

Presentation University Brno 15.11.2026

The stepstone concept
-
an example of nature conservation-integrative forest-management

by Ulrich Mergner, Rauhenebrach







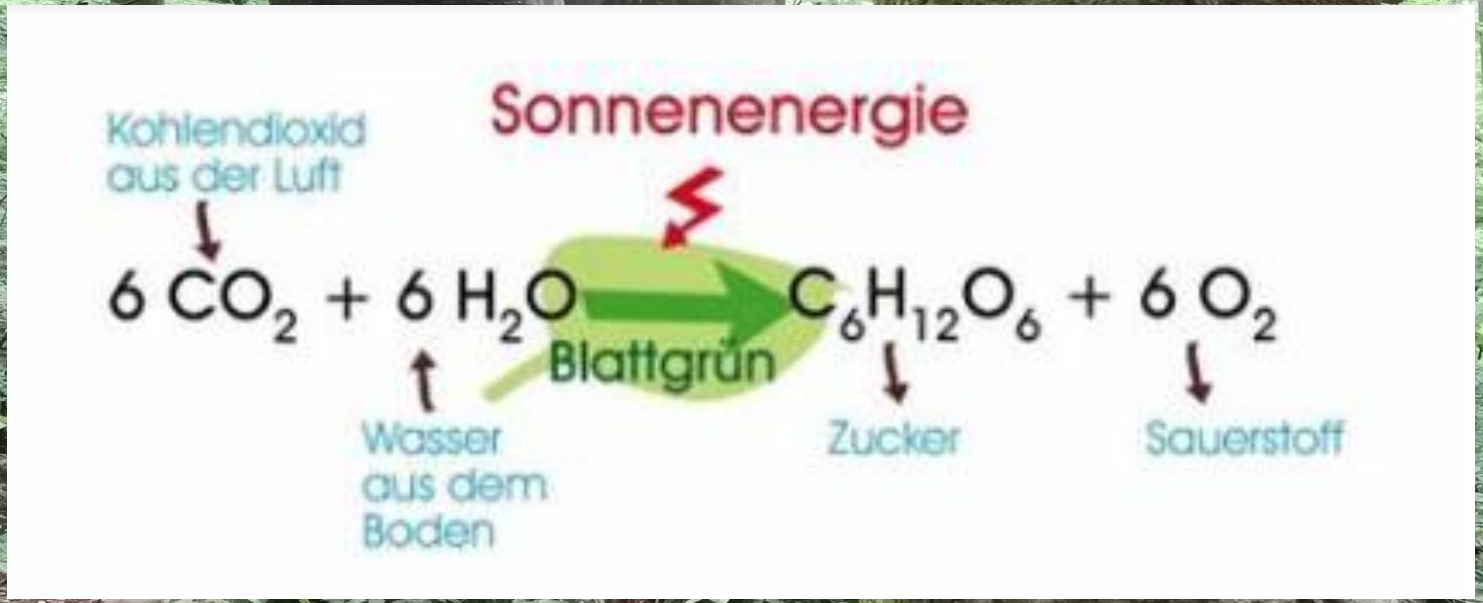


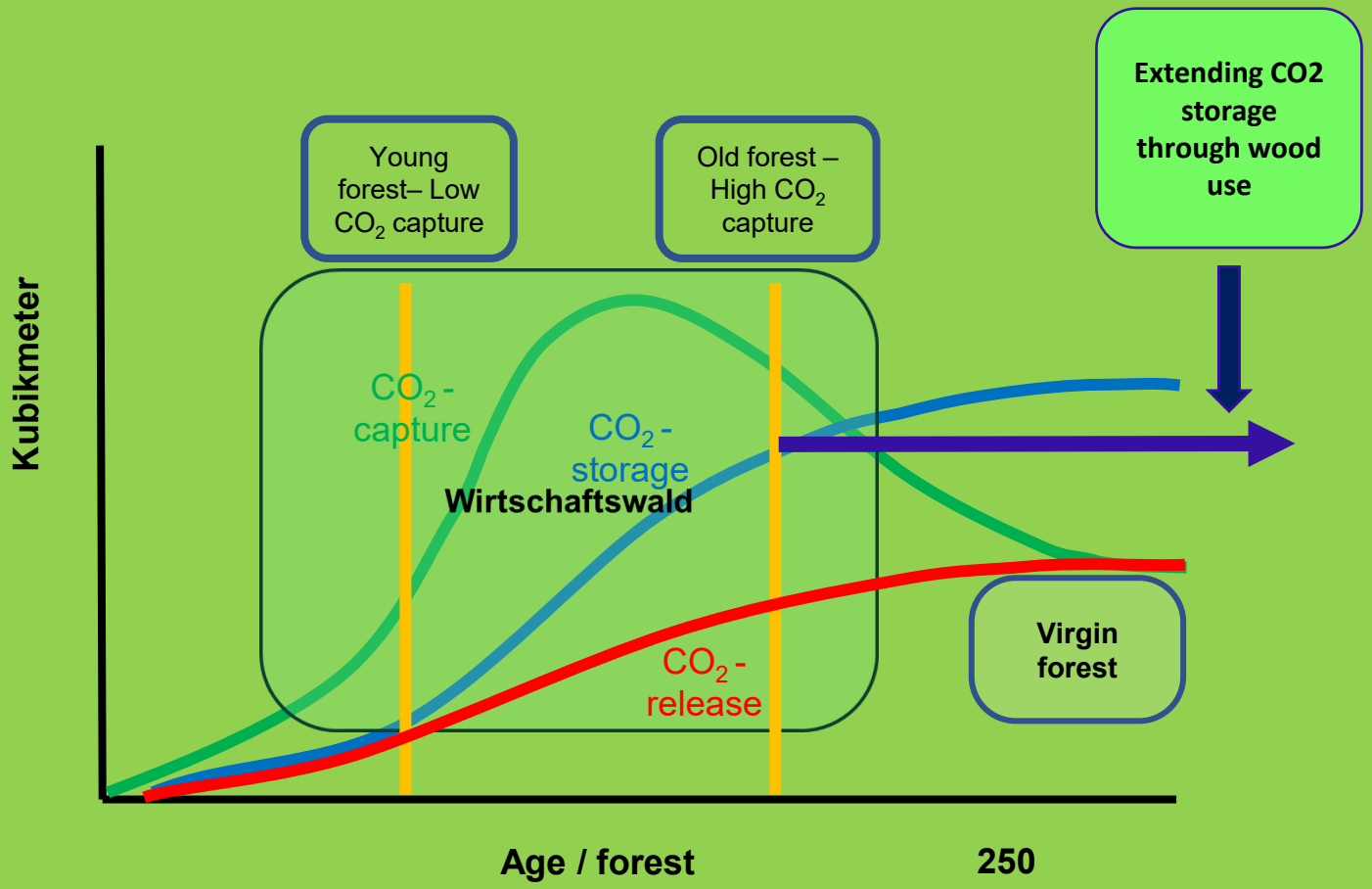
Wood is versatile.
Wood can store CO_2 or replace CO_2 emitters.

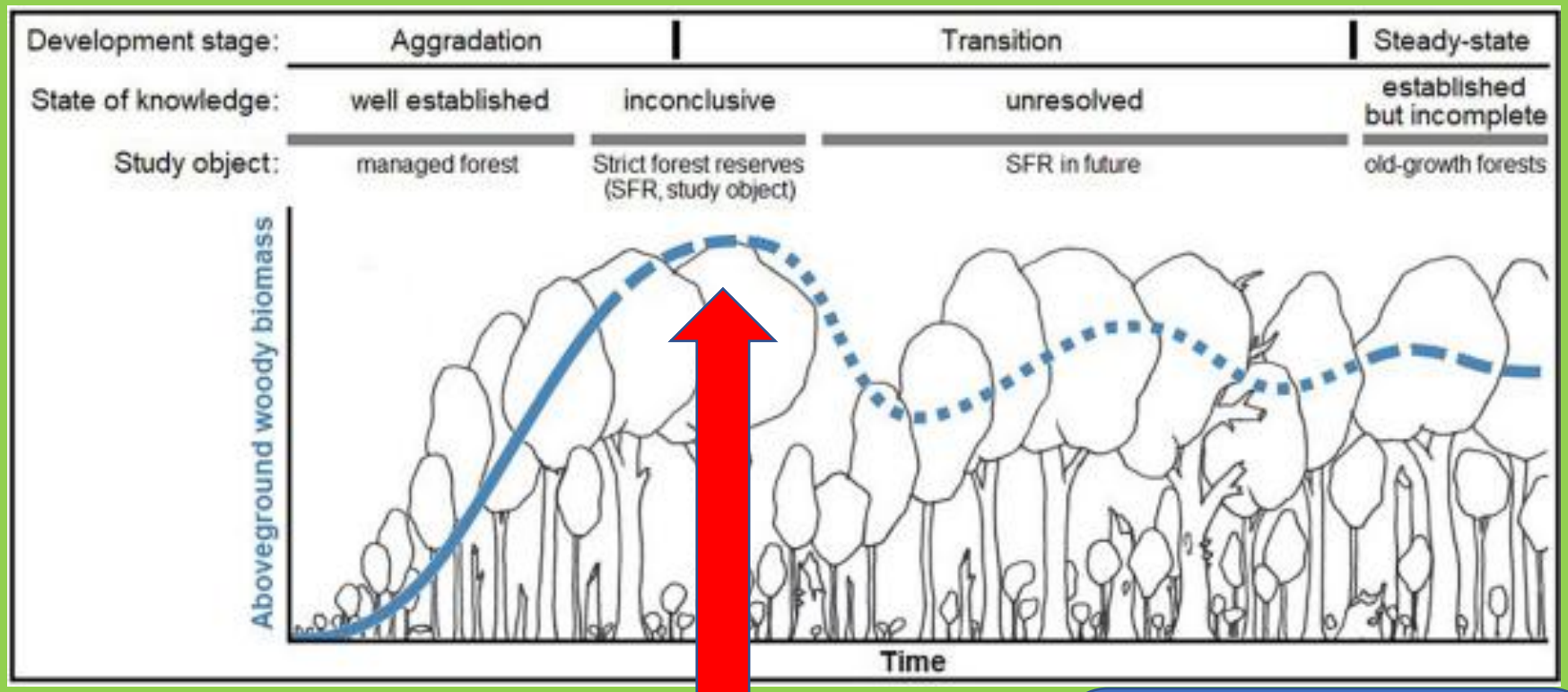




Wood binds CO_2




Extending CO2 storage through wood use
Young forest– Low CO_2 capture
Old forest – High CO_2 capture
Kubikmeter
CO_2 - capture
CO_2 - storage
Wirtschaftswald
CO_2 - release
Virgin forest
Age / forest
250



CO_2-storage-maximum after 40 years since end of use

Quelle: Nagel etal, (2023), Strict forest protection: A meaningful contribution to Climate-Smart Forestry? An evaluation of temporal trends in the carbon balance of unmanaged forests in Germany, FRONTIERS

CO2 storage in natural forests stagnates and goes into an equilibrium system after 40 years

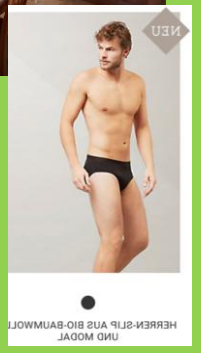
Good Reasons for Timber-Use

1. Low energy costs in production
2. Extended CO2 storage
3. Construction: replacing steel, aluminum, oil, etc.
4. Heating: replacing oil, gas, and coal
5. Clothes: replacing cotton
6. No waste – multiple uses (cascading)
7. Overall: renewable and appealing

Timber ist an important resource …





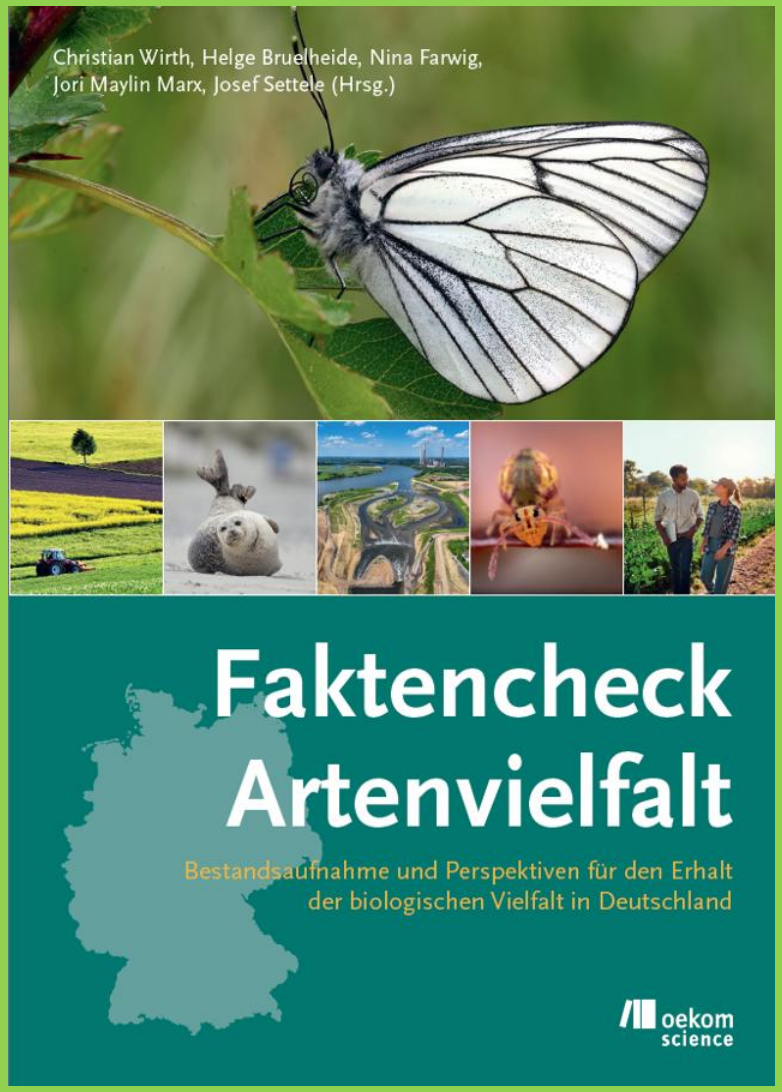








… but the global hunger for timber has a devasting impact on forest biodiversity - worldwide


Christian Wirth, Helge Bruelheide, Nina Farwig,
Jori Maylin Marx, Josef Settele (Hrsg.)
Faktencheck
Artenvielfalt
Bestandsaufnahme und Perspektiven für den Erhalt
der biologischen Vielfalt in Deutschland
oekom
science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Zusammenfassung für die
gesellschaftliche Entscheidungsfindung
oekom
science



Forest

Species found in forests in Germany

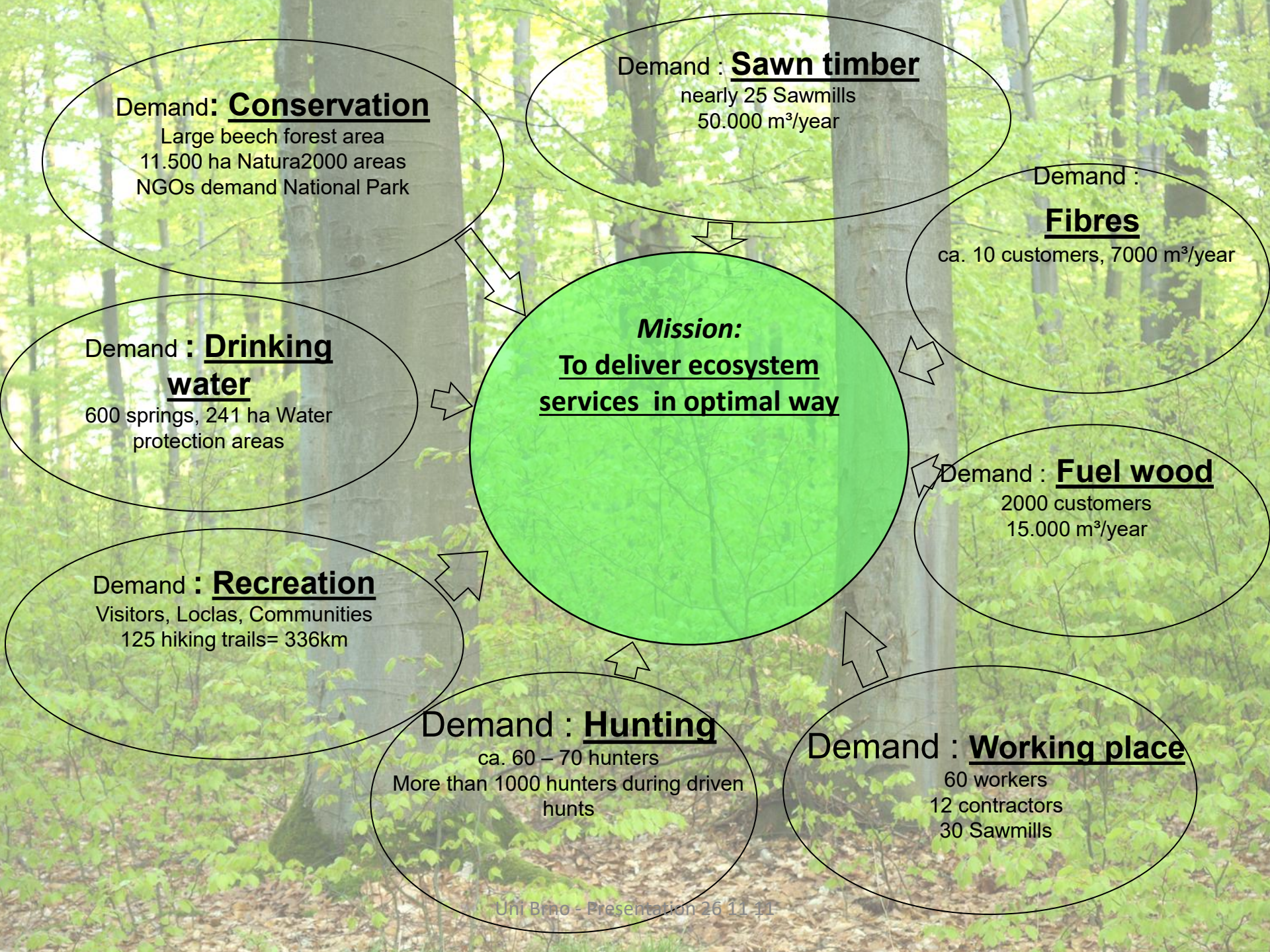
12	Amphibien
8	Reptilien
73	Vögel
71	Säugertiere
136	Schnecken
548	Spinnen
615	Wanzen
329	Zikaden
663	Hautflügler
3.783	Käfer
15	Tagfalter
585	Nachtfalter
1.216	Gefäßpflanzen
693	Moose
1.248	Pilze
227	Schleimpilze
270	Flechten
?????	Bakterien

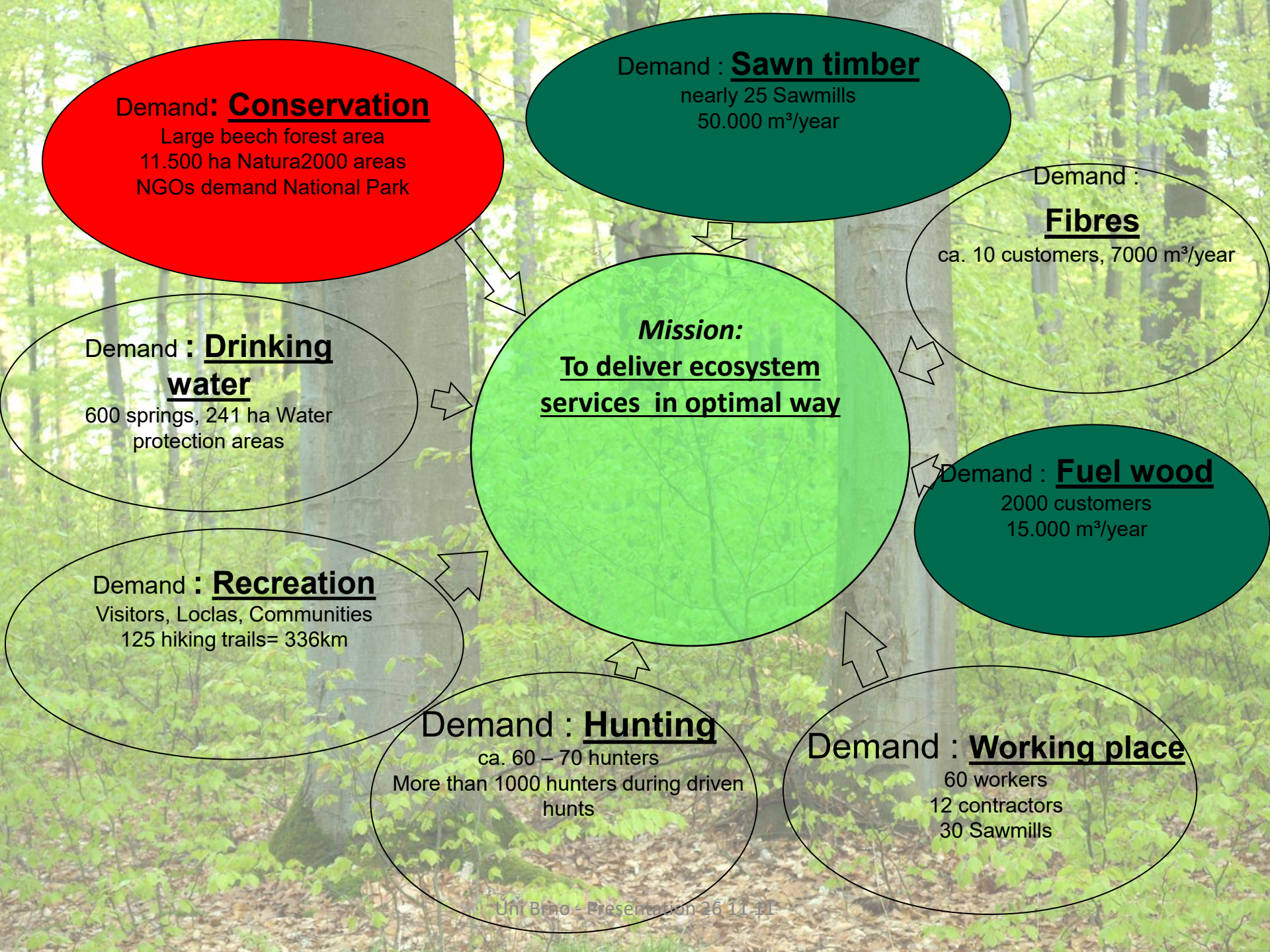
Total in Germany

10.500 species In the forests

Good reasons for biodiversity

1. Forests make up the largest natural habitat
2. Forests are rich in animal, fungal and plant species
3. The network of biodiversity strengthens the resistance and resilience of forests
4. Biodiversity helps retain water in forests (deadwood-soil improvement-forest humus)
5. Protecting the living environment has a high ethical and moral value in our culture


Demand: Conservation
Large beech forest area
11.500 ha Natura2000 areas
NGOs demand National Park
Demand : Sawn timber
nearly 25 Sawmills
50.000 m³/year
Demand :
Fibres
ca. 10 customers, 7000 m³/year
Demand : Drinking water
600 springs, 241 ha Water protection areas
Mission:
To deliver ecosystem services in optimal way
Demand : Fuel wood
2000 customers
15.000 m³/year
Demand : Recreation
Visitors, Loclas, Communities
125 hiking trails= 336km
Demand : Hunting
ca. 60 – 70 hunters
More than 1000 hunters during driven hunts
Demand : Working place
60 workers
12 contractors
30 Sawmills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125 hiking trails= 336km
Demand : Hunting
ca. 60 – 70 hunters
More than 1000 hunters during driven hunts
Demand : Working place
60 workers
12 contractors
30 Sawmills







How can we combine timber using and protection of biodiversity?











My solution:

The stepstone concept
-
an example of nature conservation-integrative forest-management

Naturschutzkonzept

für den

Forstbetrieb Ebrach



Regional Concept for conservation of natur and wood-species

Stand: Dezember 2014

The four elements of the stepstone-concept:

- **Habitat-Trees (Biotopbäume)**
- **Deadwood (Totholz)**
- **Small stepstones (Waldtrittsteine)**
- **Big stepstones (Naturwaldreservate)**

The four elements of the stepstone-concept:

- **Habitat-Trees (Biotopbäume)**
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1.
Habitat trees
the backbone for species diversity









What saproxylic and many other species need:

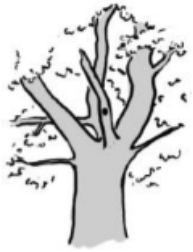
Entrance into the tree by microhabitats

One of the most important information came from European Forest Institute (EFI):

Daniel Kraus etal., 2016



CV1

Illustrationen	Code	Typ	Beschreibung	Saproxylische Mikrohabitate
		Spechthöhlen		
	CV11	ø = 4 cm	Höhleneingang mit einem ø von 4 cm und einem größeren Innenraum. Die Höhle von *Dendrocopos minor* befindet sich in Starkästen Baumkrone.	
	CV12		- 6 nnenraum. *ulis* baut seine Höhlen in den Stamm, wobei er vorwiegend Totastlöcher als Ansatzpunkt zum Höhlenbau nutzt. Der runde Höhleneingang folgt dem Habitus des Totastlochs. Die Höhlen z.B. von *Dendrocopos major* findet man an Faulstellen von Totastlöchern, toten Starkästen sowie in stehendem Totholz.	**Höhlen**
	CV13	ø > 10 cm	Spechthöhlen am Stamm weisen auf *Dryocopus martius* als Bewohner hin. Der Höhleneingang ist > 10 cm im Durchmesser, wobei dieser im Höhleninneren größer ist. *Dryocopus martius* baut seine Höhlen am astfreien Stamm. Der Höhleneingang ist oval. Die meisten Höhlenbäume haben einen BHD von mehr als 40 cm,	

Describtion of more than 60 habitatstructures

Stamm- und Mulmhöhlen

CV2

Höhlen

Baumhöhle mit Mulm und Bodenkontakt, was das Eindringen von Bodenfeuchte in den Hohlraum erlaubt. Der Eingang zur Höhle kann auch höher am Stamm liegen.	ø ≥ 10 cm (Bodenkontakt)	CV21
	ø ≥ 30 cm (Bodenkontakt)	CV22
Mit Mulm gefüllte Stammhöhle ohne Bodenkontakt.	ø ≥ 10 cm	CV23
	ø ≥ 30 cm	CV24
…der ohne …ma des Hohlraumes …eise den äußeren klimatischen Bedingungen ausgesetzt und Niederschlag kann eindringen. Der Eingang zur Höhle kann auch höher am Stamm liegen.	ø ≥ 30 cm / halboffen	CV25
Großer, kaminartiger Hohlraum im Stamm mit Öffnung nach oben, mit oder ohne Bodenkontakt.	ø ≥ 30 cm / hohler Stamm	CV26









Also important for scientific surveys


Often, there is a high ecological potential
only in ‘unmagaged' farm forests ….




… till the forester comes and …



… after thinning the habitat structures disappear

Habitatstrukturen auf den ABC-Grad-Versuchsflächen

Waldort: Abteilung Kapelle, ehem. Forstamt Fabrikschleichach - Durchforstungszeitraum: 145 Jahre

A-Grad: schwache Niederdurchforstung

B-Grad: mittelstarke Niederdurchforstung (Windwurf : 40% der Fläche)

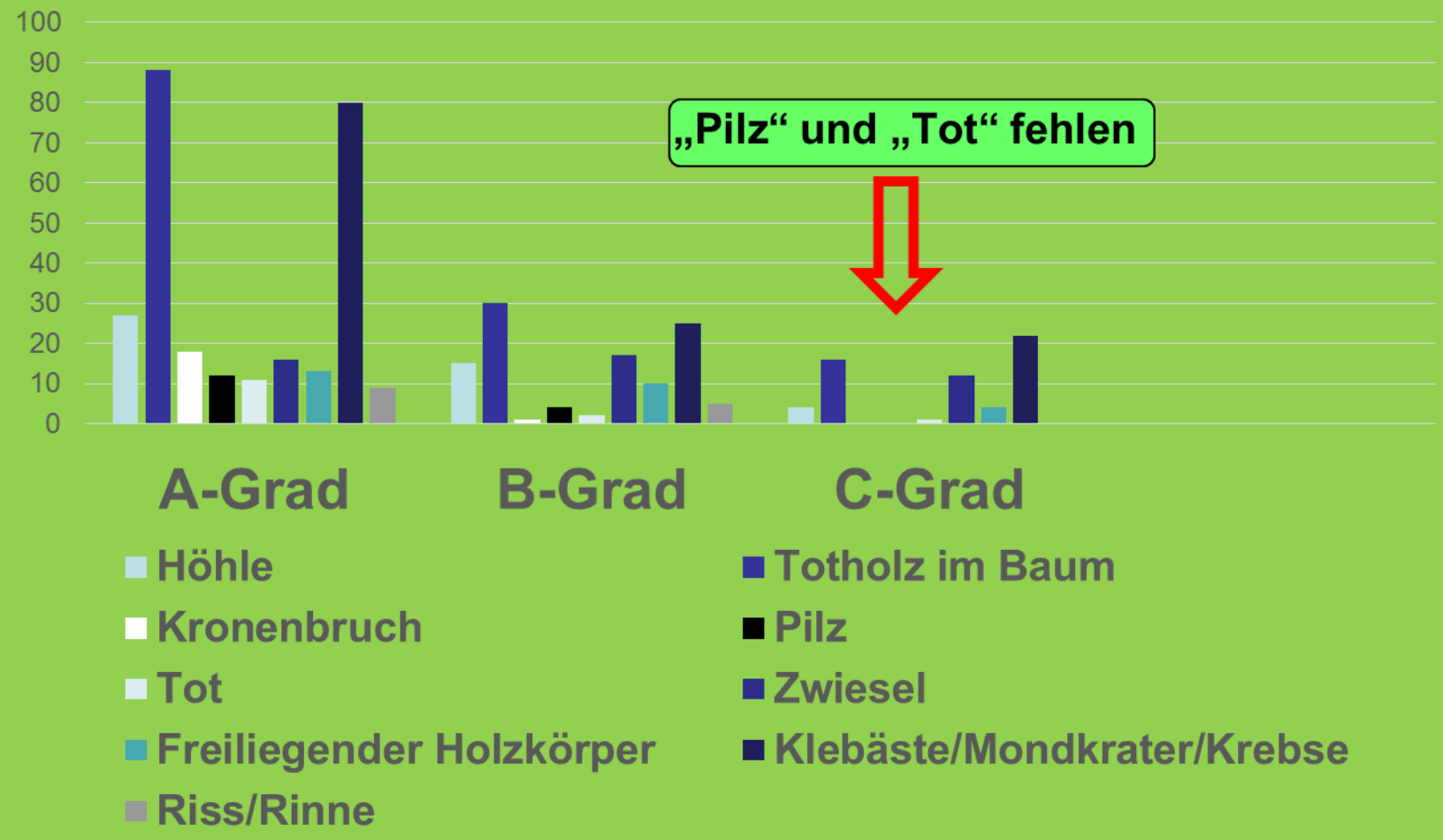
C-Grad: starke Niederdurchforstung







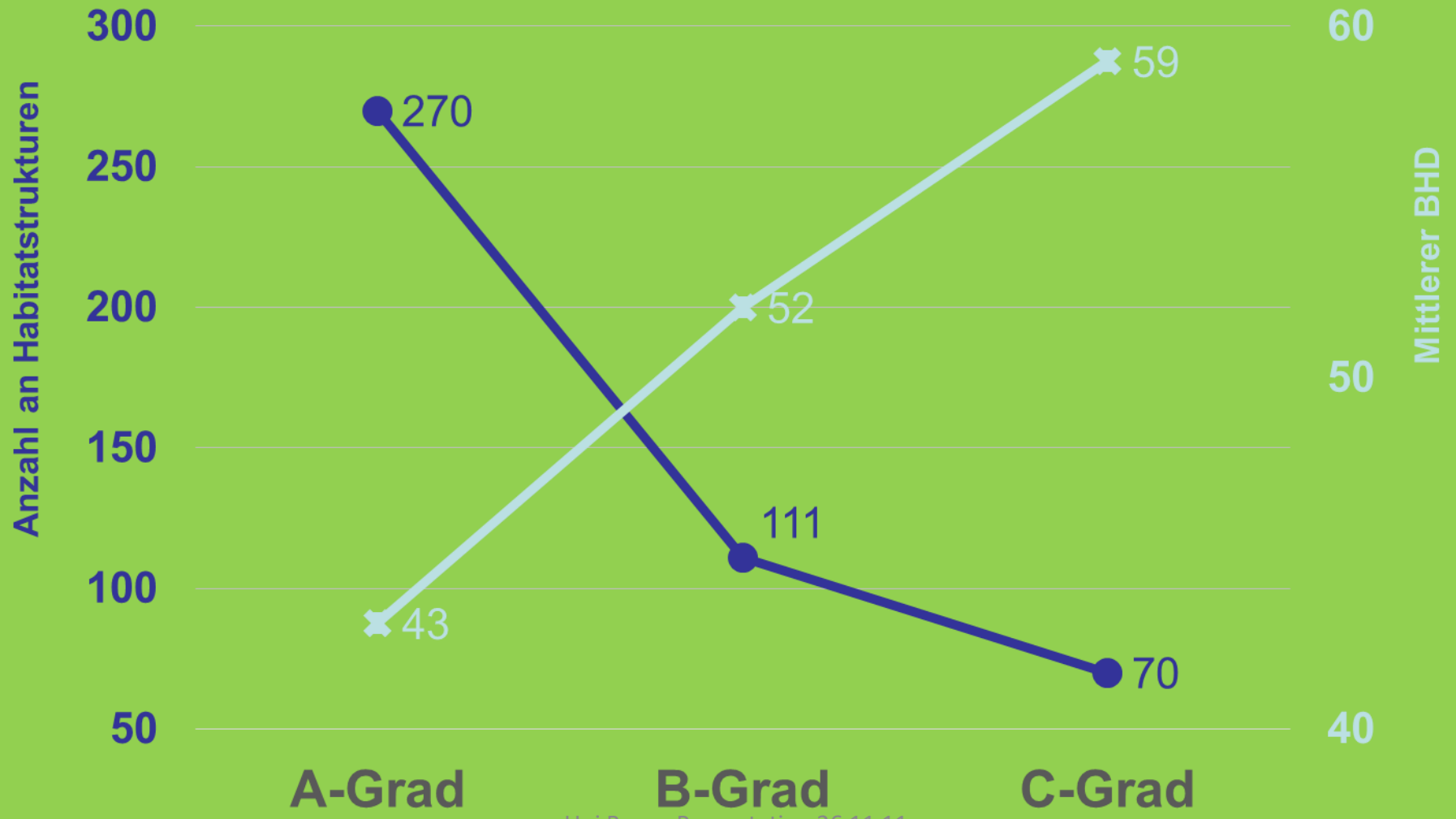
Arten der Habitatstrukturarten



Auftreten von Konsolenpilzen

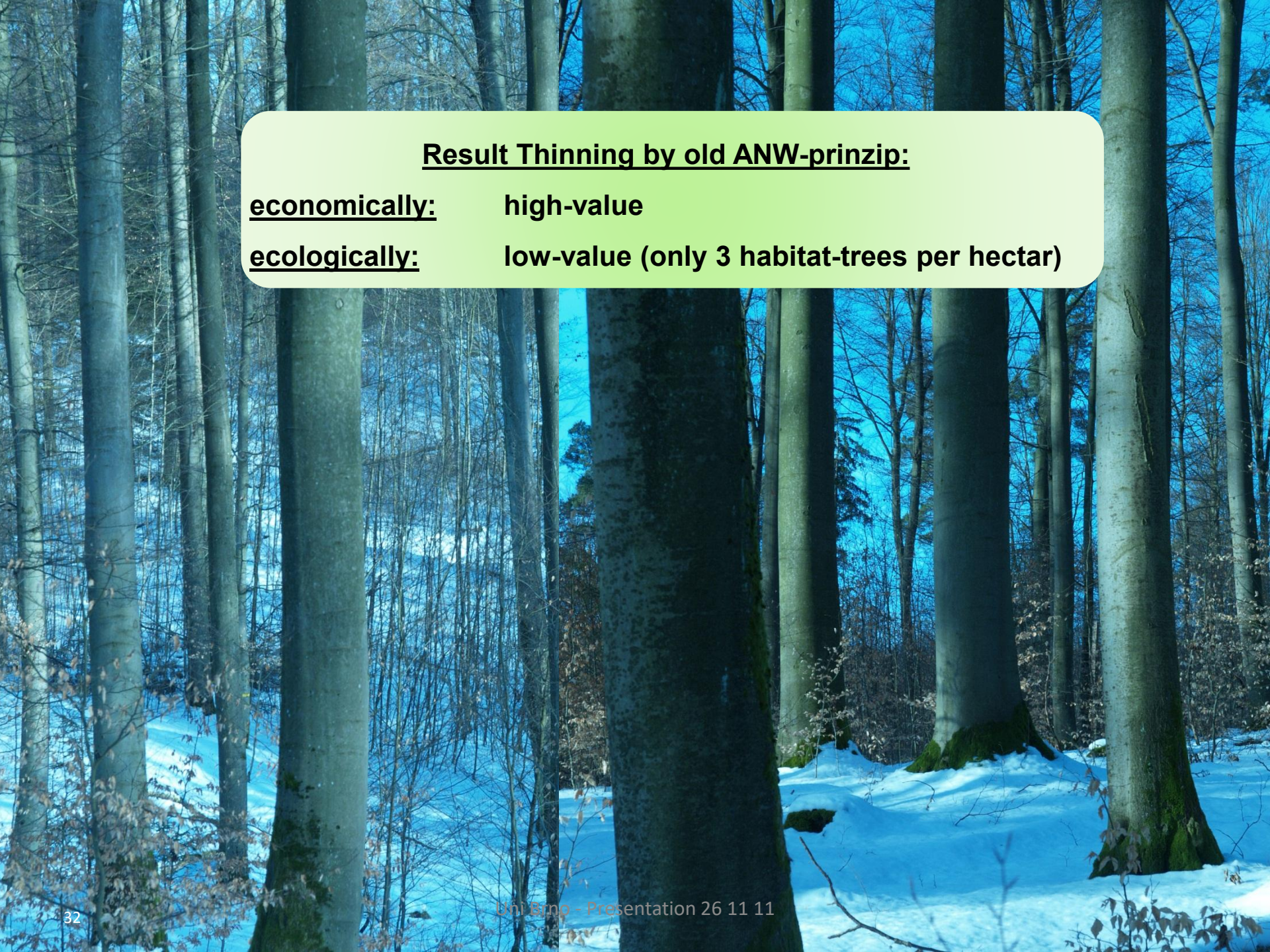


Habitatstrukturen und mittlere Baumdurchmesser in Abhängigkeit vom Durchforstungsgrad



Conclusion from ABC-research-area for thinning and sizing trees for Sizing for the use of valuable timber:

1. **Thick trees and old forests aren't necessarily ecologically valuable**
2. **Even during forest maintenance, attention must be paid to habitat structures**



Result Thinning by old ANW-prinzip:

economically: high-value

ecologically: low-value (only 3 habitat-trees per hectar)



Result of missing thinning:

economically: low-velue

ecologically: high-value (10 habitat-trees per hectar)

Die Auslesedurchforstung

Die wichtigsten erkennbaren Holzfehler (Auswahl):

- Krummer Schaft
- Zwiesel
- Trocken- und Frostrisse
- Überwallte Aststummel
- Fäule
- Gewaltsame Beschädigungen des Schaftes



VERLAG PAUL HAUPT BERN-LEIPZIG 1942

34

Biodiversität im Wald

Georg Möller

We need a discussion about thinning

Schlüsselstrukturen an lebenden Bäumen (Auswahl):

- Blitzrinnen
- Zwieselabrisse
- Risse und Spalten
- Starkastausrisse und Totastlöcher
- Verpilzte Areale
- Schürfstreifen und Kronenbrüche

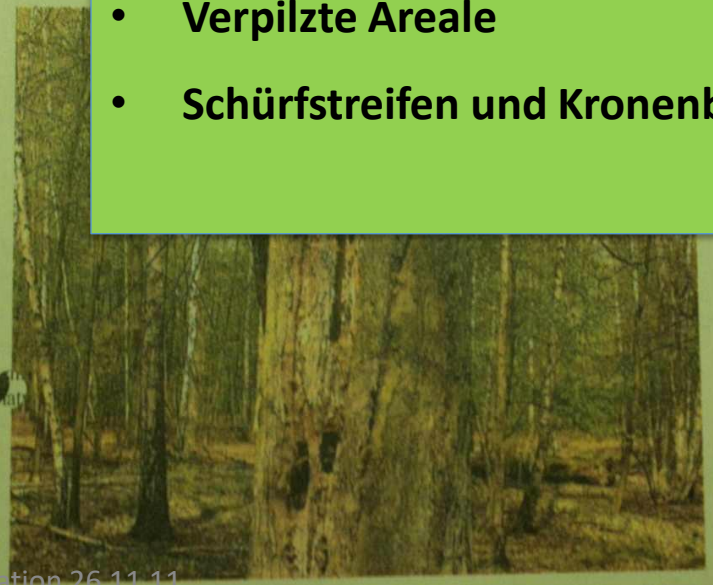


Abb. 1: Blitzrinnenbuche 2005, der pilzmyzelhaltige Holzkörper ist durch nagende Insek-

Schlüsselstrukturen an lebenden Bäume

Uni Rio - Presentation 26.11.11


Wulf-trees:
hey should not longer be
our enemies


Wulf-trees become
habitat-trees,
offen with big holes in
the lower tree trank


Big holes in the lower tree trank are the livingroom of Osmoderma eremita (and many other species)

Sustainable protection of habitat trees (1)

Tending

- **Conservation goal:**
  - Retention of wolf trees (thick-branches, douple-trunks)
  - Retention of mature „achievers“ as habitat trees
- **Silvicultural goal:**
  - Diversification of mixed tree species
- **Implementation:**
  - No tending in mono-specific young stands
  - No negative selection
  - Spray-paint instead of chainsaw (Fuelwood harvest as priority)

Sustainable protection of habitat trees (2)

Early and late thinning phases

- **Conservation goal:**
  - Retention of potential habitat trees
- **Silvicultural goal:**
  - Promotion of elite trees (tree groups)
- **Implementation:**
  - Limiting selected elite trees to max. 40 – 50 / ha
  - Positive selection and marking with coloured tape
  - Preservation of potential habitat trees
  - No negative selection, no clearing out of bad quality trees
  - Creating high stumps during harvester operations

Sustainable protection of habitat trees (3)

Regeneration phase (AD / VJN / LB)

- **Conservation goal:**
  - Accumulation of deadwood (20 m^3 / 40 m^3)
  - 10 habitat trees/ha
- **Silvicultural goal:**
  - Target diameter harvest
  - Promotion of admixtures
- **Implementation:**
  - Separation of the harvested trunk from the crown at first strong branch
  - Limiting the use of timber not processed for sale

Sustainable protection of habitat trees (4)

General rules

- No timber harvest during the period of breeding and rearing
- Early termination of harvesting in mature and old stands
- Permanent marking of habitat trees with „wave line“
- No felling of habitat trees accidentally marked for harvesting
- Trunk sections with cavities are left in the stand when a habitat tree was felled accidentally





High-trunk-habitat-trees worked by harvester

- good in younger stands
- up to 15 m from tracking-line



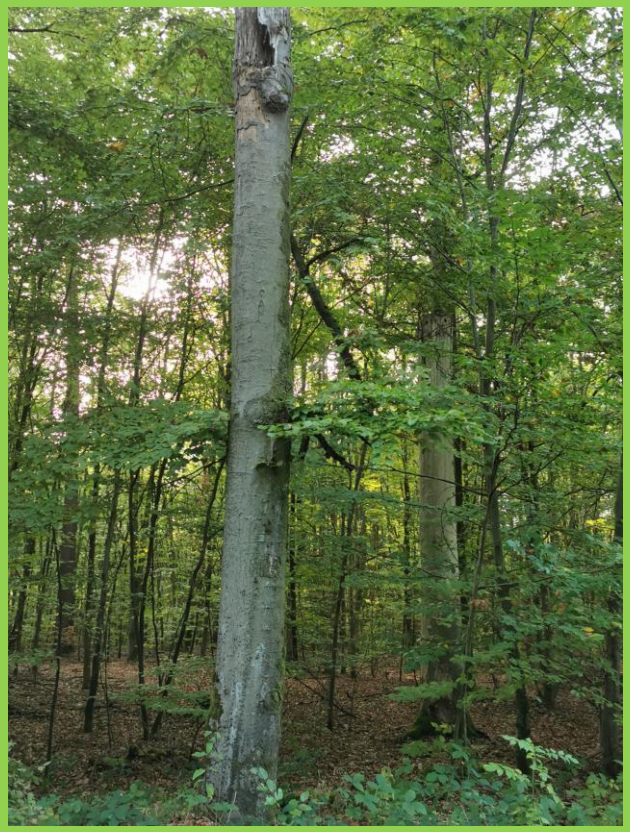
Source: All pictures: Dr. Michael Junginger, Uni Würzburg
Aufnahmeort: Uni-Forstamt Sailershausen 2021/22





Result of havester-work

already after 3 years
appear the first holes








Conversion: From the
marking for the felling …..


… to the wave line of the
future habitat tree

Pillis Forest Budapest (Hungria)
Recording of habitat trees



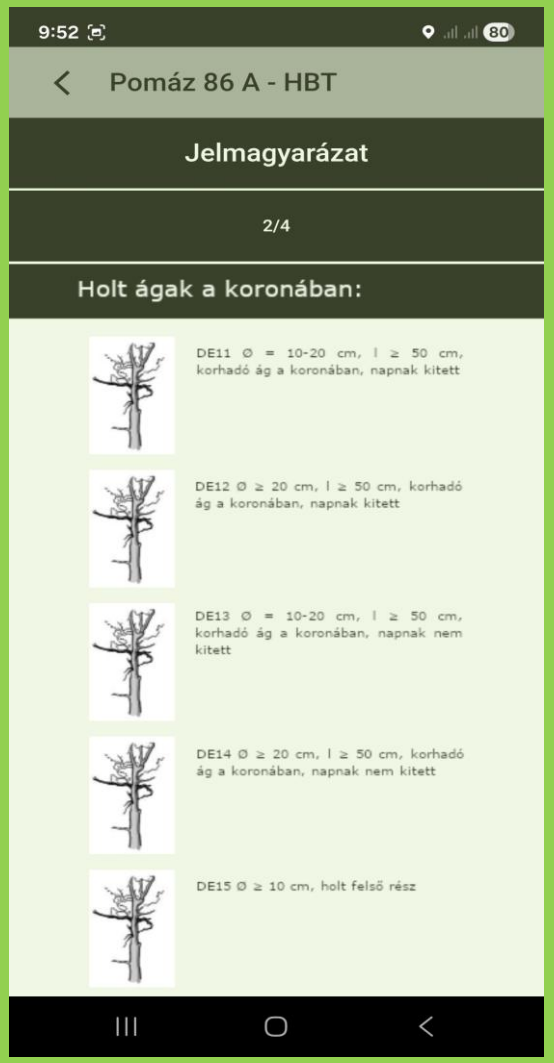


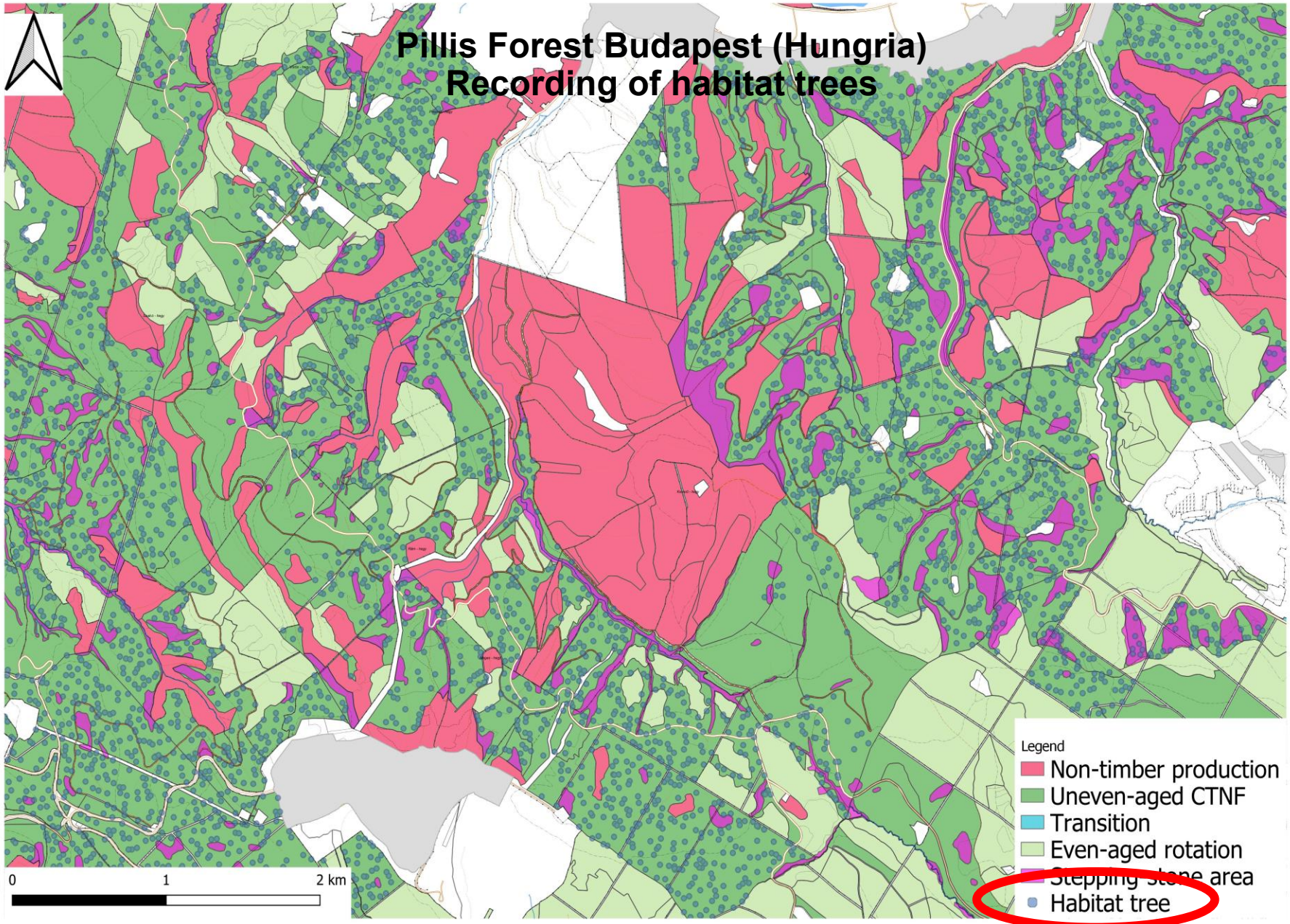


Pillis Forest Budapest (Hungria)
Recording of habitat trees








Pillis Forest Budapest (Hungria)
Recording of habitat trees
Legend
Non-timber production
Uneven-aged CTNF
Transition
Even-aged rotation
Habitat tree
0
1
2 km

Universitätsforstamt Sailershausen (Uni Würzburg-Germany)
Recording of habitat trees





Ebenen

Naturschutz - Habitatbäume

Kategorie

Habitat

Beschreibung

Habitatbaum Buche BHD 65 freiliegender Holzkörper Steiläste

Hauptordner: Universitätsforstamt Sailershausen

Breitengrad

50,0089388 °

Längengrad

10,5146045 °

Ebenen

Naturschutz -

Kategorie

Habitat

Beschreibung

Habitatbaum Erle BHD 70 Tiefzwiesel Absterbender Steilast, Spechthöhle

Hauptordner: Universitätsforstamt Sailershausen

Breitengrad

50,0093364

Längengrad

10,5100803

GPS-Quelle

internal

The four elements of the stepstone-concept:

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- **Deadwood (Totholz)**
- Small stepstones (Waldtrittstein)
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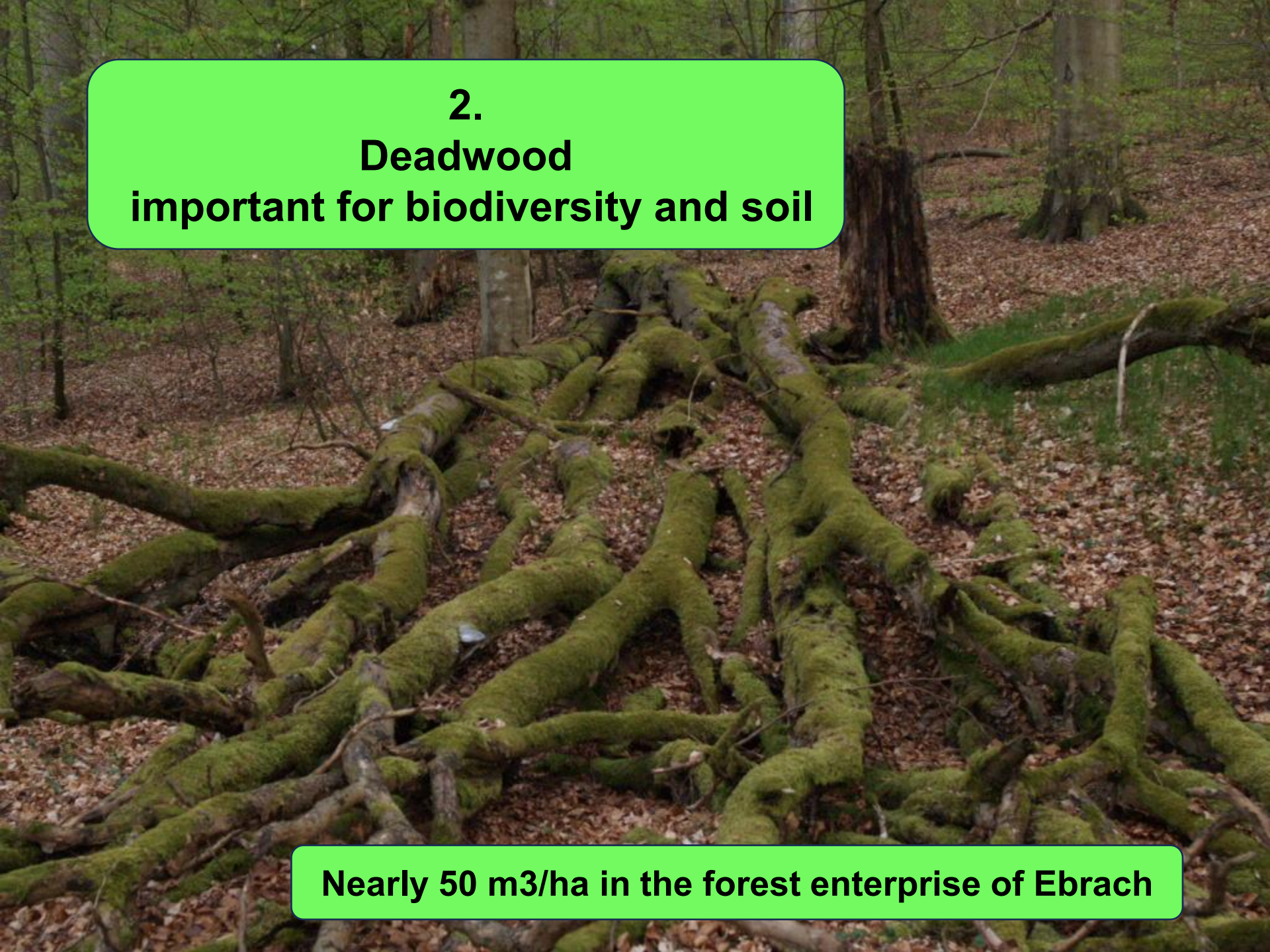
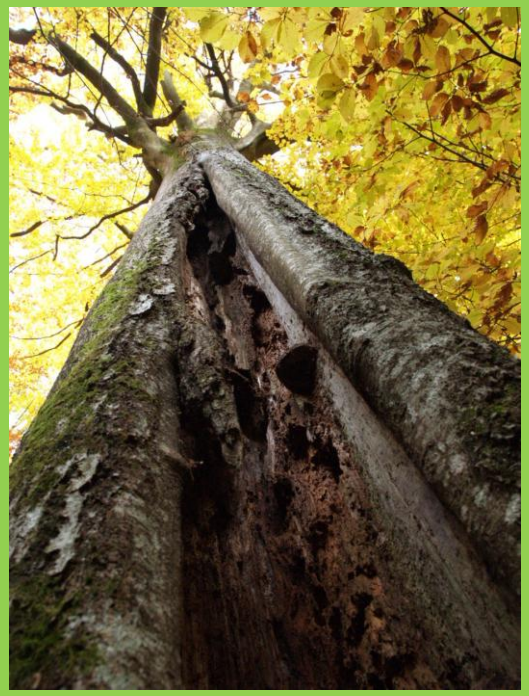

2.
Deadwood
important for biodiversity and soil
Nearly 50 m3/ha in the forest enterprise of Ebrach





Standing and lying deadwood



Deadwood is important …



... for nutrient sustainability

...and for water retention


Deadwood
–
Rotten wood –
Forest humus

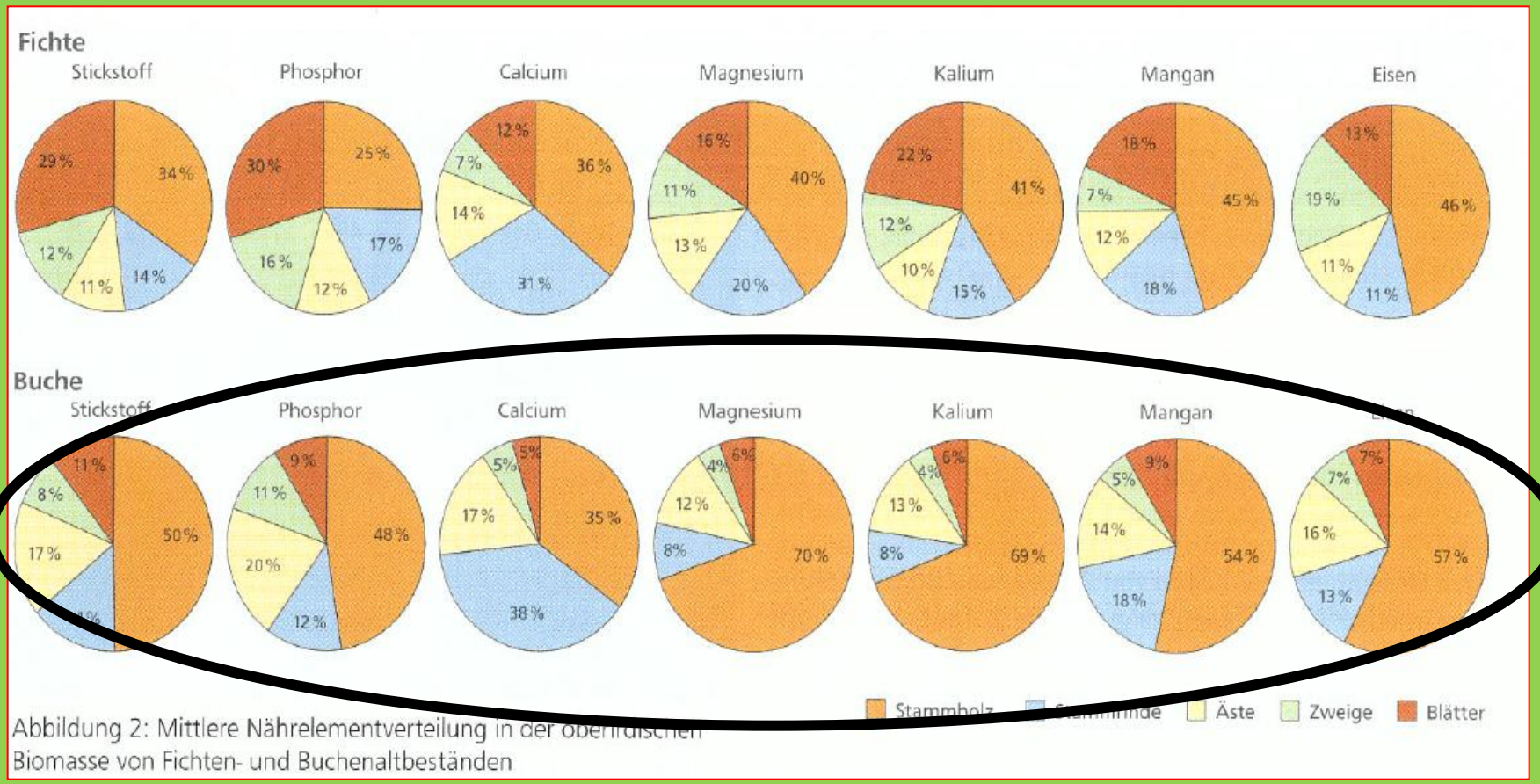


Abbildung 2: Mittlere Nährelementverteilung in der oberirdischen Biomasse von Fichten- und Buchenaltbeständen

•Quelle: Weis/Göttlein: Nährstoffnachhaltige Biomassennutzung, LWF-aktuell 90-2012



It is very easy to produce strong deadwood when felling trees ..



Hericium erinaceus



Hericium coralloides

… and it is also very important for biodiversity living on strong deadwood

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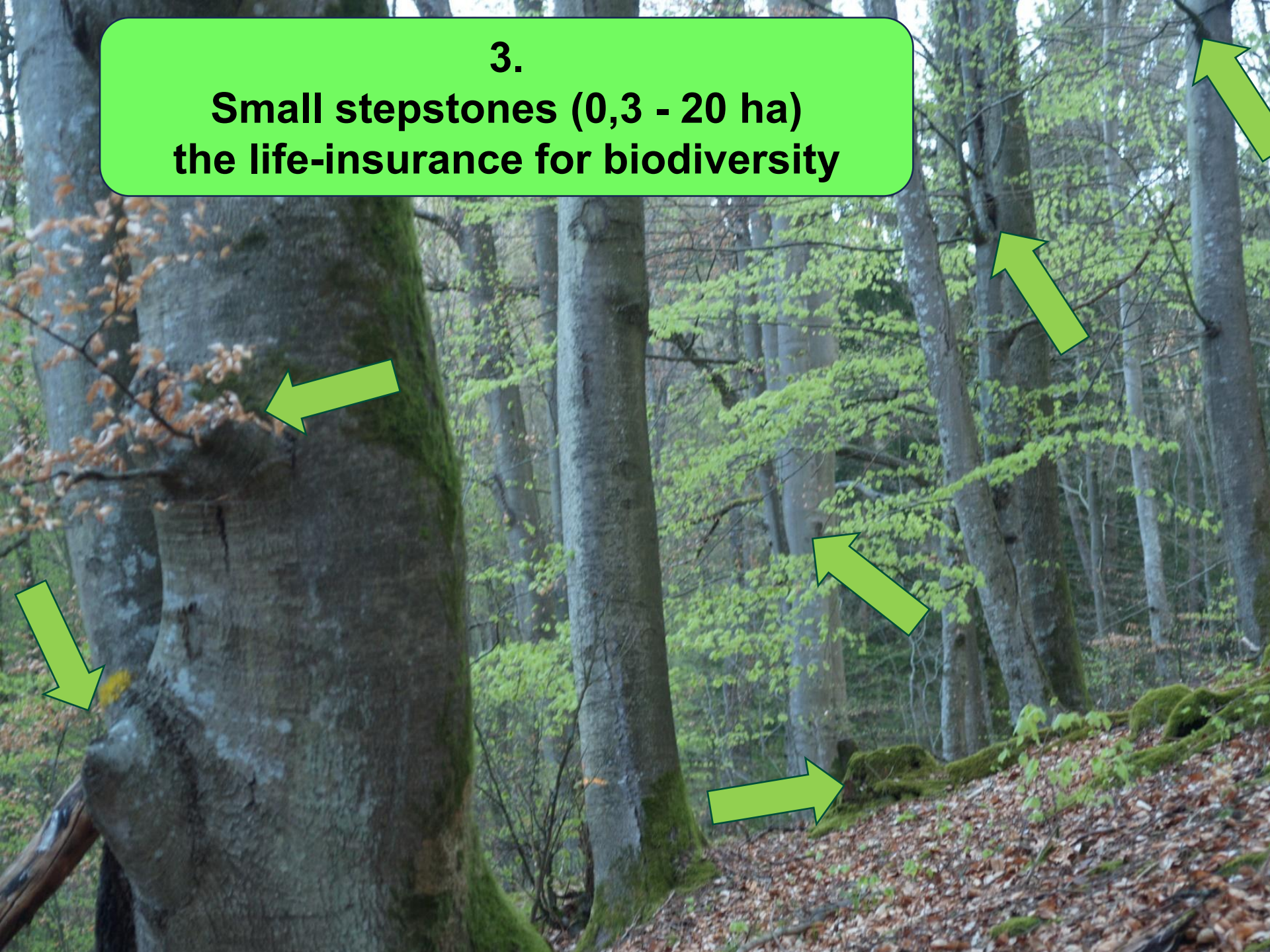
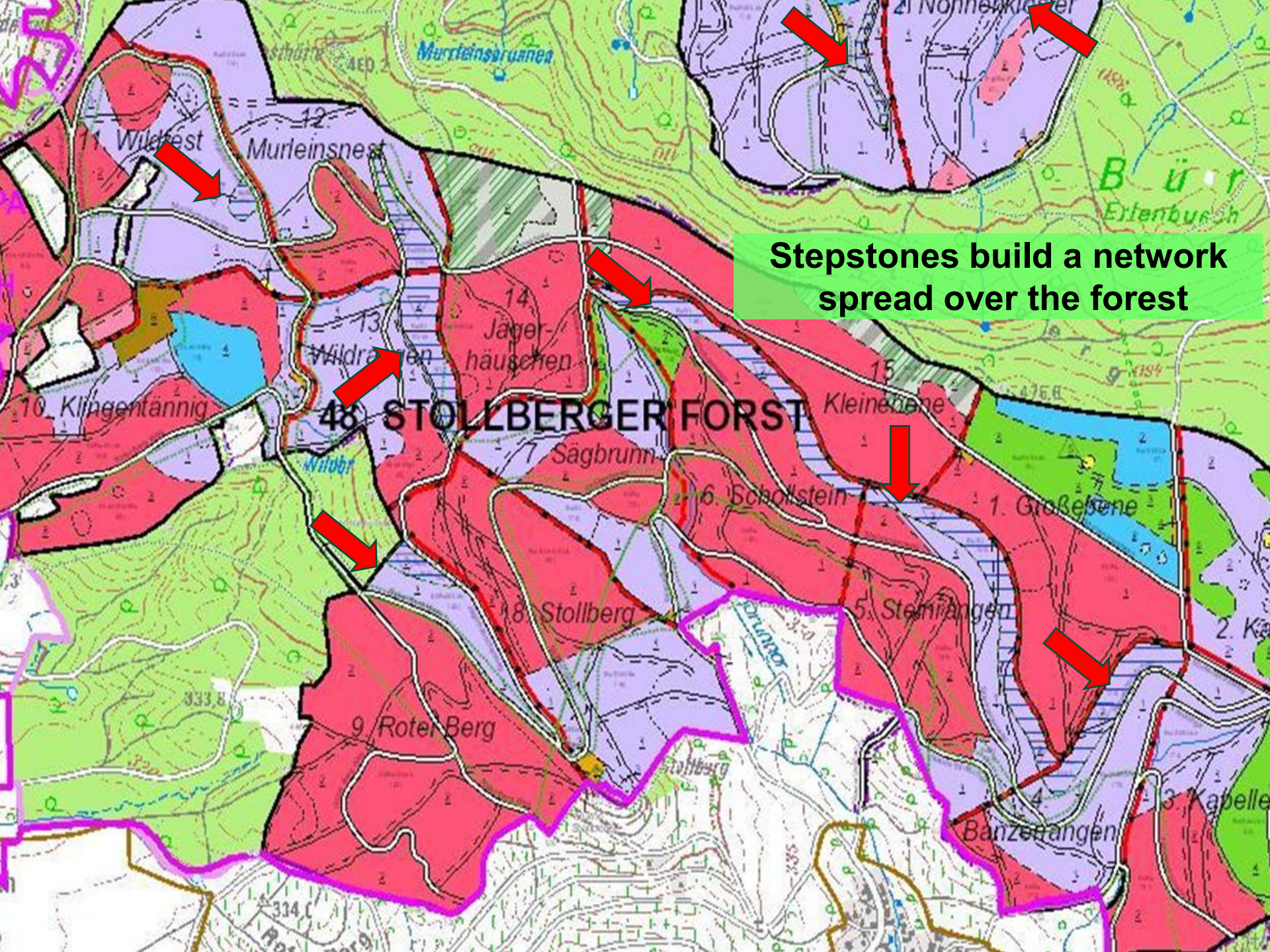

3.
Small stepstones (0,3 - 20 ha)
the life-insurance for biodiversity


Stepstones build a network spread over the forest
48 STOLLBERGER FORST
11 Wildfest
12 Murleinsnest
13 Wildrasten
14 Jäger-häuschen
15 Kleineberne
10 Klingentannig
7 Sägbrunn
6 Schollstein
1 Großeberne
8 Stollberg
5 Steinrangen
9 Roter Berg
4 Banzenrangen
3 Kapelle
Murleinsbrunnen
Wildbr
Stollberg
B ü r
Ertenbusch


Stepstone-areas are marked permanently

Many good possibilities for smal stepstones:

The 'forgotten' (long-unused) forest
The old-growth island in the young forest
The deciduous tree nest in the coniferous forest
The forest area with many black woodpecker holes
The forest on a block field
The area of a mountain peak
The hard-to-access gorge
The waterlogged valley hollow and the mossy forest
The river-adjacent steep bank
The former coppice forest
The abandoned quarry
The spoil heap
The forest edge rich in habitat trees
The habitat-wood-rich field copse

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- **Big stepstones (Naturwaldreservate)**

Naturwaldreservat Kleinengelein



Big stepstones (30-850 ha)
important for science and learning



We learn about vitality, density, natural regeneration and carbon storage

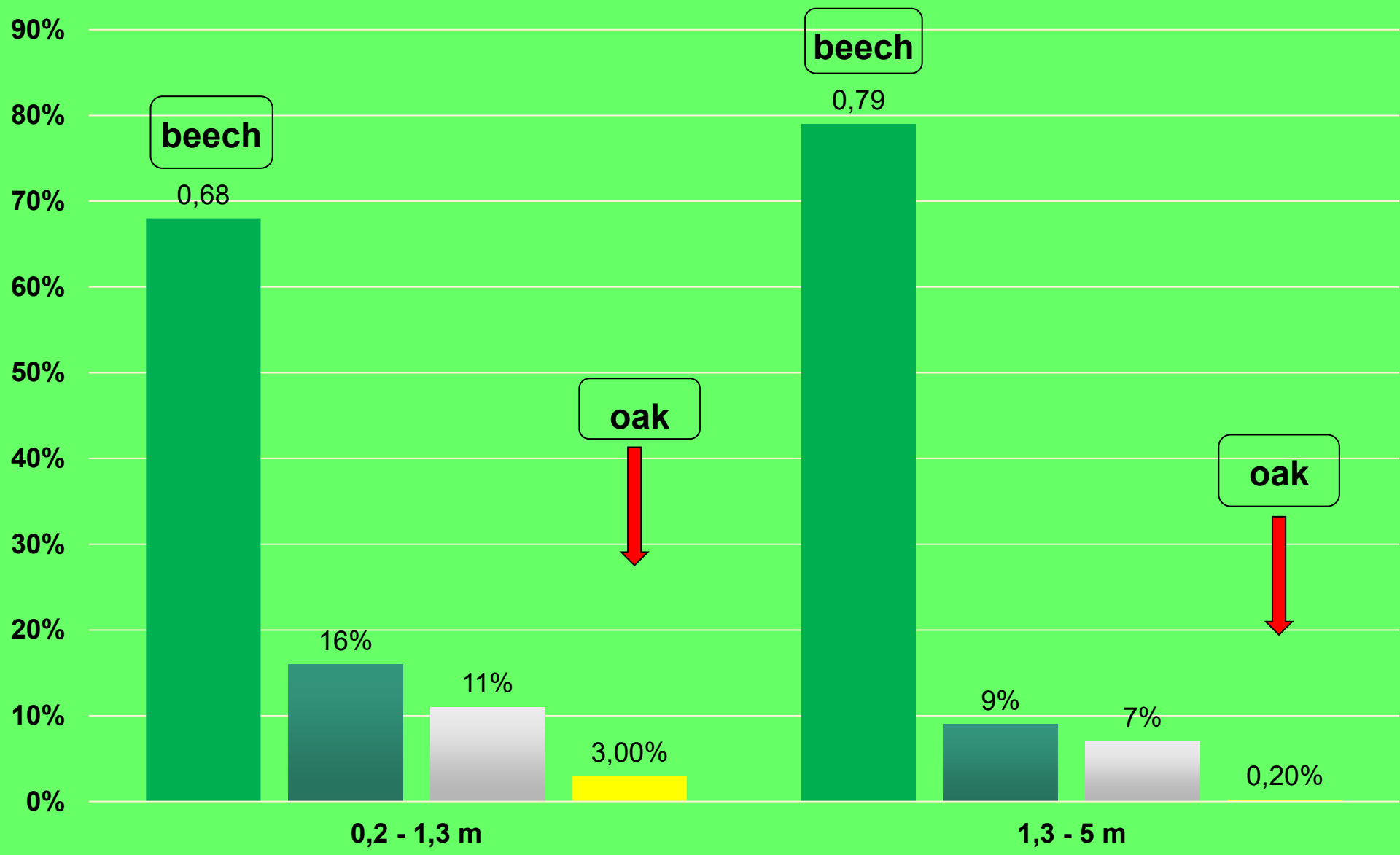


Knowledge of scientific researces in Naturwaldreservate in Steigerwald forests:

High amont of species on small areas

Strictly protectet „Naturwaldreservat Waldhaus“:
1.300 Species found on only 10 hectares

Tree species proportions in regeneration in den big stepstones (Naturwaldreservaten) in FB Ebrach



Analysis of Oak Natural Regeneration in 30 Nature Reserves

Oak nature reserves show a declining proportion of oak area.

Oak hardly appears in the regeneration of the nature reserves examined.

Sooner or later, it will largely disappear from the composition of the reserves and will hardly play any role in the next forest generation.

Source: Stimm, K. u.a. Bestandsdynamik und Verjüngung in Eichen-Naturwaldreservaten AFZ Nr. 34/2020



Xylobolus frustulatus



Phellinus igniarius

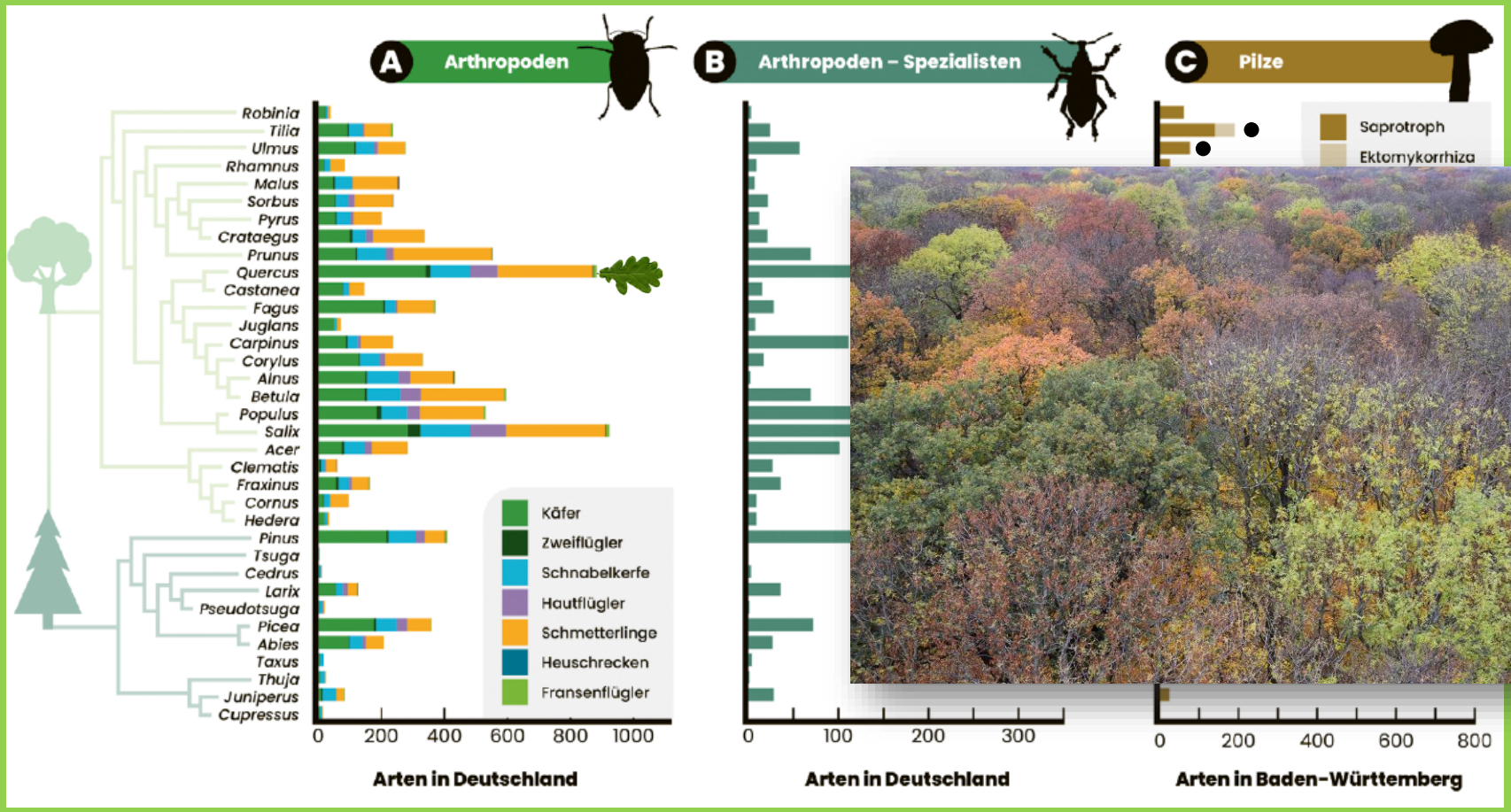


Oak is one of the most important tree for biodiversity – but we have to help her

Direkte Treiber

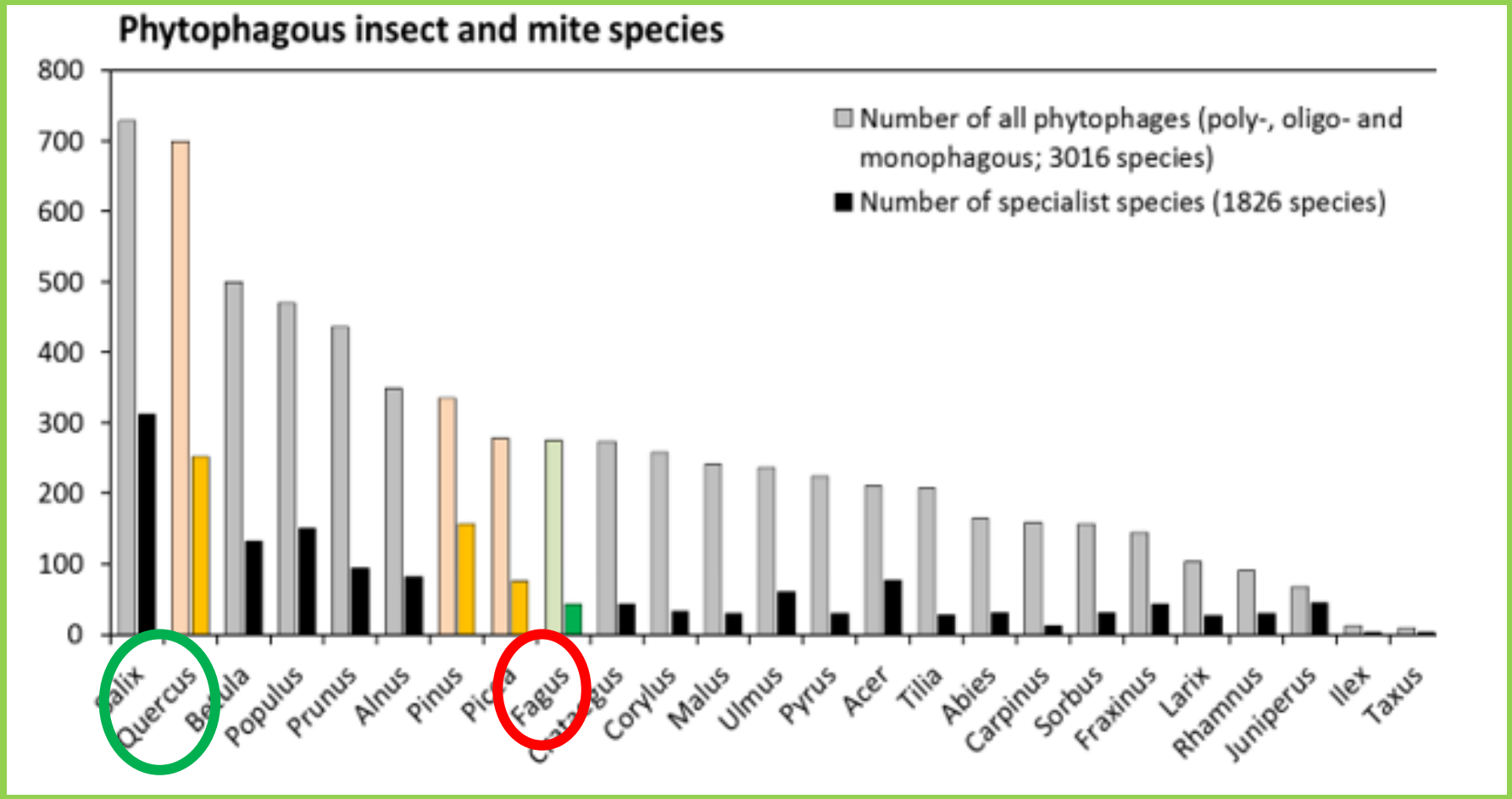
Wald

Tree species diversity is an important driver for species diversity



Müller et al. (2024) Wald, in: Wirth et al. (Hrsg.) Faktencheck Artenvielfalt. Oekom Verlag.

The importance of tree species for leaf-eating insects and mites, Source: Brändle and Brandl 2001



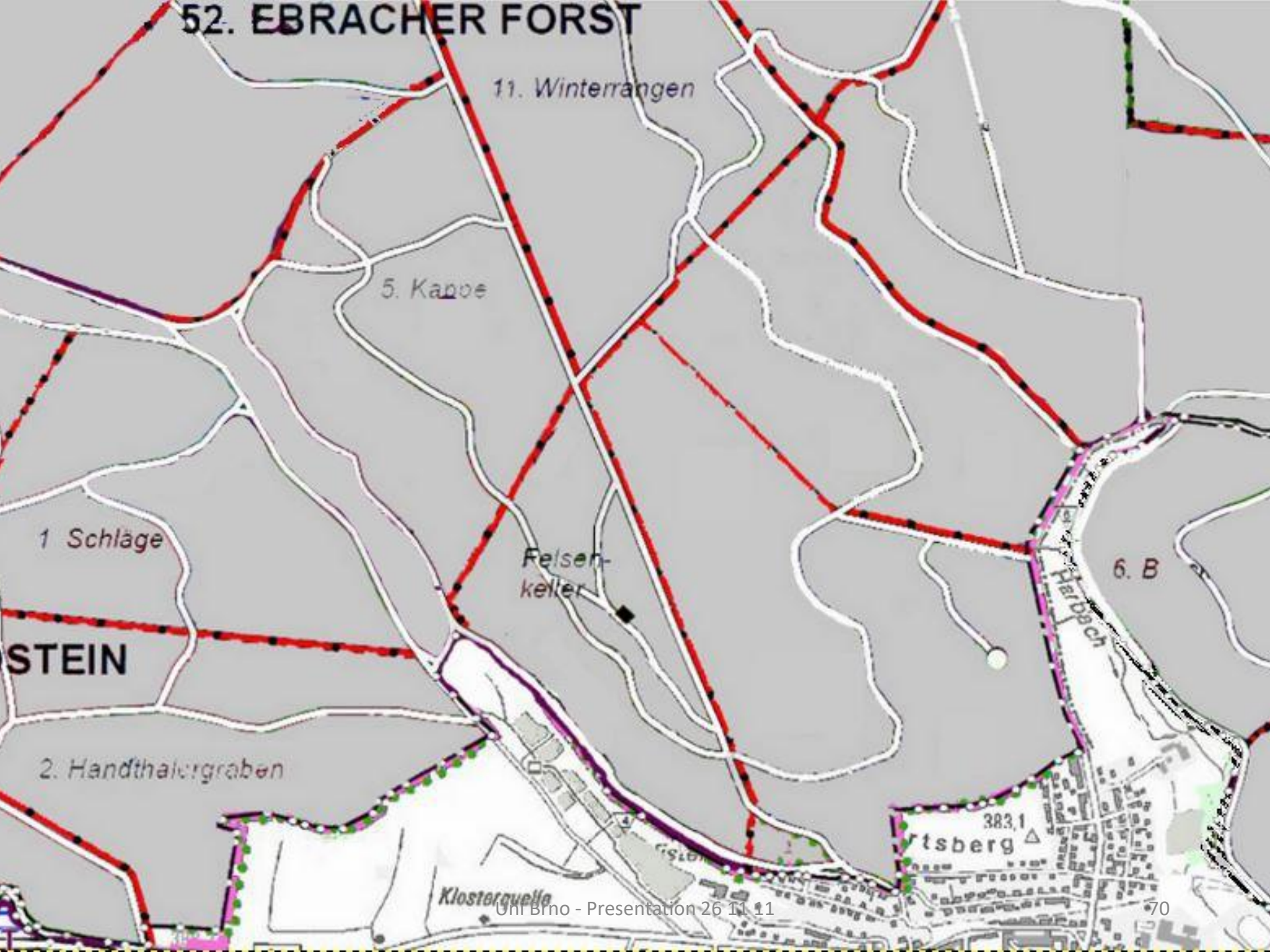


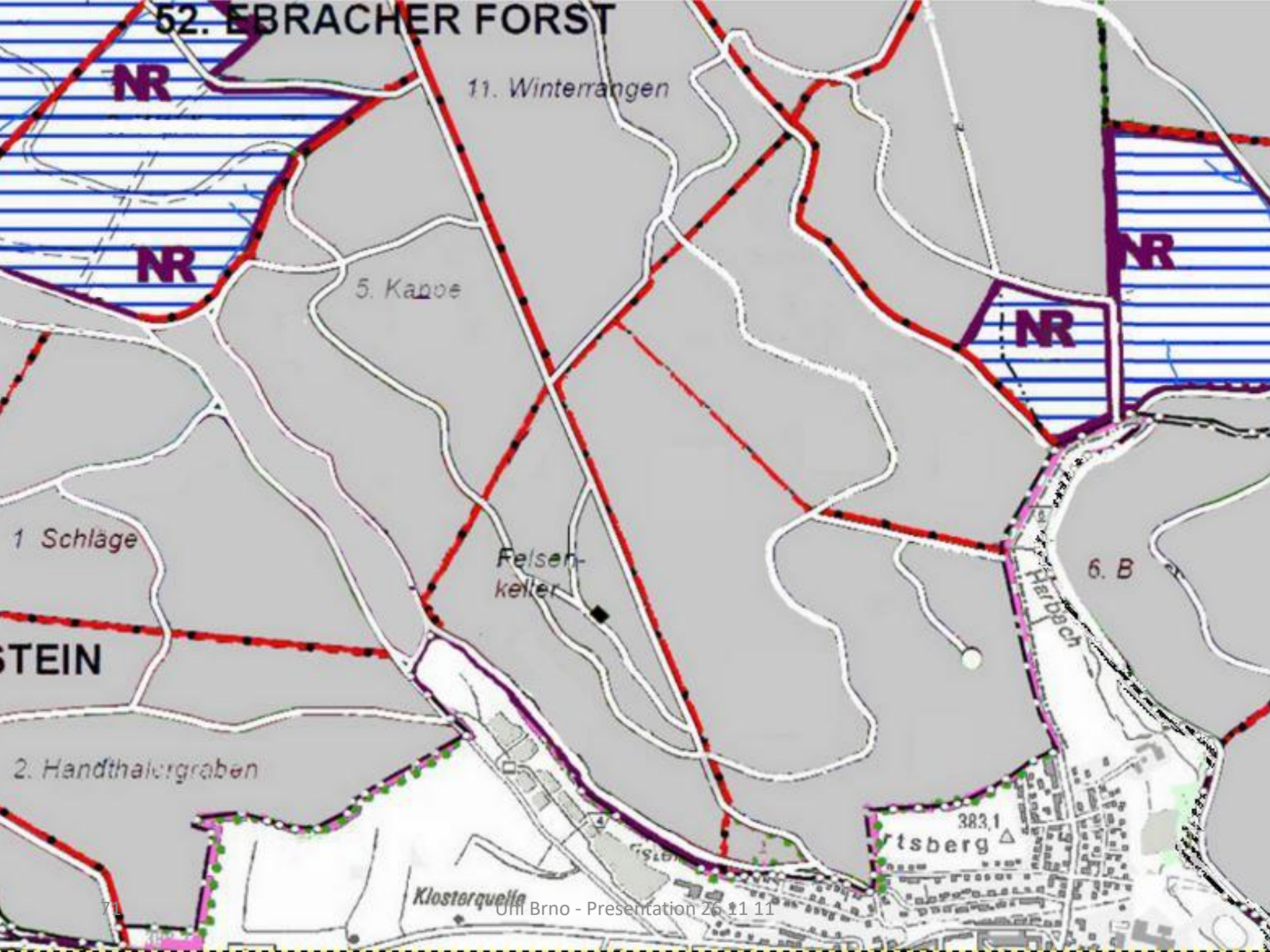
To ensure oak and other tree-species regeneration we need to hunt deer

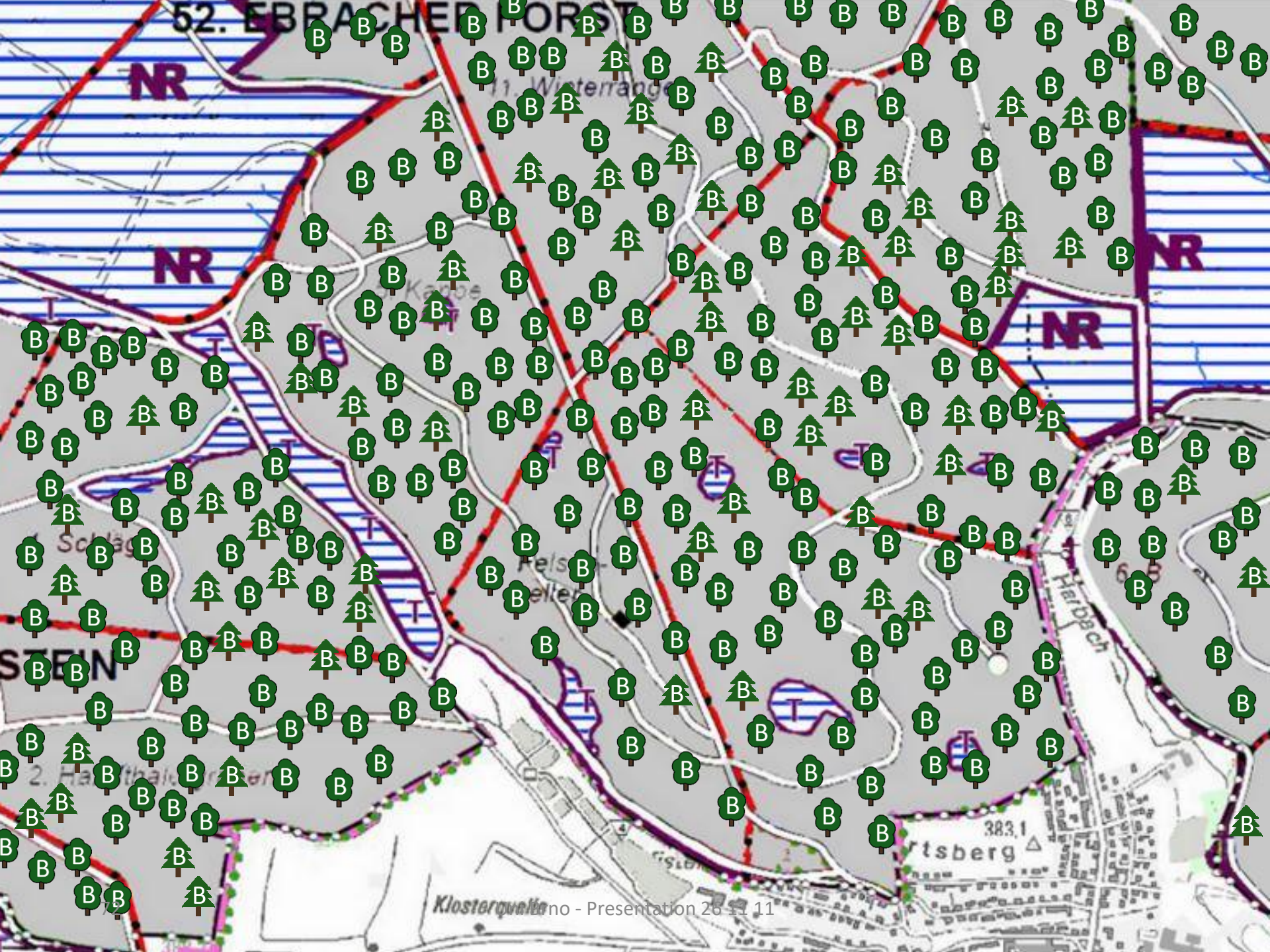


Not only two …

… but so much, that joung trees can grow without artificial protection


52. EBRACHER FORST
11. Winterrangen
5. Kappe
1 Schläge
Felsen-
keller
6. B
STEIN
2. Handthalergraben
Herrbach
383,1
tsberg
Klosterquelle


52. EBRACHER FORST
NR
NR
NR
NR
11. Winterrangen
5. Kappe
1 Schläge
Felsen-
keller
6. B
Harbach
STEIN
2. Handthalergraben
383,1
rtsberg
Klosterquelle


52. EBRACHER FORST
NR
NR
NR
11. Winterrange
Harbach
383.1
Klosterquelle

Strategy for the safeguarding of biodiversity
The local concept of Forest Enterprise Ebrach

- Integrative model „Schützen und Nutzen“
  (protecting and use)

- 1.600 ha set-asides:
  7 strict reserves
  200 „Trittstein“ habitats
  40 km edges

- 6.000 ha minimal impact in stands more than 100 years

- Deadwood management:
  40 m³/ha from140 years
  20 m³/ha from100 years

- 10 habitat trees per ha over the whole managed forest

Canadien Biologin Lenore Fahrig, Carleton Universität in Ottawa



Lenore Fahrig: Meta-study about SLOSS-discussion

- In my review of empirical studies I found that **several small patches usually hold more species than few large patches** of the same total area, that is, **SS > SL**.
- The common assumption among conservation agencies, that SL > SS, has led to preferential protection of large, contiguous areas and little or no protection of small areas, even when numerous. The findings of this review suggest that this bias towards large, contiguous areas does a disservice to the conservation of biodiversity.
- The results of this review support the notion that **much more emphasis should be placed on conservation of small patches** than is currently the case.

Reference:
Fahrig, Lenore. Why do several small patches hold more species than few large patches? Global Ecol. Biogeogr. 2020;00:1–14.



Example: Black woodpecker (Dryocopus martius)



10 ha set aside area

200 ha territory area

= 1 Breeding pair

200 ha set aside area



200 ha territory area

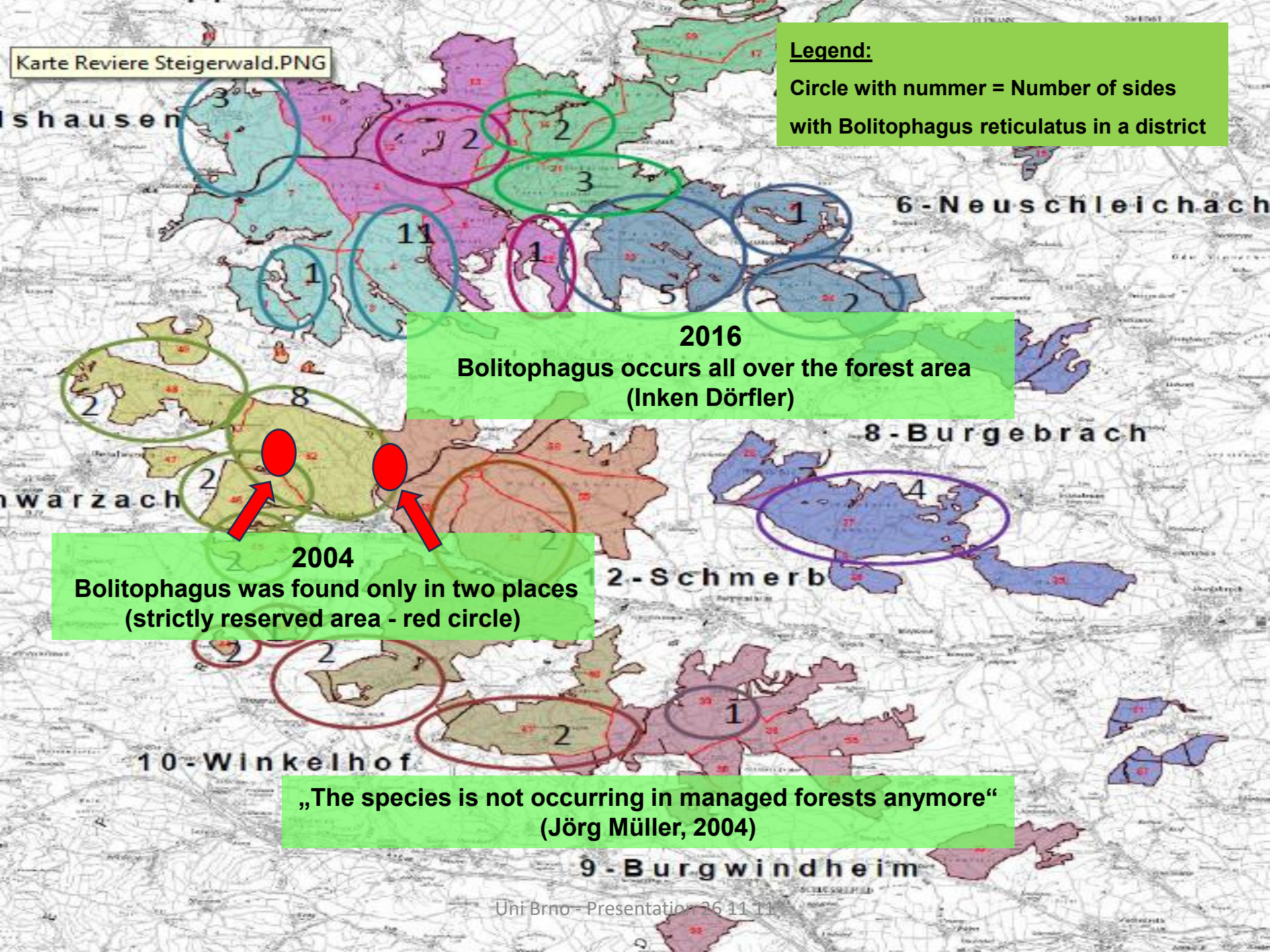
= <u>1 breeding pair</u>


200 ha
=
20 x 10 Hektar
= 20 Breeding pairs



Example: Black beetle (Bolitophagus reticulatus)

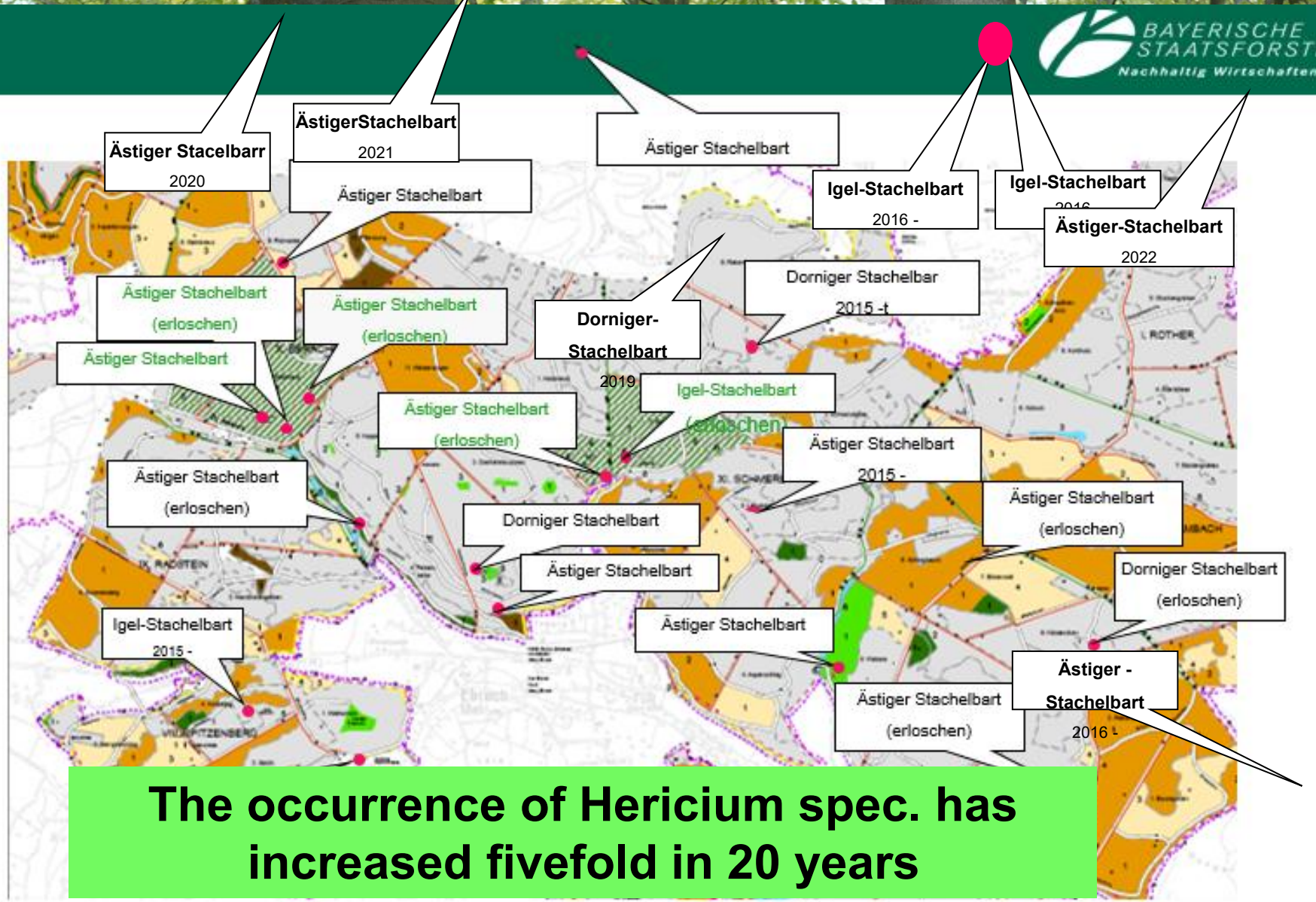

Black beetle feed and live
in Zunderschwamm (fomes fomentarius)


Karte Reviere Steigerwald.PNG
Legend:
Circle with nummer = Number of sides
with Bolitophagus reticulatus in a district
6-Neuschleichach
8-Burgebrach
2-Schmerb
10-Winkelhof
9-Burgwindheim
2016
Bolitophagus occurs all over the forest area
(Inken Dörfler)
2004
Bolitophagus was found only in two places
(strictly reserved area - red circle)
„The species is not occurring in managed forests anymore“
(Jörg Müller, 2004)



Example: Hericium spec. (H.Coralloides, H. erinaceus, H.cirrhatum)

Not a rarity anymore also in the managed forest


Ästiger Stacelbarr
2020
ÄstigerStachelbart
2021
Ästiger Stachelbart
Ästiger Stachelbart
Igel-Stachelbart
2016 -
Igel-Stachelbart
Ästiger-Stachelbart
2022
Ästiger Stachelbart
(erloschen)
Ästiger Stachelbart
(erloschen)
Dorniger Stachelbar
2015 -t
Dorniger-
Stachelbart
2019
Ästiger Stachelbart
Igel-Stachelbart
(erloschen)
Ästiger Stachelbart
(erloschen)
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2015 -
Ästiger Stachelbart
(erloschen)
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(erloschen)
Dorniger Stachelbart
Ästiger Stachelbart
Dorniger Stachelbart
(erloschen)
Igel-Stachelbart
2015 -
Ästiger Stachelbart
Ästiger Stachelbart
(erloschen)
Ästiger -
Stachelbart
2016 -
The occurrence of Hericium spec. has increased fivefold in 20 years



Collared flycatscher

(Ficedula albicollis)

Flycatcher occur nearly all over the managed forest - due to abundant small cavities



Bone beetle

(Trox perrisii)

2010 re-discovered in the managed forest

NATURA 2000: Seven FFH – umbrella - species in Steigerwald



Lucanus cervus



Triturus cristatus



Barbastella barbastellus



Myotis myotis



Myotis bechsteinii

	Evaluation			Conservation status
	Population	Habitat-Quality	Disturbance	
Lucanus cervus	C	C	B	**C**
Triturus cristatus	B	B	A	**B**
Bombina variegata	C	B	B	**B**
Babastella barbastellus	A	A	A	**A**
Myotis bechsteinii	B	B	B	**B**
Myotis myotis	B	B	A	**B**
Dicranum viride	B	B	B	**B**



Bombina varietata



Dicranum viride

Bildquelle: Wikipedia

NATURA 2000: Five woodland-societies in Steigerwald



LRT 9110
Luculo Fagetum



LRT 9130
Asperulo-Fagetum



LRT 9170
Galio-carpinetum



LRT 9180
Tilio-Acerion



LRT 91E0
Floodplain forest

	Luzulo Fagetum 9110	Asperulo Fagetum 9130	Tilio Acerion 9170	Alno-Padion 9180	Carpinion Betuli 91E0
Microhabitats	A-	A-	A-	A-	B+
Typical Species	A	A	A-	B+	B
Disturbances	A-	A-	A-	A-	B
Evaluation in total	A-	A-	A-	A-	B

The Ebrach concept shows:

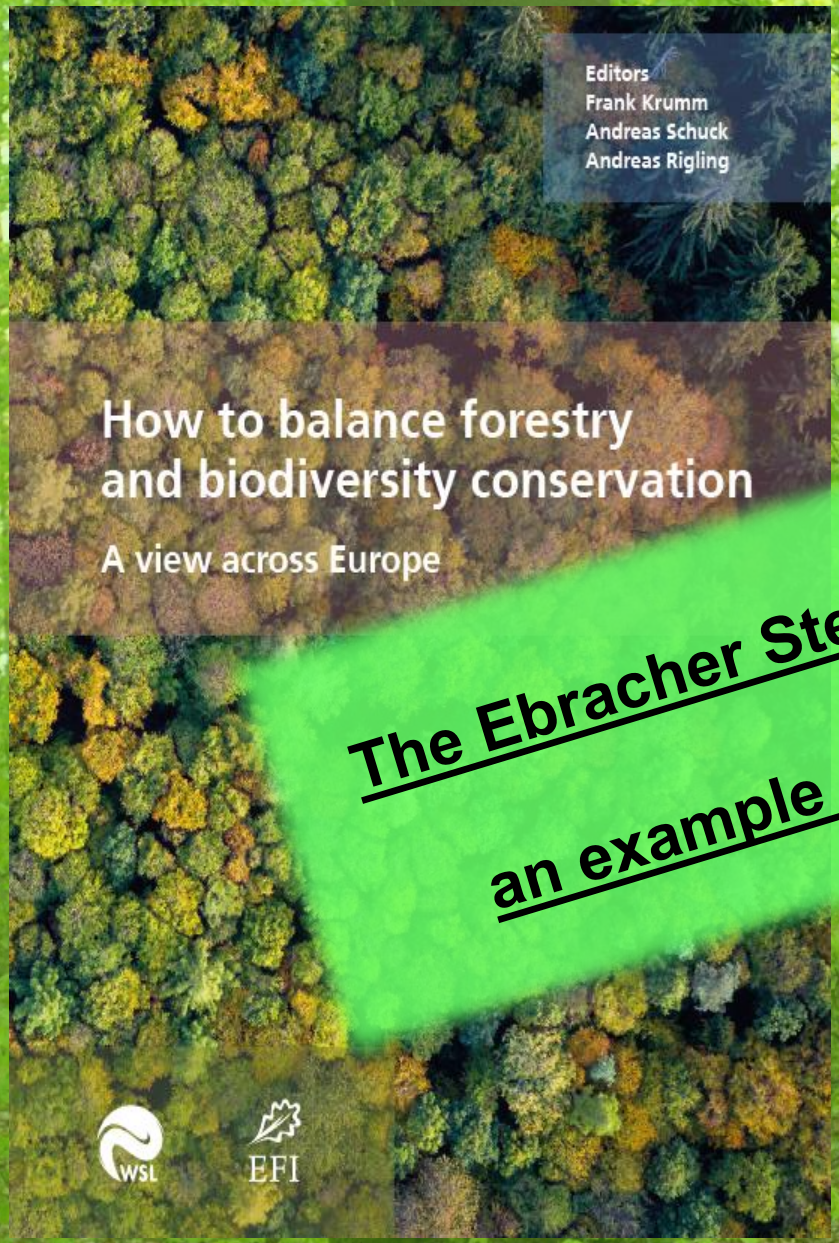
There is no problem to combine Natura2000 (Biodiversity conservation) with timber harvesting (Timber demand)

Benefits of the concept:

1. Compatibility of ecology and economy in the same forest
2. Short distance timber sales
3. Short distance wilderness experience
4. Distribution of species over total forest area
5. Applicable in nearly all forest enterprises

Preconditions:

1. Remnants of natural forest vegetation
2. Waiving of maximal income from timber sales
3. Political acceptance of local population



The Ebracher Stepstone-concept – an example across Europe



UN-Dekade zur Wiederherstellung von Ökosystemen

Deutschland setzt sich ein!

TOP-10-PROJEKT 2022

Zukunft verantworten

4 Freising

Hans-Carl-von-Carlowitz-Platz 1
85354 Freising

Tel. 0176/63861577
info@nachhaltigkeit-ev.de
www.nachhaltigkeit-ev.de

The stepston-concept was awarded as a TOP-10-Project as part of the UN-Decade „Restoring Ecosystems“ in Germany



Hohe Auszeichnung

Ebracher Trittste
Waldökosysteme

Im Zuge der weltwe
Trittsteinkonzept“ a
für Nachhaltigkeit e
für Naturschutz das
Wiederherstellung v
wurde im Forstbetri
Steigerwald entwick
Der Vorsitzende des
Vorstand Thomas Sc
vorgeschlagen. „Das Konzept ist ein hervorragendes Beispiel für anspruchsvollen Arten- und
Klimaschutz, das aber gleichzeitig eine wirtschaftliche Holznutzung ermöglicht. Damit ist es

Especially important in times of climate change

Biodiversity strengthens the resilience of forests



Salweide



Schwammspinner



Schwammspinner



Labkraut



Abendpfauenauge



Igelfliege



Eiche



Prachtgrüner Bindenspanner



Zickzackspinner



Schwammspinner



Brakwespe



Zitterpappel



Schlupfwespe



Admiral



Tagpfauenauge



Brennessel



Weidenschwärmr



Weidenröschen



Salweide



Schwammspinner



Schwammspinner



Labkraut



Abenpfauenauge



Igelfliege



Eiche



Prachtgrüner Bindenspanner



Zickzackspinner



Schwammspinner



Brakwespe



Tagpfauenauge



Zitterpappel



Schlupfwespe



Admiral



Weidenröschen



Weidenschwärmr



Brennessel


PZSF = NWR
HBG
WR
The network holds up even in times of climate change
Legende:
PZSF= Prozessschutzfläche (NWR=Naturwaldreservat
WR=Waldrefugium (=Trittstein)
HBG=Habitatbaumgruppen (=Biotopbaum)



ds entails the loss of species
y important resources in the
o for curing disease and other

ink of different species
to be exploited, while
ave value in themselves.

- **Each year sees the disappearance of thousands of plant and animal species which we will never know, which our children will never see, because they have been lost for ever. The great majority become extinct for reasons related to human activity. Because of us, thousands of species will no longer give glory to God by their very existence, nor convey their message to us. We have no such right.**

Pope Franziskus
Encyclica „Laudato Si – On Care For Our Common Home, 25. may 2015 Nr. 32-33


Thanks very much
for listening