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Simulation der ökonomischen und ökologischen Entwicklungen bei verschiedenen waldbaulichen Eingriffen

Daniel Kraus, Benoit Courbaud, François de Coligny, Laurent Larrieu,
Anthony Letord, Andreas Schuck

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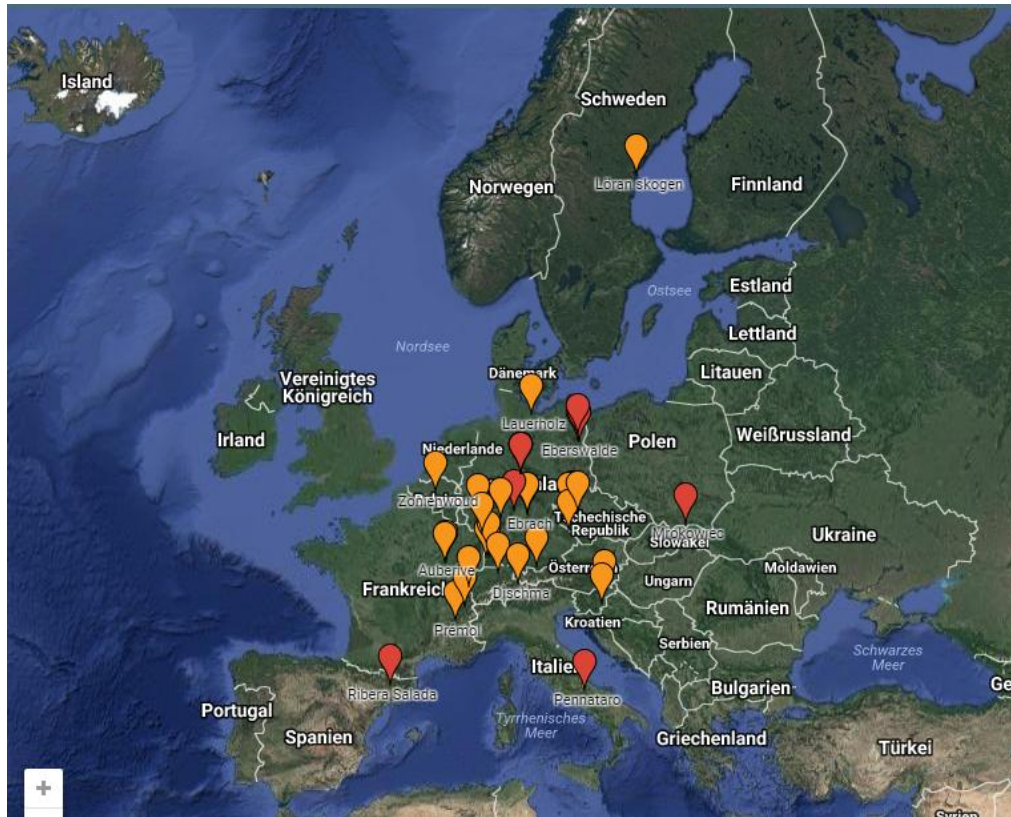
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Simulation der ökonomischen und ökologischen Entwicklungen bei verschiedenen waldbaulichen Eingriffen

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**

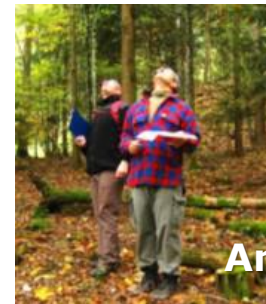
**Entwicklung einer mobilen
Software**

**Durchführung von Waldbau-
Training**

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

**Aufbau und Förderung
internat. Erfahrungsaustauschs**

Waldbautraining



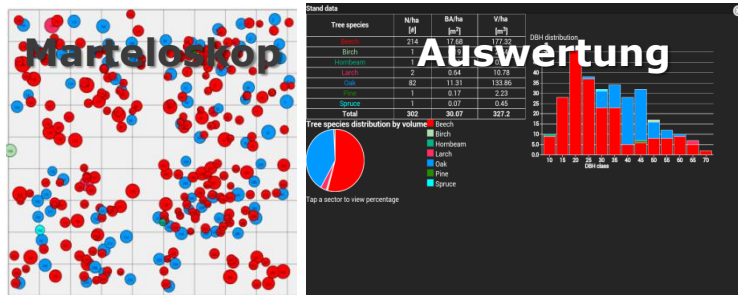
Marteloskop Steinkreuz

Name: Lukas Fischer

Ausnahmegrund	Belastungsgrund			
	Stammwunde	Blattschaden	Struktur	Verjüngung
Stammwunde	274			
Blattschaden	246			
Struktur	222			
Verjüngung	212			
Sonstige	168			
	175			

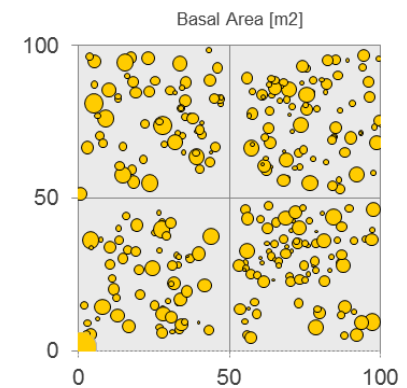
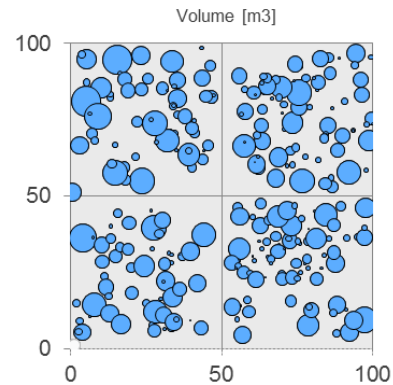
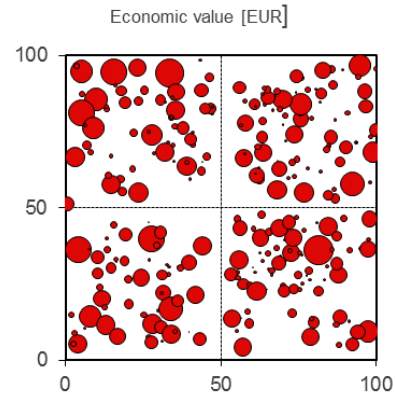
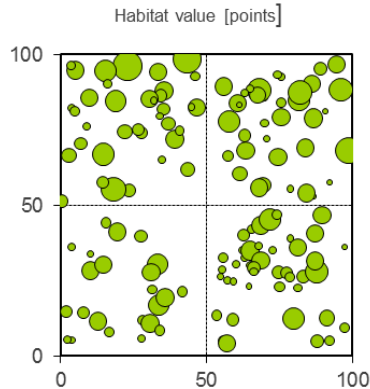
Belastungsgrund	Ausnahmegrund			
	Stammwunde	Blattschaden	Struktur	Verjüngung
Stammwunde				
Blattschaden				
Struktur				
Verjüngung				
Sonstige				

MARTELOSKOPE: praxisnahe Trainingstools für Waldbauer

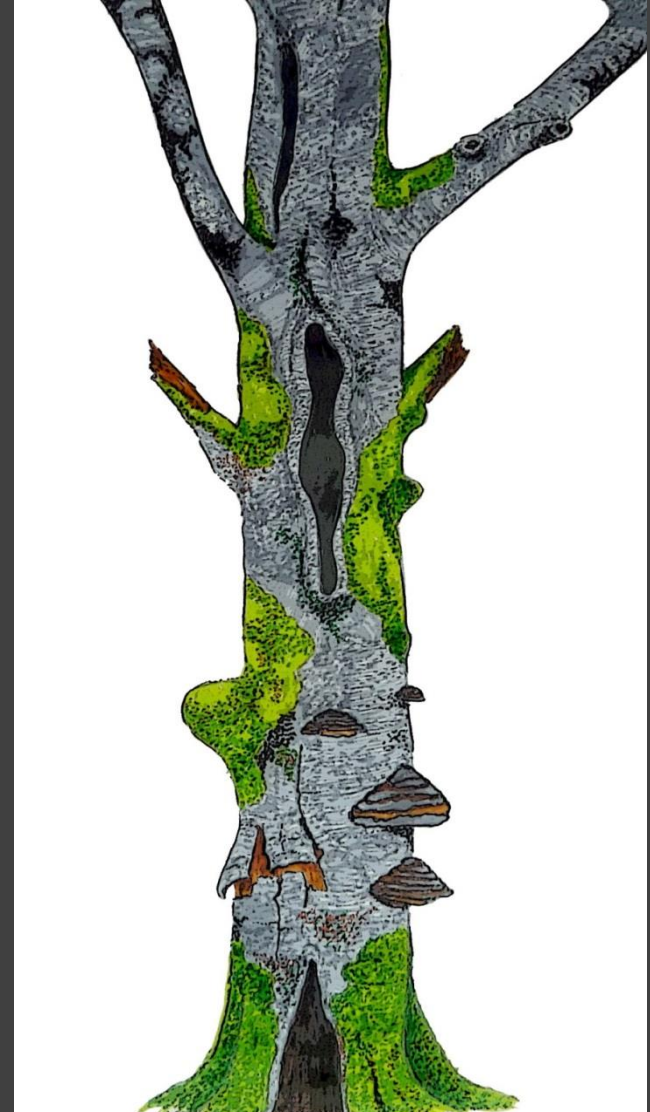


Was kann man damit machen?

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



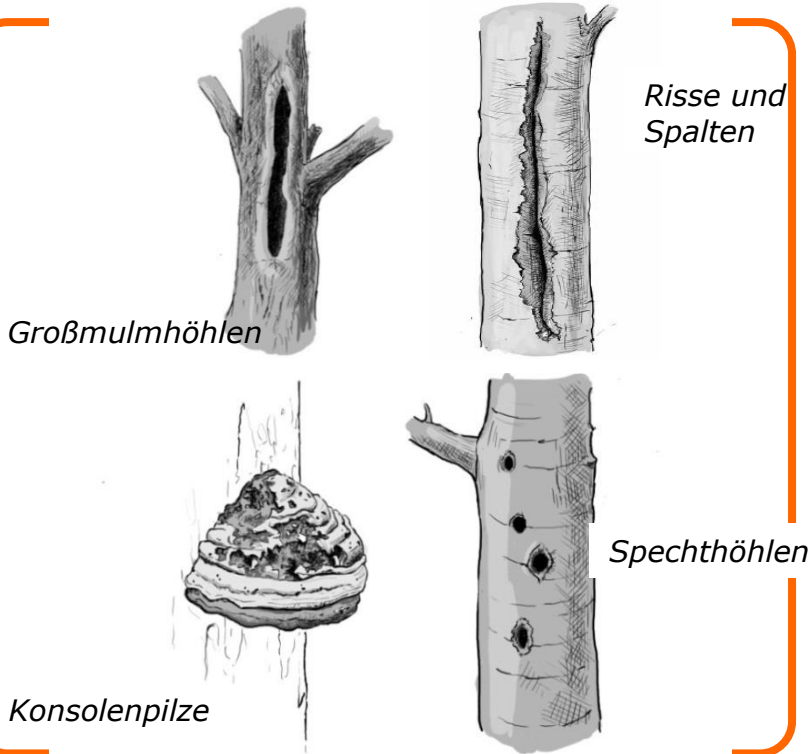
Was ist ein Habitatbaum?



Habitatwerte

Ausschnitt Kriterienliste

Baummikrohabitate



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

Habitatwerte

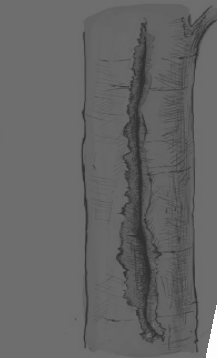
Ausschnitt Kriterienliste

Baummikrohabitate

Großmulmhöhlen



Konsolenpilze



Spechthöhlen

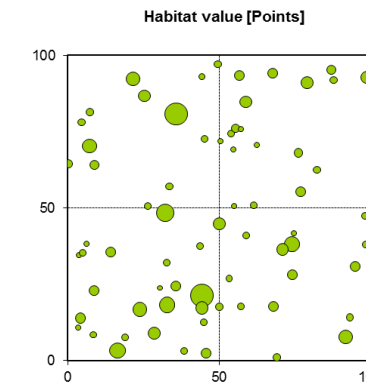
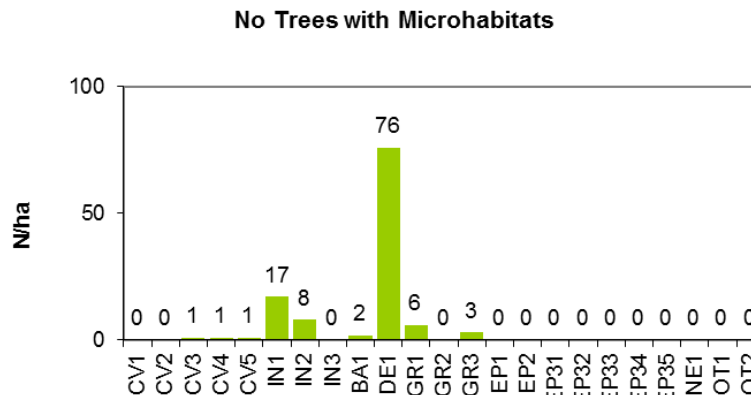
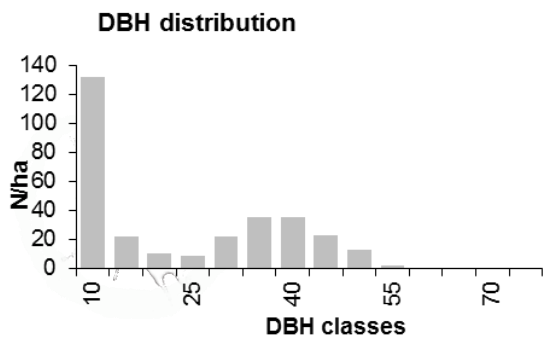
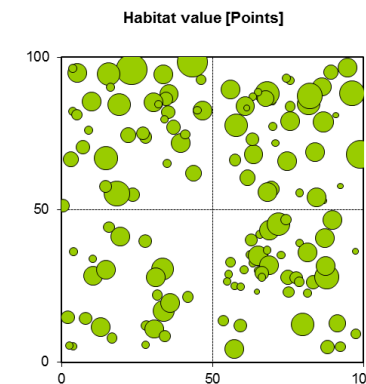
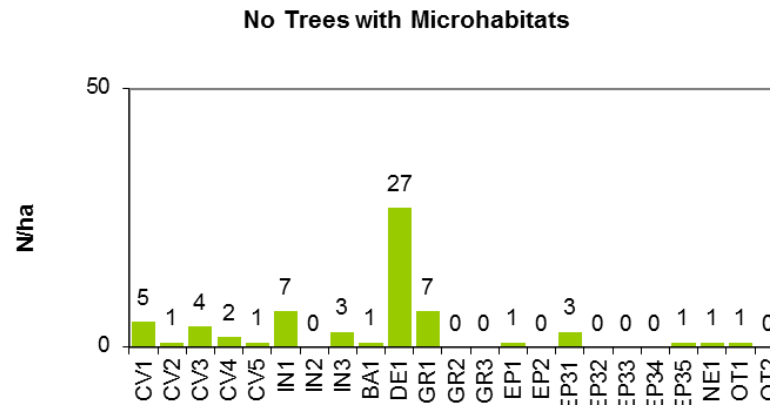
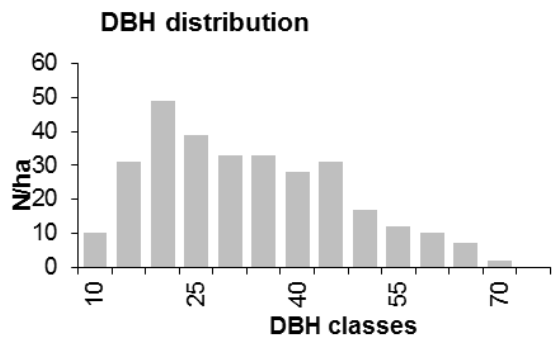
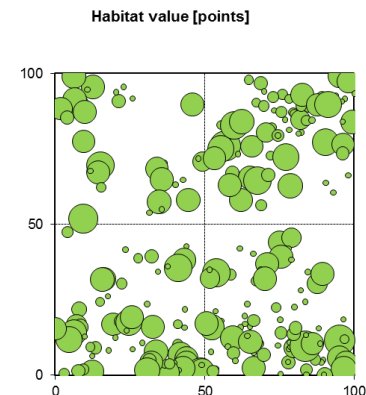
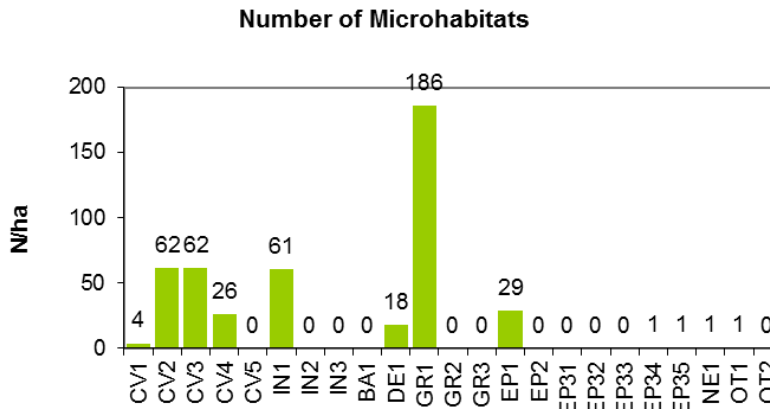
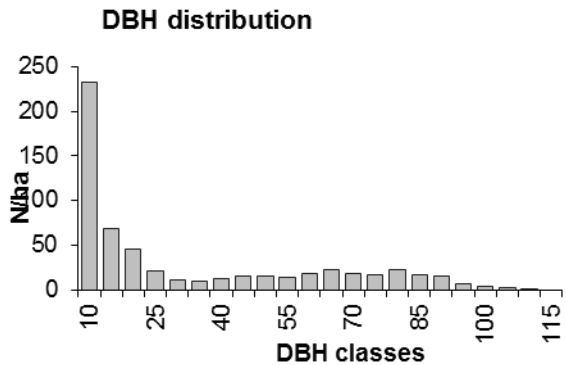
Epiphyten

Nests and aeries

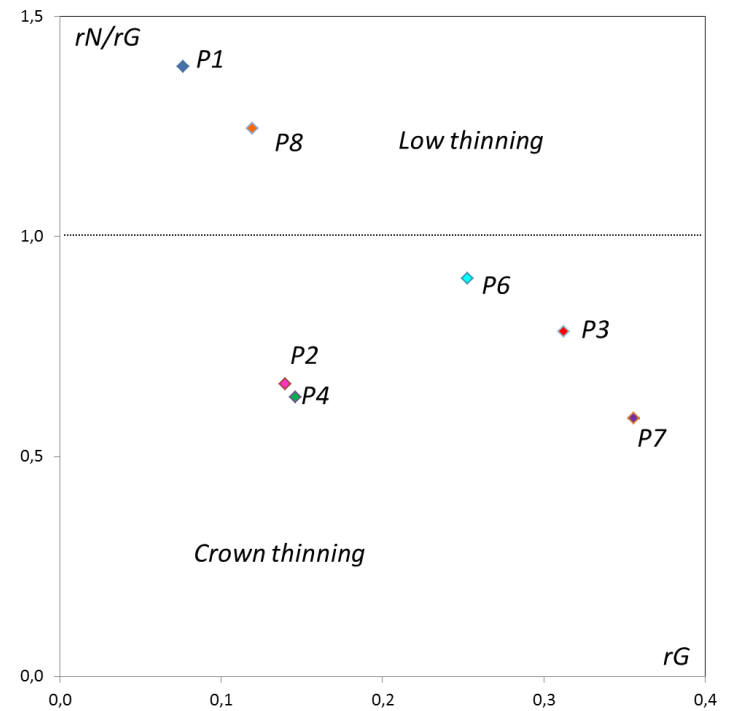
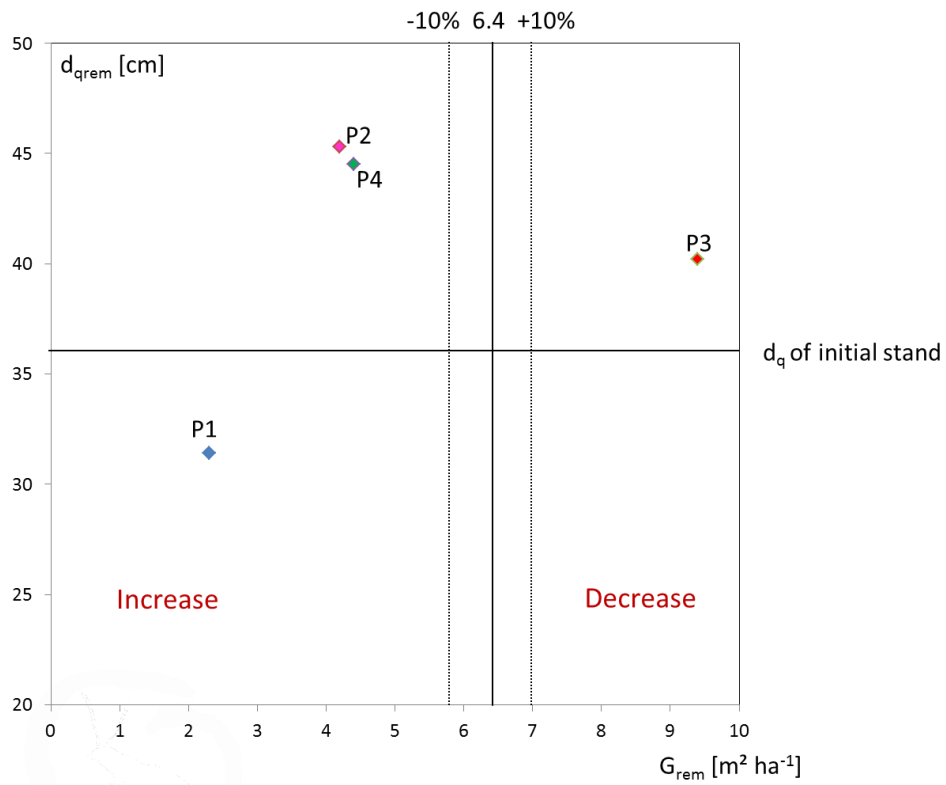
Other microhabitats



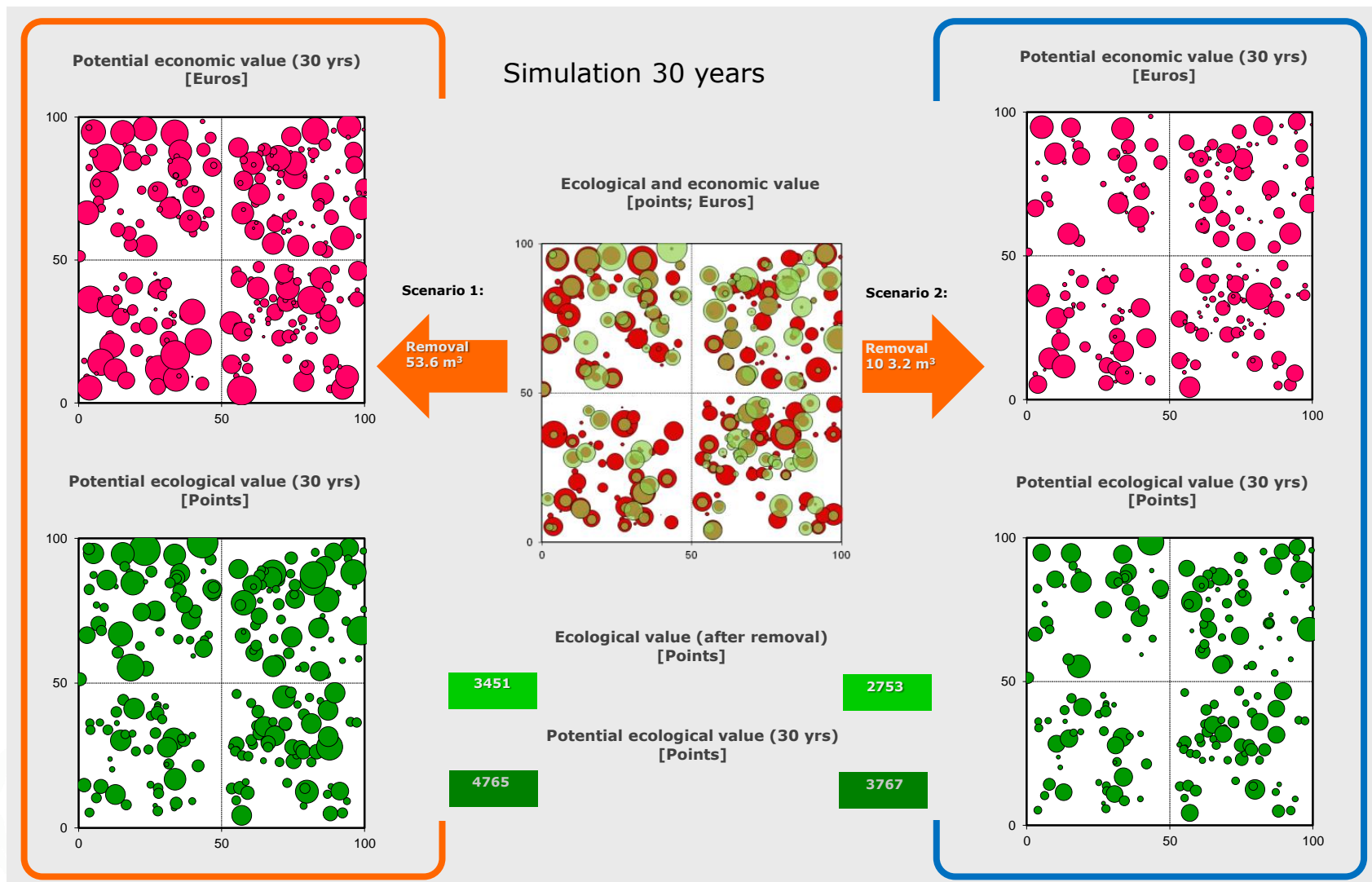
CV1	Woodpecker cavities
	Bank and mould cavities
	Branch holes
	Bendrotelms and water-filled holes
	Insect galleries and bore holes
	Bark loss / Exposed sapwood
	Exposed heartwood / Stem and crown breakage
	Cracks and scars
	Bark pockets
1	Dead branches and limbs / crown deadwood
GF1	Root buttress cavities
GF2	Witch broom
GF3	Cankers and burrs
EP1	Fruiting bodies fungi
EP2	Myxomycetes
EP3	Bryophytes
	Foliose lichens
	Lianas
	Ferns
	Misteltoe
NE1	Nests / aeries
OT1	Sap and resin run
OT2	Microsoil



Gruppenergebnisse

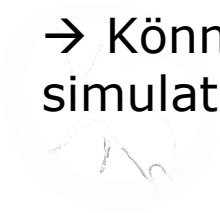


I+ Simulationen



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

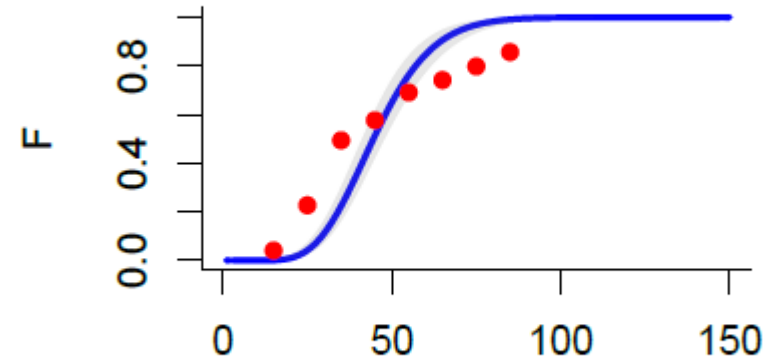


$$h(d) = \frac{dF(d)}{1 - F(d)}$$

Wahrscheinlichkeit der Entstehung von Mikrohabitaten

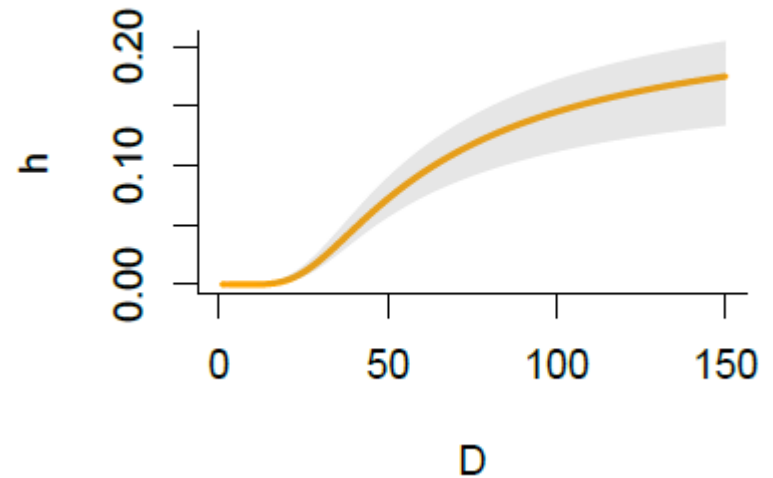
Kalibrierung der F-Funktion aus Beobachtungsdaten

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



Ableitung der h-Funktion zur Beschreibung des Entstehungsprozesses

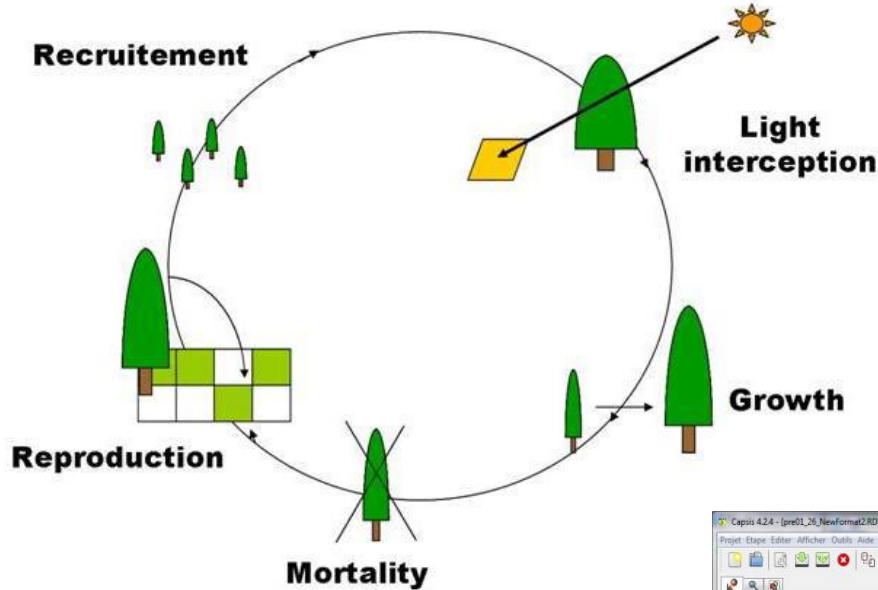
Uholka haP – *Fagus sylvatica* (UH-haP)



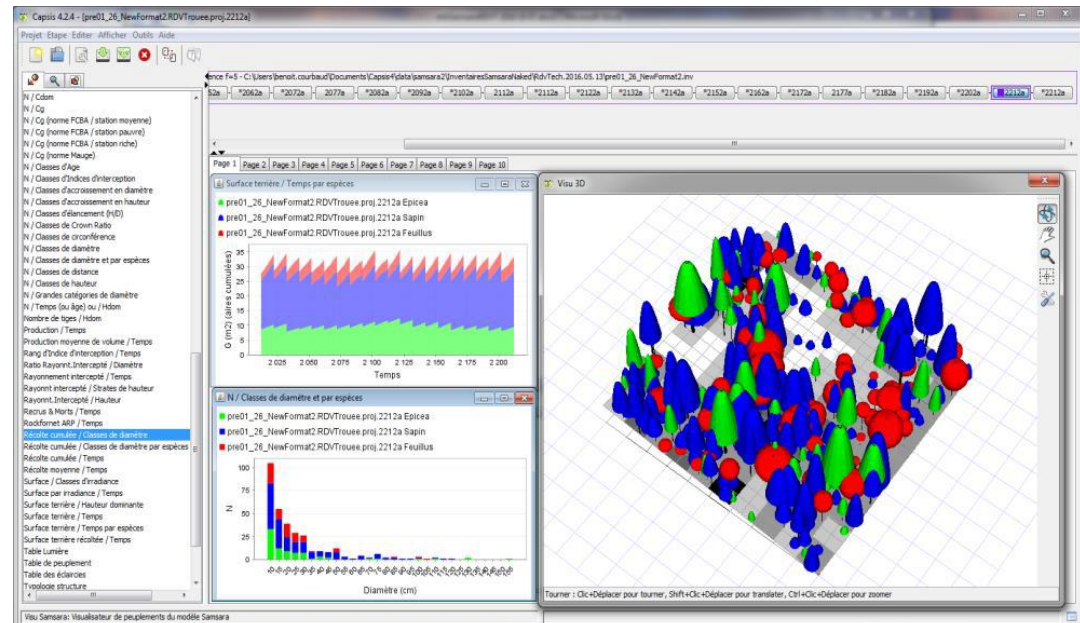
Integration in den Waldwachstumssimulator Samsara

Samsara: an individual-based, spatially explicit simulation model

Courbaud et al., 2003
Courbaud et al. 2015

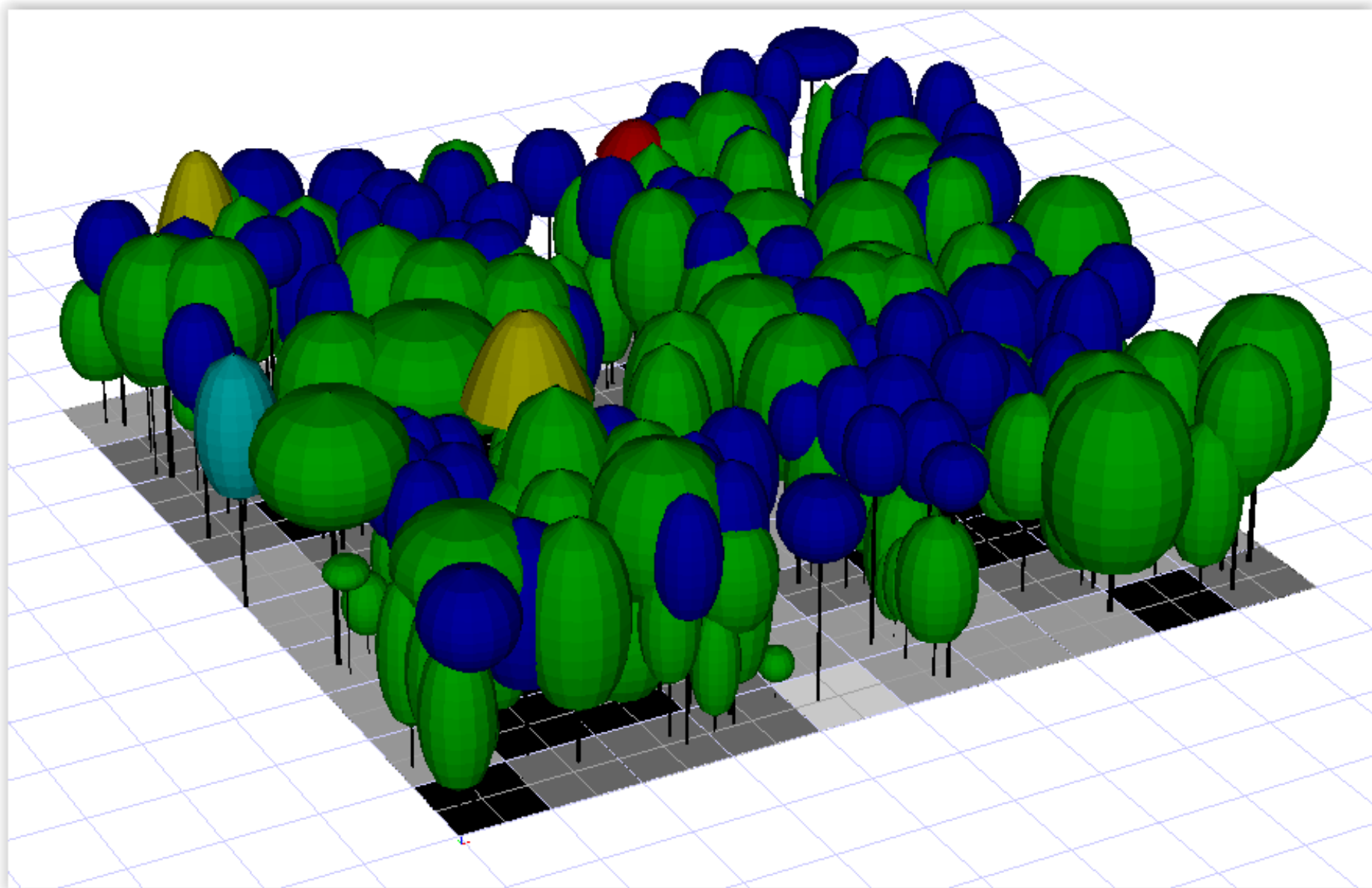


Entwicklungsplattform CAPSIS

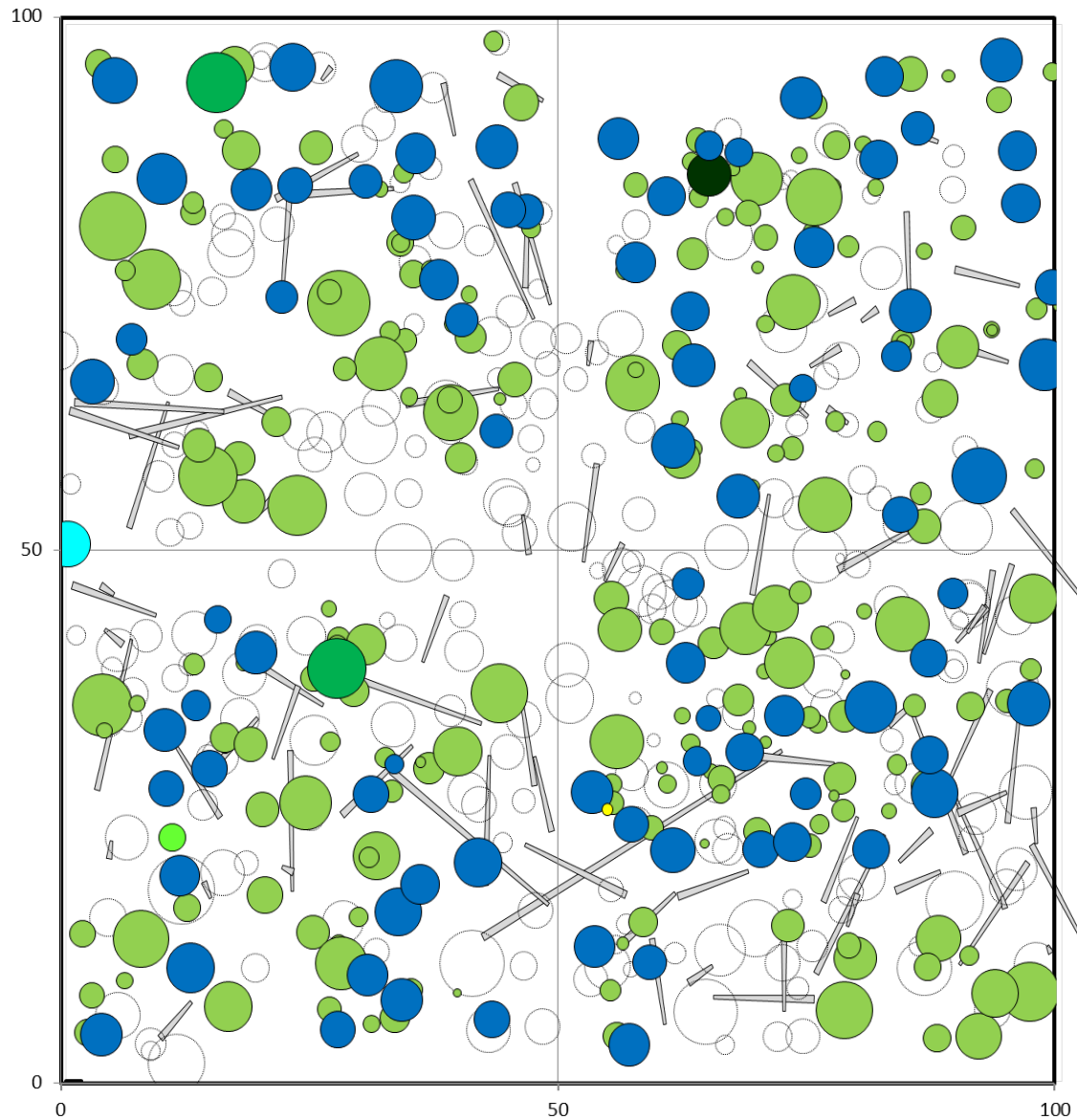


Coligny et al., 2003
Dufour-Kowalski et al. 2012

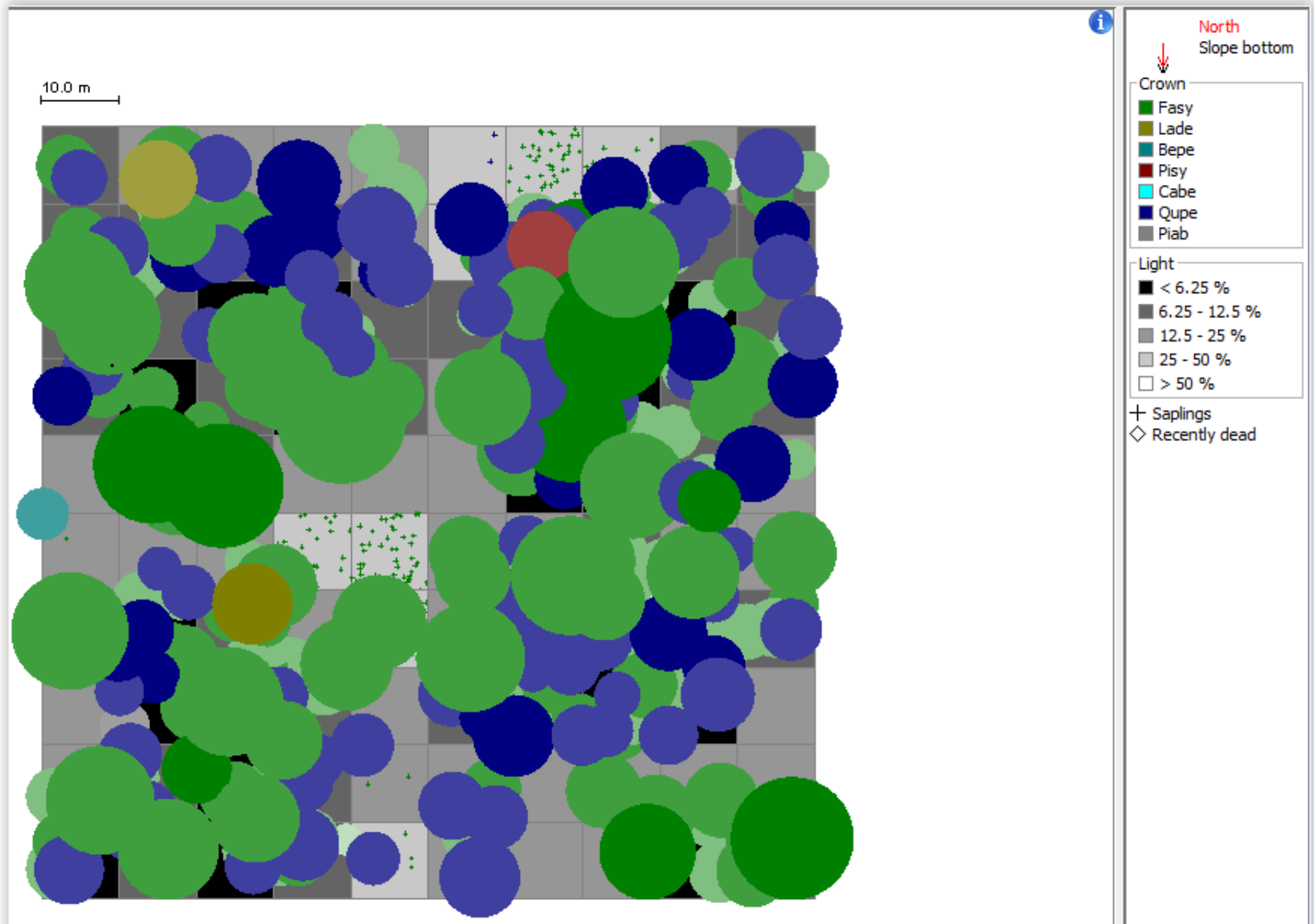
Das Marteloskop am Steinkreuz - der Bestand



Totholzinventur am Steinkreuz

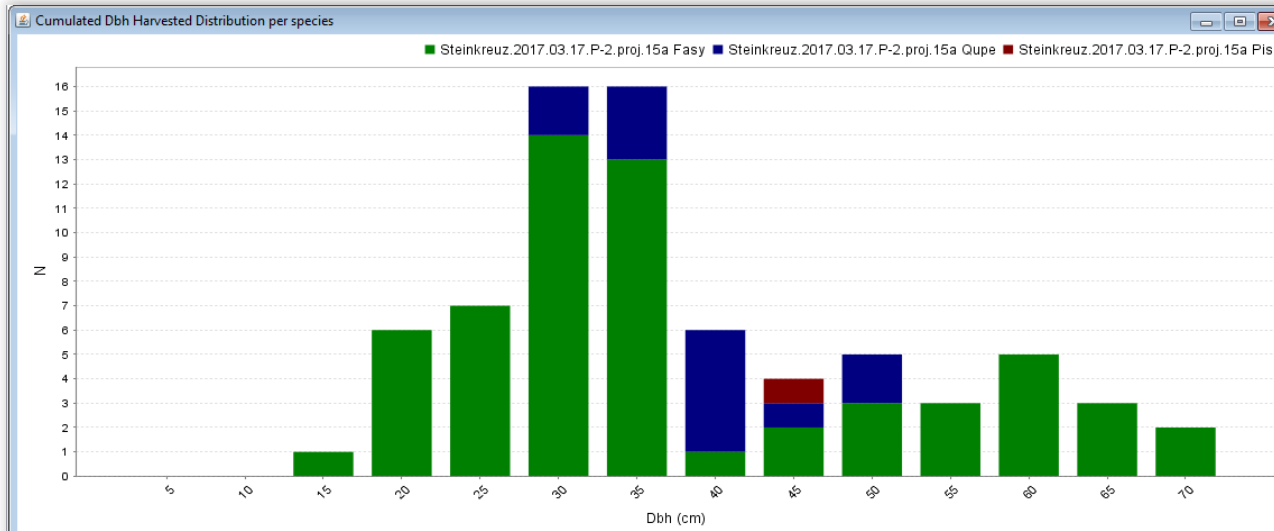


Ausgangsbestand mit Verjüngung

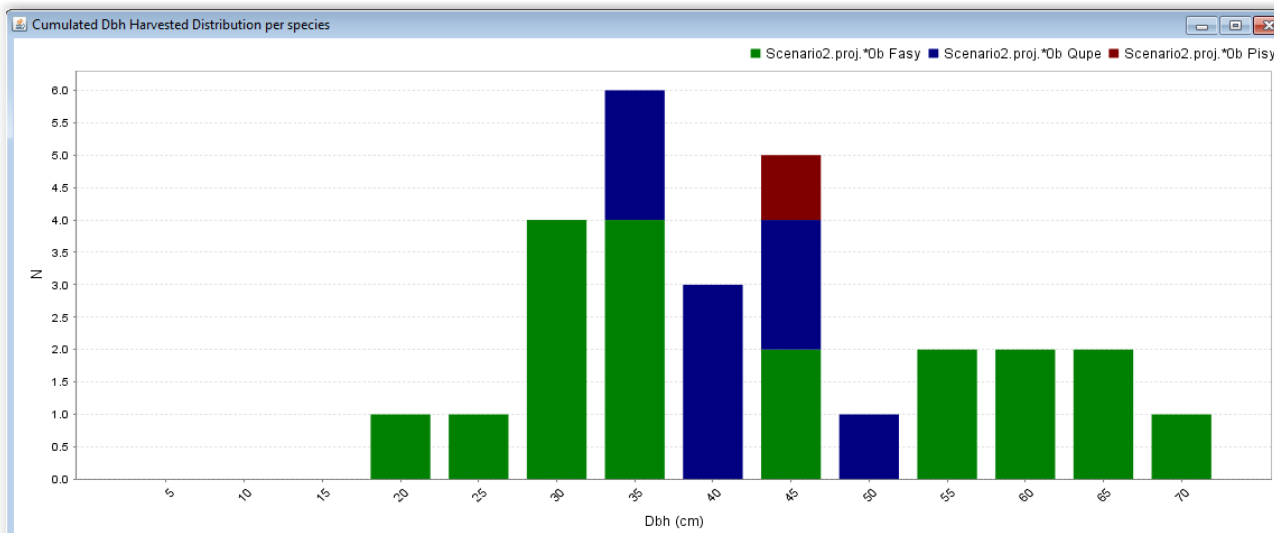


Simulation der Szenarien

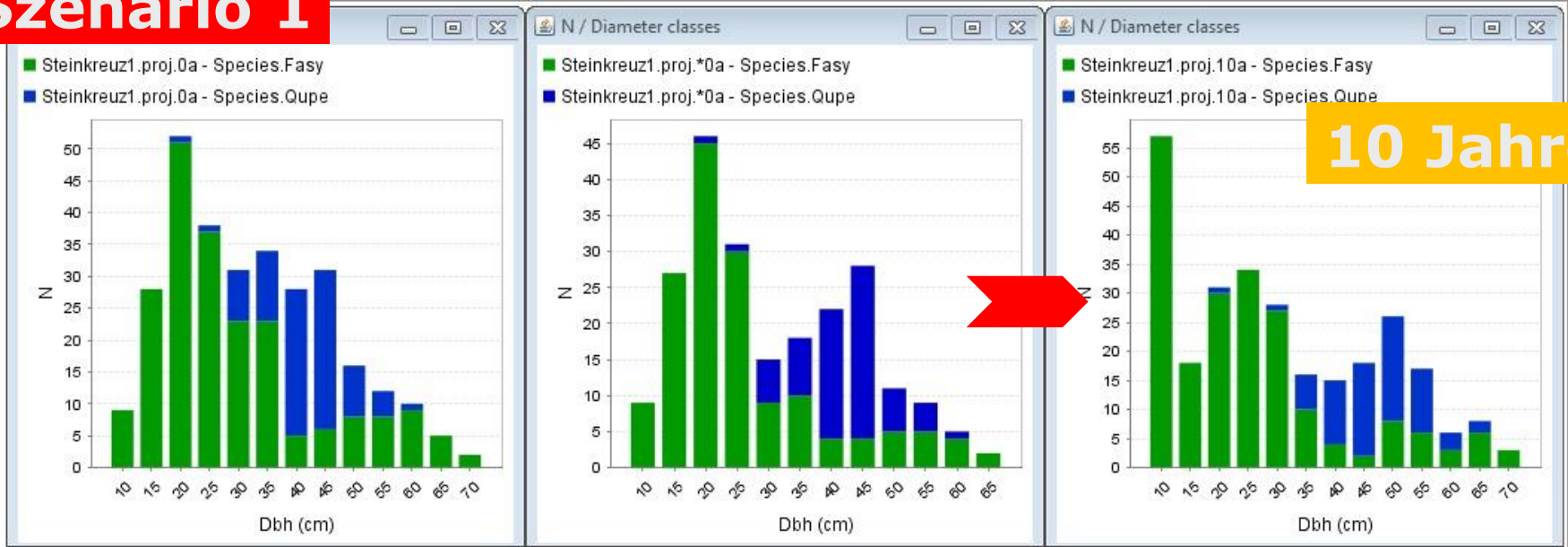
Szenario 1:



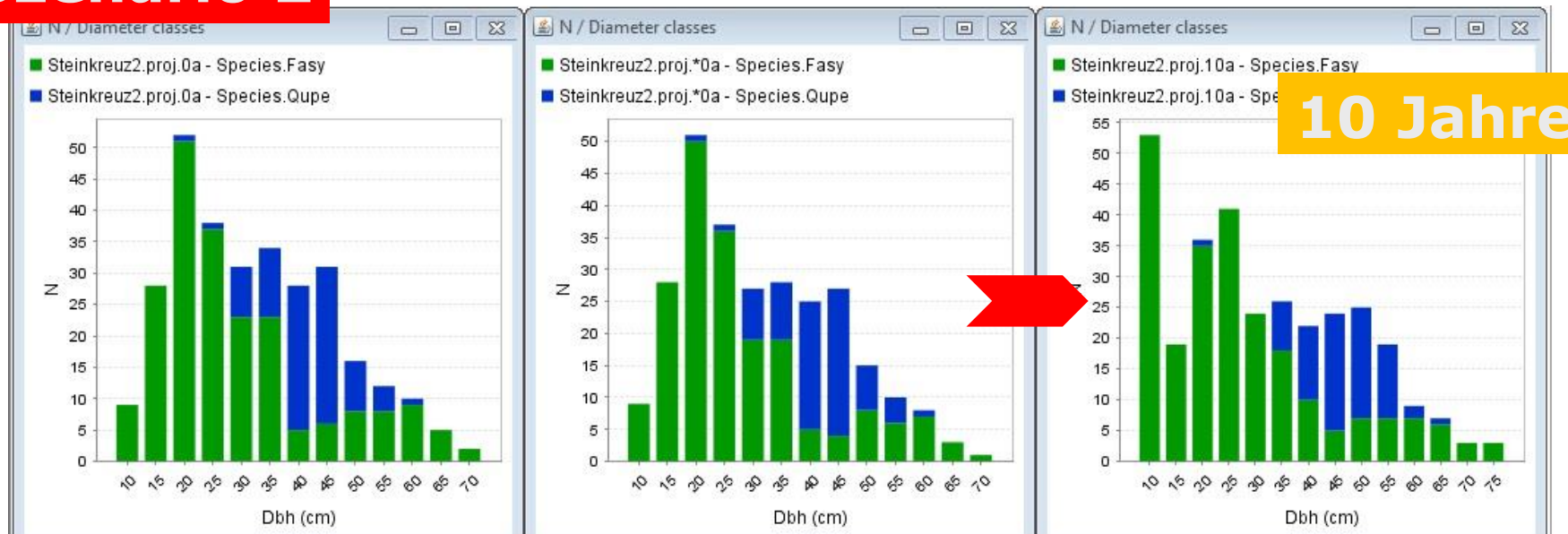
Szenario 2:



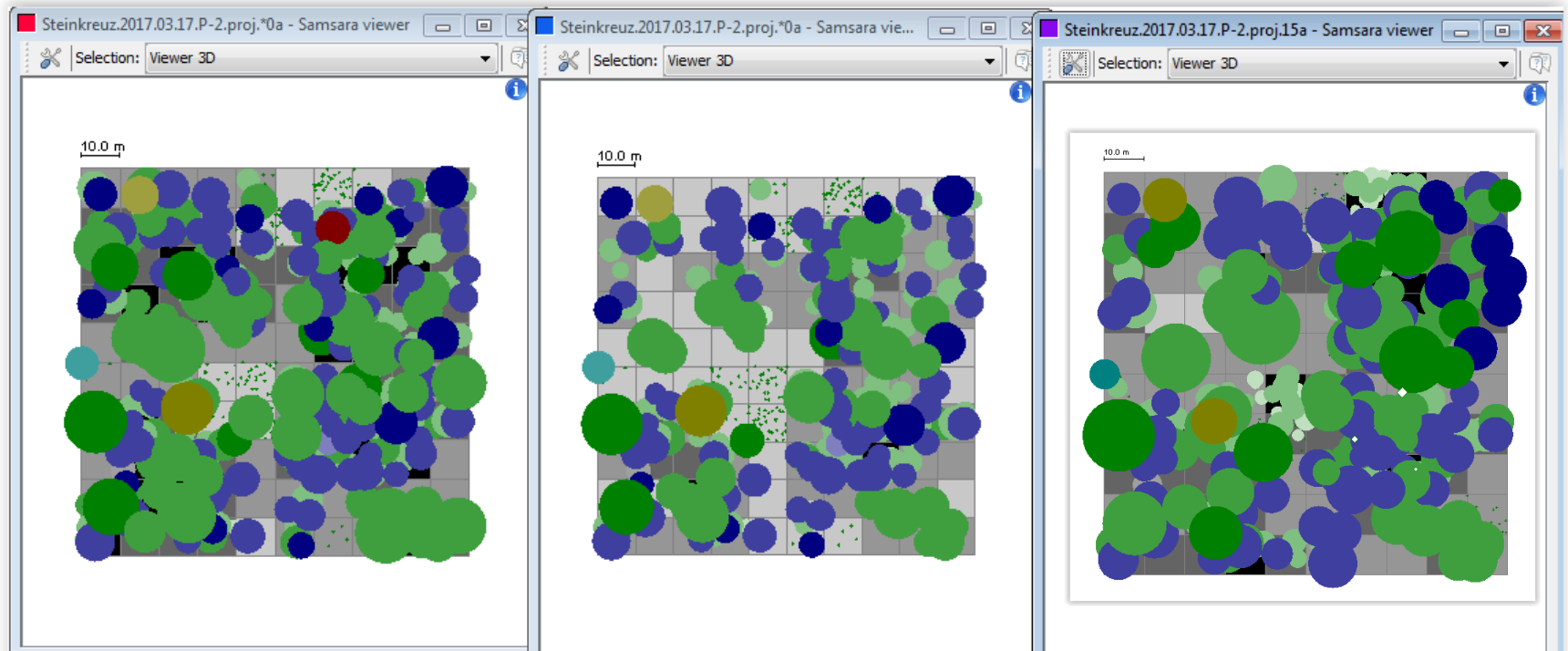
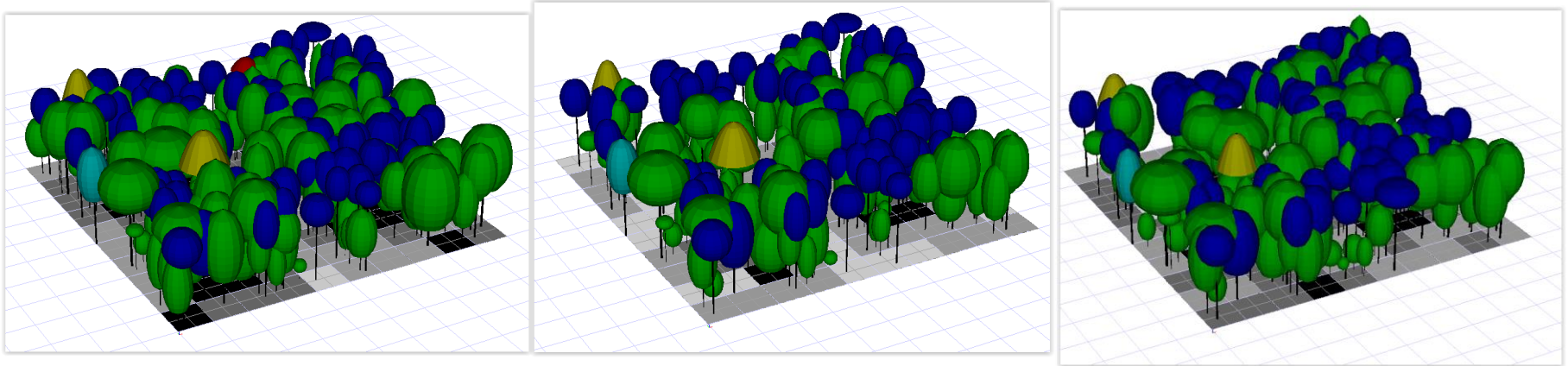
Szenario 1



Szenario 2



Szenario 1

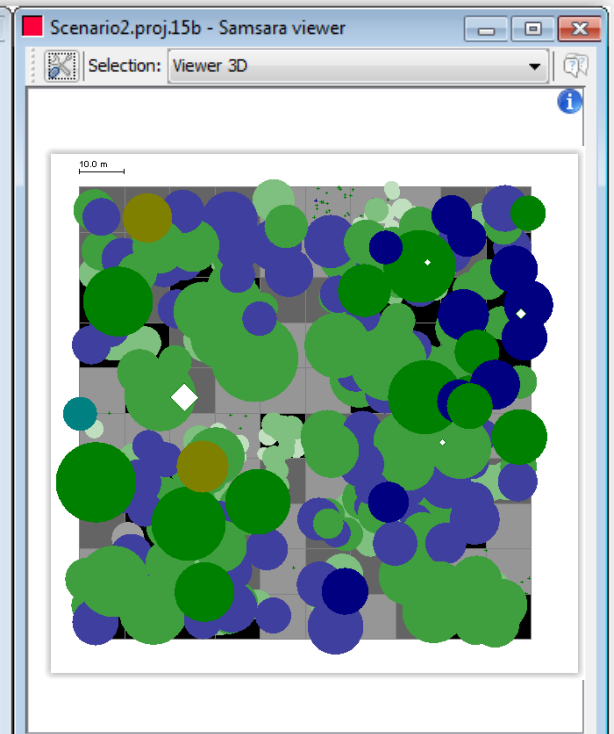
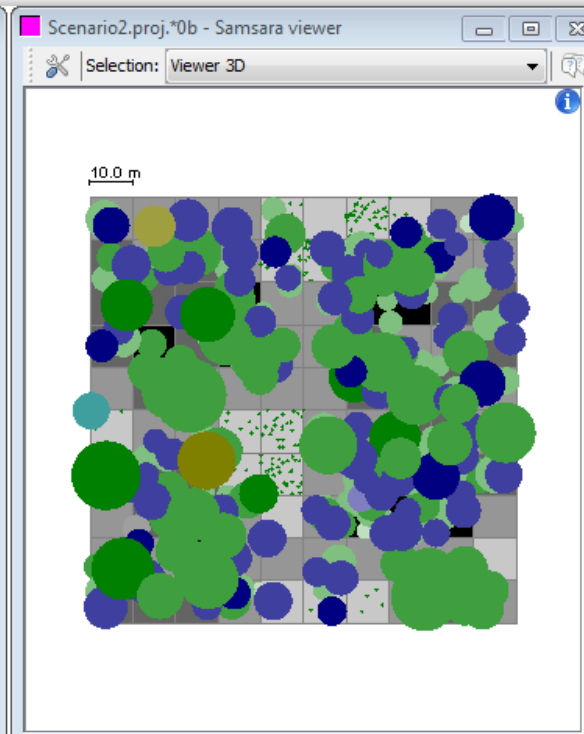
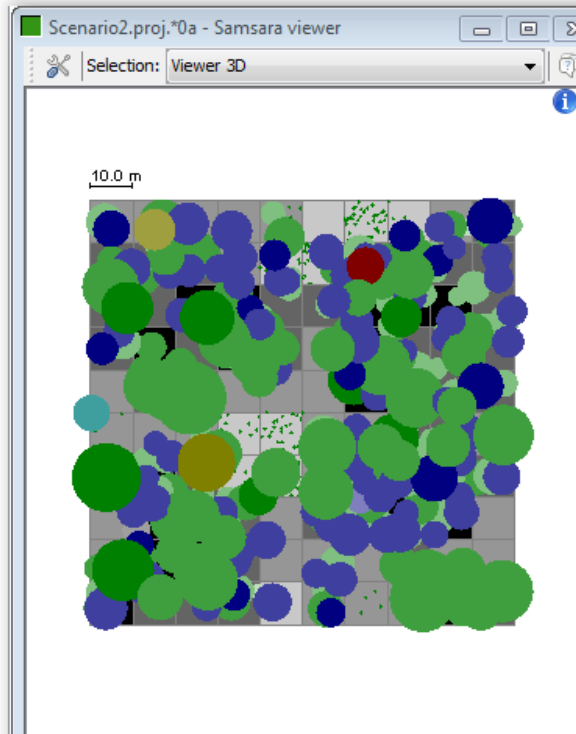
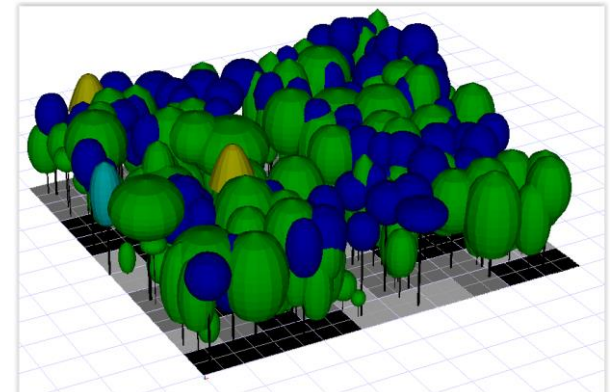
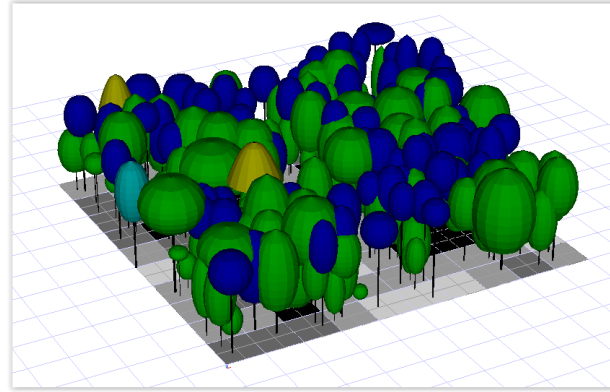
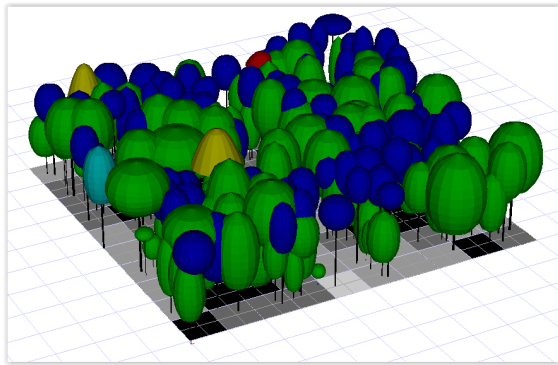


Ausgangsbstand

Nach dem Eingriff

Nach 20 Jahren

Szenario 2



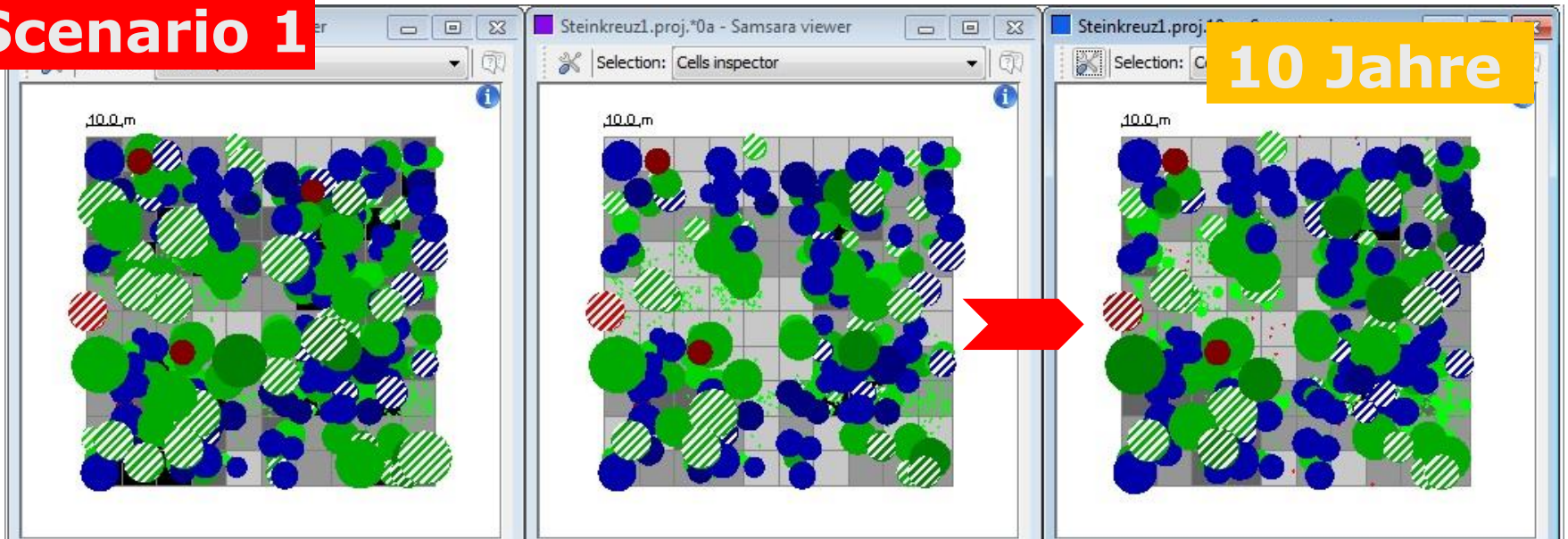
Ausgangsbestand

Nach dem Eingriff

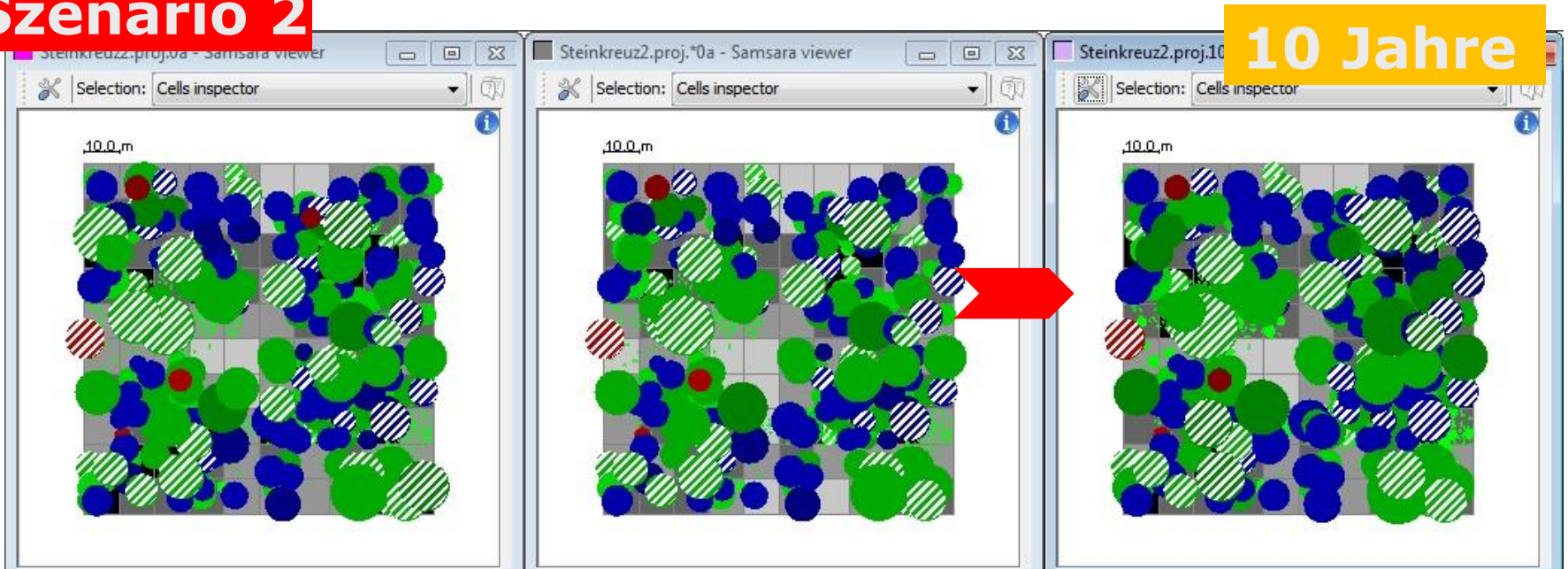
Nach 20 Jahren

Habitatbaumnchlieferung

Scenario 1



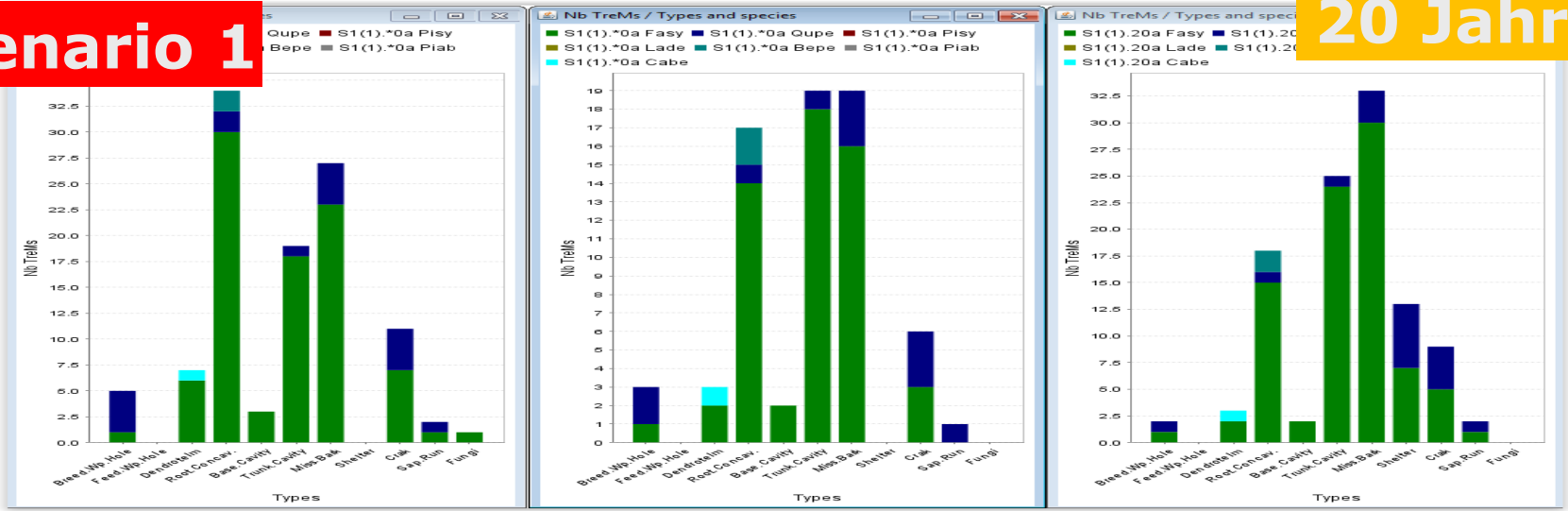
Szenario 2



Mikrohabitatneubildung

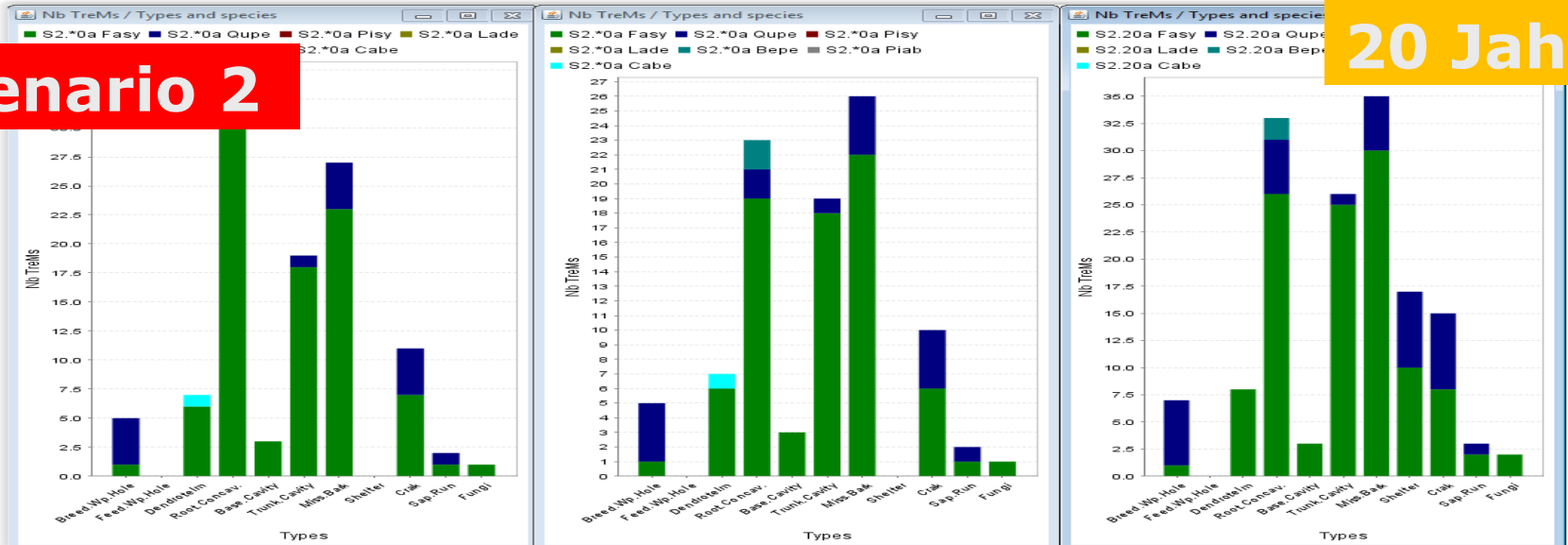
Szenario 1

20 Jahre



Szenario 2

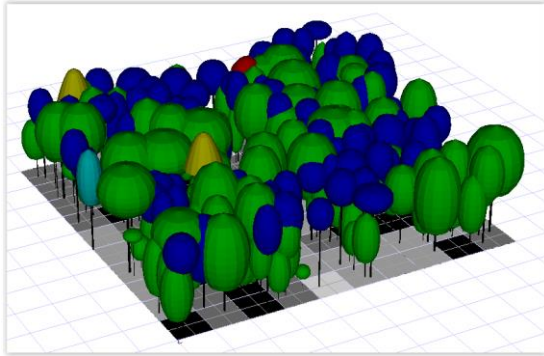
20 Jahre



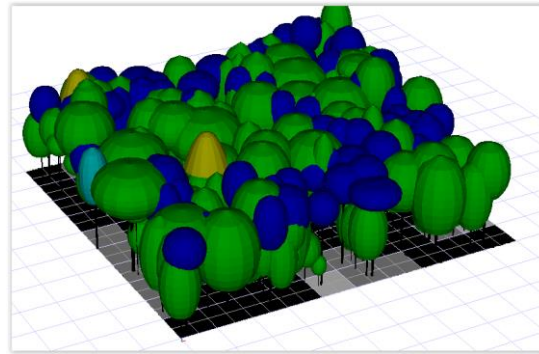
Szenario 0: Mikrohabitatbildung 200 Jahre



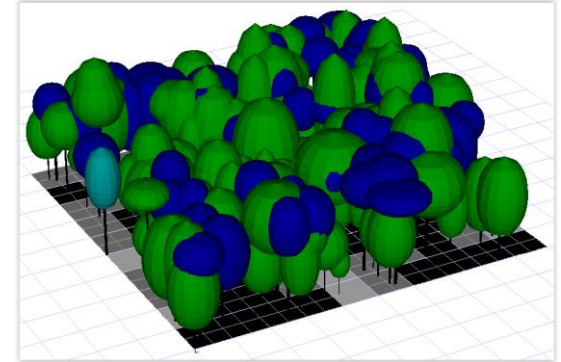
Szenario 0: Bestandesentwicklung 200 Jahre



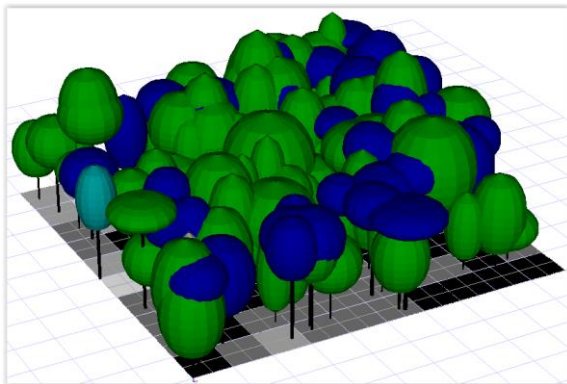
t=0



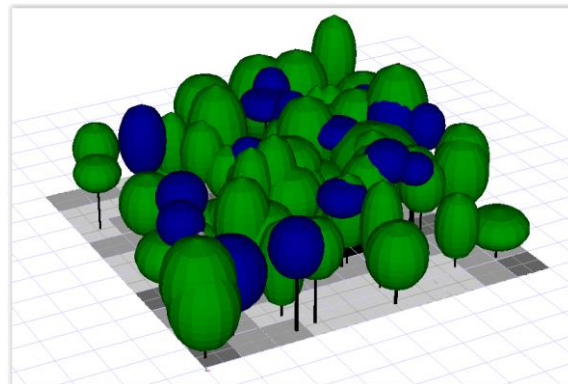
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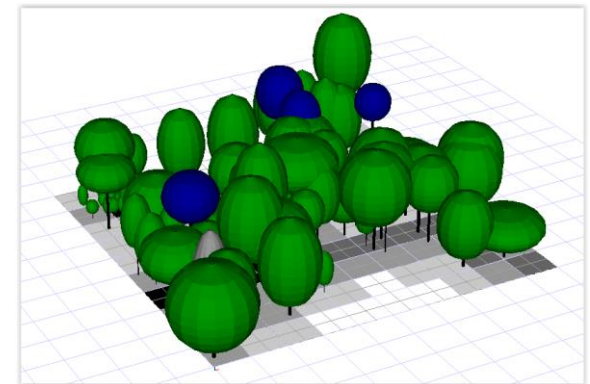
t=80



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 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 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 'Marteloscopes' do the term originates from French and describes a detailed examination of tree growth and their consequences for the stand.

They are silvicultural training tools. In one hectare in which all trees are numbered, mapped and measured an evaluation and selection of trees for virtual tree selection can be performed. The results can be displayed to show the consequences of interventions and future stand dynamics.

Different management interventions and their economic consequences on the stand can be simulated by the

The diagram shows a 20x20 grid representing a forest stand. Red and blue dots represent different tree species. A legend below the grid defines the symbols by tree species and Diameter at Breast Height (DBH) in centimeters. A north arrow is also present.

Tree species	DBH (cm)	Symbol
Beech	0.0 - 10.0	Small red dot
Oak	10.1 - 25.0	Small blue dot
Hornbeam	25.1 - 35.0	Medium red dot
Birch	35.1 - 45.0	Medium blue dot
Larch	45.1 - 55.0	Large red dot
Pine	55.1 - 75.0	Large blue dot
Spruce	> 75.0	Very large red dot

