



PRAHA, 07.01.2012

Lessons from 30 years of natural disturbances in the Bavarian Forst National Park

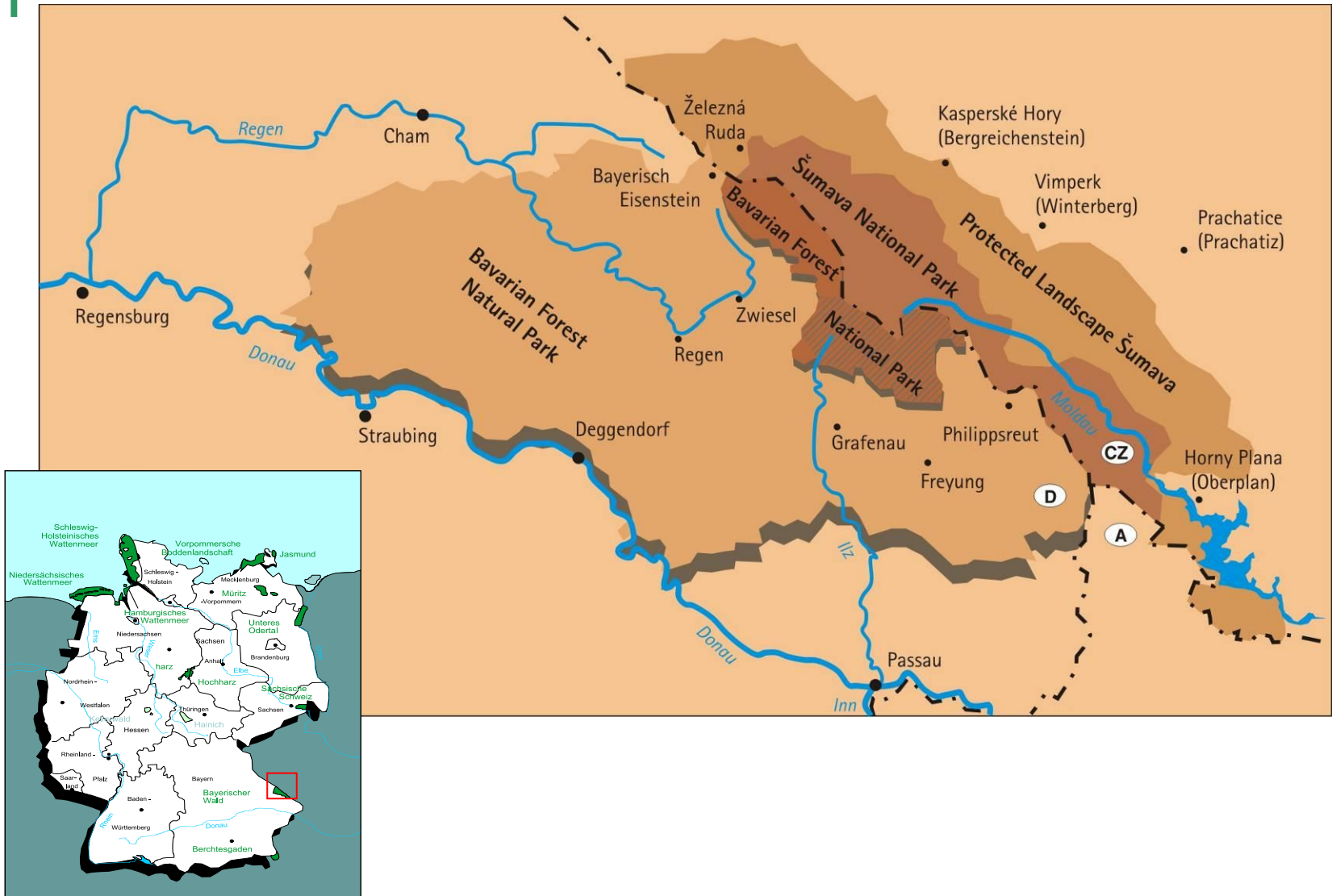
Marco Heurich



Nationalpark
Bayerischer Wald



Study Area



Study Area

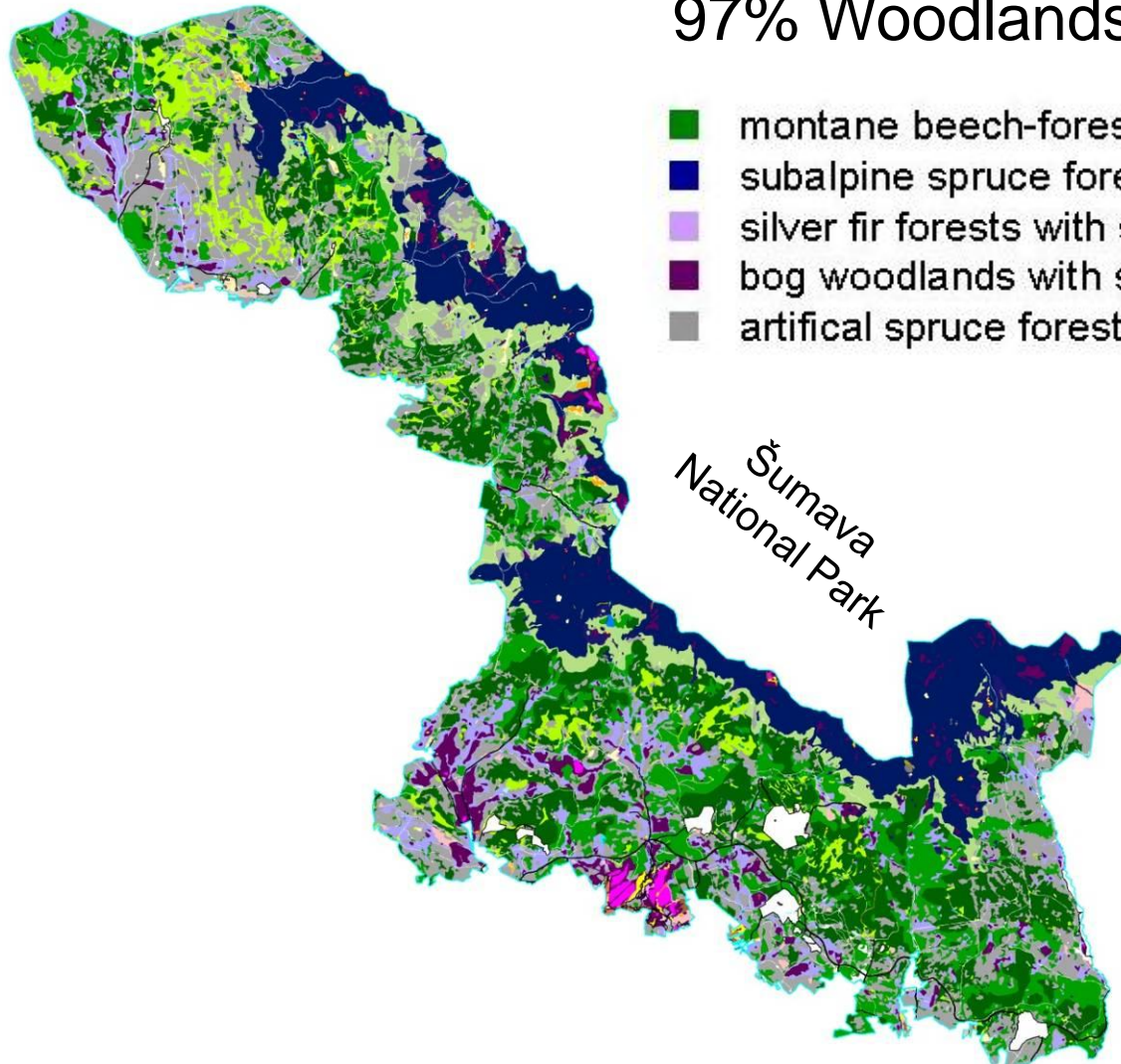
- Elevation: - 600m to 1.453m a.sl. (Großer Rachel)
- Relief: - ± steep slopes, SE-, S-, SW-orientation
- Geology: - Part of the Moldanubicum, a very old low mountain range
- Cristalline rocks (gneis, granite)
- Soils: - Relatively poor and acid, stony
- 19% wet mineral or organic soils
- Climate: - rough and humide



Vegetation

97% Woodlands

- montane beech-forests with spruce + fir (52%)
- subalpine spruce forests (19%)
- silver fir forests with spruce (8%)
- bog woodlands with spruce or pine (6%)
- artificial spruce forests (15%)



Bavarian Forest National Park

Foundation:	7 th October 1970
Dimension:	13.300 hectares
1974:	Added to UN list of National Parks (IUCN)
1986:	European Diploma Category A
Extension:	1 st August 1997
Actual size:	24.250 hectares

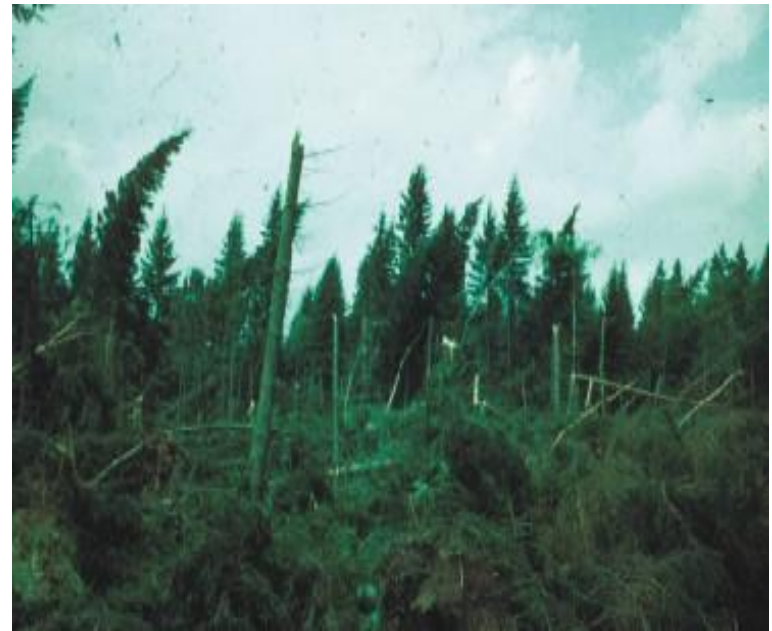
Primary aim:

Protection of natural or near-natural ecosystems within their inherent dynamics

Windthrow ...

...Triggers of radical changes in the woodlands of the Bavarian Forest National Park

- Thunderstorm on 1st August 1983
- Heavy storms in autumn of 1984
 - **173 ha** windthrow area totally, spread over 43 regions
 - **14,3 ha** in the mountain spruce forests
 - **88 ha** in the strict protected zone (~30.000 fm timber)



First Practical Test ...

...for the management of the National Park

...and a quite new concept: The protection of dynamic processes

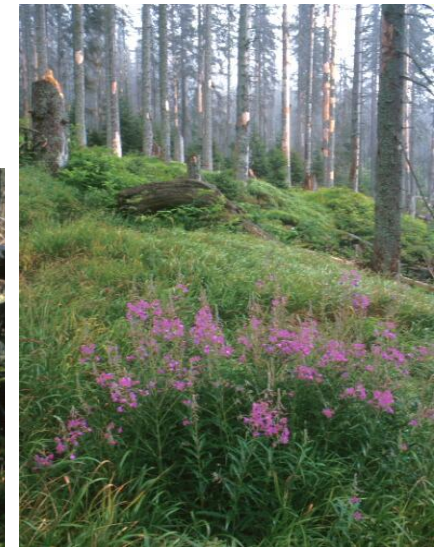
Bavarian State Minister Dr. Eisenmann:

These events give us the opportunity to get „a primeval forest for our children and grandchildren“

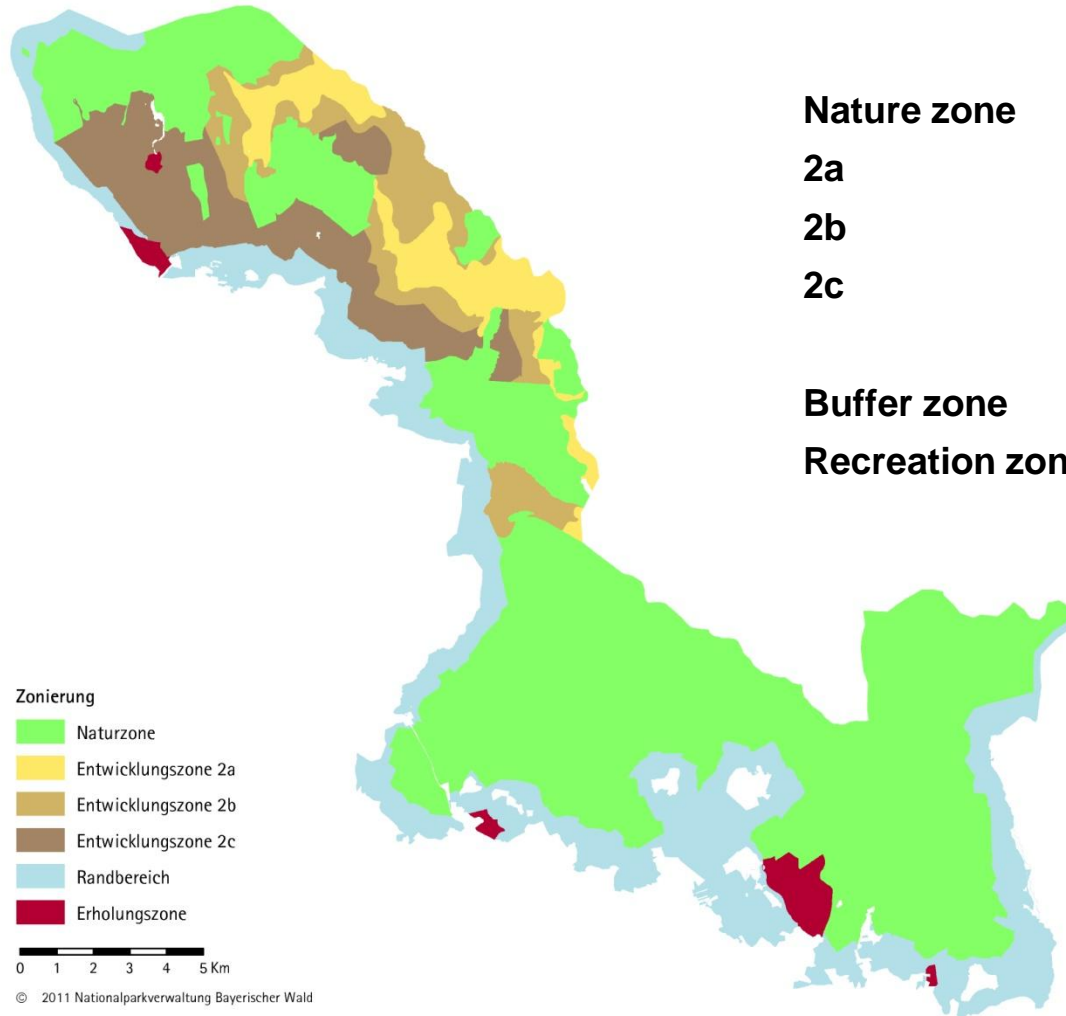
⇒ no clearing of windthrow areas

⇒ no fighting the bark beetle

...in the strict natur protection zone

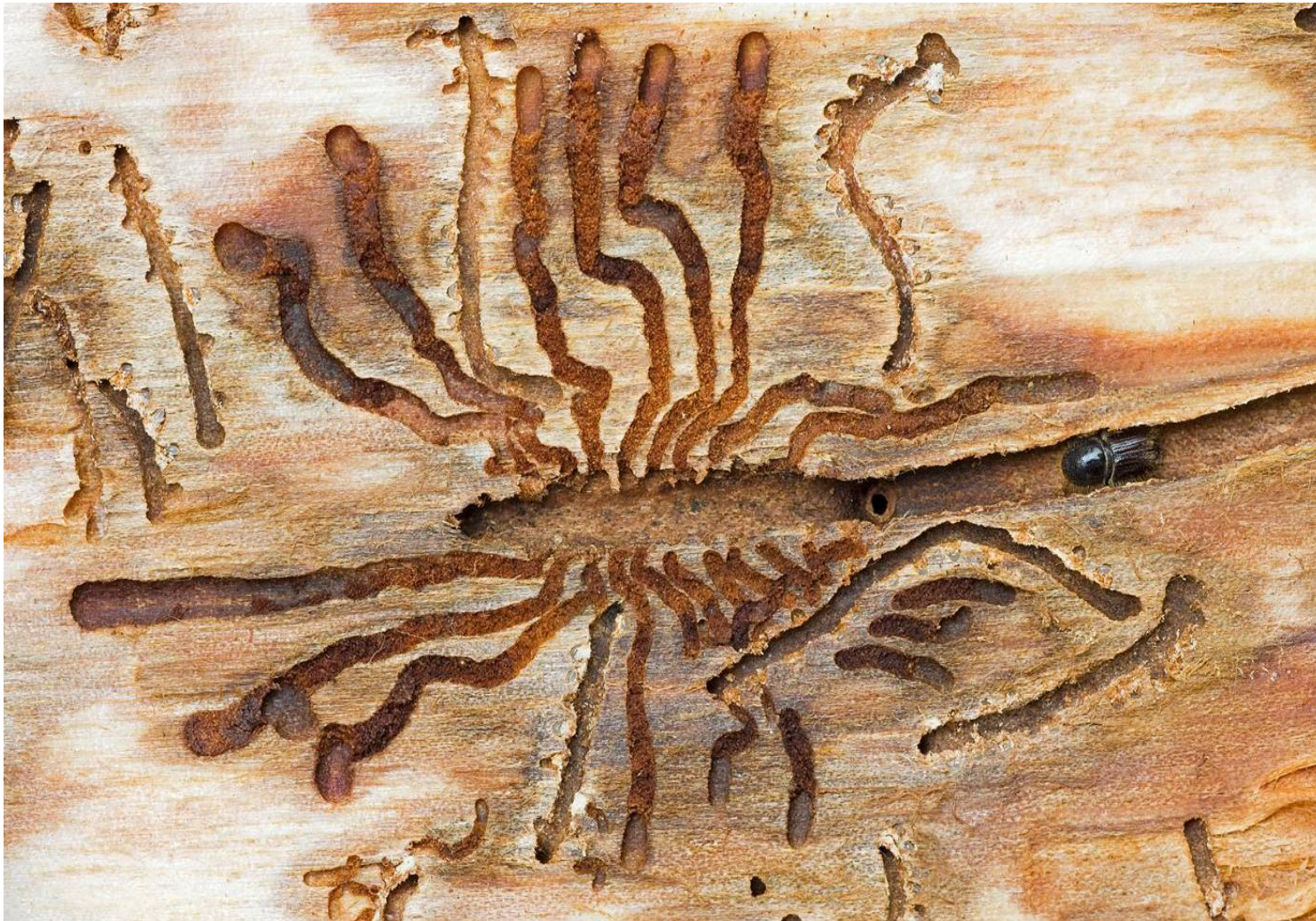


Management Zonation (Stand 1.10.2012)



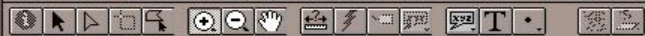
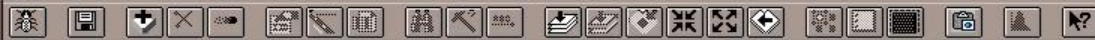
Nature zone	13233,5	55%
2a	1329	5%
2b	1632,3	7%
2c	2275,1	9%
Buffer zone	5346	22%
Recreation zone	405,9	2%

The Bark Beetle *Ips typographus*



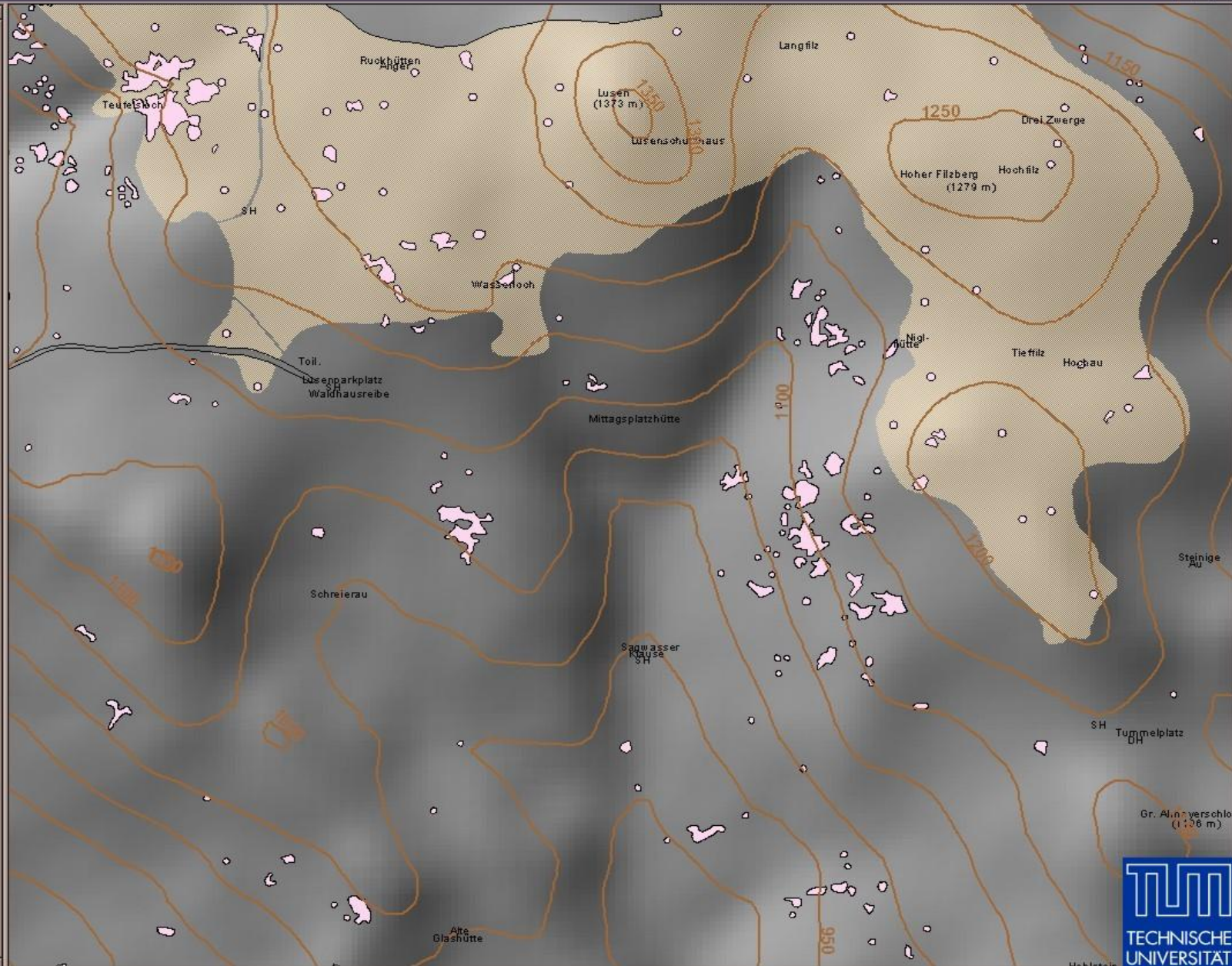
Expected development

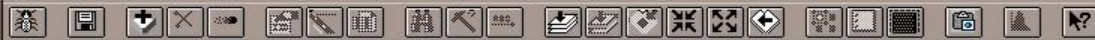




Totholzflächen 1

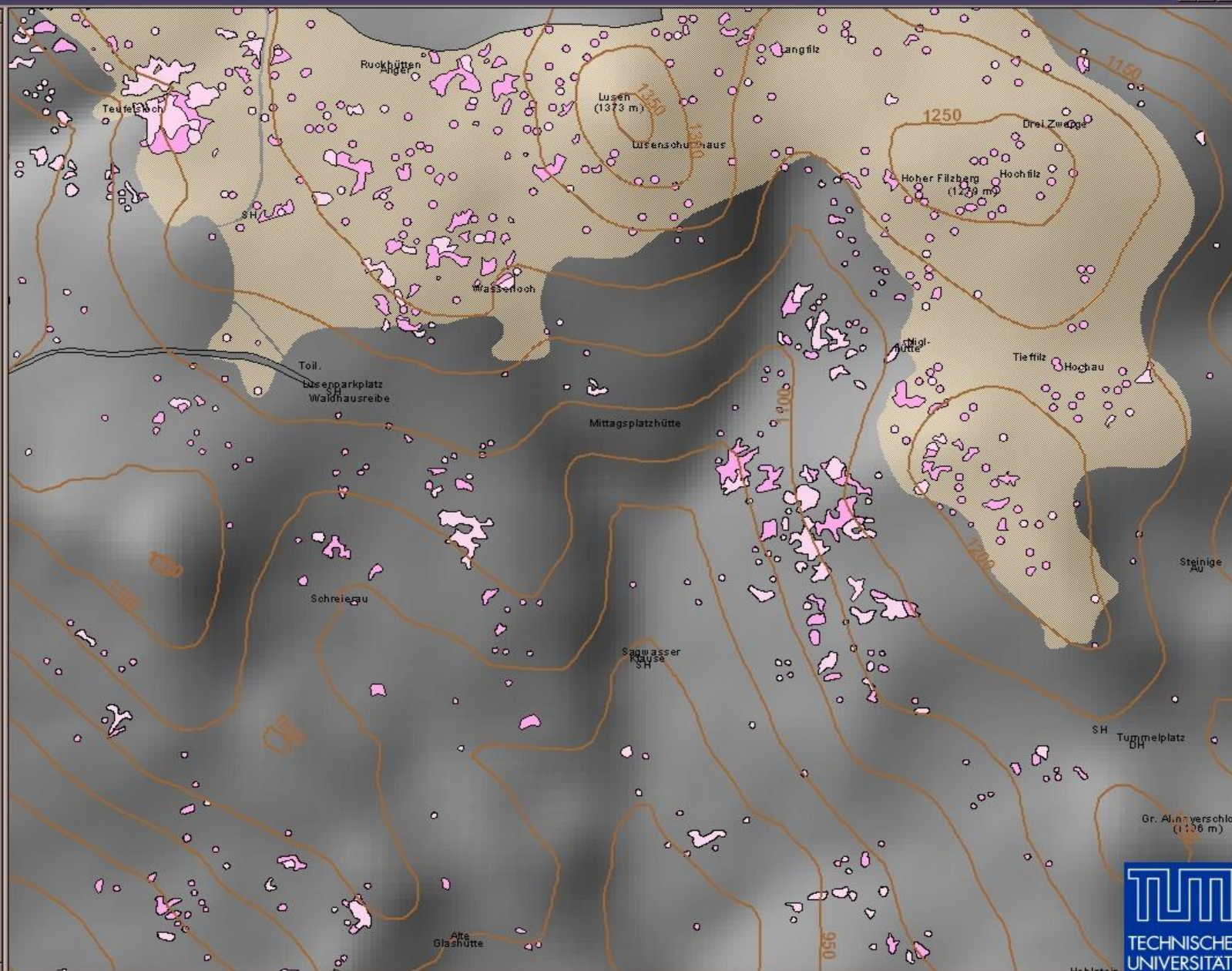
- Zusatz Waldkarte (AG)
- Relief (AG)
- 100m-Höhenlinien
- 50m-Höhenlinien
- 10m-Höhenlinien
- 5m-Höhenlinien
- Staatswaldgrenze (AG)
- Wasserflächen (AG)
- Einzelbäume stehend
 - Laubholz
 - Nadelholz
- Totholz umgebrochen
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- Totholz bis 1993
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- Schummerung (AG)

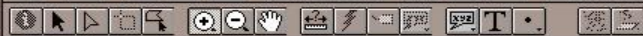
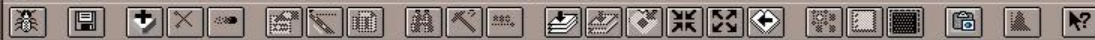




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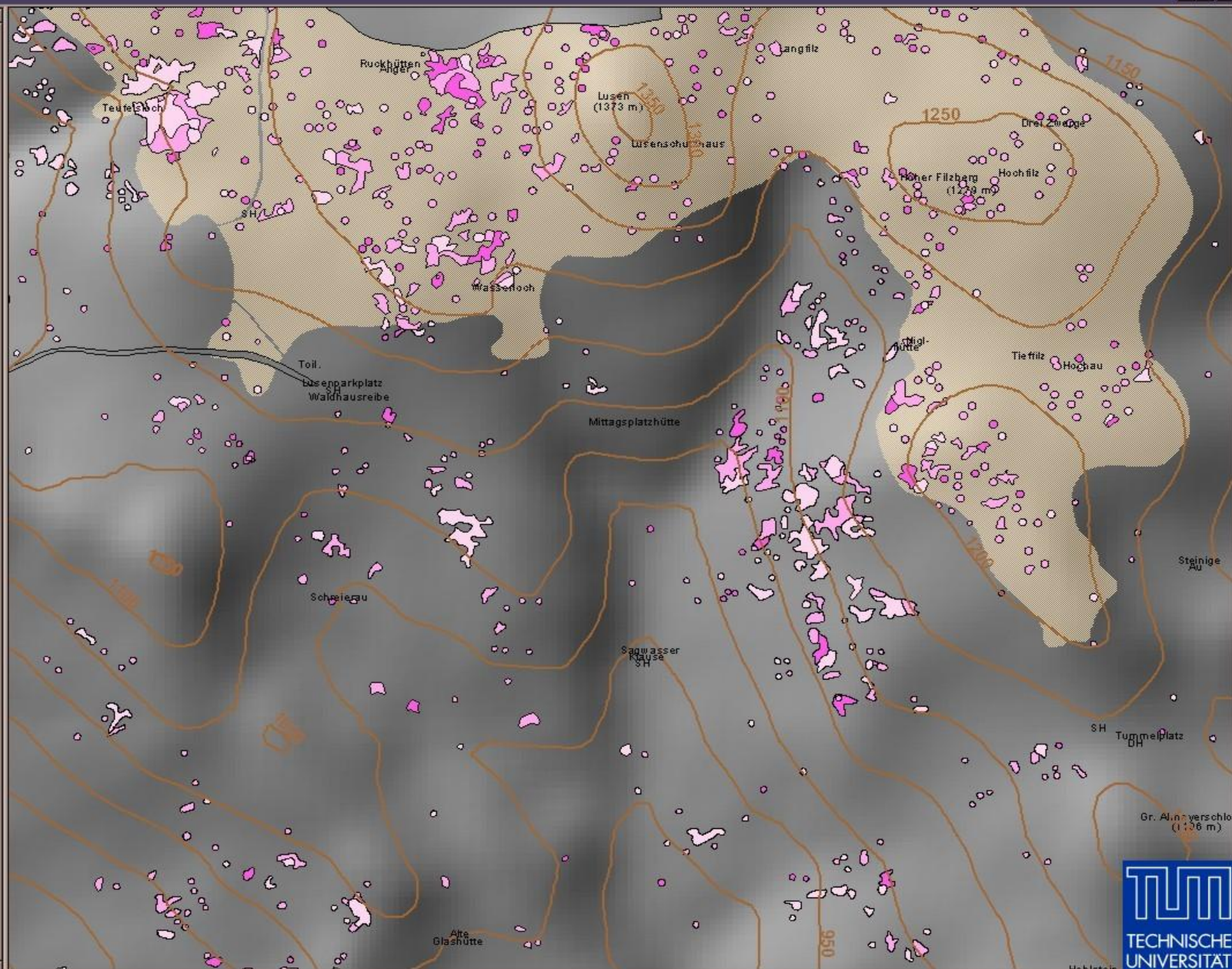
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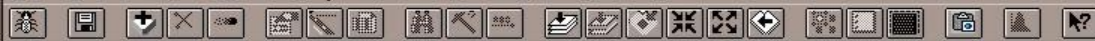




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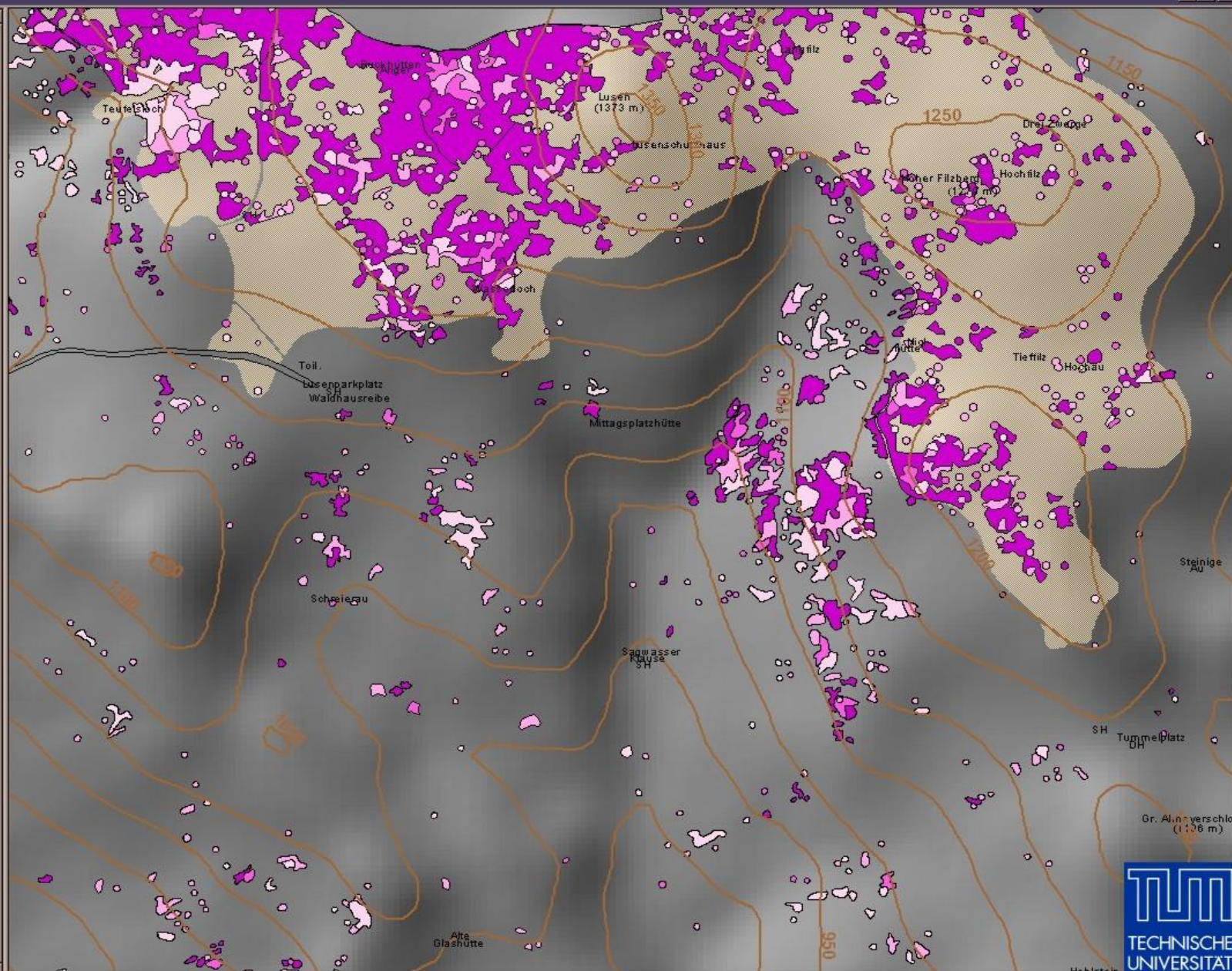
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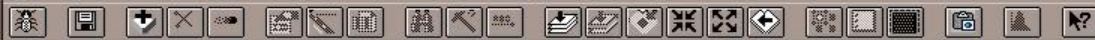




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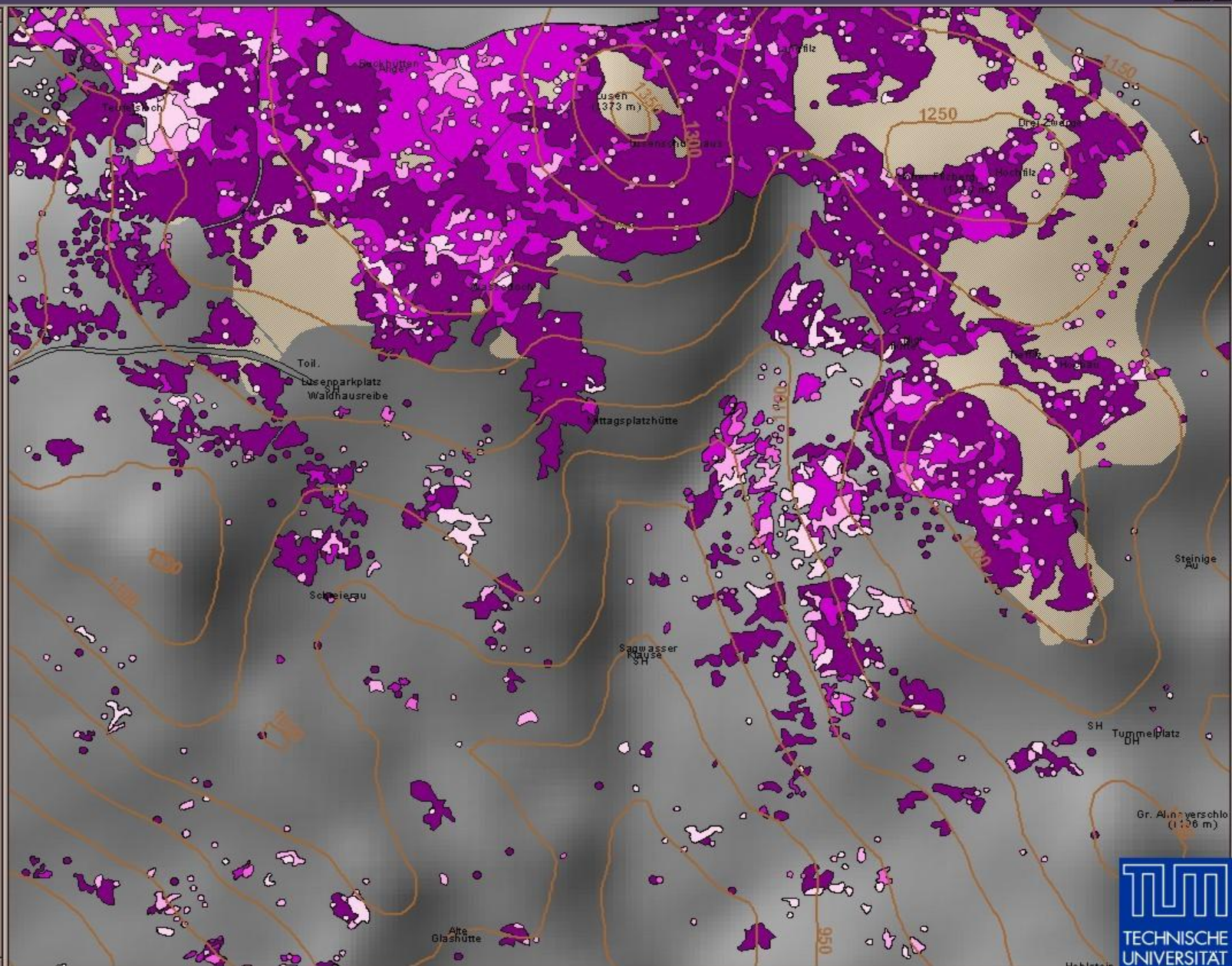
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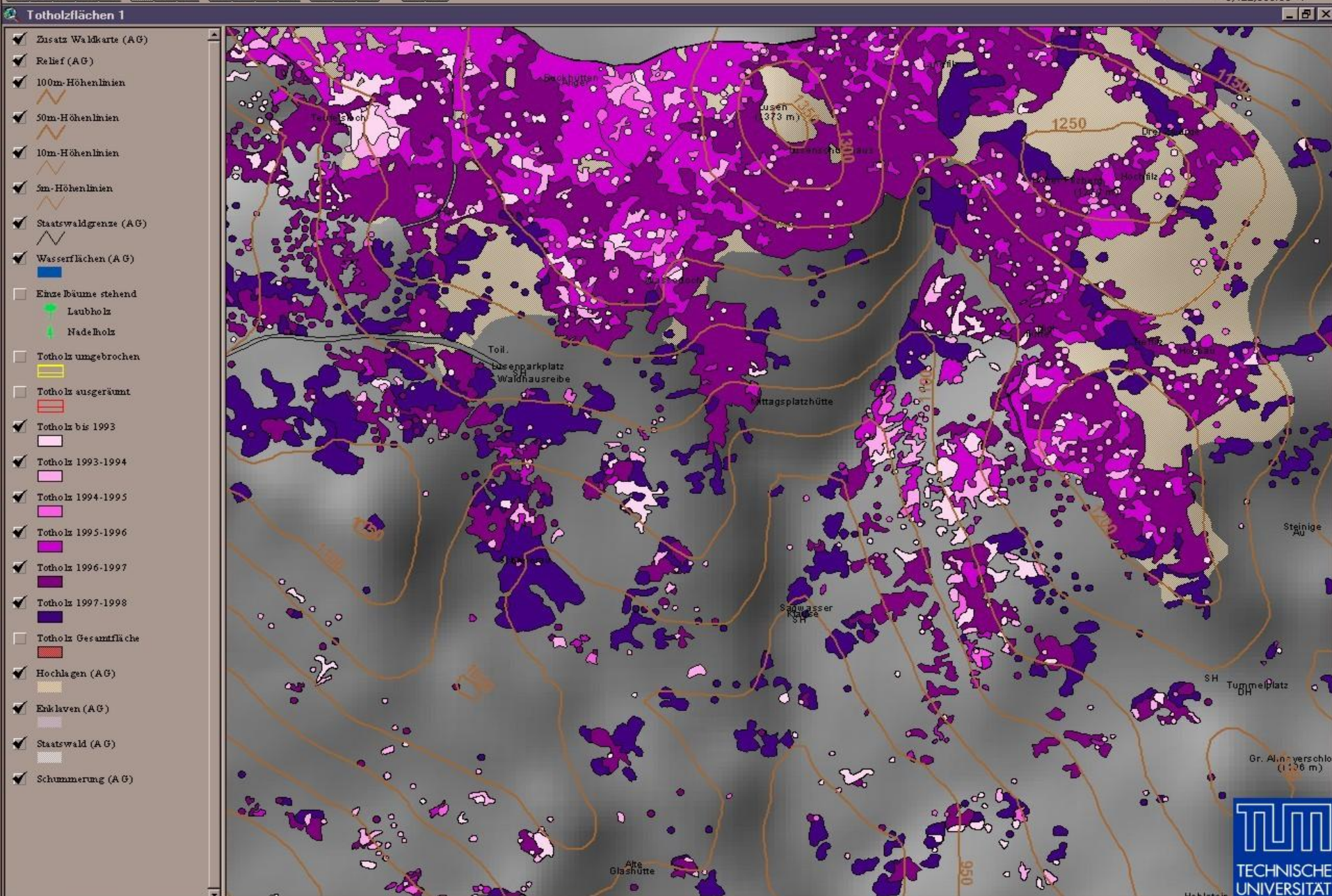
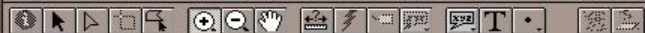
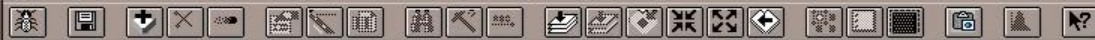




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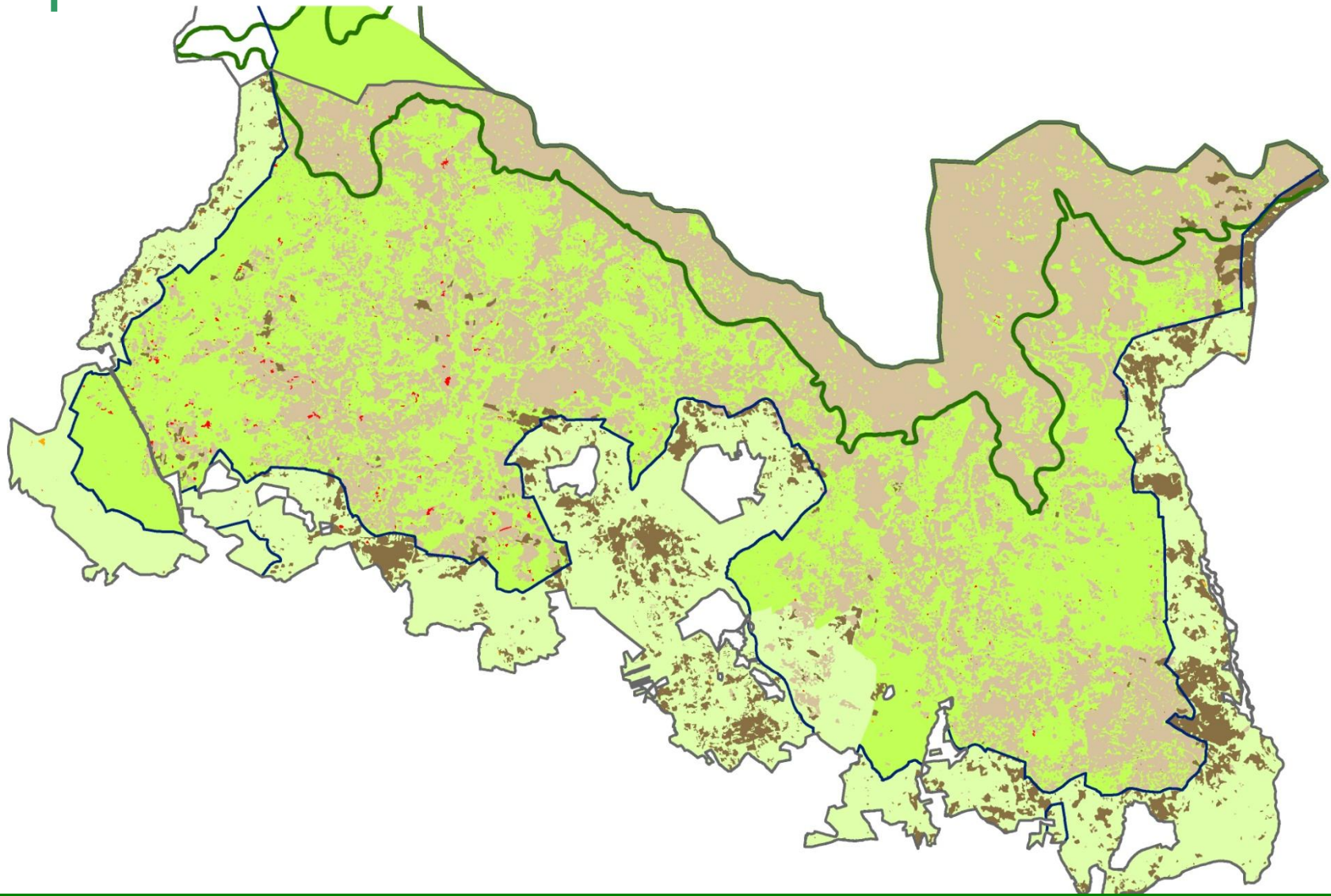




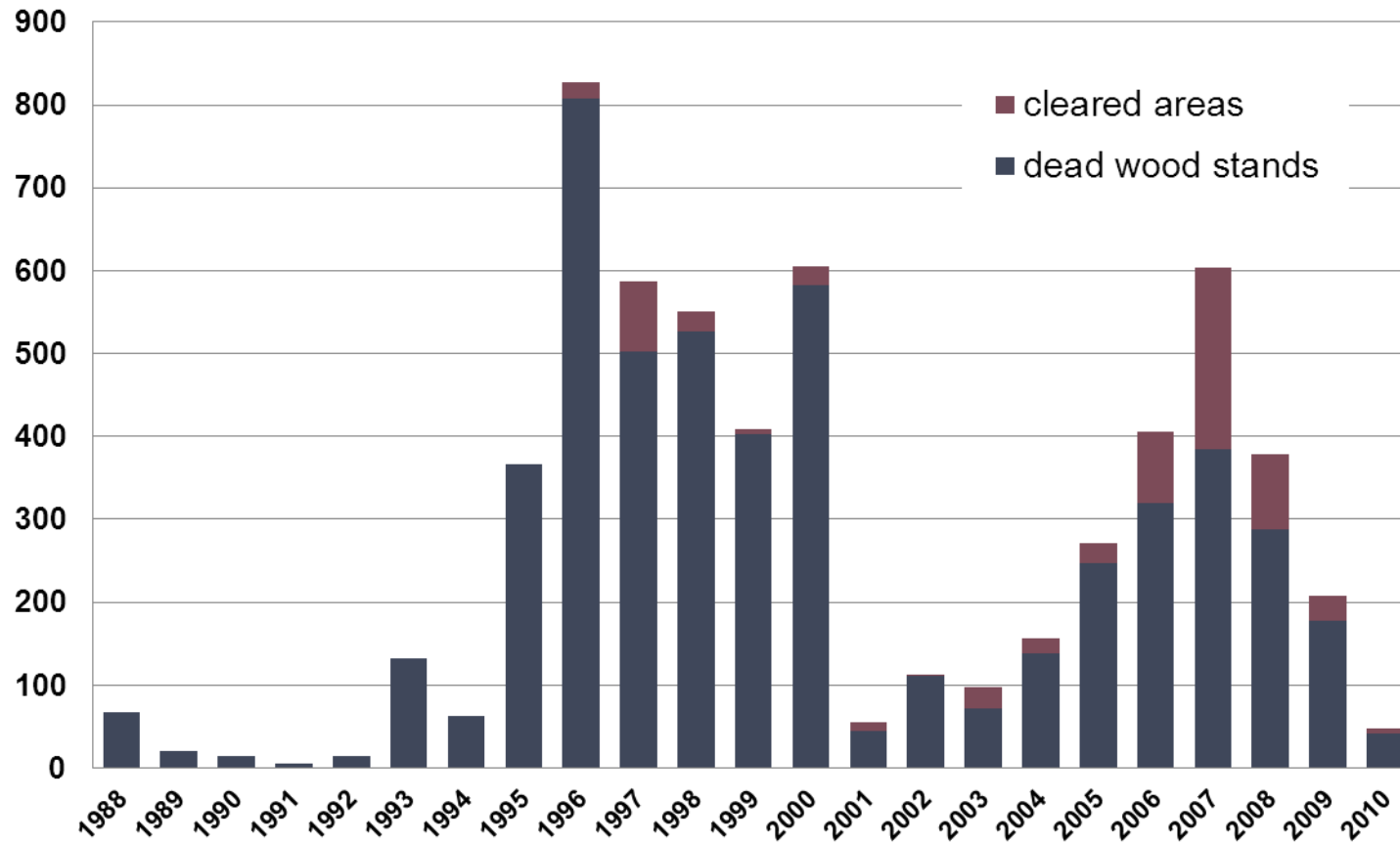
Methodology:



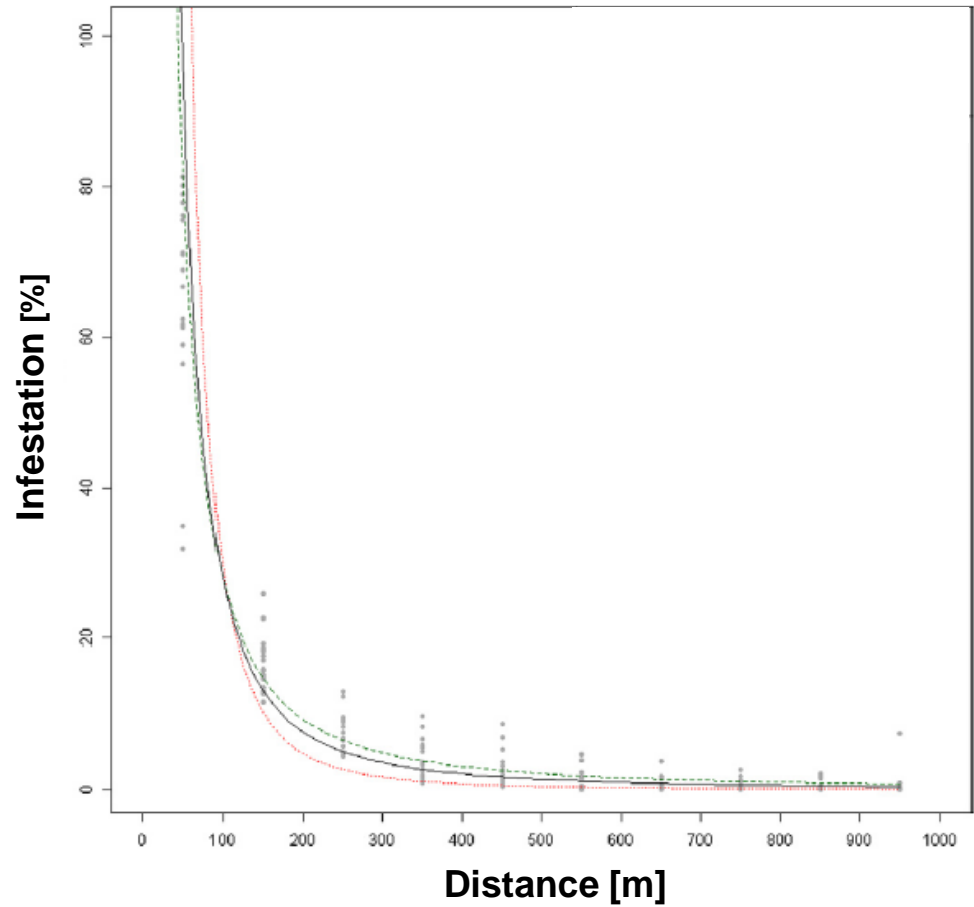
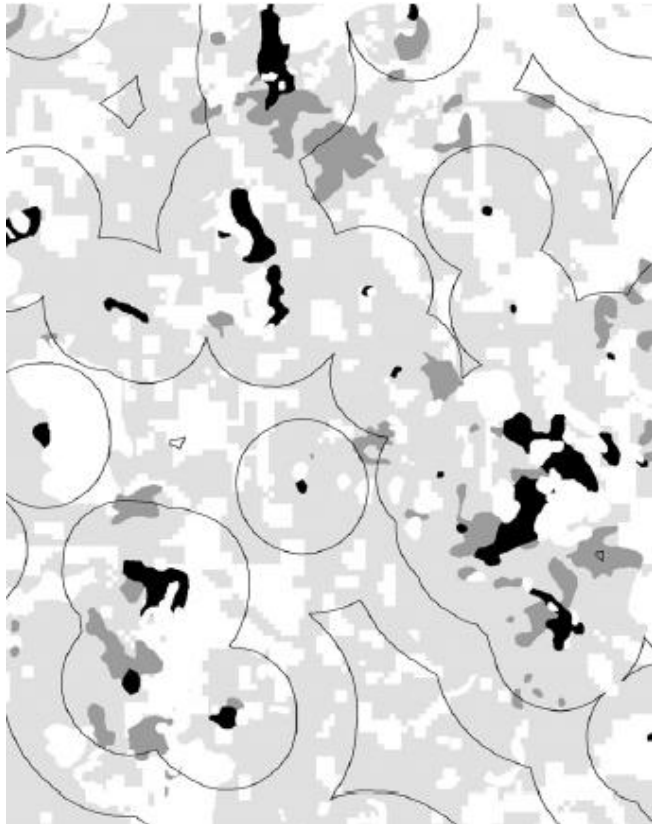
Dead wood stands in the RLG:



Development of dead wood stands in the RLG:



Distance of infested patches in consecutive years



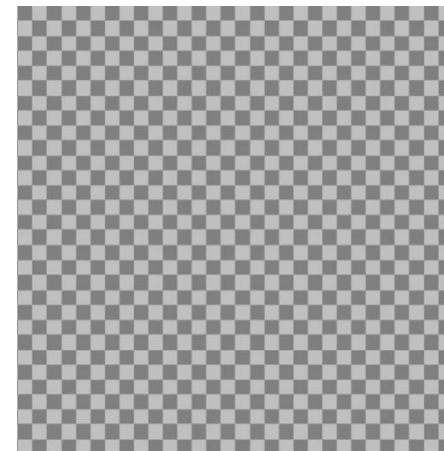
Spatially explicit agent-based simulation model (SAMBIA)

Why programming a simulation model?

- Understand the complex interplay between beetles, host trees, antagonists and management
- the model offers the possibility to perform experiments , without destroying anything...

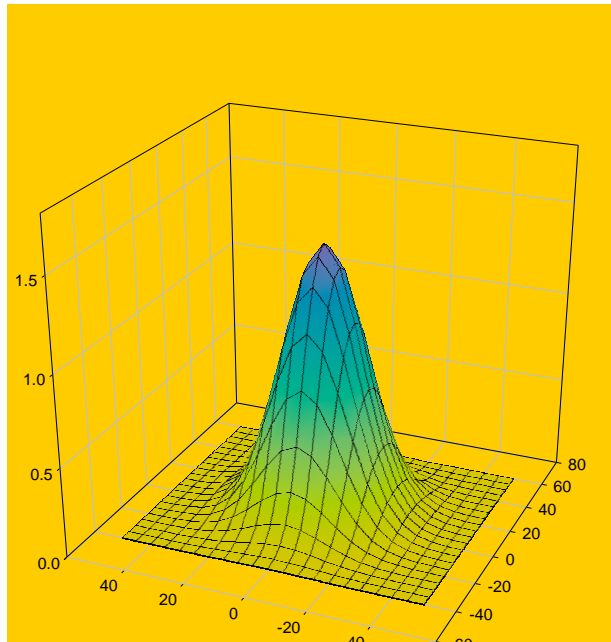
Structure of SAMBIA

- Grid based
- Bottom-up-approach:
local processe → regionale patterns

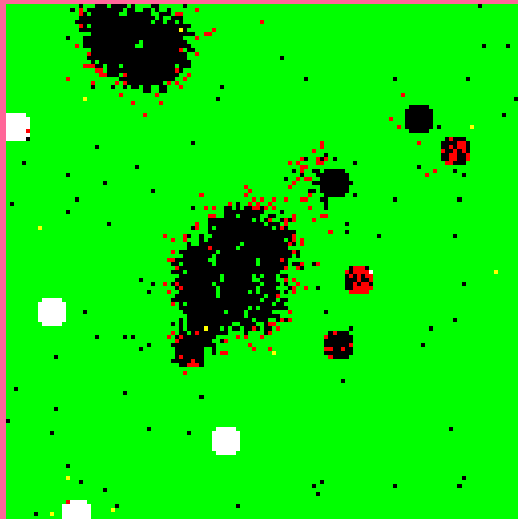


Implementation of biological processes

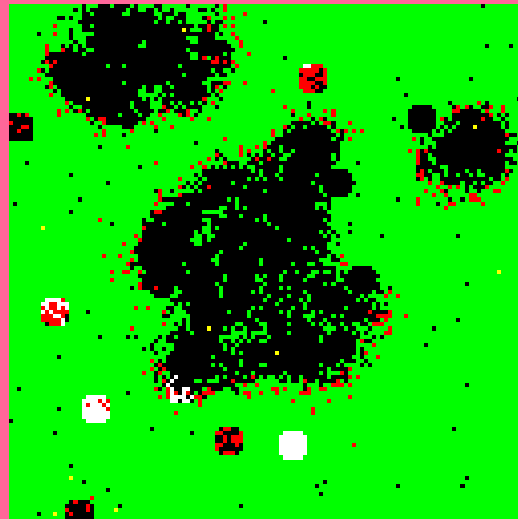
- population dynamics
(*reproduction, mortality*)
- dispersal



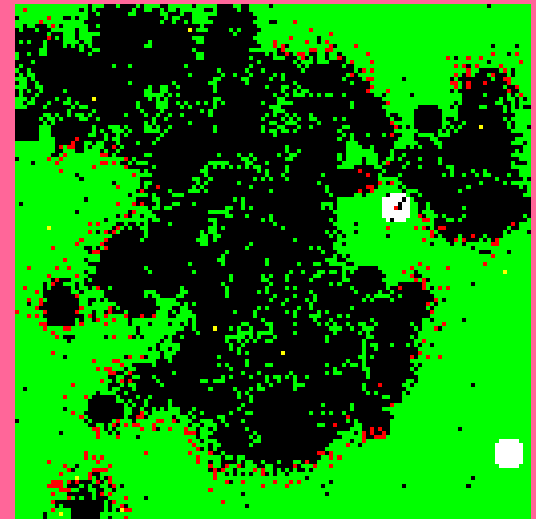
Infestation patterns in consecutive years



$t = 1$



$t = 2$



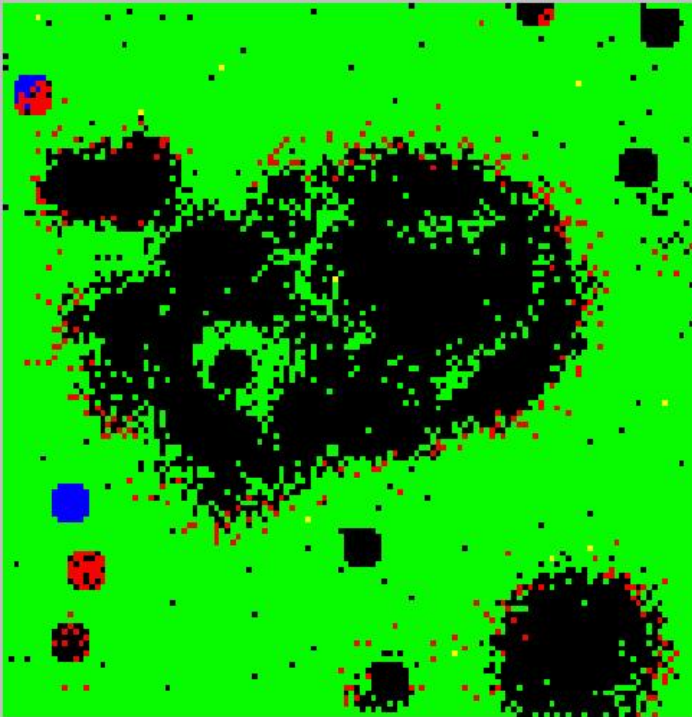
$t = 3$

User interface of SAMBIA

IPS A5c

(c) L. Fahse, UFZ Leipzig 2002

Wald am Ende von Jahr 5 Saison 1 Status : Abgebrochen ...



* (k,l) = (0,0)

Simulationen : max. Zahl der Simulationen
 Simulationszeit Jahre Anzahl an Flugsaisons pro Jahr :

Dispersion : **Flugkohorten** Anzahl Primärweite a Dispersion D

Flugkohorte	Anzahl	Primärweite a	Dispersion D
stark	<input type="text" value="2"/>	<input type="text" value="0"/>	<input type="text" value="15"/>
normal	<input type="text" value="2"/>	<input type="text" value="0"/>	<input type="text" value="10"/>
schwach	<input type="text" value="2"/>	<input type="text" value="0"/>	<input type="text" value="5"/>

Repeller
 Max. Ablenkweite Repeller-Pheromone wirken auf
 alle starke keine Flugkohorten

Bäume
 pSurv der Larven =0 bei N1= StdAbw.
 Gesunde Bäume : mittl. Schwelle StdAbw.
 Warnweite Faktor

geschwächte Bäume bei t=0 :
 regelmäßig verteilt zufällig verteilt Klumpung
 Anzahl Anzahl Cluster
 Schwelle für geschwächte Bäume

Käferlöcher bei t=0 :
 Anzahl Zahl der Käfer bei t=0 :

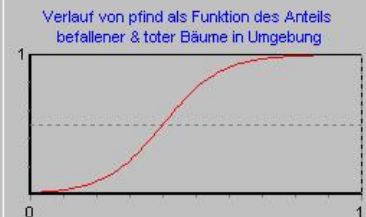
Randbereich kmin kmax lmin lmax
 keine Fichten im Randbereich

Verjüngung | Störung | Latenz | Management | Ausgabe

Ausgabe
 in Dateien Präfix
Graphik : Bitmap speichern alle Jahre
 Einzelschritt
 Wald zeigen
 geschw. Bäume zeigen

Simulation Start
 Abbruch
 Schließen

Verlauf von pfind als Funktion des Anteils befallener & toter Bäume in Umgebung



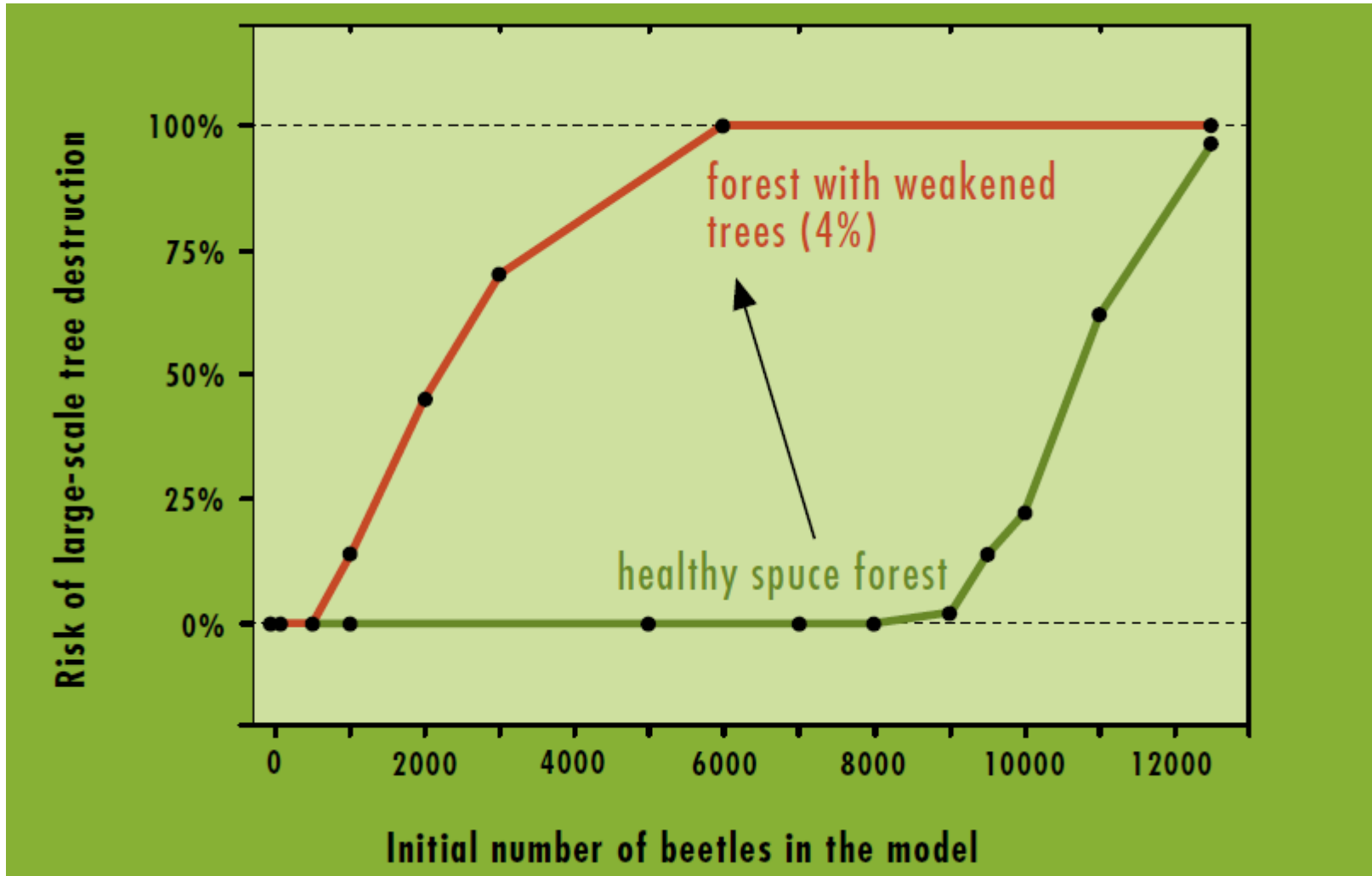
Parameter speich. Parameter laden

Simulation : 1
 Werte zu Beginn von
 Jahr 5 Saison 2
 GesAnzIps : 2014979

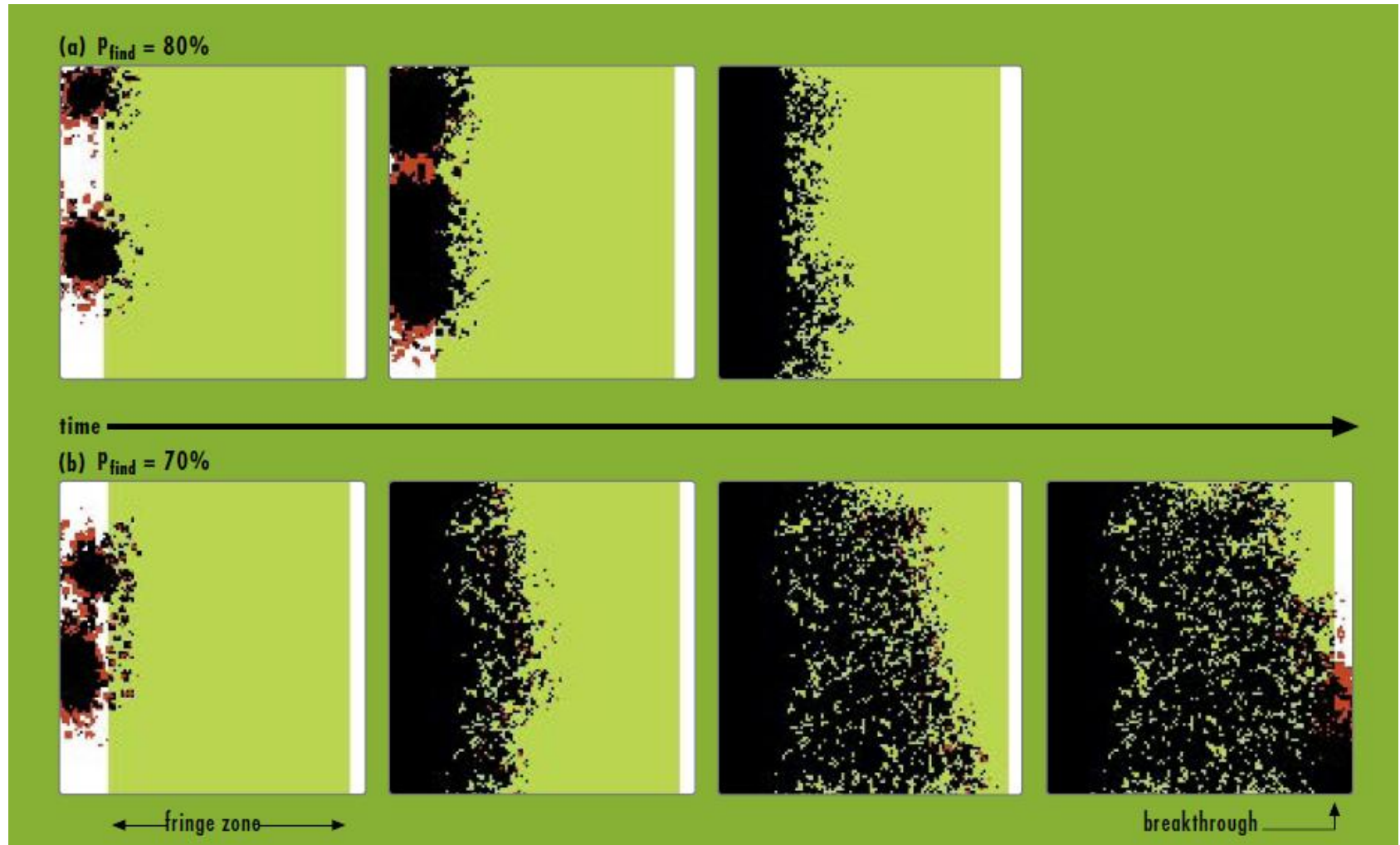
??



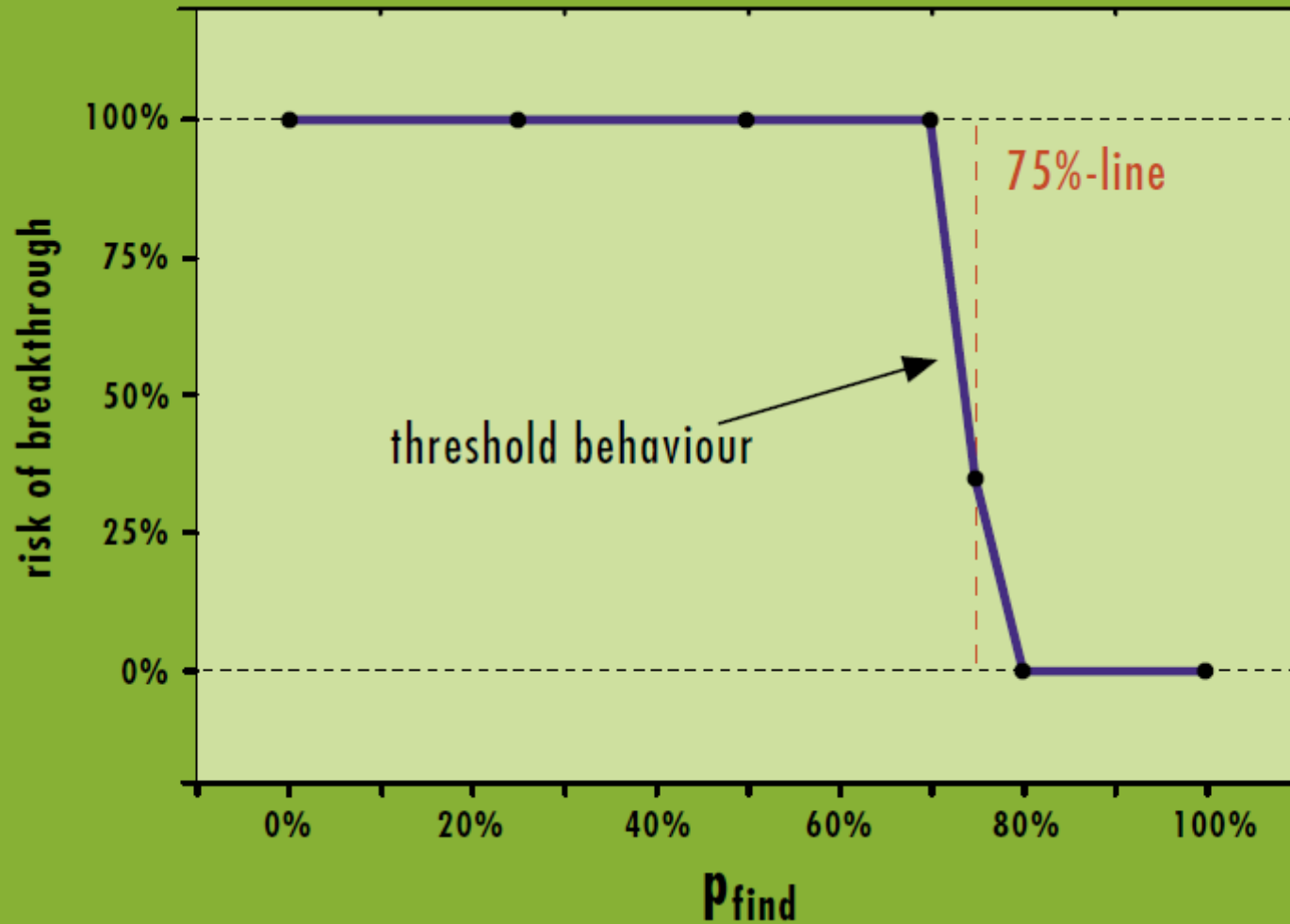
Risks of outbreaks as a function of the initial numbers



Efficiency of management zone



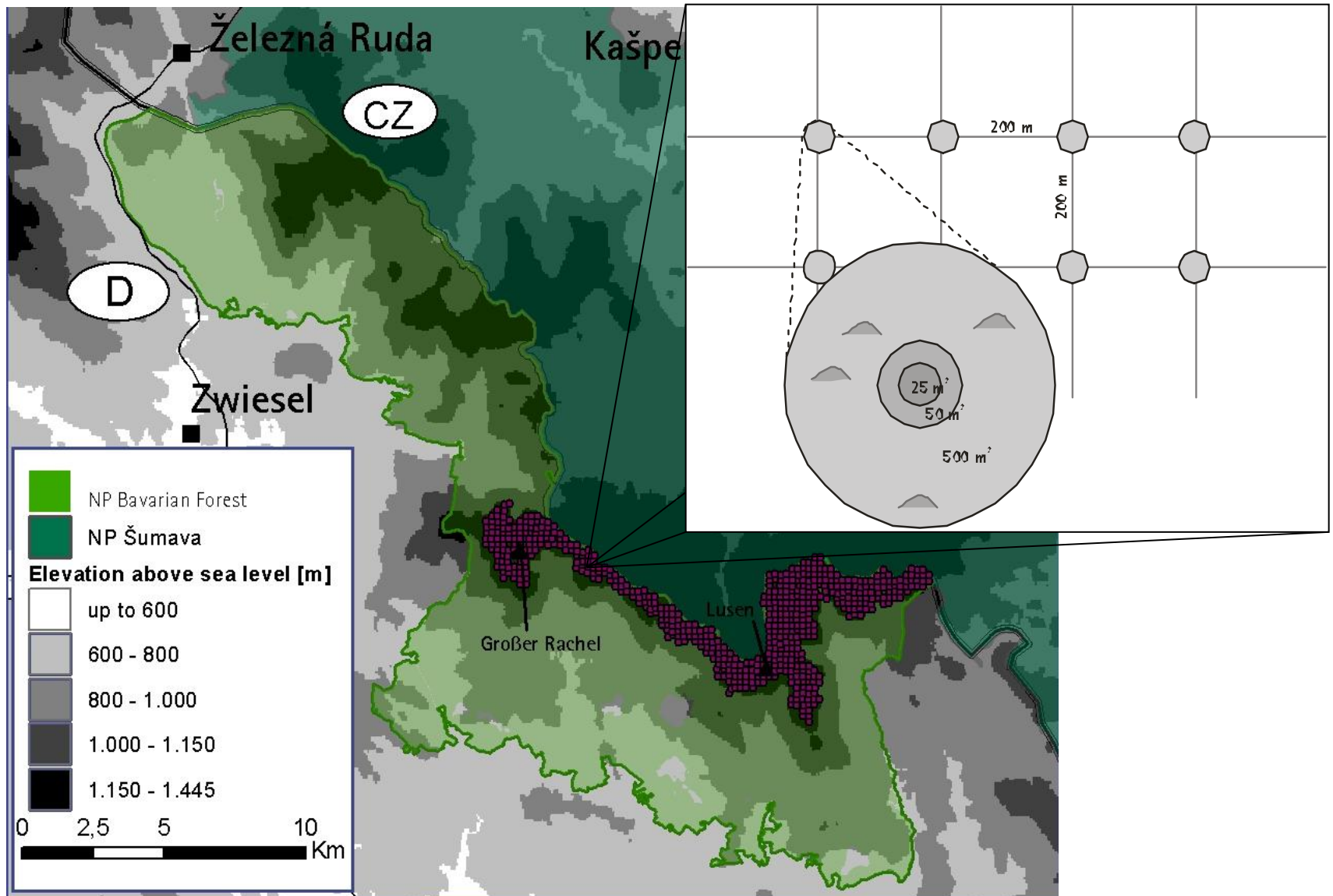
Threshold for management efficiency



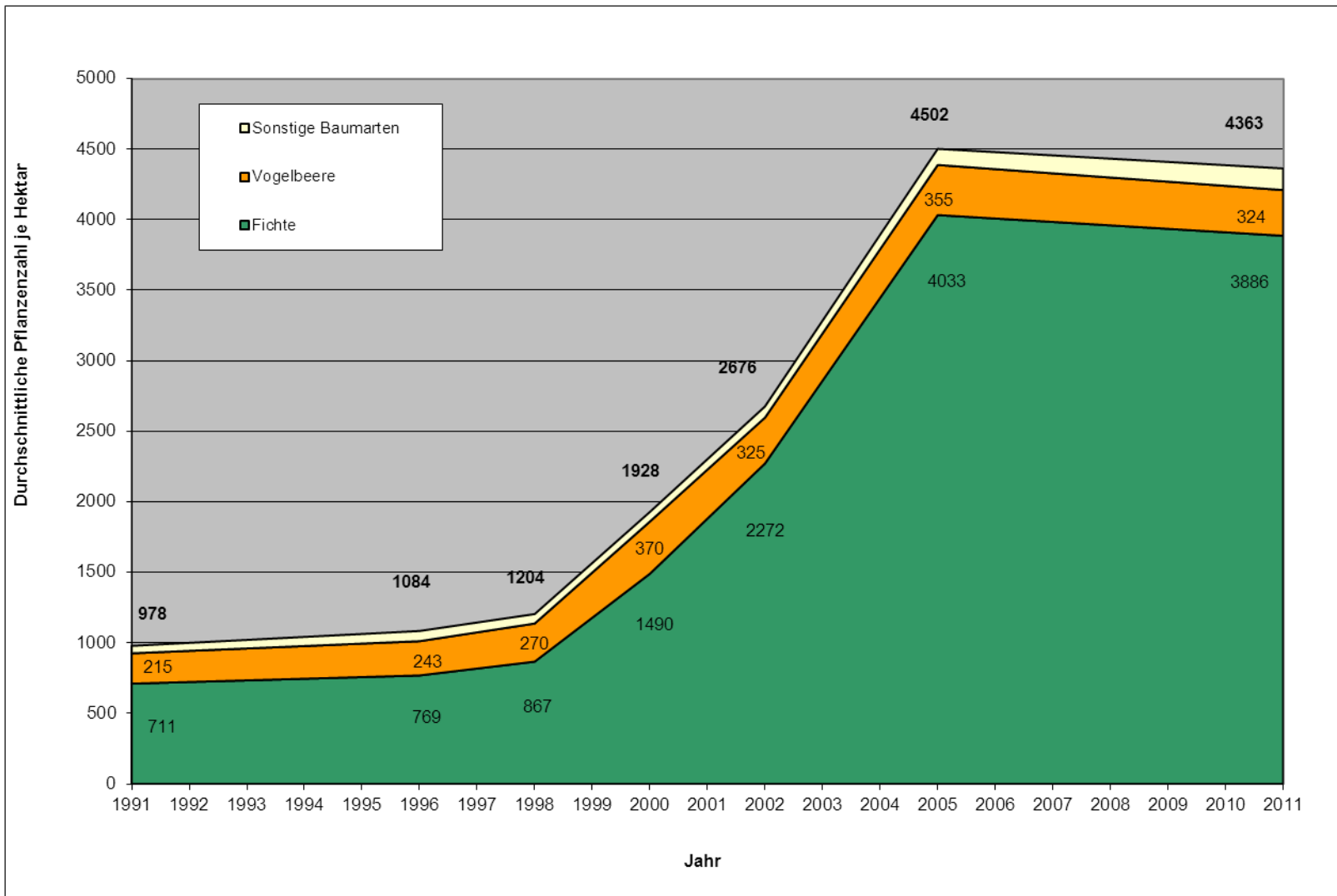
Conclusions

- *Natural development is now allowed on 12580 ha (52 %) of the park area*
Přirozený vývoj je nyní umožněn na 12580 ha (52%) území parku
- *Bark beetle affected 6000 ha of the Rachel-Lusen-Area*
kůrovec zasáhl 6000 ha v okolí vrcholů Roklan a Luzný
- *Bark beetle shows a cyclic dynamic influenced by climatic characteristics (wind, temperature)*
kůrovec vykazuje cyklickou dynamiku ovlivněnou klimatickými charakteristikami (vítr, teplota)
- *Bark beetle outbreak can be explained by natural dynamics*
kůrovcová kalamita může být vysvětlena přírodní dynamikou ekosystému
- *Bark beetle management can keep the disturbance within park borders*
Management kůrovce může udržet disturbance uvnitř hranic NP
- *For efficient bark beetle management you have to reduce beetle numbers by 75 %*
pro efektivní zásah proti kůrovci musíte snížit jeho početnost o 75%

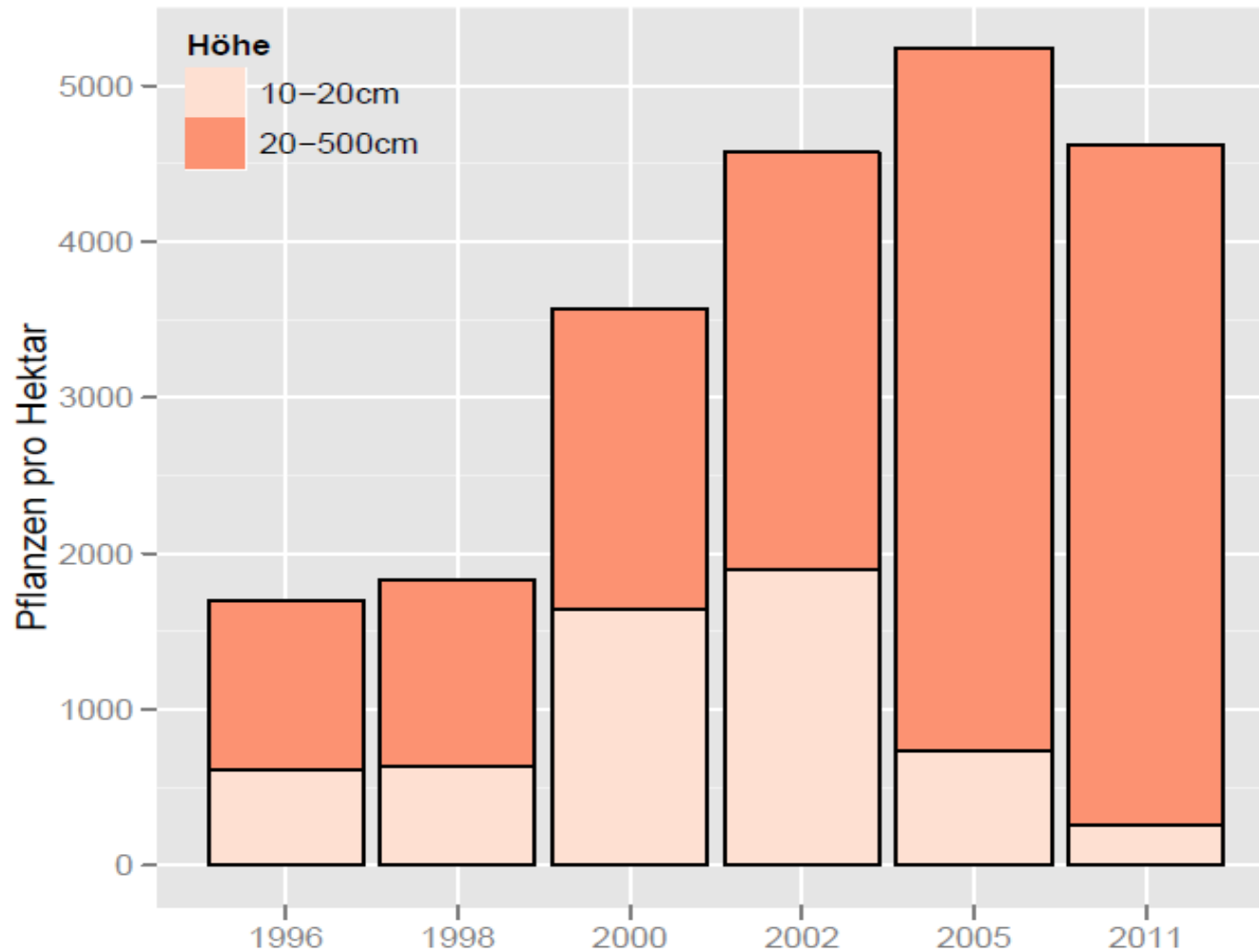
Study design



Development of regeneration density > 20 cm



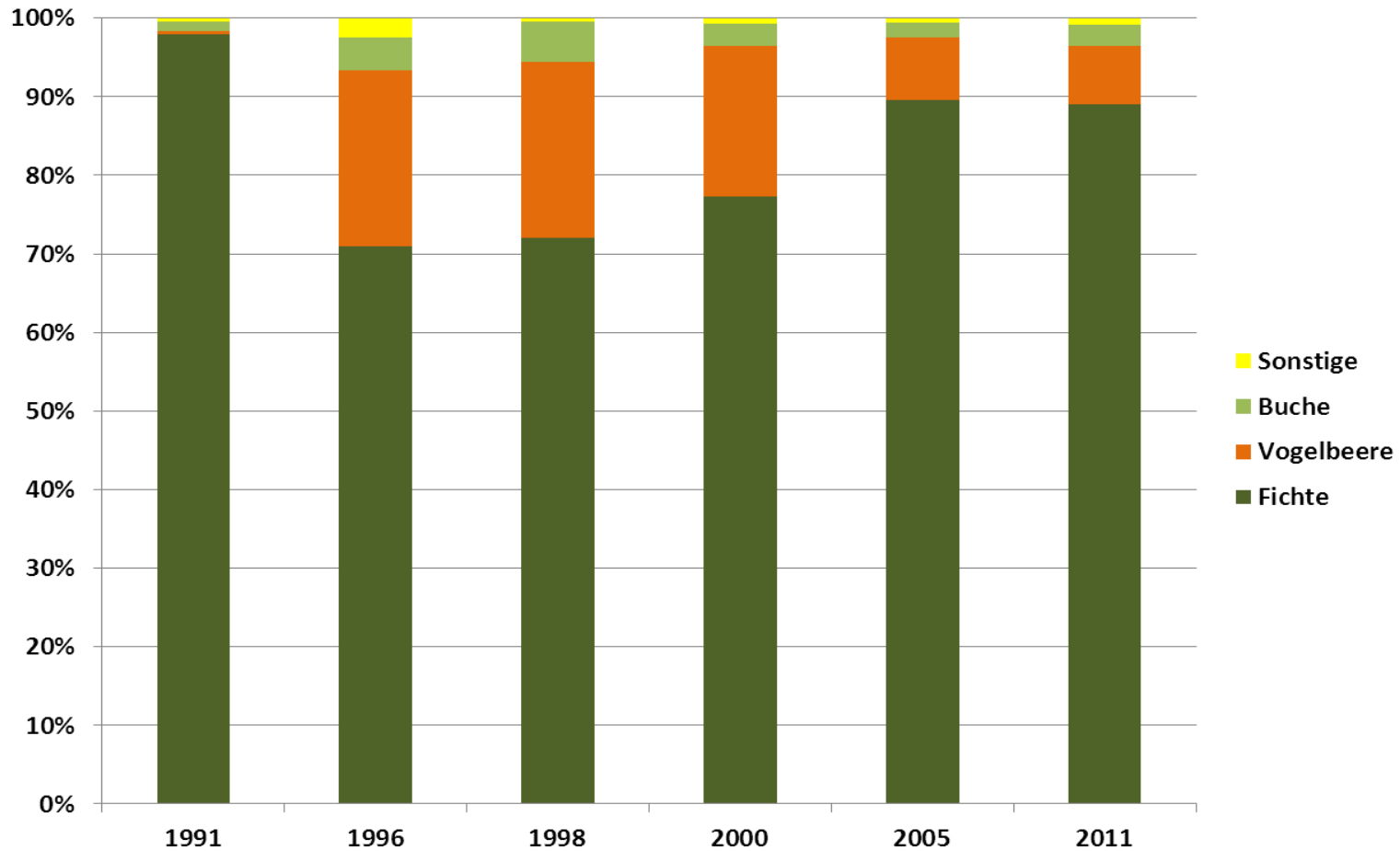
Development of regeneration density >10 cm



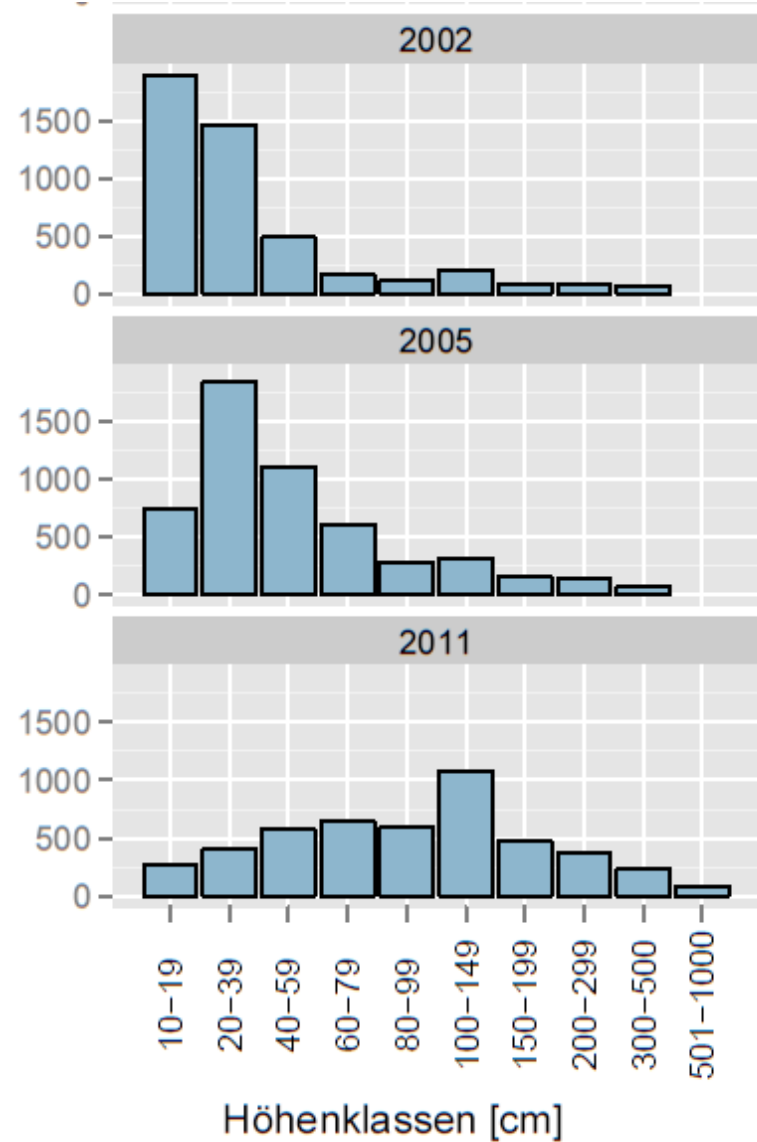
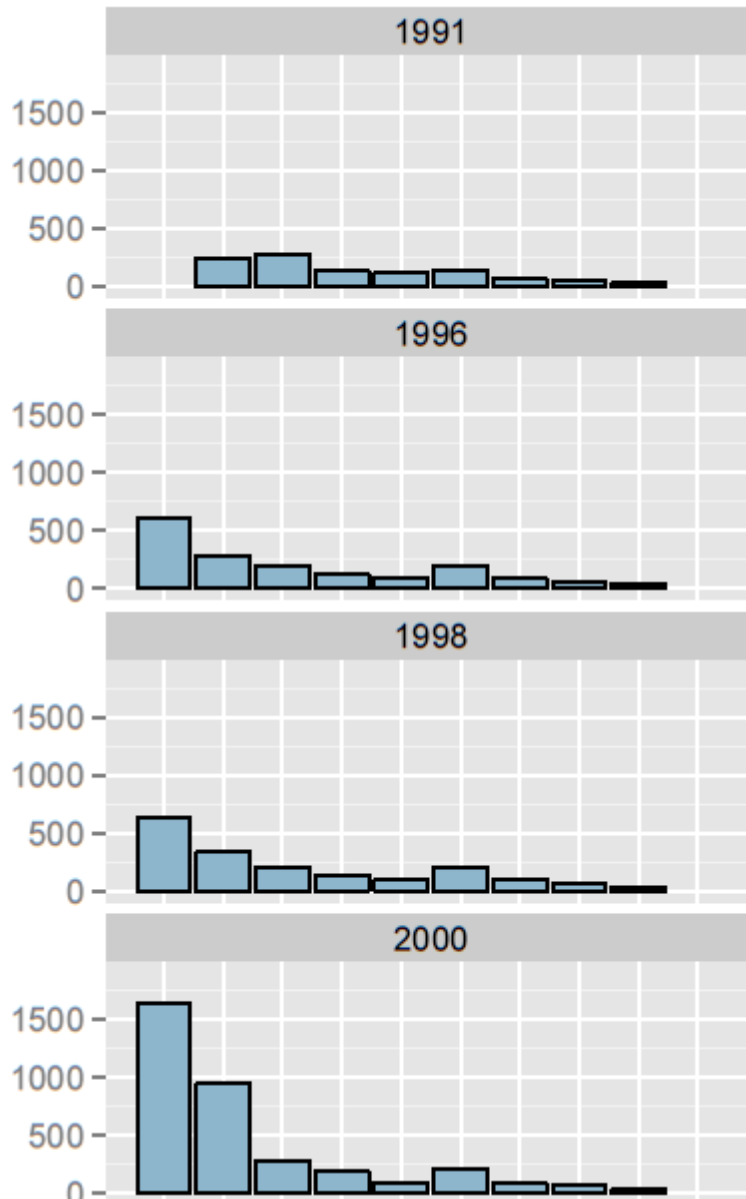
High competition within regeneration



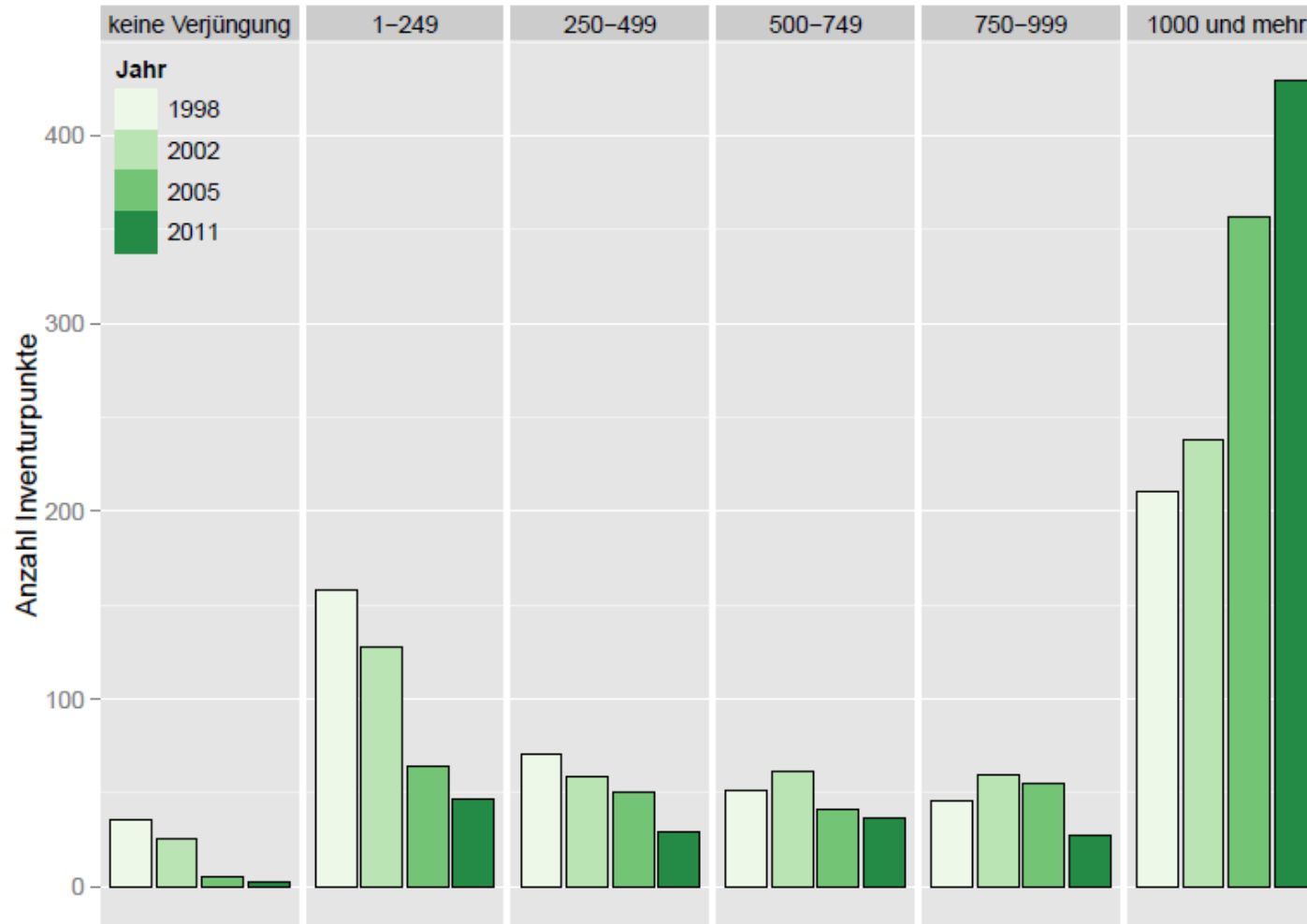
Development tree species composition



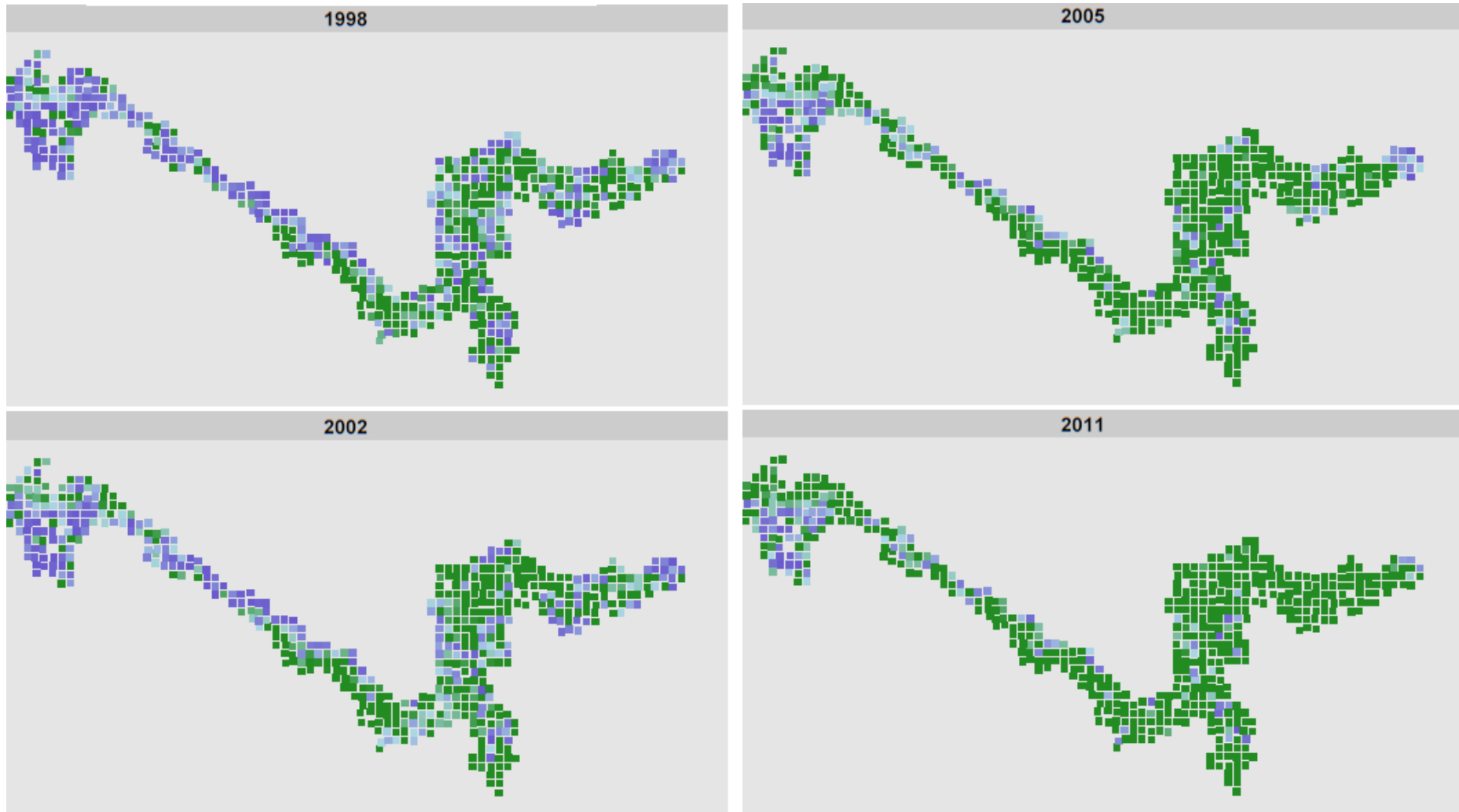
Development of regeneration height



Frequency distribution of regeneration density



Spatial distribution of regeneration density

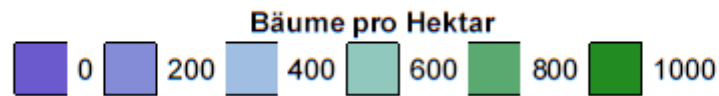


1998

2005

2002

2011



Conclusions

- Decreasing number of young trees from 4502 to 4463 plants /hectare. **Snížení počtu zmlazení stromů z 4502 na 4463 jedinců**
- Reasons for the decline: natural (spacial) competition between the young trees, where the density of regeneration is very high. **Důvody snížení počtu: přirozená (prostorová) konkurence mezi stromky tam, kde je zmlazení velice husté**
- Species composition in the previous stand and the regrowing stand is not different. **Druhové zastoupení dřevin v původním porostu a v rámci zmlazení se neliší.**
- In general the regeneration of the stands is developing well. Currently more than 2185 tree plants > 1m/ hectare meter are recorded there. **Celkově se zmlazení vyvíjí dobře. V současné době je zde zaznamenáno více než 2158 stromků > 1m/ hektar (v roce 1991: 296)**

Conclusions

- At 75% of the total area of the most elevated sites (more than 1150 m a.s.l.) are more than 1000 trees / hectare. The regeneration is missing only on 0,5% of the area. **Na 75% plochy nejvyšších poloh (nad 1150 m.n.m.) odrůstá více než 1000 stromů / hektar. Pouze na 0,5% plochy zmlazení chybí.**
- Development of the regrowth is following the bark beetle infestation progress (what died first – is regenerated first). **Rozvoj zmlazení následuje postup kůrovce (co dřív odumře, to se dříve zmladí).**
- Only south from the Rachel summit there are places with sparse regeneration. But also there the situation is gradually improving. **Pouze jižně od vrcholu Roklanu existují místa, kde je zmlazení málo. Ale i zde se situace postupně zlepšuje.**



Thanks for your attention!