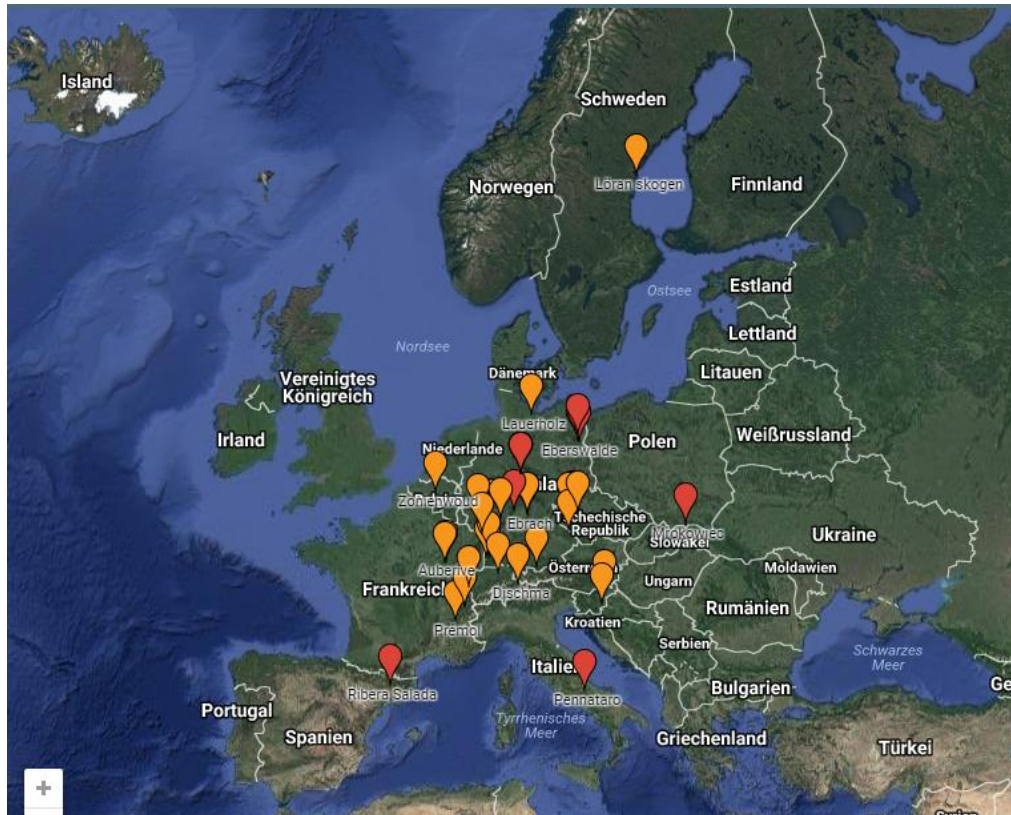


Simulation der ökonomischen und ökologischen Entwicklungen bei verschiedenen waldbaulichen Eingriffen

D. Kraus, B. Courbaud, F. de Coligny, L. Larrieu, A. Letort, A Schuck



“Establishing a European network of demonstration sites for the integration of biodiversity conservation into forest management (Integrate+)”



**2013-2016, gefördert vom
BMEL**

**Etablierung eines europäischen
Netzwerks von Demonstrations-
und Schulungsflächen**

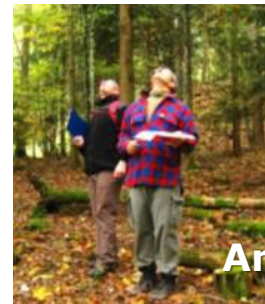
**Entwicklung einer mobilen
Software**

**Durchführung von Waldbau-
Training**

**Kooperation mit Netzwerk-
partnern aus Wissenschaft und
Praxis**

**Aufbau und Förderung
internat. Erfahrungsaustauschs**

Waldbautraining

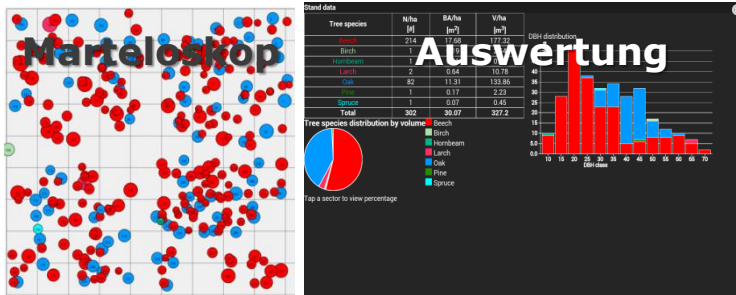


Marteloskop Steinkreuz

Name: Lukas Fischer

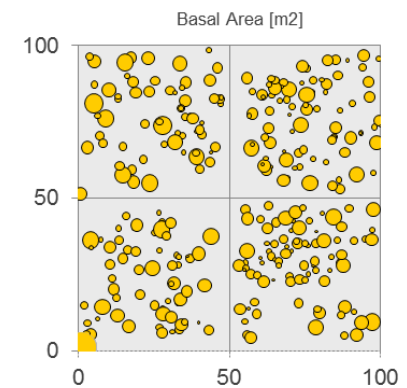
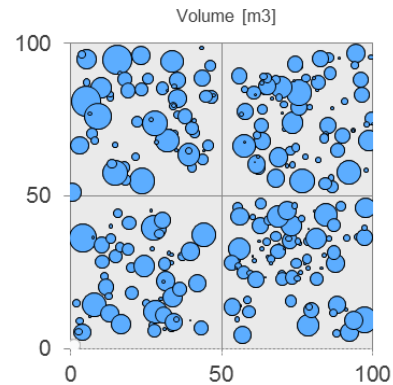
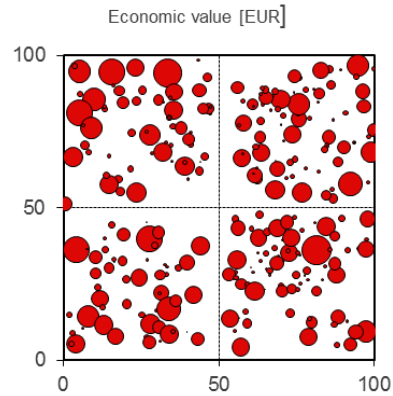
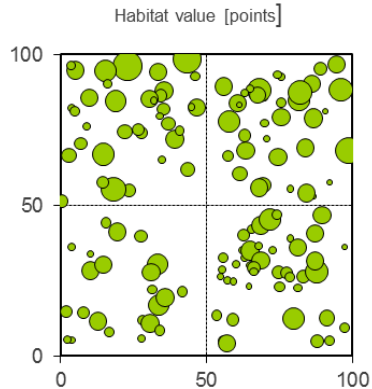
Kategorie	Entnahmegrund				Belassunggrund				
	Zufällige Auswahl	Befalliger Standort	Vergleichung	Sonstige	Entnahmemotiv	Samenbaum	Diversität	Vergleichung	Belassungsmotiv
Summenwerte	274	246	222	212					
	316								
	175								

MARTELOSKOPE: praxisnahe Trainingstools für Waldbauer

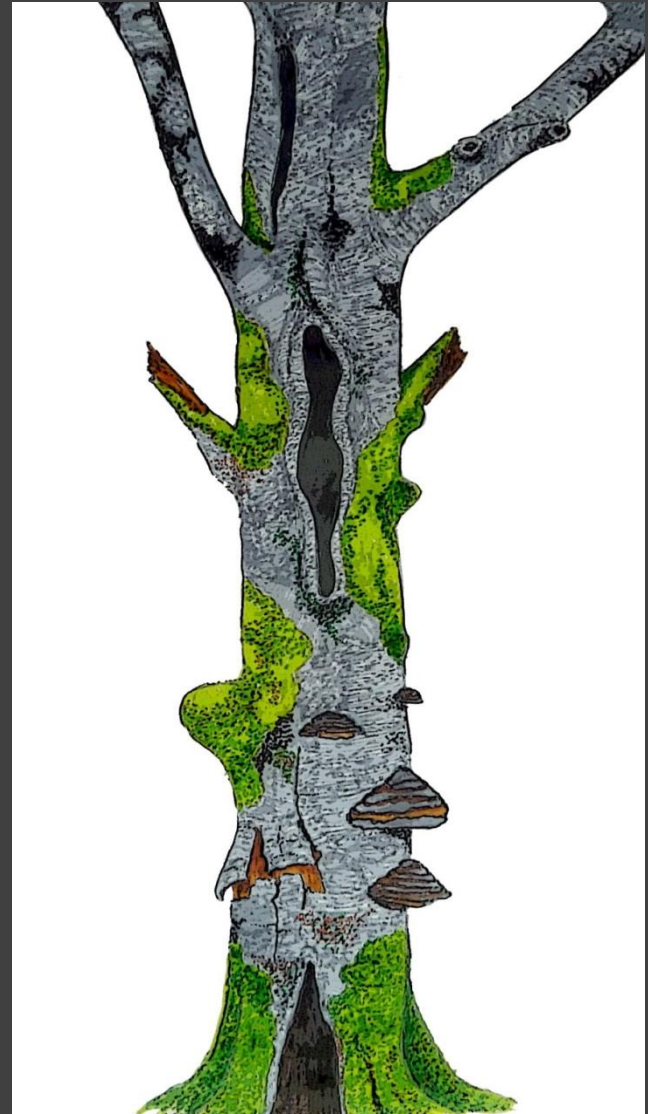


Was kann man damit machen?

- Didatisches Werkzeug für Waldbau-Übungen
- Transparente Auswertung waldbaulicher Entscheidungen, Feedback
- Darstellung ökonomischer und ökologischer Effekte
- Quantitative Vergleiche
- Objektive Diskussion ist möglich



Was ist ein Habitatbaum?



Habitatwerte

Ausschnitt Kriterienliste

Baummikrohabitate

Großmulmhöhlen



Konsolenpilze



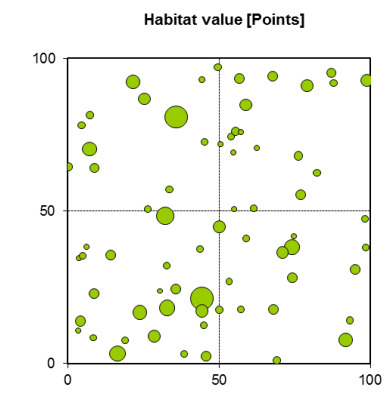
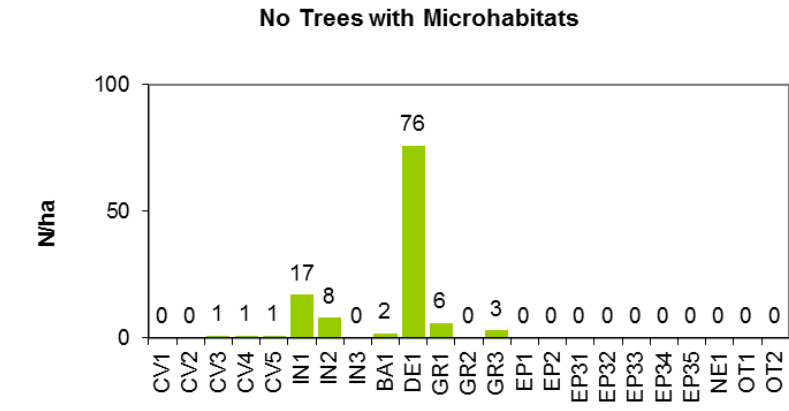
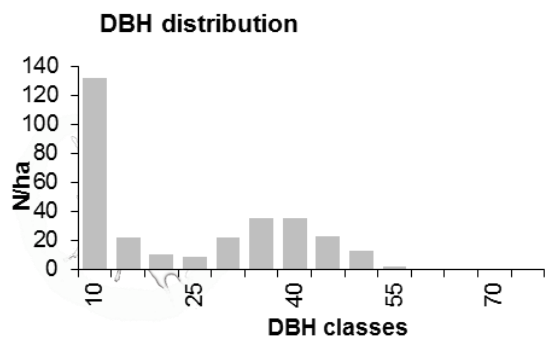
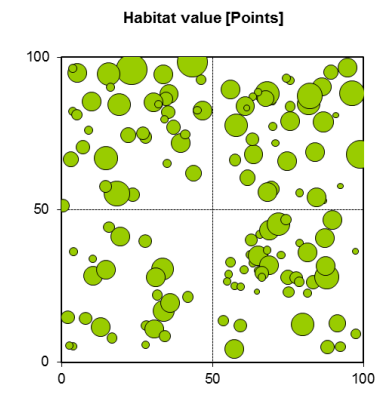
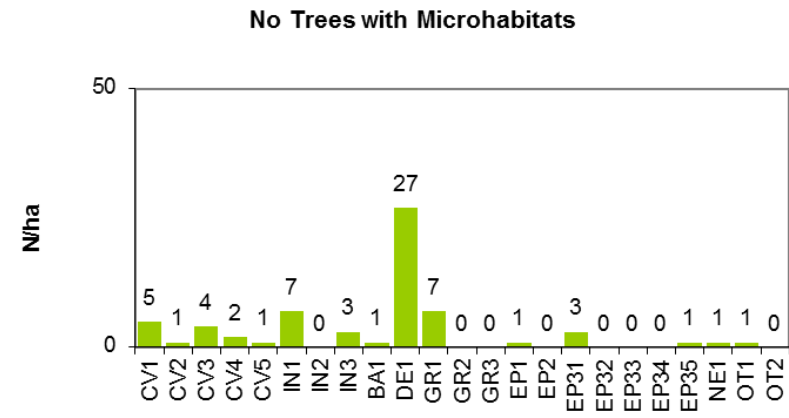
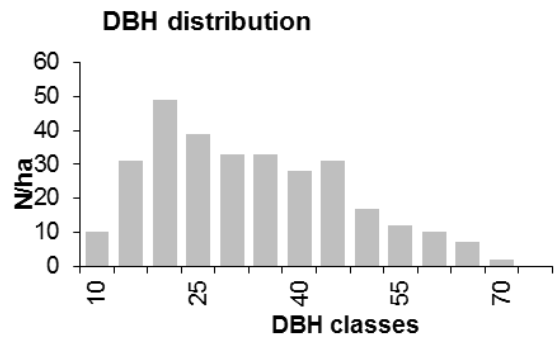
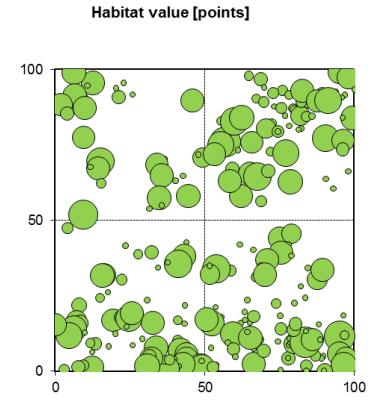
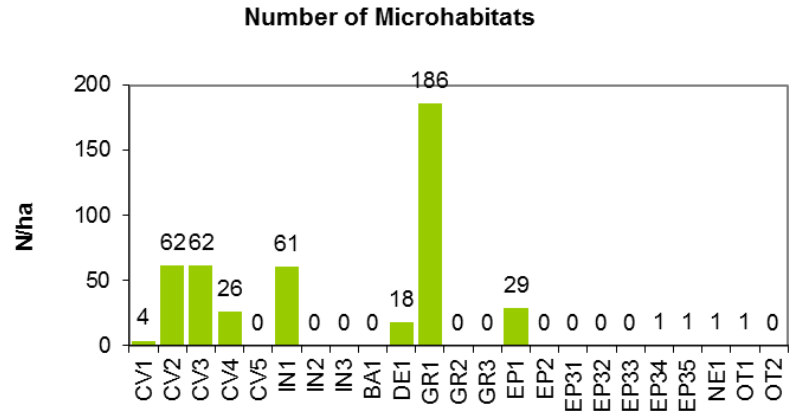
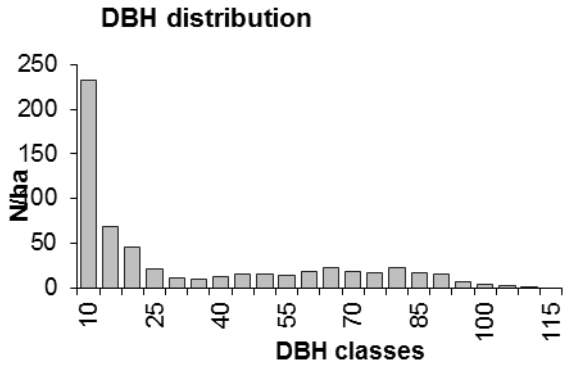
Spechthöhlen



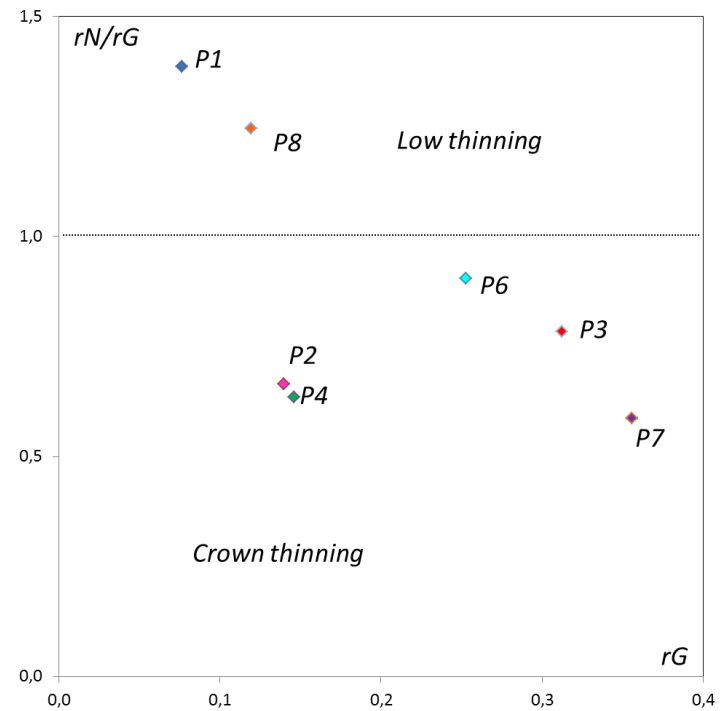
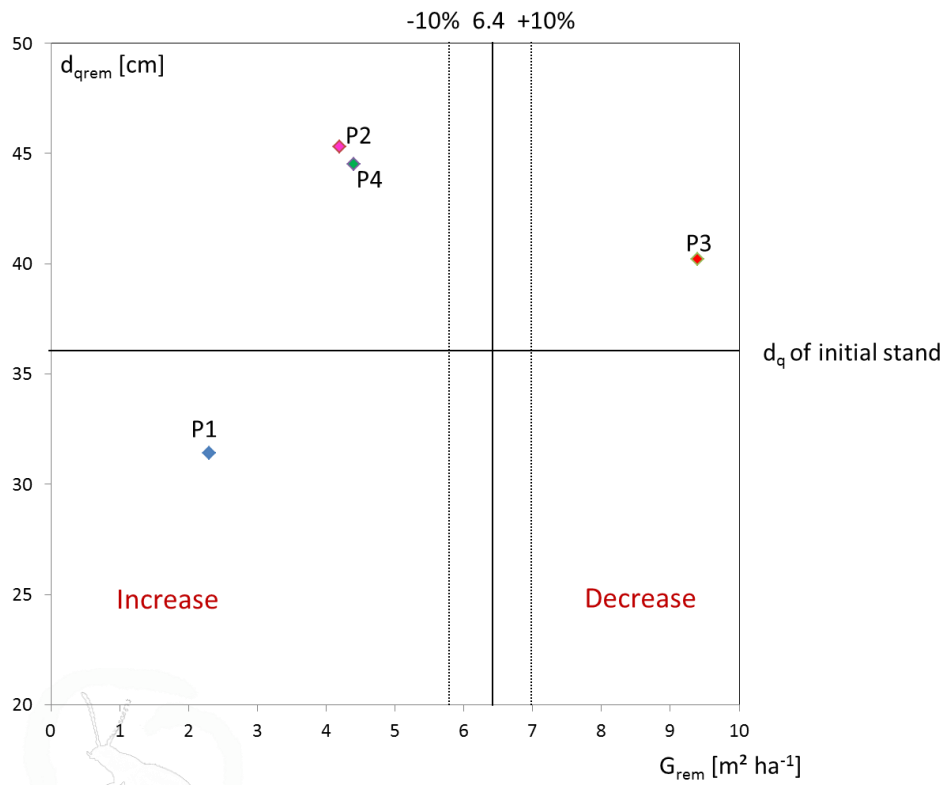
Catalogue of tree microhabitats

Reference field list

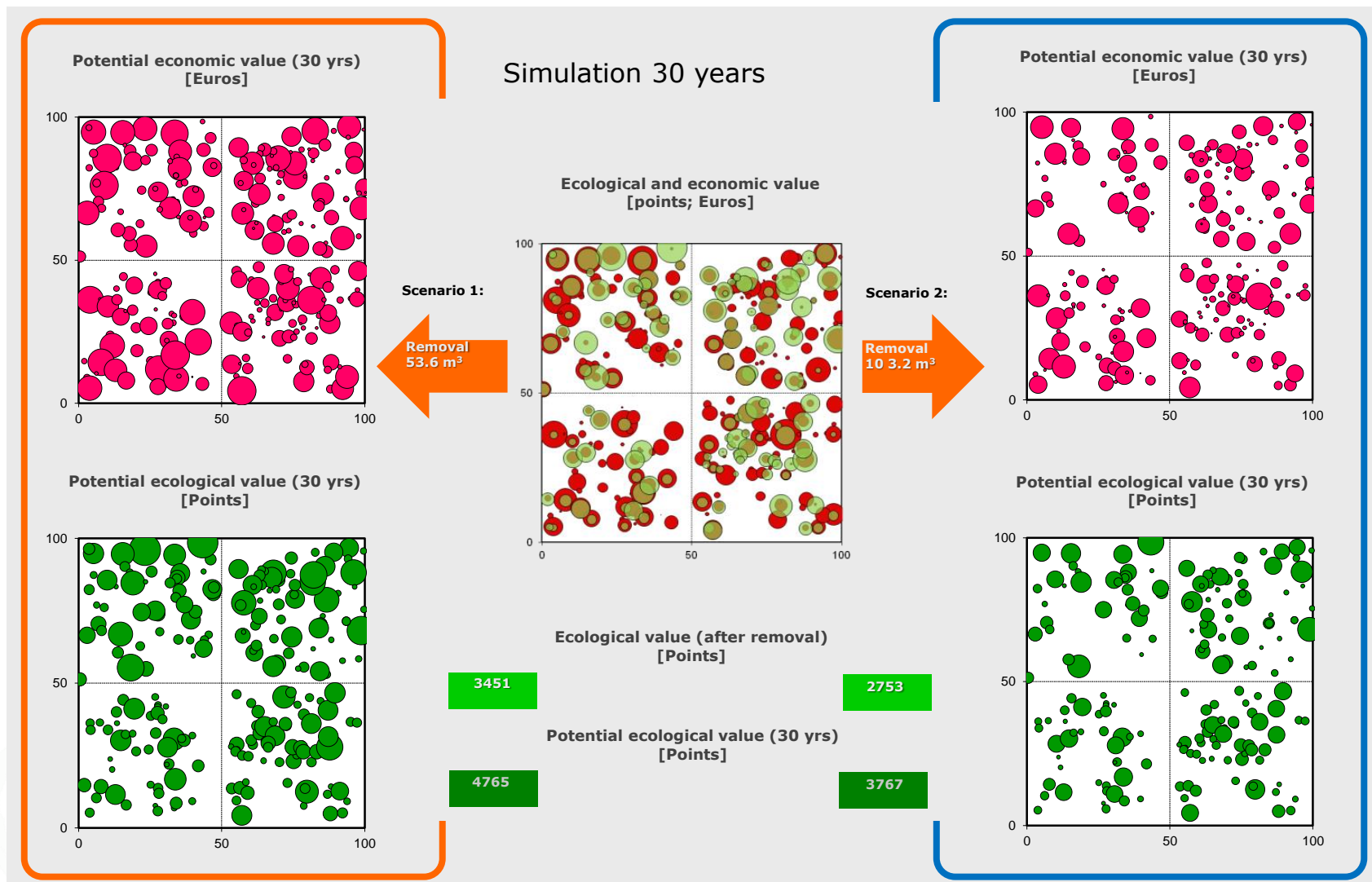
- CV1 Woodpecker cavities
- CV2 Sink and mould cavities
- CV3 Branch holes
- CV4 Pendrotelms and water-filled holes
- CV5 Insect galleries and bore holes
- CV6 Bark loss / Exposed sapwood
- CV7 Exposed heartwood / Stem and crown breakage
- CV8 Cracks and scars
- CV9 Bark pockets
- CV10 Dead branches and limbs / crown deadwood
- GF1 Root buttress cavities
- GF2 Witch broom
- GF3 Cankers and burrs
- EP1 Fruiting bodies fungi
- EP2 Myxomycetes
- EP3 Bryophytes
- EP4 Foliose lichens
- EP5 Lianas
- EP6 Ferns
- EP7 Misteltoe
- NE1 Nests and aeries
- NE2 Nests / aeries
- OT1 Sap and resin run
- OT2 Other microhabitats
- OT3 Microsoil



Gruppenergebnisse



I+ Simulationen



Nachlieferung von Mikrohabitaten?

- Innerhalb des integrativen Waldnaturschutzes muss eine konstante Nachlieferung von Mikrohabitaten gewährleistet sein
 - Gleichgewicht zwischen der Neubildung und dem Verschwinden von Mikrohabitaten
- Beobachtung von Mikrohabitaten auf verschiedenen Bäume zu einem bestimmten Zeitpunkt
 - Die Neubildungsrate von Mikrohabitaten kann nicht direkt gemessen werden.
 - Können wir die Wahrscheinlichkeit der Neubildung eines Mikrohabitats vorhersagen?
 - Können wir ein Mikrohabitat-Modul in einen Waldwachstums-simulator integrieren?



Ereigniszeit-Analyse (Survival analysis): indirekte Schätzmethode, bei der die Zeit bis zu einem bestimmten Ereignis genutzt wird, um die Wirkung zB eines schädlichen Ereignisses zu bewerten

Anwendung auf Mikrohabitatbildung:

D: Zufallsvariable abhängig vom BHD, ab dem sich das erste Mikrohabitat bildet

F(d): **Cumulated Distribution Function** (CDF) der Zufallsvariable D. Entspricht der Wahrscheinlichkeit, dass mindestens ein Mikrohabitat an einem Baum vorkommt

$$F(d) = P(D \leq d)$$

h(d): **Hazardfunktion** der Zufallsvariable D. Wahrscheinlichkeit der Bildung des ersten Mikrohabitats an einem Baum, der bisher keines ausgebildet hat

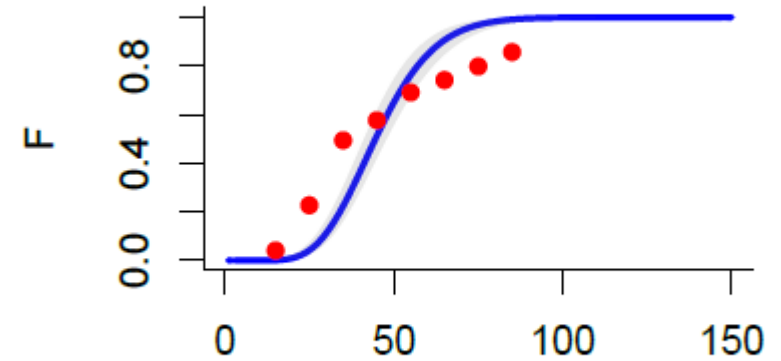


$$h(d) = \frac{dF(d)}{1 - F(d)}$$

Wahrscheinlichkeit der Entstehung von Mikrohabitaten

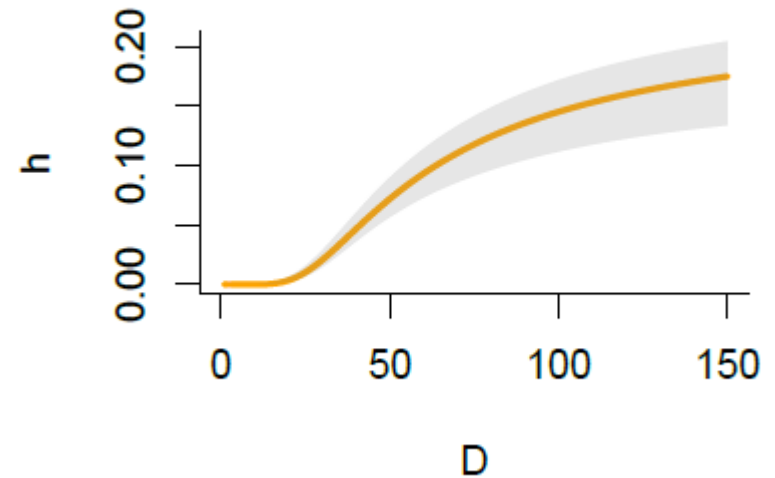
Kalibrierung der F-Funktion aus Beobachtungsdaten

Uholka haP – *Fagus sylvatica* (UH-haP)



Ableitung der h-Funktion zur Beschreibung des Entstehungsprozesses

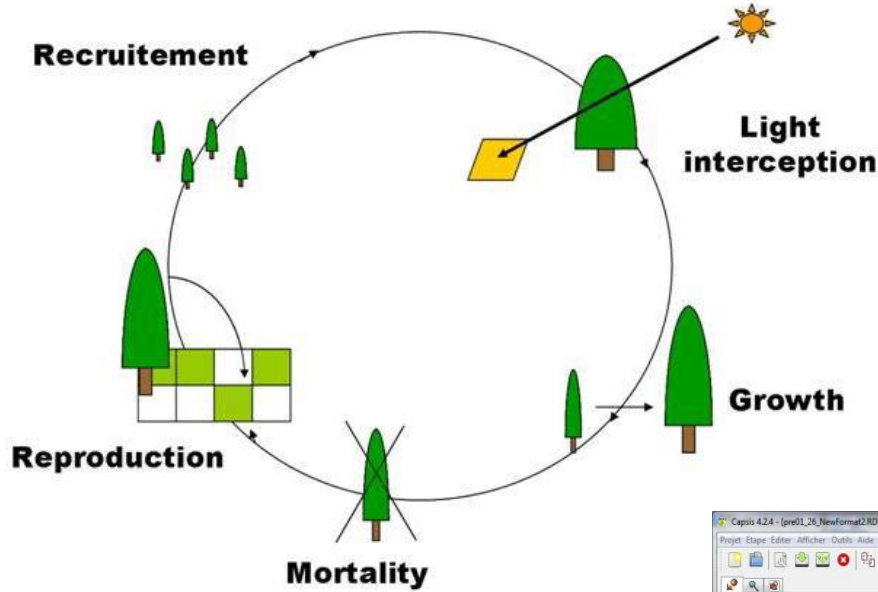
Uholka haP – *Fagus sylvatica* (UH-haP)



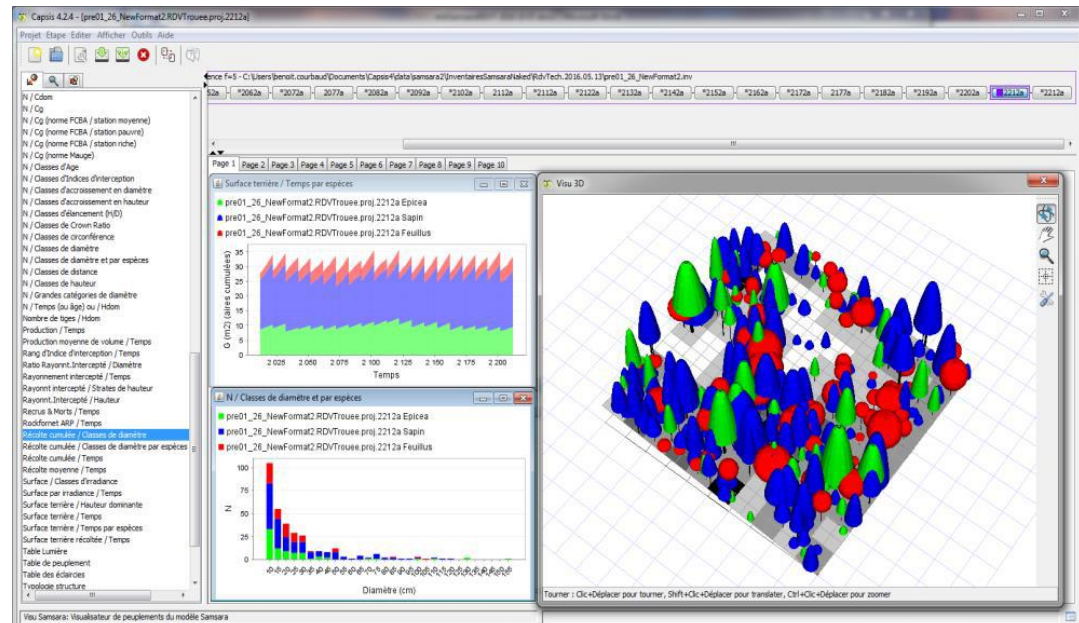
Integration in den Waldwachstumssimulator Samsara

Samsara: an individual-based, spatially explicit simulation model

Courbaud et al., 2003
Courbaud et al. 2015

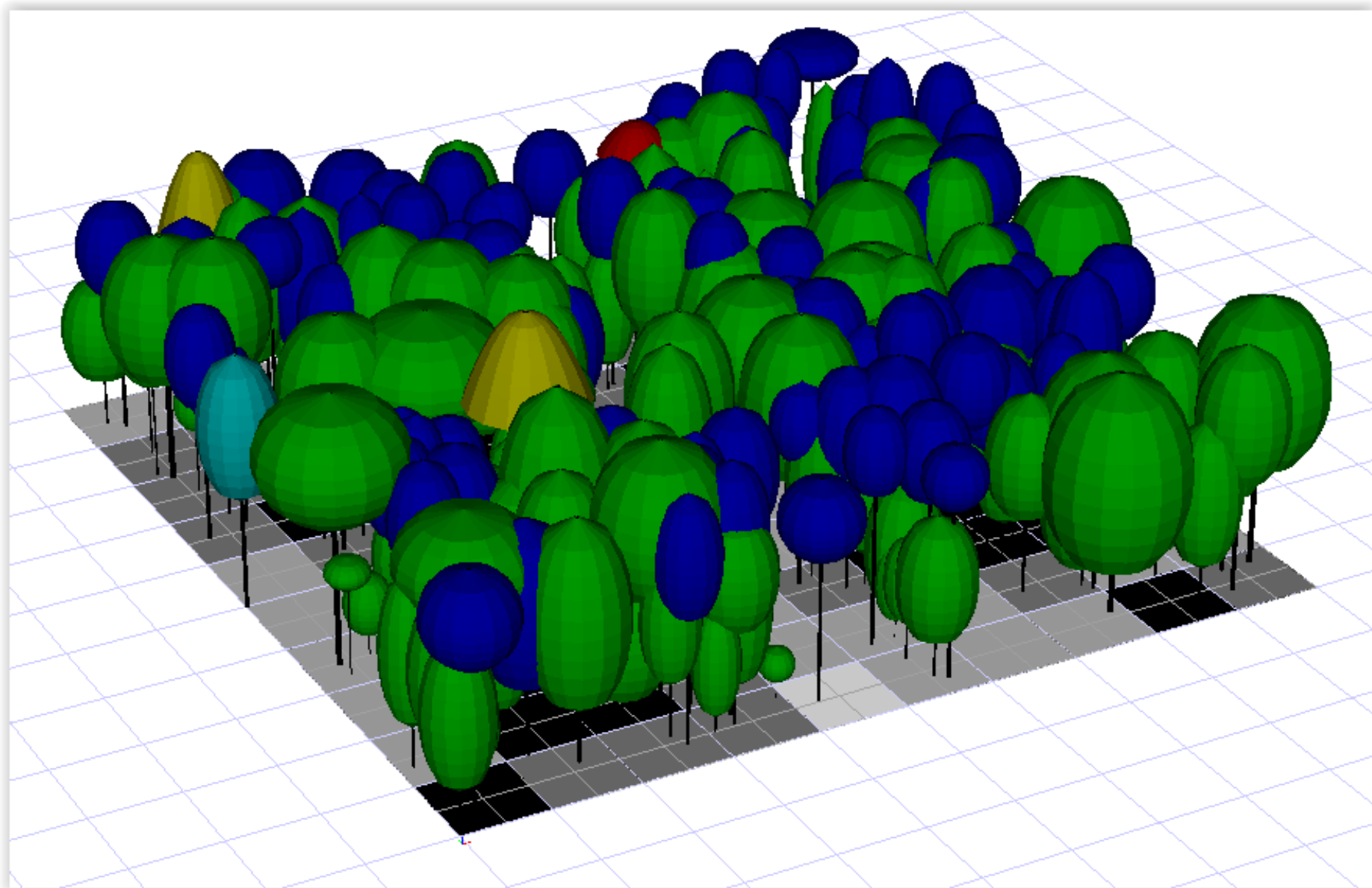


Entwicklungsplattform CAPSIS

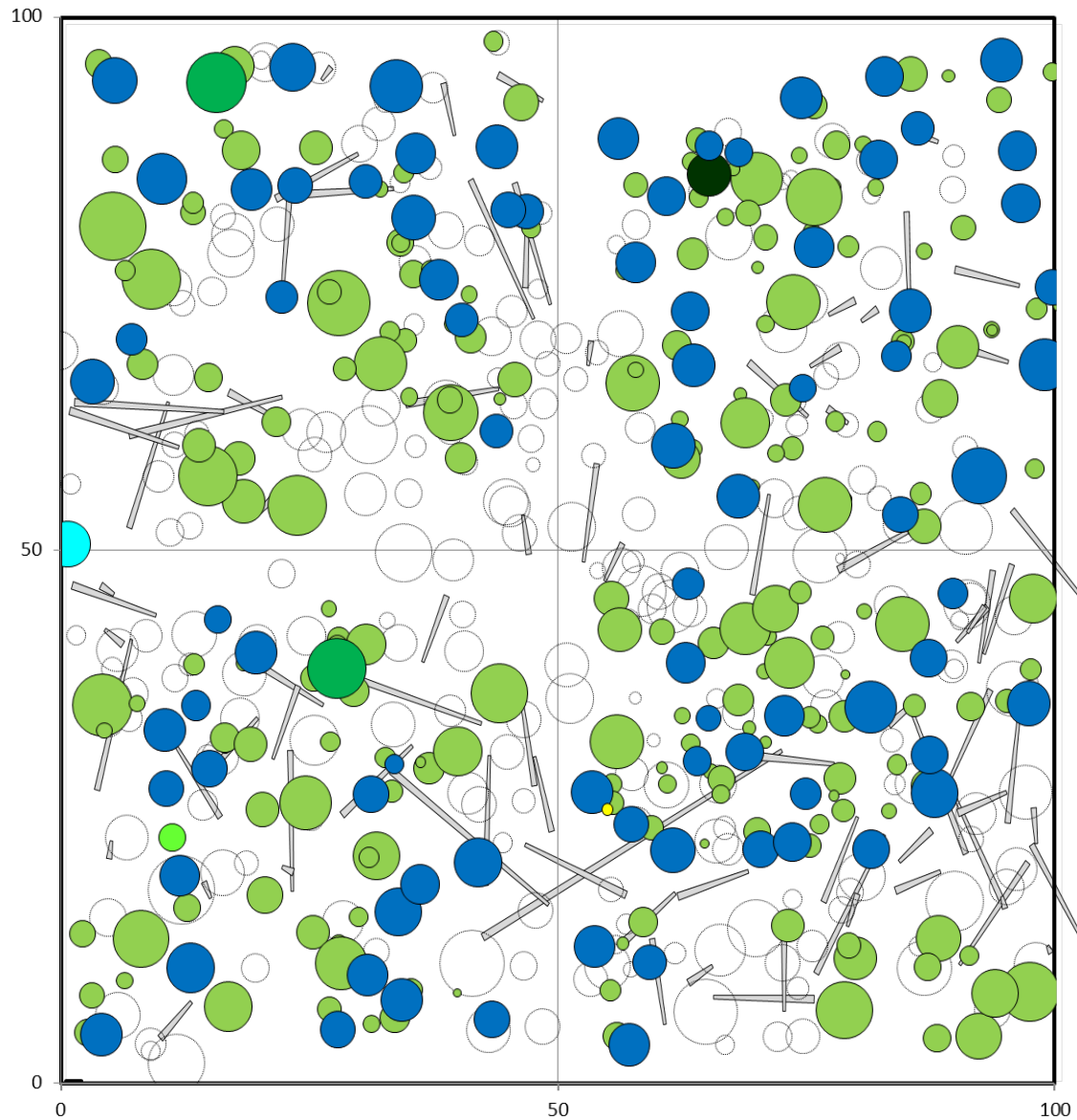


Coligny et al., 2003
Dufour-Kowalski et al. 2012

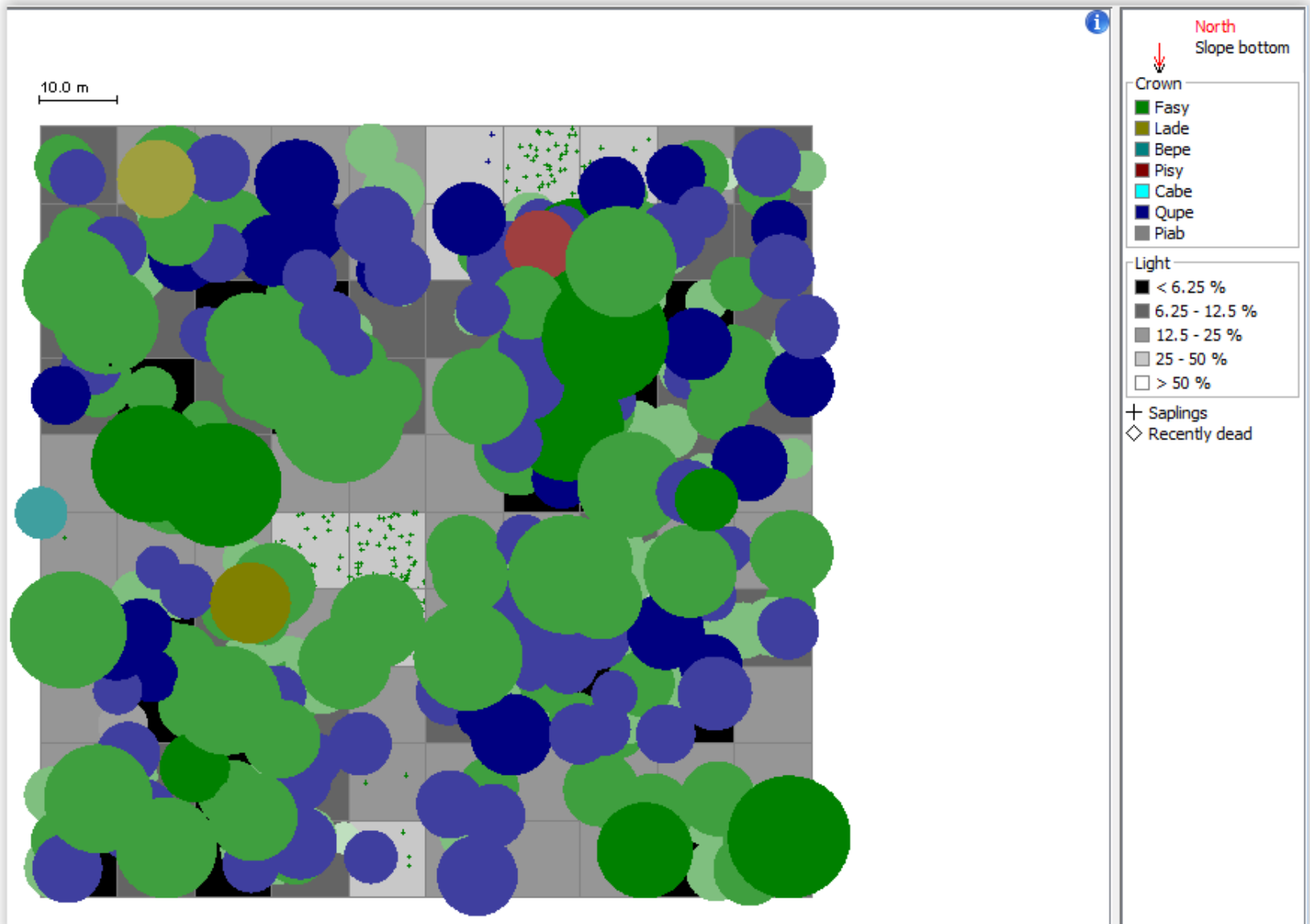
Das Marteloskop am Steinkreuz - der Bestand



Totholzinventur am Steinkreuz

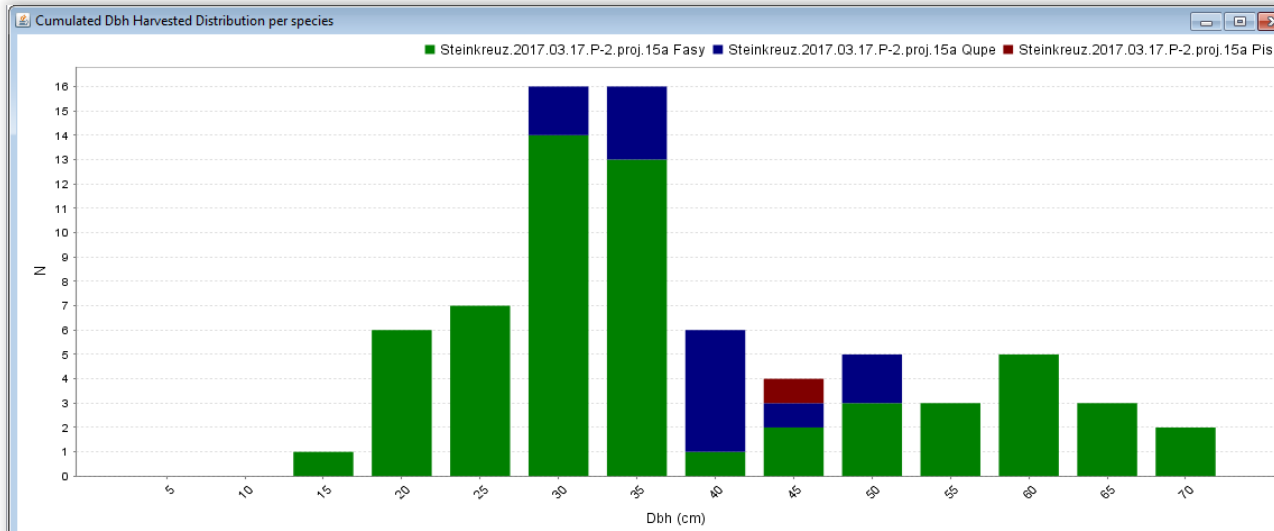


Ausgangsbestand mit Verjüngung

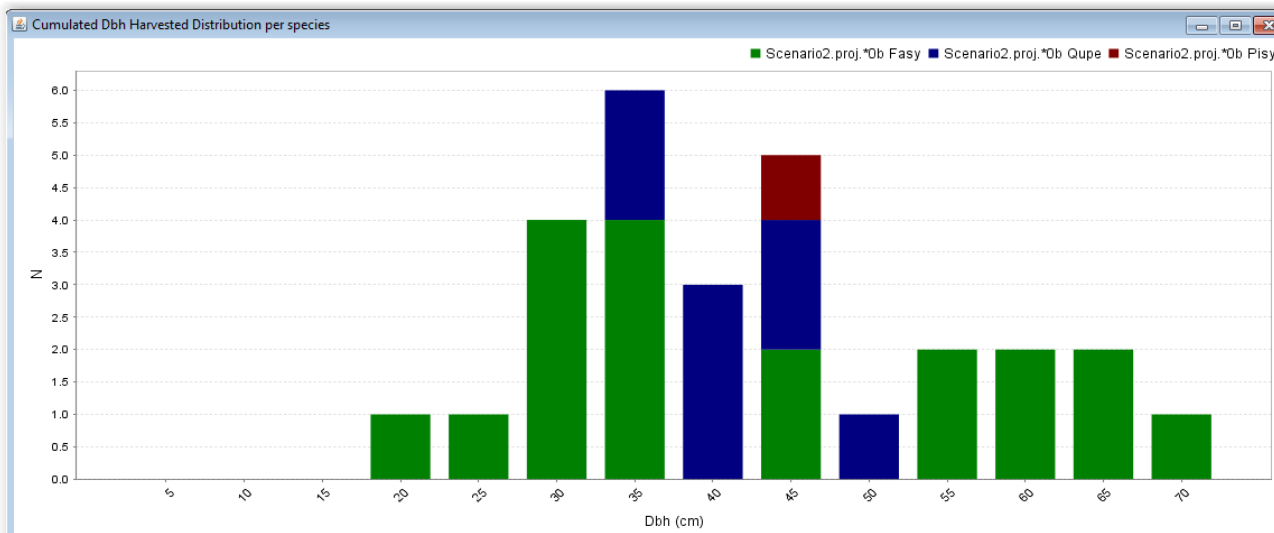


Simulation der Szenarien

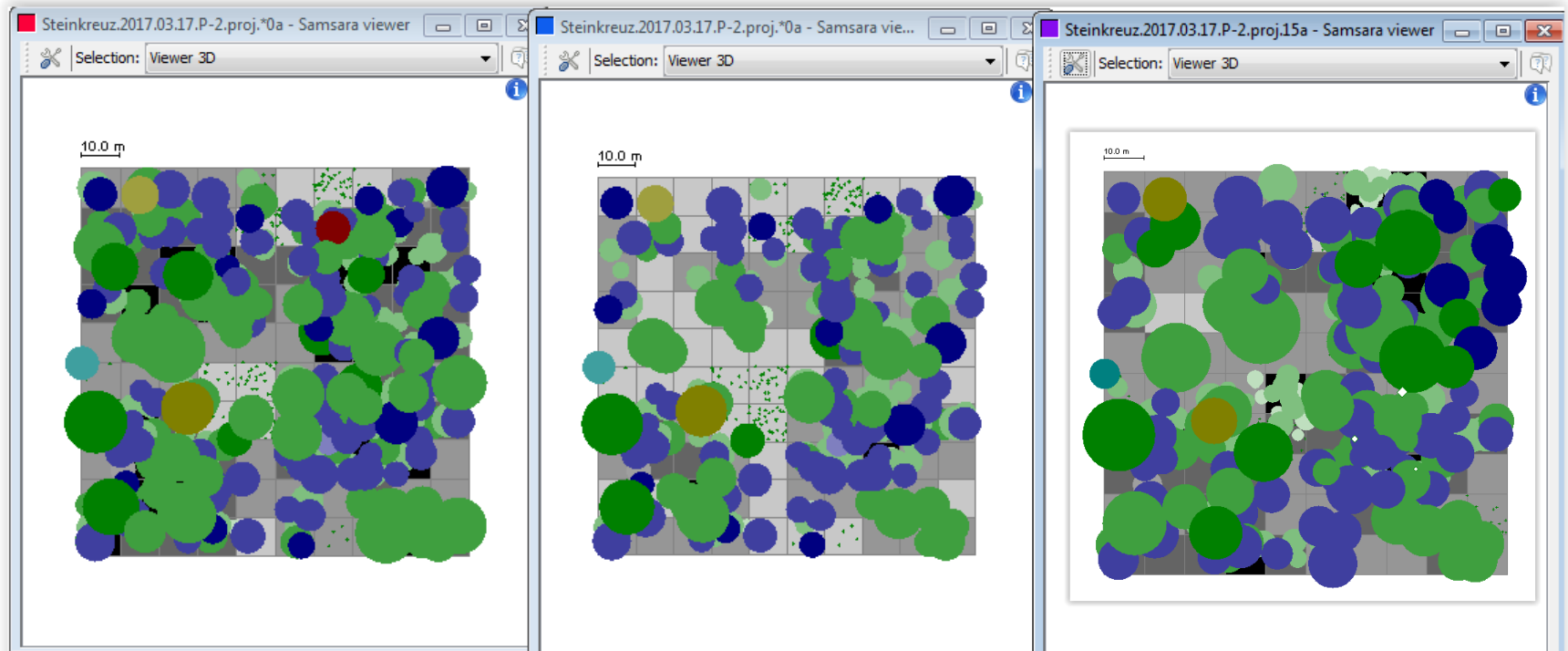
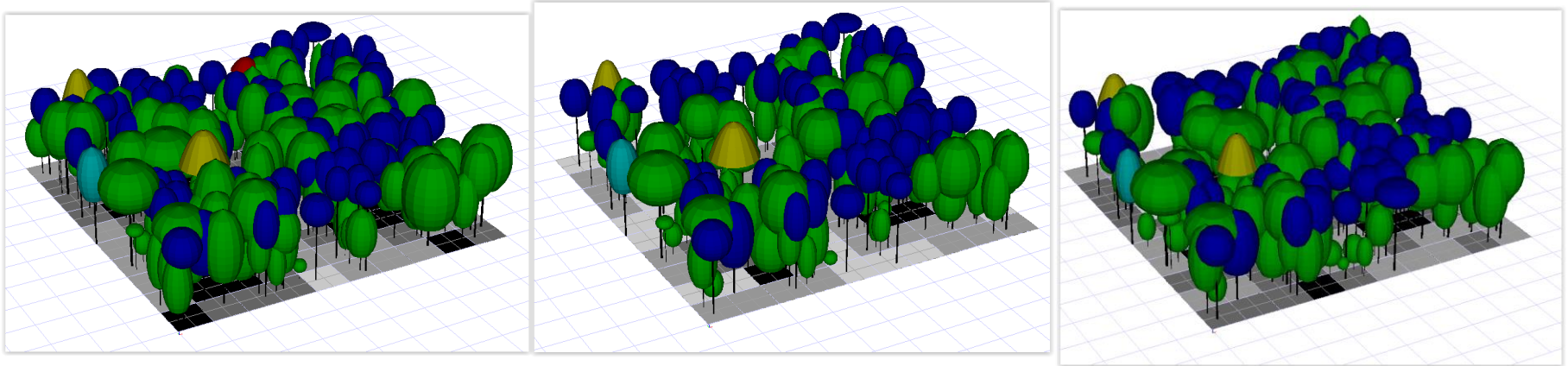
Szenario 1:



Szenario 2:



Szenario 1

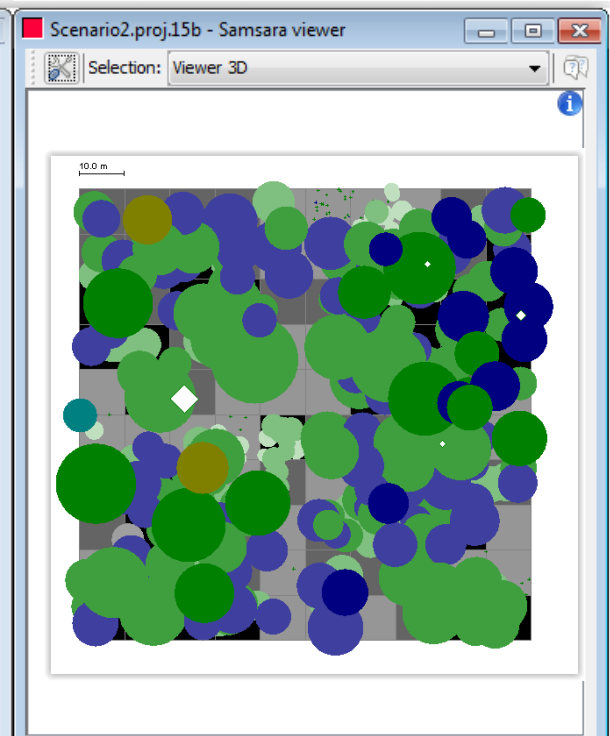
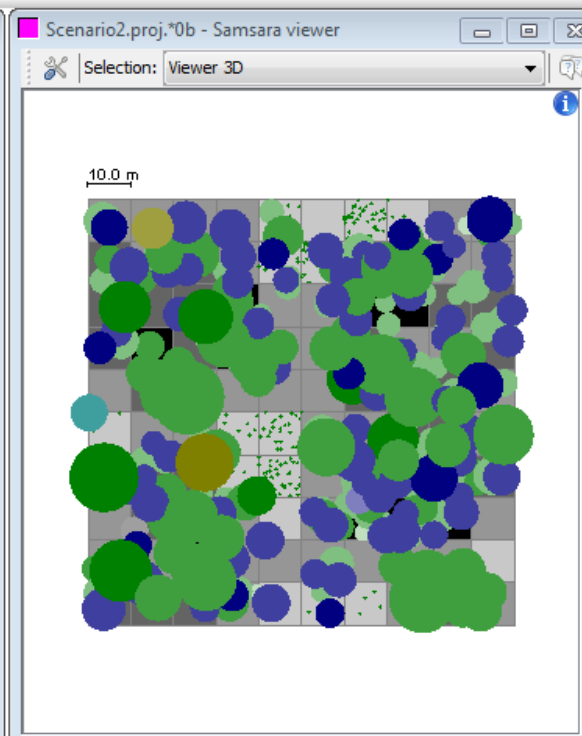
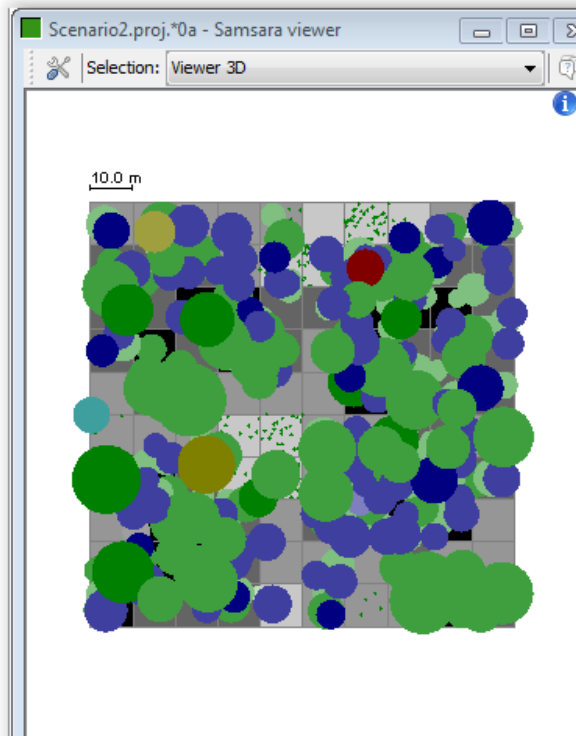
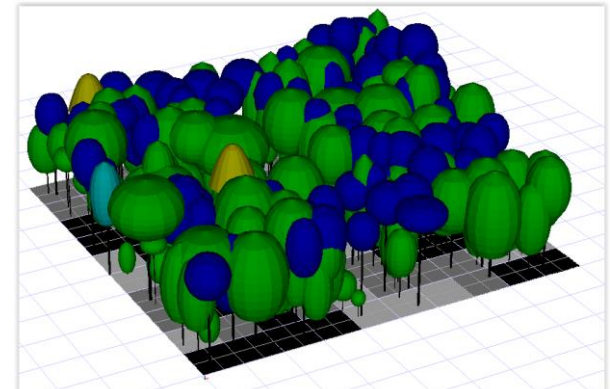
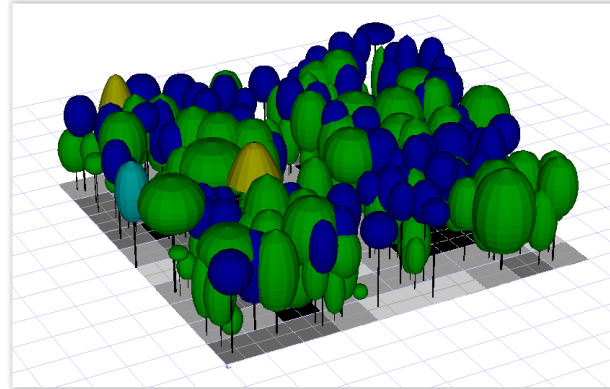
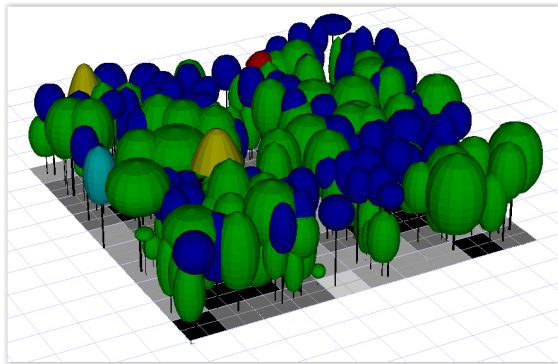


Ausgangsbestand

Nach dem Eingriff

Nach 20 Jahren

Szenario 2



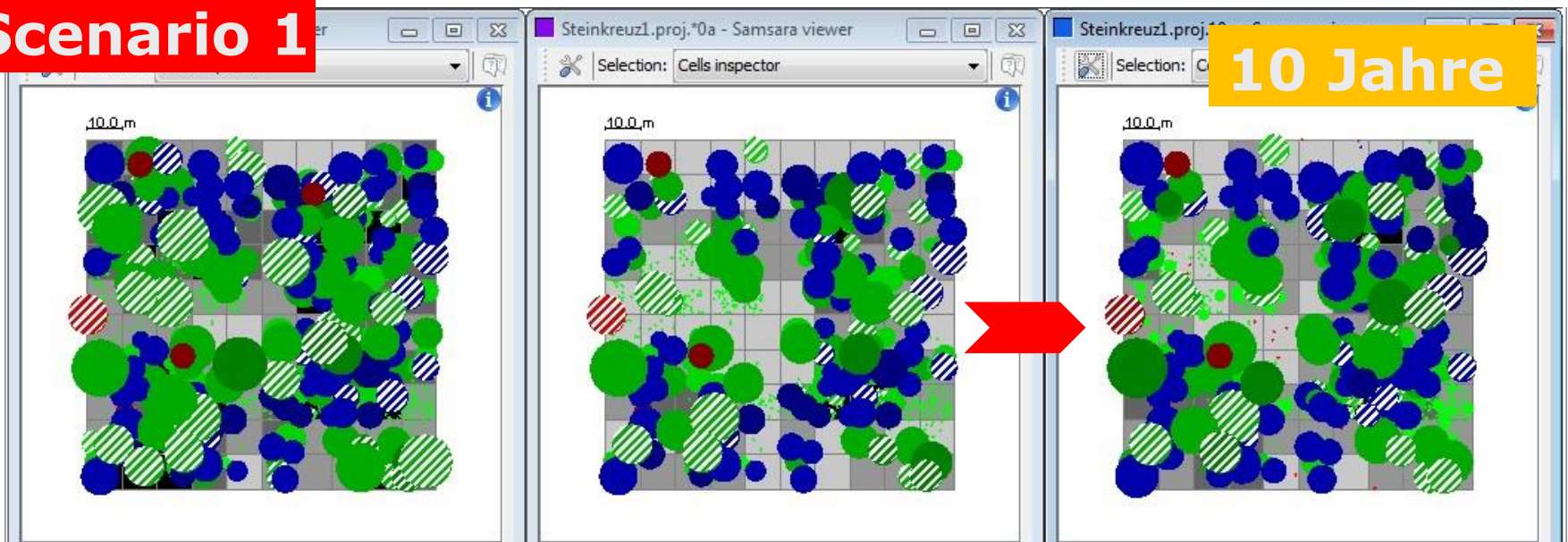
Ausgangsbestand

Nach dem Eingriff

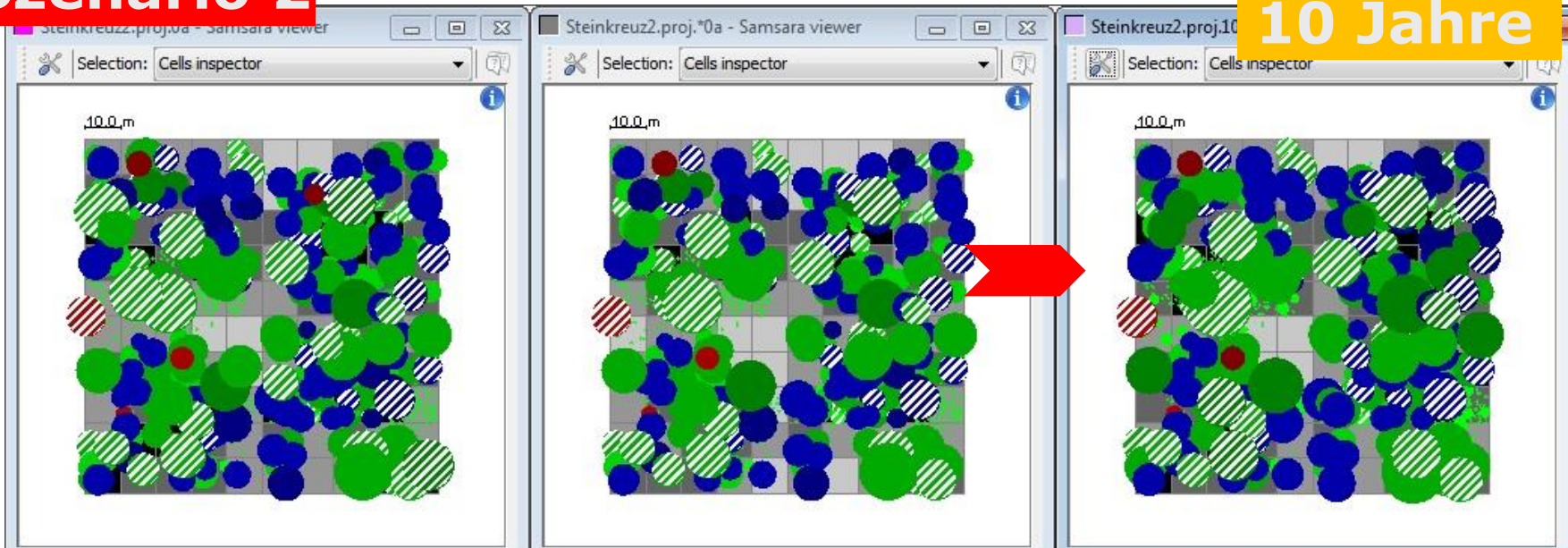
Nach 20 Jahren

Habitatbaumnchlieferung

Scenario 1



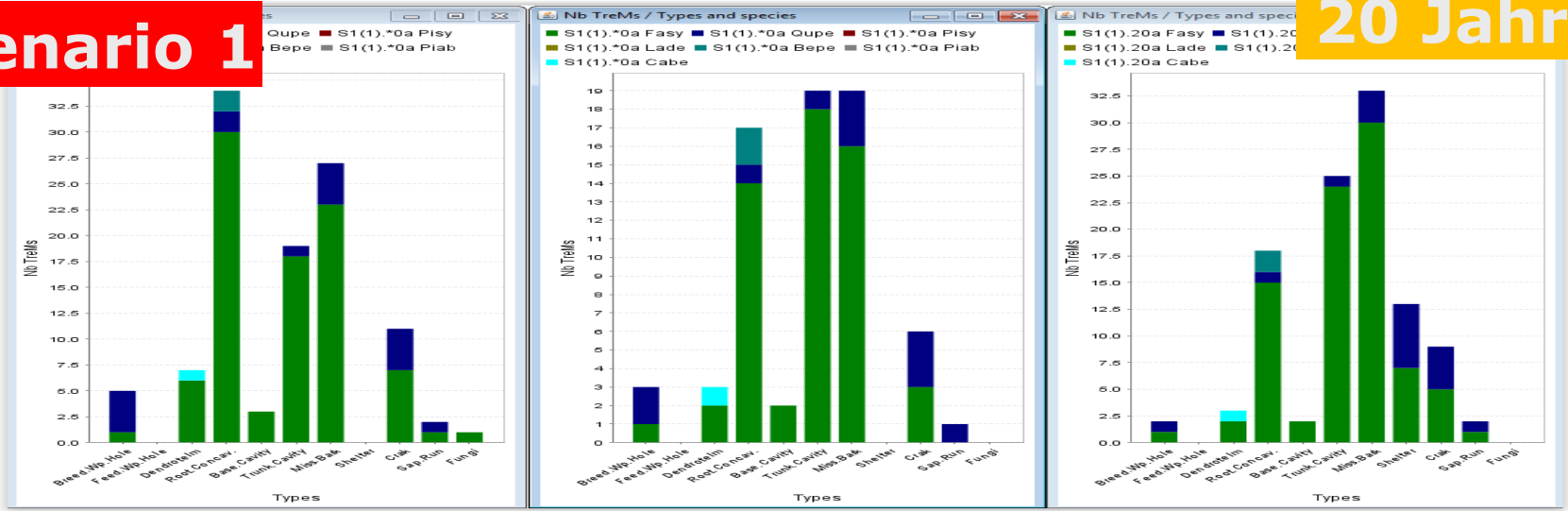
Szenario 2



Mikrohabitatneubildung

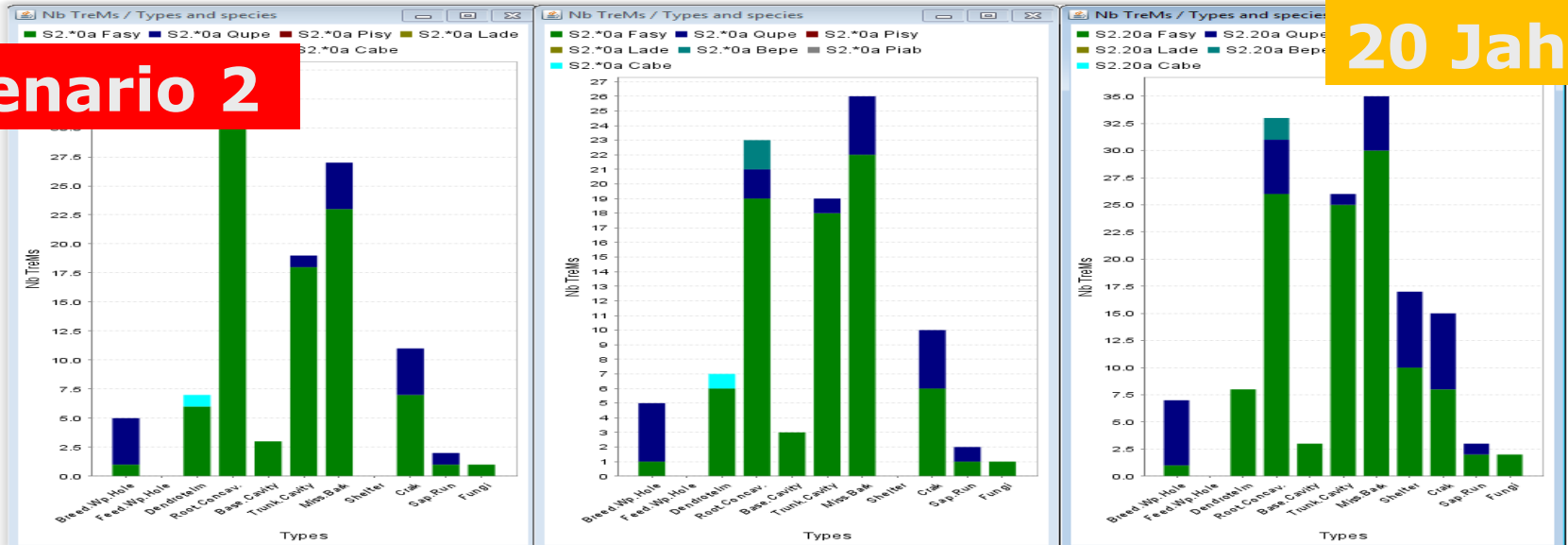
Szenario 1

20 Jahre



Szenario 2

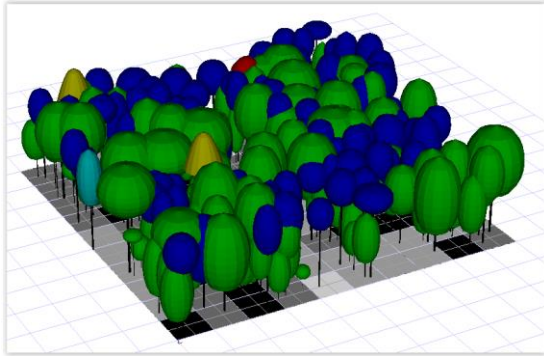
20 Jahre



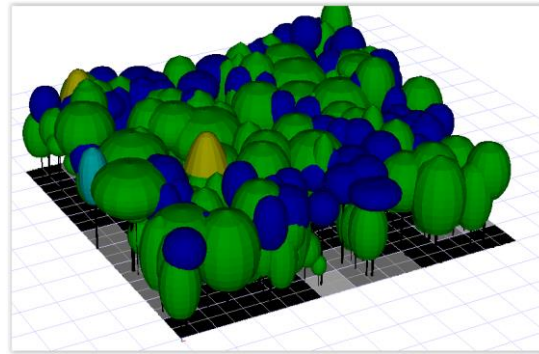
Szenario 0: Mikrohabitatbildung 200 Jahre



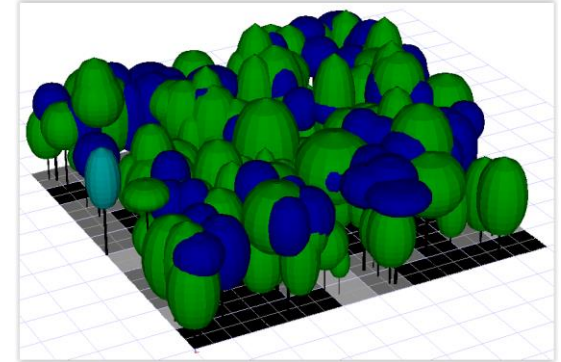
Szenario 0: Bestandesentwicklung 200 Jahre



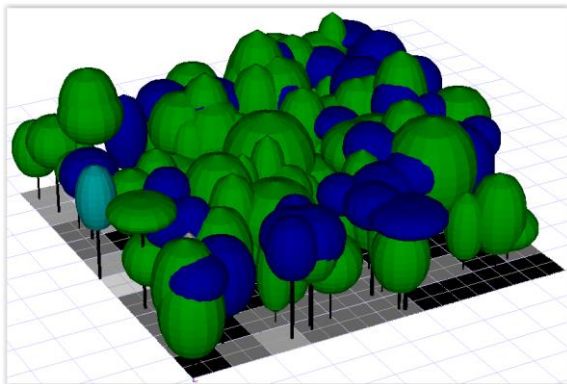
t=0



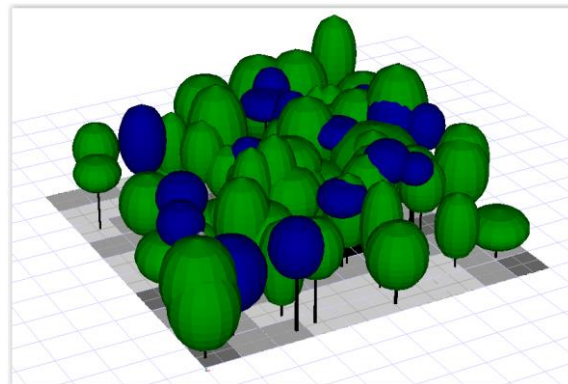
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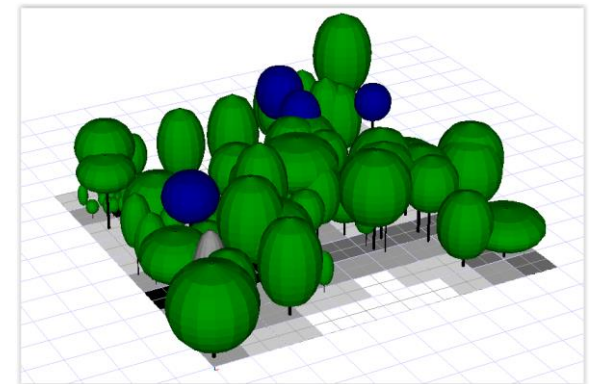
t=80



t=120



t=160



t=200



Wir bedanken uns bei

B. Courbaud (Irstea) , F. de Coligny (INRA), L. Larrieu (INRA/CNPF) und A.Letort (Irstea)

für die geleistete Unterstützung!!!





Vielen Dank für die Aufmerksamkeit!



Integrate+

What are Martelloscopes?

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 important 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 the above question. Nonetheless simulating interventions applied by practitioners on the same stand can provide such answers.

So-called 'Martelloscopes' do the term originates from French and describes a detailed examination of tree and their consequences for the stand.

They are silvicultural training tool. In one hectare in which all trees are numbered, mapped and their growth is monitored, an evaluation and virtual tree selection can be performed. The tool also displays the results of interventions and future projections.

Different management approaches and their economic consequences for the stand can be discussed by the

The diagram shows a 10x10 grid representing a forest plot. Each cell contains a colored circle representing a tree. The size of the circle indicates the tree's diameter at breast height (DBH), and the color indicates the tree species. A legend below the grid provides the key for species and DBH classes.

Tree species	DBH (cm)
Beech	0.0 - 10.0
Oak	10.1 - 25.0
Hornbeam	25.1 - 35.0
Birch	35.1 - 45.0
Larch	45.1 - 55.0
Pine	55.1 - 75.0
Spruce	75.1 - 100.0

Integrate+

Martelloscopes

Calibrating silvicultural decision making

This image shows the cover of a report titled 'Martelloscopes: Calibrating silvicultural decision making'. It features a grid of 12 small photographs showing different forest scenes, likely representing the results of various silvicultural interventions. The text on the cover includes the title and the subtitle.