



Berner
Fachhochschule



Capturing Dendrometric Variables Using Mobile Phone Applications

ICF National Conference 2018: Innovation for Change
Edinburgh 2-3 May 2018

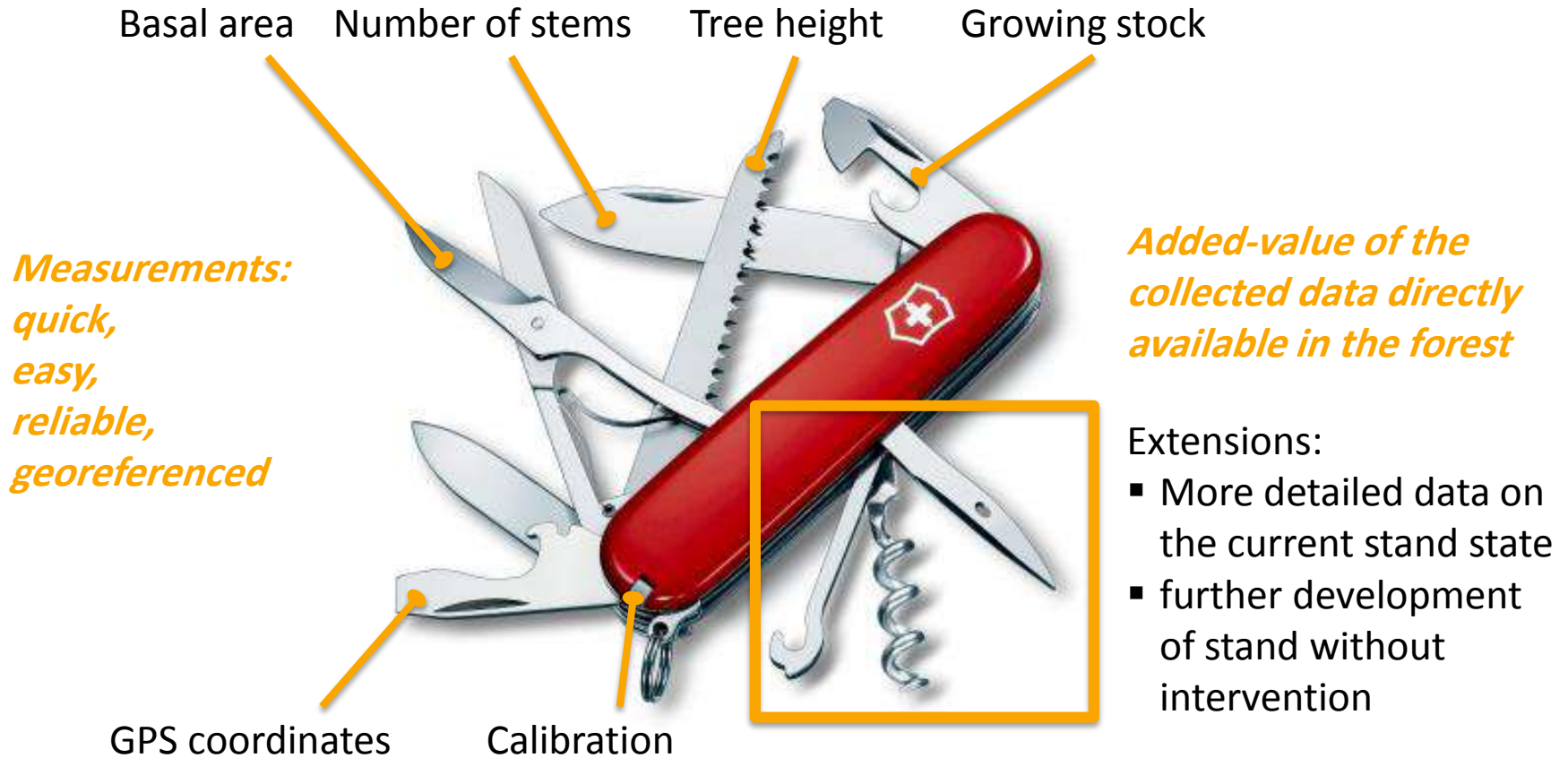
Christian Rosset, Bern University of Applied Sciences (Switzerland)

► Berner Fachhochschule | Hochschule für Agrar- Forst- und Lebensmittelwissenschaften HAFL

MOTI

> Swiss army knife for forest inventories and forest growth

The tool: always at disposal, simple to use, handy



MOTI: easily quantify what you see in the forest

Growing stock?
Tree height?
Stem density?
Basal area?



MOTI: easily quantify what you see in the forest

Growing stock?
Tree height?
Stem density?
Basal area?



Sample plot

DATA COLLECTION RESULTS SIWAWA

Sample plot: peuplement érables

Position [m]: 602330 / 204630

Summary of the sample plot:

Basal area [m²/ha]: 40

Stem number [-/ha]: 833

Dom. height [m]: 27

Timber stock [m³/ha]: 438

The timber stock was calculated using the form-height-values of the main tree species in the Swiss forest calendar (see Help for details).

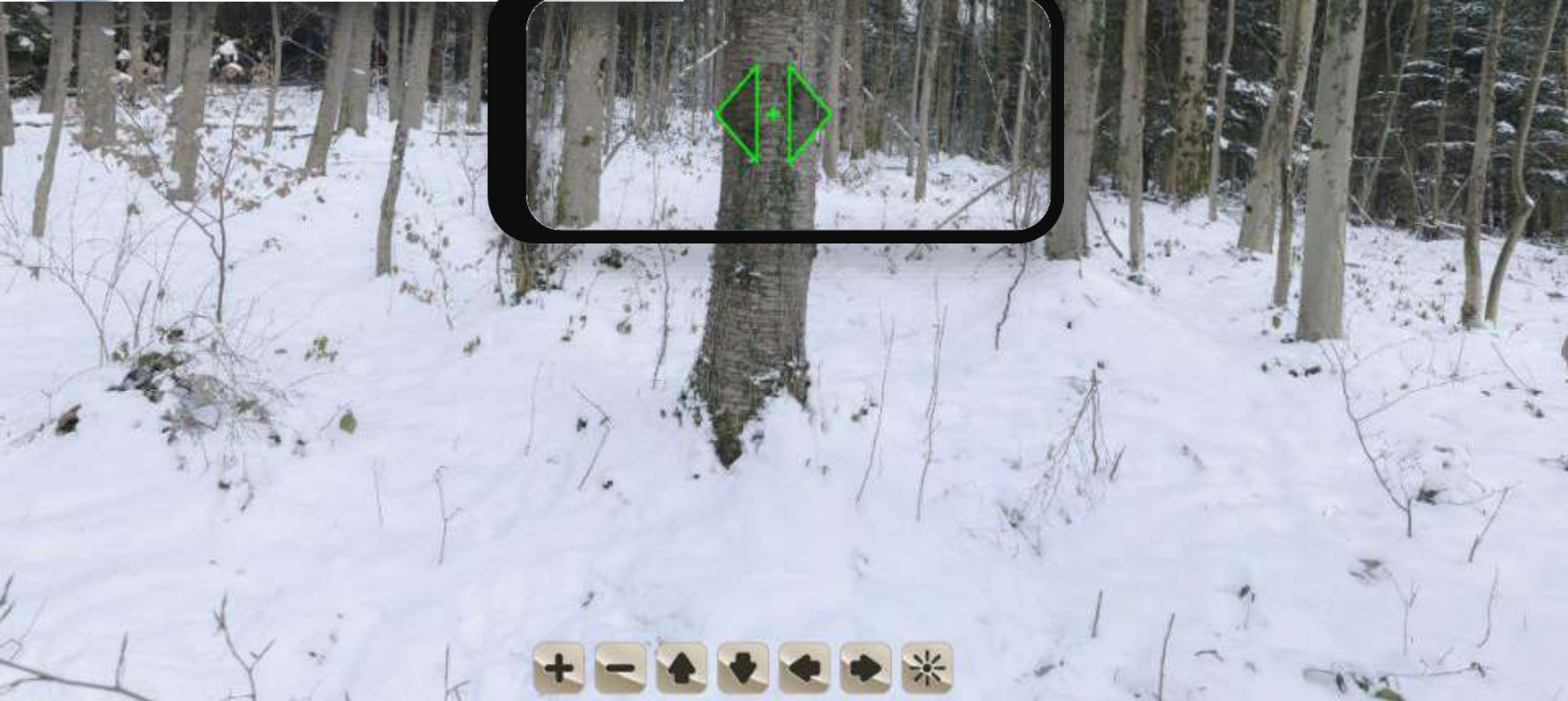
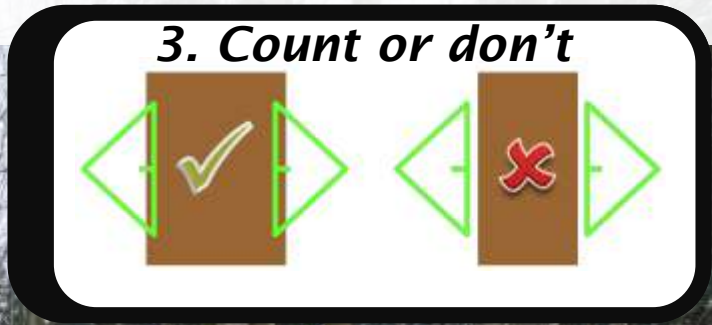
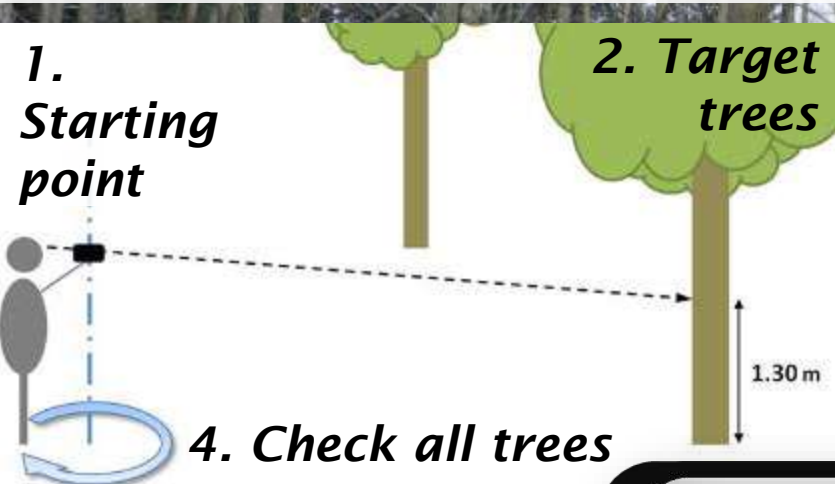
Quadratic mean diameter [cm]: 24

Tree species composition based on G

Larch:	5%
Ash:	15%
Sycamore:	45%
Oth. dec.:	35%

Navigation icons: +, -, up, down, left, right, star

Measurement of basal area with MOTI





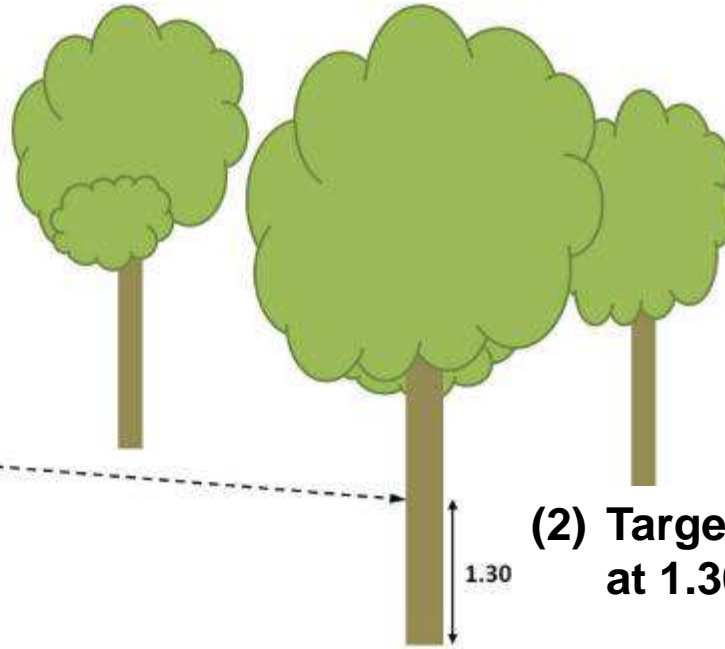
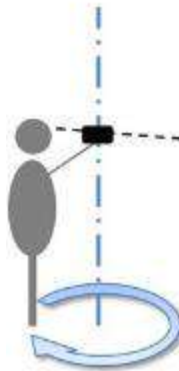
Measurement of the basal area per ha (G)



(1) Starting point

Mark the **sampling point** by e.g. sticking a branch in the ground.

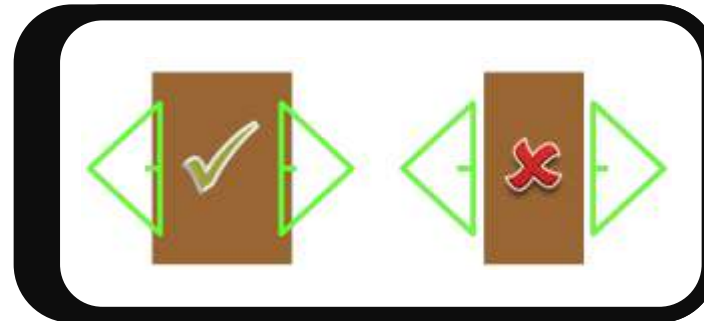
Start with the **nearest tree** in order to remember where you started off.



(2) Target the trees at 1.30m height

(4) Check all the trees

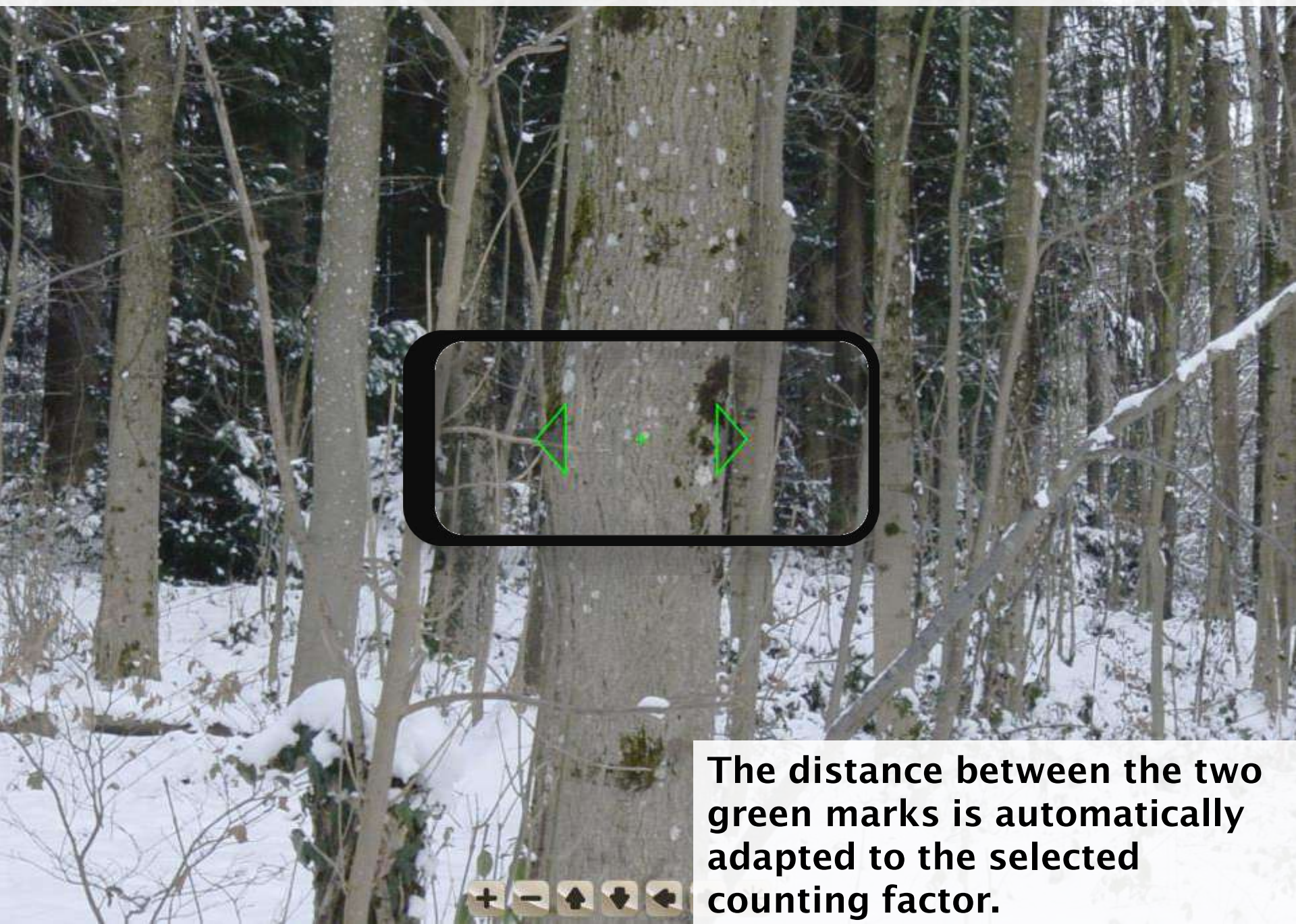
... in the nearby surrounding area by rotating the Smartphone **360° around** a specific location.



(3) Count a tree or don't

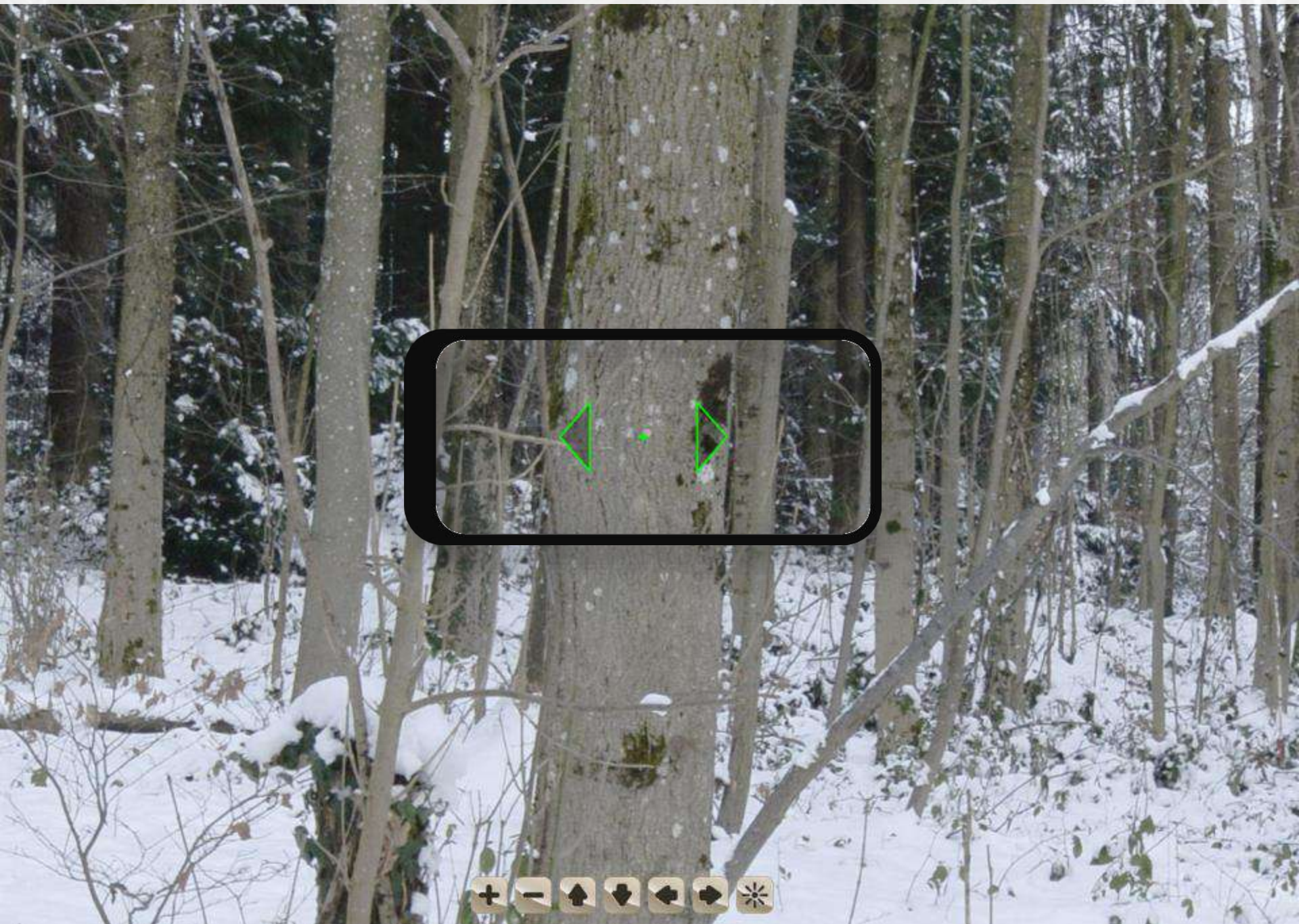
The **slope** is automatically taken into account by built-in sensors

Counting factor $k = 4$

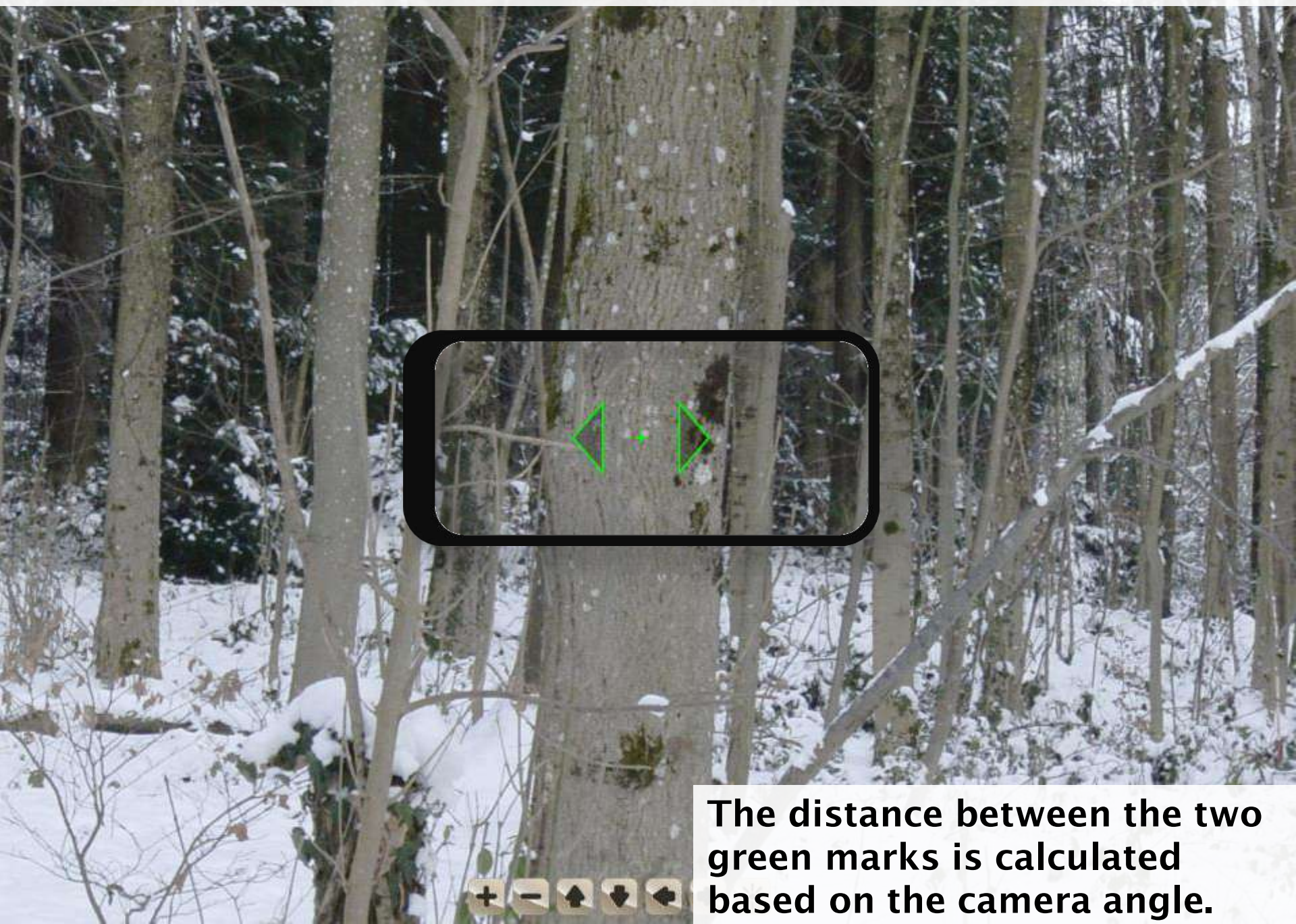


The distance between the two green marks is automatically adapted to the selected counting factor.

Counting factor $k = 2$



Counting factor $k = 1$

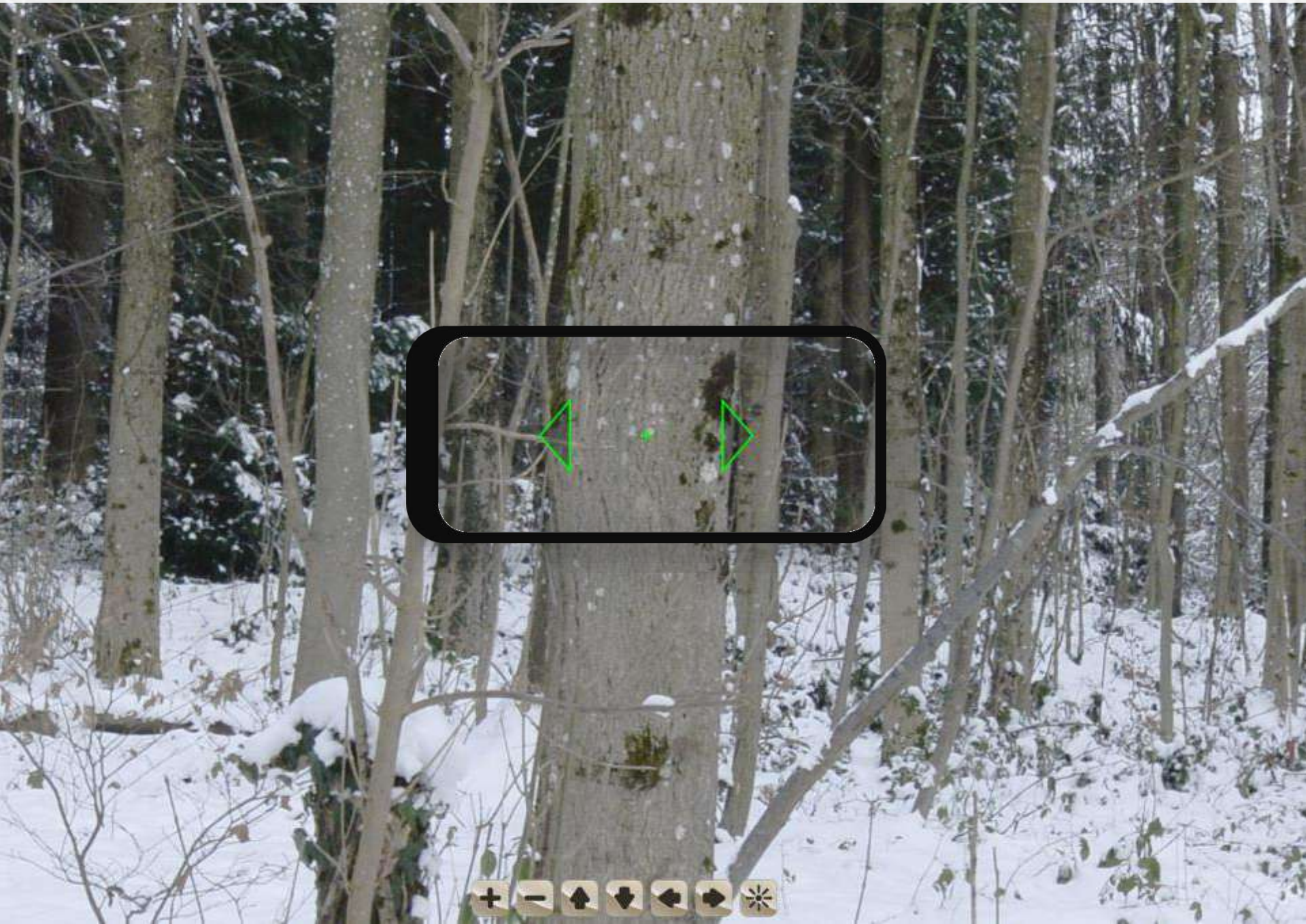


The distance between the two green marks is calculated based on the camera angle.

Essential advantage of camera: possibility to zoom in

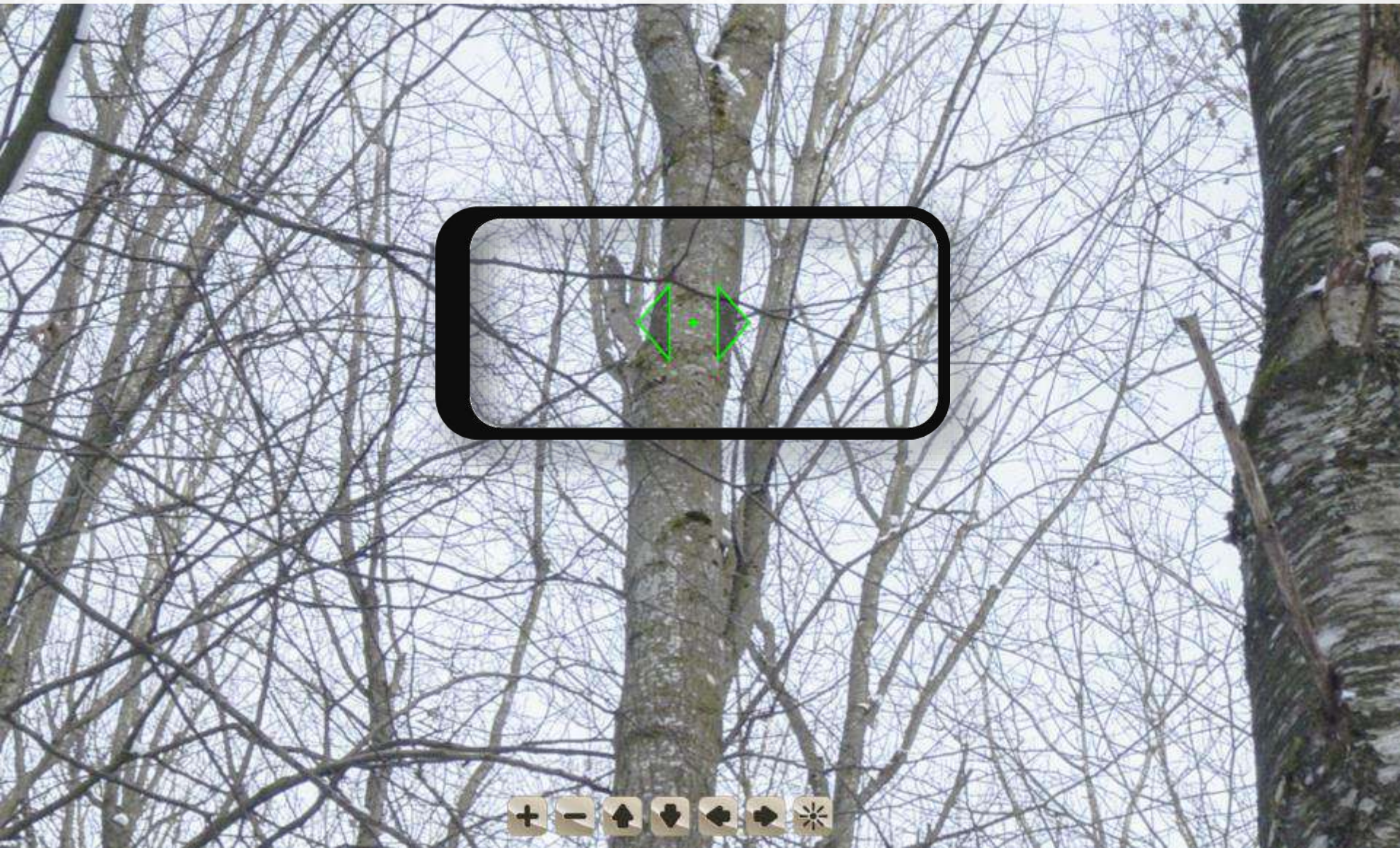


Essential advantage of camera: possibility to zoom in



Vertical orientation of the smartphone automatically taken into account by built-in sensors

- > distance between the two green marks adapted accordingly**
- > particularly important in the case of slope**



Settings: ex. counting factor k
Online-Help (Measurements and Calibration)



Single measurements without saving the values

Save the results in a sample plot, including its location with GPS

Home



Determination of k
(counting factor)



moti
mobile timber cruise

Measuring instruments



Basal area

0 m²/ha



Stem cou...

0 /ha



Tree heig...

0 m



Timber v...

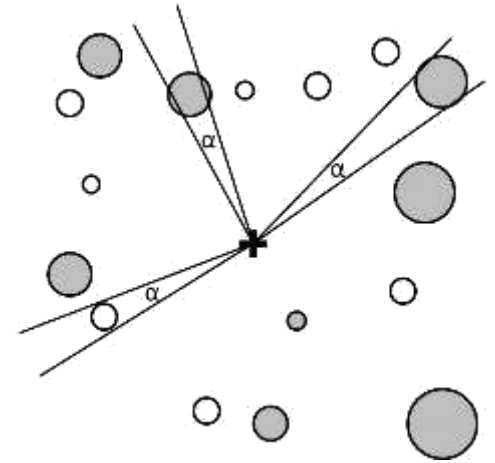
0 m³/ha

Inventories

Sample p...

Stand inven...

Local inven...



Home



Determination of k
(counting factor)



moti
mobile timber cruise

Measuring instruments



Basal area

0 m²/ha



Stem cou...

0 /ha



Tree heig...

0 m



Timber v...

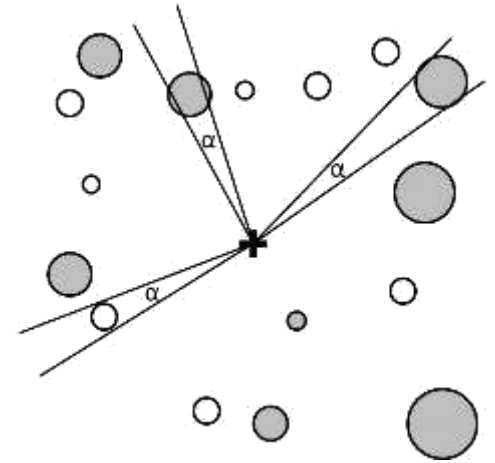
0 m³/ha

Inventories

Sample p

Stand inven

Local inven



MOTI



- ▶ Use of **embedded sensors** to simplify measurements (e.g., flexible count factor, slope)
- ▶ Use of the **touch screen** for easy measurement taking (zoom in/out, counting button)
- ▶ **Calibration** procedure integrated in the app
- ▶ **Data** synchronization with a server, convenient data download at the office or direct data export

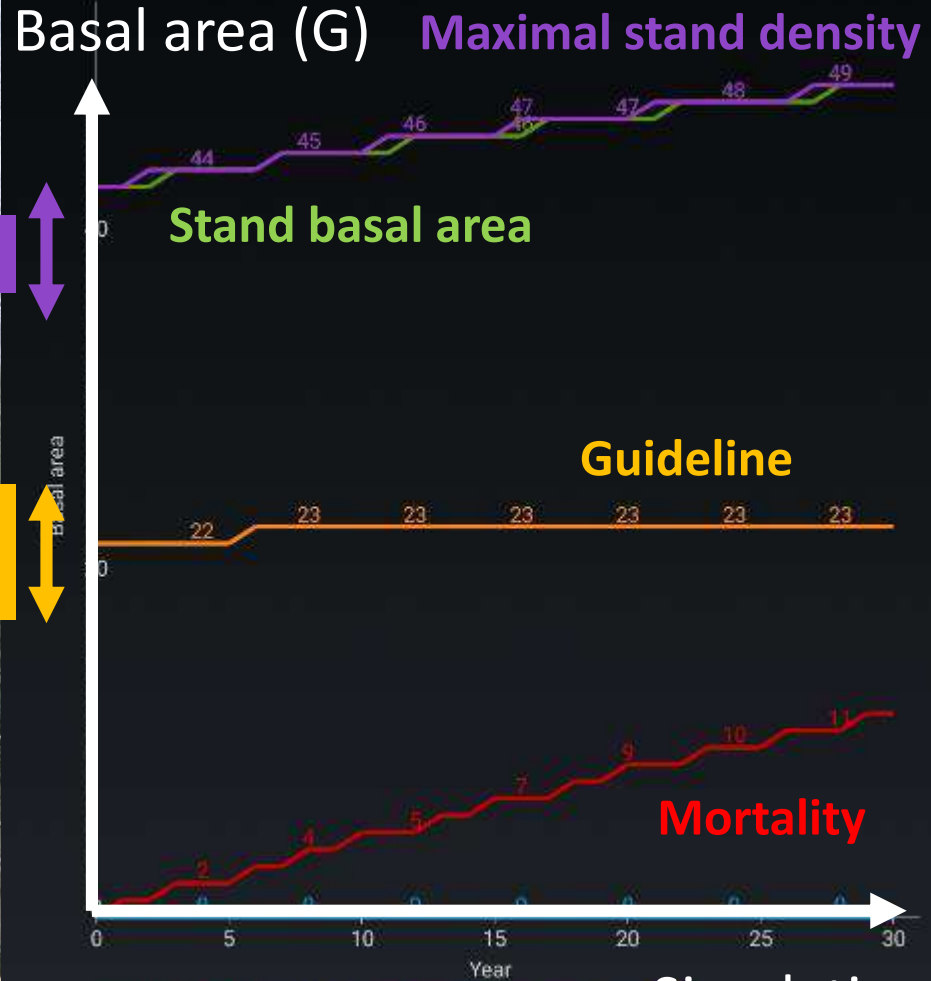
The screenshot shows the Google Play Store page for the MOTI app. At the top left is the app's icon, a stylized tree. To its right, the app name 'MOTI' is displayed in bold, followed by the developer 'HAFL Zollikofen' and the PEGI rating 'PEGI 3'. Below this information are two buttons: 'UNINSTALL' and 'OPEN'. A horizontal line separates this section from the next, which contains four circular icons: '10 THOUSAND Downloads', a '4,5' star rating with five stars below it, a 'Tools' icon (a wrench), and a 'Similar' icon (two overlapping documents). Below these icons is a short description: 'easily measure and store key dendrometric parameters such as timber stock'. At the bottom, there is a 'WHAT'S NEW' section with a starburst icon and the text 'Direct data export'.

SiWaWa embedded in MOTI: forest dynamic at your fingertips

Growth dynamic?
Dead wood?
Thinning urgency?

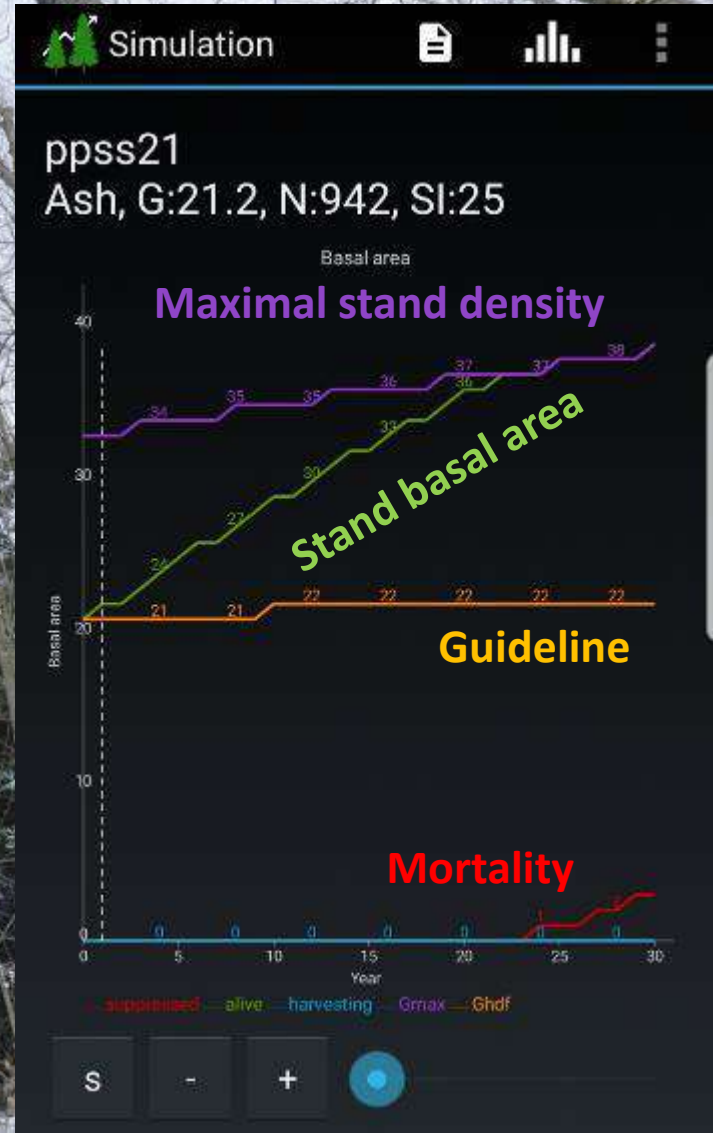
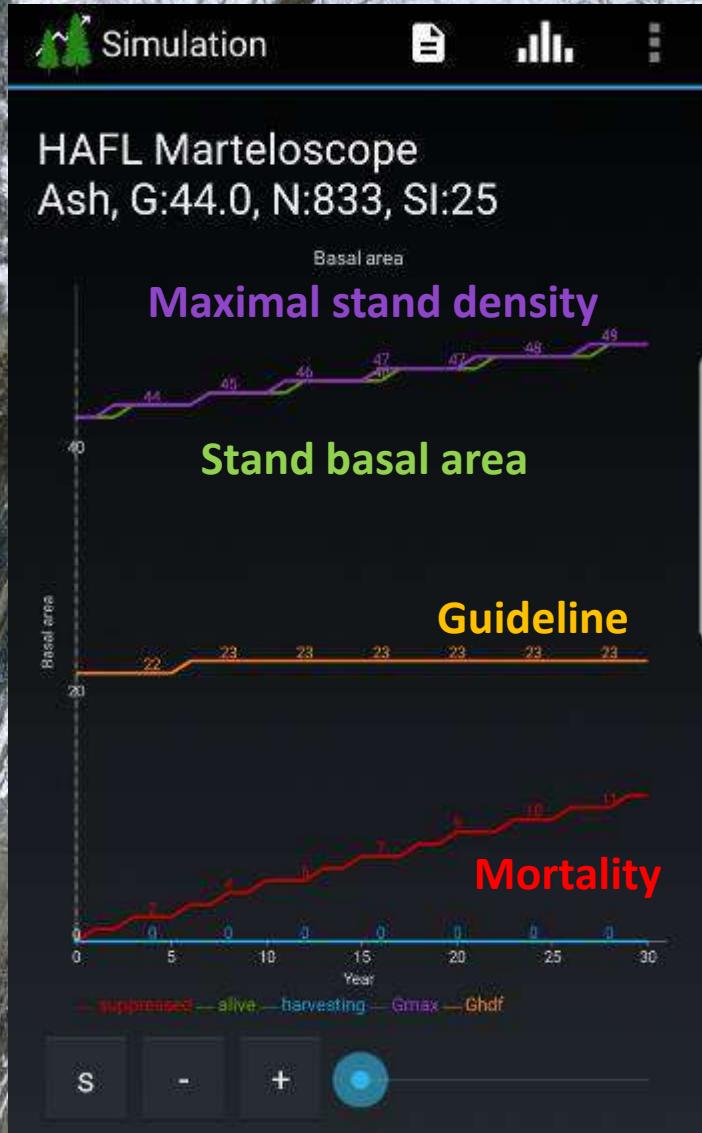
Productivity?
Wood quality?

Stability?



SiWaWa: clear silvicultural references, anticipate further development ...

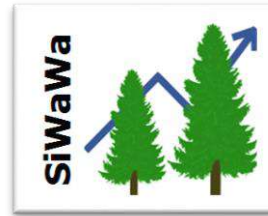
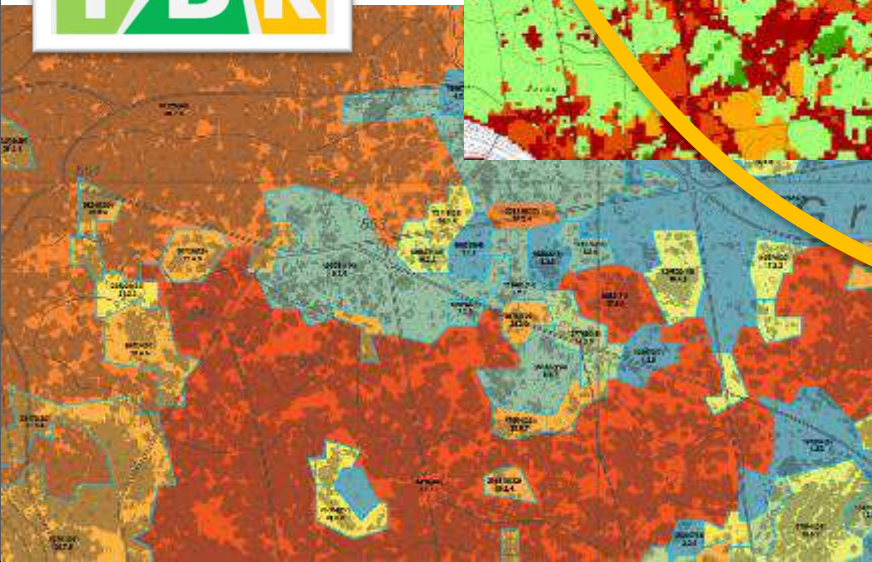
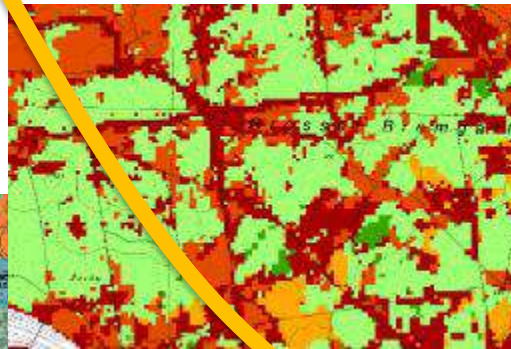
Growth dynamic?
Dead wood?
Thinning urgency?



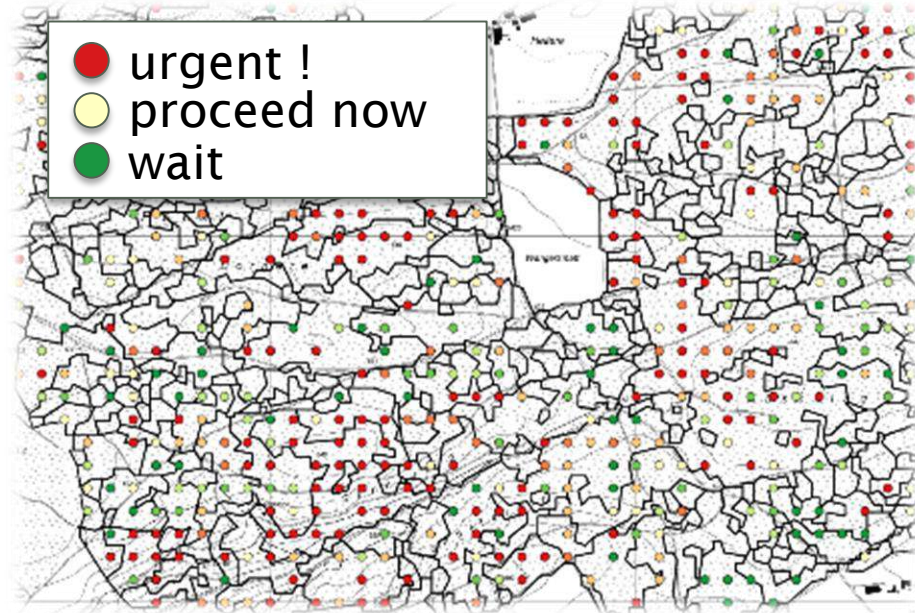
MOTI > synergies with other apps to support close-to-nature, multifunctional and sustainable forest ecosystem management



Toolkit to elaborate stand maps from remote sensing data (e.g. LiDAR, Sentinel-2)



Forest dynamics at your fingertips
Growth simulation model based on the input of MOTI
Example of application ...



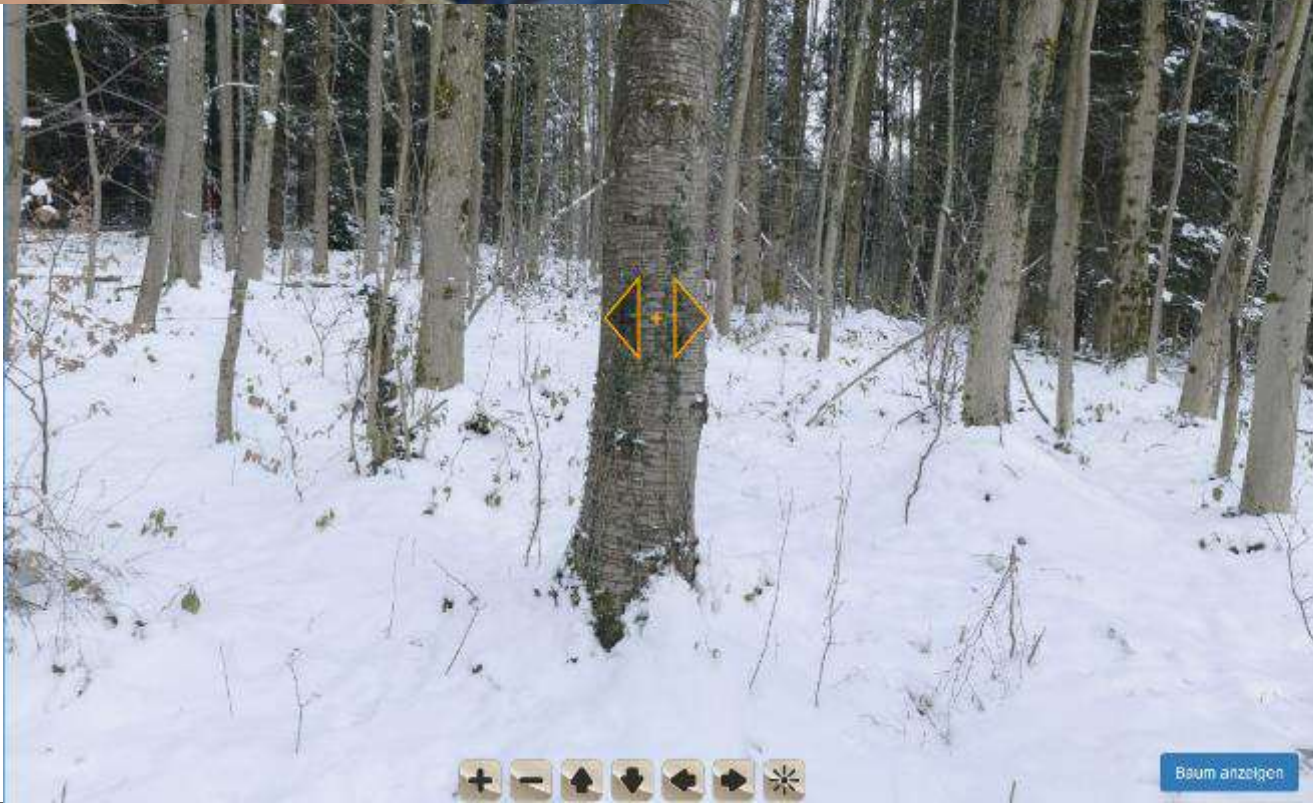
Management tool for goal-oriented and efficient management of forest ecosystems

MOTI > further developments ...

Forest Glass > based on Google Glass
> New ways to interact with computers

Forest Time Machine

> Forest Inventory based on 360° photography



Baum Photosphäre Auswertung

Auswertung

Mittlerer Kronenanteil: Keine Angabe

Grundfläche: 44
Anzahl Bäume: 11
Verwendeter Zahlfaktor: 4

Baumpositionen:

Baumart	Anzahl	Prozent
Esche	5	45%
Bergahorn	5	45%
übriges Laubholz	1	9%

Vertikale Soziale

Innovation for change ...

- ▶ More accurate perception of forest ecosystems (quantify what you see, get a detailed overview of a given forest area, ...)
- ▶ Ease comparisons with similar situations, exchanges among professionals, knowledge increase
- ▶ Support for silvicultural decision making, basis for optimization of production systems



Thank you very much for your attention !

Download on Google
Play Store:



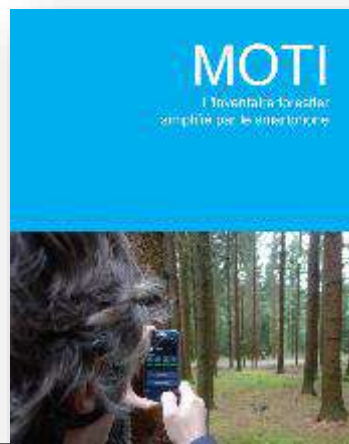
Download on Apple
App Store:



Tutorial for the
Calibration Procedure:



New book (FR/GE) on
forestrybooks.com:



Many thanks to our
founding organizations:

- Swiss Forest and Wood Research Fund
- Swiss Federal Office for the Environment (FOEN)
- FP7-Project FOCUS
- Swiss Cantons: BL, BS, FR, GE, GR, LU, SG, SO, TI, VD, VS, ZH

Project in collaboration
with BFH-TI (Team Ulrich
Fiedler)

Contact:

> info@moti.ch

> christian.rosset@bfh.ch

Manuel ...



Technique and planning > Forest inventory > A tool for forest inventories

Article

Author(s): Christian Rosset et al. (School of Agricultural, Forest and Food Sciences HAFL)
 Editorial office: WSL, Switzerland
 Comments: Article has 0 comments
 Rating: ★★★★★ (9)

To my favourites

MOTI: a pocket-sized tool for forest inventories

An application developed by Swiss researchers at the School of Agricultural, Forest and Food Sciences (HAFL) makes it possible to collect forest inventory data, such as the basal area or tree height, directly on a smartphone.

MOTI is a smartphone application that enables users to record quantitative data on what they see in the forest with just a few clicks – especially the wood stock, basal area, number of trees per hectare and growth increment. Try to estimate these key figures for the scene in figure 2, taking the person in the middle of the picture as a reference.

Without experience, making such estimates is anything but simple. One of the main goals of MOTI is to help users train their eyes to improve their personal assessments by being able to measure these figures quickly and easily. The app is also intended to provide decision support in the field (for marking, planning of silvicultural interventions ...).

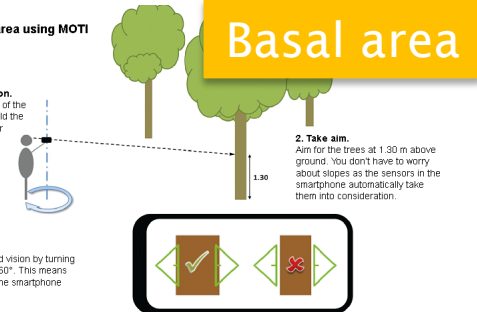
With MOTI, single or clustered sample plots in a stand can be measured and even local inventories performed (e.g. one sample plot every 100 m). The statistical error is then continuously computed. The app also includes a growth model for simulating the medium-term development of the investigated stand. The data collected is saved on a server and can later be downloaded from the office in Excel format.



Fig. 1 – MOTI is like a Swiss army knife: simple, easy to use and highly efficient.
 Photo: Eric Wullemin (HAFL)

Determining the basal area using MOTI

1. Take up your position.
 Visually mark the center of the plot, e.g. with a stick. Hold the smartphone directly over the mark.



4. Record.
 Include all trees in the field vision by turning around the smartphone 360°. This means you have to turn around the smartphone and not vice versa!

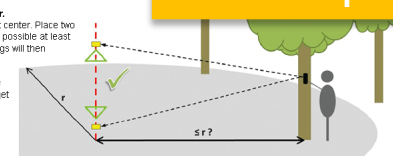
Attention: Do not miss out hidden trees!
 If the view of a tree is blocked by another tree or something else, move sideways until you can see it well. Take care to stay the same distance away from the tree as from the plot center.

3. Count or don't count.
 Count those trees with stems wider at 1.3 m above ground than the green markings on the screen.

The distance between these markings correspond to the counting factor k . You can also zoom in. If the green markings precisely match the edges of the tree, you have found a limit tree. Count only every second of these trees. Untrained users should then systematically vary these trees to train their eyes. (Distance from plot center to tree \times BHD 2 , $c=50$ for $k=1$, $c=35.56$ for $k=2$, $c=25$ for $k=4$)

Determining the number of stems per ha using MOTI

1. Mark the plot center.
 Place a stake on the plot center. Place two markings on the stake, if possible at least 2 m apart. These markings will then serve as references for calculating the distance between the smartphone and the stake. Don't forget to record the heights of the two markings in the MOTI settings.

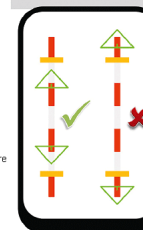


Stems per ha

2. Take up position and aim.
 Hold the smartphone beside the middle of the stem and aim at the stake.

4. Record.
 Check all the trees around the stake that may be located in the circular plot.

Start at the nearest tree, so you can remember where you started.



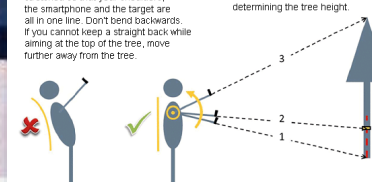
3. Count or don't count.
 A tree is only counted if the baseline of the two triangles comes to rest between the two markings on the stake.

The distance between these markings on the display is defined by the plot size and the height of the two stake markings. The smartphone lies on the radius r of the circular plot (e.g. 9.77m for $d=20$) if the baselines of the green triangles lie exactly on the stake markings. The slope is automatically considered.

Determining tree height using MOTI

2. Take up position and take aim.
 Position yourself at a distance from the tree between a half and one tree height away.

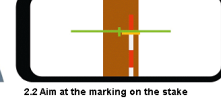
Aim at three points: first at the stem base (ground), then at the marking on the stake, and finally at the top of the tree (2.1 to 2.3). It is important to keep your arms stretched so that your shoulders, the smartphone and the target are all in one line. Don't bend backwards. If you cannot keep a straight back while aiming at the top of the tree, move further away from the tree.



1. Set the reference.
 Place a stake next to the tree and define one mark. The height of the mark serves as a reference for determining the tree height.



2.3 Aim at the top of the tree



2.2 Aim at the marking on the stake



Good to know...
 For a more accurate result, do at least three measurements and choose the automatically calculated mean as a value.

Tree height



My Waldwissen

TECHNIQUE AND PLANNING

Natural hazards

Forest technology

Landscape development

Forest inventory

FORESTRY

FOREST ECOLOGY

LEARNING AND TEACHING

DID YOU ALREADY KNOW?

78 MOTI, l'inventaire forestier mobile

Christian Rosset, Roland Brand, Dominique Weber, Eric Wuillemin, Clotilde Gollut, Iris Caillard, Ulrich Fiedler



MOTI, les inventaires forestiers dans la poche

par Christian Rosset*, Roland Brand*, Eric Wuillemin*, Clotilde Gollut*, Iris Caillard*, Ulrich Fiedler*

Mesurer la surface terrière d'un peuplement et sa hauteur avec votre smartphone, c'est possible grâce à une application mise au point par des étudiants chercheurs suisses.

Strumenti & Applicazioni

MOTI (MOBILE Timber cruise)



a cura di Massimo Bidini

Fare l'inventario forestale con tablet e smartphone

Autor(en): Christian Rosset et al. (Hochschule für Agrarwissenschaften, Universität für Waldwirtschaft, WSL, Schweiz)
 Redaktion: WSL, Schweiz
 Kommentare: Artikel hat 0 Kommentare
 Bewertung: ★★★★★ (17)

MOTI – Waldinventur im Taschenformat

... verschiedene Waldinventur-Daten wie die Grundfläche, die Stammzahl oder die Baumhöhe zu erfassen. Daraus berechnet die App automatisch den Holzvorrat und...

MOTI (mobile timber cruise) ermöglicht die Erfassung von Stammmessungen einer Parzelle. Dazu gehören die Stammmessung, die Stammmessung und der Zuwachs...

... die auf einfache Weise in Kombination mit anderen Daten...



Agri Vendredi 20 janvier 2016 Dossier / Forêt 19

SYLVICULTURE

La technologie booste la cartographie

Sarah Deillon

La cartographie des forêts est un domaine qui ne cesse de se développer en partie grâce aux nouvelles technologies qui permettent de réaliser des processus.

Une vue d'ensemble

Après, grâce aux nouvelles technologies qui boostent de plus en plus de données sur les forêts, il est possible de réaliser un inventaire de plus en plus précis. À l'heure actuelle, on dispose d'un outil qui permet de réaliser un inventaire de plus en plus précis. On dispose d'un outil qui permet de réaliser un inventaire de plus en plus précis.

Christian Rosset a été le chef de projet dans l'élaboration de l'application Moti.

Les smartphones au service de la forêt

par Olivier Noiret
 Expertise et gestion forestière

La forêt n'est pas immuable, elle évolue avec la société, ses besoins et ses technologies. Les connaissances de la forêt, la façon de l'appréhender et sa gestion évoluent aussi. Il n'y a pas si longtemps, la mesure de paramètres simples et très utiles à la prise de décisions nécessitait des compétences techniques, un outillage coûteux et parfois beaucoup de temps. Les progrès technologiques rendent aujourd'hui certaines de ces mesures accessibles à tout le monde pour un coût « réduit ». En effet, les smartphones et les tablettes sont les nouveaux couteaux suisses du forestier car ils permettent de répondre à bon nombre de...

MOTI – ein Tool für die Waldinventur im Taschenformat

Eine App, die von Schweizer Forschenden der HAFI entwickelt wurde, macht es möglich, Waldinventurdaten wie etwa die Grundfläche des Bestandes oder die Baumhöhe mit dem Smartphone zu erfassen.

von Christian Rosset, Roland Brand, Dominique Weber, Eric Wuillemin, Clotilde Gollut, Iris Caillard, Ulrich Fiedler

MOTI ist eine Smartphone-App, die es ermöglicht, mit nur wenigen Klicks zentralisierte zu erfassen, was im Wald zu sehen ist – insbesondere Holzvorrat, Baumhöhe, Grundfläche, Stammzahl pro Hektare und Zuwachs. Schauen Sie sich die Abbildung 2 an und versuchen Sie, diese Werte zu schätzen, indem Sie die Person in der Mitte des Bildes als Referenz nehmen. Wie die Resultate tatsächlich aussehen, erfahren Sie später in diesem Artikel.

Wenn man nicht über eine breite Erfahrung verfügt, ist eine solche Schätzung alles andere als einfach. Eines der...

Hauptziele von MOTI besteht darin, durch die Möglichkeit der raschen und einfachen Messung der Daten das eigene Reaktionsvermögen zu trainieren und das Auge zu schulen. Gleichzeitig soll die App aber auch eine objektive und sofortige Entscheidungsstufe vor Ort liefern (für Anzeichnungen, die Planung waldbaulicher Eingriffe...).

Mit MOTI können einzelne oder in einem Bestand angeordnete Probestellen gemessen oder auch lokale Inventuren (z. B. eine Stichprobe alle 100 m) durchgeführt werden, wobei der statistische Fehlerbereich laufend berechnet wird (vgl. Abb. 1 oben). Die App umfasst zudem ein Wachstumsmodell, mit dem die mittelfristige...



Abb. 2: Foto eines Fichtenbestandes, in dem zwei Studenten eine Bestandsaufnahme im Rahmen einer selbstständigen Arbeit an der HAFI durchführen.

Les inventaires forestiers dans la poche

... surface terrière d'un peuplement et sa hauteur avec son smartphone, c'est possible grâce à MOTI. Il peut être téléchargé sur Google Play Store ou sur l'App Store de l'iPhone.

... (mobile timber cruise) est une application pour qui permet en quelques clics de chiffrer ce que l'on voit en forêt, en particulier le diamètre, la hauteur des arbres, la surface terrière, le volume et l'accroissement. Essayez, par exemple, d'estimer ces valeurs à partir de la figure 2, en prenant comme référence la personne au centre de la photo.



Enter the target coordinates in WGS84 format (E.g. 7.43864 / 46.95108) or as Swiss coordinates (E.g. 600000 / 200000)

Target coordinates:

E: 696750.0 N: 245200.0

Raster navigation:

E: + - N: + -

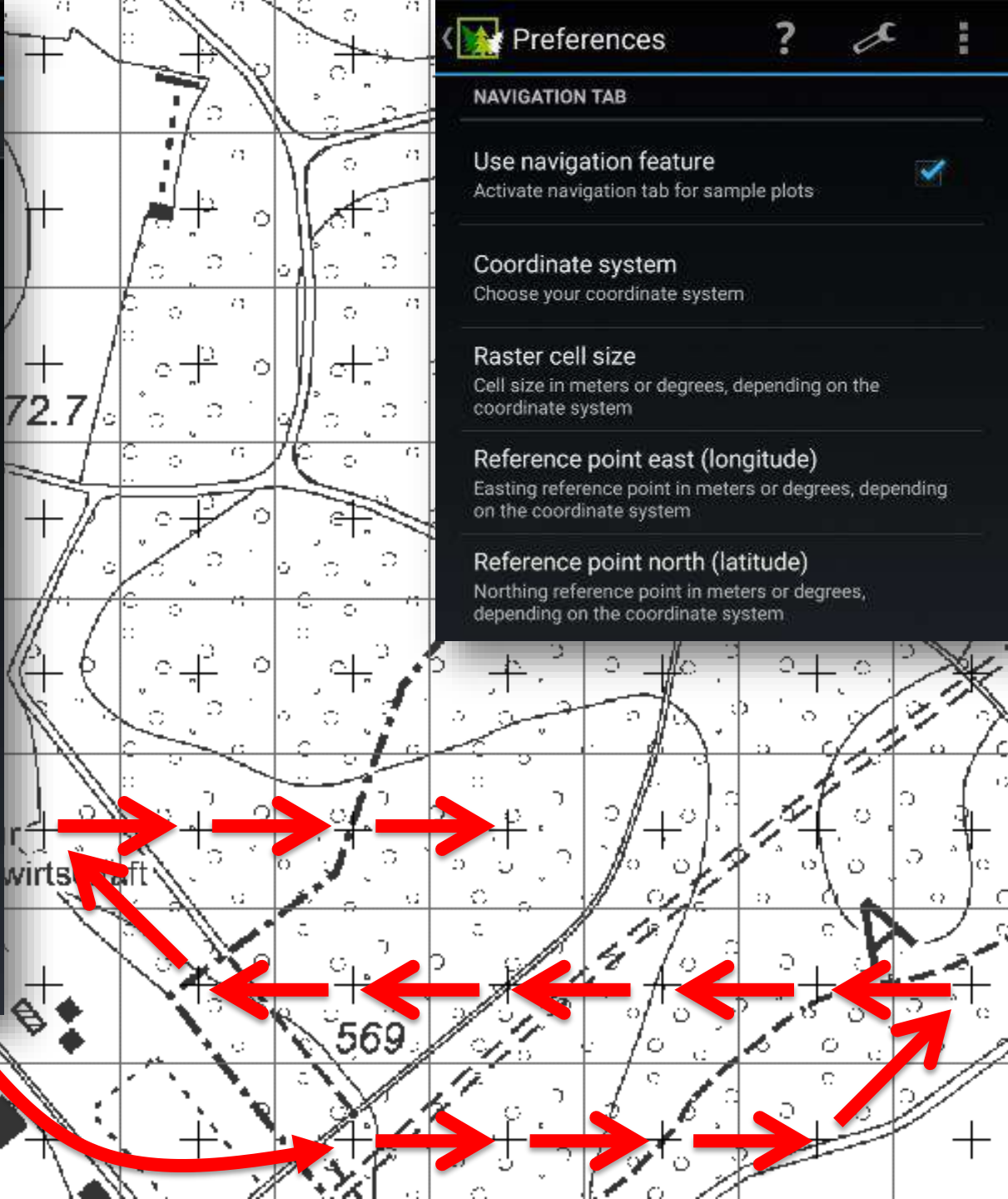
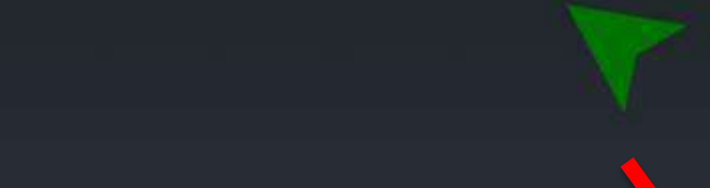


Current coordinates:

E: 696737 N: 245183 4m

Distance: 21m

Orientation: 38°



NAVIGATION TAB

Use navigation feature
Activate navigation tab for sample plots

Coordinate system
Choose your coordinate system

Raster cell size
Cell size in meters or degrees, depending on the coordinate system

Reference point east (longitude)
Easting reference point in meters or degrees, depending on the coordinate system

Reference point north (latitude)
Northing reference point in meters or degrees, depending on the coordinate system

204'500
204'469.25
204'438.5

72.7

wirtsch

569

Inhaltsverzeichnis [Verbergen]

- 1 Sich fit machen für die Grundflächenbestimmung ...
 - 1.1 Parcours
 - 1.2 Auftrag
 - 1.3 Vorgehen
- 2 Sich fit machen für die Baumhöhenmessung ...
 - 2.1 Parcours
 - 2.2 Auftrag
- 3 Kontakt
- 4 Dank

Sich fit machen für die Grundflächenbestimmung ...

Parcours

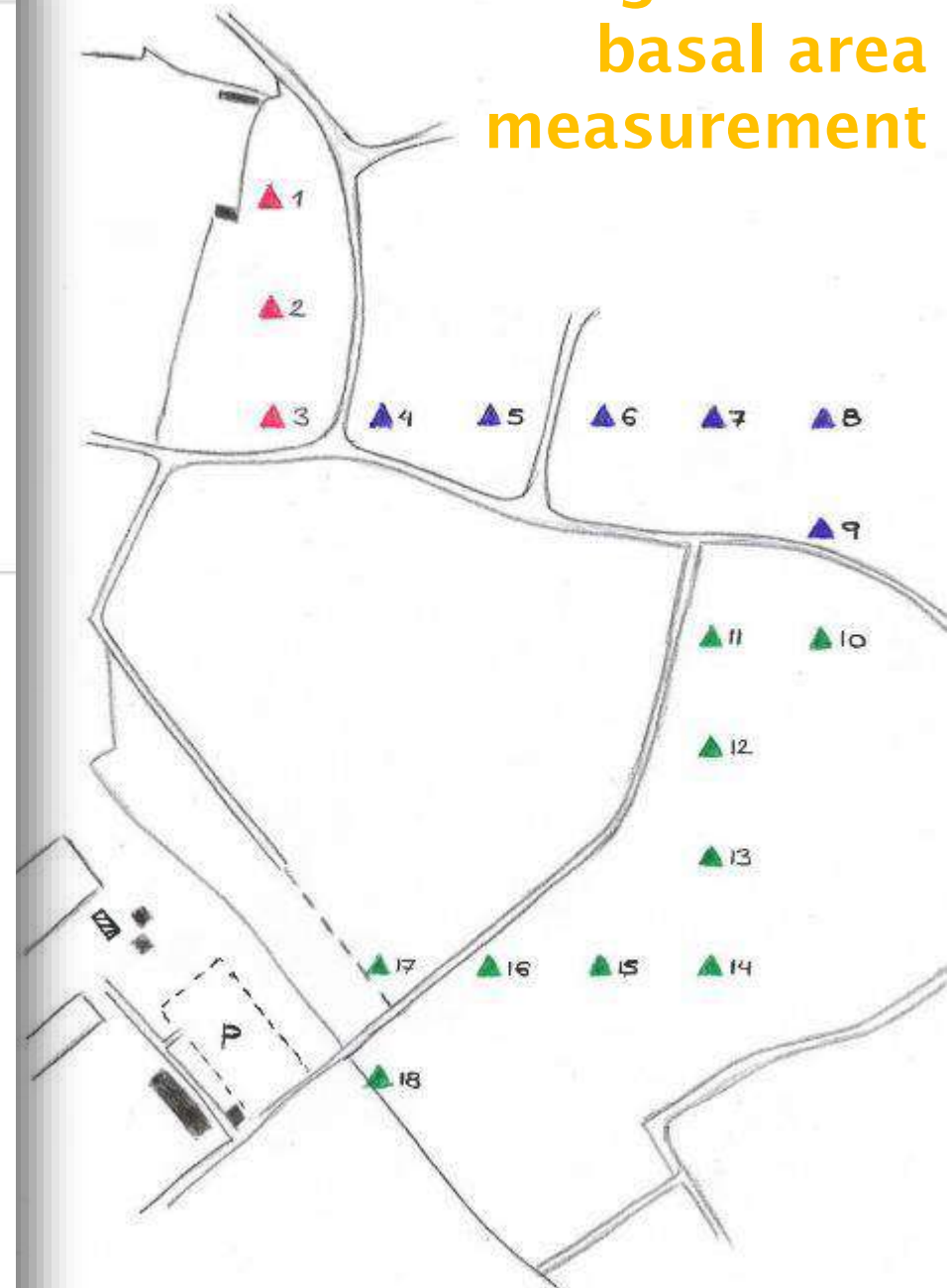
Parcours in 3 Teilen mit insgesamt 18 Probeflächen, deren Zentren mit Pfählen aus Eichenholz gekennzeichnet sind.

1. Teil: 3 Probeflächen mit gekennzeichneten Bäumen je nachdem ob sie mit $k=4$ (rote Punkte) bzw. $k=2$ (orange Punkte) gezählt werden müssen



1. Probefläche mit gekennzeichneten Bäumen: $k=4$ > rote Punkte bzw. $k=2$ > orange Punkte

Training trail for basal area measurement

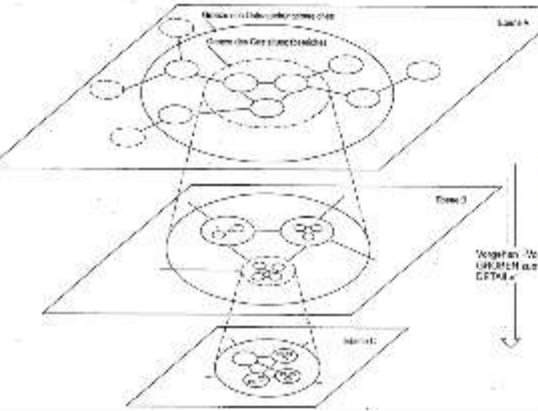
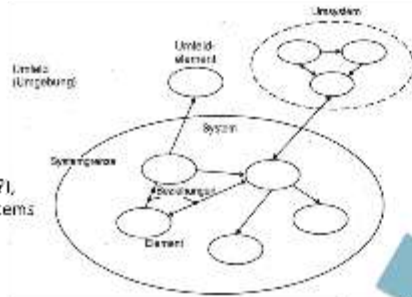


Main approach

Diffusion Innovation Theory (Rogers 1995, after Lin and Chen 2012)

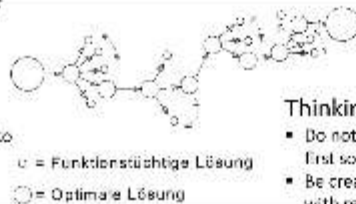
System Thinking

- Delimitation (what has to be considered, what not?), interface to other systems
- Main elements and interconnections (what is essential?)



Proceeding from the whole to the composite parts

- Maintain an overview, do not get lost in details
- Step-by-step with regard to complexity, learning process



○ = Funktionstüchtige Lösung
 ○ = Optimale Lösung

Thinking in variations

- Do not only focus on the first solution
- Be creative and self-critical with regard to ones own solution
- Try to find the best possible solution

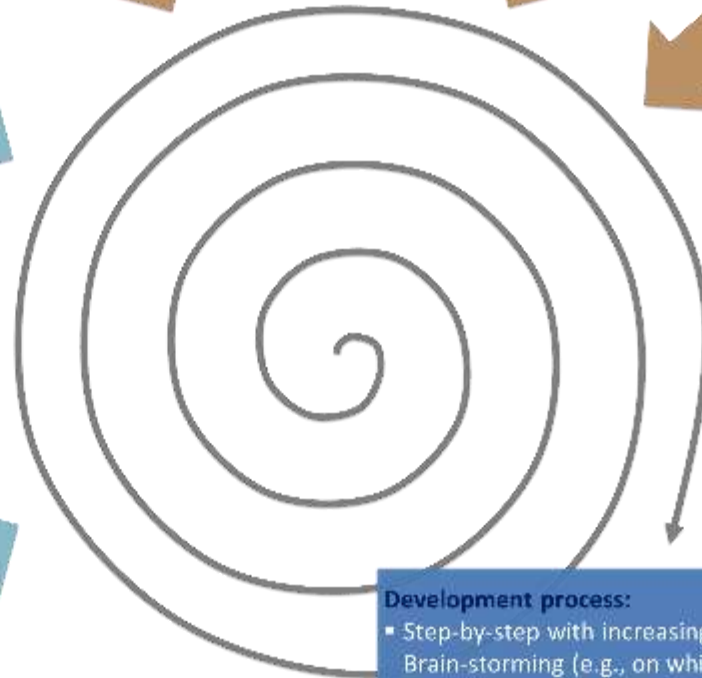
Relative advantage to the current situation?

Compatibility of the current structure?

Degree of complexity and the corresponding perceived difficulty of using the new technique?

Trailability before purchasing?

Degree of observability with respect to the recognition of the consequences for the introduction of a new technology?



Development process:

- Step-by-step with increasing formalism and functionalities: Brain-storming (e.g., on white board) > paper prototyping > modelling techniques with simple symbolism (e.g., data flow diagram, flow chart) > UML (e.g., activity diagram, class diagram) > test and demo prototype > consolidation
- Developer team with >= 5 members to mix skills, competencies and points of view (background, languages)
- Stakeholder involvement from the beginning on a regular basis

Uneven-aged: what reference to maintain demographic equilibrium?

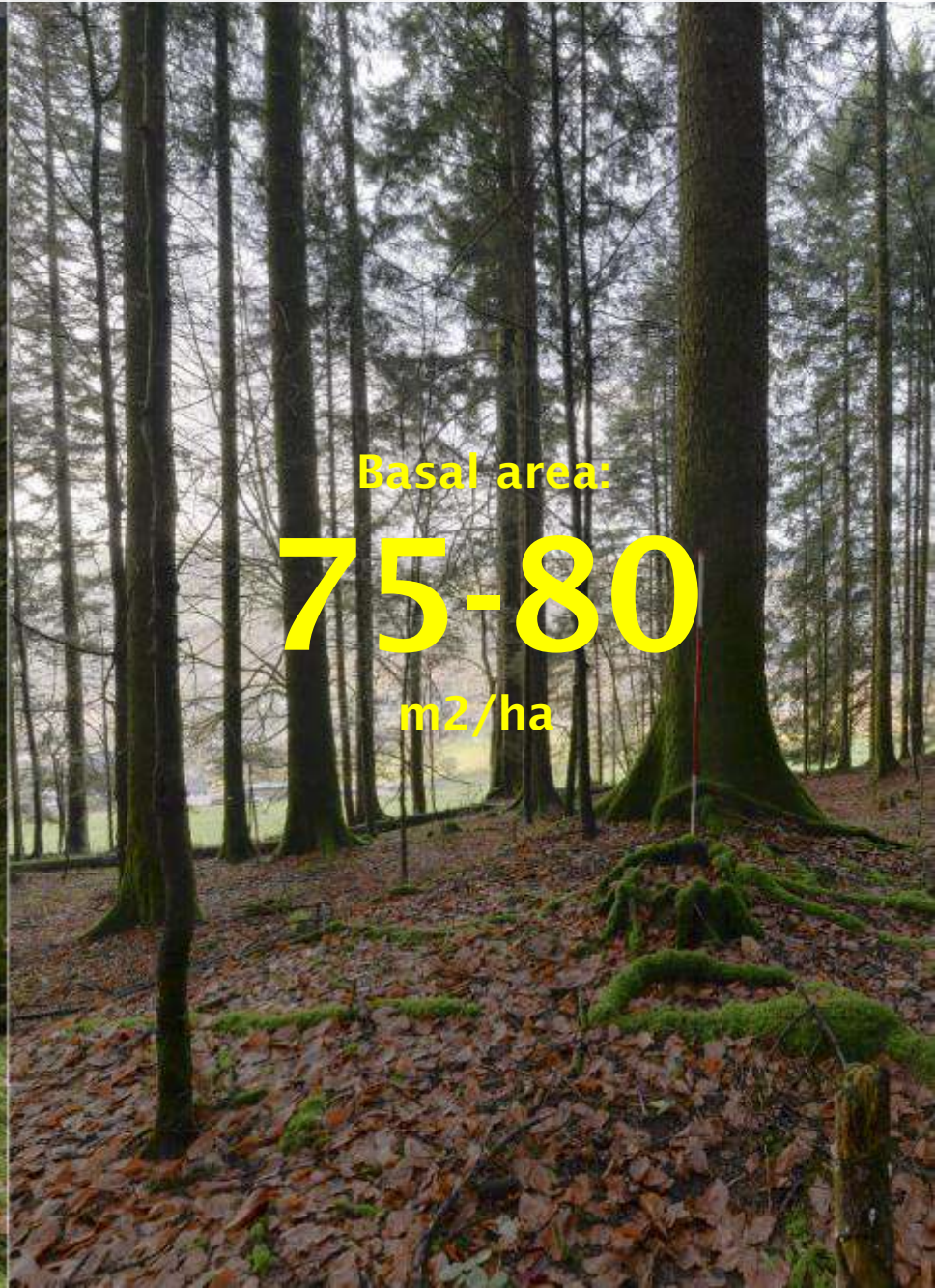
Typical Plenter-forest



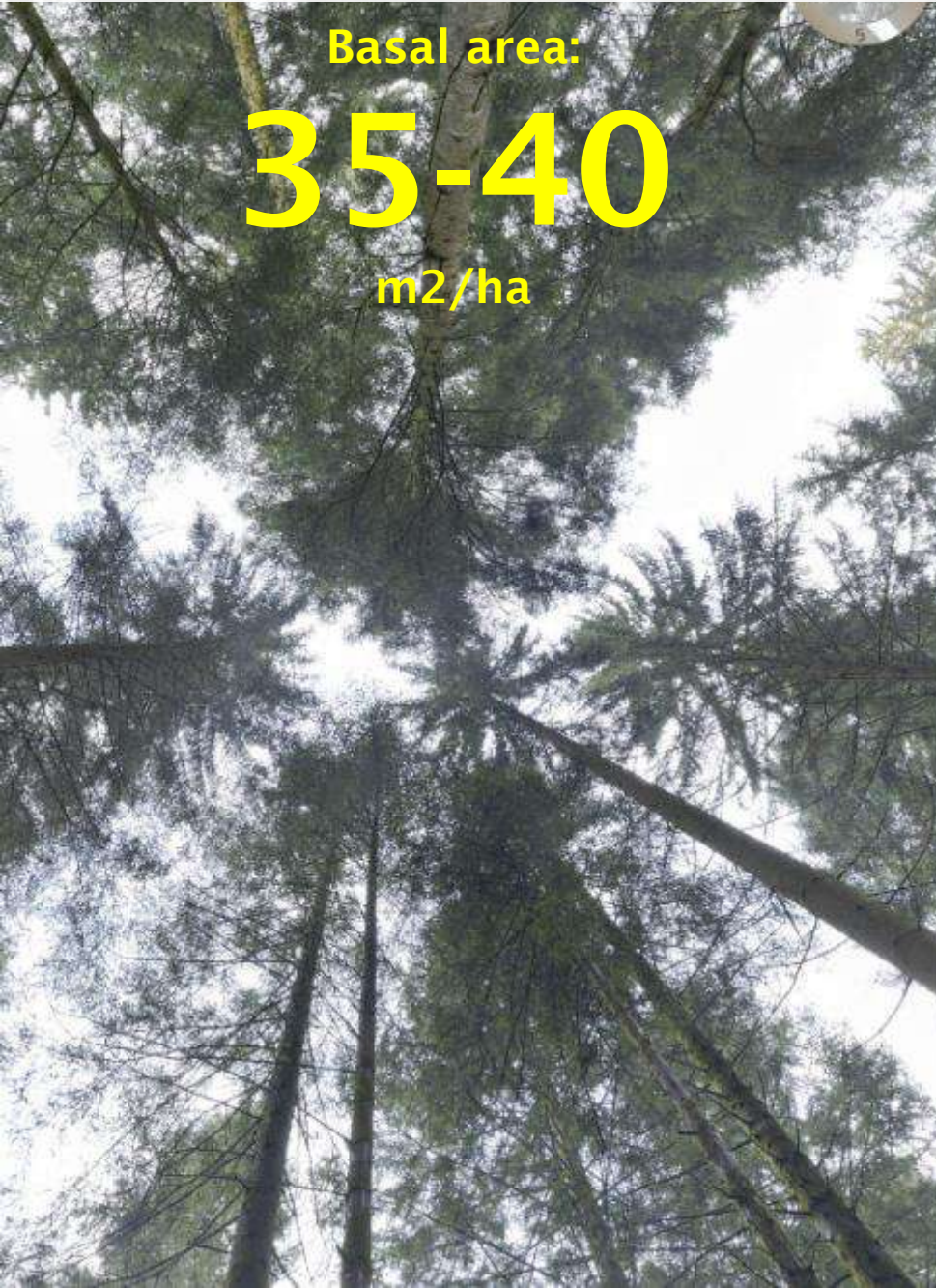
Former Plenter-forest without any intervention for 50 y



Uneven-aged: what reference to maintain demographic equilibrium?



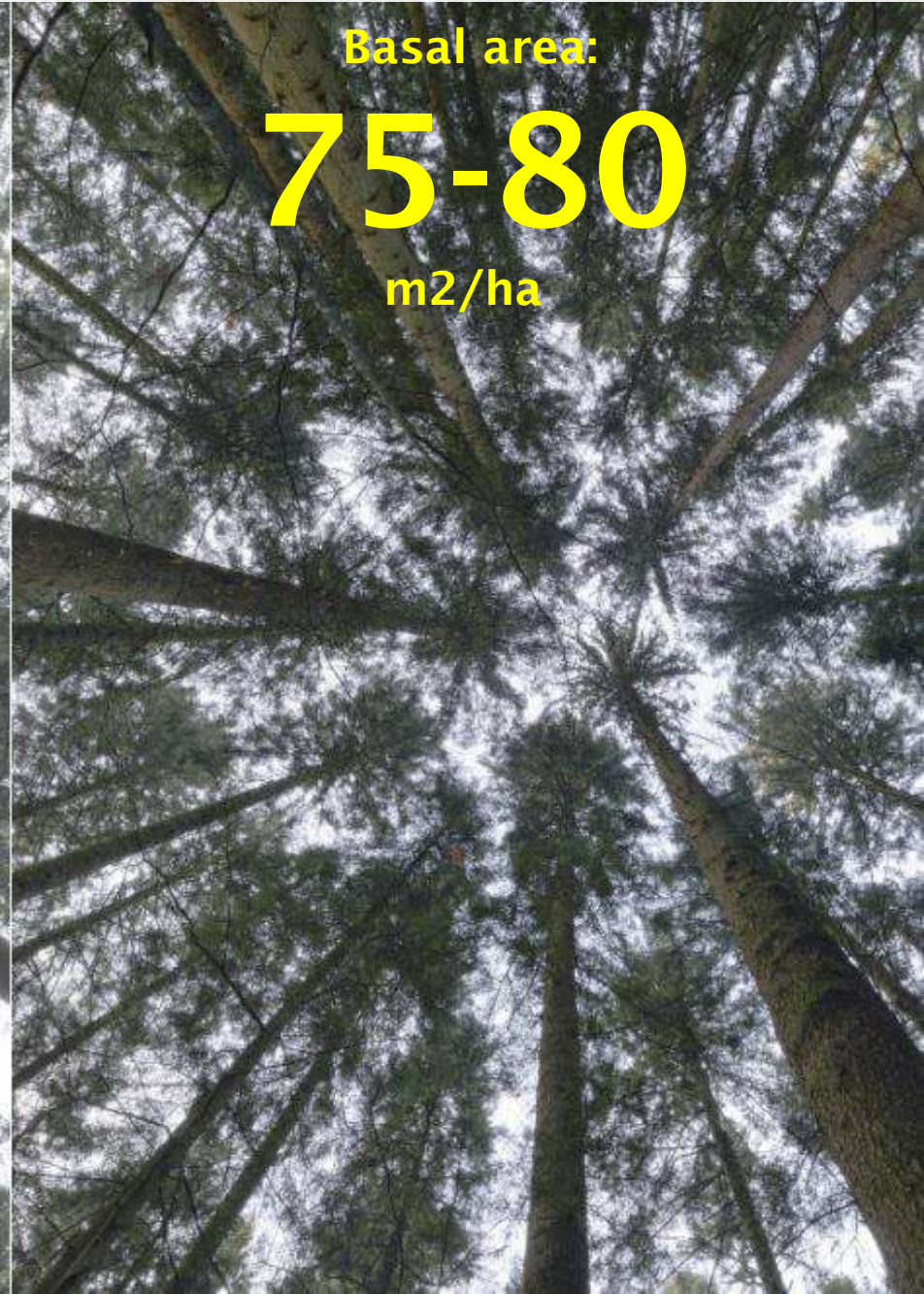
Uneven-aged: what reference to maintain demographic equilibrium?



Basal area:

35-40

m²/ha



Basal area:

75-80

m²/ha