finishing the exercise



After analysing the results, the exercise can be saved by clicking the green button in the corner. Clicking 'Finish and save' will automatically upload your results to the central database (this only works if there is an internet connection), as well as creating a PDF for personal use.

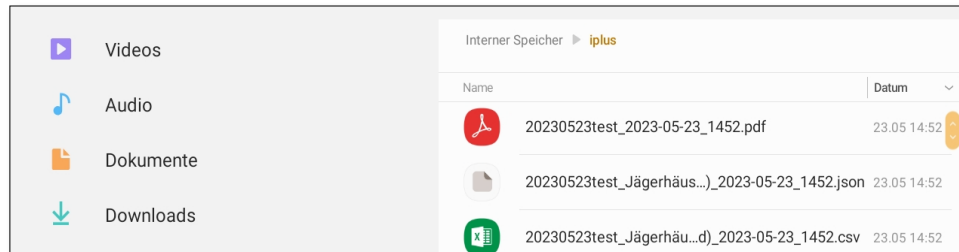


If there is no internet connection, the results file is temporarily stored on the tablet. It can then be uploaded to the central I+ database in the initial menu when internet access is available. In this way, all transferred exercise result files can be viewed and further processed via the I+ Manager software for marteloscope operators / training personnel (if the I+ Manager software is installed on a PC / laptop).

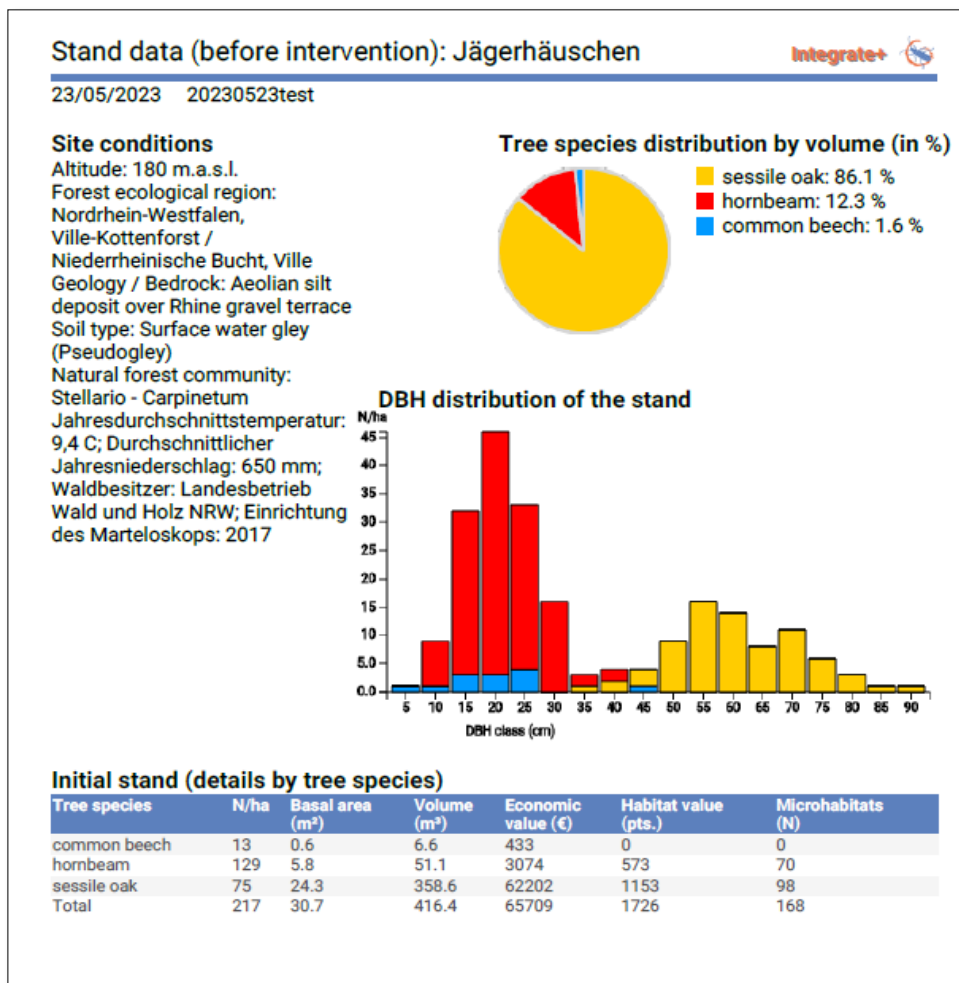


If 'Create a pdf only' is selected, the exercise result is then only saved locally on the mobile device. If the exercise is to be continued / corrected, click on 'Edit selection' (the saving process can then be postponed until after having revisited the exercise results again).

An exercise is saved as a '.pdf' and '.csv' file. Depending on how the tablet is set up, the saved files are located in one of your folders in the file manager. For explanations of the '.csv' file, please consult the '['+ Manager Guide'](#)' (Chapter 6, pages 14 and 15).



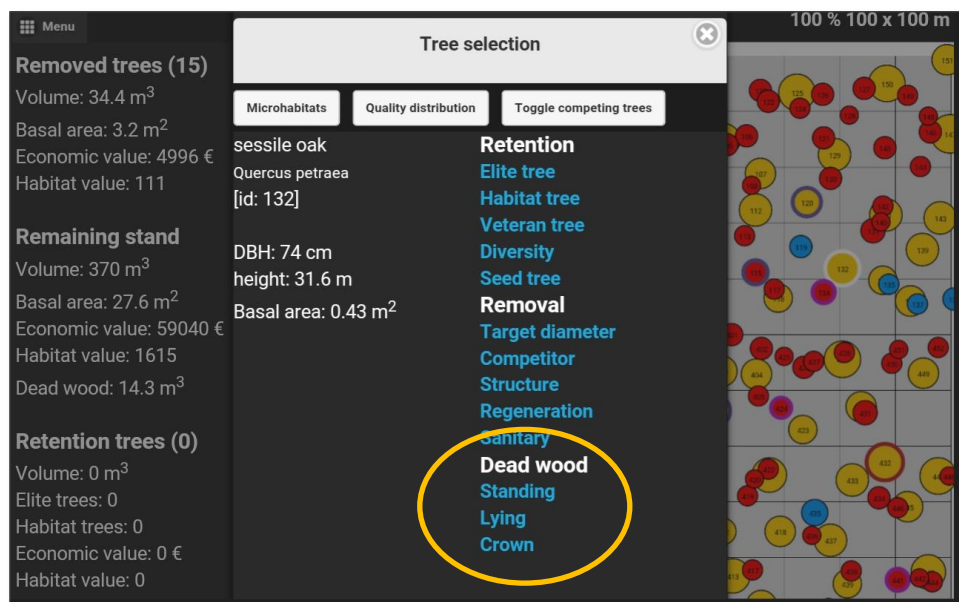
The automatically created '.pdf file' contains all important exercise results on more than 10 pages (Excerpt of the pdf: see below.).



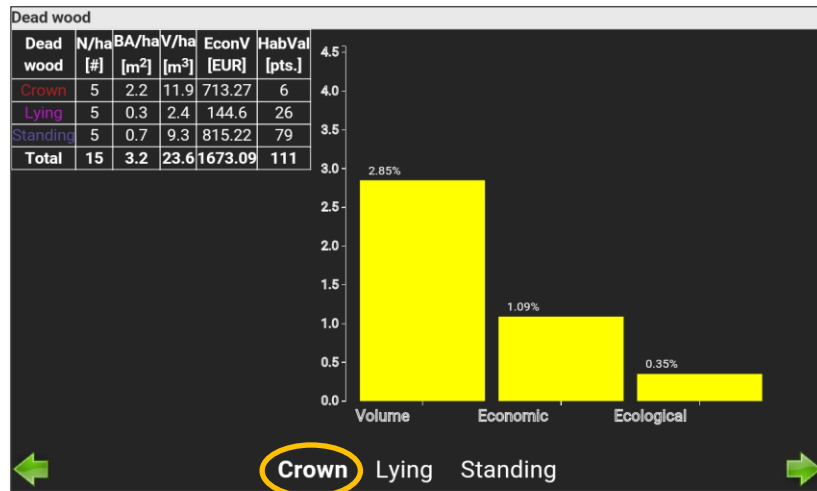
3. New modules and functionalities

3.1. Creation of deadwood

One of the new I+ Trainer software versions allows to practice deadwood creation in marteloscopes e.g. how fast can different deadwood types (standing / lying), quantities (m^3) be enriched or what is the 'cost' of increasing deadwood amounts?). A tree can be designated as 'standing deadwood' (e.g. through natural dieback or active measures such as ring girdling, high capping) or as 'lying deadwood' (e.g. felling and leaving the entire tree in the stand). Furthermore, the 'crown' of a tree can remain in the stand after felling. The term 'crown' is used for representing the poor quality class/classes of a tree (i.e. 'firewood'; 'D-quality wood').

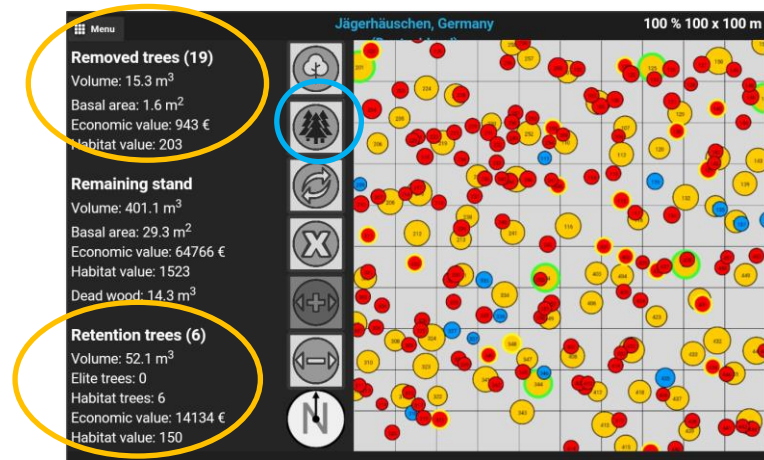
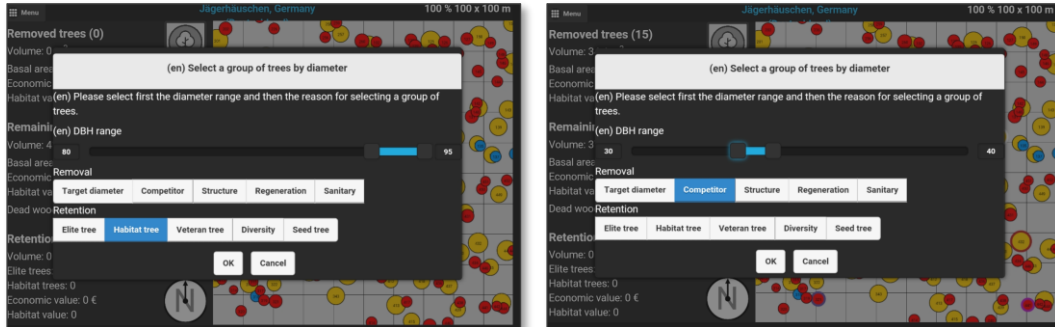


In the exercise results, the virtual interventions are presented in a separate window in tabular form and in a bar chart. The bar chart visualises the share of deadwood of the total in percent ('crown', 'lying', 'standing') for volume, economic and habitat value.



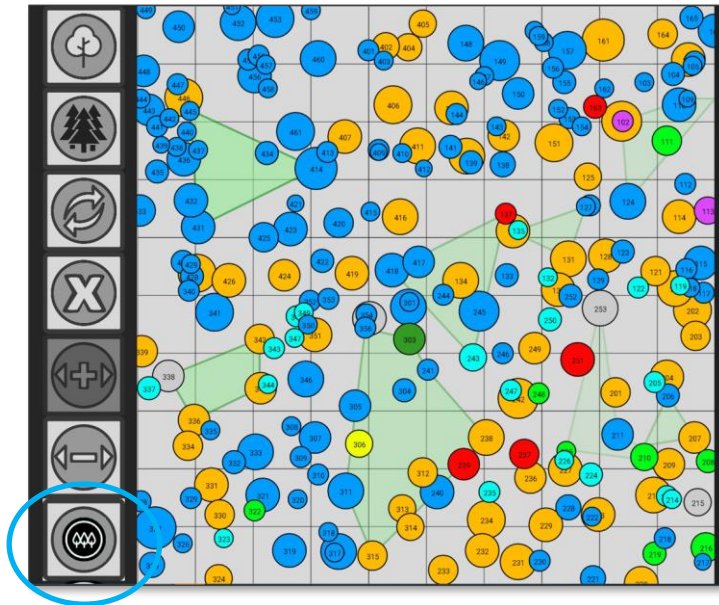
3.2. Group selection

Under the group selection tab (highlighted in blue) a diameter range can be defined that should either be removed or retained (reason for removal or retention can also be specified). Selected trees are highlighted with green and yellow circles. Numeric values after an intervention are shown on the left.

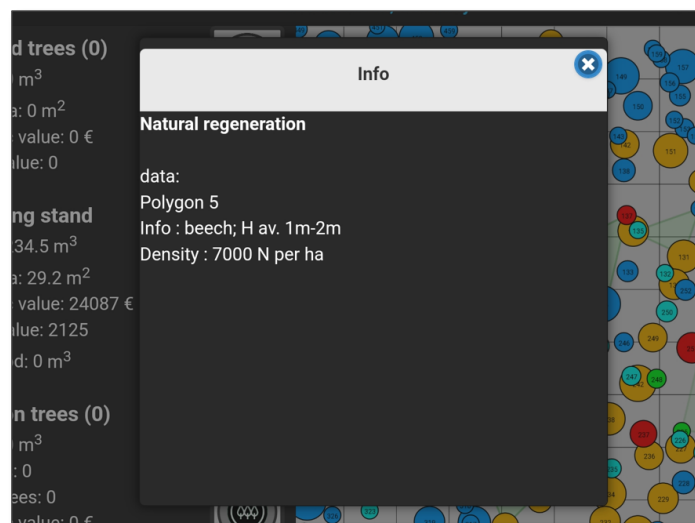


3.3. Regeneration

In case regeneration patches have been recorded in a marteloscope site there is a possibility to visualise them as an additional layer in the tree base map (green patches). It can also be hidden from the view of participants by clicking on the below highlighted symbol (in blue). In this way the regeneration patches are not shown if this is wished for a specific training exercise. The regeneration feature is still under further development.



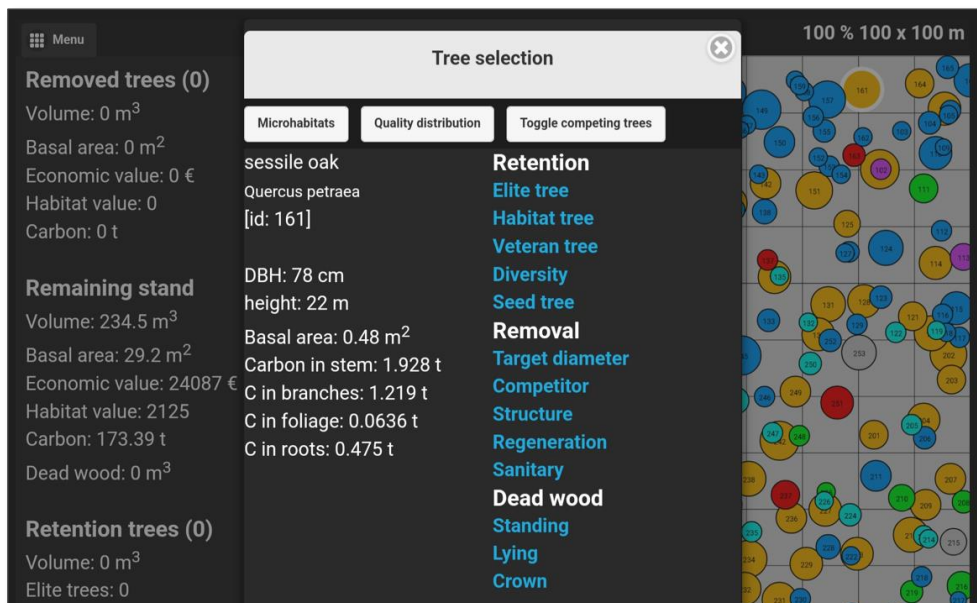
Using the touch screen, you can access further details on the regeneration patch if such information was collected in the field and provided. It includes the trees species in the regeneration patch, information on average height and a calculation of the number of trees extrapolated to one hectare.



3.4. Carbon Module

Newer I+ Trainer software versions allow information on the amount of sequestered carbon to be displayed by compartments on individual trees, as well as for the entire stand separately by tree species. As information on the volumes of different quality classes is available for each individual tree, their respective quality sections can be presented in tonnes of carbon (see table).

Carbon stored (tonnes)										
Tree species	Count	Wood	Branches	Foliage	Roots	C in A	C in B	C in C	C in IT	C in FW
Scots pine <i>Pinus sylvestris</i>	2	0.79	0.117	0.027	0.213	0	0.252	0.179	0	0.351
common beech <i>Fagus sylvatica</i>	133	39.248	26.257	0.641	10.634	1.56	6.838	13.175	3.663	11.614
field maple <i>Acer campestre</i>	2	0.221	0.036	0.017	0.09	0	0	0	0.116	0.057
hornbeam <i>Carpinus betulus</i>	20	0.585	0.389	0.033	0.38	0	0	0.098	0	0.342
large-leaved lime <i>Tilia platyphylla</i>	5	1.467	0.44	0.034	0.472	0	0	0.462	0	0.9
sessile oak <i>Quercus petraea</i>	63	44.878	29.476	1.793	12.571	3.461	12.597	14.121	6.55	7.024
silver birch <i>Betula pendula</i>	2	0.586	0.135	0.018	0.191	0	0	0	0	0.557
wild service tree <i>Sorbus torminalis</i>	8	0.868	0.349	0.031	0.403	0.154	0	0.167	0.232	0.18
Plot	235	88.643	57.199	2.594	24.954	5.176	19.688	28.202	10.561	21.024



The screenshot displays the 'Tree selection' window in the I+ Trainer software. On the left, a sidebar shows the status of the stand:

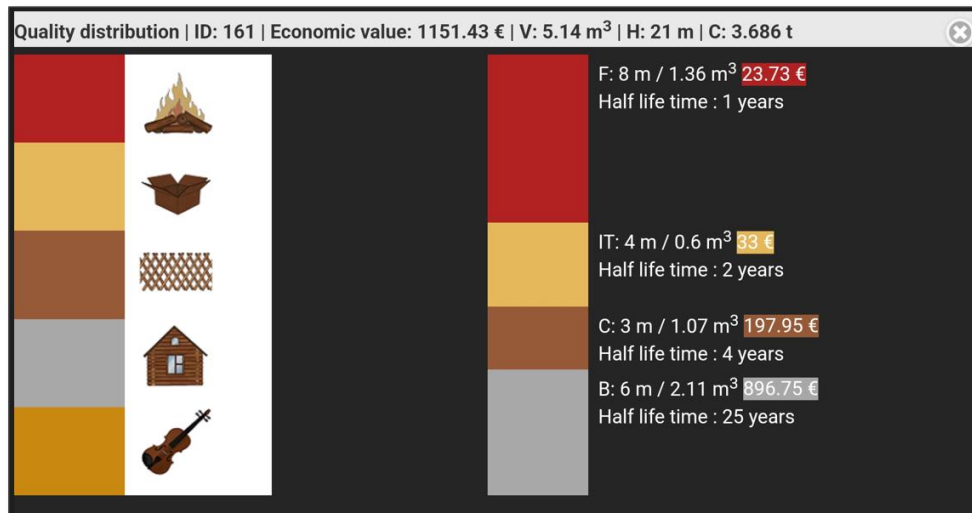
- Removed trees (0)**: Volume: 0 m³, Basal area: 0 m², Economic value: 0 €, Habitat value: 0, Carbon: 0 t
- Remaining stand**: Volume: 234.5 m³, Basal area: 29.2 m², Economic value: 24087 €, Habitat value: 2125, Carbon: 173.39 t, Dead wood: 0 m³
- Retention trees (0)**: Volume: 0 m³, Elite trees: 0

The 'Tree selection' window has three tabs: 'Microhabitats', 'Quality distribution', and 'Toggle competing trees'. The 'Quality distribution' tab is active, showing a list of tree quality classes:

- Retention**
 - Elite tree
 - Habitat tree
 - Veteran tree
 - Diversity
 - Seed tree
- Removal**
 - Target diameter
 - Competitor
 - Structure
 - Regeneration
 - Sanitary
- Dead wood**
 - Standing
 - Lying
 - Crown

The selected tree is a sessile oak (*Quercus petraea*) with ID 161. Its characteristics are: DBH: 78 cm, height: 22 m, Basal area: 0.48 m², Carbon in stem: 1.928 t, C in branches: 1.219 t, C in foliage: 0.0636 t, and C in roots: 0.475 t. The background shows a 100% view of a 100 x 100 m plot with various trees represented by colored circles.

In addition to information on tree height (m), volumes (m³), revenue (€) and carbon (t), the half-life time of individual quality classes can be displayed for each individual tree. The quality classes are illustrated by selected "wood products" on the left.



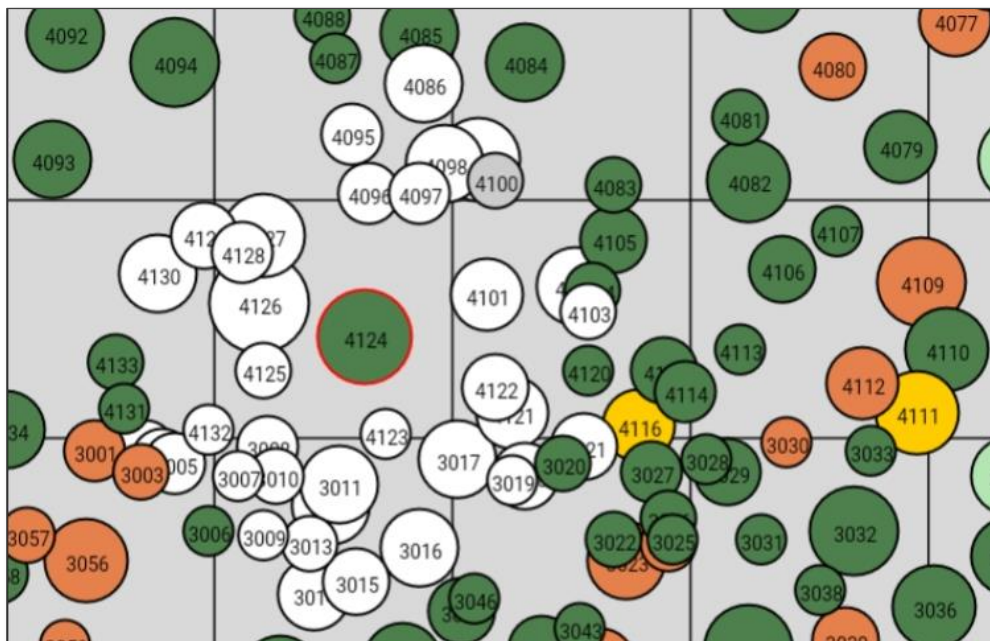
After carrying out an exercise, the results of individual groups / participants can be accessed as already explained. The results show the removal of carbon from the marteloscope area. On the one hand, the carbon of selected trees (by tree species) is presented for all compartments (Carbon [t]), while HWP [t] being harvested wood products gives information of the part of the tree that is removed from the stand (based on quality classes) and further stored in corresponding products.



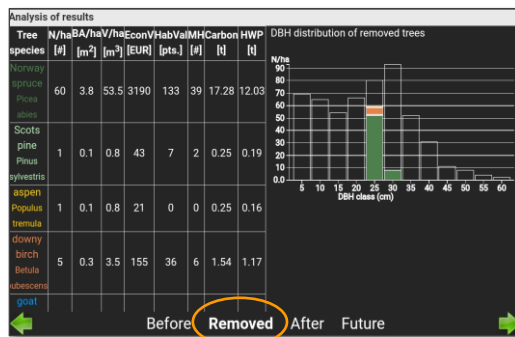
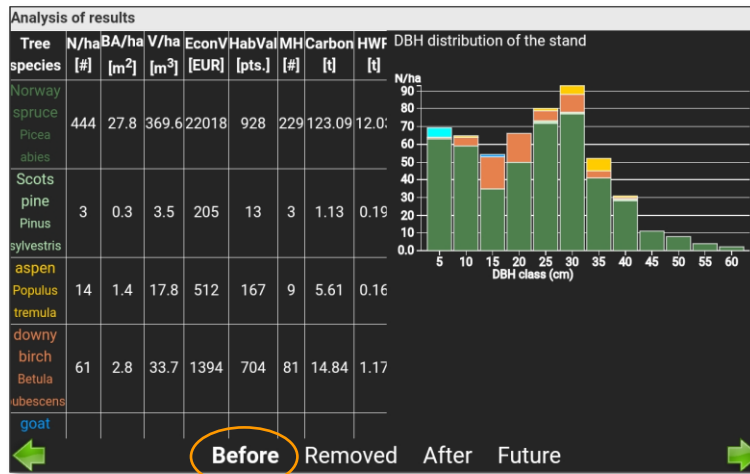
The carbon module was realised within the projects “FoReSite” and “Metsänomistajien päätöksenteon tuki muuttuvassa toimintaympäristössä (Integrate)”.

3.5. Stand development (prediction 20 years)

A stand development prediction module was developed in the Finnish project “Metsänomistajien päätöksenteon tuki muuttuvassa toimintaympäristössä (Integrate)”. It is a simple prediction model for a period of 20 years and utilises available data and information for individual trees inventoried in marteloscopes. The spatial distribution of trees to one another is available through tree coordinates. Tree size is defined by diameter at breast height (dbh).



Combined with tree species and site related growth functions, the potential growth of each tree is calculated. Once virtual management measures have been applied during field training events, the increment of all removed trees is distributed to neighbouring trees based on Competition Index (CI) which is calculated based on tree distance (k-nearest neighbour approach) and tree size (dbh). The module has been set and tested for forest types in Finland. Results were acceptable and confirmed by experts from science and practice in the course of field exercises.



The software module has been developed in a way that it can be tailored to any regional / local growth functions for given trees species in which a marteloscope is located. Such will need to be provided to EFI's developers team, who can then tailor the stand prediction module.