



GUIDELINES FOR ESTABLISHING **I+ marteloscopes**



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Reference

Derks, J., Schuck, A., Krumm, F., Kraus, D. (2020). Guidelines for establishing I+ marteloscopes. European Forest Institute

<https://integratenetwork.org/>

<http://iplus.efi.int/>



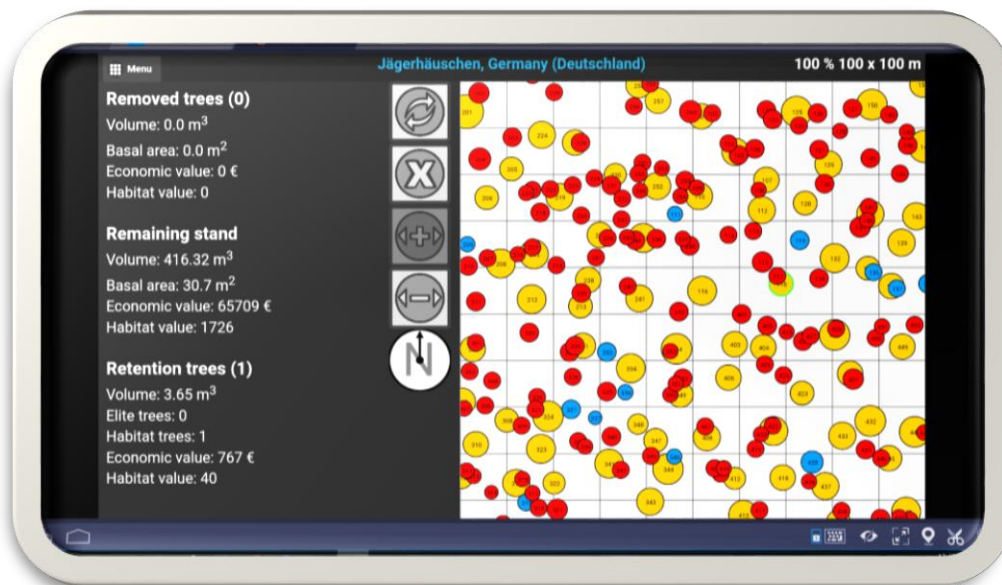
1. Aim and applications of marteloscopes

1.1. Introduction

The objective of this document is to compile all the necessary information and the corresponding methodology for establishing a new marteloscope. It describes which marteloscope parameters/variables need to be assessed and provides a step-by-step description of the whole procedure, without going in detail on the techniques that are described.

A marteloscope - from French 'martelage' (tree selection and the ancient Greek term "σκοπέιν/skopein" (to view) - is a forest stand of roughly one hectare, in which every single tree has been inventoried and numbered.

The collected information is then linked to a software application that can be used on-site to guide management decisions and to spur constructive discussions.

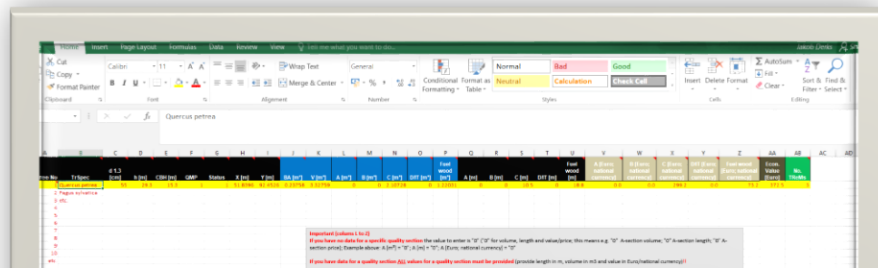


1. Image of a marteloscope stand in the I+ Trainer software

1.2. Which information needs to be recorded?

In the Integrate+ marteloscope network, information is collected on (1) tree species, (2) tree status as dead/alive, (3) forest mensuration data (dbh, tree height and crown base height), (4) timber quality and (5) tree related microhabitats using the tree microhabitat catalogue field guide.

Tree microhabitats are assessed using the typology that is described in the **tree microhabitat catalogue**, which is also available as an app. All the registered data have to be inserted in a standardised Excel **data entry sheet**. Both documents can be found under this link: <http://iplus.efi.int/documentation.html>



1.3. Good to know before starting

There are many different ways to collect the necessary data for setting up an I+ marteloscope, that may depend on the local customs but also on the available staff, time and tools. The process as described in this document is a suggestion of how the inventory could be structured, but it does not exclude different approaches to reach the same result.

This manual is designed for a two-person survey team. Two is the absolute minimum required to perform the task; for some steps (notably steps 1, 2 and 3) it is preferable to work with three people. Other steps can also be carried out individually if needed, such as tree numbering and microhabitat assessment. It is advised to go through each of the steps quadrant by quadrant.

2. Checklist of tools and materials

Tools		
<input type="checkbox"/>	<i>Distance measuring tape</i>	Demarcating the quadrants
<input type="checkbox"/>	<i>Tree measuring tape or tree calliper</i>	Measuring tree dbh
<input type="checkbox"/>	<i>Ranging rods</i>	Demarcating the quadrants
<input type="checkbox"/>	<i>Bright spray paint</i>	Painting wooden stakes
<input type="checkbox"/>	<i>White (spray) paint or tree tags</i>	Numbering trees
<input type="checkbox"/>	<i>Precision compass</i>	Demarcating the quadrants; measuring angle of tree to centre (eg. Suunto KB14)
<input type="checkbox"/>	<i>Hypsometer (or measuring tape + clinometer + calculator)</i>	Measuring distance of tree to centre; measuring tree and stem height. Ultrasound (eg. Haglöf Vertex) or laser (eg. LTI TruPulse)
<input type="checkbox"/>	<i>Binocular</i>	Finding tree microhabitats
<input type="checkbox"/>	<i>Catalogue of tree microhabitats</i>	Identifying tree microhabitats
Consumables / other stuff		
<input type="checkbox"/>	<i>Wooden stakes</i>	Marking the corners and the centres of the quadrants
<input type="checkbox"/>	<i>Signalling tape</i>	Demarcating the quadrants
<input type="checkbox"/>	<i>Steel brush/drawing knife</i>	Preparing rough tree bark for numbering
<input type="checkbox"/>	<i>Paper</i>	With pre-printed tables
<input type="checkbox"/>	<i>Writing board</i>	Supporting the paper and keeping it dry
<input type="checkbox"/>	<i>Pencil</i>	Still works when it is wet or cold
<input type="checkbox"/>	<i>High-visibility clothing</i>	Helps your colleague to spot you in the undergrowth

3. Checklist of parameters

Tree parameters		
<input type="checkbox"/>	Tree-ID	Labelling and identification of trees (tree number)
<input type="checkbox"/>	Tree position	Visualisation of the forest stand, location of individual trees
<input type="checkbox"/>	Tree species	Tree species composition and distribution
<input type="checkbox"/>	Diameter at breast height	Threshold for dbh varies according to the local circumstances. Input for calculation of tree volume and quality assessment
<input type="checkbox"/>	Tree height	Stand height, height/diameter-ratio; input for calculation of tree volume
<input type="checkbox"/>	Crown base height	Information on the volume of the merchantable stem and light conditions in the stand
<input type="checkbox"/>	Timber quality and assortments	Assessment and calculation of economic value (individual trees and stand), allows for comparison of marteloscopes; option for demonstrating effects that virtual interventions with „I+“ software have on the present and future stand in terms of economic revenue
<input type="checkbox"/>	Tree microhabitats	Assessment and calculation of ecological value (individual trees and stand); allows for comparison of marteloscopes; option for demonstrating effects that virtual interventions with I+ software have on the present and future stand in terms of ecological value
Stand parameters		
<input type="checkbox"/>	Site description	Describing site (including e.g. location, mean annual temperature; annual precipitation, forest type)
<input type="checkbox"/>	Increment	Allows to give indications on tree/stand growth (m ³ /ha) including tree/stand development based on virtual tree selections with I+ software
<input type="checkbox"/>	Deadwood	Important stand parameter; input for the calculation of the overall ecological value of a stand; effects on stand vitality, water and carbon storage and protective function in mountainous regions

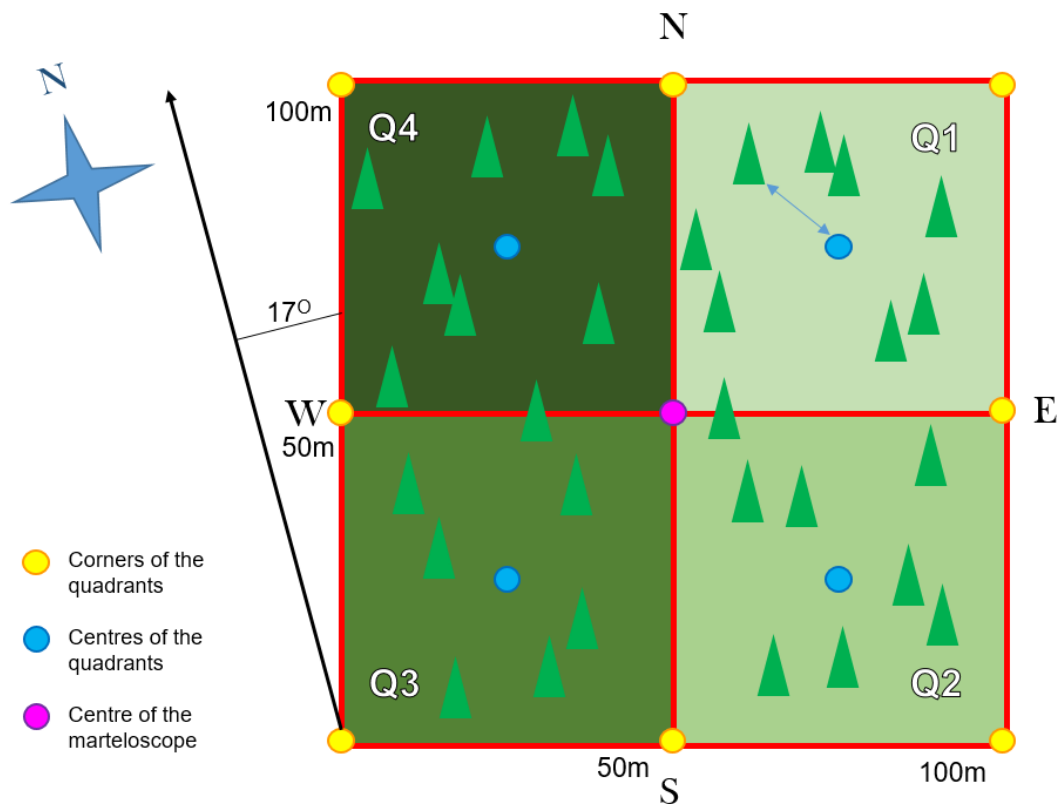
4. Selecting a marteloscope site

4.1. Site location and stand type

- Find a site that is representative for the forest district
- Look for a site with a certain “need” for management action
- Guarantee a continuity for at least 5 years (no planned interventions)
- Try to find a site that is accessible and safe

4.2. Size and form of a marteloscope






- Size: preferably 1 hectare, but smaller sites are also possible
- Form: as quadratic as possible (100x100 meters on for a 1 ha site)
- Try to orientate the stand along a north-south axis if possible



2. Schematic overview of a marteloscope site

5. Inventorying the stand data






5.1. Measuring and demarcating the site

Measuring tape (min. 50 m)	Precision compass	Wooden stakes (13)
		
Spray paint (3 colours)	Ranging rods	
		

✓ *First roughly estimate the size of the site (eg. counting your steps) to make sure the plot will nicely fit*

- Measure the outer borders of the plot. Put a ranging rod every 50 meters. Make sure two adjacent sides are always in an exact angle of 90° .
- Measure the inner borders between the quadrants and put a ranging rod every 50 meters.
- When everything is correct, replace the ranging rods with permanent wooden stakes. Spray the stakes in a bright colour (eg. orange) for visibility
- Find the centre of each quadrant using triangulation (it should be at approximately 35,5 meter from the corner stakes).
- Spray the central stake of each quadrant in a bright colour (eg. blue) for visibility.
- Spray the central stake of the marteloscope in a bright colour (eg. pink) for visibility.

5.2. Numbering and identifying the trees; measuring dbh

White (spray) paint	or	Tree tags	Signalling tape
			
Measuring tape	or	Tree calliper	
			

- ✓ Go through the stand clockwise, starting with the north-eastern quadrant
 - ✓ Number the trees separately for each quadrant
 - ✓ The trees in quadrant 1 start at 101, the trees in quadrant 2 start at 201 etc.. If there are more than a 100 trees in a quadrant, continue with 1001
 - ✓ It can be helpful to temporarily demarcate the quadrant with signalling tape
- Person 1 walks around the quadrant and numbers the trees clockwise (with paint or tags), starting in the north of the quadrant. The numbers face either one chosen direction or the centre of the quadrant.
 - Person 2 measures dbh with a tape or a calliper.
 - Person 2 writes down tree number, tree species and dbh



Signalling tape helps to make the quadrants more visible during their demarcation and during the tree assessment.








The tree numbers need to be clearly marked and face either the centre of the quadrant, or one side of the stand.



To measure the distance from the tree to the centre of the quadrant, place the transponder next to the centre stake. If needed, attach it to a high ranging rod for visibility.

5.3. Geo-referencing the trees

	Ultrasound hypsometer	Transponder	Precision compass
High-tech option			
	Measuring tape (min. 35 m)	Precision compass	
Low-tech option			

✓ *This step can be combined with step 2 if preferred. This can best be done with three people: one numbering the trees, one taking measurements and one writing down the data*

- Attach the transponder to a pole or ranging rod at the centre of the quadrant.
- Person 1 walks around the quadrant following the numbering order. At each tree, person 1 measures the distance and the angle from that tree to the transponder at the centre of the quadrant.
- Person 2 writes down the distance and the angle of each tree to the centre.
- Low-tech option: If you don't have a hypsometer, a (less accurate) alternative is to use the distance measuring tape.



In a stand with little undergrowth and good visibility, a laser hypsometer can make height or distance measurements easier.









In stands with a dense undergrowth, the use of an ultrasound hypsometer (eg. Haglöf Vertex) is recommended.



Wood quality assessment is best done in the presence of a local forest manager.







5.4. Measuring tree height

	Ultrasound hypsometer	Transponder	Laser hypsometer
High-tech option			
	Measuring tape (min. 35 m)	Clinometer	Calculator
Low-tech option			

✓ This step can also be used to record the crown base height

- Person 1 holds the transponder to the tree at breast height.
- Person 2 stands at a sufficient distance and uses the Vertex to measure the height of the tree and writes it down.
- Alternatively, person 1 can use a laser rangefinder and write down the results. This can be done by one person, but only in open stands with little understorey.
- Low-tech option: If you don't have a hypsometer, a (tedious and less accurate) alternative is to use an inclinometer, a distance measuring tape and a calculator.

5.5. Recording wood qualities

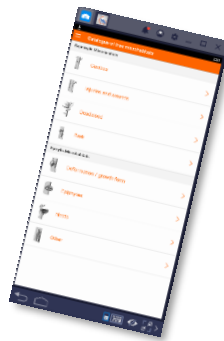
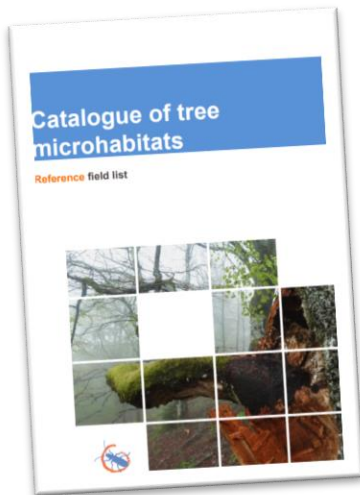
	Ultrasound hypsometer	Transponder	Laser hypsometer
High-tech option			
	Measuring tape (min. 35 m)	Clinometer	Calculator
Low-tech option			

- ✓ Before starting this, discuss the quality standards and wood market demands with the forest owner or manager.
- ✓ This step can also be used to record the crown base height
- ✓ Measuring trees is not needed if the assortment is clear with the naked eye
 - Person 1 holds the transponder to the tree at breast height and clearly says the tree number to person 2.
 - Person 2 uses the Vertex to measure the height of the merchantable stem.
 - Alternatively, person 2 can use a laser rangefinder if the understory is not too dense.
 - Person 1 inspects the tree for quality defaults all around the stem and the survey team agrees on the quality distribution.
 - Low-tech option: If you don't have a hypsometer, a (less accurate) alternative is to use an inclinometer, a distance measure tape and a calculator, or even educated guesses.

5.6. Recording tree microhabitats

Catalogue of tree microhabitats

Binocular



- The two people each carry a binocular so they can inspect the tree from all sides.
- Person 1 carries the catalogue, person 2 writes the microhabitats down next to the tree number.
- Person 1 focusses on the tree base while person 2 focusses on the crown.

6. Finalising the process

Insert all the recorded data into the designated Excel data entry sheet and send it to EFI's IT team. Once the data have been digitalised, enjoy your exercises!



3. Performing a virtual thinning on a tablet using the I+ Trainer software