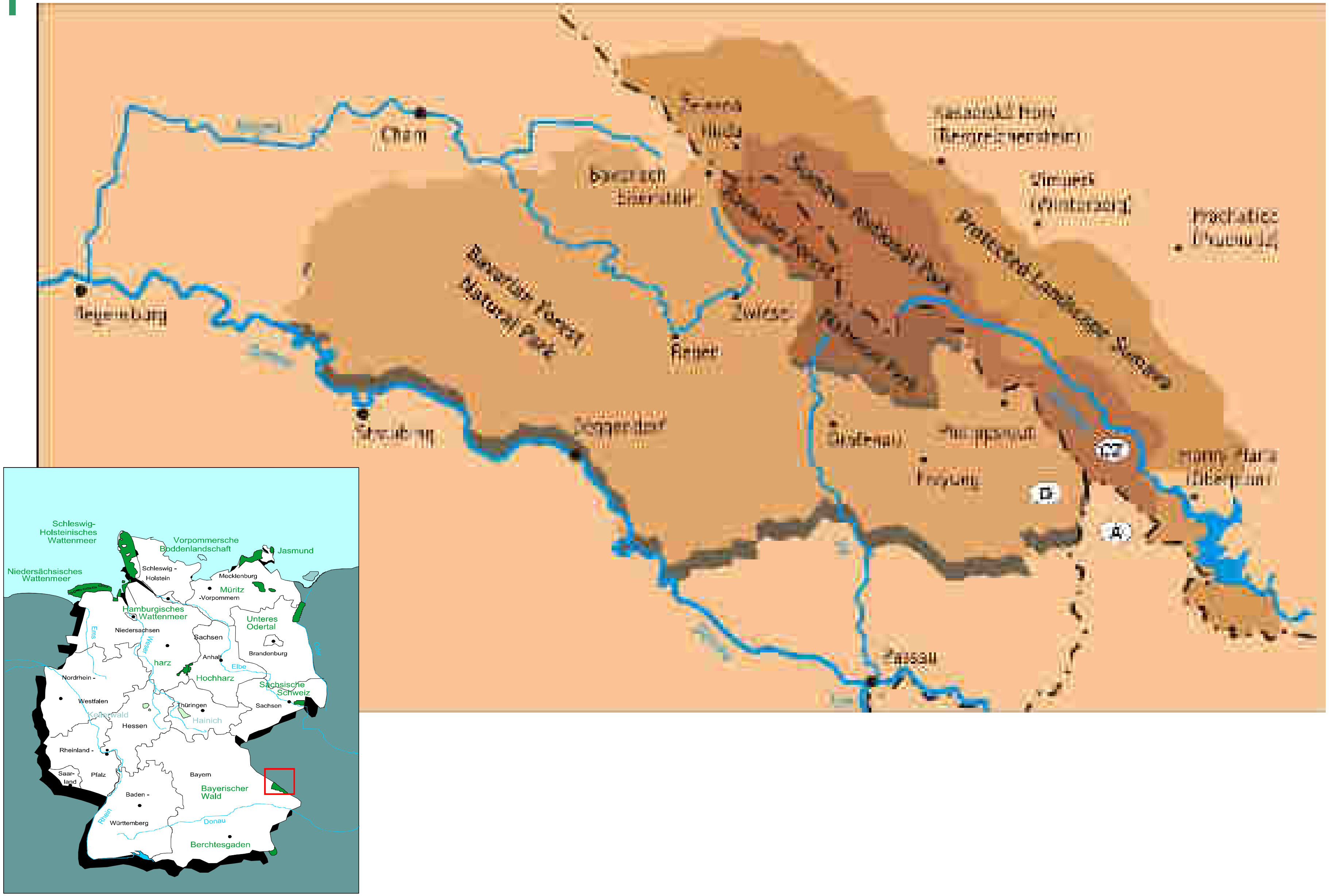
PRAHA, 07.12.2011

Lessons from 28 years of natural disturbances in the Bavarian Forst National Park

Hans Jehl, Marco Heurich, Thorsten Zeppenfeld, Burkhard Beudert, Jörg Müller, Claus Bässler

Nationalpark Bayerischer Wald

Study Area


Cham
Bavarian Forest
Natural Park
Regen
Zwiesel
Passau
D
A
Schleswig-
Holsteinisches
Wattenmeer
Vorpommersche
Boddenlandschaft
Jasmund
Niedersächsisches
Wattenmeer
Schleswig -
Holstein
Mecklenburg
-Vorpommern
Müritz
Hamburgisches
Wattenmeer
Unteres
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Niedersachsen
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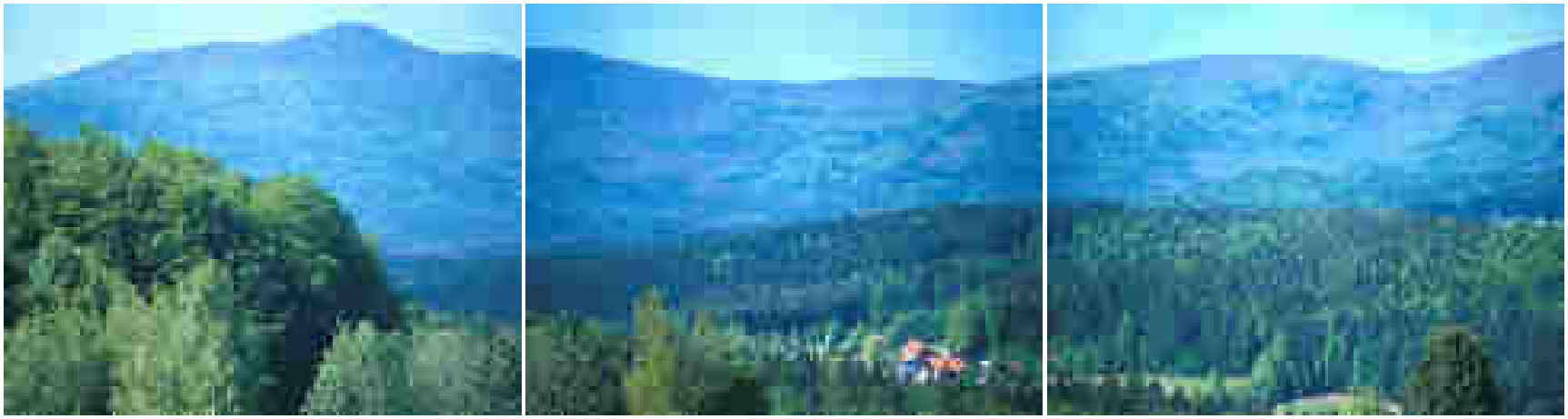
Anhalt
Brandenburg
harz
Hochharz
Elbe
Sächsische
Schweiz
Nordrhein -
Westfalen
Thüringen
Sachsen
Hainich
Hessen
Rheinland -
Pfalz
Saar-
land
Bayern
Bayerischer
Wald
Baden -
Württemberg
Donau
Berchtesgaden

Study Area

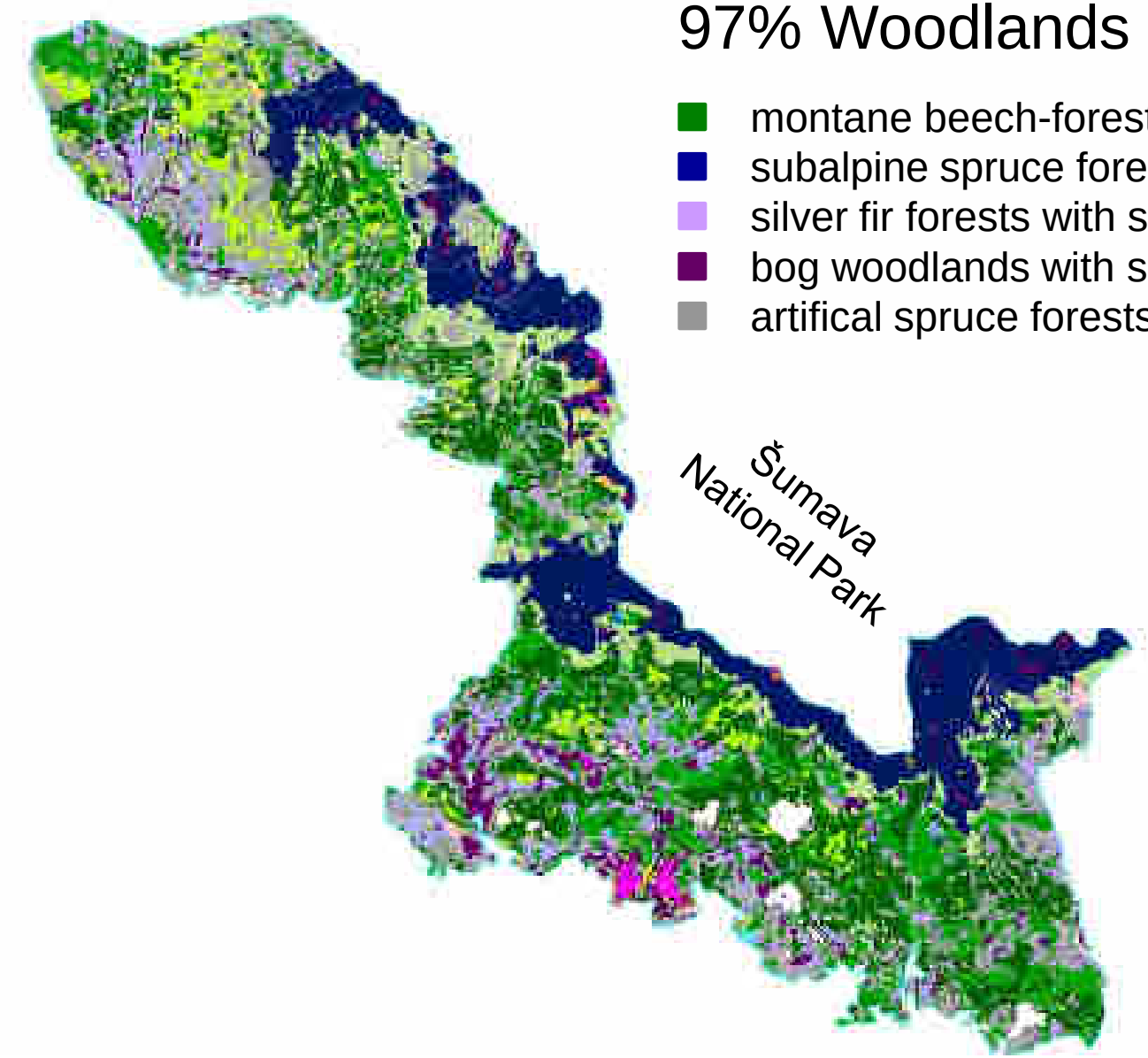
Satelite LANDSAT 1988

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%)
- artifical spruce forests (15%)

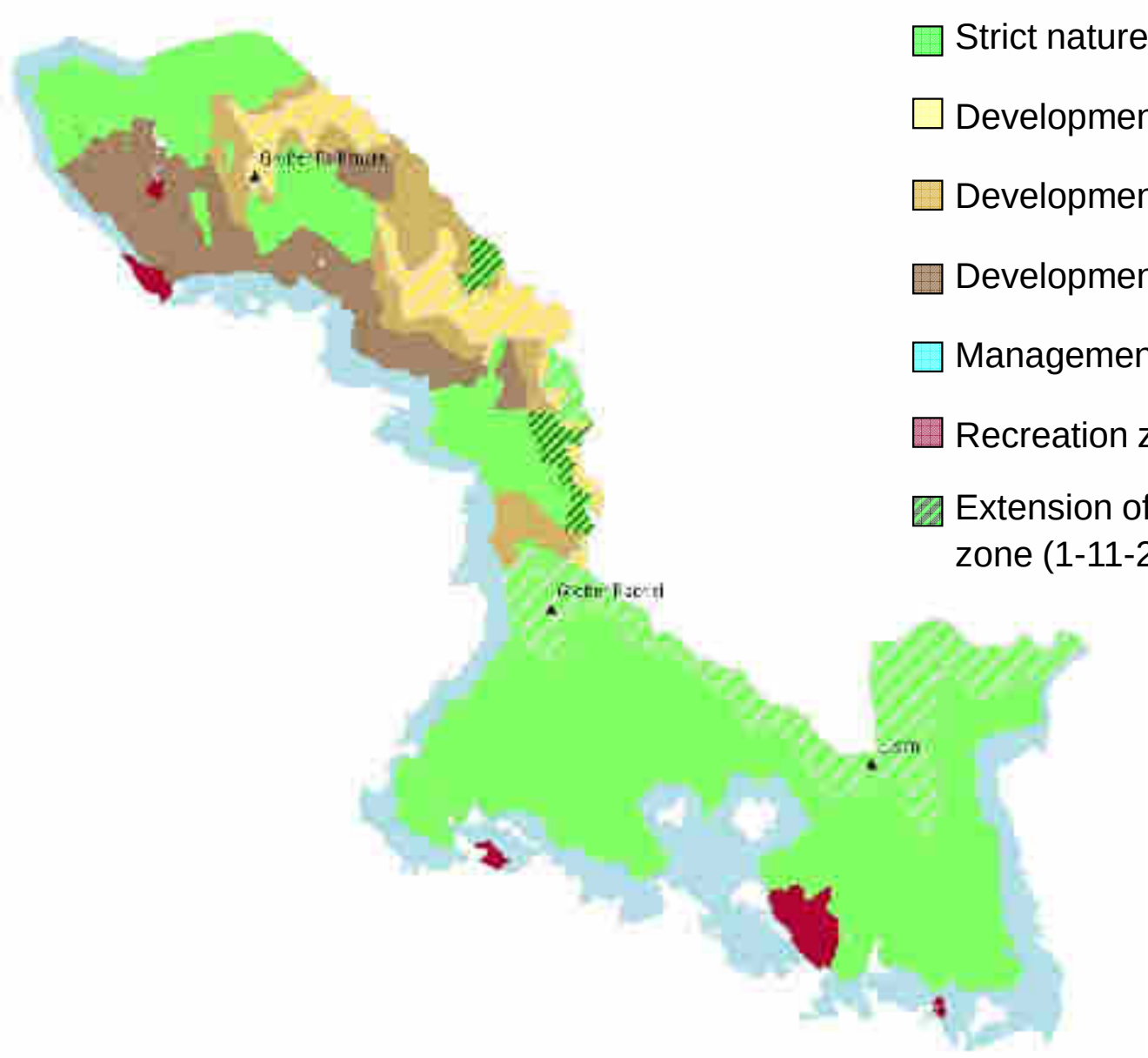
Bavarian Forest National Park

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

Primary aim:

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

Management Zones



- Strict nature protection zone (55%)
- Development zone 2a (5,5%)
- Development zone 2b (7%)
- Development zone 2c (9%)
- Management zone (22%)
- Recreation zone (2%)
- Extension of strict nature protection zone (1-11-2011)

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)

The Powerlessness of Men...

...against the forces of nature:

- Heavy storms with disastrous damages in forests accompanied forestry since the beginning;
- about **90** important storms in the Inner Bavarian Forest since 1850.

for example:

The „Large Storm“ in 1868/70:

About 2000 ha of the area of the original Bavarian Forest National Park had been damaged and cleared (630.000 fm timber)

04.07.1929:

About 900 ha had been damaged (360.000 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:

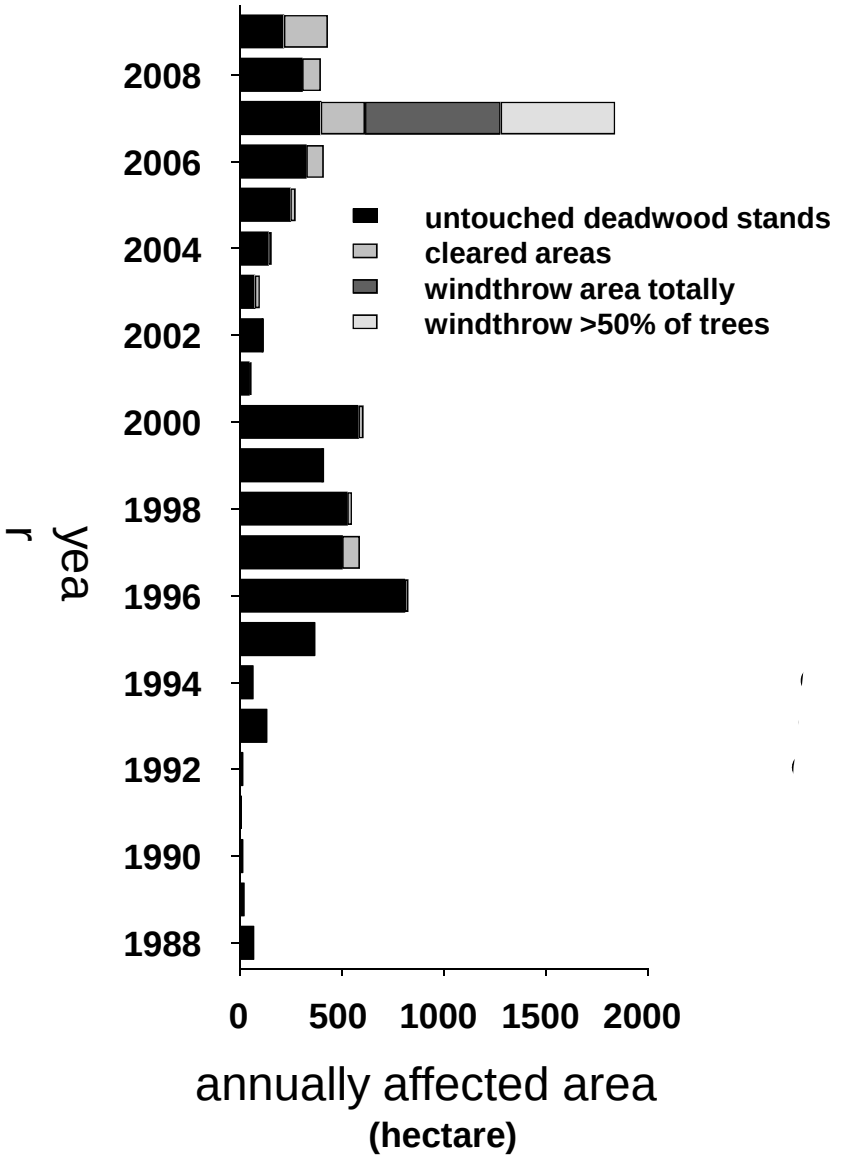
These events give us the opportunity to get „a primeval forest for our children and grandchildren“

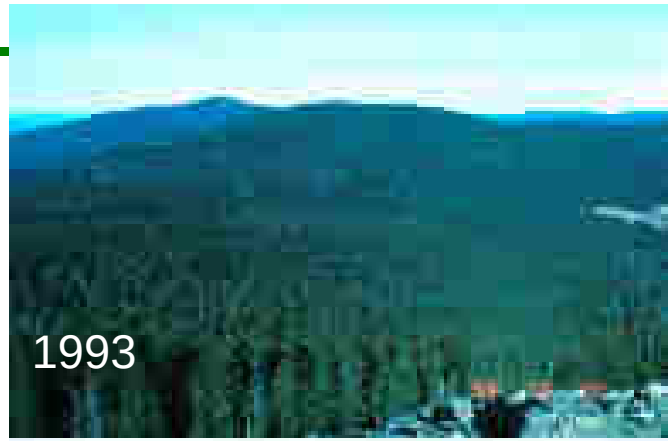
⇨ no clearing of windthrow areas

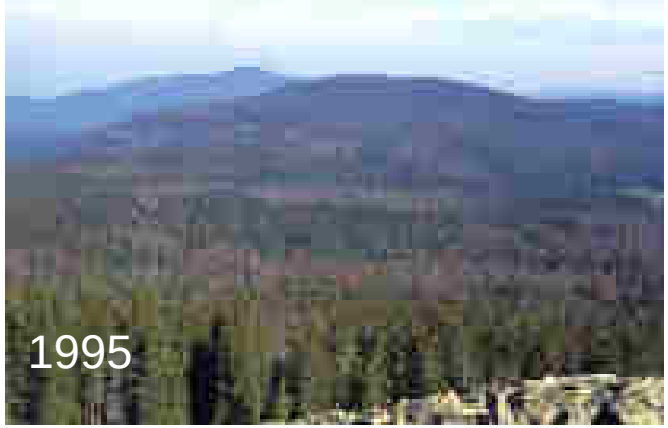
⇨ no fighting the bark beetle

...in the strict natur protection zone

Bark Beetle Outbreak







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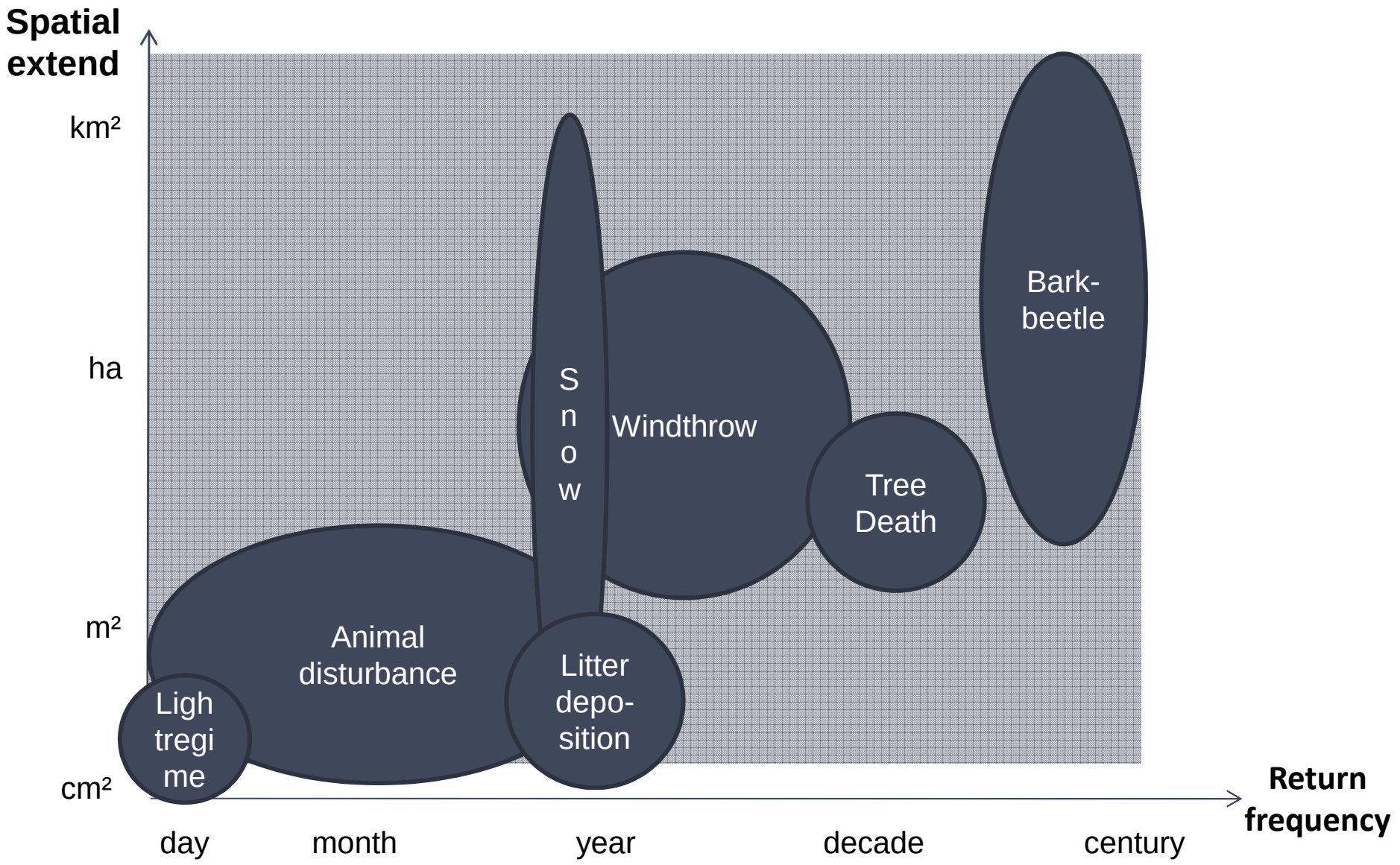
Natural forest dynamics following windthrow and bark beetle attacks

Hans Jehl

Nationalpark Bayerischer Wald

Disturbances



Monitoring

Concept:

Documentation of the development of disturbed forests in the main forest communities in comparison to the adjacent intact forests.

Questions:

- How does vegetation change after large-scale disturbances (species combination in different layers)?
- Which role plays the divers mosaic of microsites for forest development and forest stand structure in the future?

Methods:

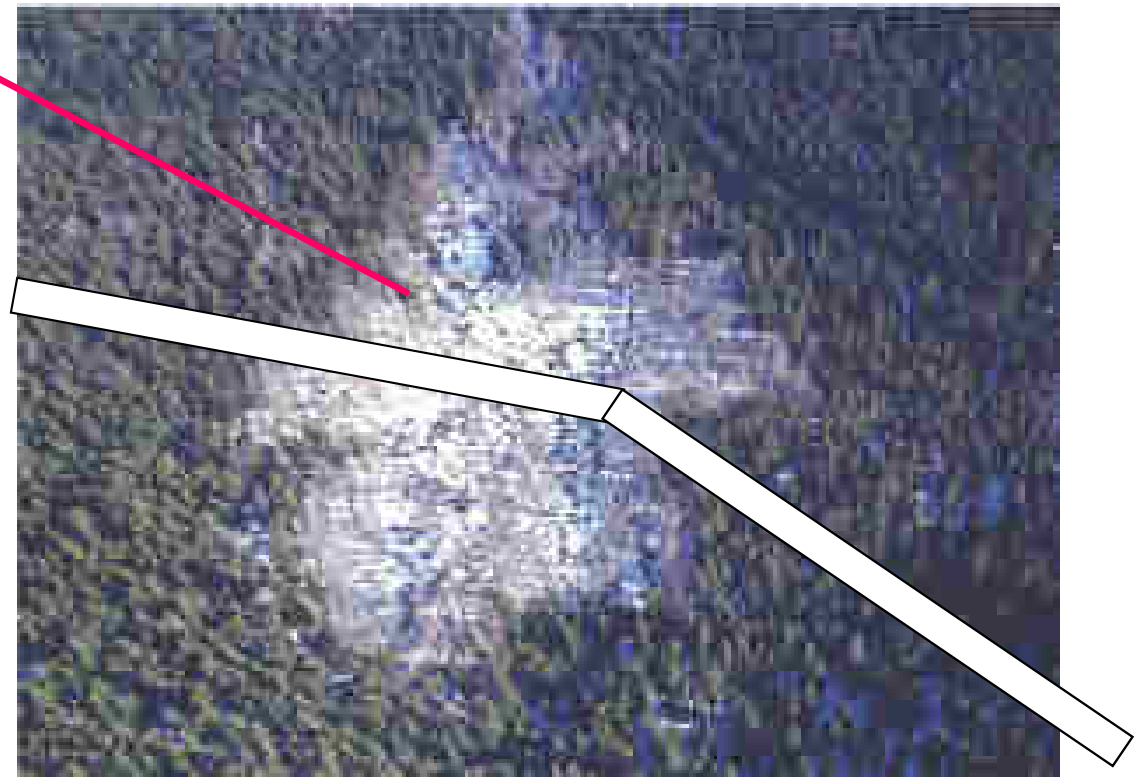
- Transects, subdivided into plots, 10 x 10m each
- Phytosociological investigations
- detailed observation of forest structure and microsite diversity
- Repitition: every 5 years in the very dynamic initial stage, than every 10 years

Forest Stand Structure Measured

Living trees: (height ≥ 0,2m)	-Species -Position -Height and dbh -Damages (browsing, fraying, pealing) -Microsite -Special aspects of growing
Standing deadwood: (dbh ≥ 7cm)	-Species -Position -Height and dbh -Decaying status
Lying deadwood: (diam. > 7cm)	-Species -Position -Length, diameter on both sides -Decaying status
Stumps, rootplates, big rocks	-Position -Dimension -Decaying status (stumps)

Study Area

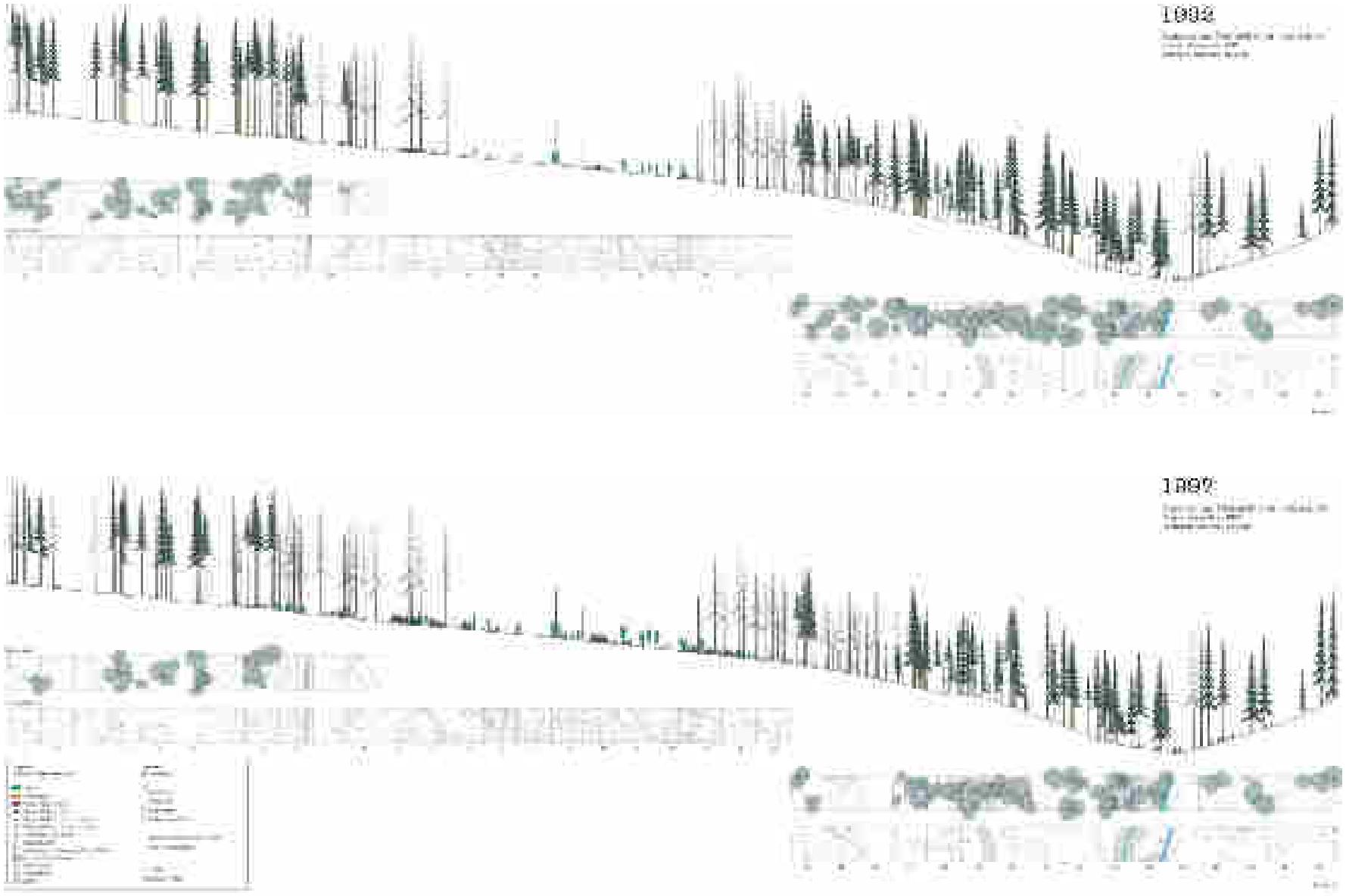
1992

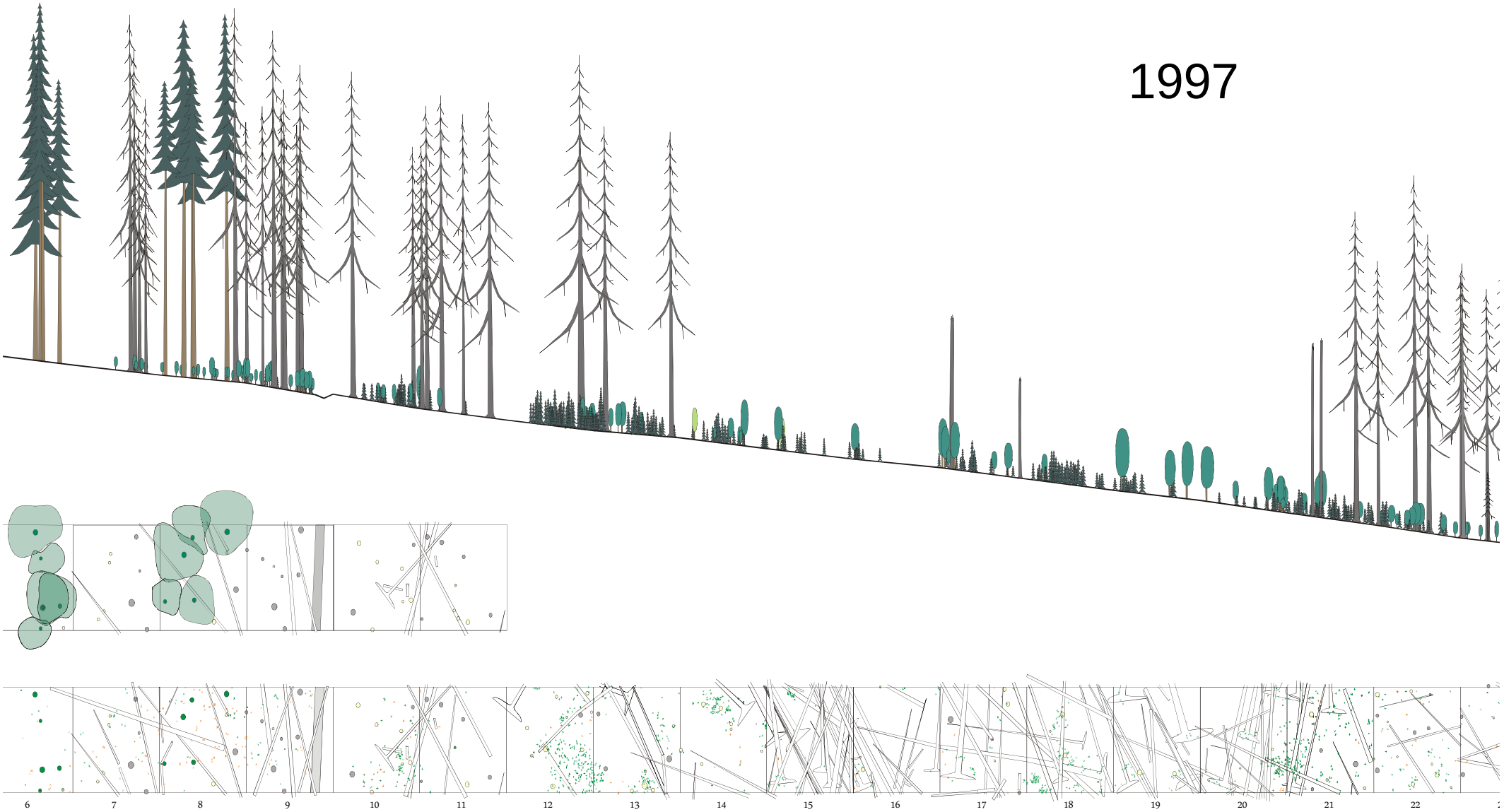


Forest district „Gfeichtethöh“
(1150 – 1190 m a.sl.) in the NE part of the National Park...

...and the position of the transect

Results: Forest Stand Structure




1997
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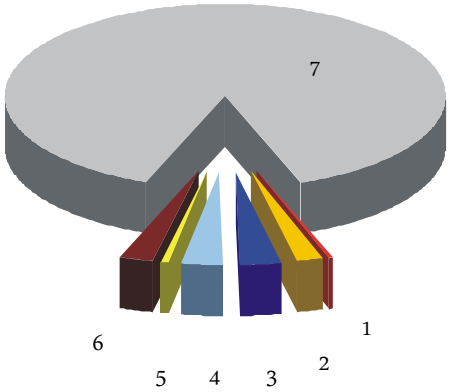
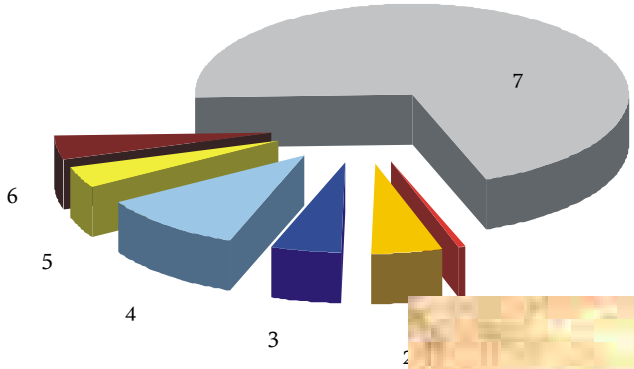
Microsites

Distribution of Microsites

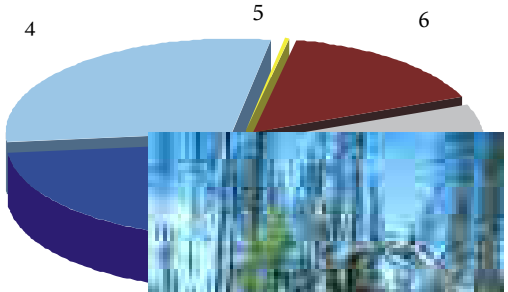
Intact old forest stand

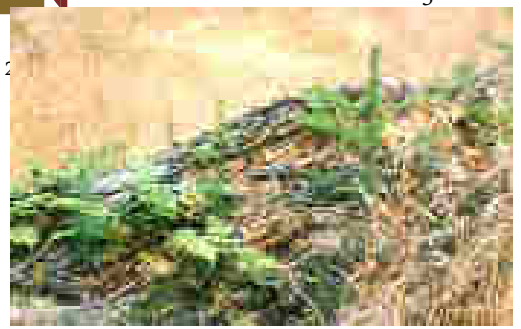


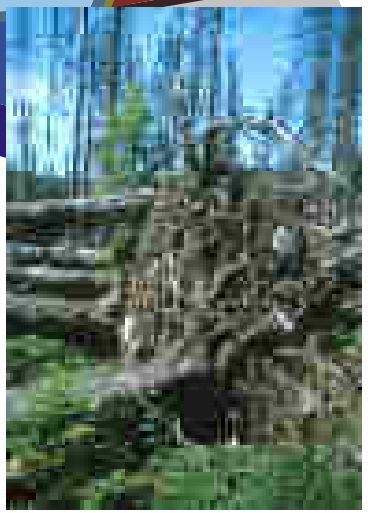
Deadwood stand

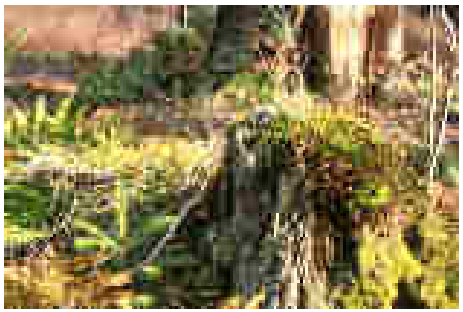


Untouched windthrow









1+2 Stumps + surroundings

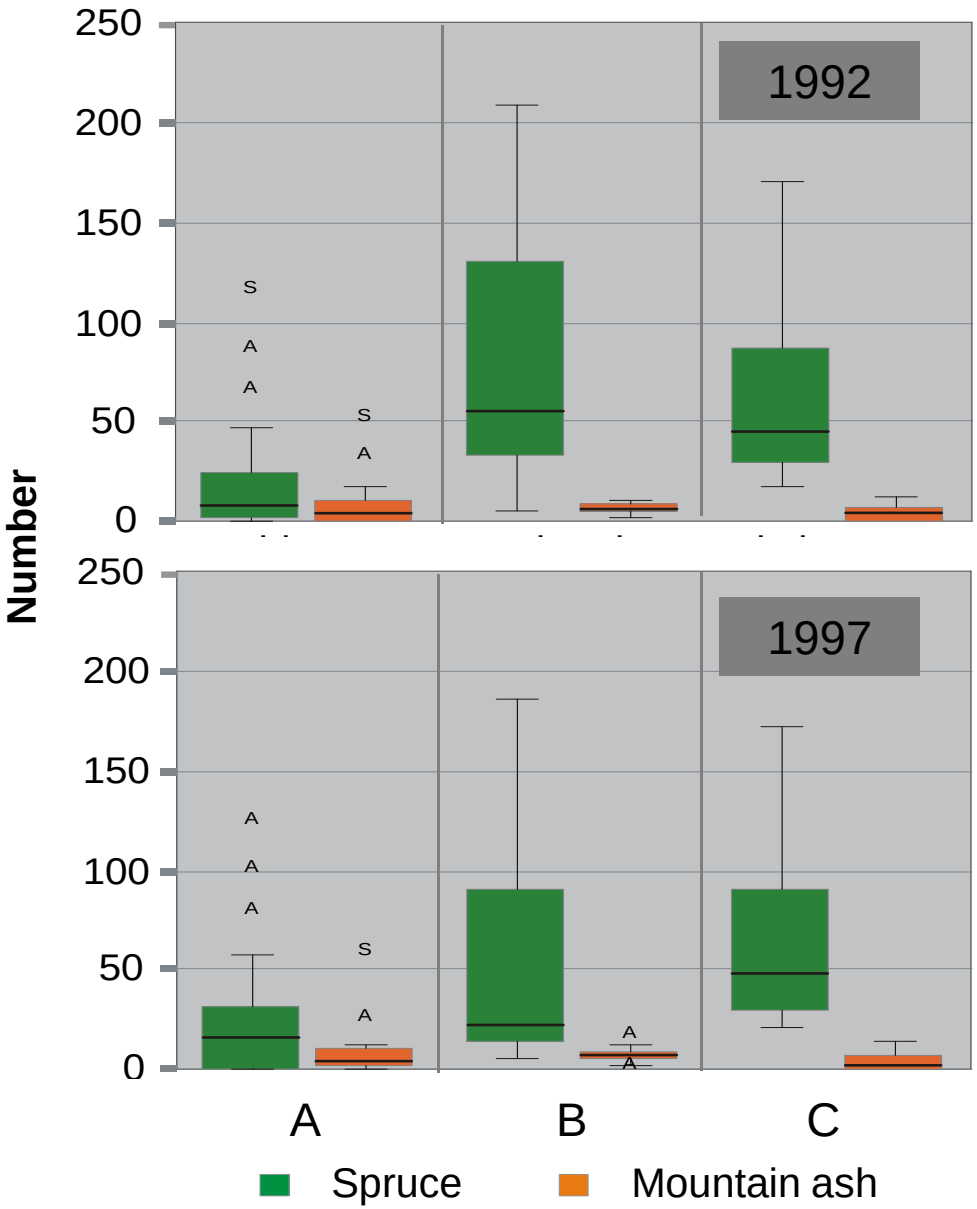
3+4 Lying deadwood + surroundings

5 Collars around standing deadwood

6 Opened soils

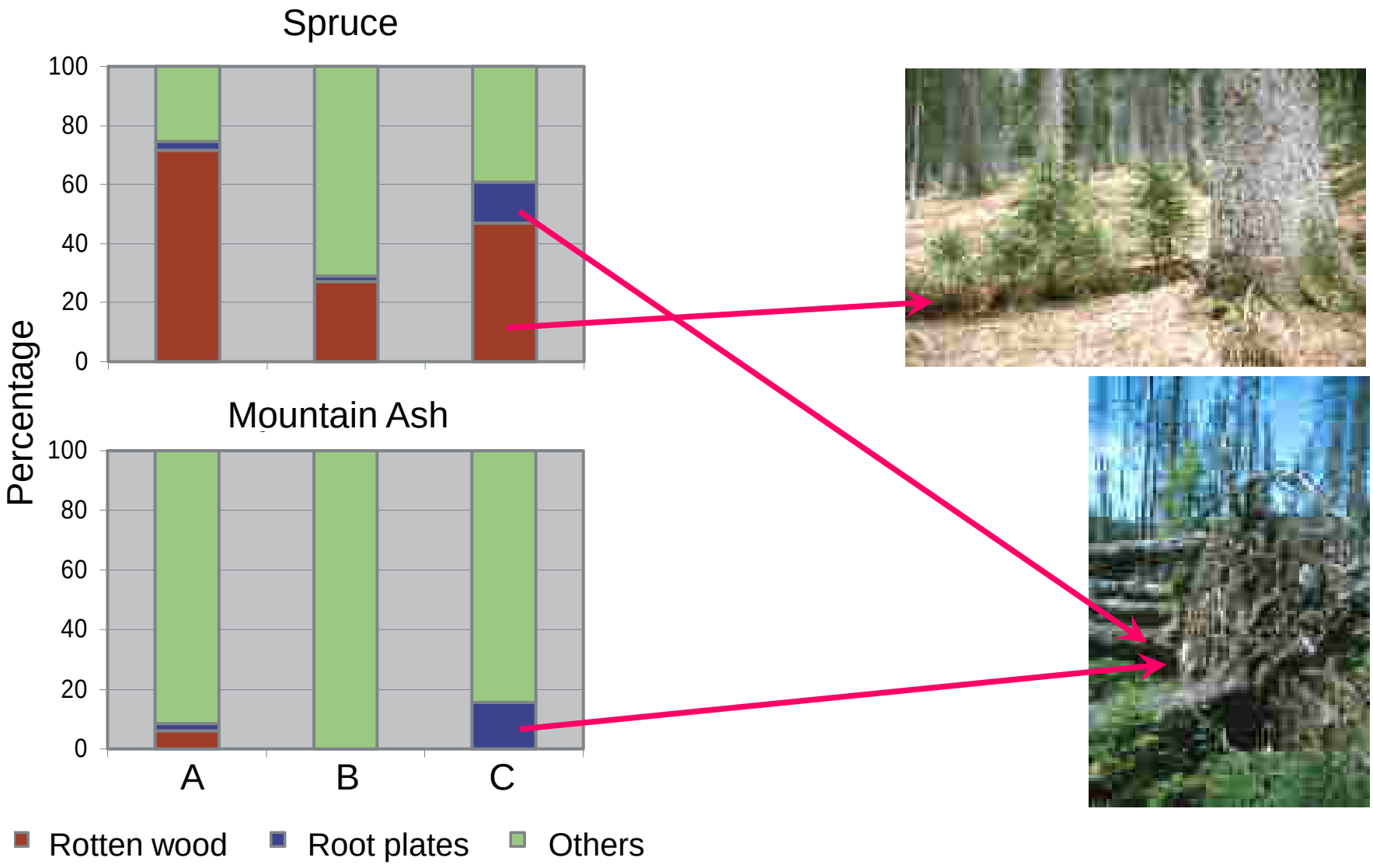
7 Areas without special microsites

Natural Regeneration

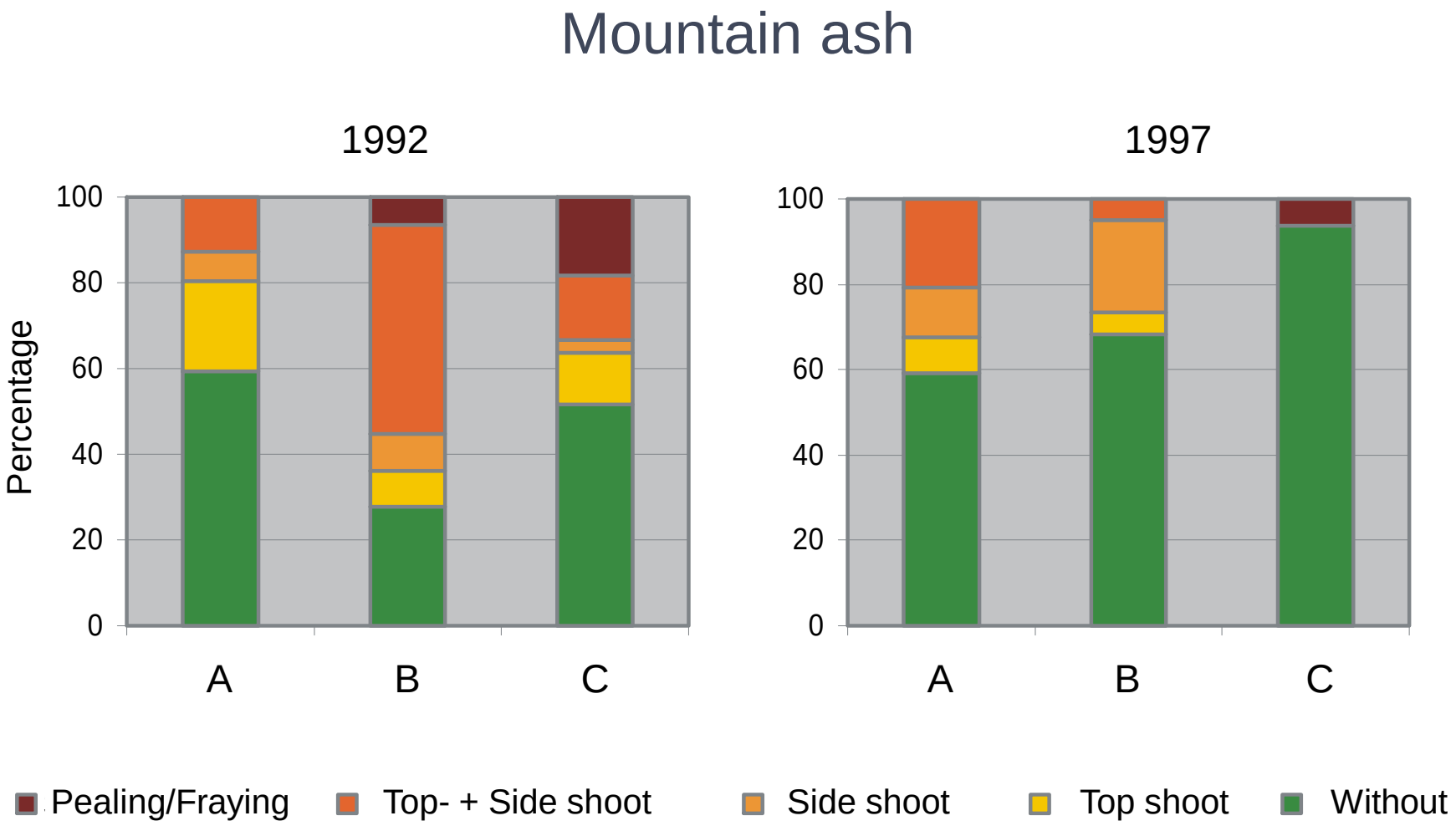


A Intact old forest stand
B Deadwood stand
C Untouched windthrow

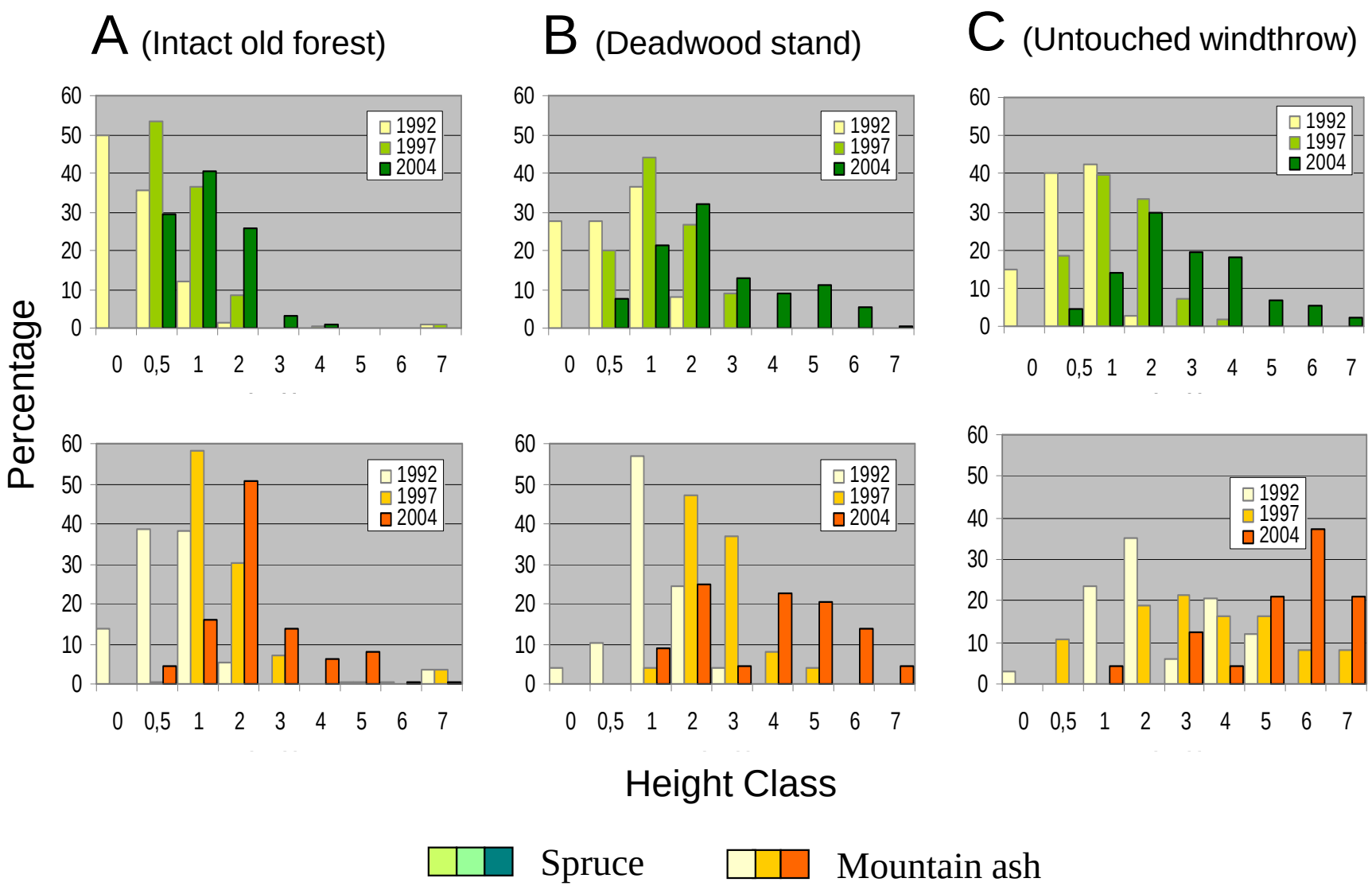
Natural Regeneration - Microsites



Influence of Ungulates



Growth of young trees



Windthrow Area „Gfeichtethöh“

1992

2007

Conclusions

Large-scale disturbances seem to be an essential part of natural forest dynamics in spruce dominated forests.

Windthrow and bark beetle outbreaks change the environmental conditions fundamentally, increasing variability of light regimes.

Such disturbances create a divers mosaic of microsites, which play an important role for the recruitment and growing success of young trees.

Seedlings and saplings are already established in old forests, if there are enough suitable microsites, such as rotten wood. Most of them survived the disturbence events.

The recruitment of young trees has a characteristic pattern, dependant to the distribution of microsites.

Pioneer trees and herbs play a minor role. They establish mainly on opened soils (uprooted trees). Their proportion rapidly decreased in time.

Salvage logging in such areas reduces the diversity of microsites and the number of natural regeneration.

hlavní ponaučení

Velkoplošné disturbance jsou zřejmě základní součástí dynamiky přírodního smrkového lesa.

Polom a kůrovcové kalamity zásadním způsobem mění podmínky prostředí, zvyšuje se proměnlivost světelných podmínek.

Tyto disturbance vytváří rozmanitou mozaiku mikrostanovišť, které hrají důležitou roli pro uchycení a úspěch růstu mladých stromků.

Semenáčky a malé stromky jsou v starých lesích již přítomny, pokud je tam dostatek vhodných mikrostanovišť jako např. tlejícího dřeva. Většina z nich disturbance přežije.

Uchycení mladých stromků má charakteristickou prostorovou strukturu, závislou na rozložení mikrostanovišť.

Pionýrské dřeviny a rostliny nehrají hlavní roli. Uchytí se hlavně na otevřených půdách (vývraty). Jejich podíl postupem času rychle klesá.

Asanace těžbou v takovýchto plochách snižuji rozmanitost mikrostanovišť a počet přirozeného zmlazení.

PRAHA, 07.12.2011

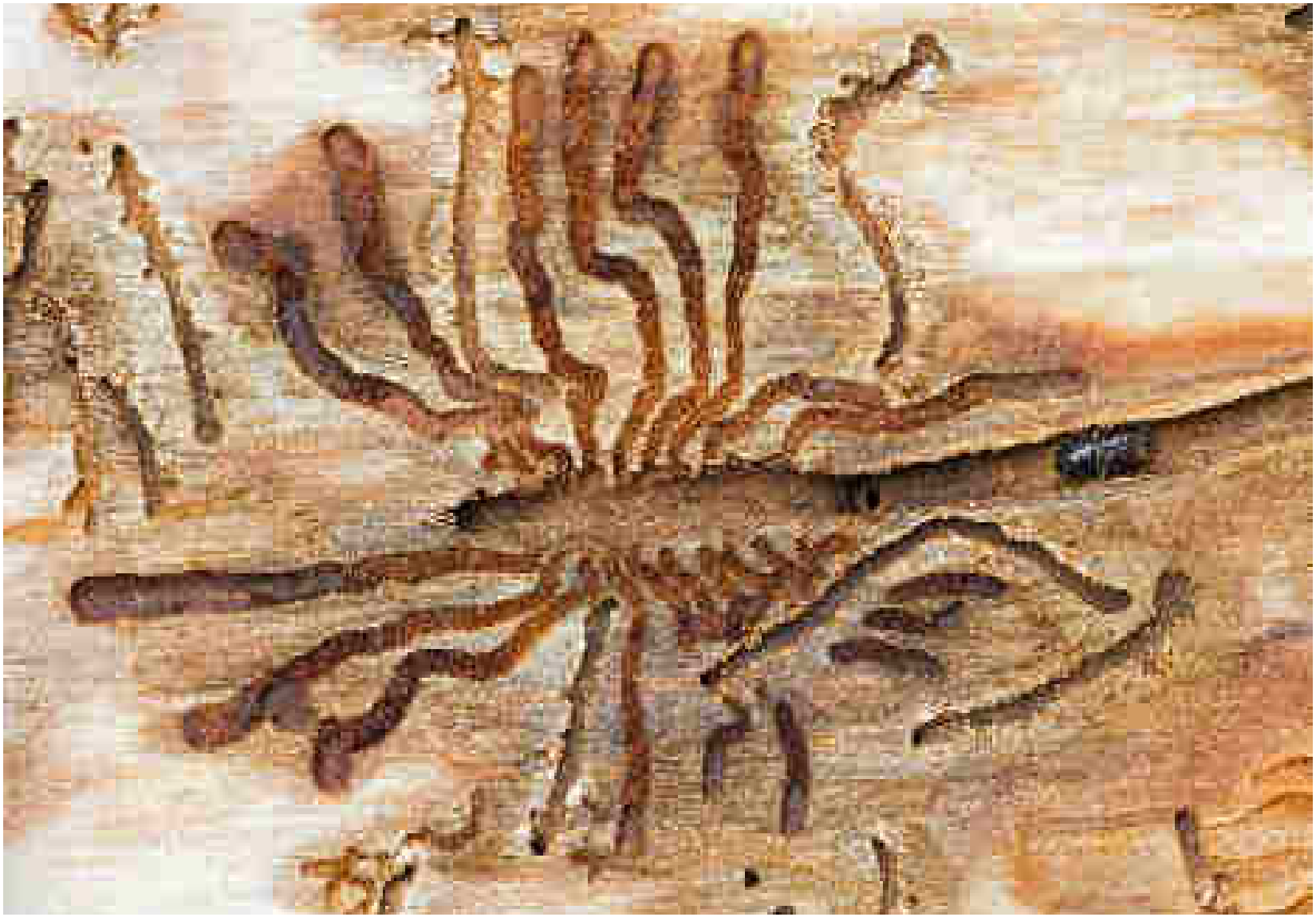
Natural Disturbances in a National Park

The bark beetle outbreak

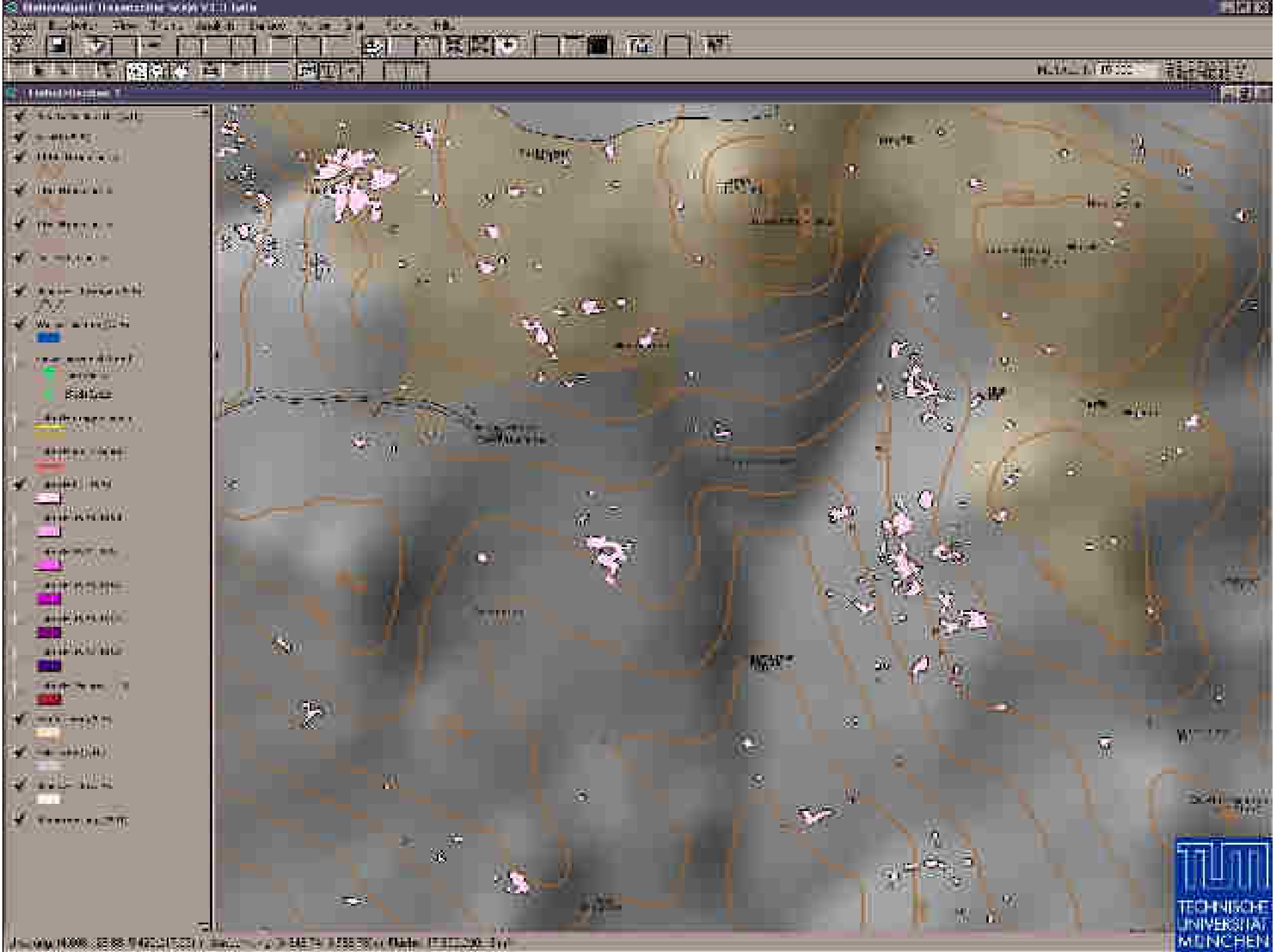
Marco Heurich

Nationalpark Bayerischer Wald

The Bark Beetle *Ips typographus*



Expected development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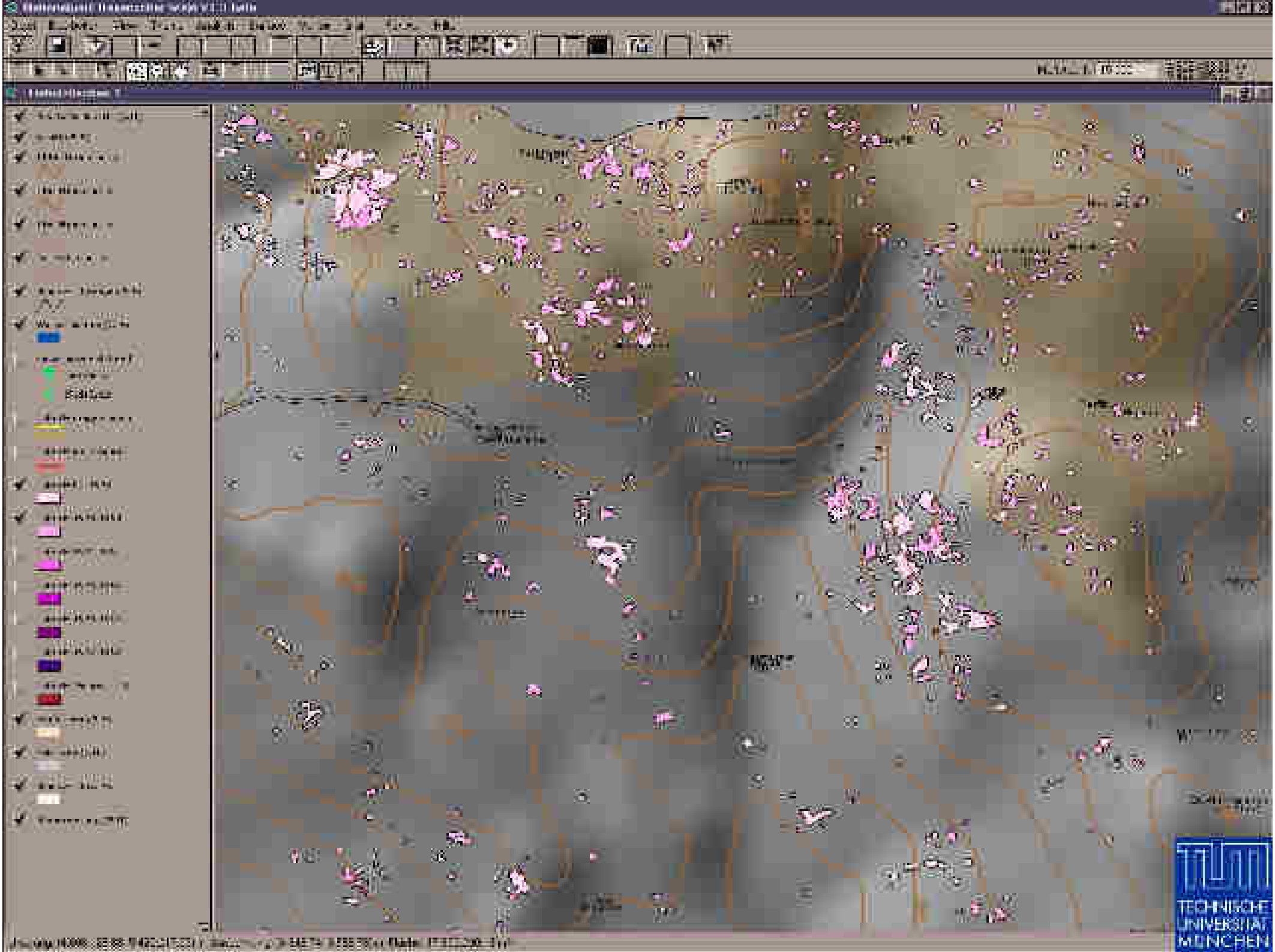
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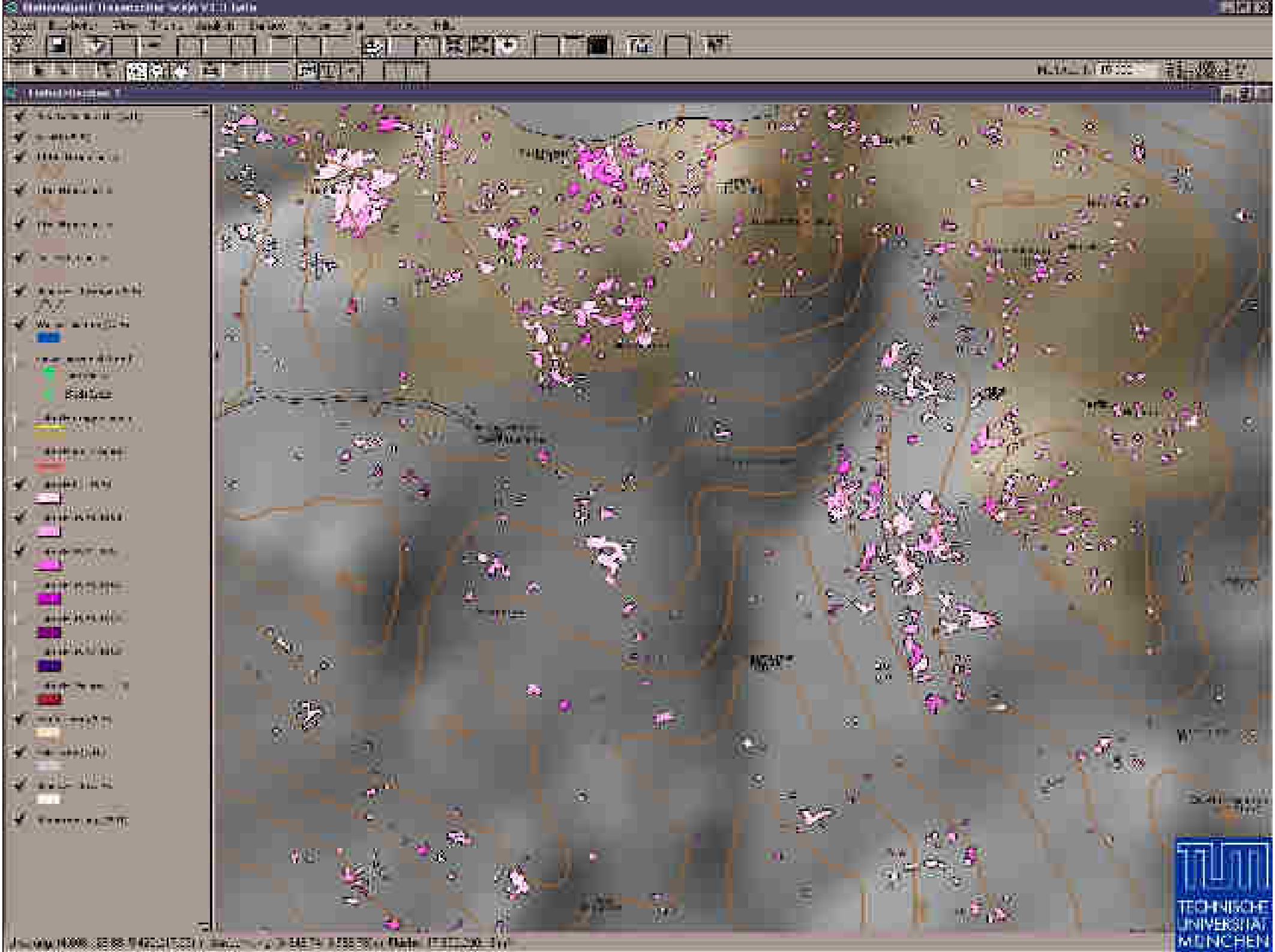
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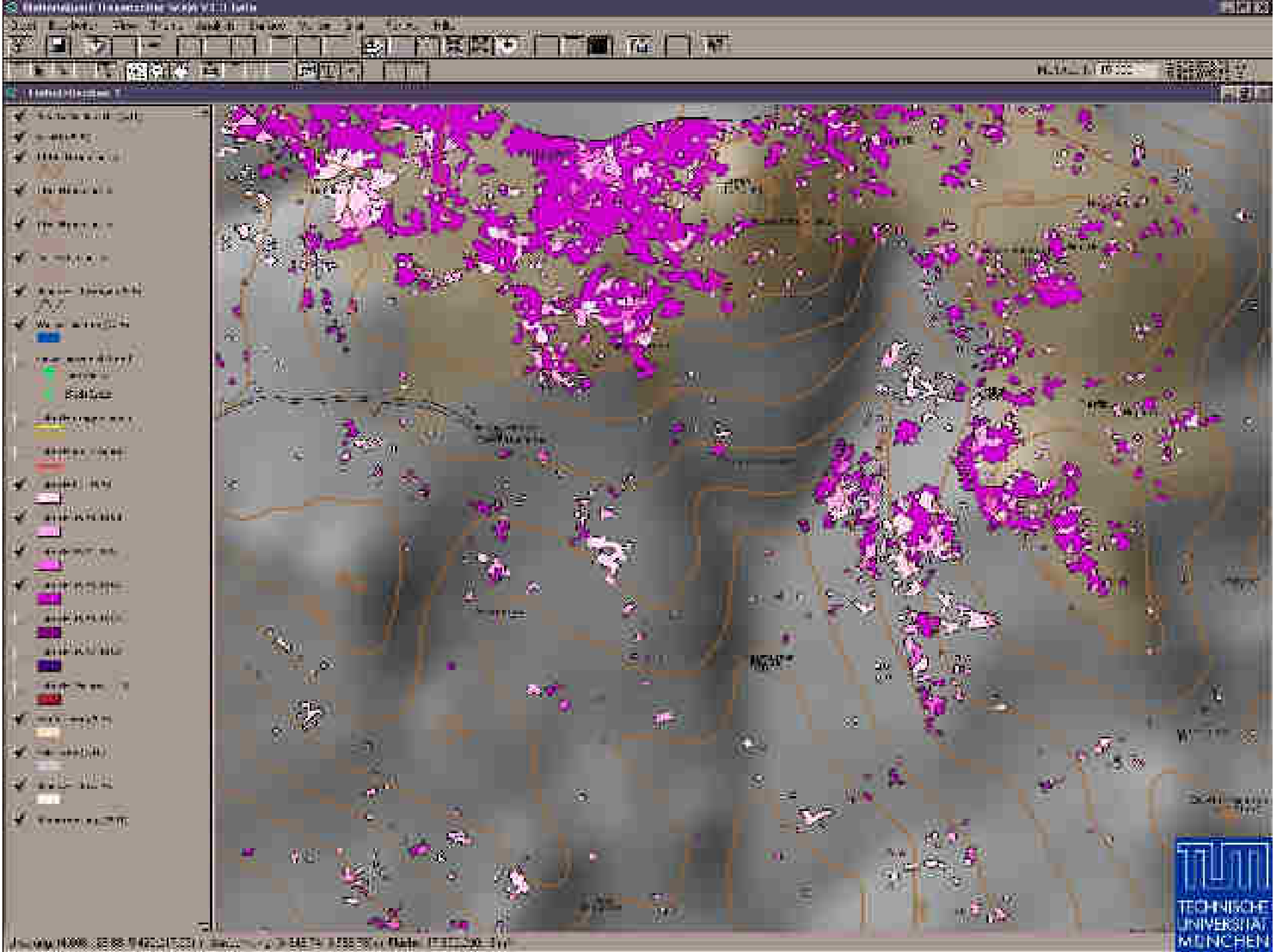
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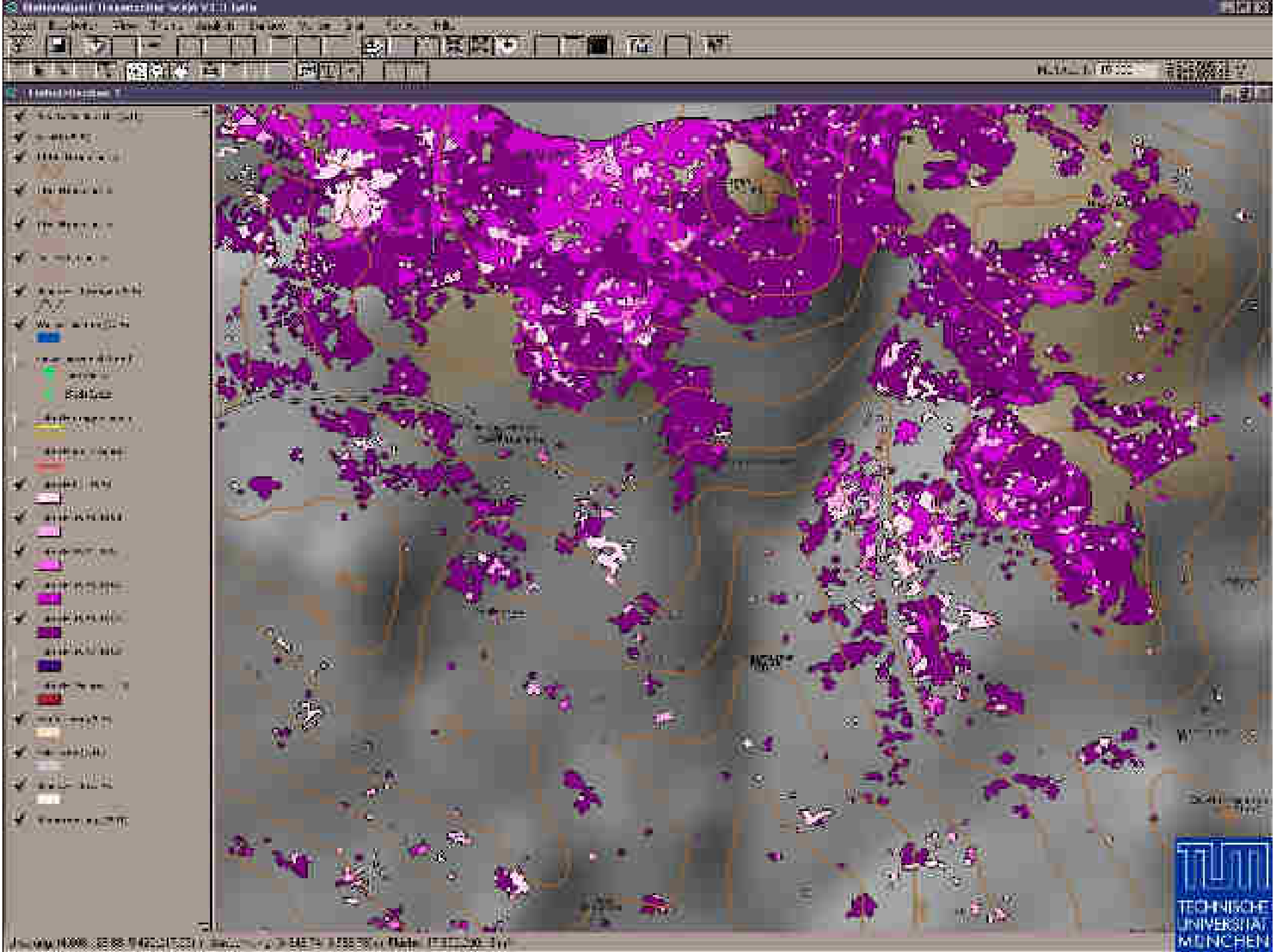
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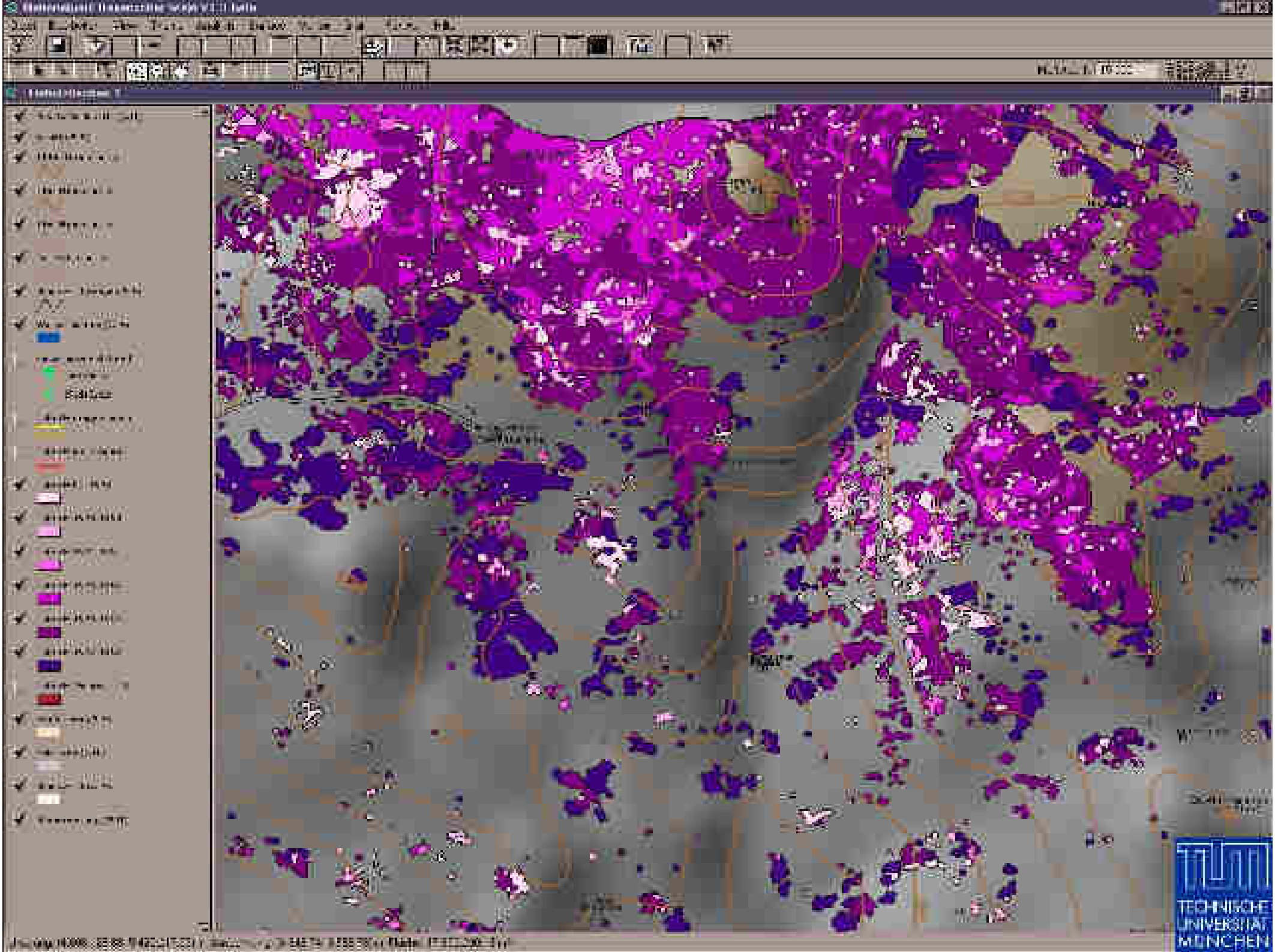
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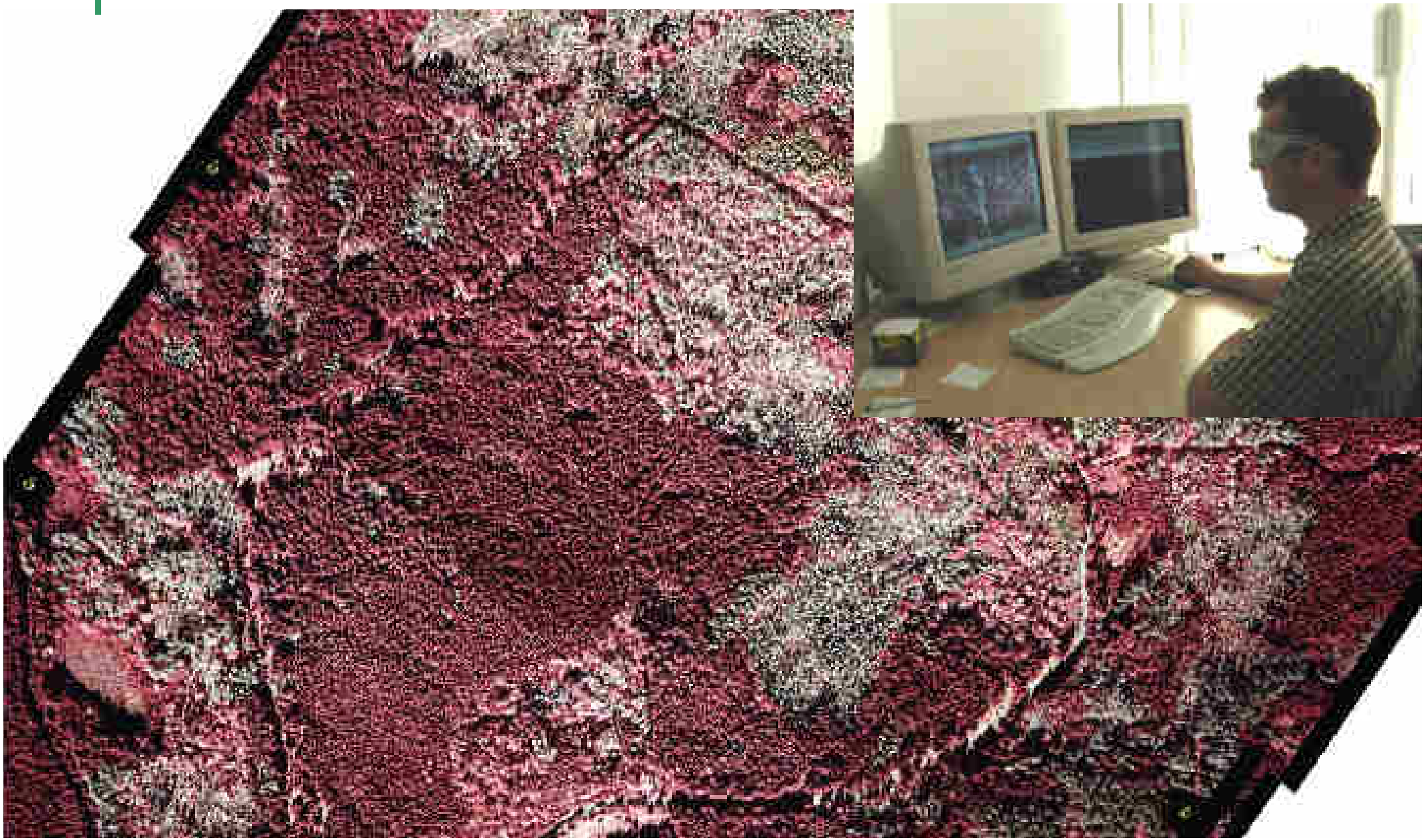
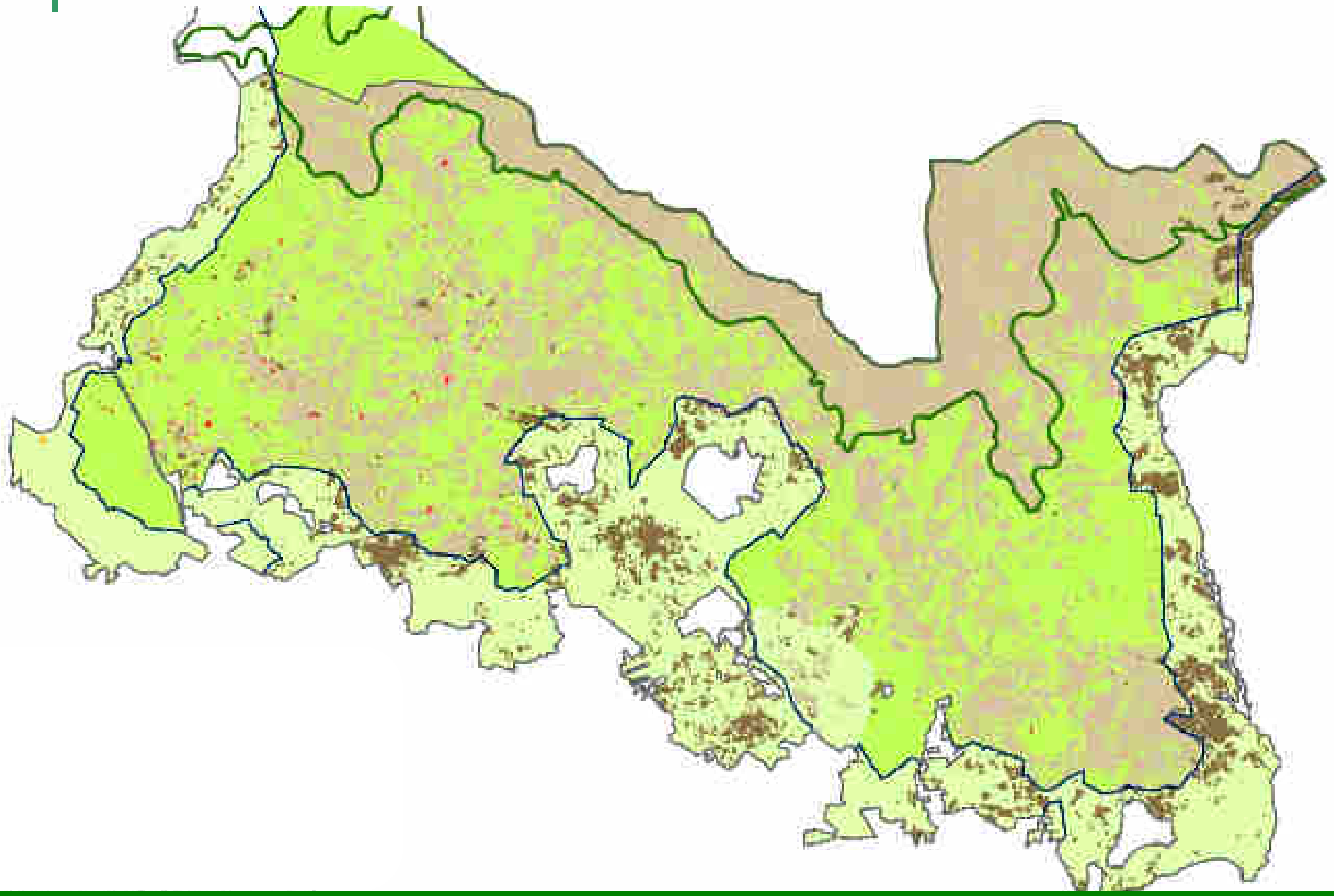
Methodology:

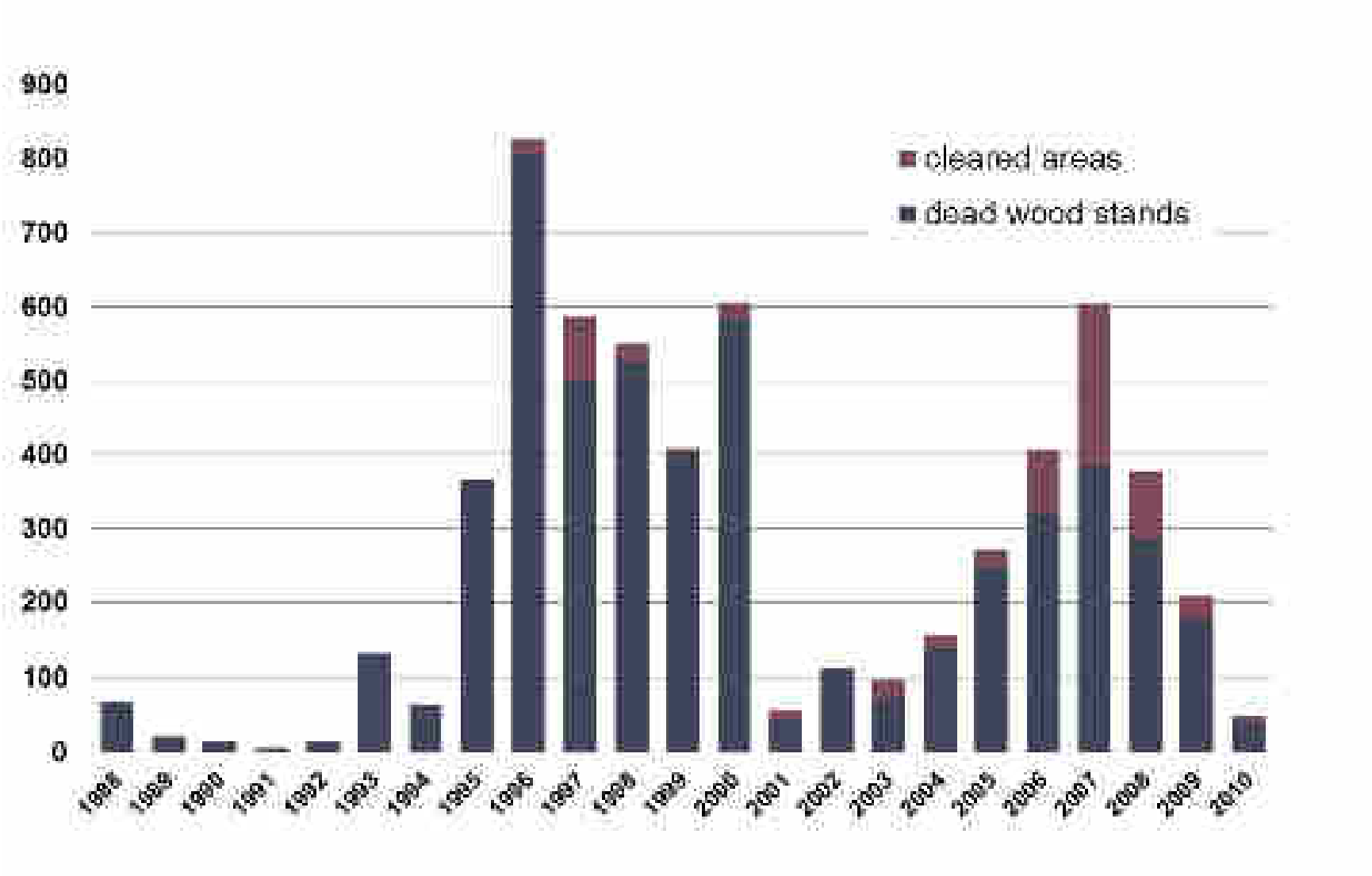


Heurich et al (2010) European Journal of Forest Science

Dead wood stands in the RLG:

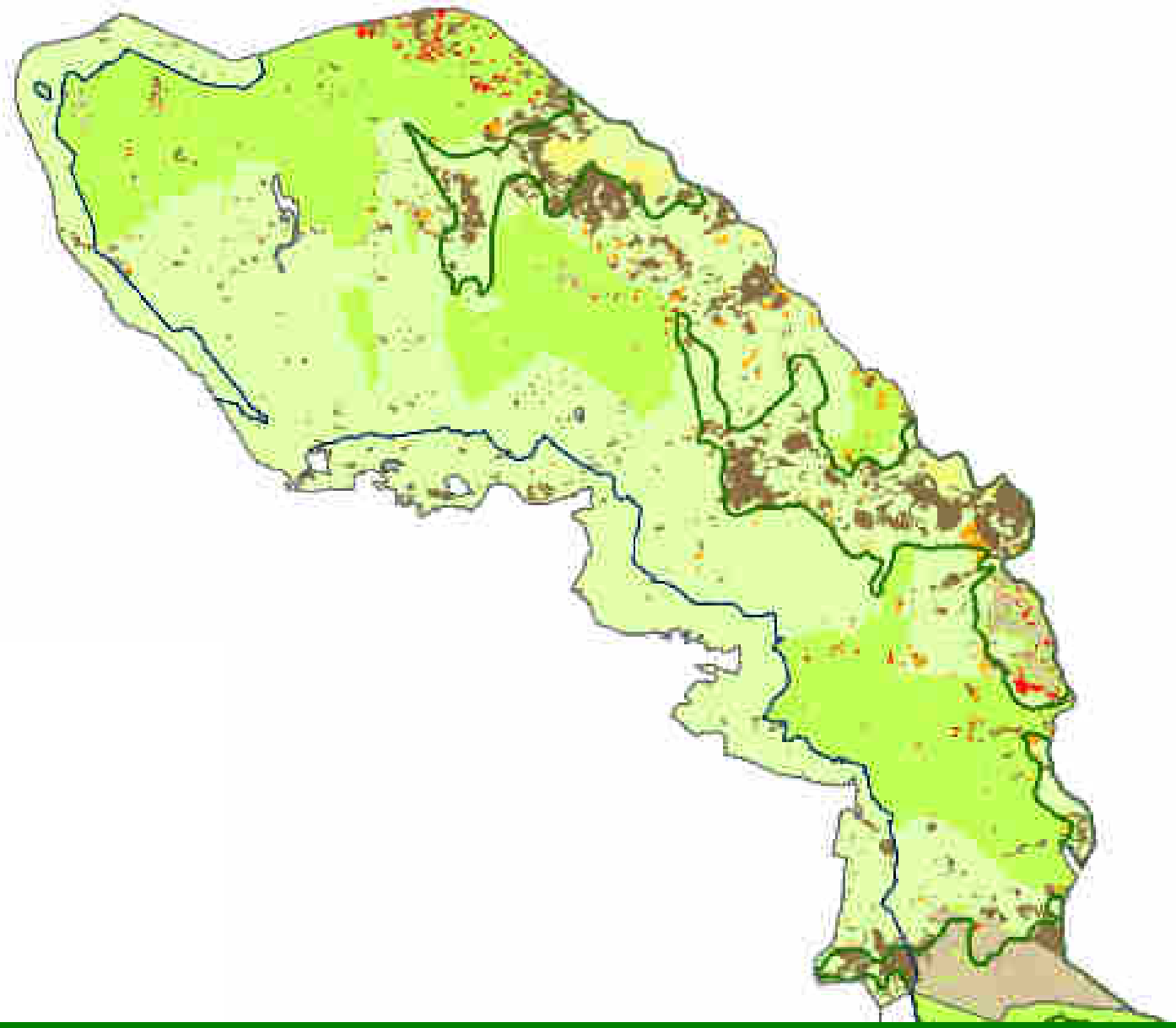


Development of dead wood stands in the RLG:

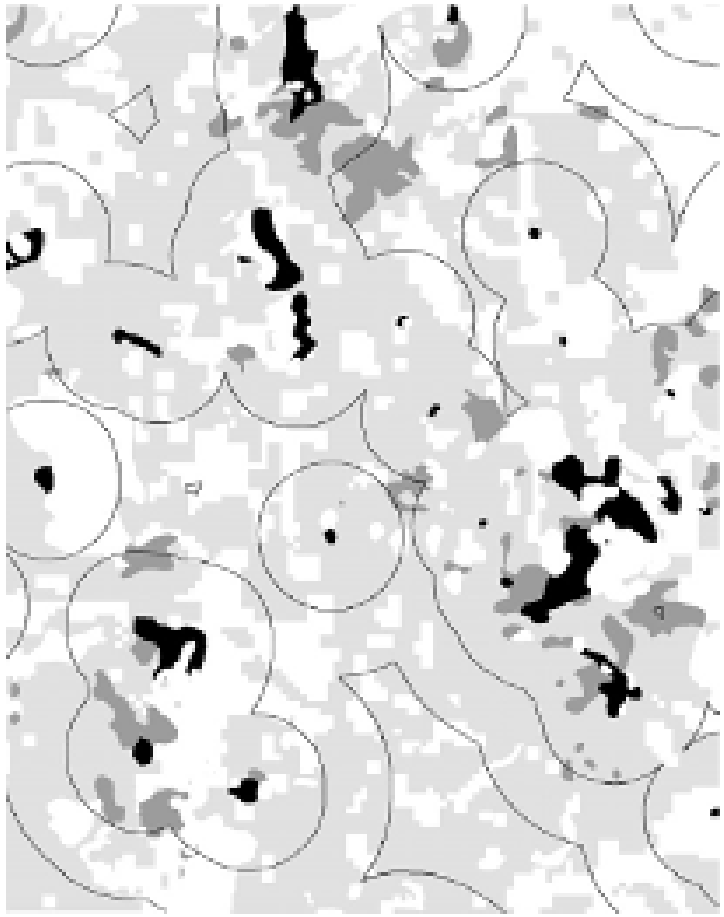


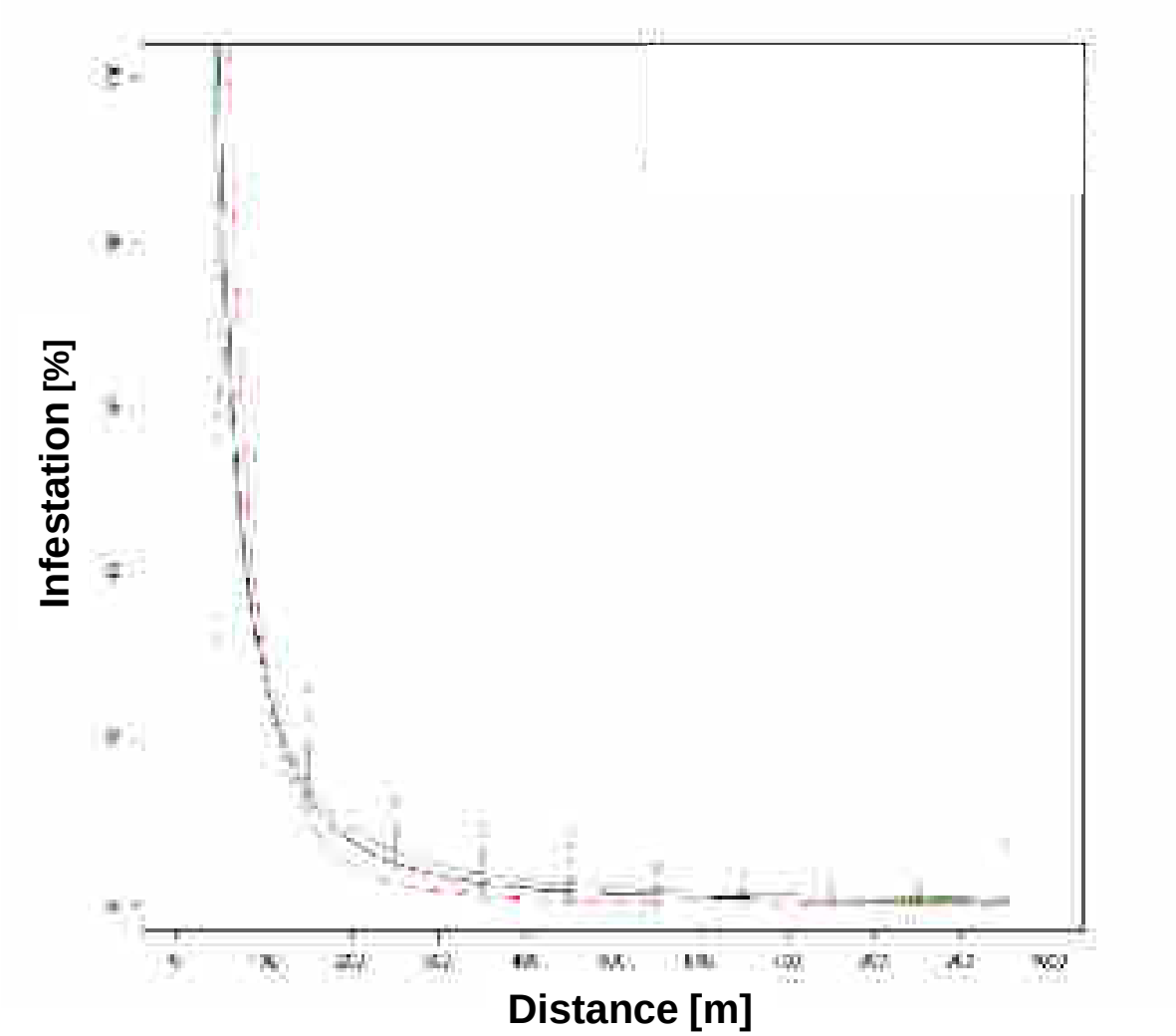
Lausch et al (2011) Forest Ecology and Management

Dead wood stands in the FRG:



Distance of infested patches in consecutive years





Kautz et al (2011) Forest Ecology and Management

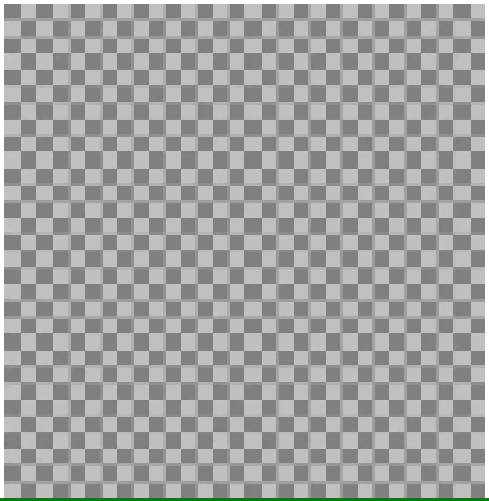
Spatially explicit agent-based simulation model (SAMBIA)

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

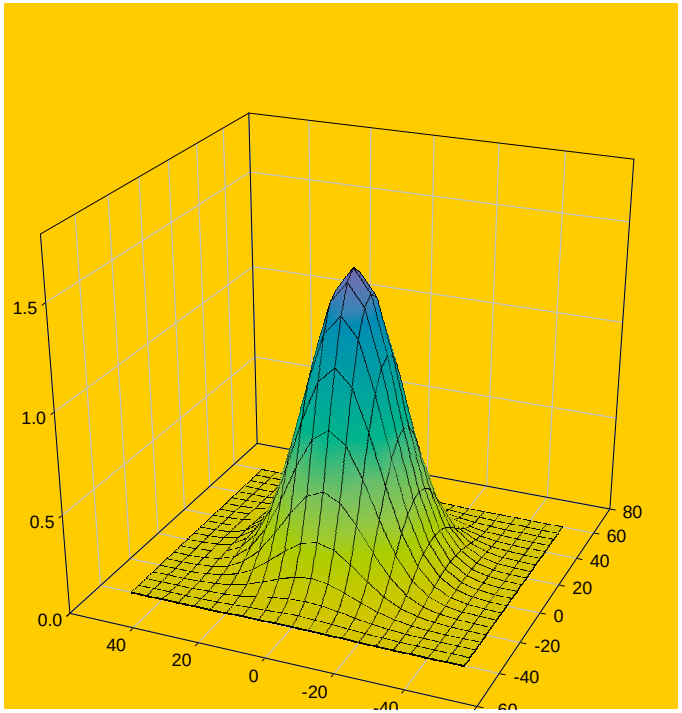


Implementation of biological processes

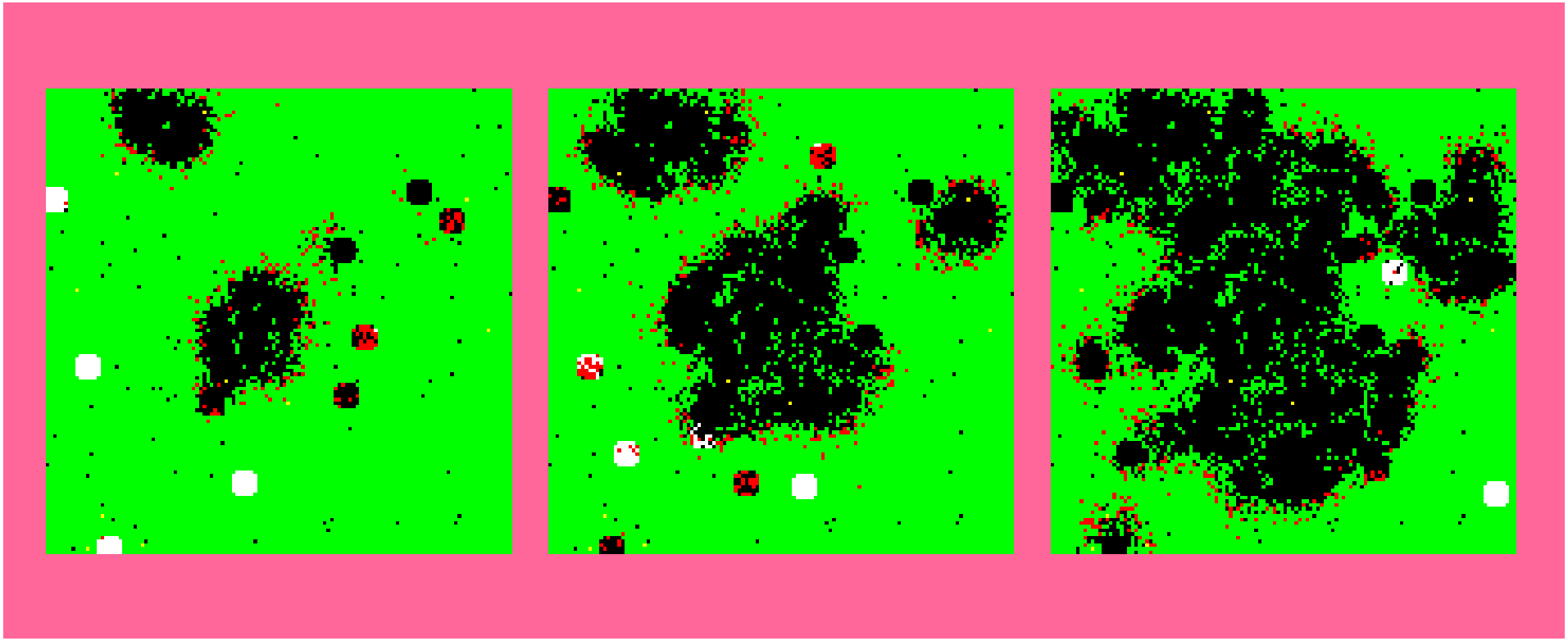
- population dynamics

  (reproduction, mortality)

- dispersal

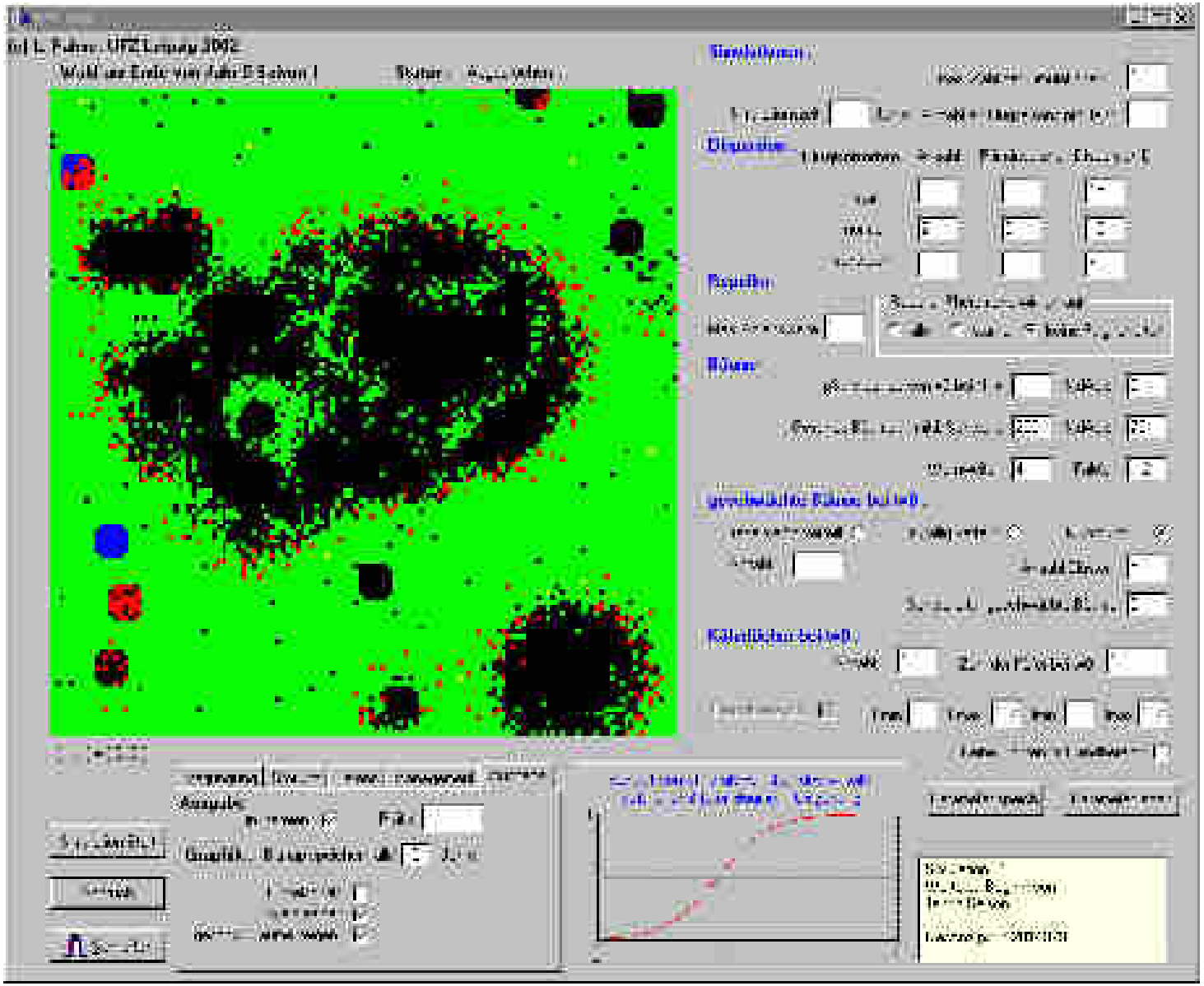


Infestation patterns in consecutive years



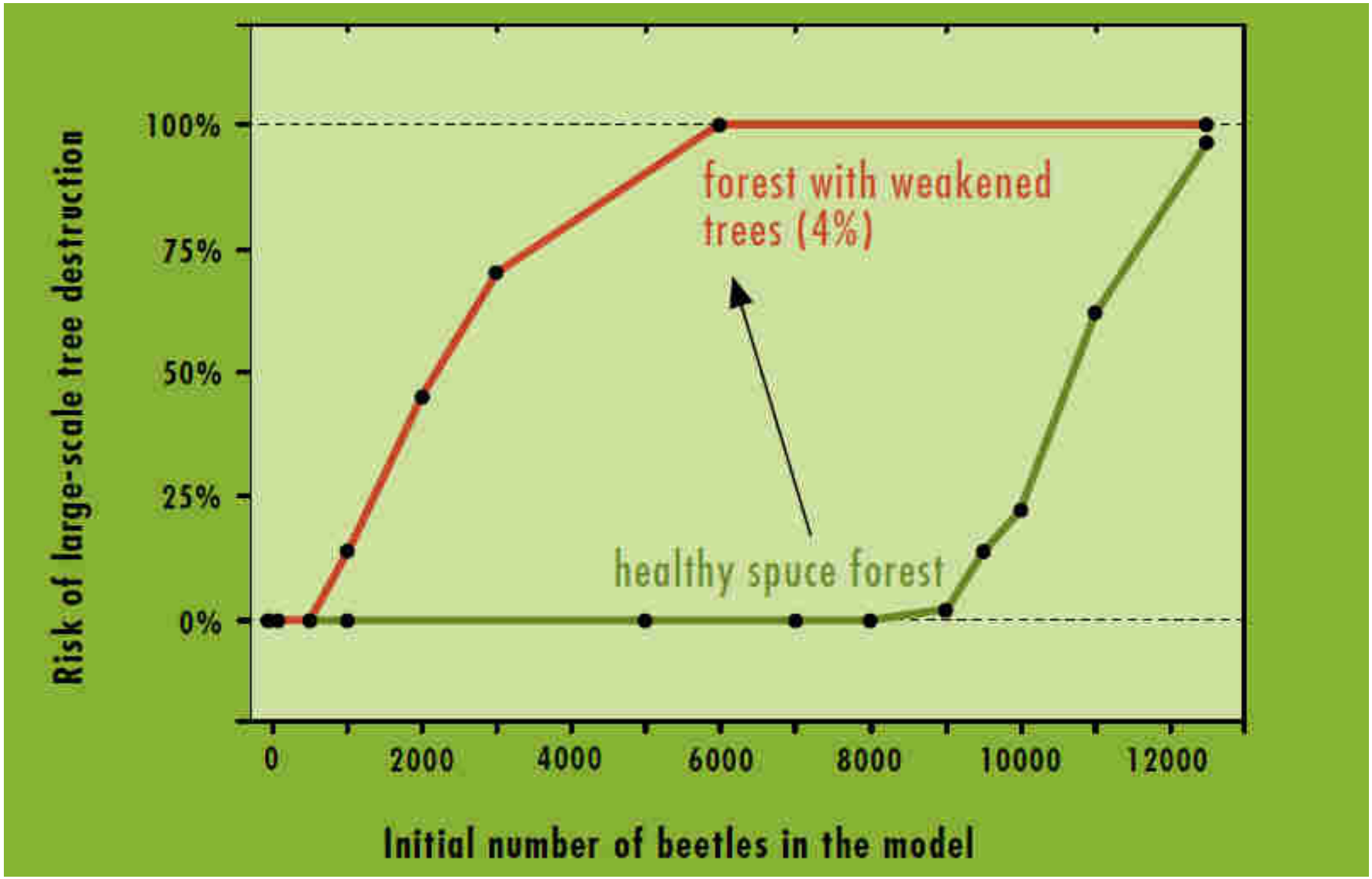
t = 1 t = 2 t = 3

User interface of SAMBIA



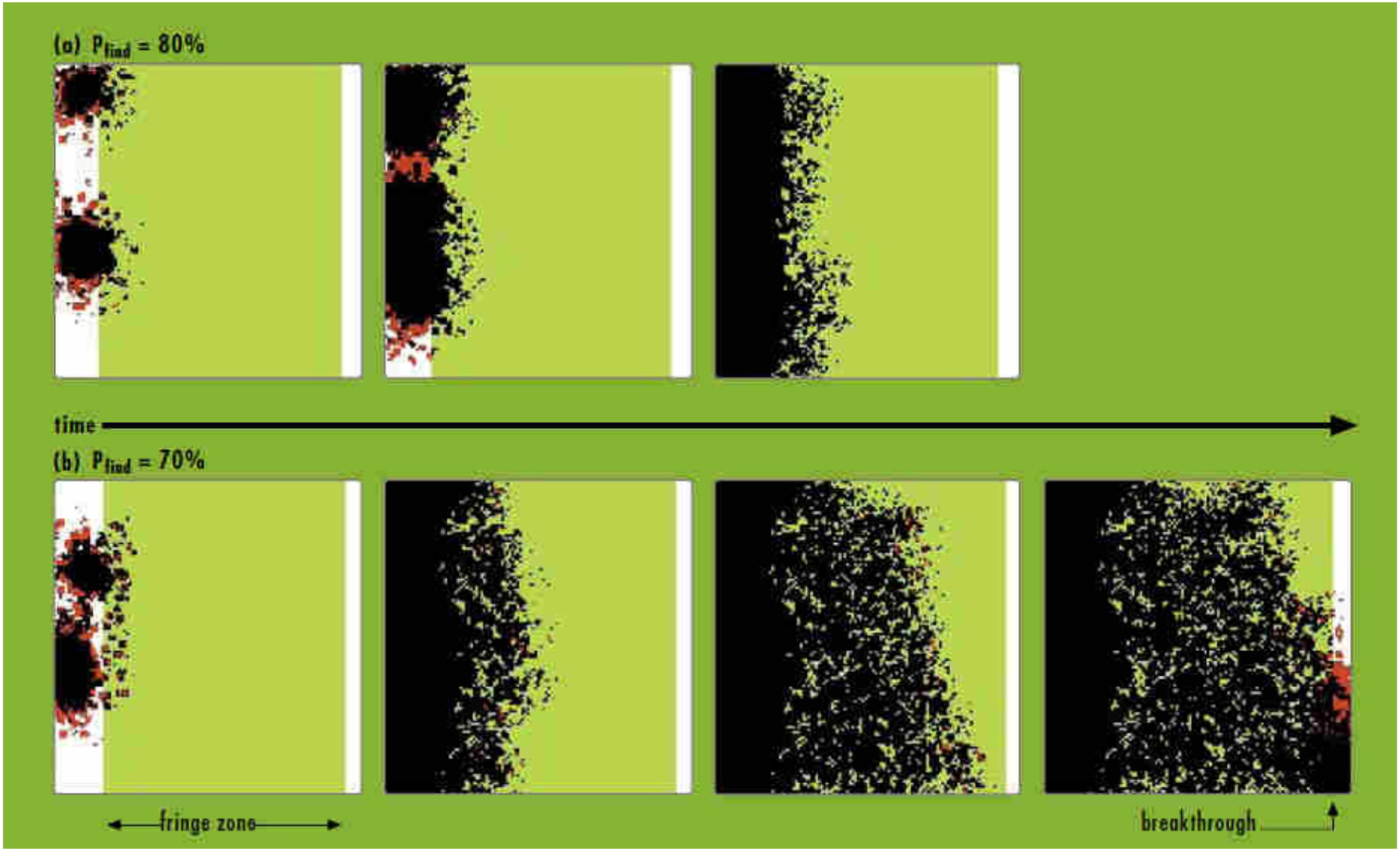
? ?

Risks of outbreaks as a function of the initial numbers



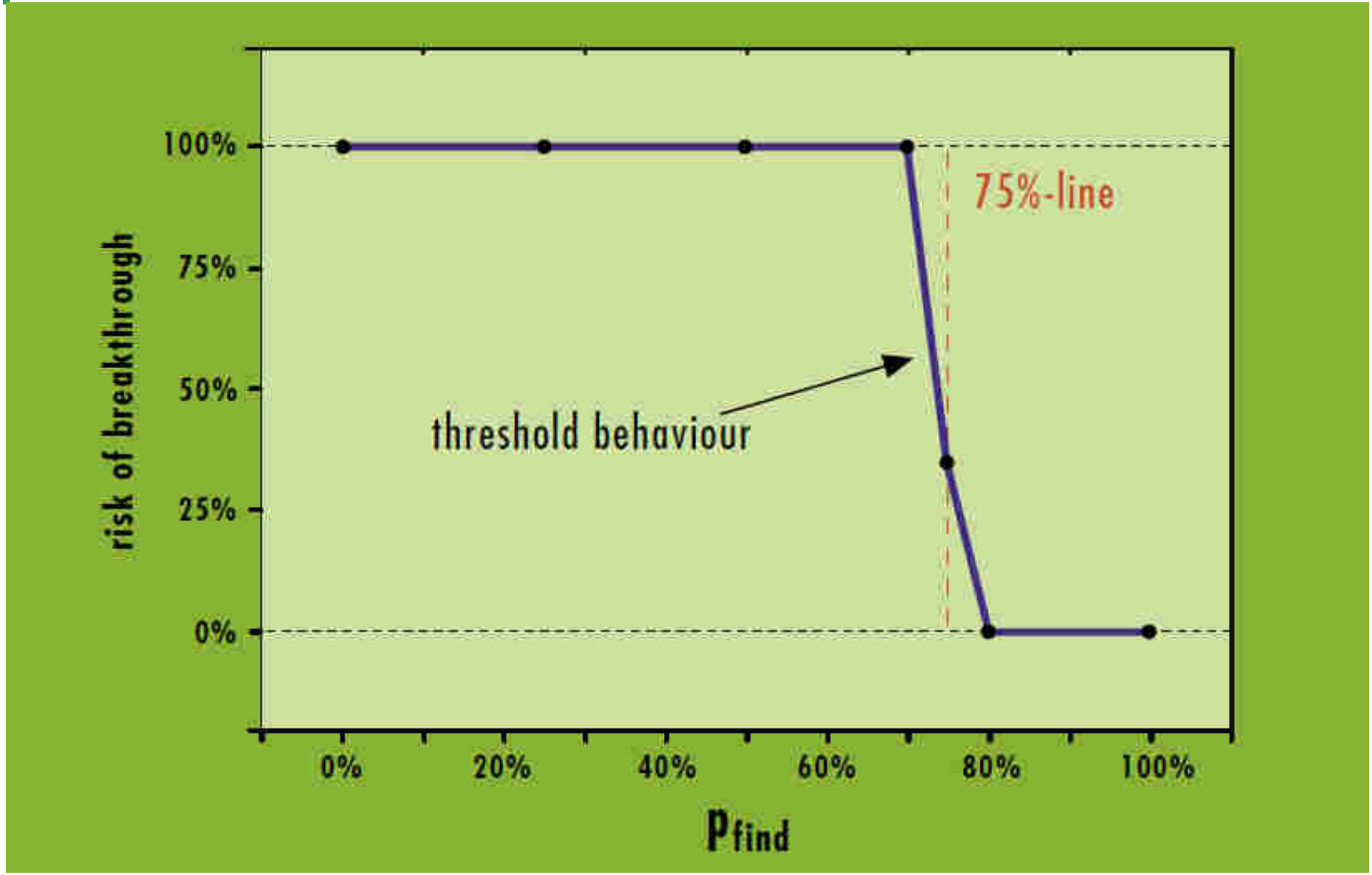
Fahse and Heurich (2011) Ecological Modelling

Efficiency of management zone



Lorenz F. and M. Heurich (2003): Research for the Environment

Threshold for management efficiency



Lorenz F. and M. Heurich (2003): Research for the Environment

Conclusions

- **Natural development is now allowed on 12580 ha (52 %) of the park area**
- **Bark beetle affected 6000 ha of the Rachel-Lusen-Area**
- **Bark beetle shows a cyclic dynamic, influenced by climatic charakteristics (wind, temperature)**
- **Bark beetle outbreak can be explained by natural dynamics**
- **Bark beetle management can keep the disturbance within park borders**
- **Sanitary logging has to focus on the vicincy of previous infestation**
- **For efficient bark beetle management you have to reduce beetle numbers by 75 %**

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 charakteristics (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 disturbanci 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%**

PRAHA, 07.12.2011

Regenerations‘ response in space and time

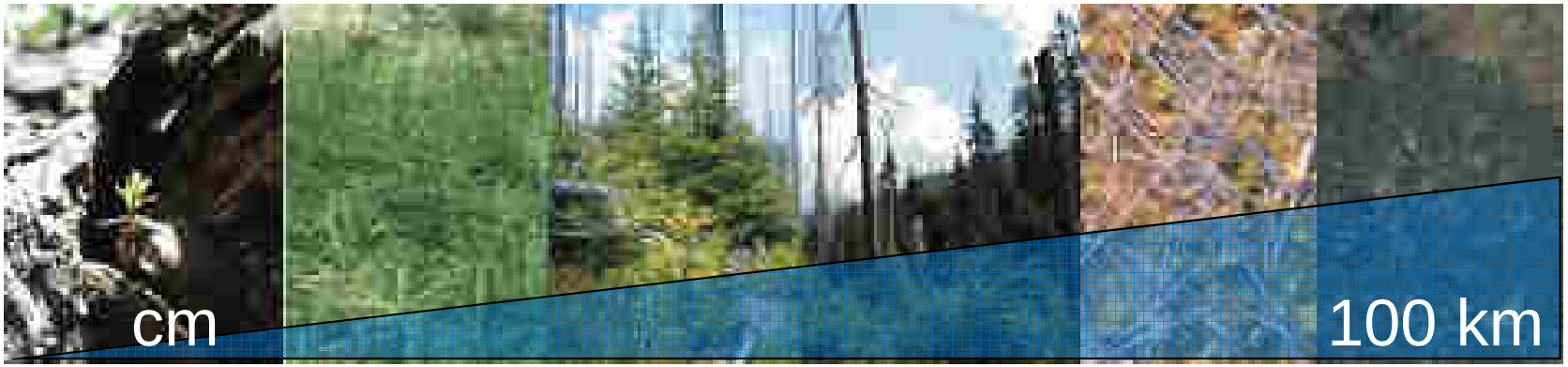
Thorsten Zeppenfeld

Nationalpark Bayerischer Wald

Background

Scales of Regeneration

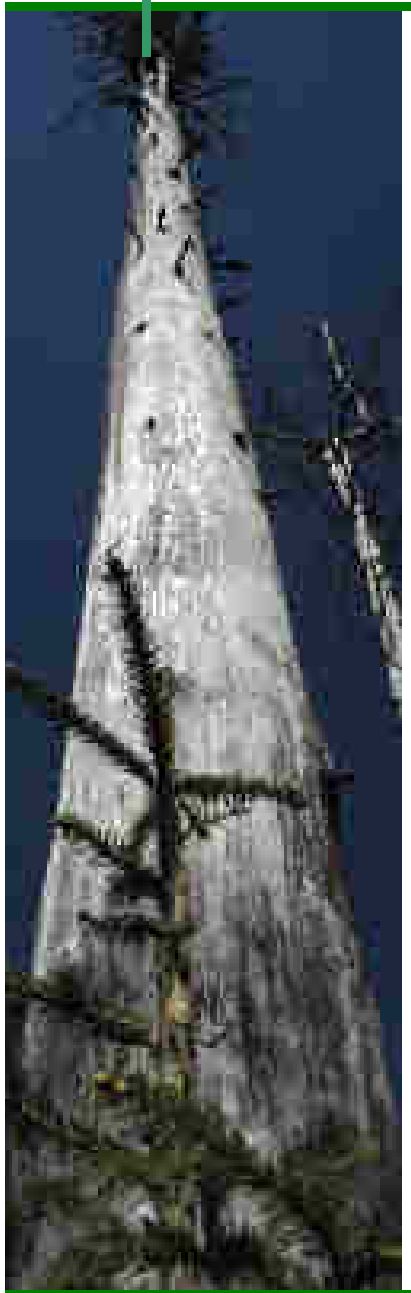
Space



(Micro-) Site — Landscape

Time

Aims



Regeneration response on landscape scale

Species composition and density

Is there natural regeneration and which species are involved?

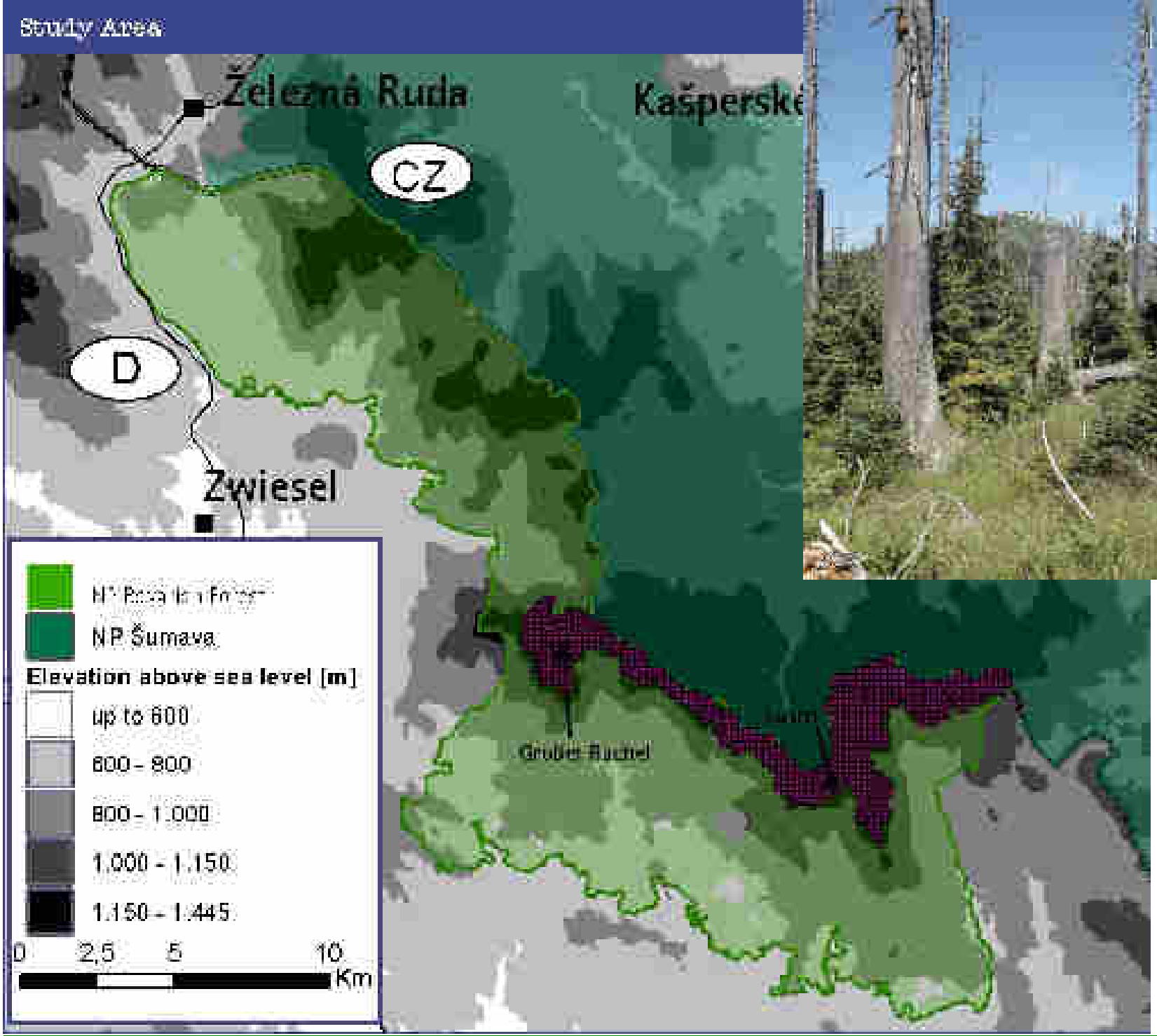
Density in **space** and **time:**

Is there a general spatio-temporal effect on regeneration?

Methods: Data

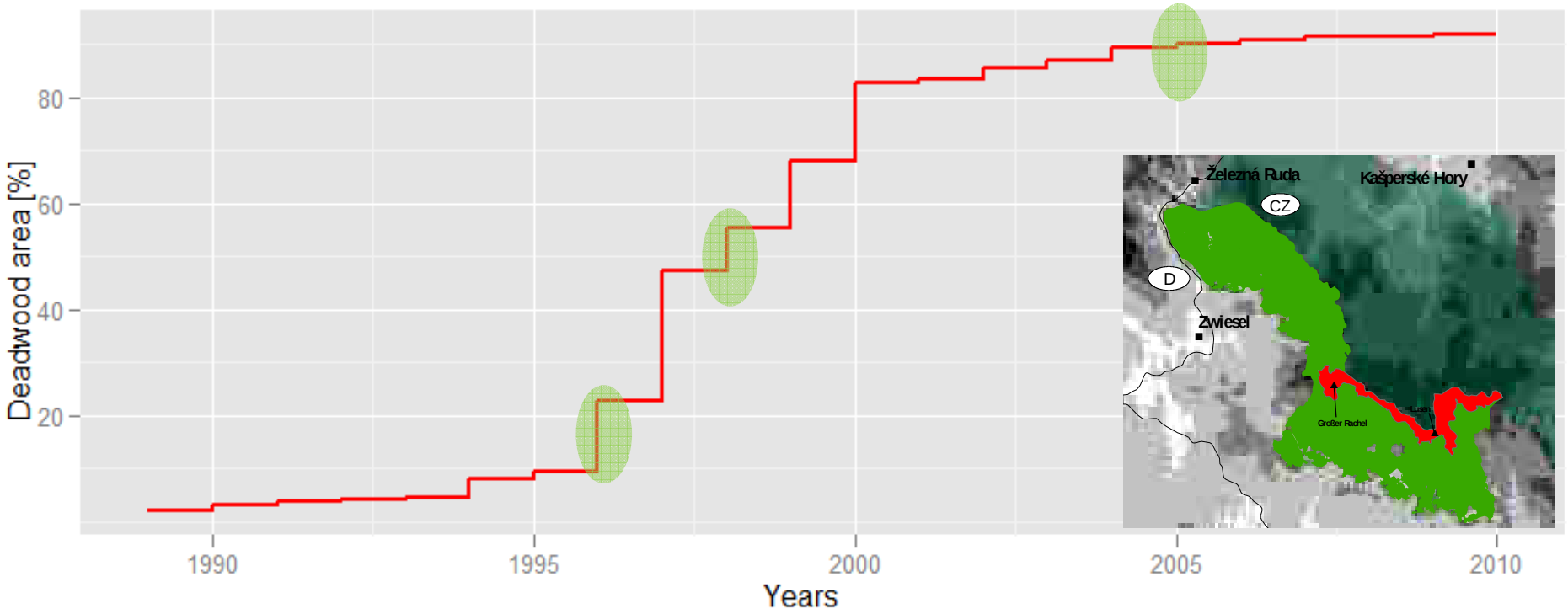
	Regenerations' Response	Space	Time
HOW	**Inventory data**	Sampling Design	Aerial Photogrammetry
WHEN	1991,1996,1998,2000, 2002,2005,2011		Since 1988, annual
WHERE	Upper montane spruce forest	572 Plots Area of 2300 ha	
WHAT	Trees 10 – 500 cm		Deadwood area
DATA	**Density of trees**	**Easting & Northing**	**Age since Infestation**

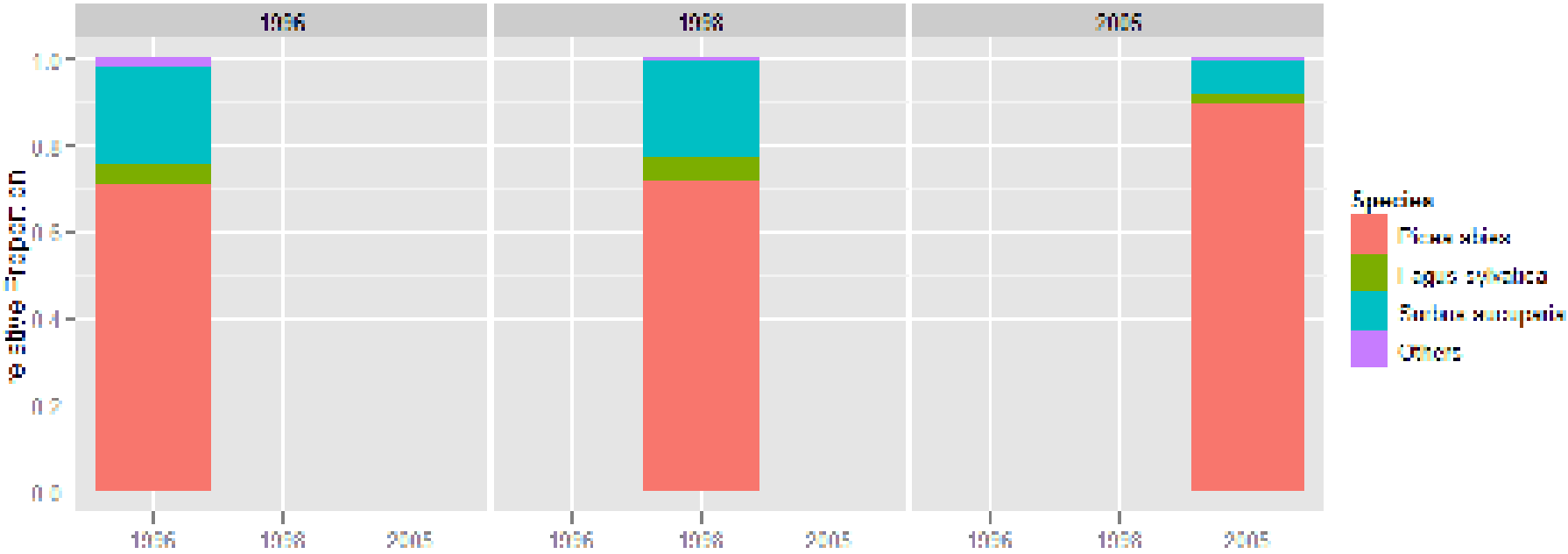
Study Area


Železná Ruda
Kašperské
CZ
D
Zwiesel
N.P. Šumava
Elevation above sea level [m]
up to 600
600 - 800
800 - 1.000
1.000 - 1.150
1.150 - 1.445
0
2,5
5
10
Km

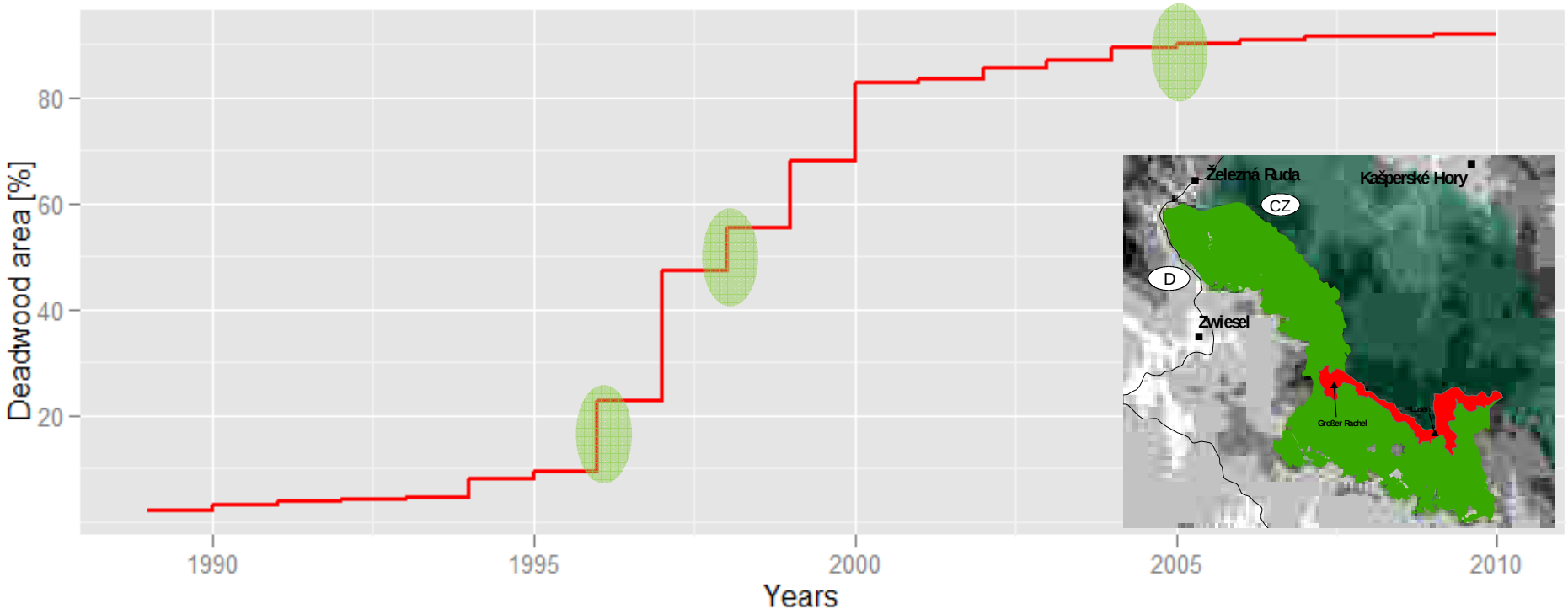
Results

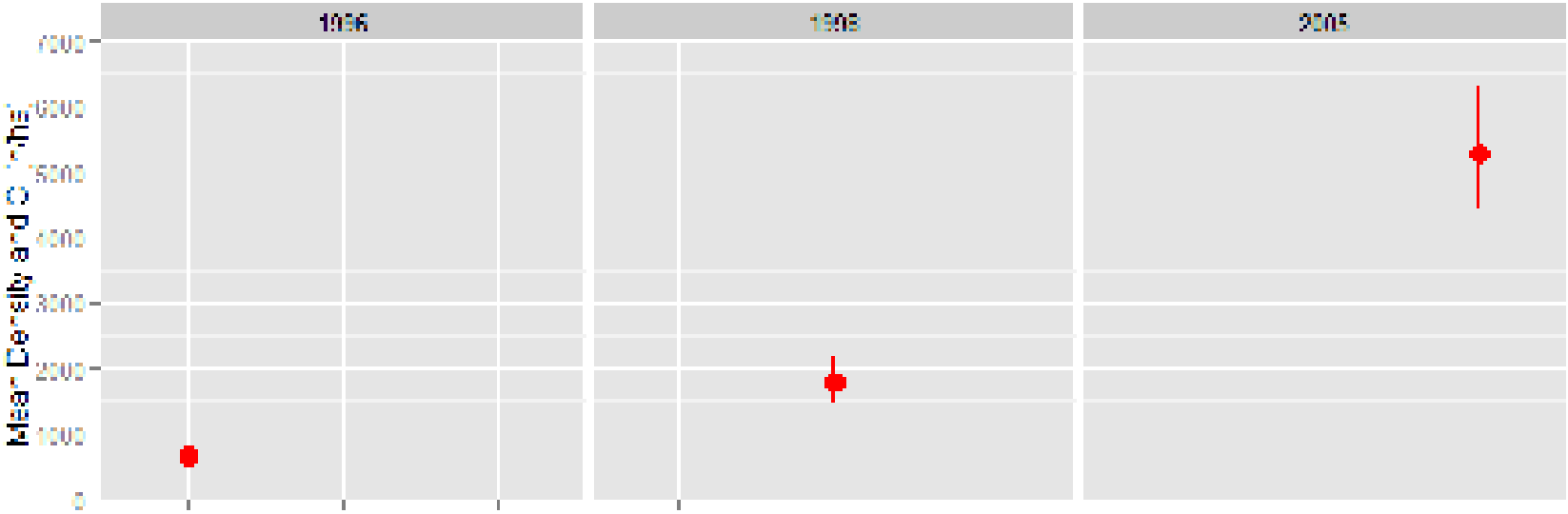
Species Composition & Density



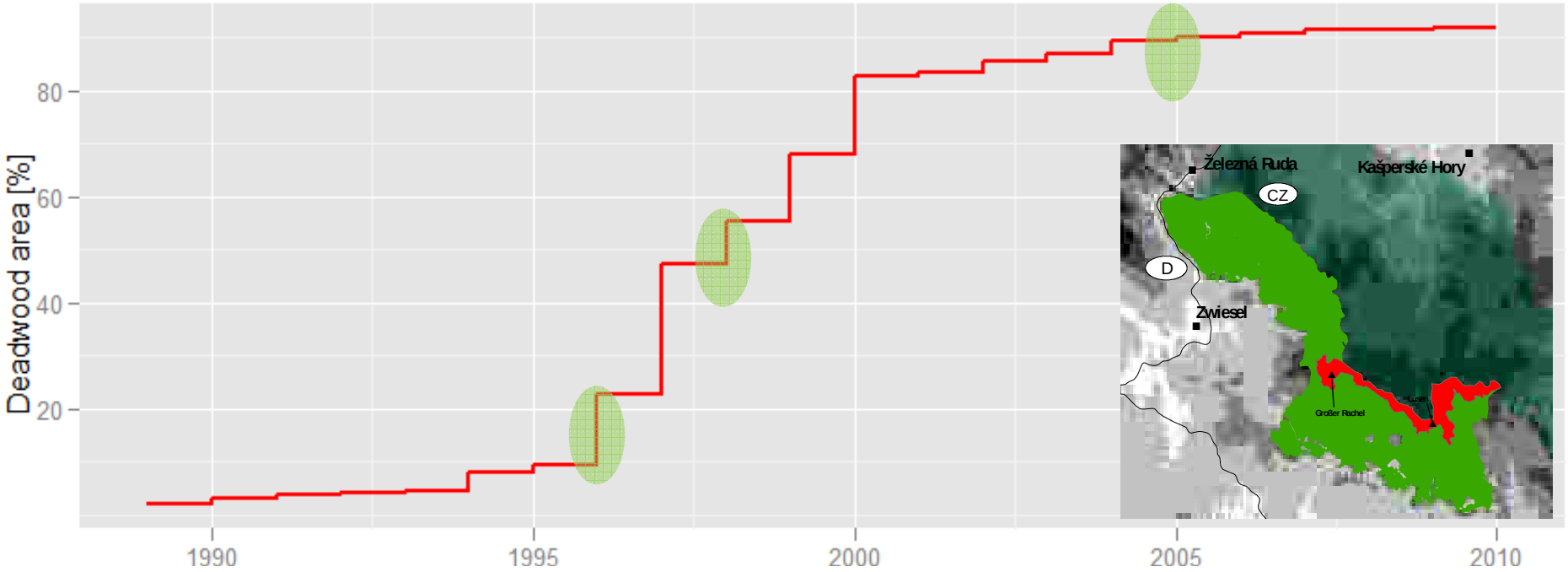


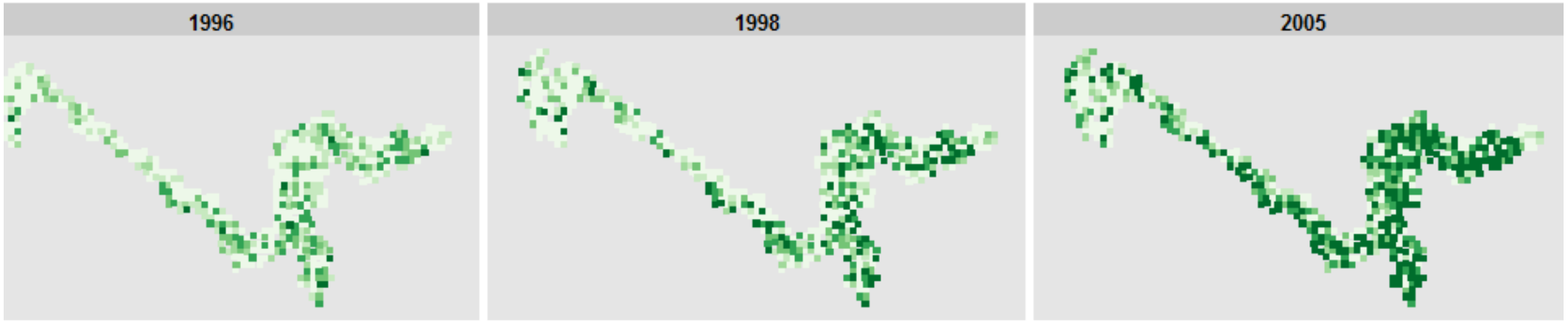
Species composition





Regeneration Density





Trees per hectar

0 | 1-499 | 500-999 | 1000-1999 | 2000-4000 | 4001 and more

Spatial distribution of Regeneration Density

Effects of Space and Time

Results: Effect of Space & Time

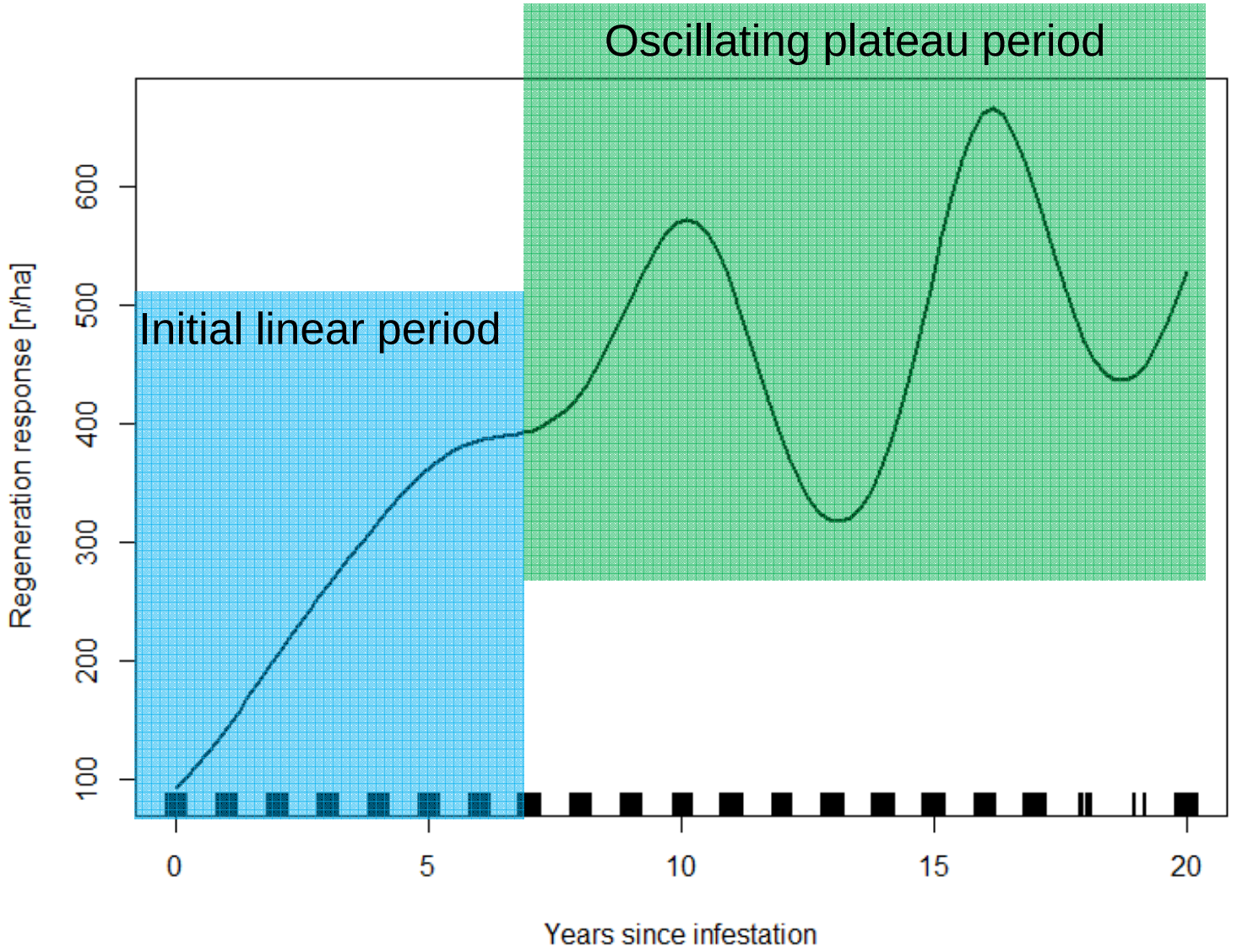
Data:

Regeneration density = **Koordinates** + **Age since infestation**

Model:

Regeneration response = **Space-effect** + **Time effect** + **Random effects**

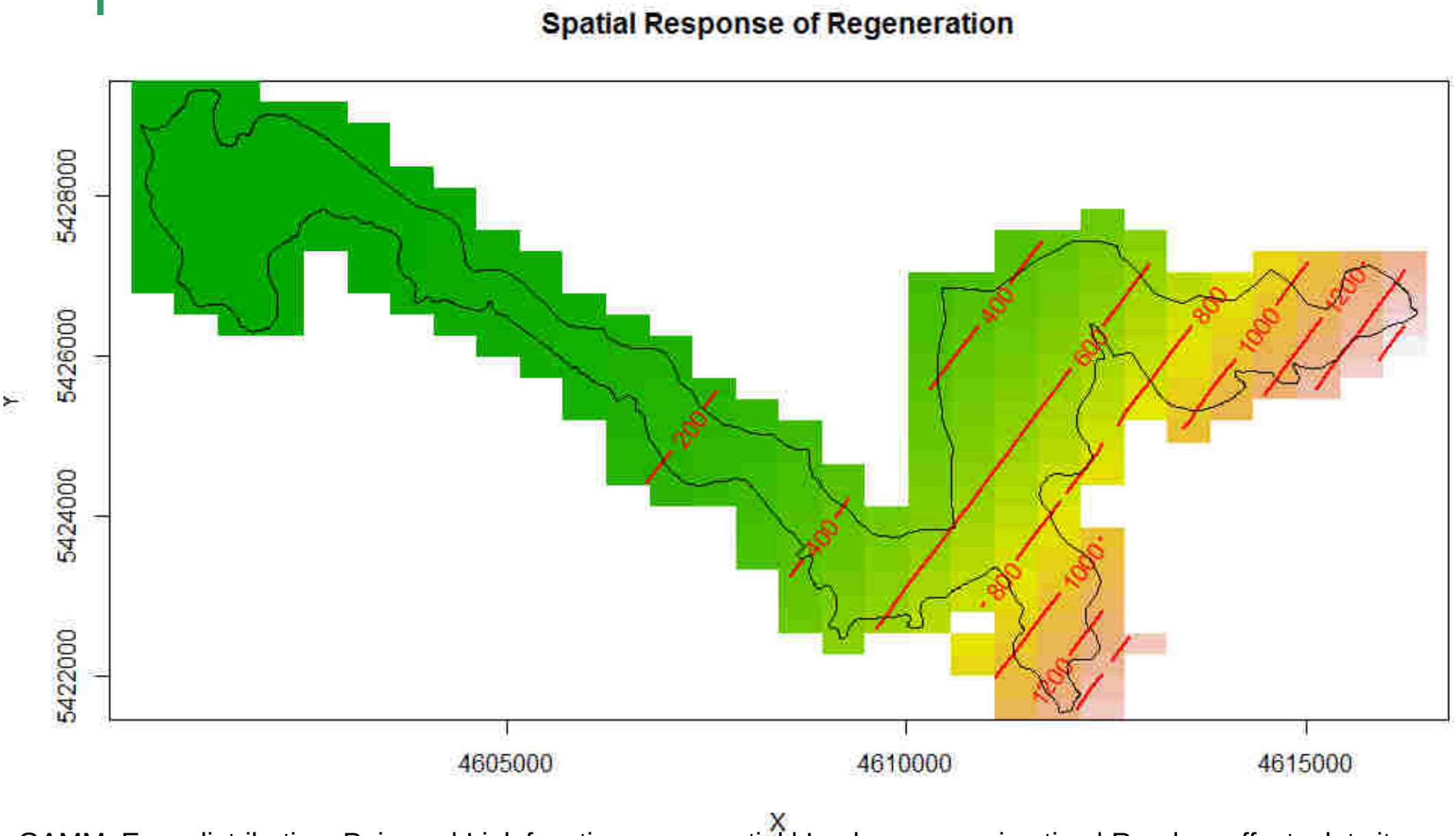
Results: Time



GAMM: Error distribution: Poisson | Link function: exponential | Laplace approximation | Random effect: plot site

Regeneration Density = smoothed temporal Effect + random Site Effect

Results: Space



GAMM: Error distribution: Poisson | Link function: exponential | Laplace approximation | Random effect: plot site

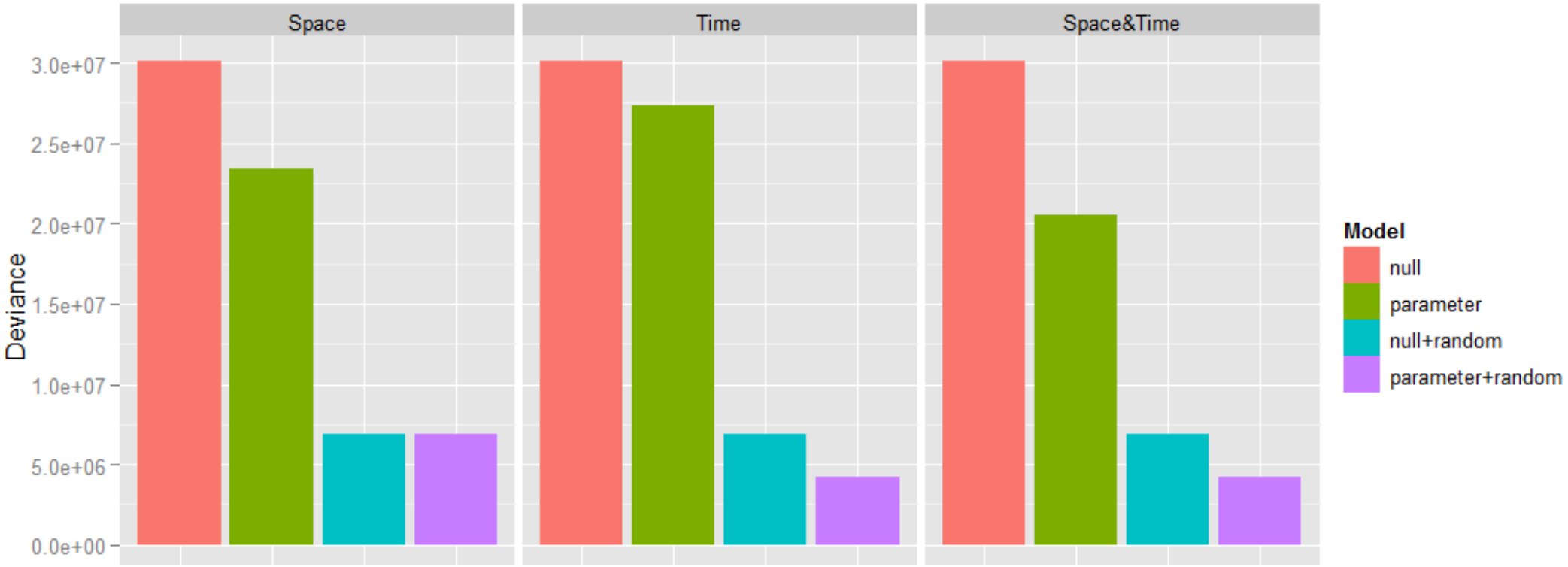
Regeneration Density = smoothed Spatial Effect + random Site Effect

Results: random effects

Random effects of each sampling site contain:

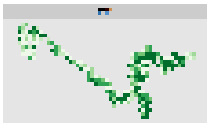
- coincidence (*e.g.* seed occurence)

- site specific factors: *e.g.* deadwood structures



Conclusions

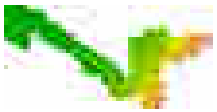
Is there natural regeneration and which species are involved?



Yes, there is regeneration!

Spruce is dominating and there is little species turnover

Is there a general spatio-temporal effect on regeneration?



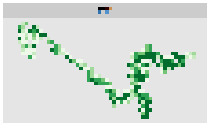
Space: - SE-NW Orientation

Time: - increases initally and reaches a plateau

Underlying Effects of Space & Time on regeneration are massively superimposed by random effects

Conclusions

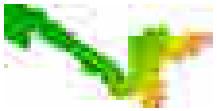
Je zde přirozené zmlazení a jaké je jeho druhové složení?



Ano, je zde přirozené zmlazení!

Smrk dominuje a je zde malá změna druhové skladby

Existují obecné zákonitosti obnovy v prostoru a čase?



prosotorově: JV - SZ orientace

časově: zpočátku roste postupně se ustálí

časová a prostorová struktura obnovy je zásadně ovlivňována okrajovými efekty.

PRAHA, 07.12.2011

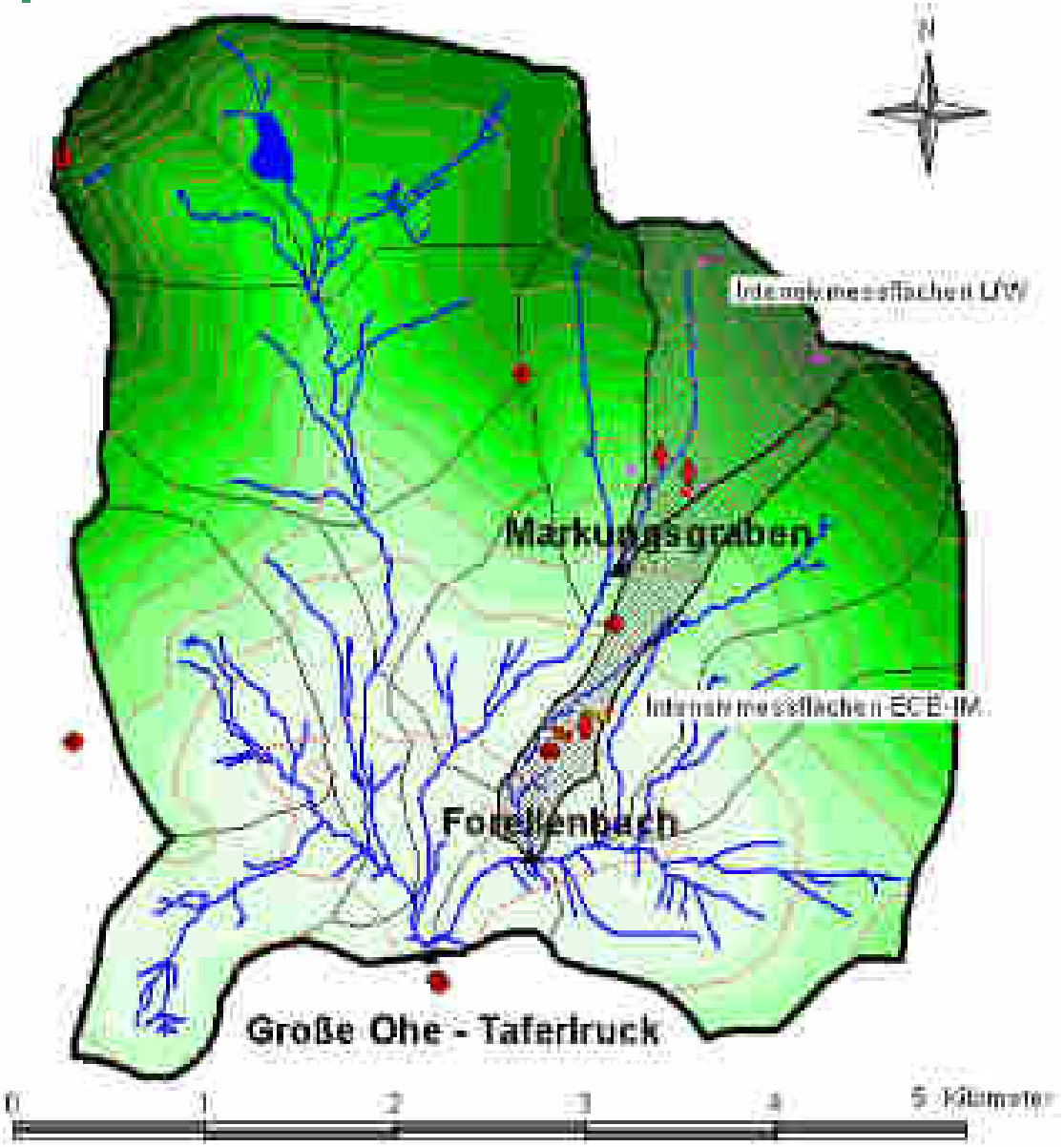
How severe does bark beetle outbreak affect ecosystem services ??

Burkhard Beudert

Nationalpark Bayerischer Wald

Contents

Sites and Methods



Markungsgraben

Monitoring on Air Pollution Effects on Groundwater Quality

Bavarian Environment Agency, NPA
(1989, 1.1 km²)

Forellenbach

UN/ECE ICP Integrated Monitoring on Air Pollution and Climate Change Effects on Ecosystems

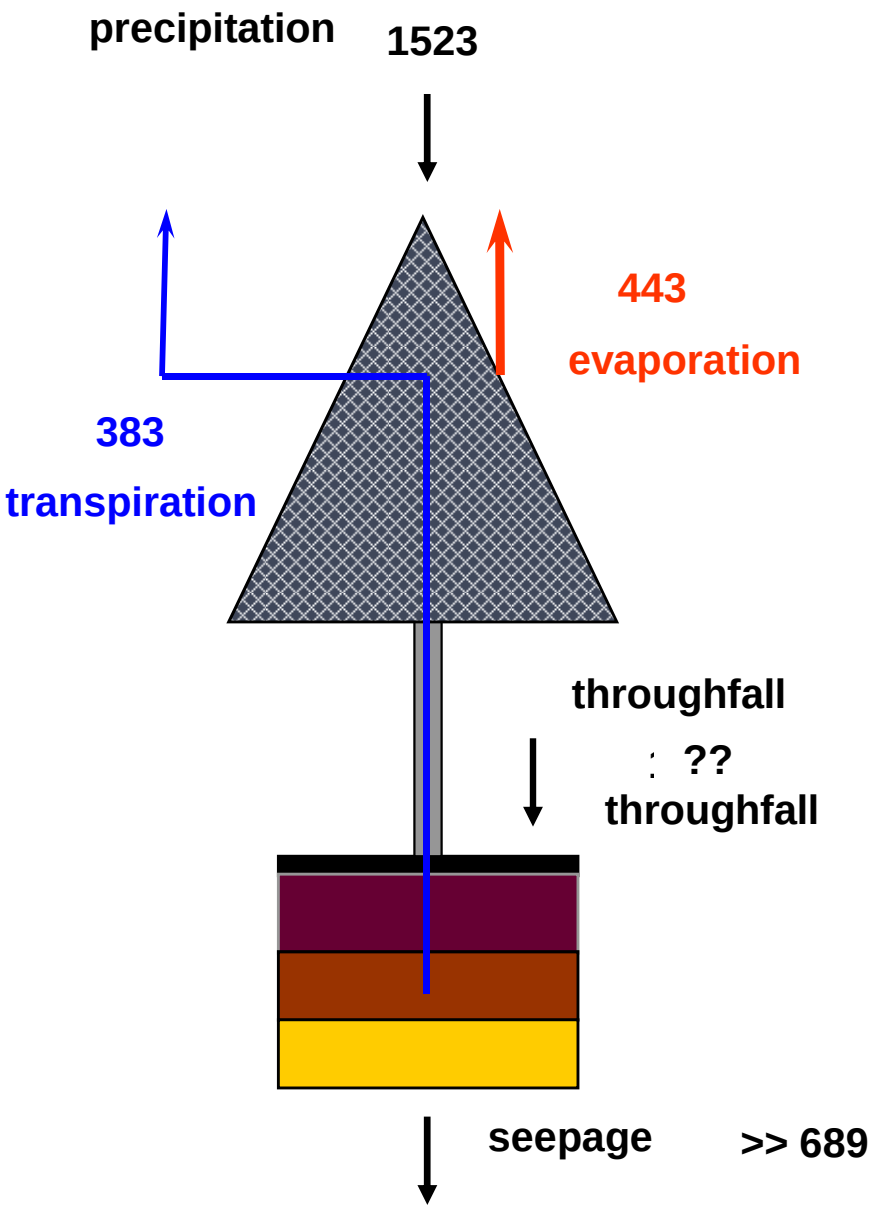
Federal Environment Agency, NPA
(1990, 0.7 km²)

Große Ohe

Monitoring on Changes in Water Cycling during Transition from managed to natural Forest

research cooperation, NPA
(1978, 19.1 km²)

Hydrological processes and balances



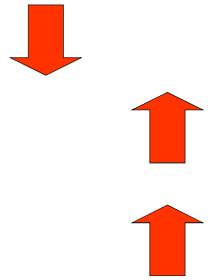
Water cycle (mm/a) of a low elevation spruce plot (810 m a.s.l, Ø 1992-1995)

After the dieback:

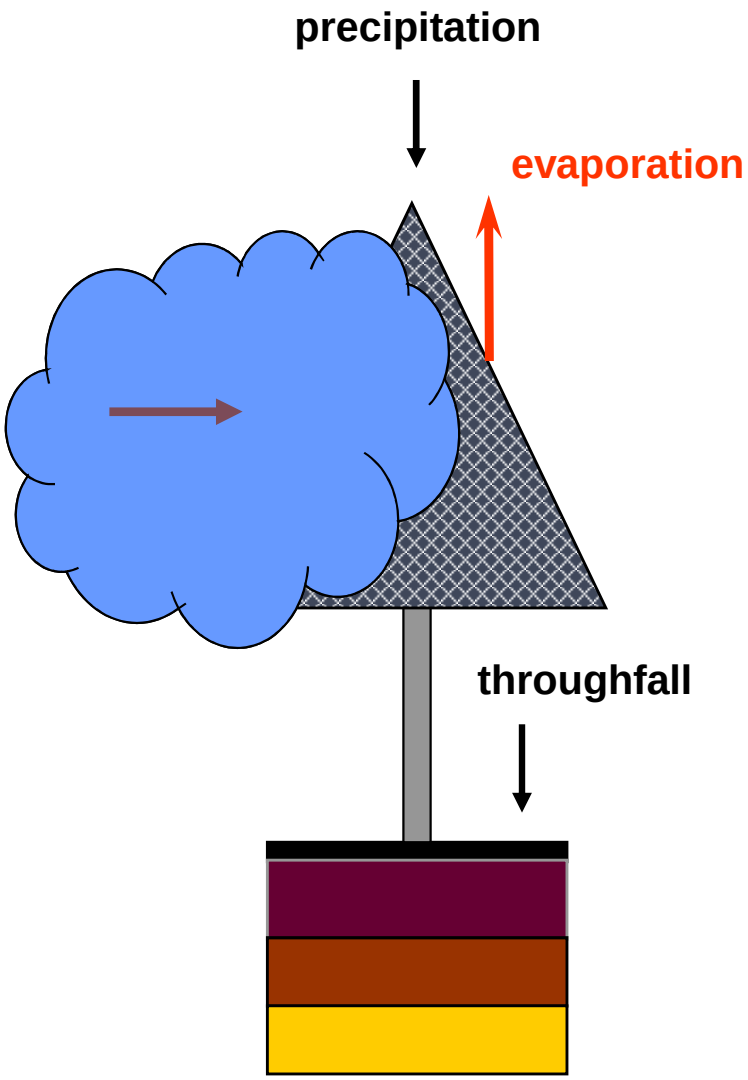
evapotranspiration

„stand precipitation“

seepage



Hydrological processes and balances



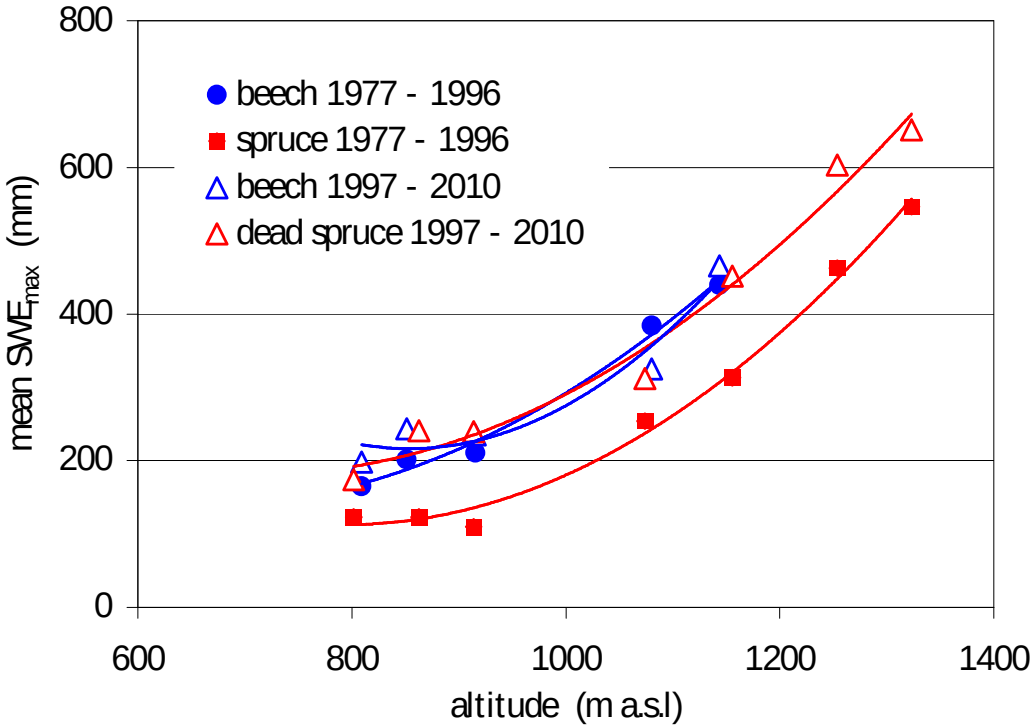
Water cycle (mm/a) of high elevation spruce plots (> 1200 m a.s.l)

cloudwater (C) = throughfall (TF) − precipitation (P) + evaporation (E)

local		TF - P	E	C
1991-1996:	810 m a.s.l.	-443	443	
1999-2001:	800 m a.s.l.	-292	292	
2006-2009:	785 m a.s.l.	-529	529	
1992:	1300 m a.s.l.	-180		120
1989:	1215 m a.s.l.	-142	300	158
1988:	1203 m a.s.l	+ 87		387

Hydrological processes and balances

Snow cover dynamics (aboveground water store)



Until 1996 average maxima of water stores in snow cover had been higher under beech than under spruce at comparable altitude.

Since 1997 mature spruce stands on measuring sites are dead.
Mean maxima of snow water equivalents are now equal to those under beech.

The changes in vegetation cover influence snow cover dynamics (build-up, melting) and probably alter runoff dynamics in spring.

Hydrological processes and balances

Trend analysis of annual statistics of daily discharge (mm/day)

	exceeedance	Große Ohe (1992-2010)	Forellenbach (1992-2010)	Markungsgraben (1992-2008)
low flow	95%			0.04
	90%			0.04
year	50%			
	10%	0.16		
high flow	5%	0.21		
low flow	95%			0.05
	90%			0.04
winter	50%			
	10%	0.26		0.39
high flow	5%	0.28	0.23	0.47
low flow	95%	0.02		**0.05**
	90%	0.02		**0.05**
summer	50%	0.04	0.04	0.06
	10%			
high flow	5%			

High flow discharges (10% - 5% exceedance) has been increasing in all streams ($p < 0.05$), but only in winter.
There‘s no increase in flood peak

Mean flow discharges (50%) has been increasing in all streams ($p < 0.01$), but only in summer.

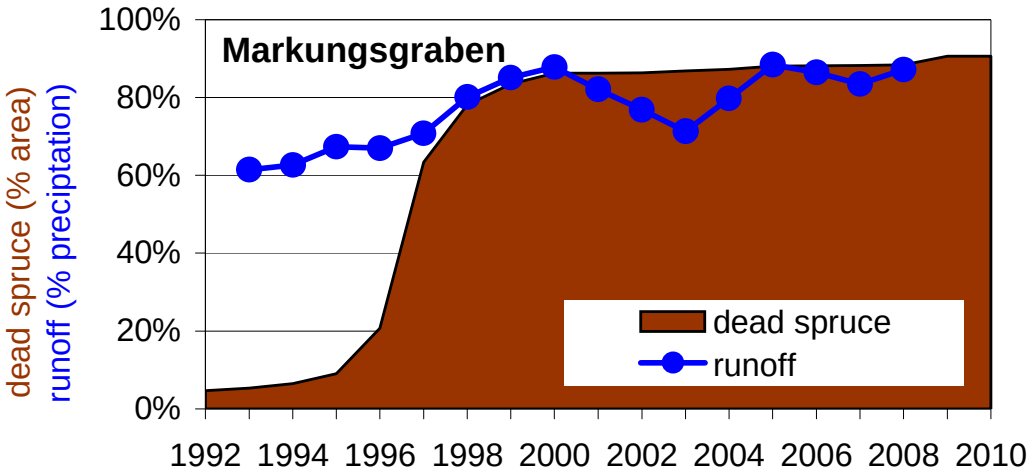
Low flow discharges (95% - 90% exceedance) has been increasing during summer in Große Ohe and most distinctive in Markungsgraben ($p < 0.001$).

During initial regeneration phase evapotranspiration on dead spruce stands is reduced compared to vital stands, enabling higher rates of groundwater recharge and thus higher low flow during summer.

Changes in high flow during winter only are probably related to changes in snow cover dynamics.

Hydrological processes and balances

Vegetation cover changes and catchment water balances

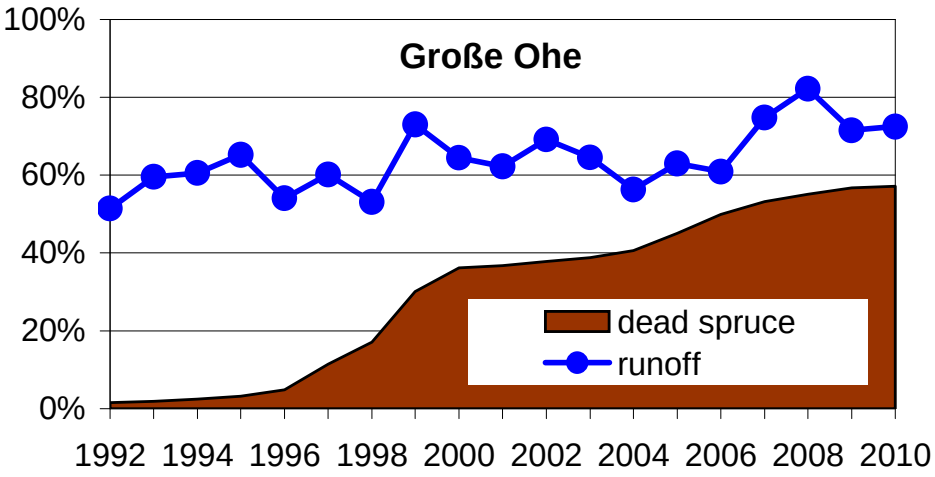


Killled spruce stands increased in the high elevation **Markungsgraben** catchment from < 10% (1995) to > 60% (1997) and to > 80% (1998).

evapotranspiration decreased
and
catchment runoff increased

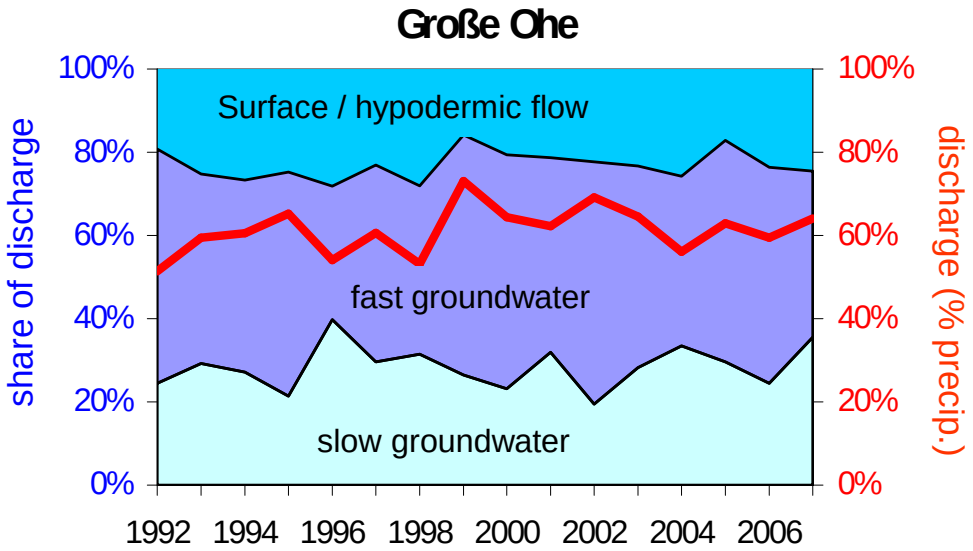
In the superordinate **Große Ohe** catchment dieback of spruce stands and hydrological effects proceeded more slowly.

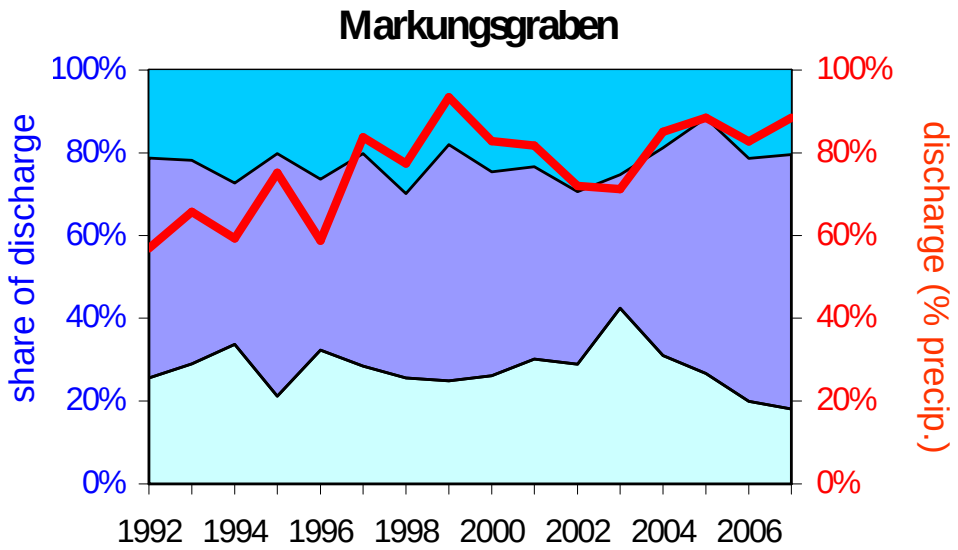
The onset of runoff reaction (> 25% area) was equal to the other catchments, but size and duration were small and damped, illustrating scale effects.



Hydrological processes and balances

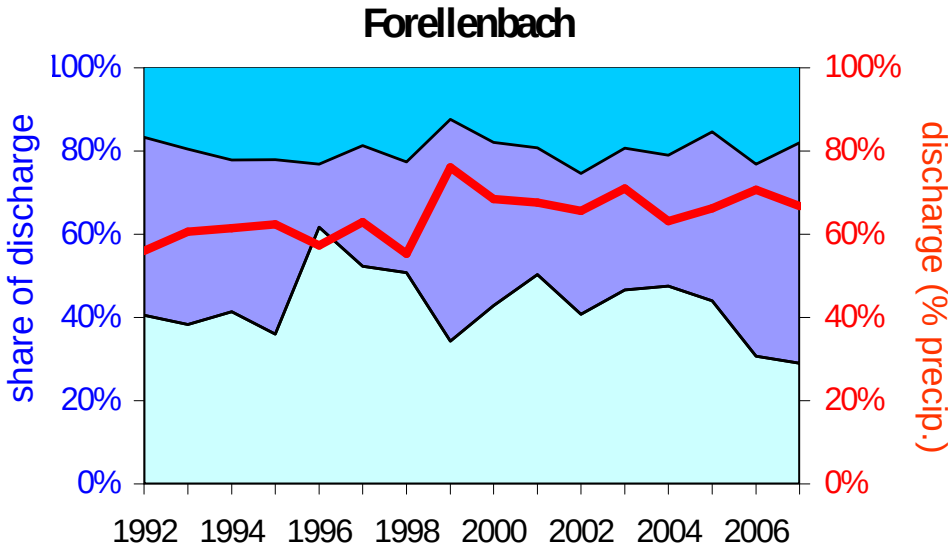
runoff generation





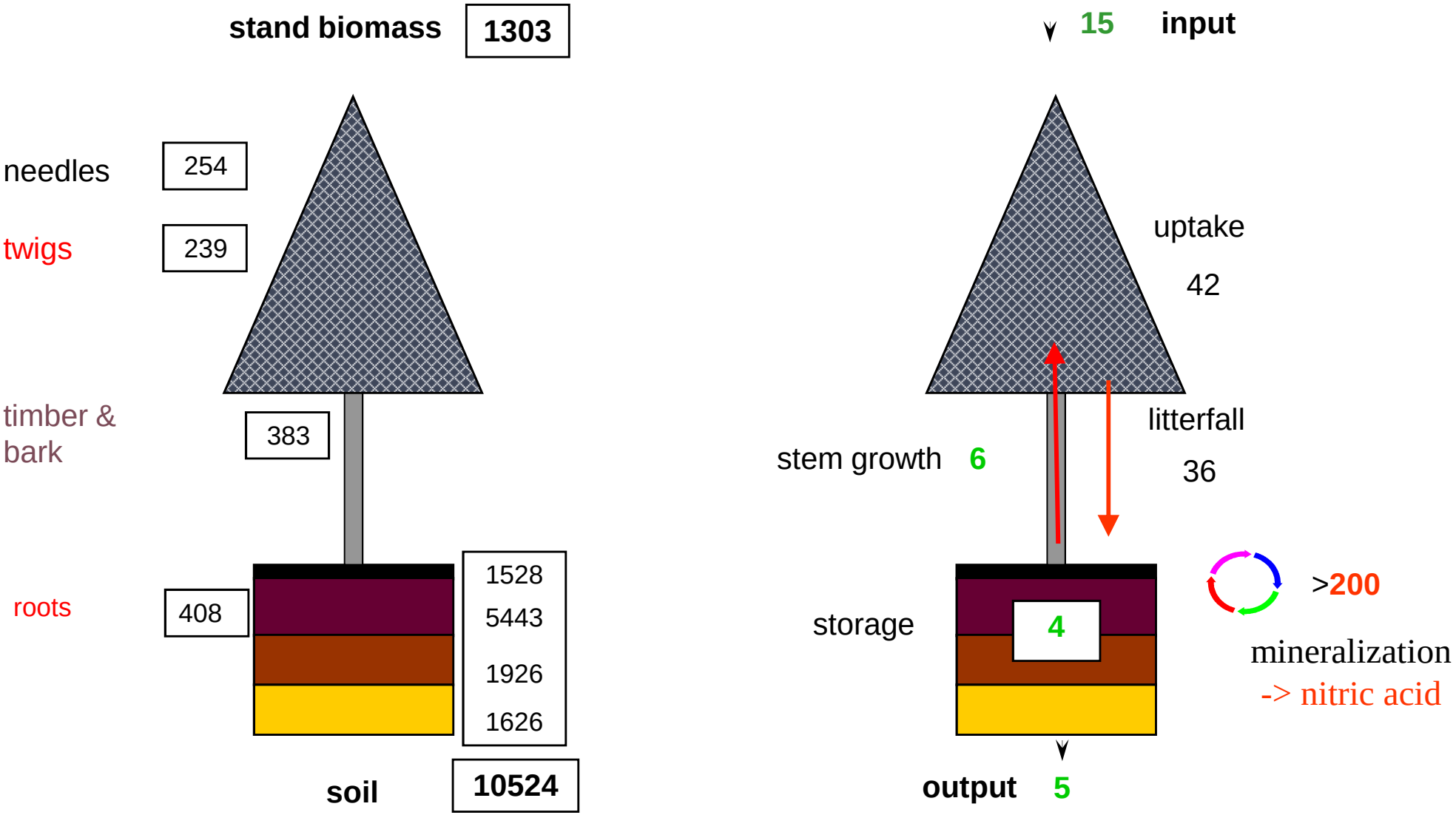
Annual discharge has been increased due to changes in vegetation cover,
but contributions of different runoff generation processes remained the same:

surface and hypodermic flow 20%,
groundwater flow 80% with catchment specific contributions of the slow and fast component.



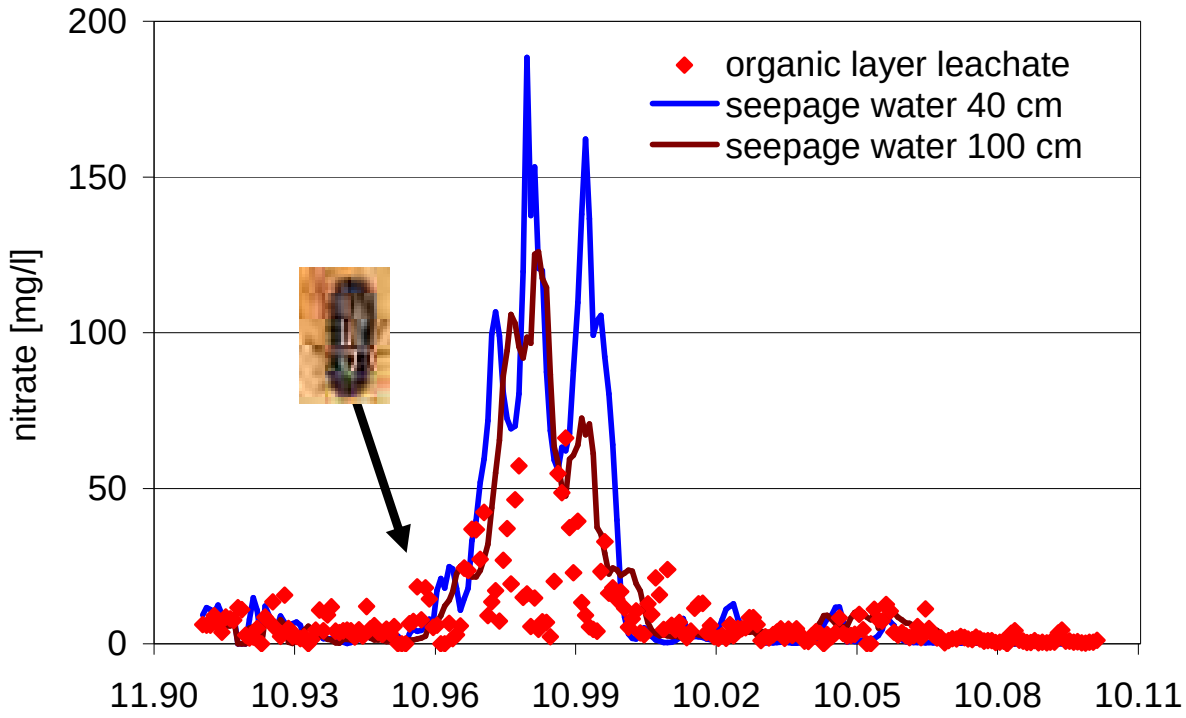
Biochemical processes and element fluxes

nitrogen pools and annual fluxes on spruce plot (kg/ha)



Biochemical processes and element fluxes

Excess mineralization



Already two months after bark beetle induced dieback in harvest 1996 nitrate concentrations began to increase in the organic layer percolate.

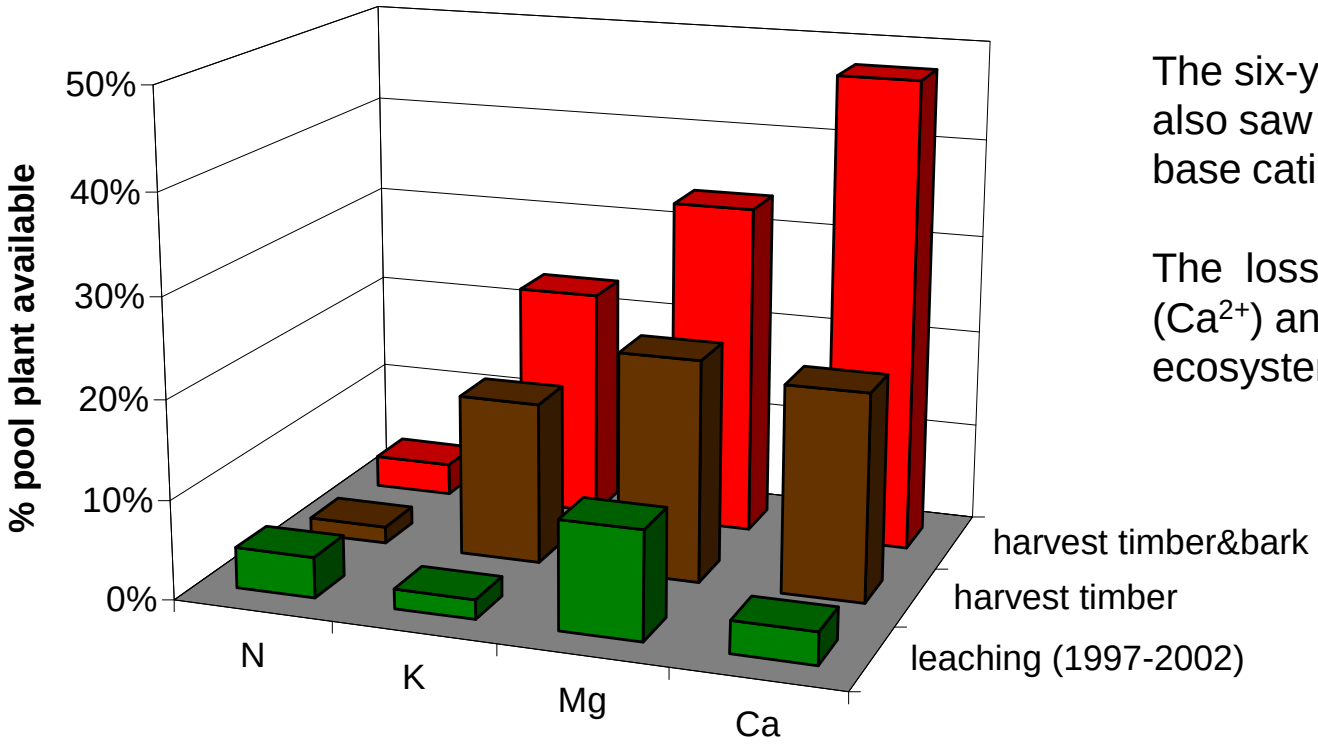
Highest concentrations occurred in mineral soil water in 40 cm (~ 200 mg/l) and 100 cm depth (125 mg/l).

The acid produced during nitrification was partly buffered by the release of aluminum ions in the soil.

Consumption of acidity has been occurring in the aquifer by mineral weathering, releasing base cations
Concentrations of aluminum ions in groundwater has not been increased.

Biochemical processes and element fluxes

Base cation issues



The six-year-period of excess mineralization also saw an increase in losses of nutritional base cations via seepage.

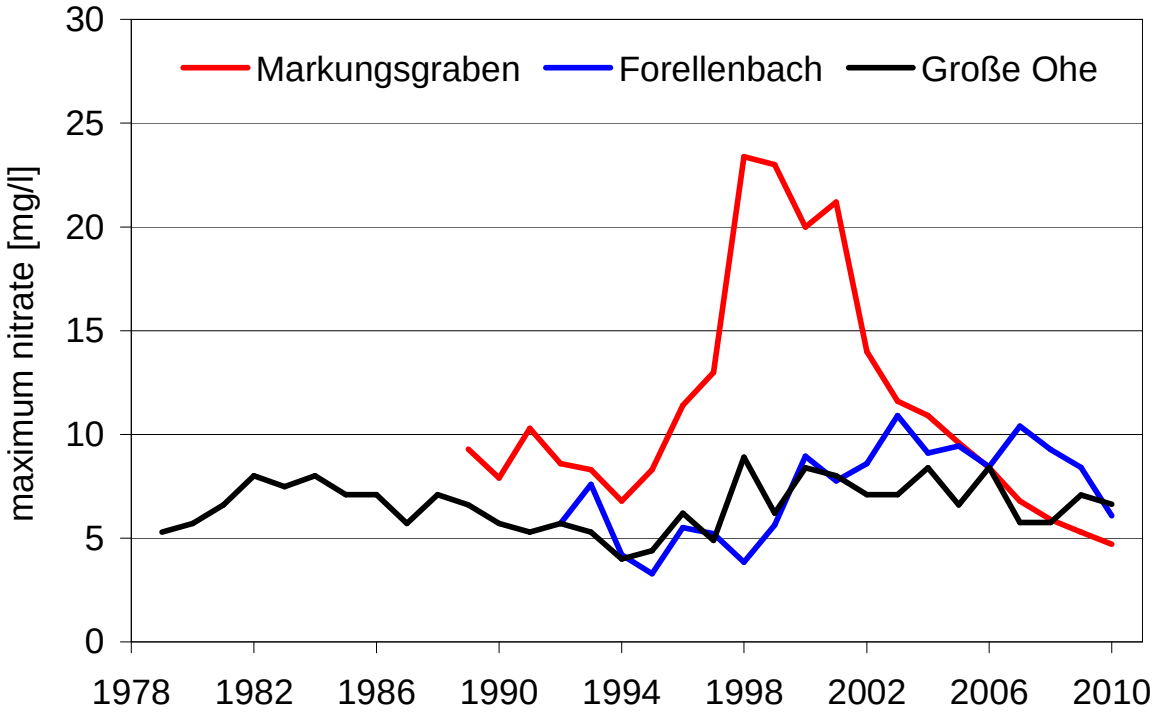
The losses accounted for 2% (K^+), 3% (Ca^{2+}) and 11% (Mg^{2+}) of plant available ecosystem pools.

The dieback induced losses of base cations were much less than the export via biomass harvest.

This holds true for the harvest of timber only, which is considered to be sustainable use.

Biochemical processes and element fluxes

Following the nitrate signal through the catchments



Nitrate in fast flowing groundwater reached only 10% of maximum soil water concentrations, slow flowing groundwater only 5%.

Seepage water from vital forest stands (mixing effect), the spatiotemporal distribution of killed stands and the short duration of excess nitrification result in very diluted concentrations in groundwater and finally in streamwater.

Markungsgraben exhibited comparatively high nitrate concentrations for some years.

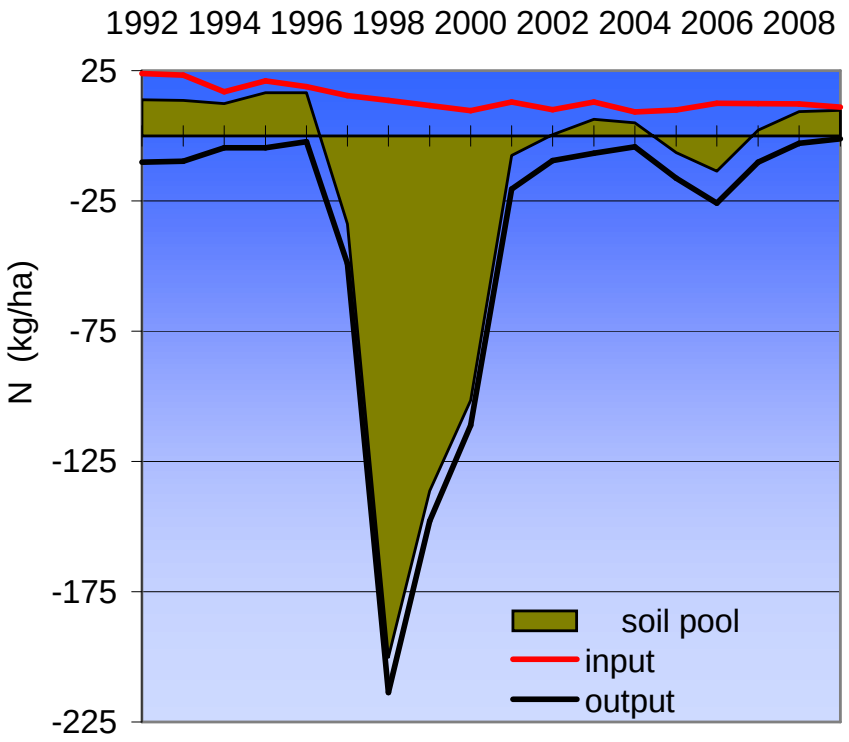
Forellenbach and Große Ohe reached maximum concentrations from 7 to 10 mg/l (~1980s)

Excess nitrification is finished on catchment scale (Markungsgraben, Forellenbach).

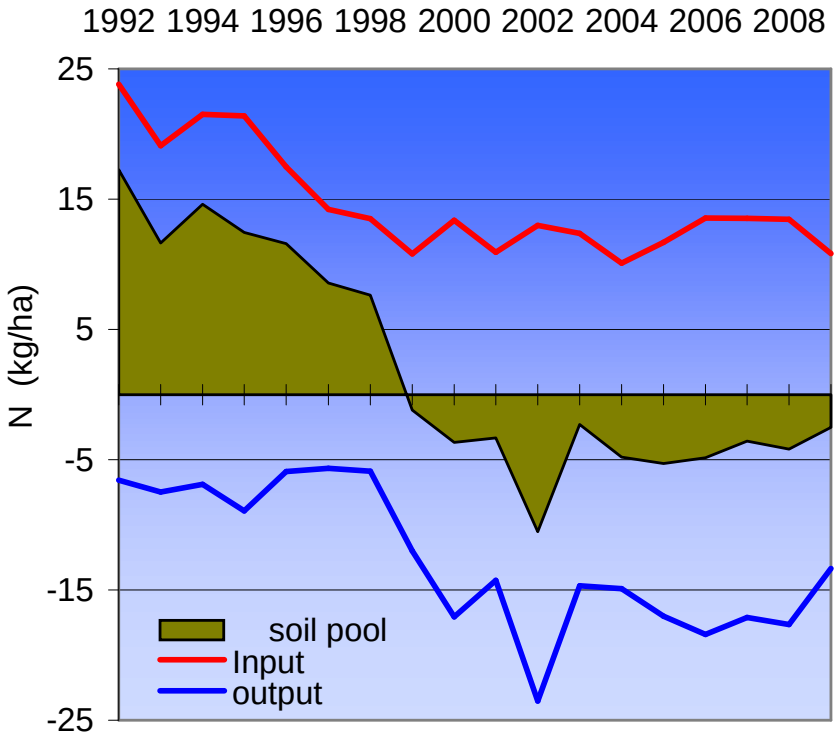
Biochemical processes and element fluxes

Nitrogen budgets

spruce plot



Forellenbach catchment



Net nitrate losses reached > 200 kg N/ha/a and ~ 500 kg N/ha during 5 years following dieback.

The system seems to balance since 2002 and quite recently to get back its sink funktion.

By 1999 the catchment has turned from net sink to net source of nitrogen.

The stream output rates are quite stable, since groundwater is the prominent source of nitrate.

Conclusions

Bark beetle outbreak and follow-up processes affect ecosystem services

- Leaf and surface area index decrease substantially, reducing roughness of vegetation cover and thus interception of airborne substances and water
- Evapotranspiration in summer half year is therefore reduced, increasing the amount of seepage water and the recharge of groundwater
- Low flow characteristics change to higher discharges in summer esp., demonstrating that the quantity of groundwater remains constant at least
- High flow characteristics change to higher discharges in winter only, but flood crest didn‘t increase
- Quality of useable water is altered (enriched in nitrate and base cations), but fulfills all requirements for human nutrition (German laws, WHO)

These effects are due to natural disturbances only, lasting for 10 – 30 years

(until young and dense tree stands will be established on catchment scale)

Why should we aggravate these outcomes by management intervention in a National Park ???

hlavní ponaučení

Kůrovcová kalamita a následné procesy ovlivňují "ekosystémové služby"

- index olistění a plochy pokryvu výrazně klesá, "hrubost" rostlinného pokryvu se snižuje a tím i intercepce vody a látek přenášených vzduchem.
- Důsledkem toho je evapotranspirace v letní polovině roku snížena, roste množství vsakující se vody, hladina podzemní vody se rychleji obnovuje
- charakter nízkých stavů vody se mění, zvláště v létě, ve prospěch vyšších průtoků, což ukazuje, že množství podzemní vody zůstává přinejmenším stále stejné
- charakter vysokých stavů vody se mění ve prospěch vyšších průtoků pouze v zimě, ale kulminační výška hladiny za povodní se nezvyšuje
- kvalita pitné vody se mění (obohacení o kationy dusíku a Ca, Mg, K), ale nadále splňuje nároky na lidskou výživu (německé zákony, WHO)

Tyto změny jsou pouze důsledkem přírodních disturbancí a trvají 10 - 30 let

(dokud se mladé a husté porosty dřevin neuchytí plošně na úrovni povodí)

Jsou tyto výsledky tak znepokojující, že je nutné hospodářsky zasáhnout v Národním parku ???

PRAHA, 07.12.2011

Natural Disturbances and Biodiversity

Jörg Müller

Nationalpark Bayerischer Wald

The influence of disturbance on biodiversity

Is this an ecological desert?

Aims

To test the …

influence of disturbance on the diversity of habitats

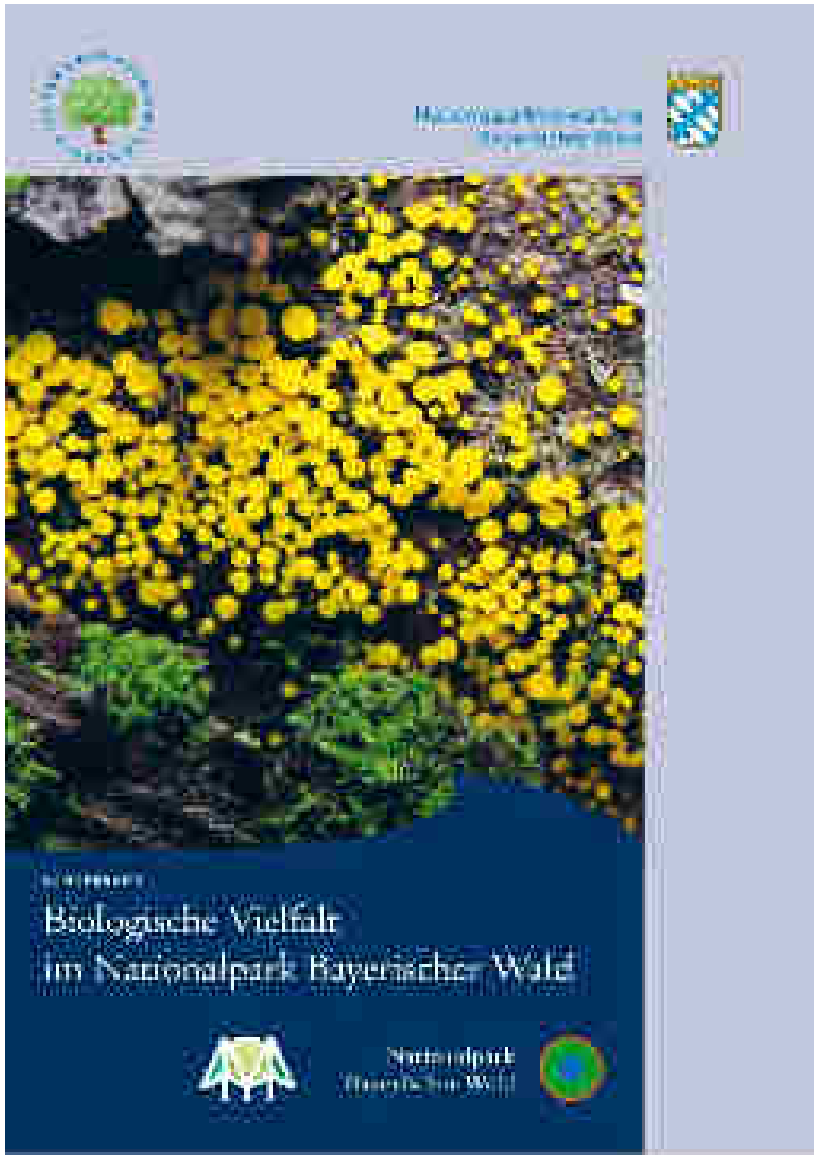
influence of disturbance on the diversity of species

and

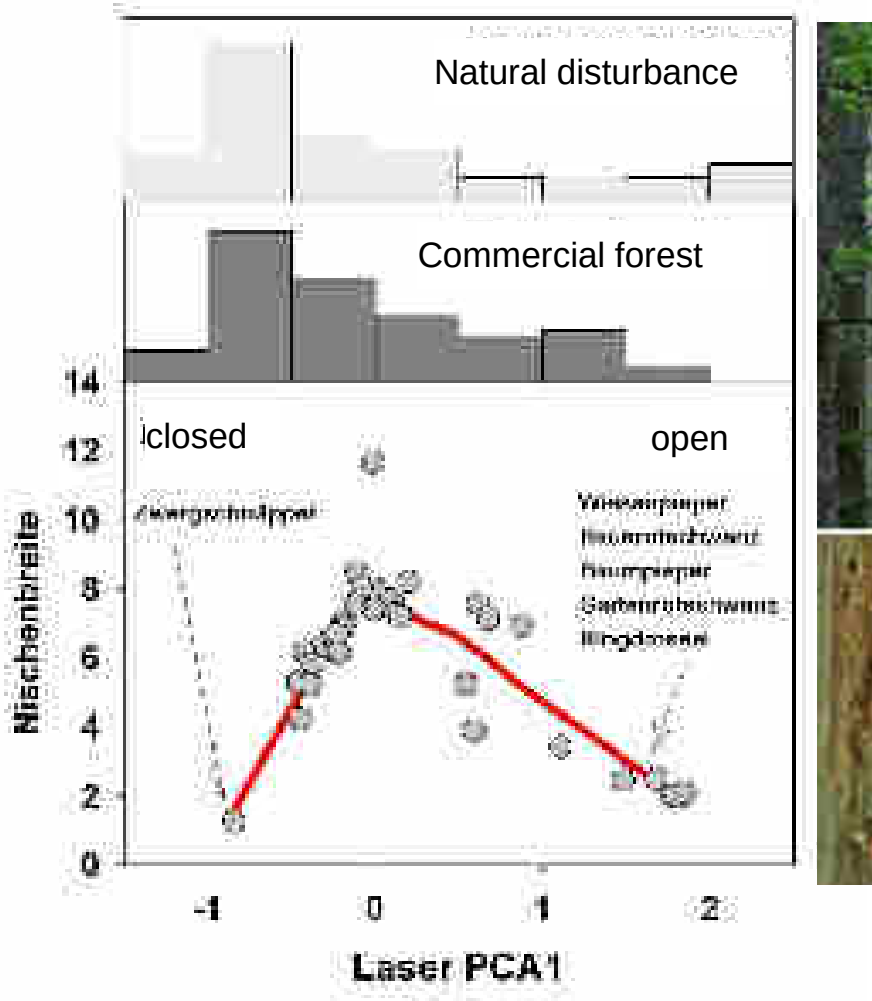
implications from winners and losers

Methods

- Standardized sampling across forest stands with different degree of disturbance (24 taxonomical groups)
- Measurement of canopy openness by disturbance with lidar
- Species richness, diversity and community analysis



Results: Diversity of habitats



Moning & Müller (2008) Forest Ecology and Management
Müller et al (2010) Remote Sensing of Environment

Results: Diversity of moths


Autographa jota

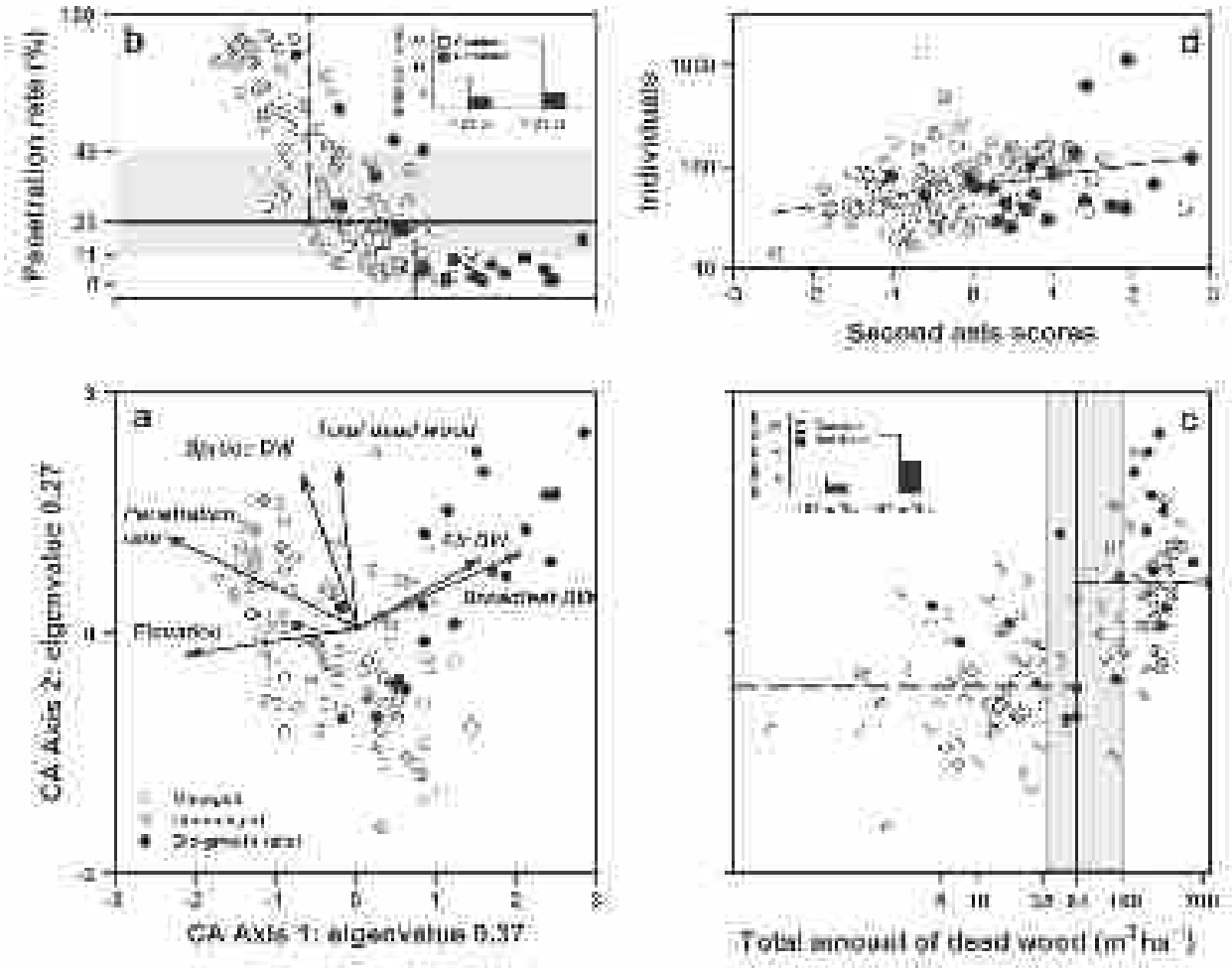

Coranarta cordigera

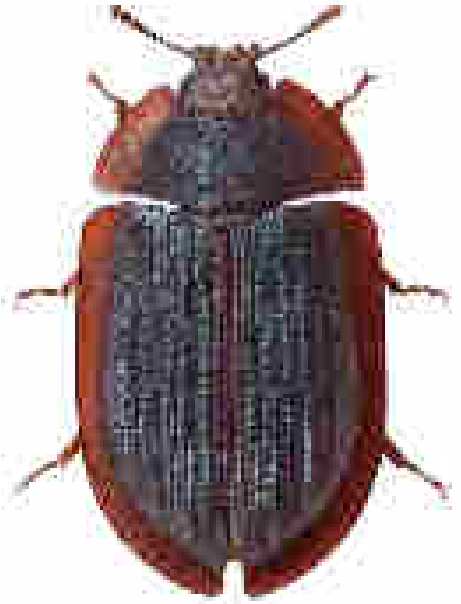

Arichanna melanaria

Results: Diversity of moths

Results: Diversity of saproxylic beetles

… most responsive to forest management (Brunet 2011)





Ostoma ferruginea

Müller et al (2008) Biodiversity and Conservation
Müller et al (2010) Biological Conservation

Results: Diversity of saproxylic beetles

The effect of canopy opening

Spruce specialists prefer open stands after disturbance, in the same way as the regeneration of spruce saplings

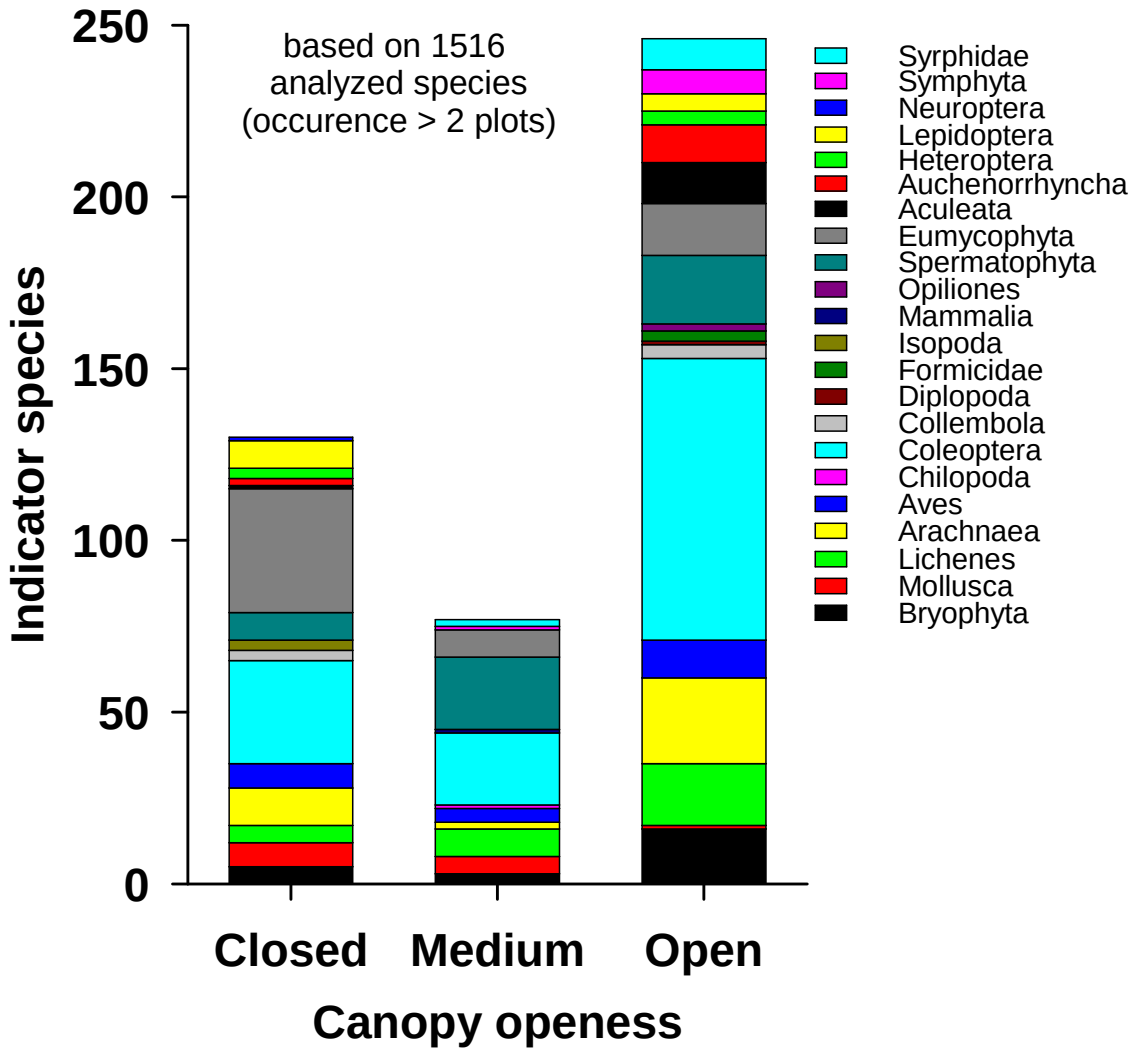
Judolia sexmaculata

Chrysobothris chrysostigma

Results: Diversity of lichens

Moning et al (2010) Forest Ecology and Managment
Bradtka et al (2011) Waldökologie Online

Results: Total diversity



Lehnert et al in prep.

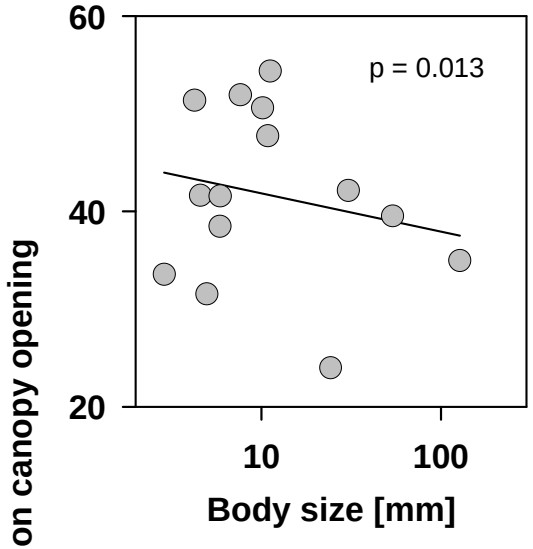
Results: The bark beetle as a keystone species

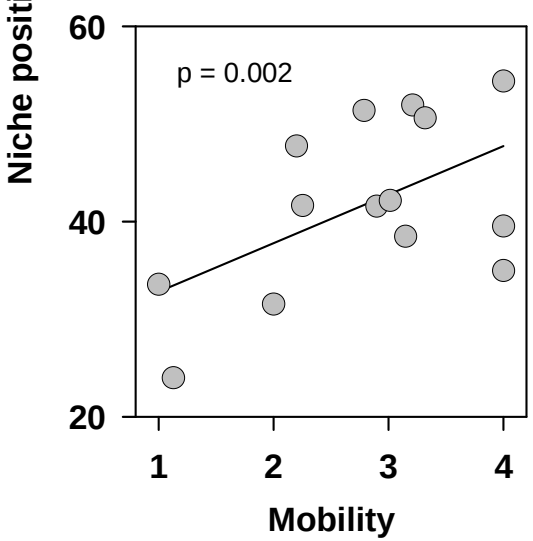
Müller et al (2008) Biodiversity and Conservation

Results: Management

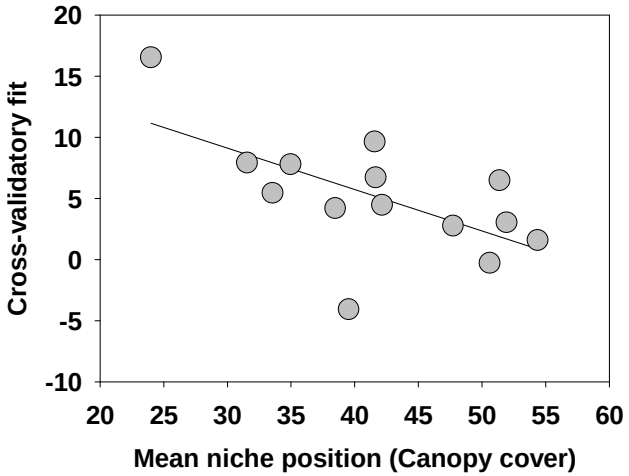
Phoenicurus phoenicurus

Results: Community assembling - a lesson from nature

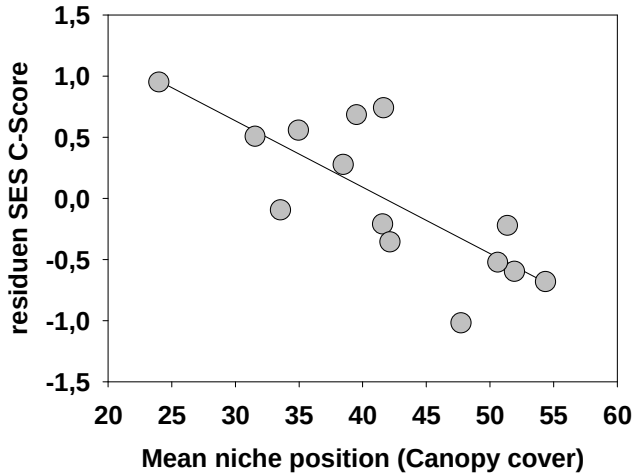




Predictability by environment



Deterministic versus stochastical processes



14 taxonomical groups of animals – from molluscs to birds

Conclusions from Biodiversity research

Bark beetle and windblow have enriched the diversity of habitats in the Nationalpark

Kůrovec a polomy zvýšily rozmanitost stanovišť v Národním parku

Thereby species diversity increased

tím se zvýšila druhová rozmanitost

Particular those species were favored which are closely related to spruce (historical old process)

Zvláště byly zvýhodněny druhy, které jsou více vázány na smrk (což je hisotrický proces)

Bark beetles are important keystone species for diversity in boreal spruce dominated forests

Kůrovci jsou důležitými klíčovými druhy pro rozmanitost v boreálních smrkem dominovaných lesích

Salvage logging alters natural communities and reduces habitats as snags

Asanace napadeného dřeva mění přirozená společenství a snižuje vznik stanovišť jako jsou tlející kmeny

Community assembling in the open forests was driven by the regional species pool rather than by competition

Sestava společenstev v otevřených porostech je určována místními druhy spíše než kompeticí

PRAHA, 07.12.2011

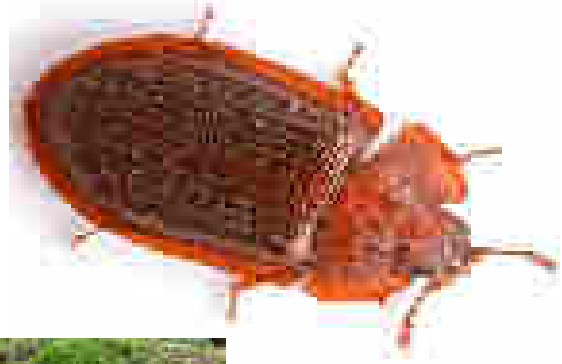
Natural Disturbances in a National Park

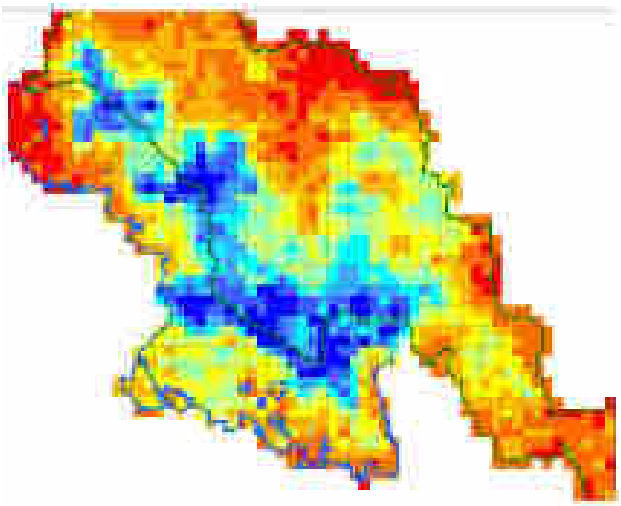
Effects on rare species

Claus Bässler

Nationalpark Bayerischer Wald

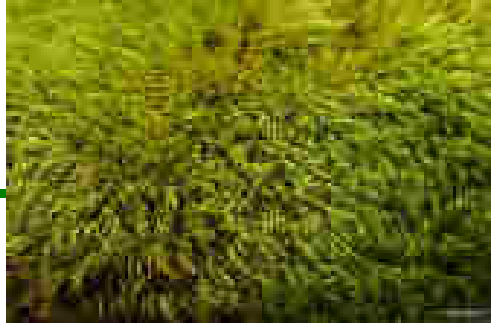
Data

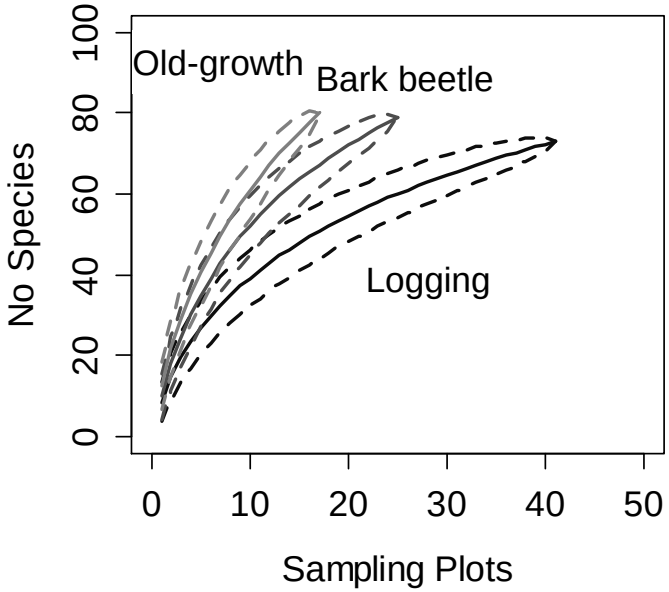


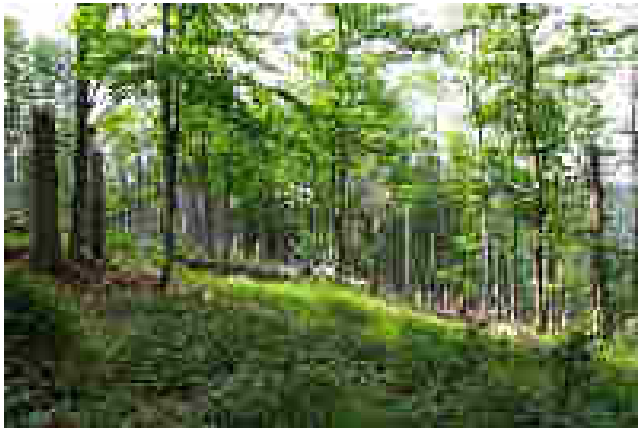


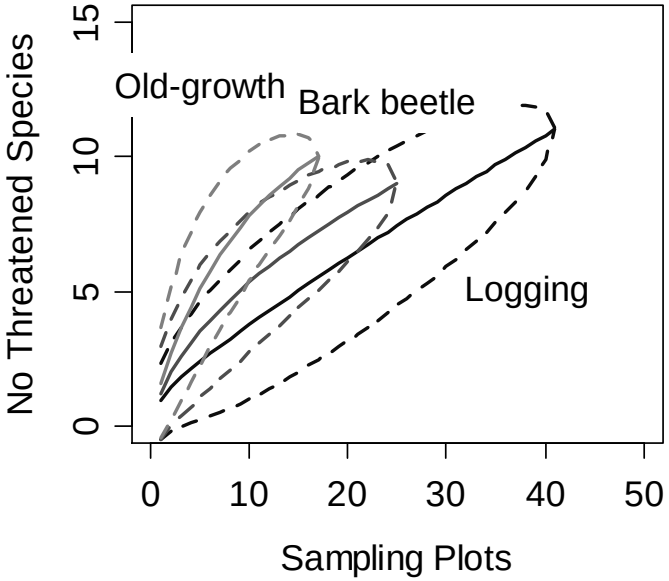
Bässler et al (2009) Forest Ecology, Landscape Research and Nature Conservation

Results





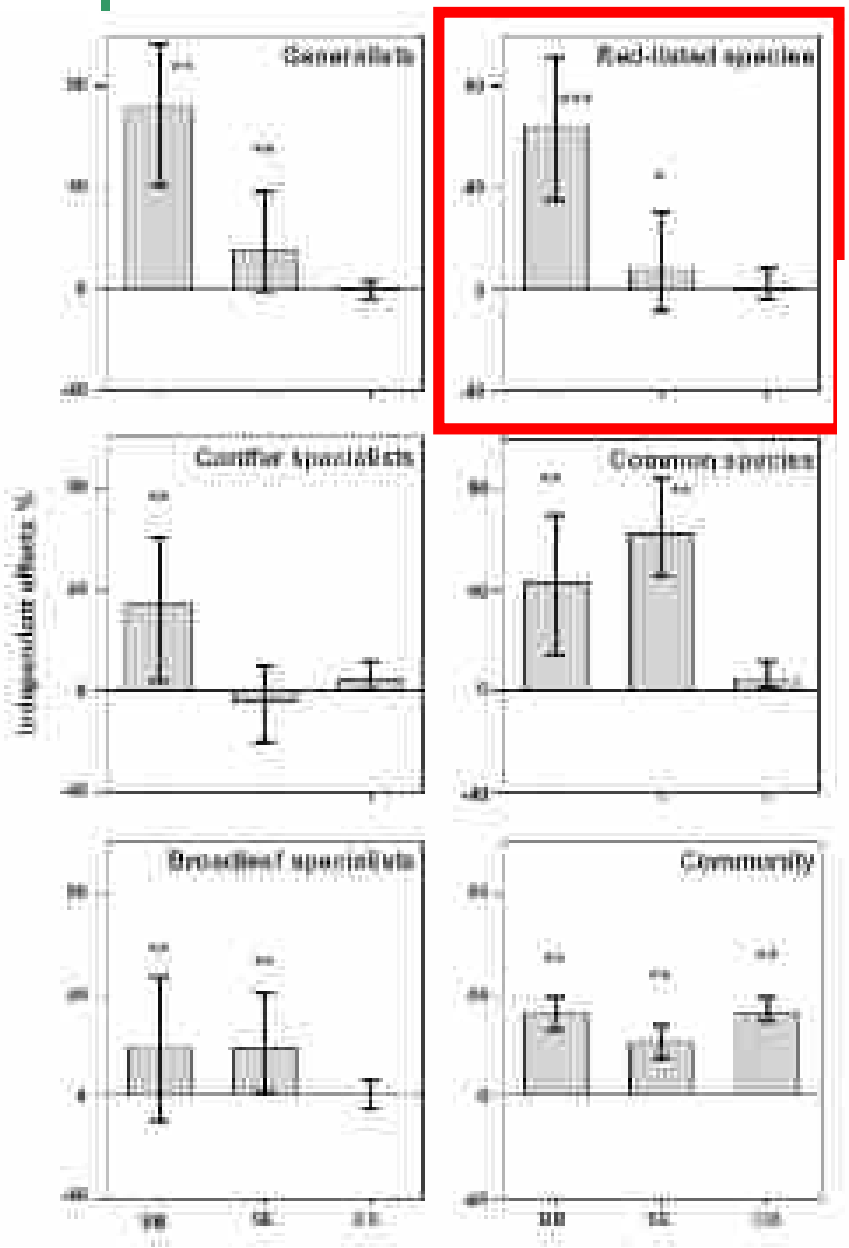


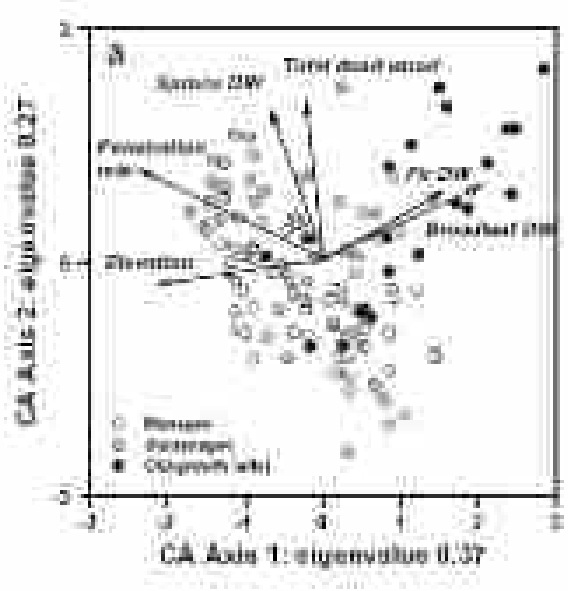


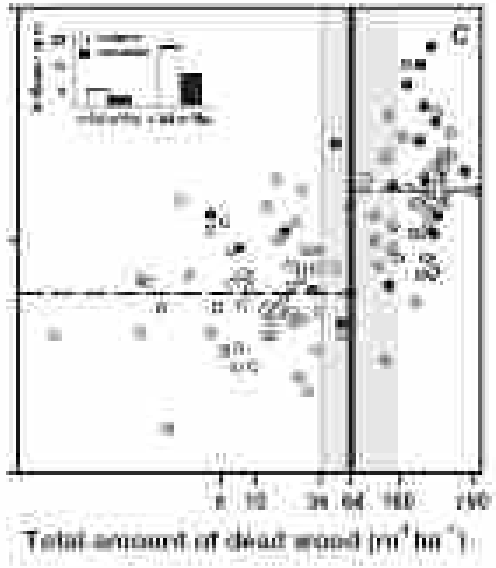
1. Soil related bryophytes profit from open canopies
2. Wood inhabiting bryophytes profit from dead wood under closed canopies

Raabe et al (2010) Forest Ecology and Management

Results







Müller et al (2010) Biological Conservation

Results

Ostoma ferruginea

>100 individuals

Ampedus auripes

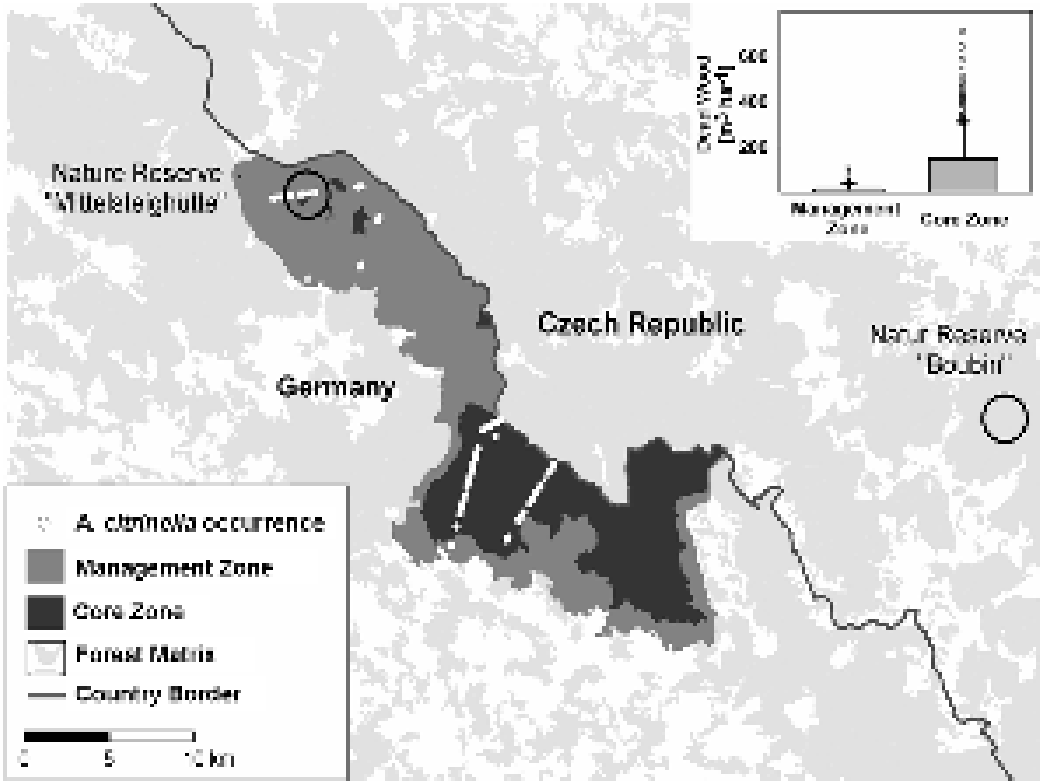
>300 individuals

1. Enrichment of spruce wood and openness of the canopy due to the bark beetle supports red listed species and conifer specialists
2. Restoration of population densities
3. Amount of dead wood should exceed 60m^3 ha^{-1} (at present ~ 15m^3 ha^{-1})

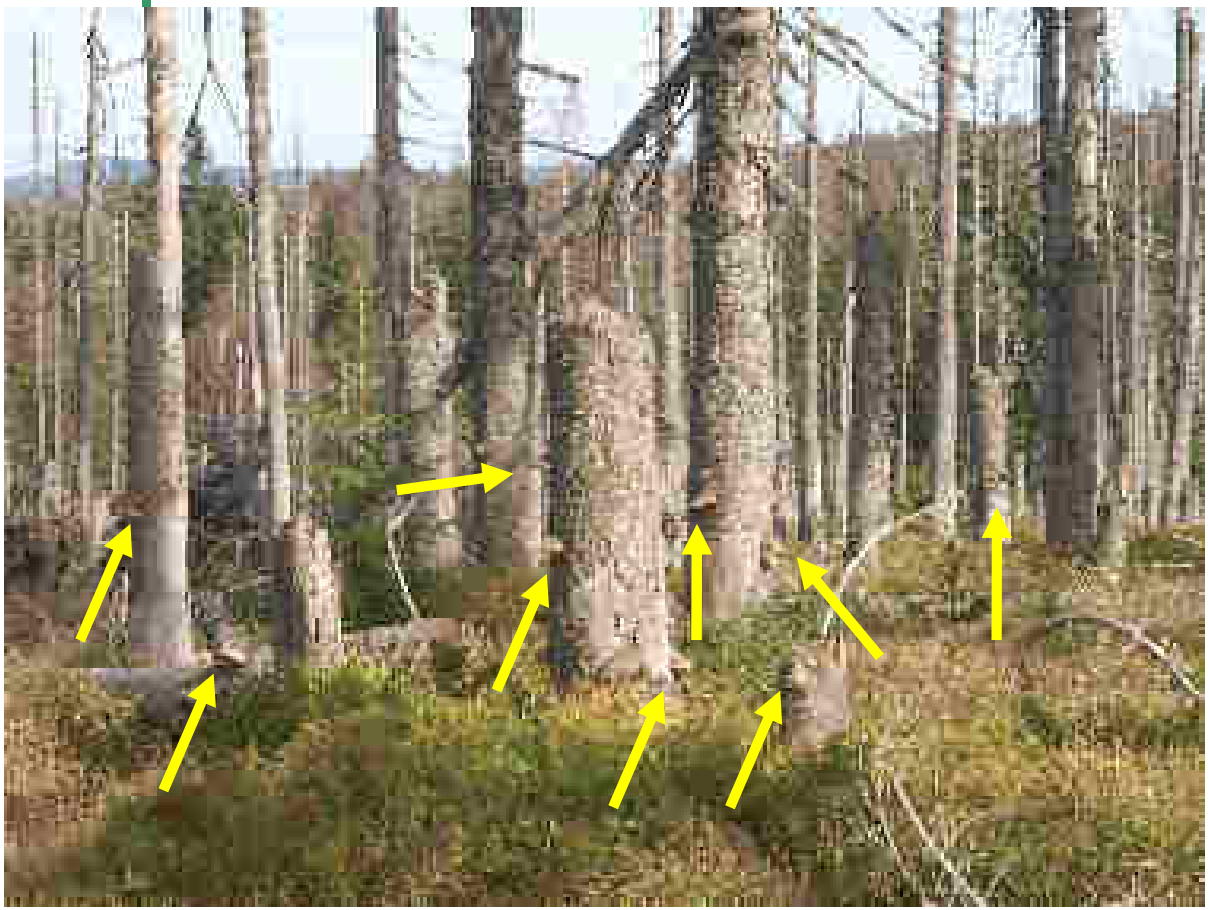
Müller et al (2010) Biological Conservation

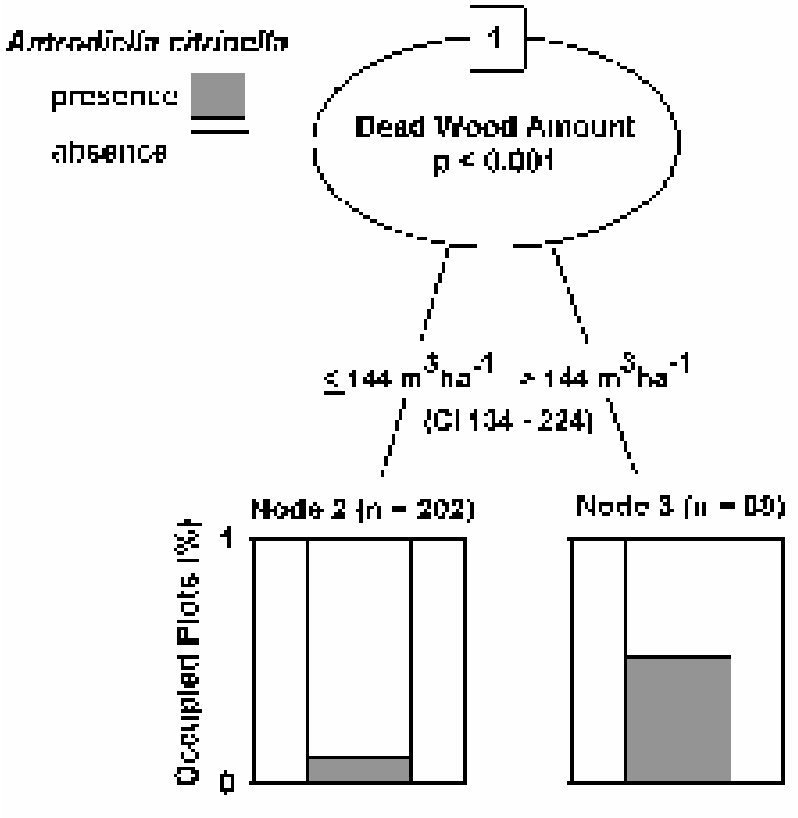
Results


Antrodiella citrinella


Nature Reserve
"Mittelelbehulle"
Czech Republic
Germany
Nature Reserve
"Boubín"
A. citrinella occurrence
Management Zone
Core Zone
Forest Matrix
Country Border
Management Zone
Core Zone

Results

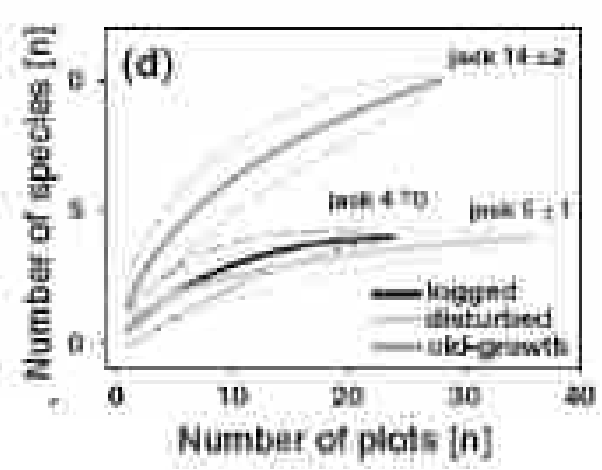


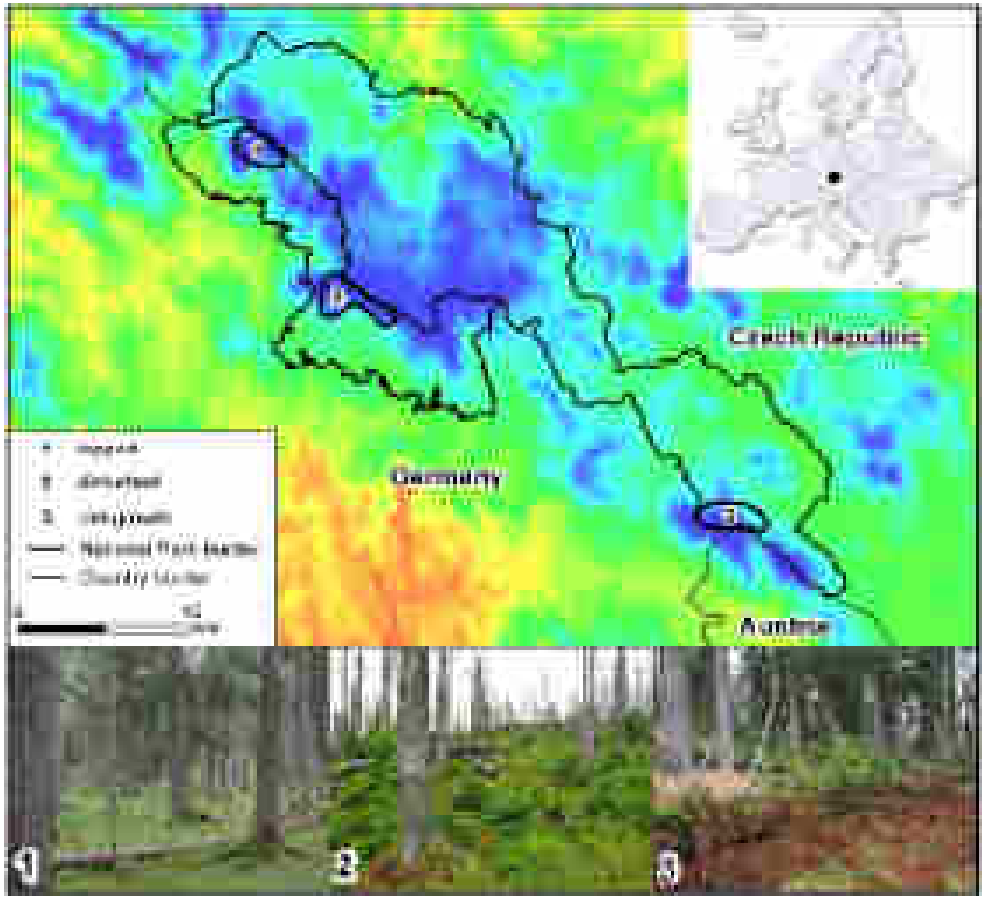


A. citrinella	Volume of dead wood		Stage of decomposition	
	Estimator	Independent effect	Estimator	Independent effect
Abundance (Poisson)	1.28***	92.6 %	0.60***	7.4 %
Probability (Binomial)	1.80***	90.7 %	1.31***	9.3 %

Bässler & Müller (2010) Fungal Biology

Results

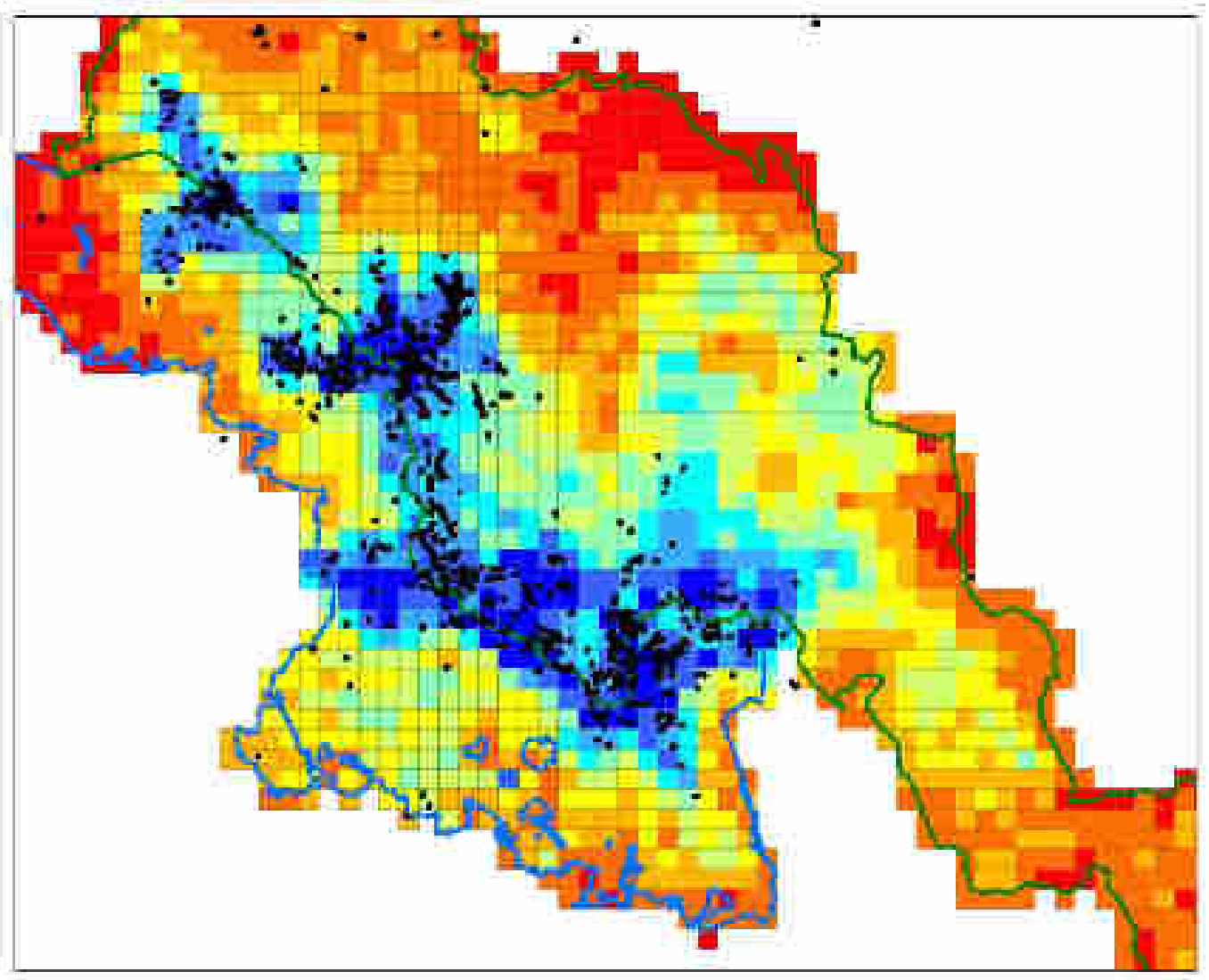




1. No short term effects for red listed fungi
2. Preserving old growth forests
3. Large scale reserves guarantee variation in structure (cause of tree mortality etc.)

Bässler et al (2011) Biodiversity and Conservation

Results



Modelfit

Capercaillie data from 2000-2005

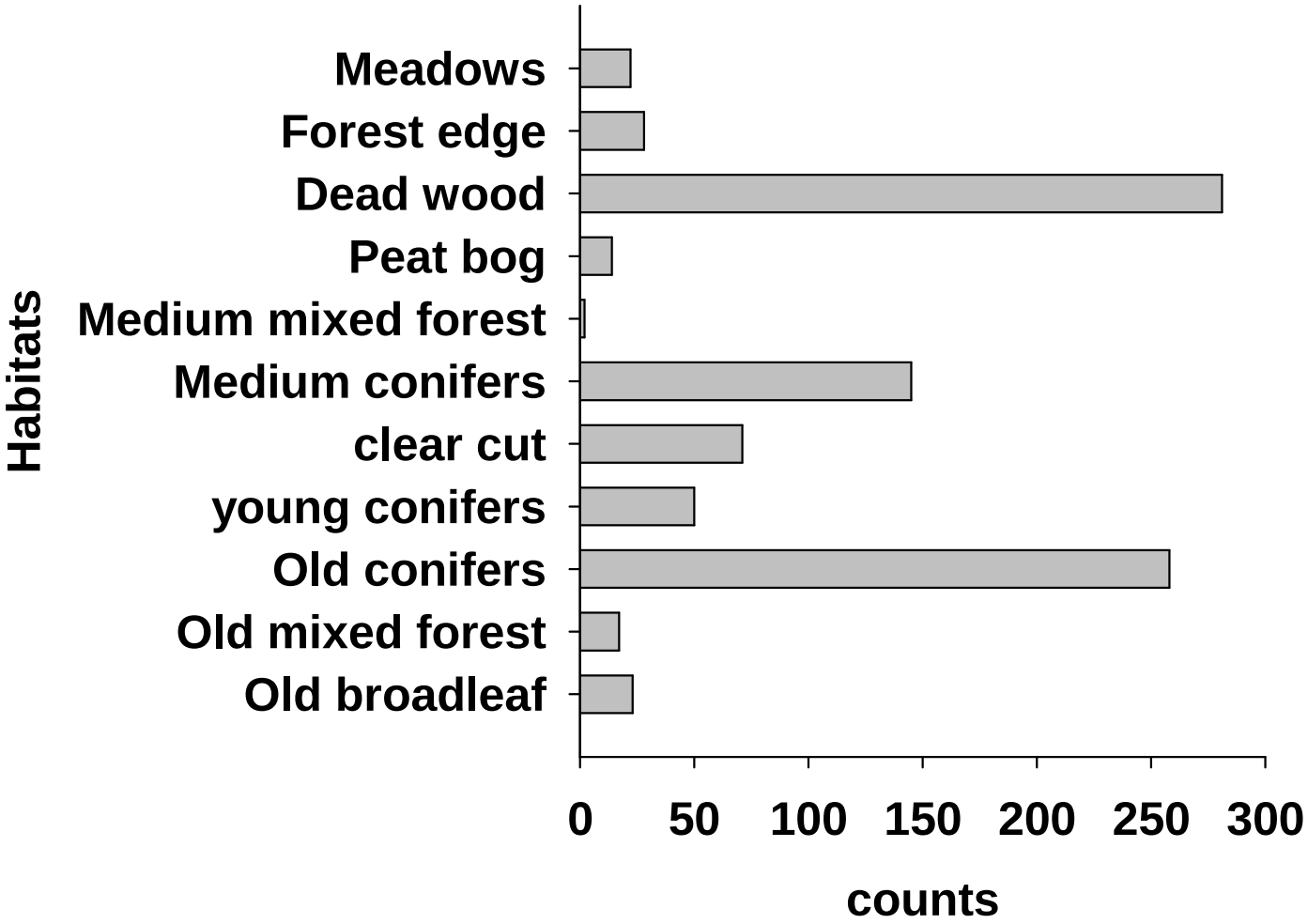
Aerial fotos from 2003

Validation

Capercaillie data from 2006-2010

Aerial fotos from 2008

Results



Teuscher M. et al. 2011 Ornithologischer Anzeiger in Druck

Conclusions

To assess the effects of passive management we need reliable data across various taxonomic groups.

Pro zhodnocení efektů pasivního managementu potřebujeme průřezově z různých taxonomických skupin spolehlivá data

Positive effects on the number of rare species are a result of the enrichment of dead wood and openess of the canopy due to windthrow and bark beetle

Pozitivní vývoj početnosti vzácných druhů je důsledkem nárůstu množství mrtvého dřeva a otevření korunového zápoje v důsledku polomů a kůrovce.

Bark beetle activity allows the returning of rare species and an restoration of population densities of rare species

Aktivita kůrovce umožňuje návrat vzácných druhů a obnovu jejich populačních hustot.

For some species groups we can not observe a short term effect which supports the need preserving old-growth forests as donnor sites within protected landscapes

U některých skupin druhů zatím nemůžeme pozorovat krátkodobý vliv, což podporuje potřebu ochranu pralesovitých porostů jako „dárcovských“ stanovišť v chráněných krajinách.

Thank for your attention!

PRAHA, 07.12.2011

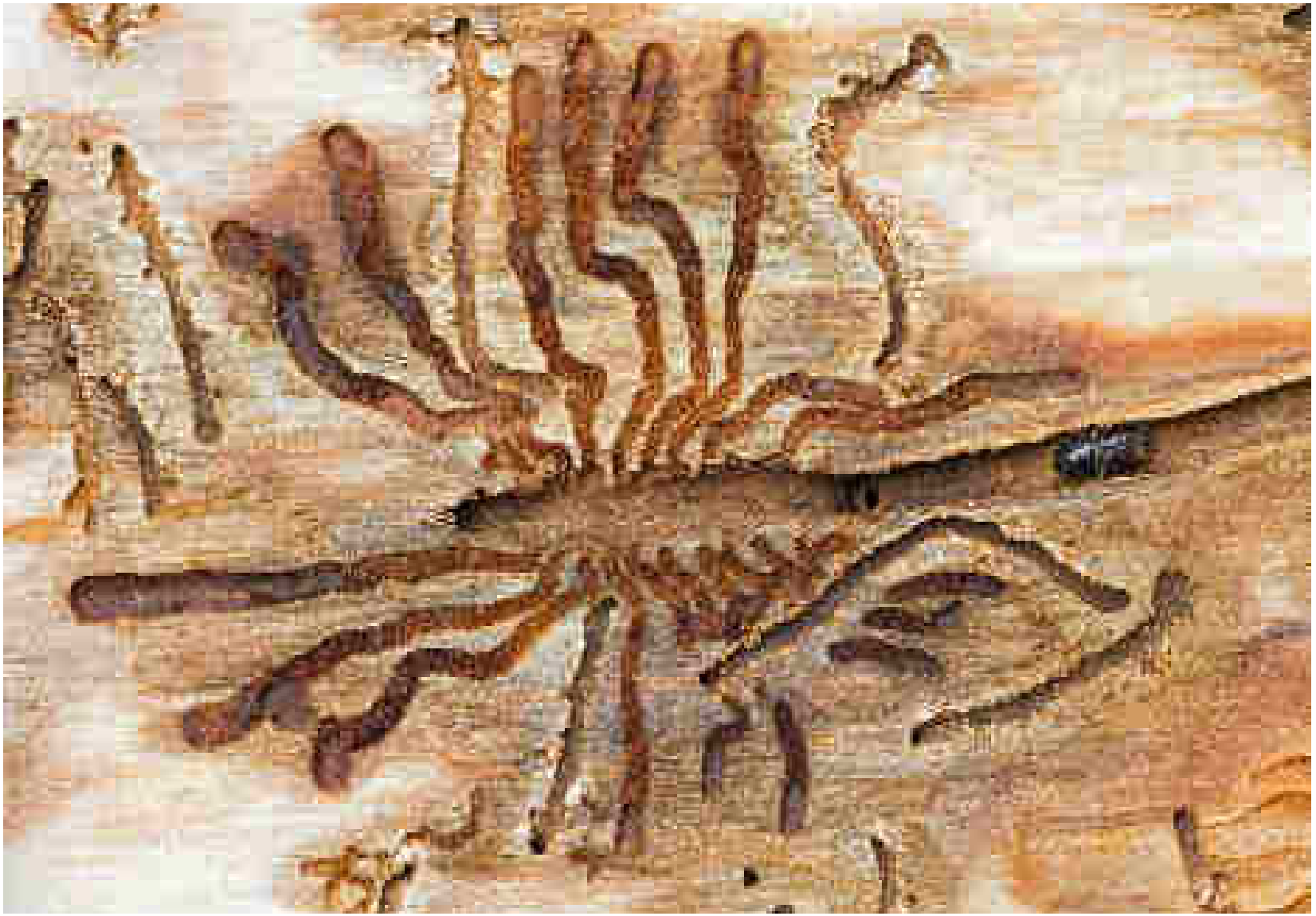
Natural Disturbances in a National Park

The bark beetle outbreak

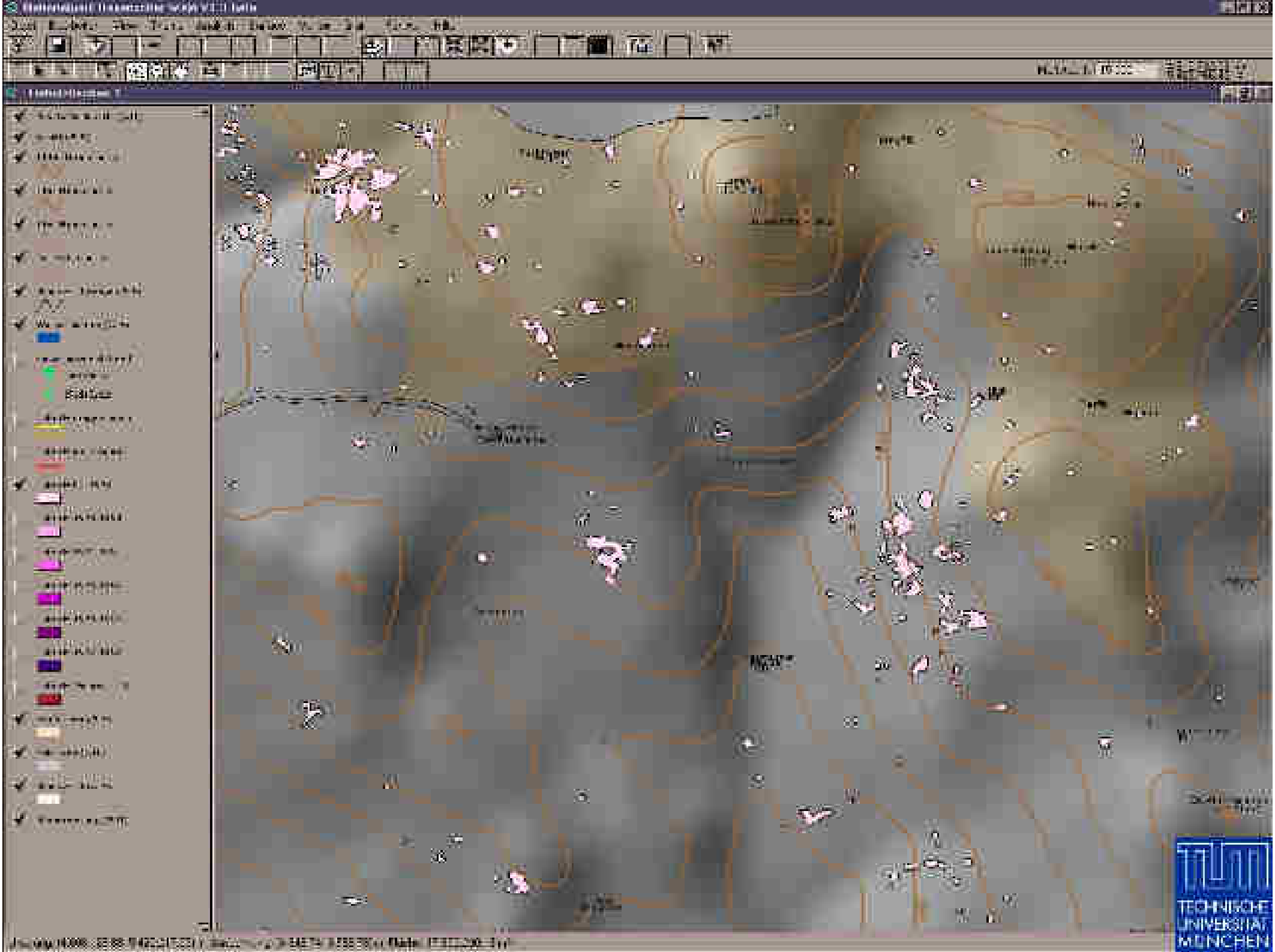
Marco Heurich

Nationalpark Bayerischer Wald

The Bark Beetle *Ips typographus*



Expected development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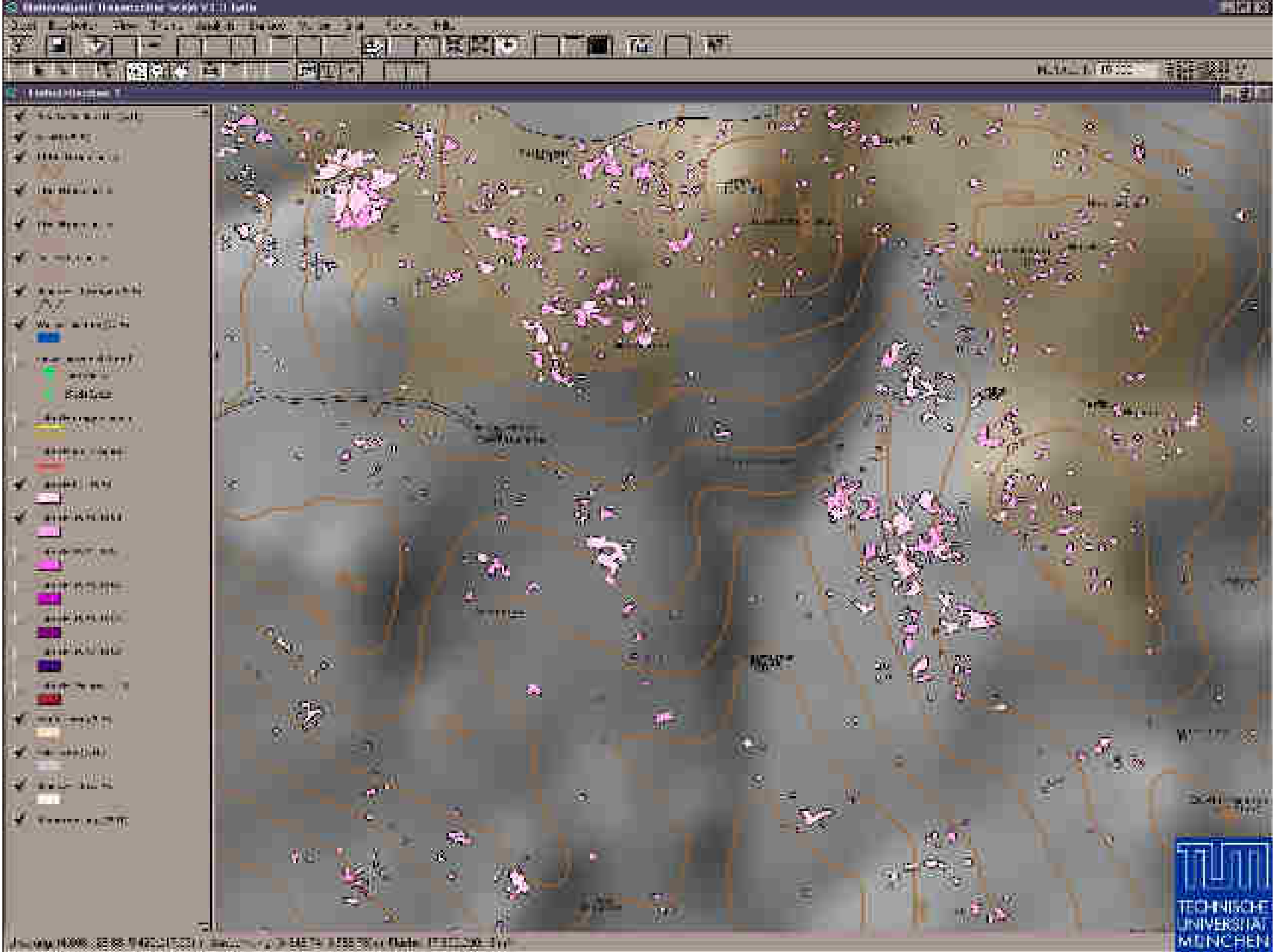
UNIVERSITÄT
MÜNCHEN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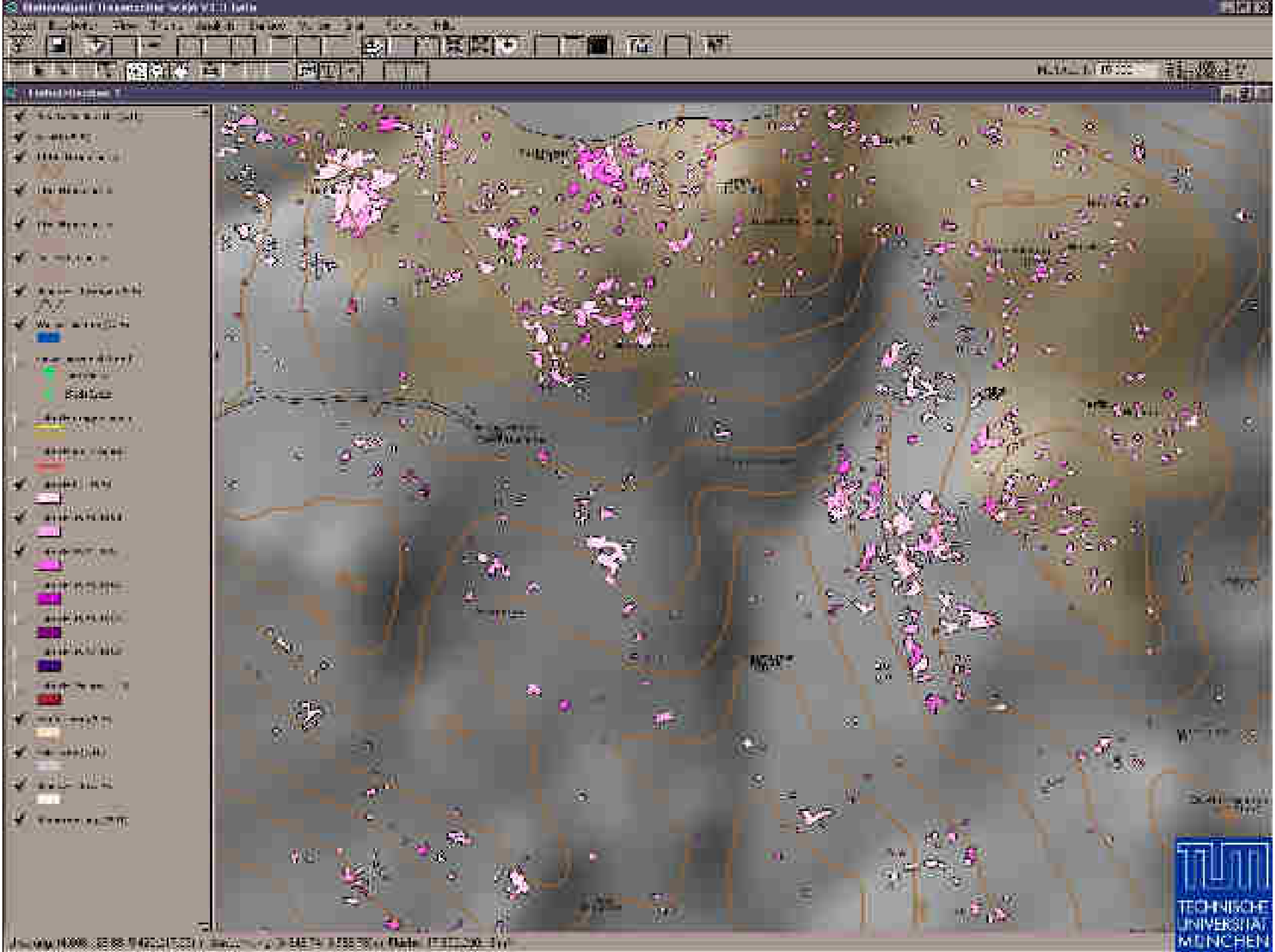
MÜNCHEN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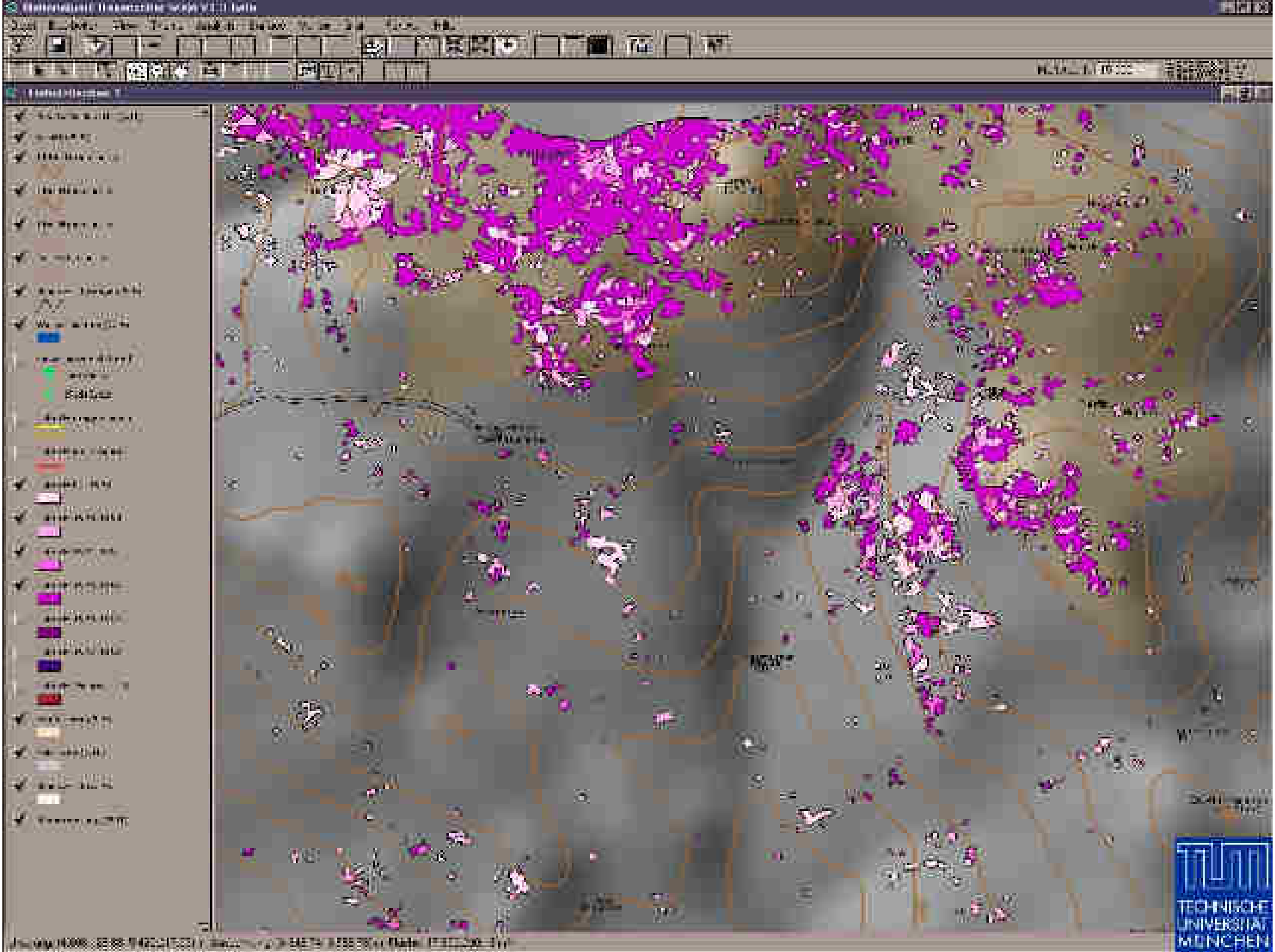
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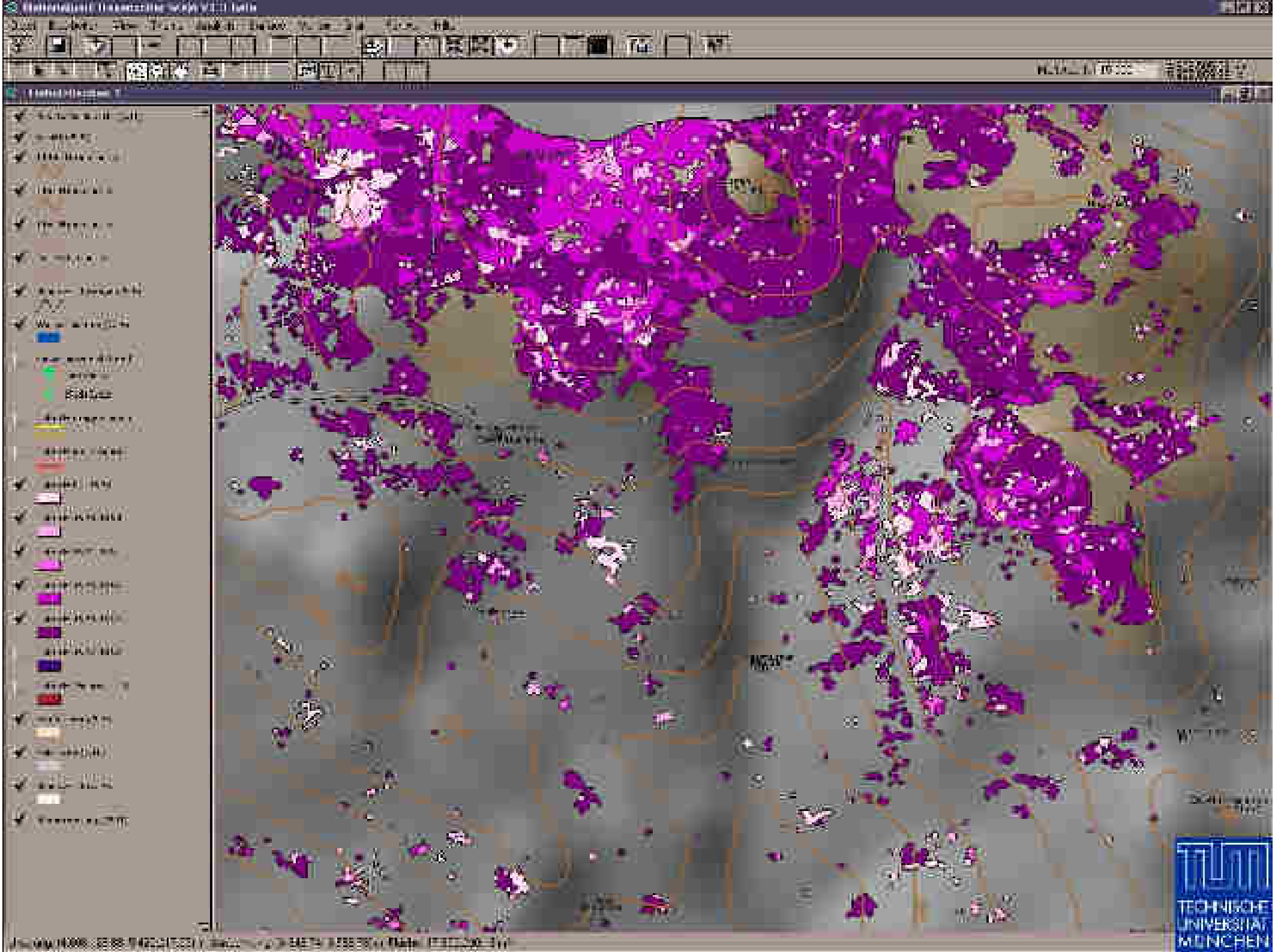
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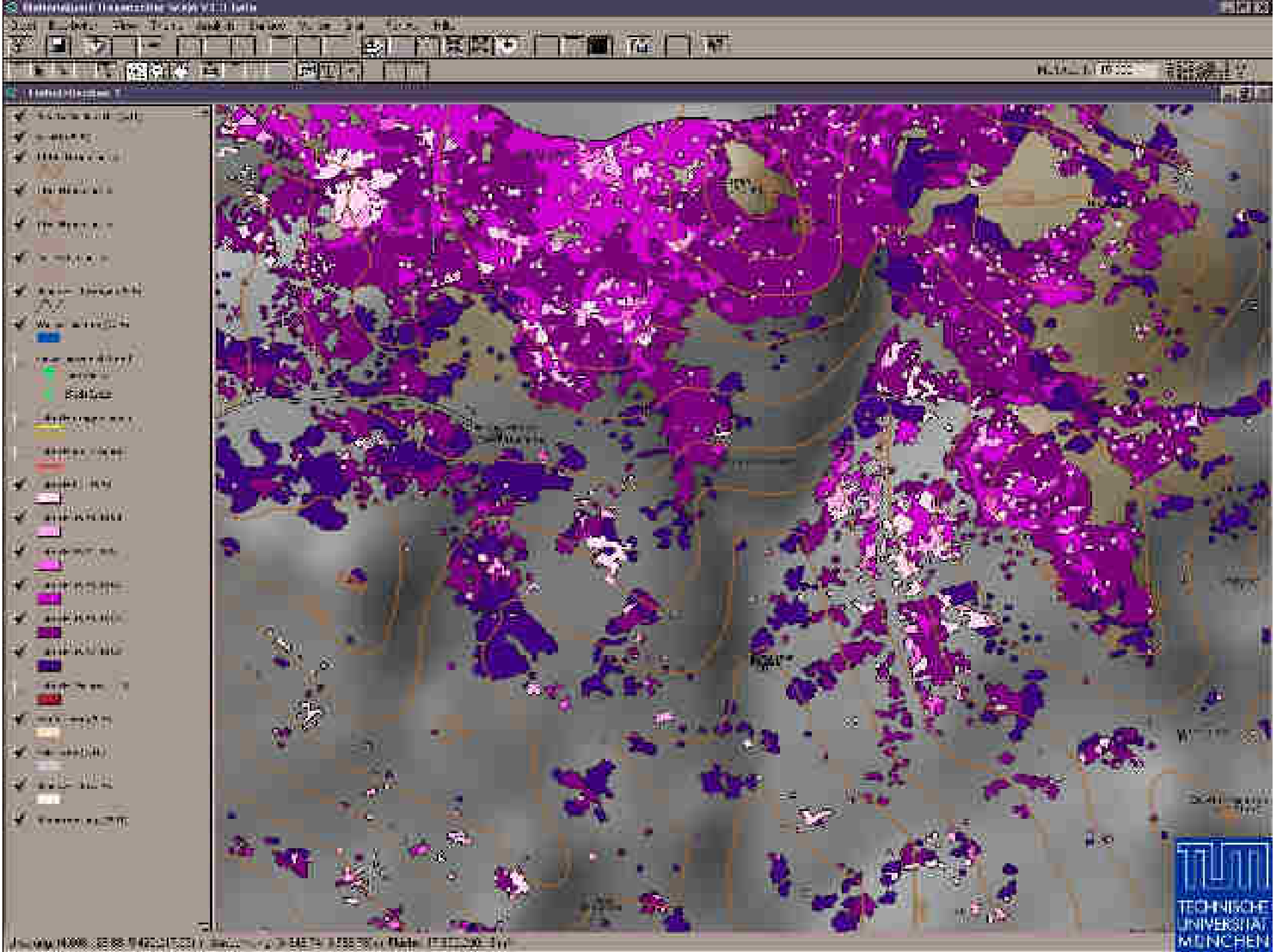
TECHNISCHE
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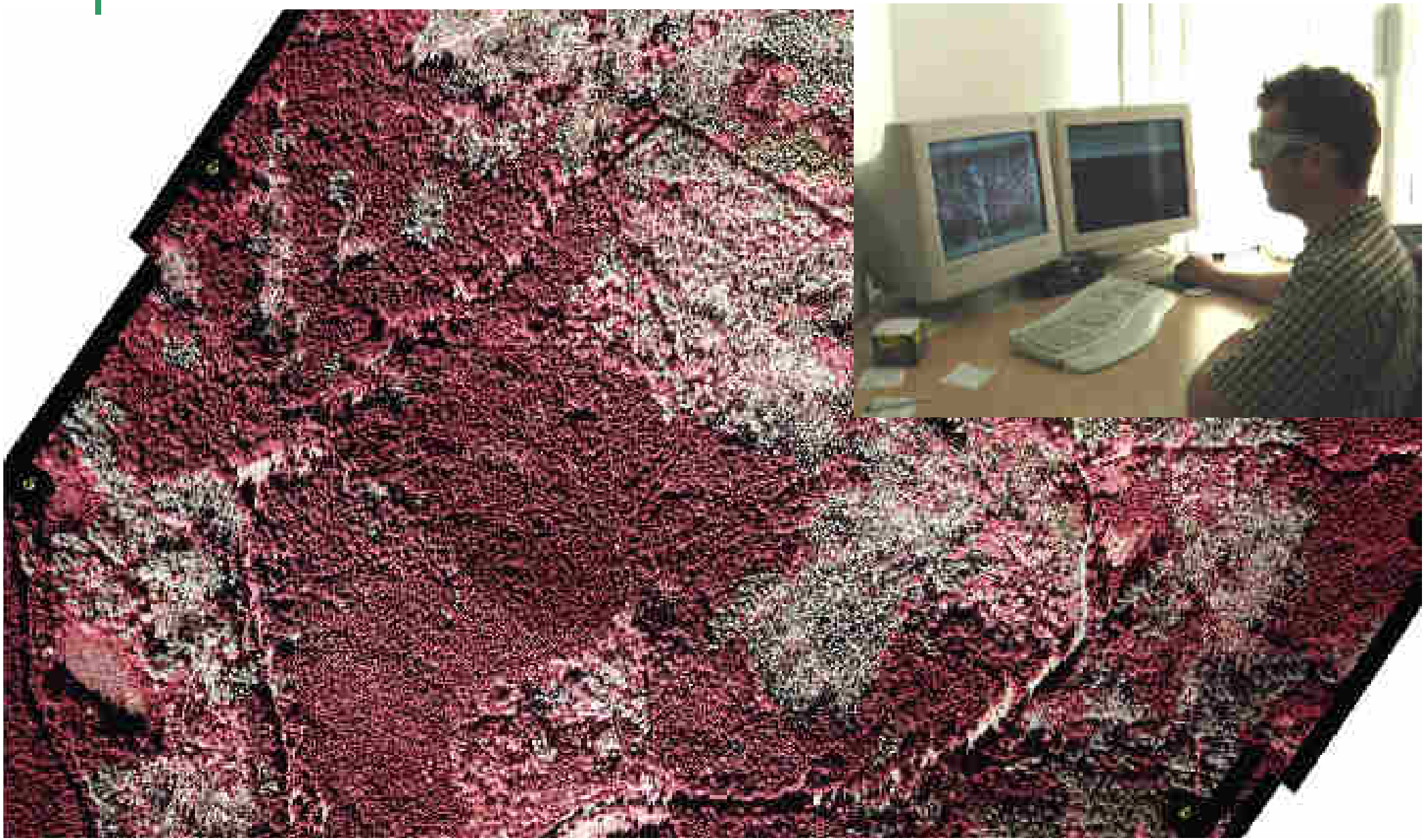
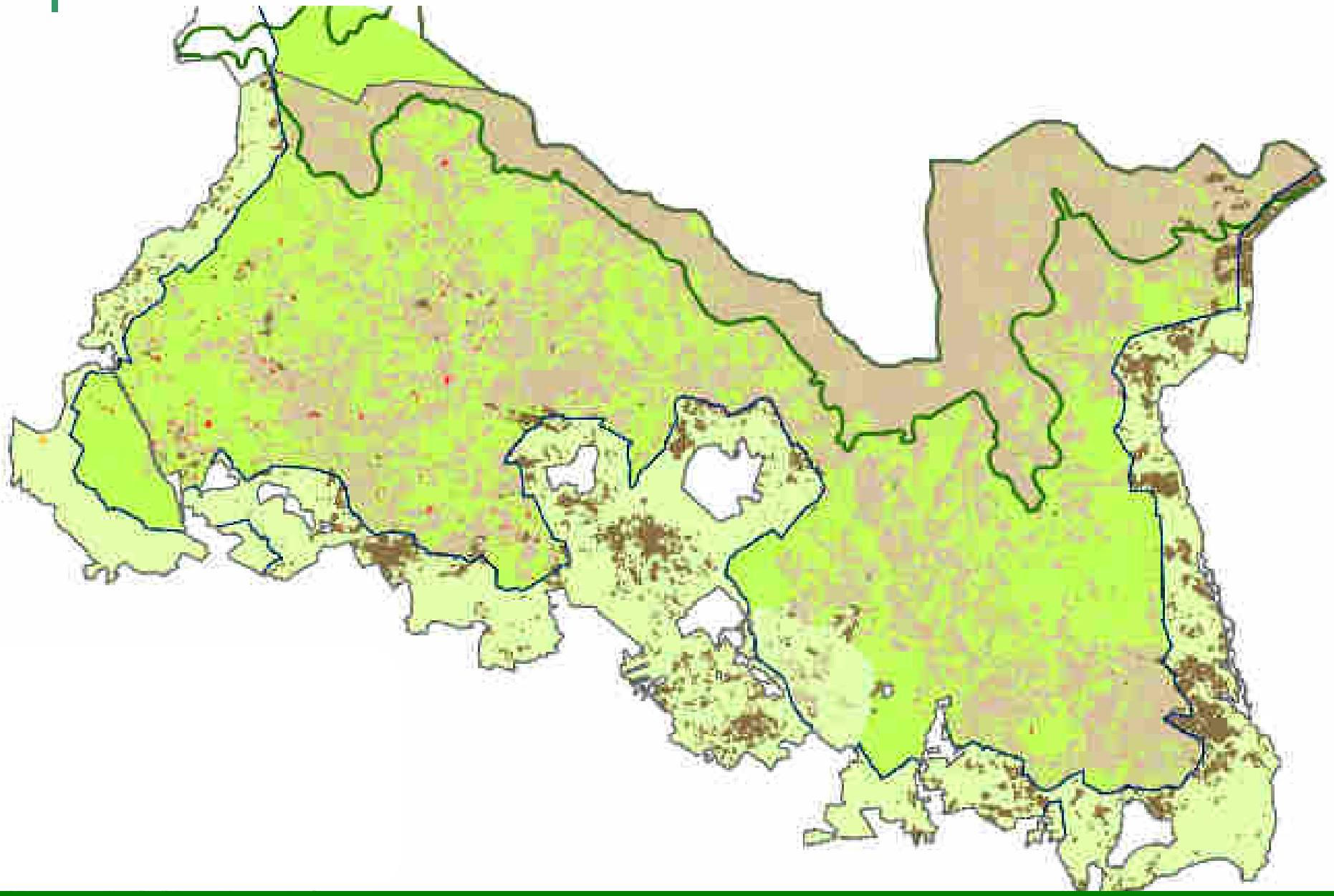
Methodology:

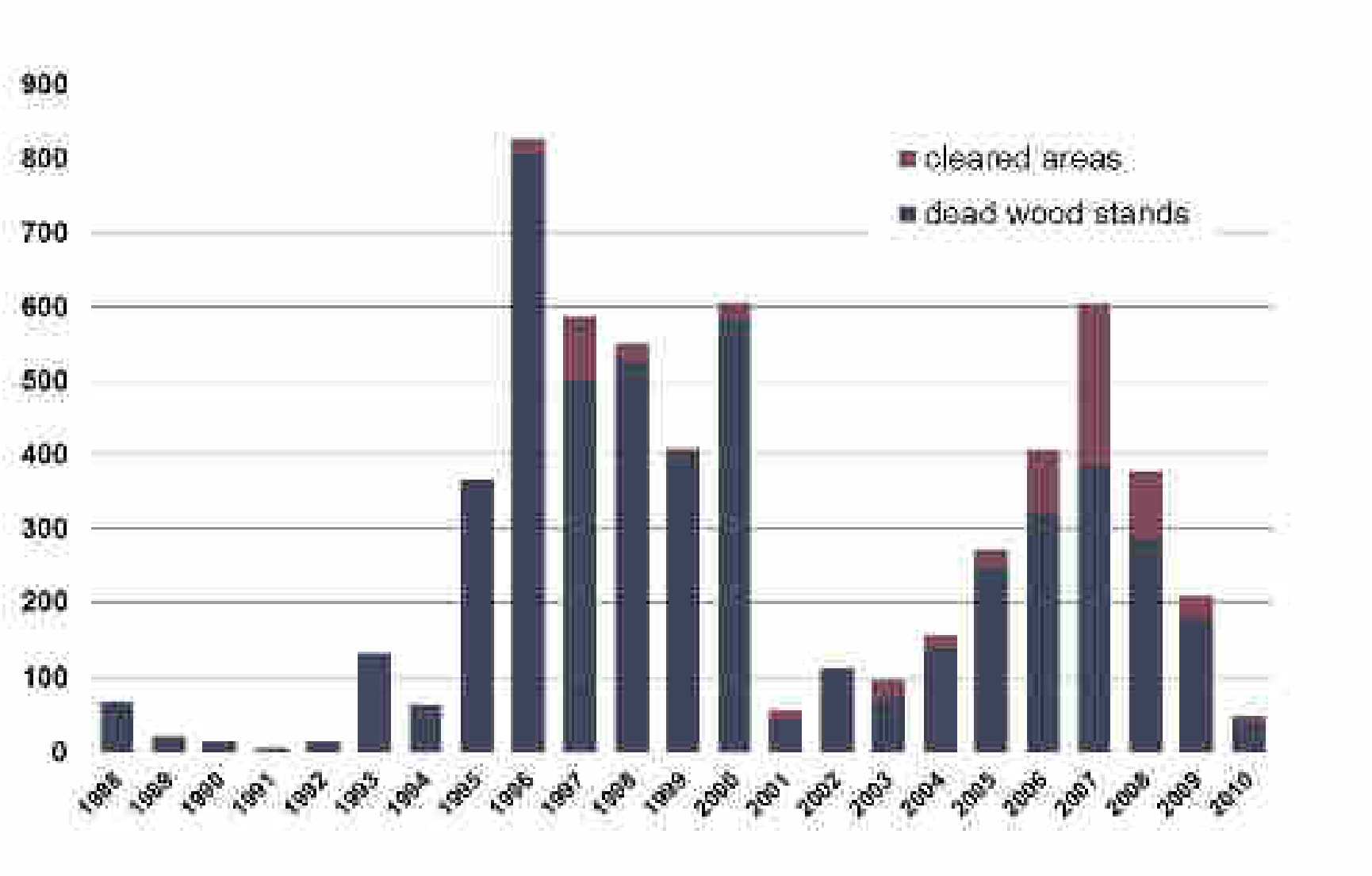


Heurich et al (2010) European Journal of Forest Science

Dead wood stands in the RLG:

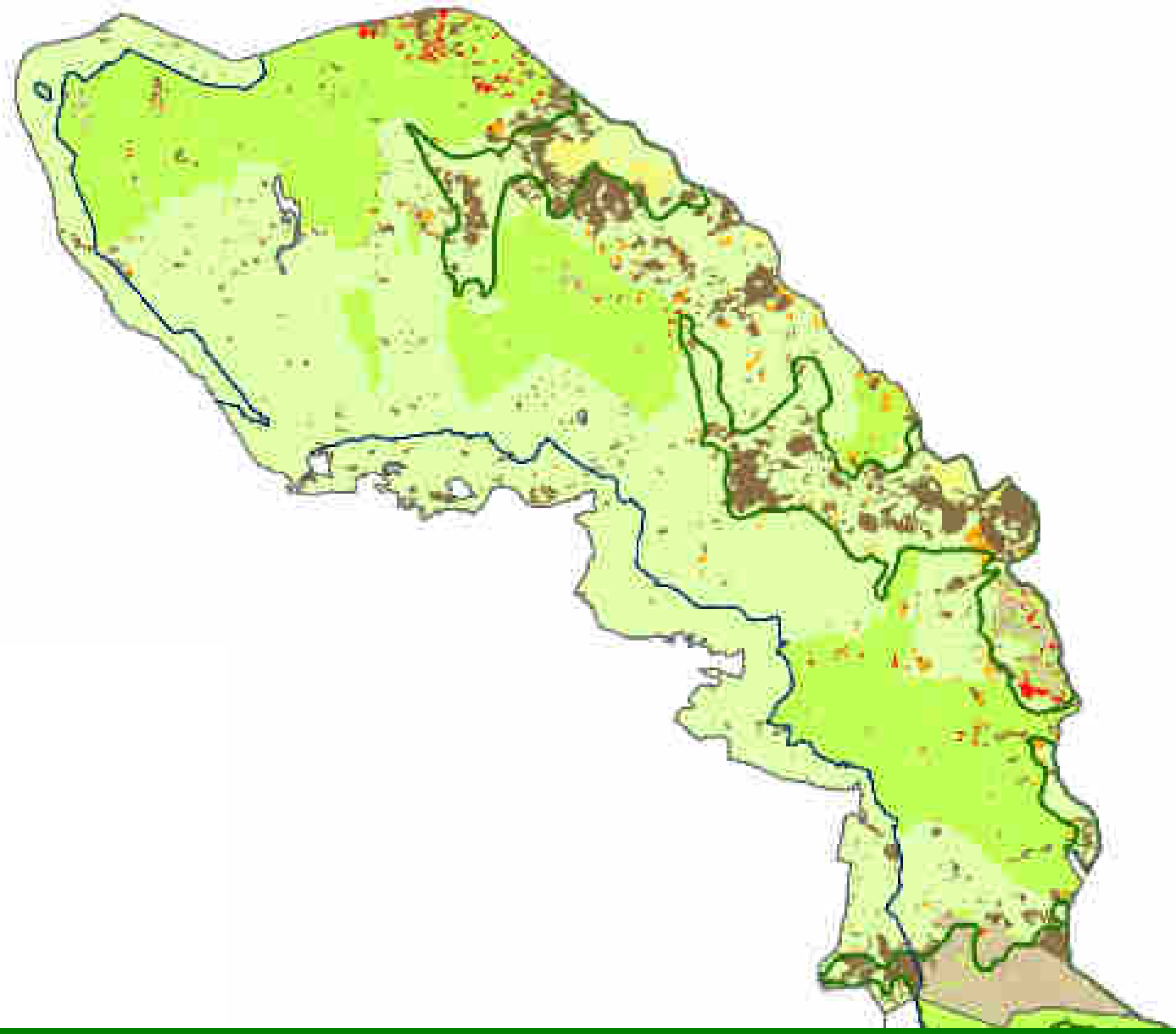


Development of dead wood stands in the RLG:

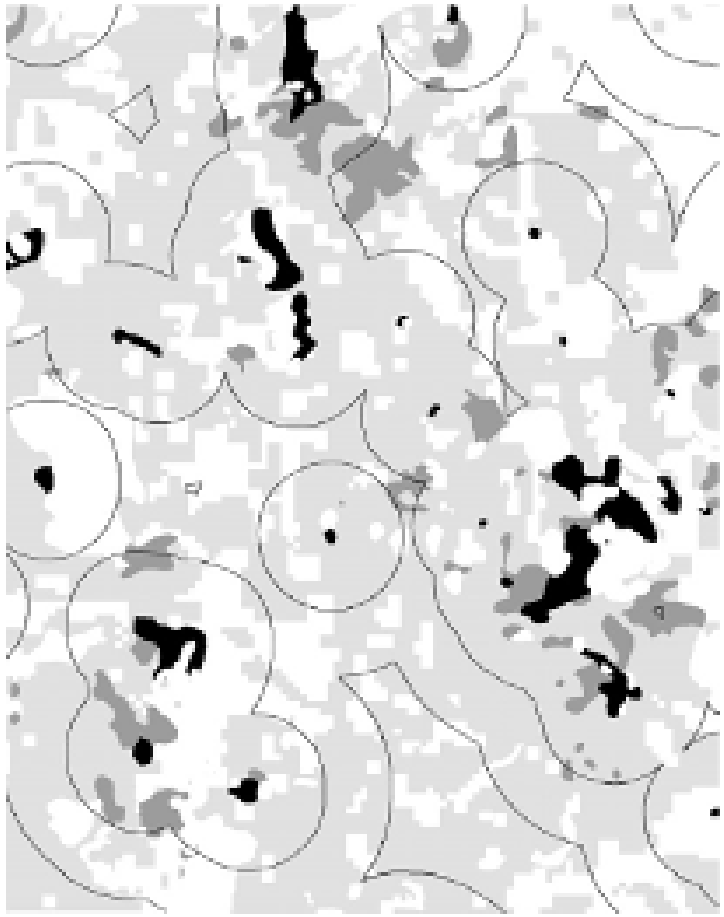


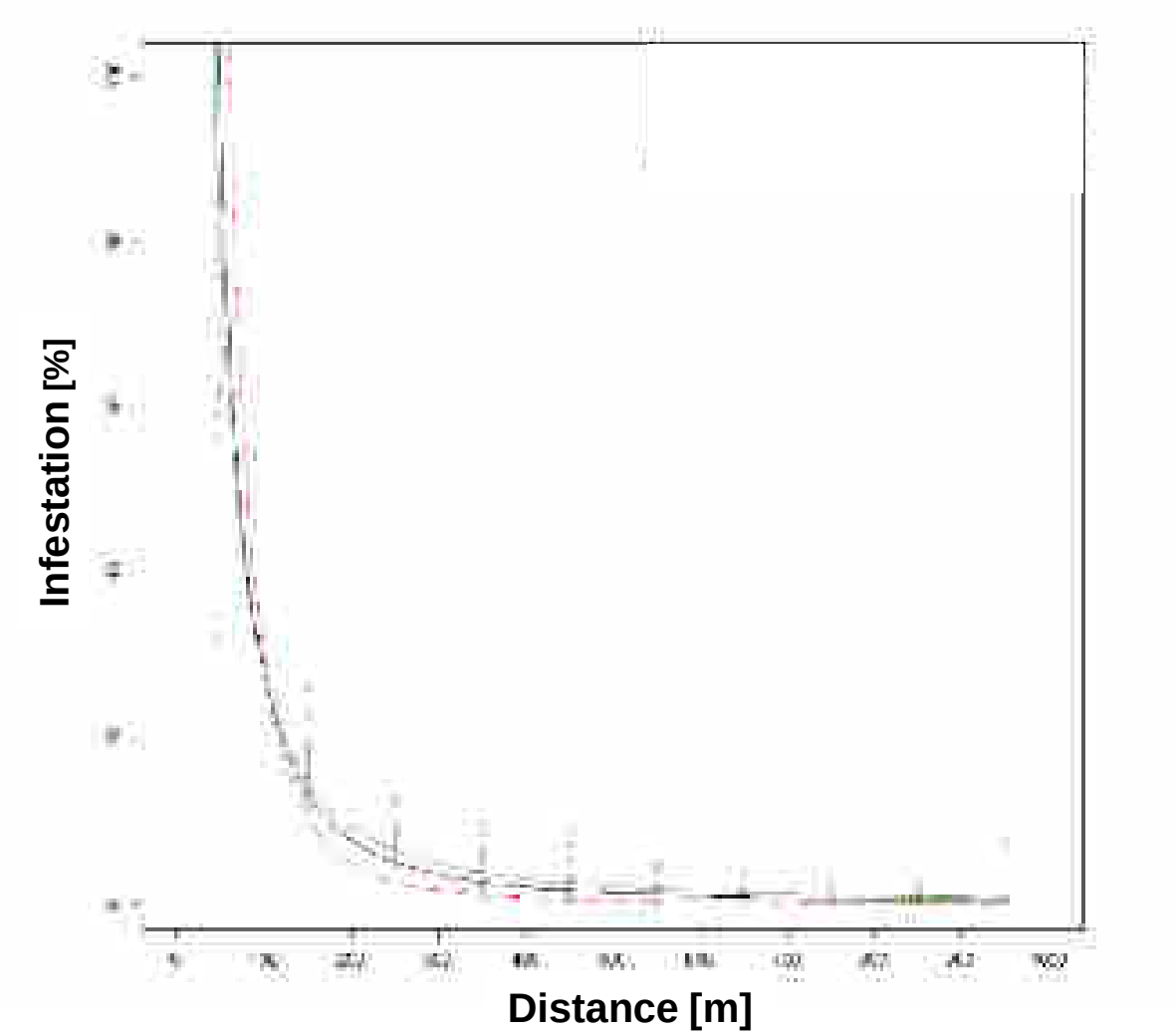
Lausch et al (2011) Forest Ecology and Management

Dead wood stands in the FRG:



Distance of infested patches in consecutive years





Kautz et al (2011) Forest Ecology and Management

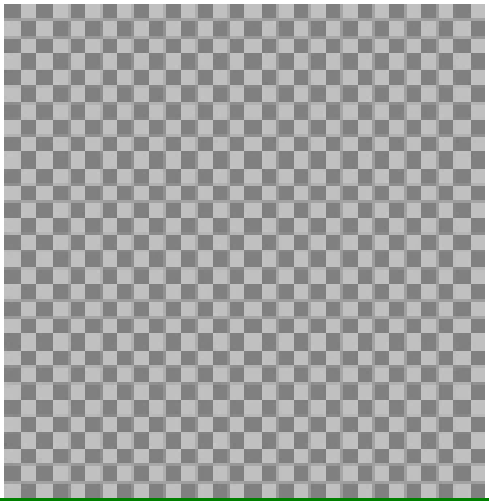
Spatially explicit agent-based simulation model (SAMBIA)

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

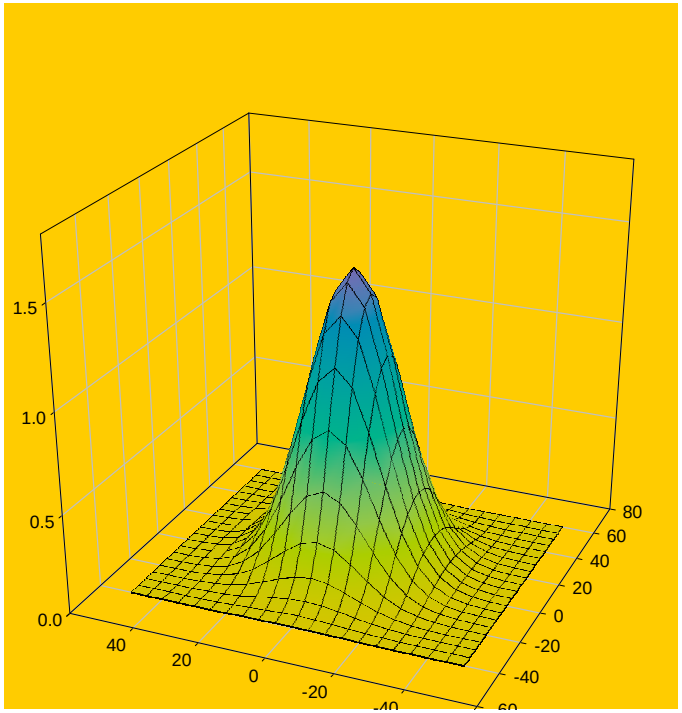


Implementation of biological processes

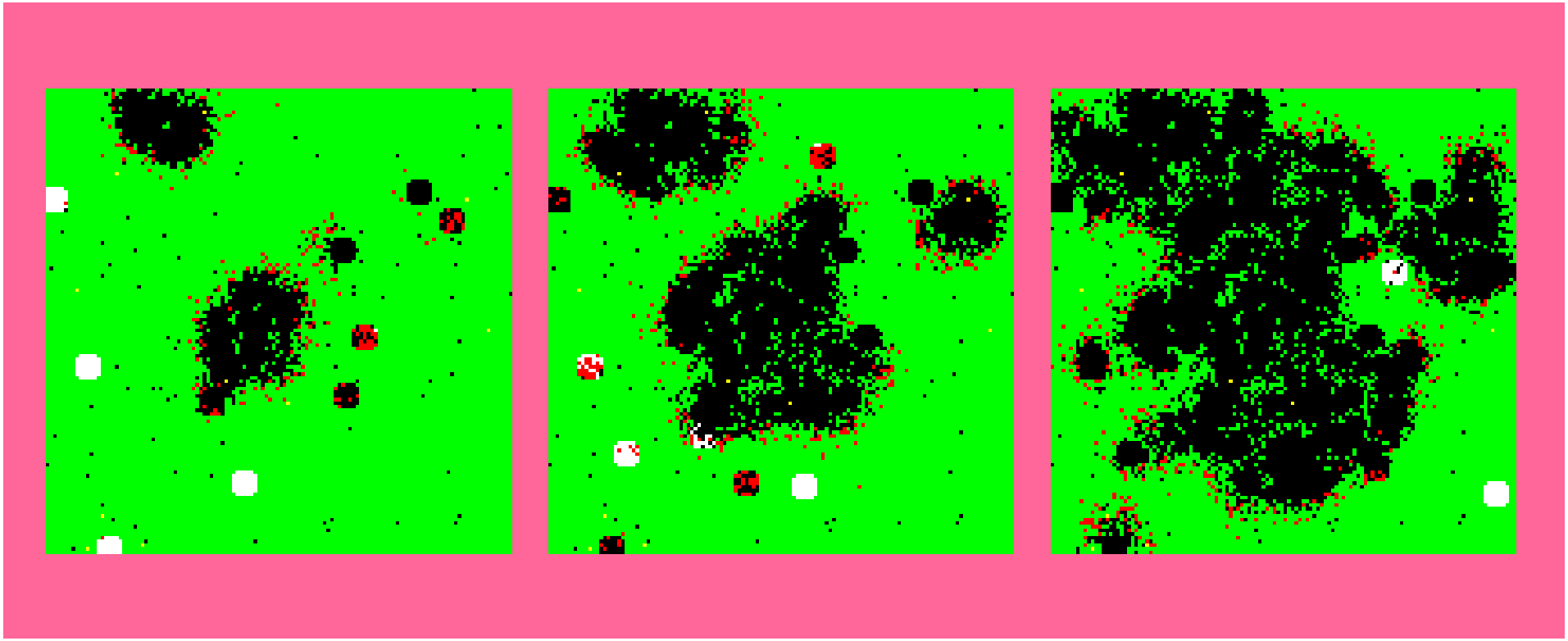
- population dynamics

  (reproduction, mortality)

- dispersal

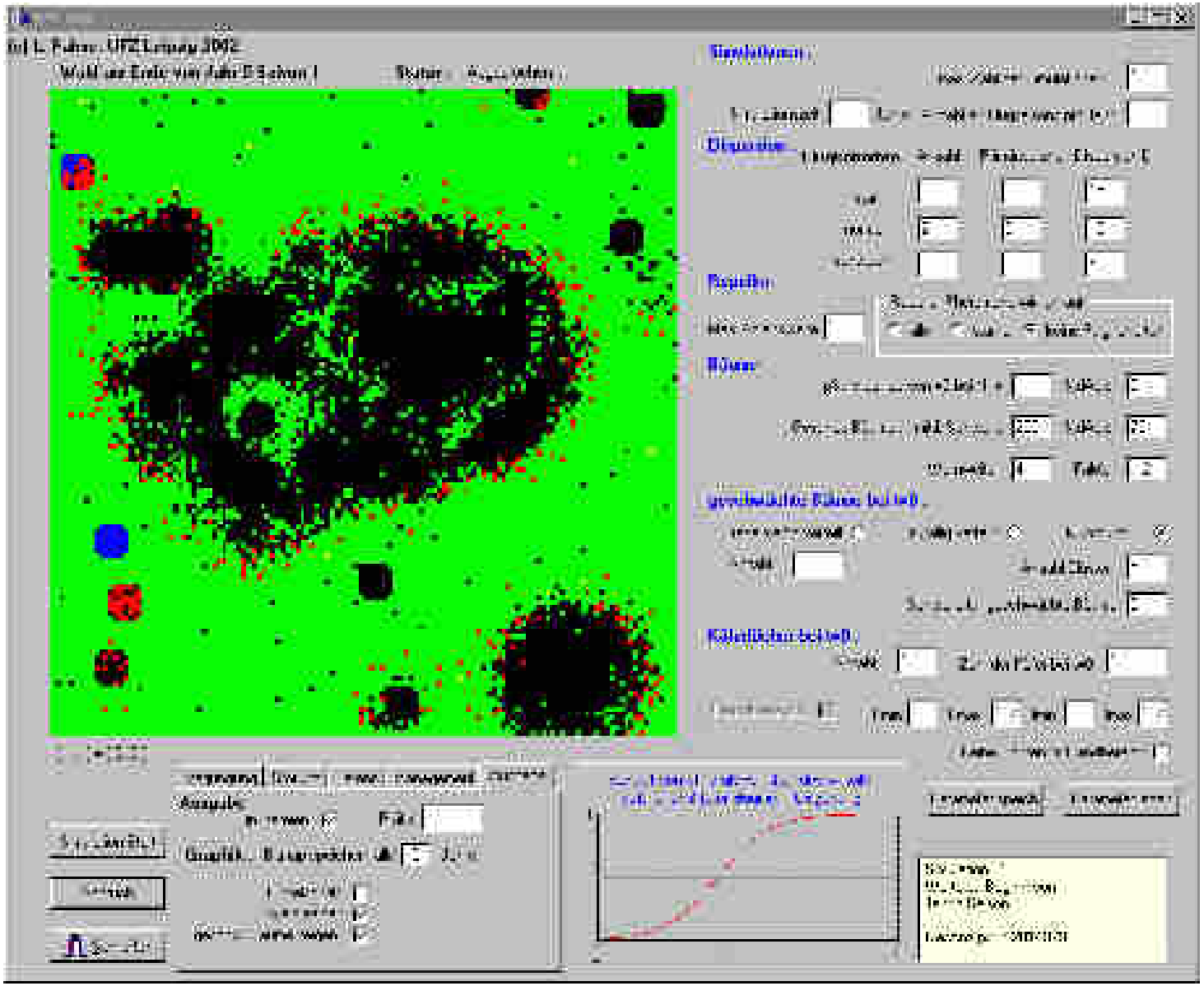


Infestation patterns in consecutive years



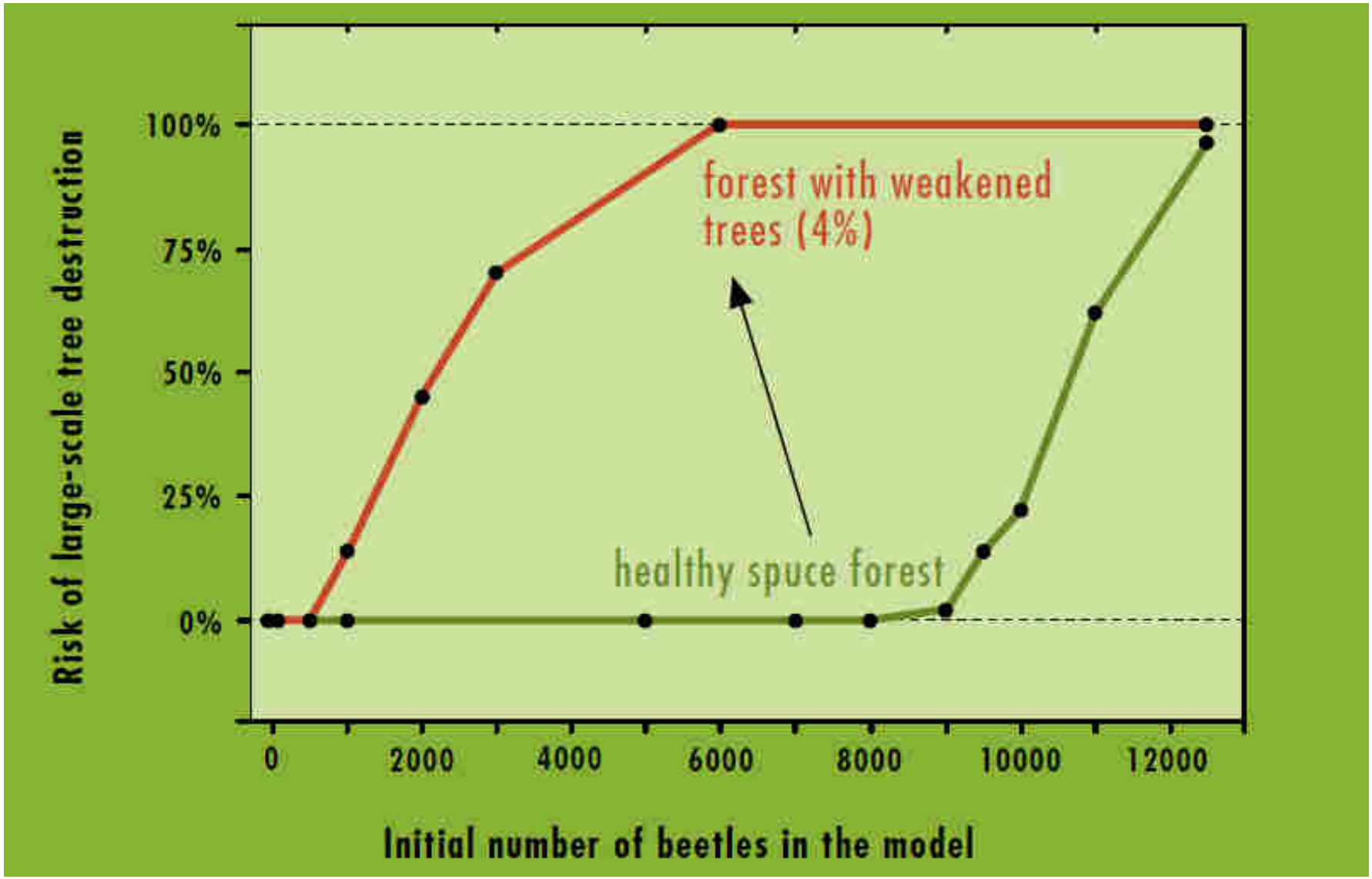
t = 1 t = 2 t = 3

User interface of SAMBIA



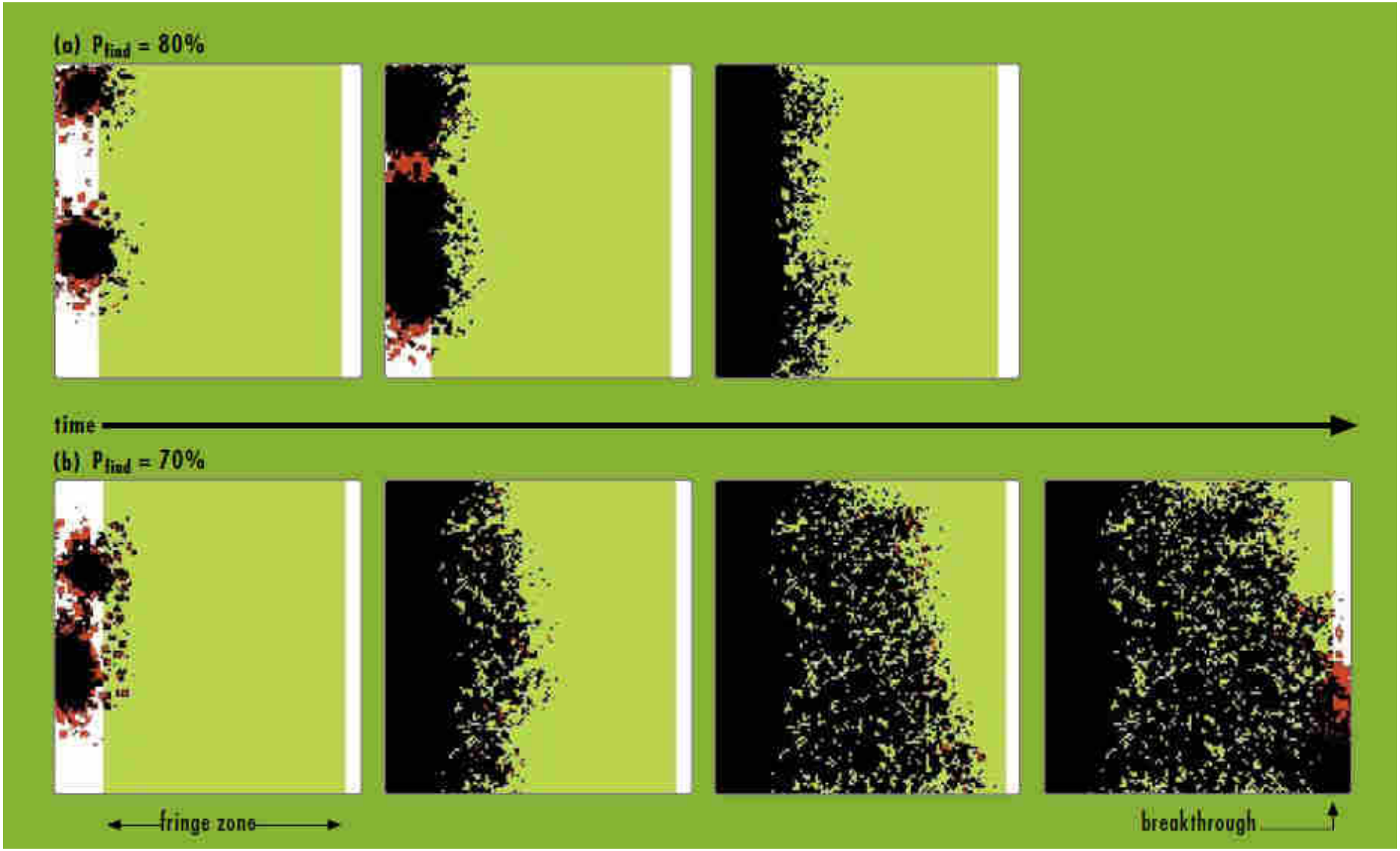
? ?

Risks of outbreaks as a function of the initial numbers



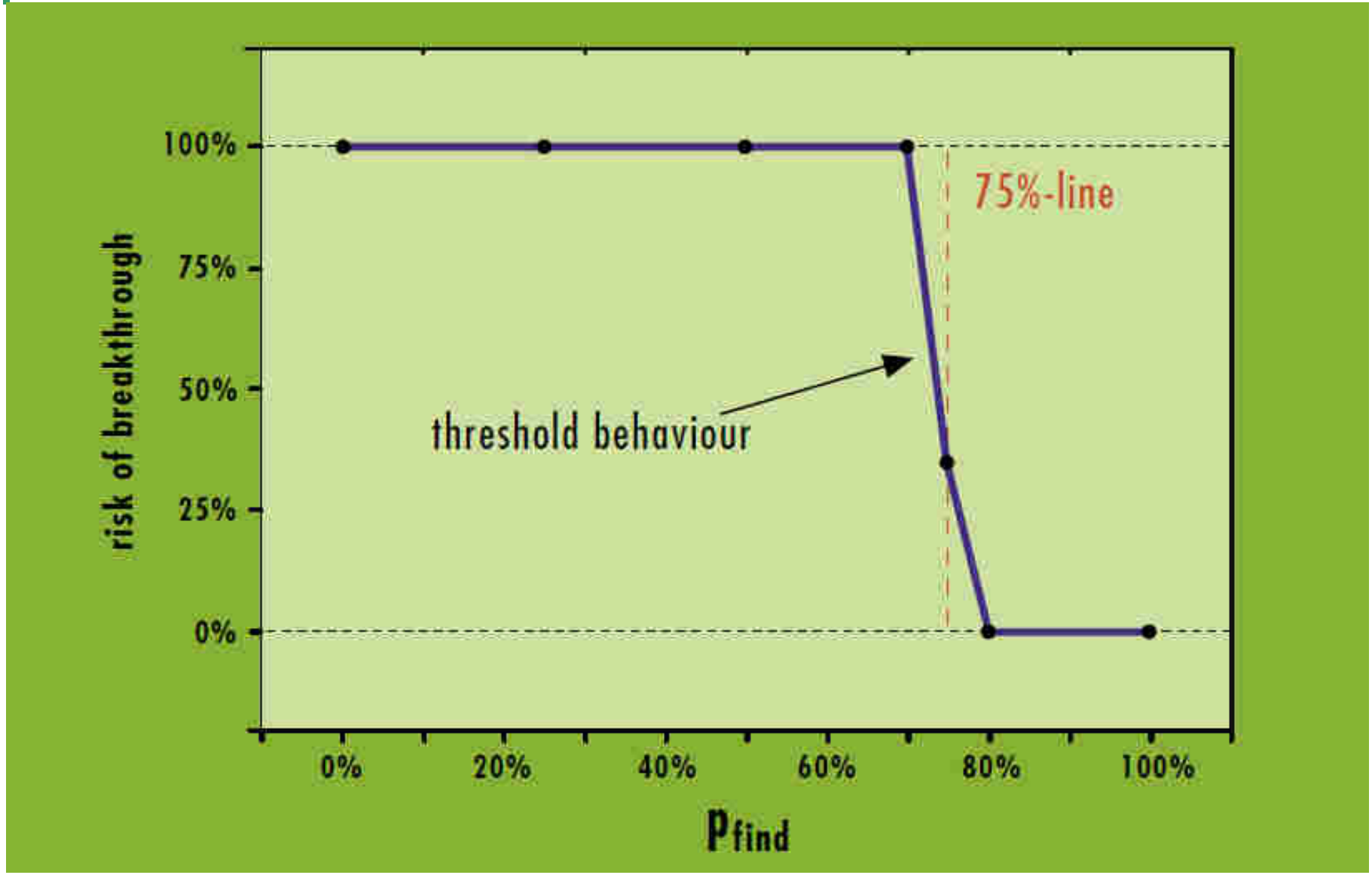
Fahse and Heurich (2011) Ecological Modelling

Efficiency of management zone



Lorenz F. and M. Heurich (2003): Research for the Environment

Threshold for management efficiency



Lorenz F. and M. Heurich (2003): Research for the Environment

Conclusions

- **Natural development is now allowed on 12580 ha (52 %) of the park area**
- **Bark beetle affected 6000 ha of the Rachel-Lusen-Area**
- **Bark beetle shows a cyclic dynamic, influenced by climatic charakteristics (wind, temperature)**
- **Bark beetle outbreak can be explained by natural dynamics**
- **Bark beetle management can keep the disturbance within park borders**
- **Sanitary logging has to focus on the vicincy of previous infestation**
- **For efficient bark beetle management you have to reduce beetle numbers by 75 %**