Forest management trends with special emphasis on Germany

by

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Content:

- **History and present situation of forestry**
  - forests and their ecological, economic and social conditions
- **Improvement of forest management**
  - regeneration
  - thinning and pruning
  - final cut
- **Future trends:**
  - increasing adaptive capacity to changes
  - reducing risks
  - applying multipurpose, close to nature forest management

History and present situation of forestry in Germany:

- development of the forests and
- their **ecological** conditions
- their **economic** conditions
- their **social** conditions

History and present situation of forestry in Germany:

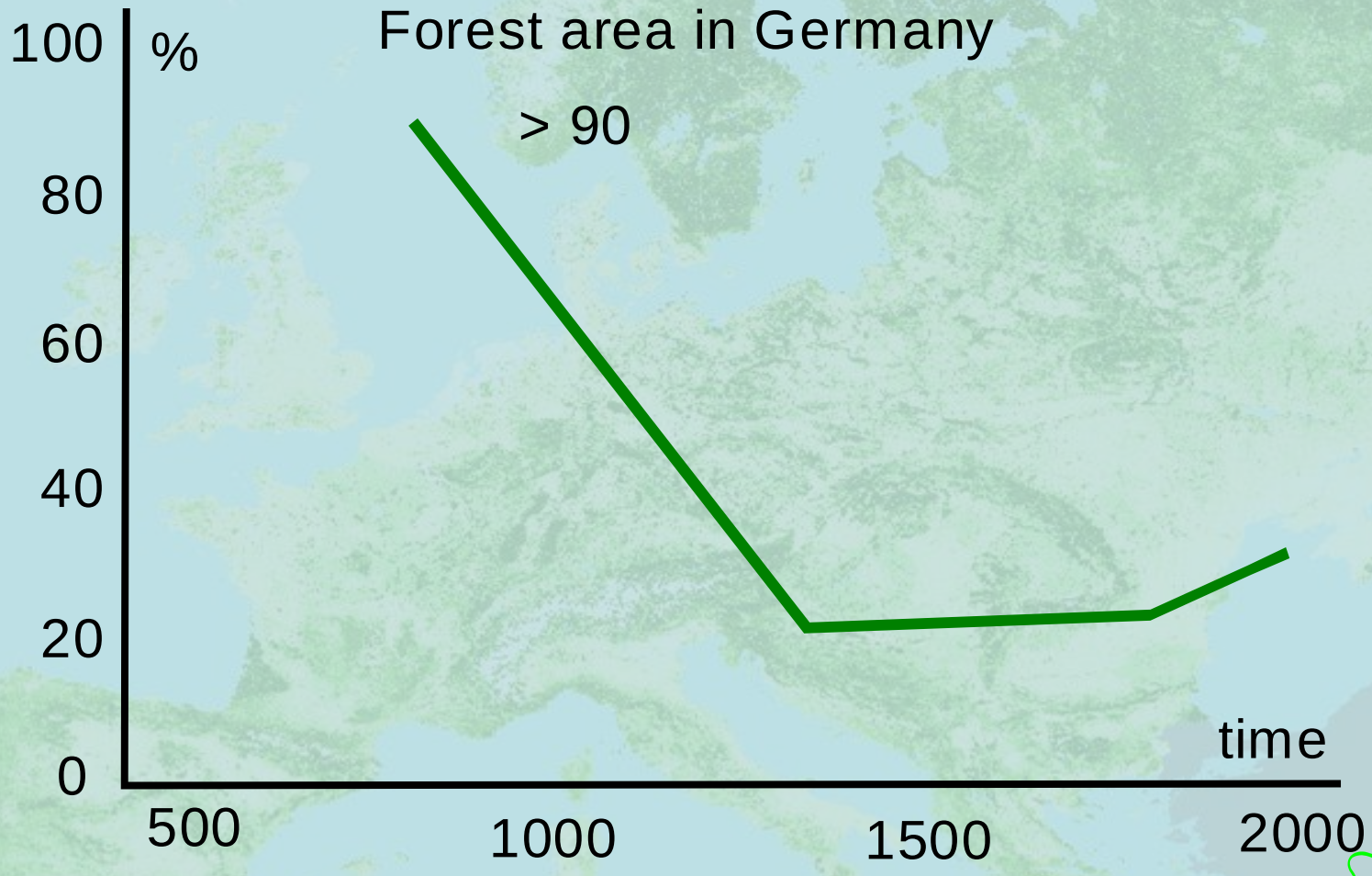
- **development of the forests** and
- their ecological conditions
- their economic conditions
- their social conditions

Forest history:

1. Forest Exploitation
2. Forest Re-establishment

Today about 1/3 of the land in Germany consist of forests and the growing stock per ha is 330 m^3

Short history:



Caspar David Friedrich, 1822, lonely tree, Germany

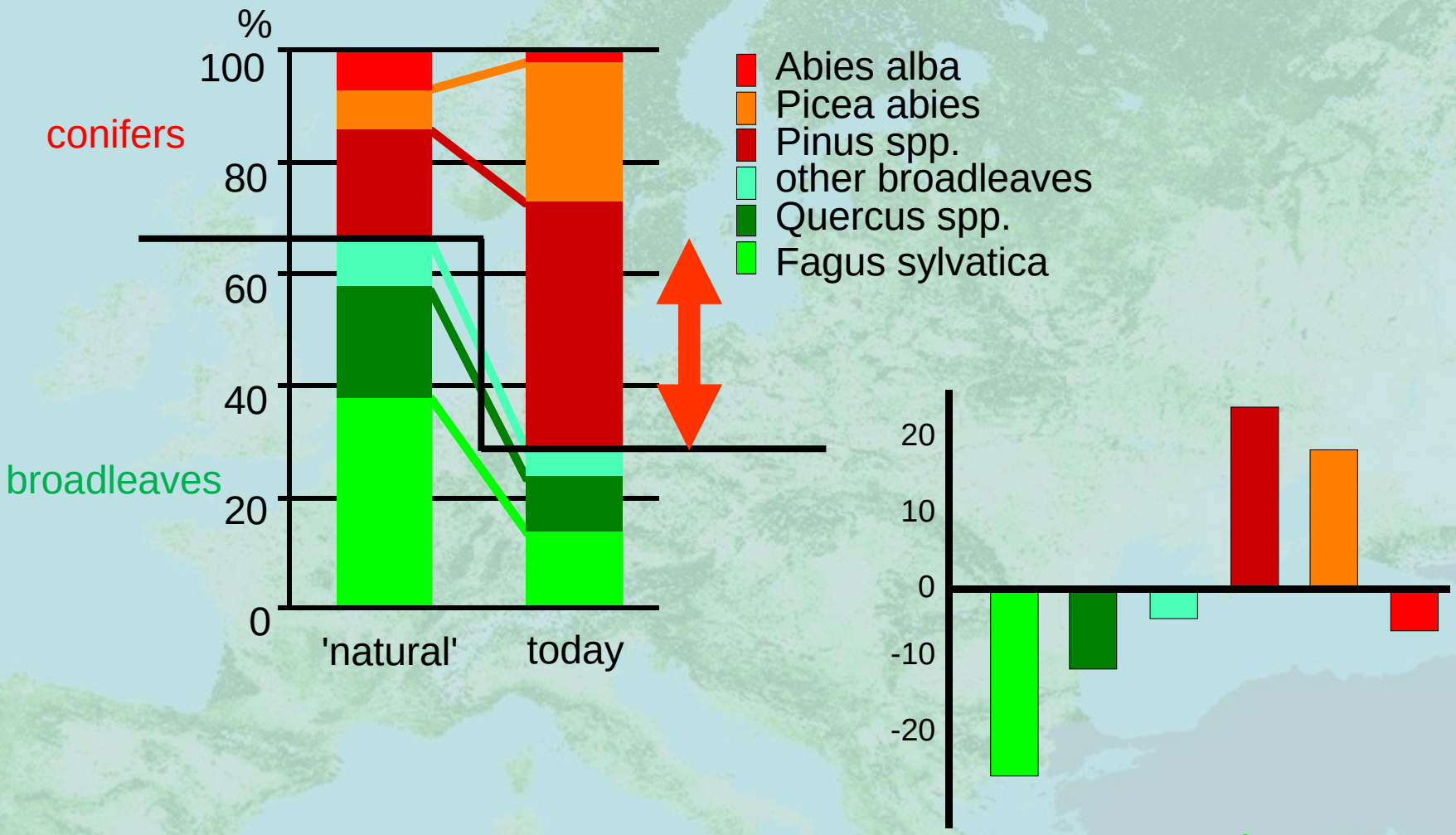
1368
Peter Stromer
Coniferous seeding

The history of the sustainable use of the forests

In **1713** the leading official of a Saxon coal-mine, **Hanns Carl von Carlowitz**, had exhorted the **"sustainable use of the forests"** in the opus **Sylvicultura Oeconomica**.

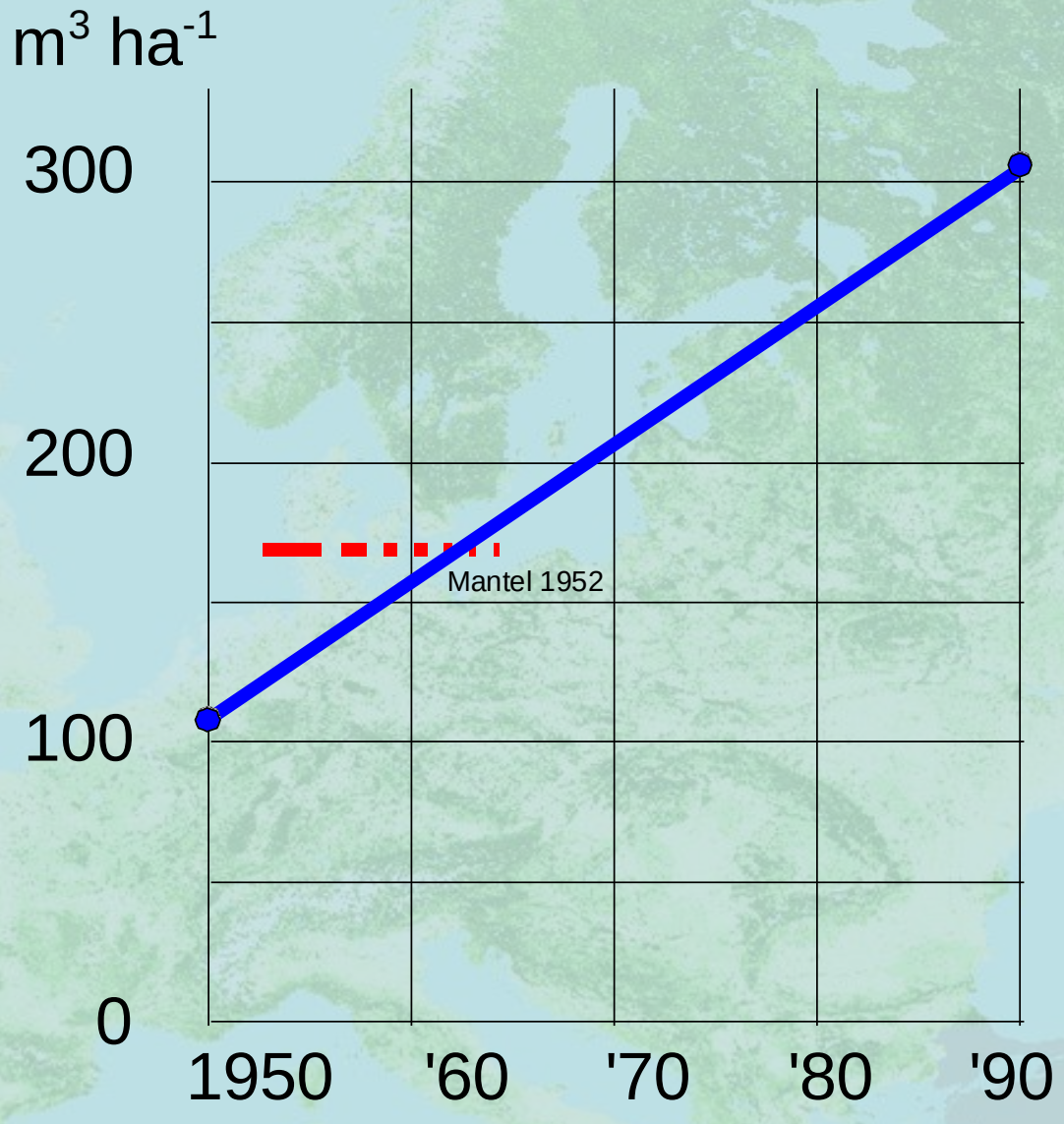
This year we can celebrate 300 years sustainability in forestry!

Change of tree species composition in Central European forests



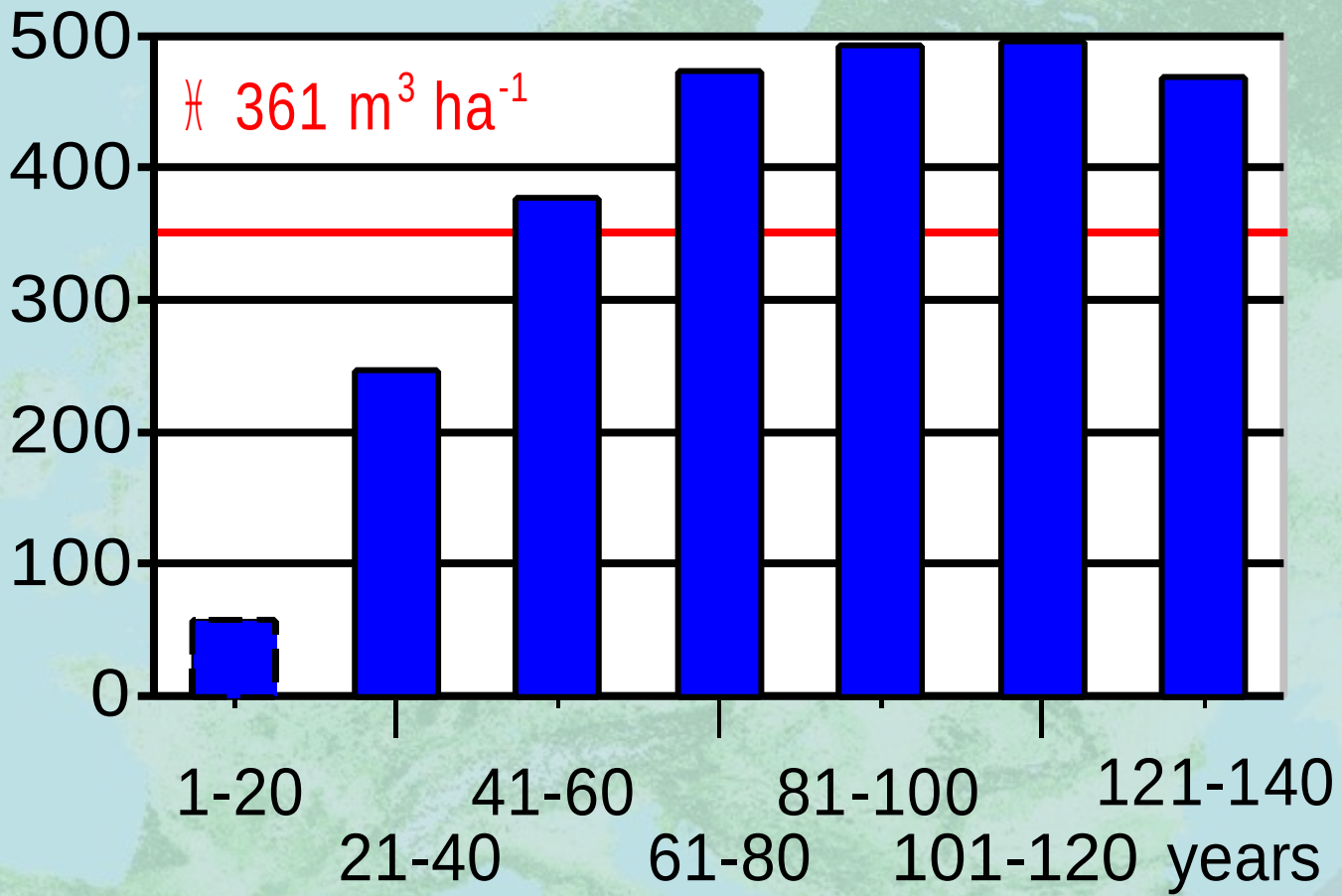
(Source: Spiecker 2000 based on data by Mayer 1984)

Growing Stock (former W.Germany)



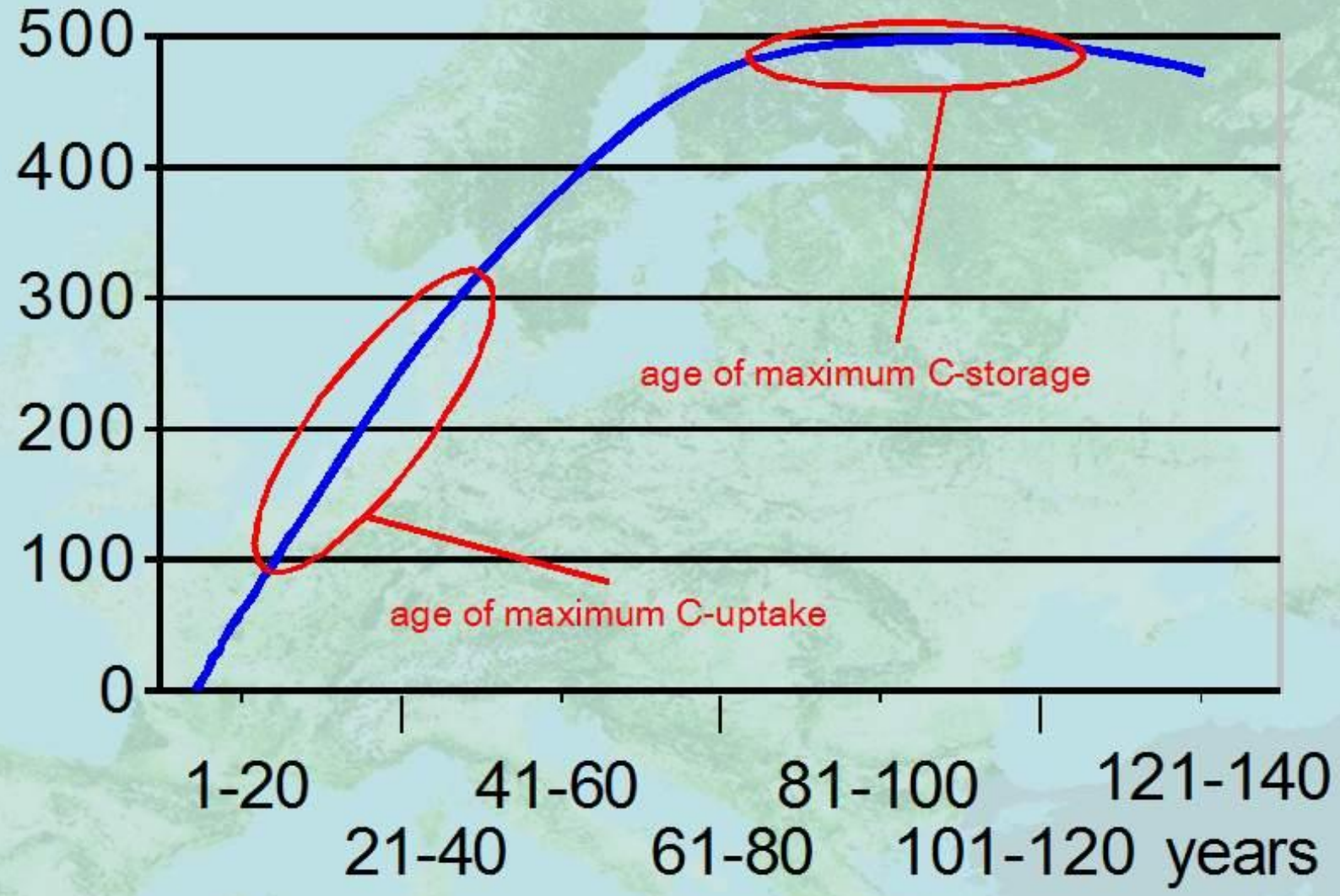
source: Weck 1961 and BWI 1990

volume [m^3 ha^{-1}] in age classes (Ba.-Wü. 1990)

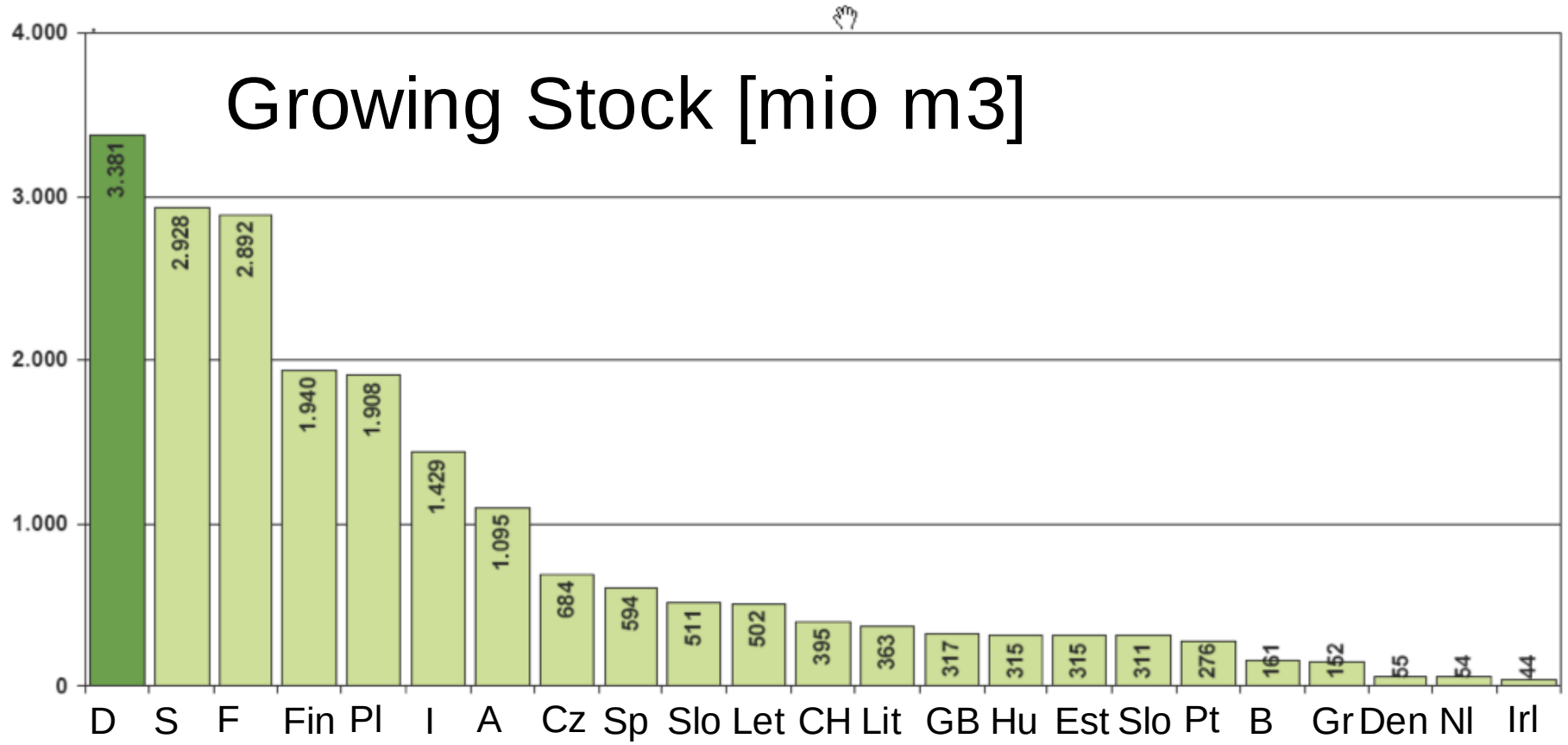


growing stock has increased 1961/71-1981/90 by 23%

growing stock [m^3 ha^{-1}] in age classes (Ba.-Wü. 1990)

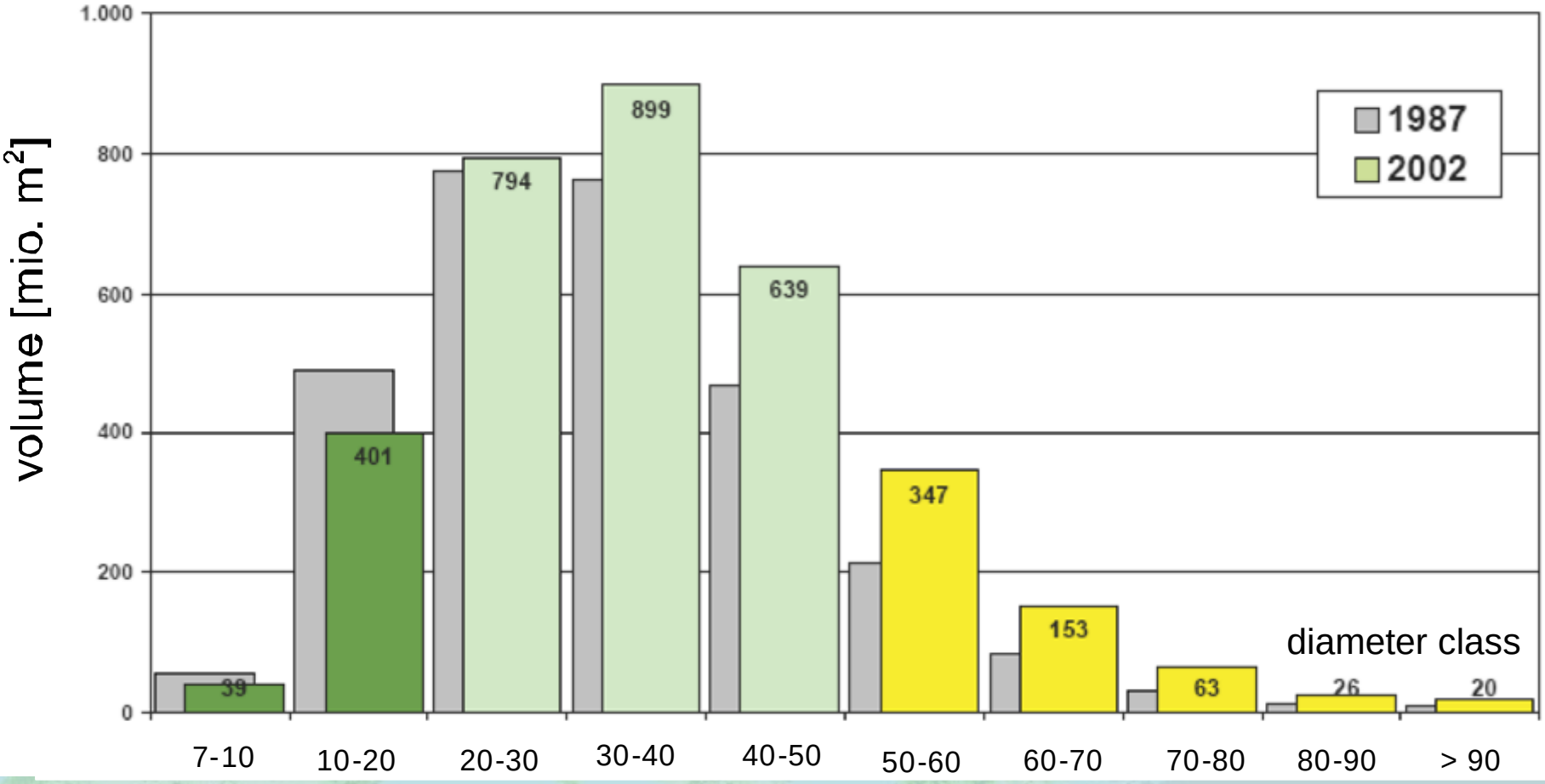


Comparing Total Growing Stock by Country

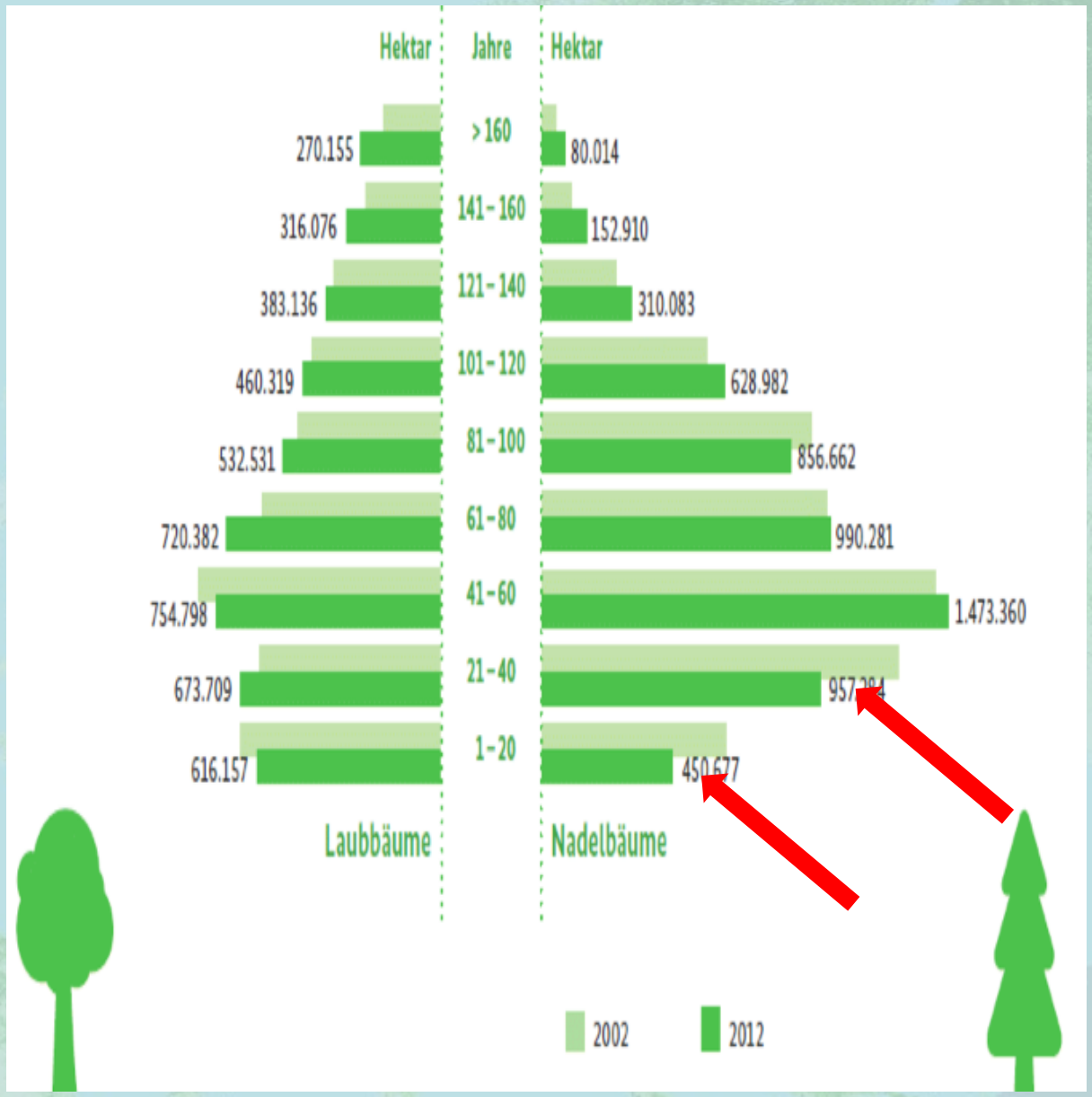


Growing stock 1987 and 2002 Germany

Change in volume by diameter class



Age composition 2002 and 2012 in Germany



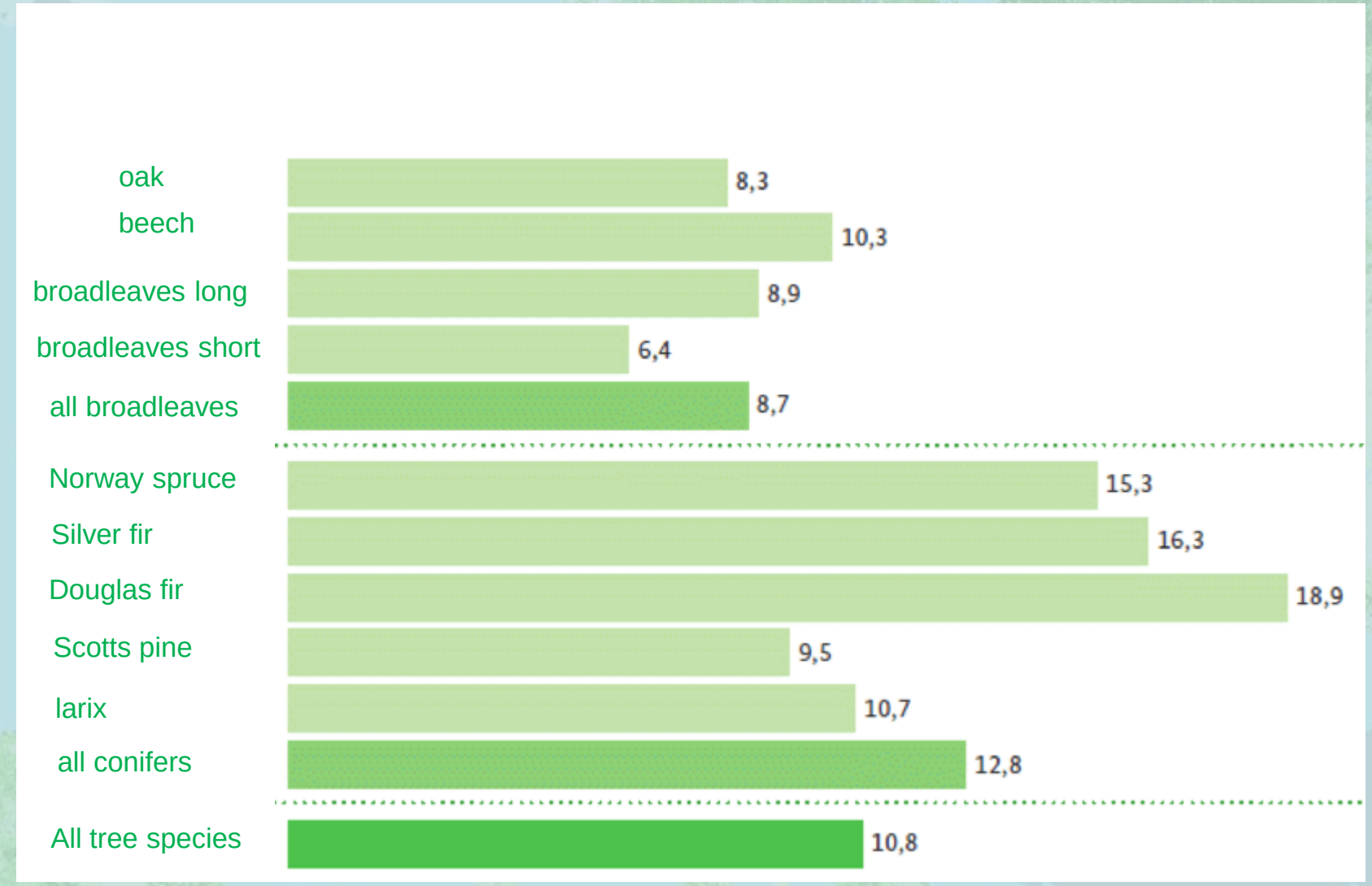
BWI III 2012

Average age of the forests in Germany 2008:

77 years

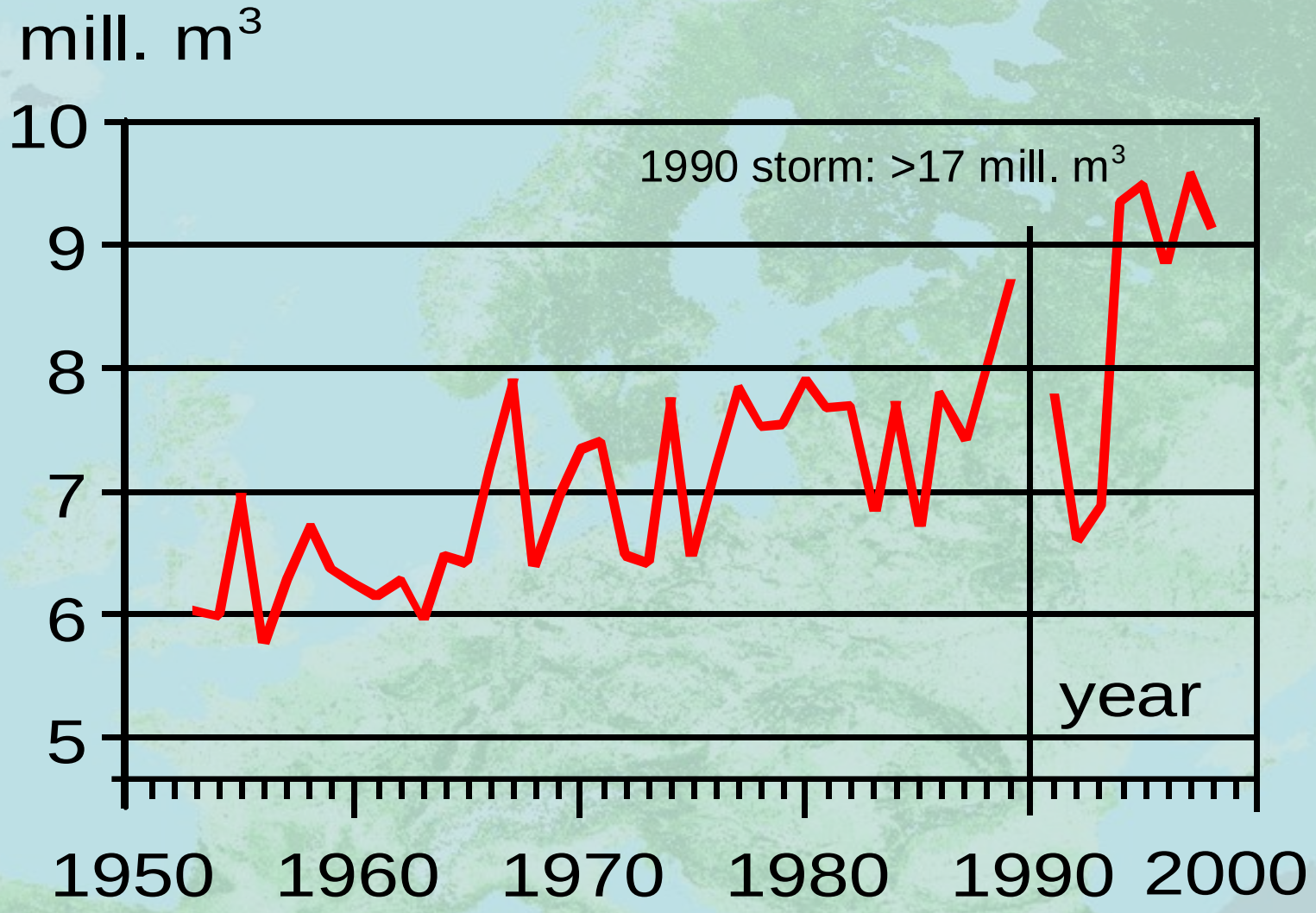
The age increased in 2002-2008 (7 years) by 4 years

Annual volume increment per ha by species 2003-2012 in all Germany [m^3 ha^{-1}]:



BWI III 2012

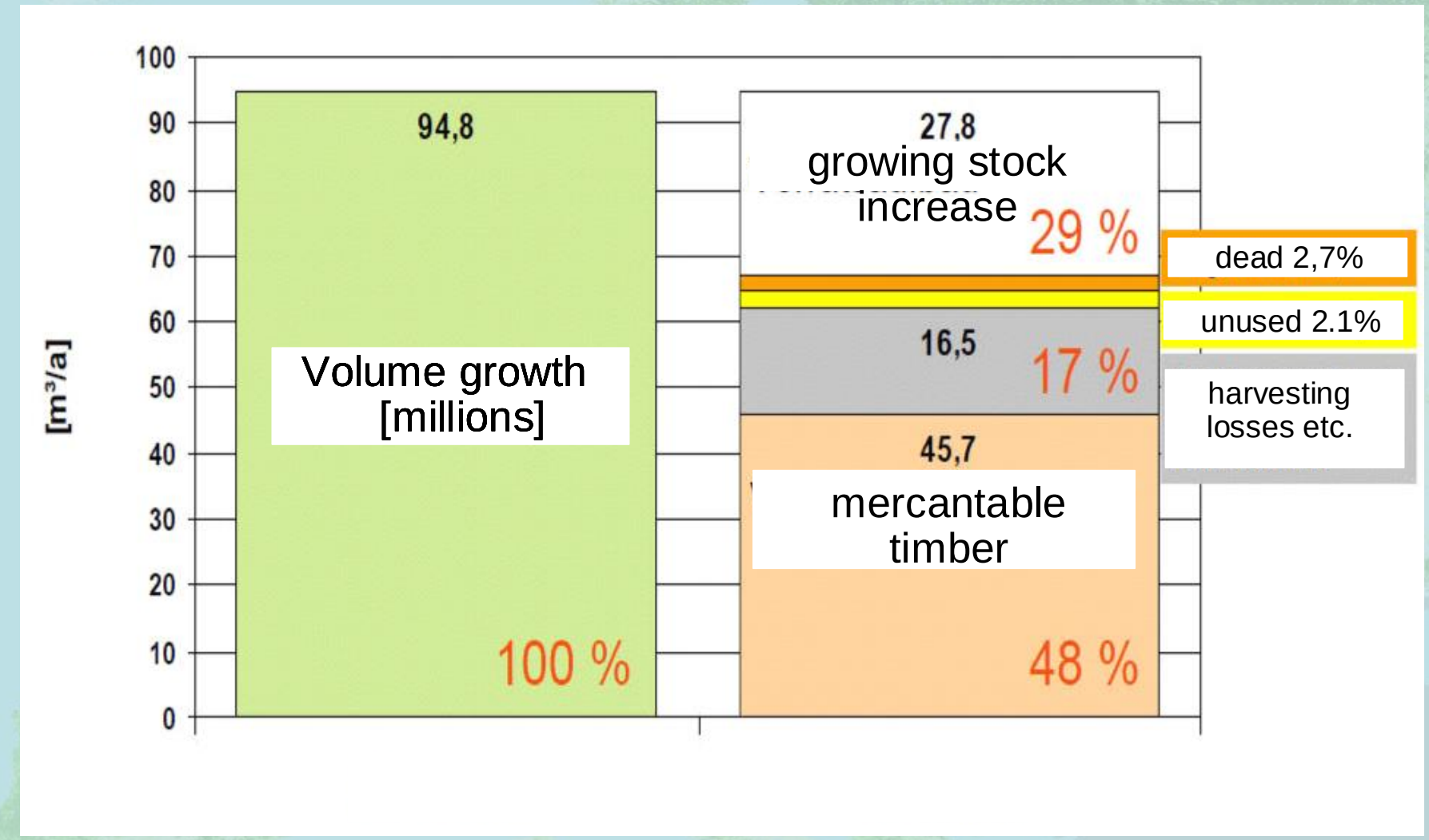
annual cut, public forest Ba.-Wü.



annual increment 1987-2002:13.8 $m^3\ ha^{-1}$

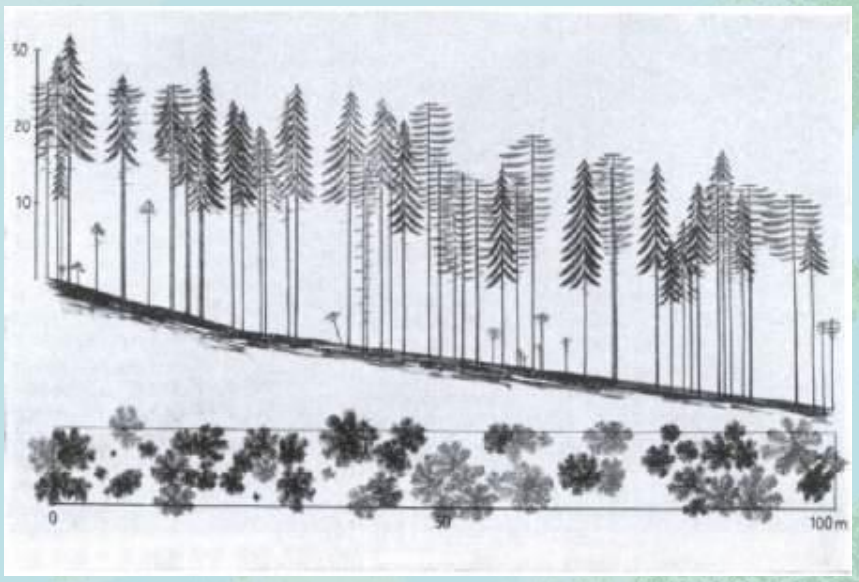
growing stock 2002: 367 $m^3\ ha^{-1}$

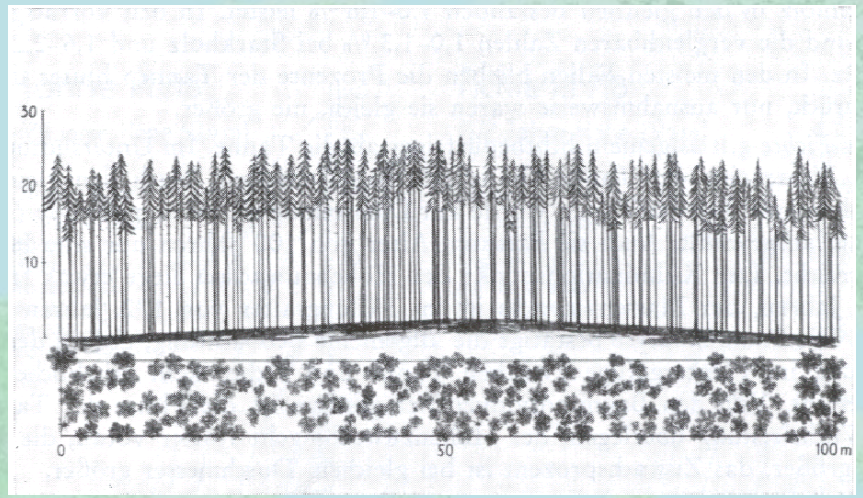
Annual growth and use of wood from former West-German forests 1987-2002



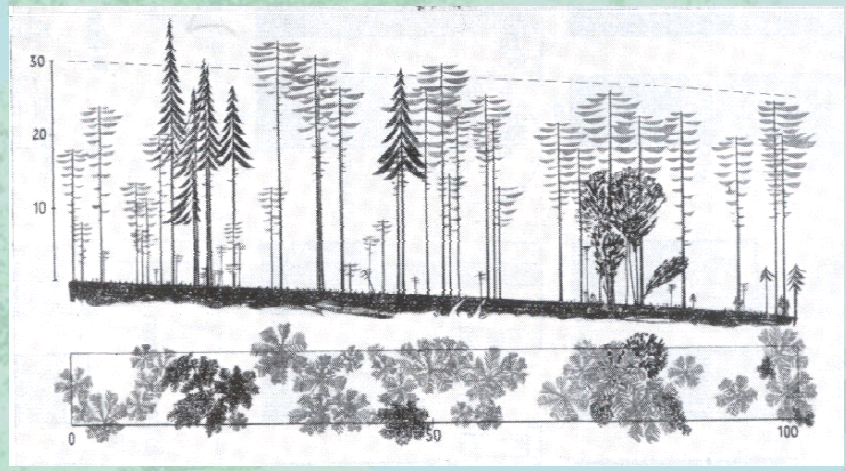
Polley et al. 2004

„Conversion“





The new trend towards continuous cover forestry



We will discuss the characteristics and principles of continuous cover forestry, the prerequisites, advantages and disadvantages, The new trend towards continuous cover forestry in detail when you visit selection forests in the Black Forest on our excursion.

Forest types (Baden-Württemberg):

% of total forest land

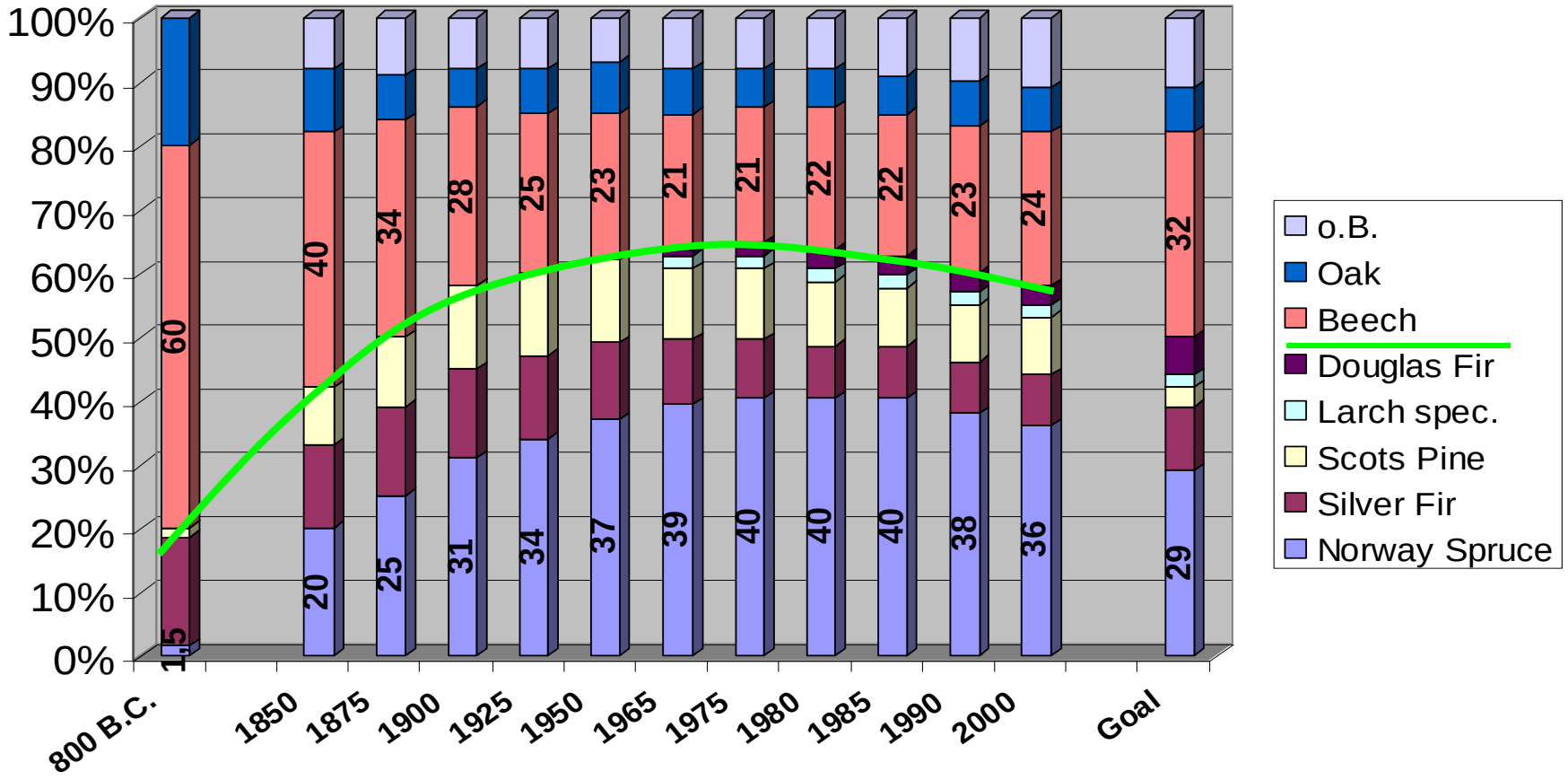
± even aged forests:	96.1 %
selection forest:	3.5 %
coppice with standards:	0.1 %
coppice forest:	0.3 %

Black Forest: selection forest

Black Forest: mixed forest

Change of species Composition

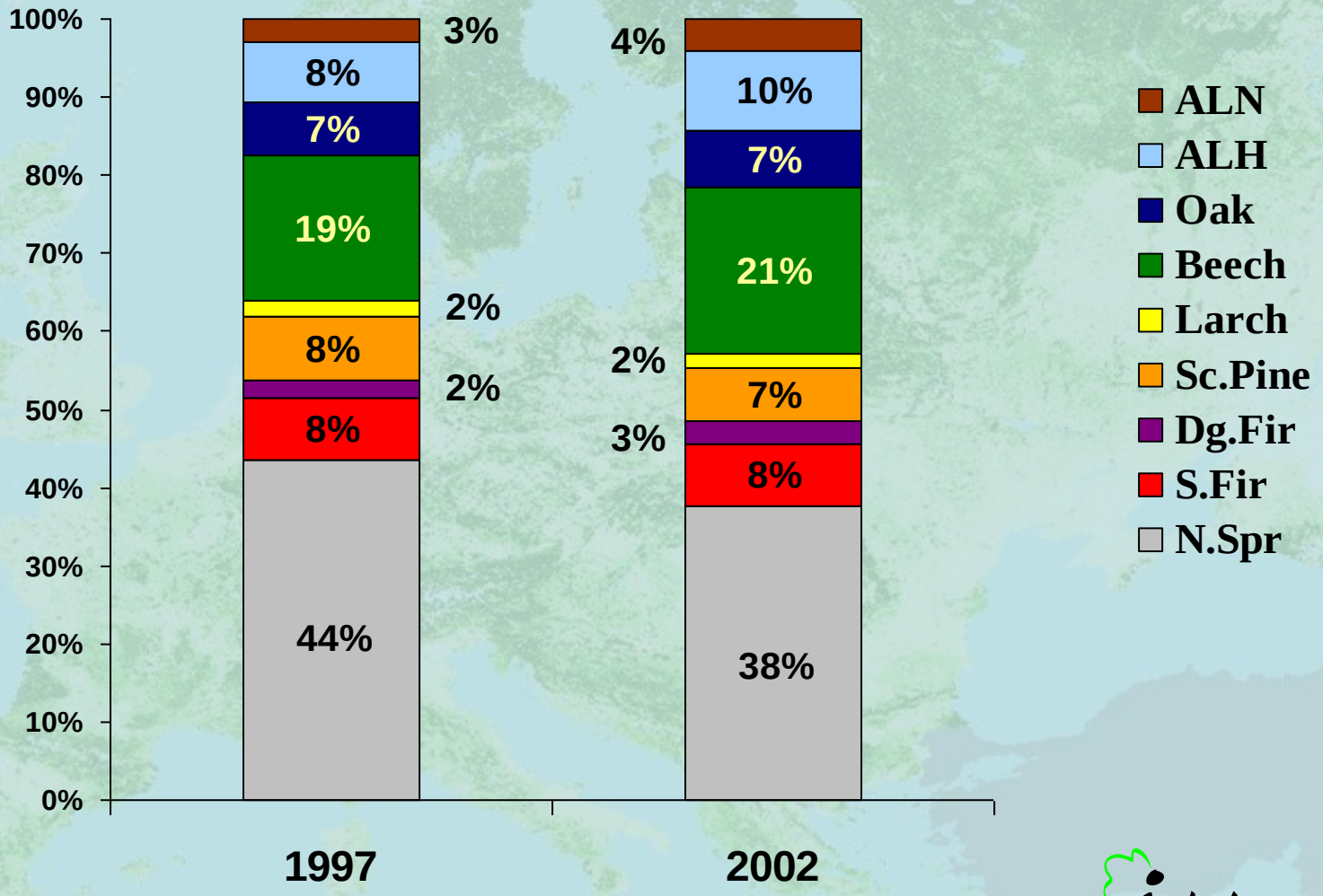
In the public forests of Baden-Württemberg



actual changes in species composition:

less: conifers
spruce! (not fir)
more: broad leafed species
beech, maple, alder, cherry etc.

Change in tree species composition in Baden-Württemberg 1987- 2002

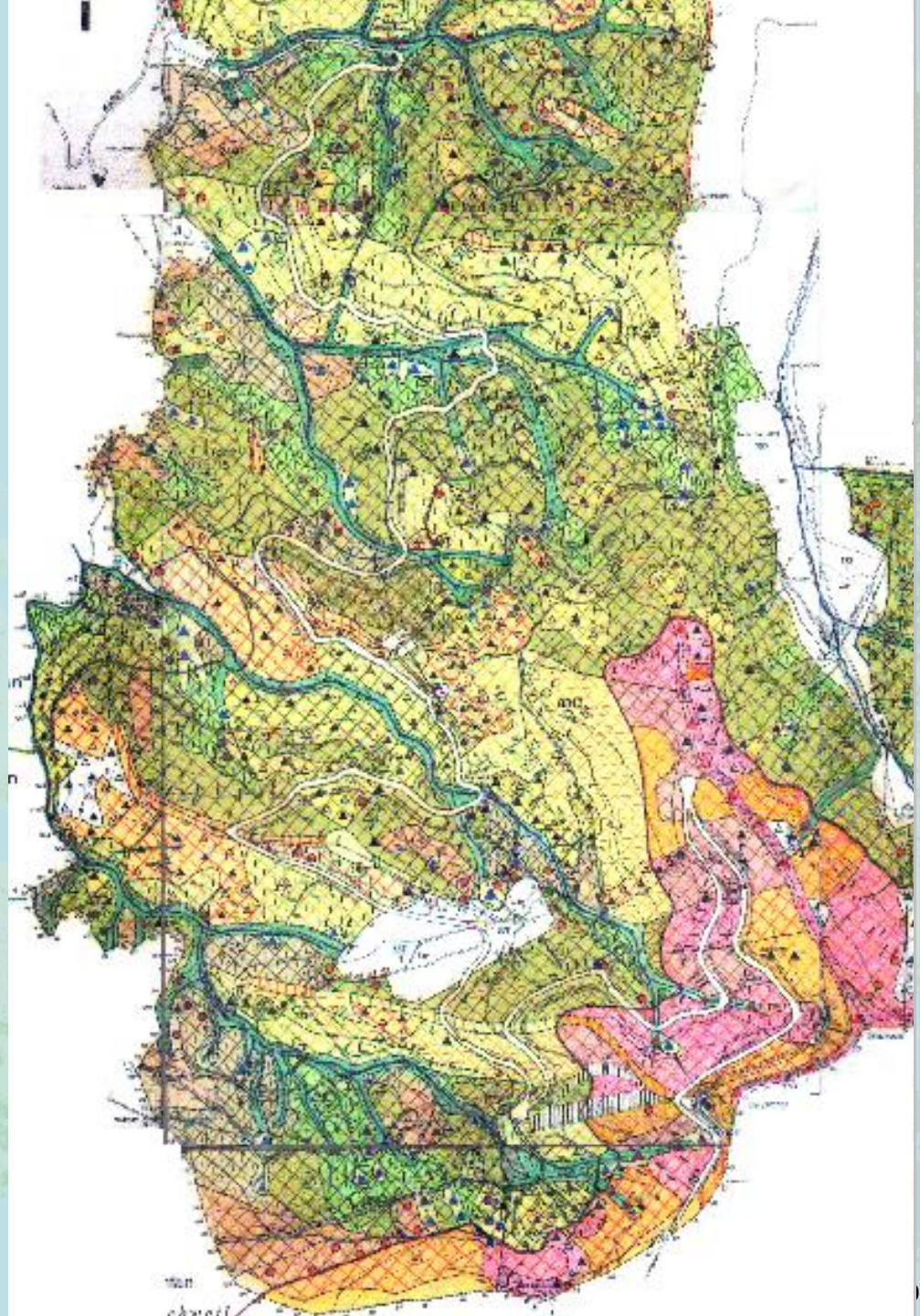


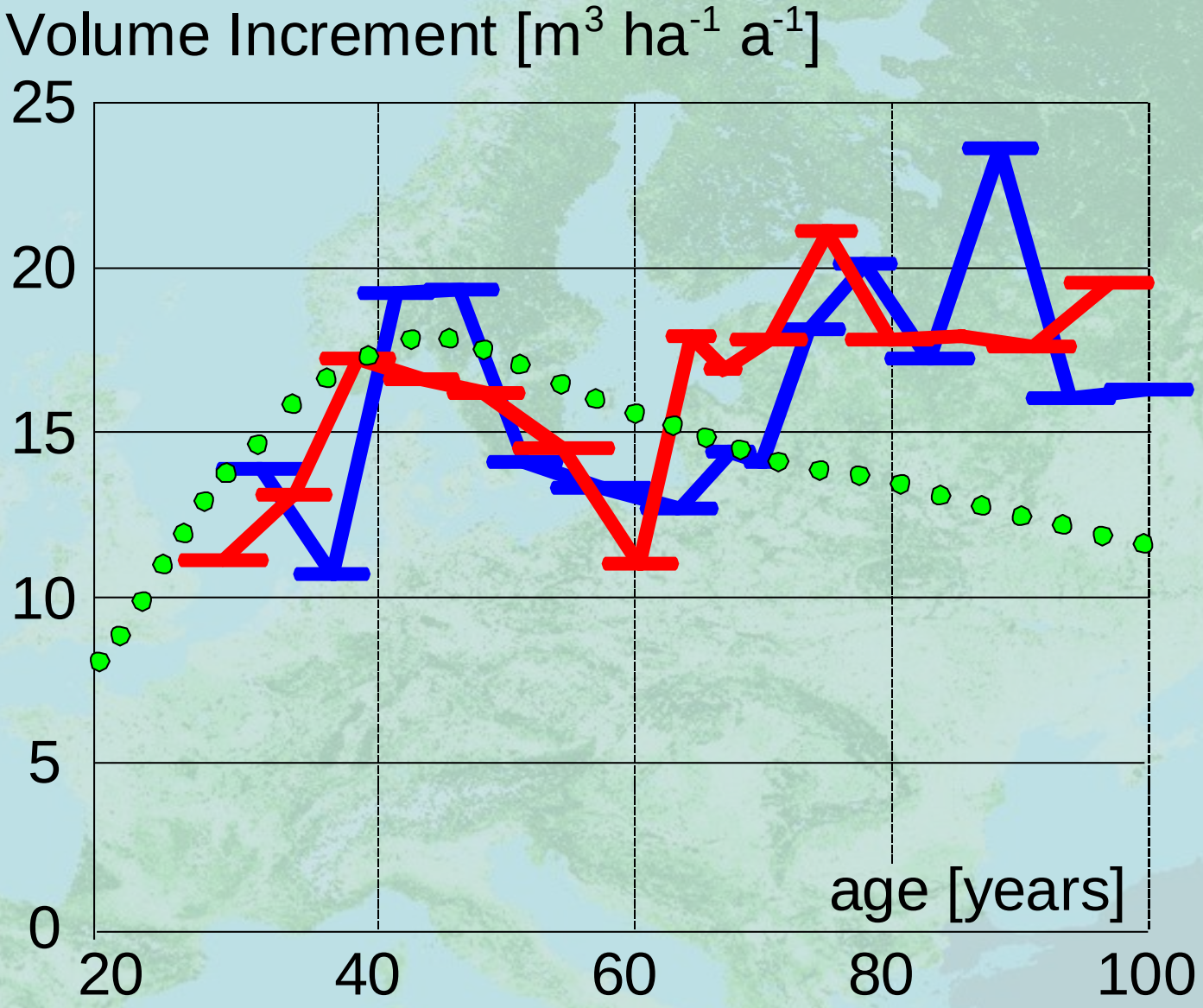
Change in Growing stock Germany 2002-2012

(BWI III 2012)

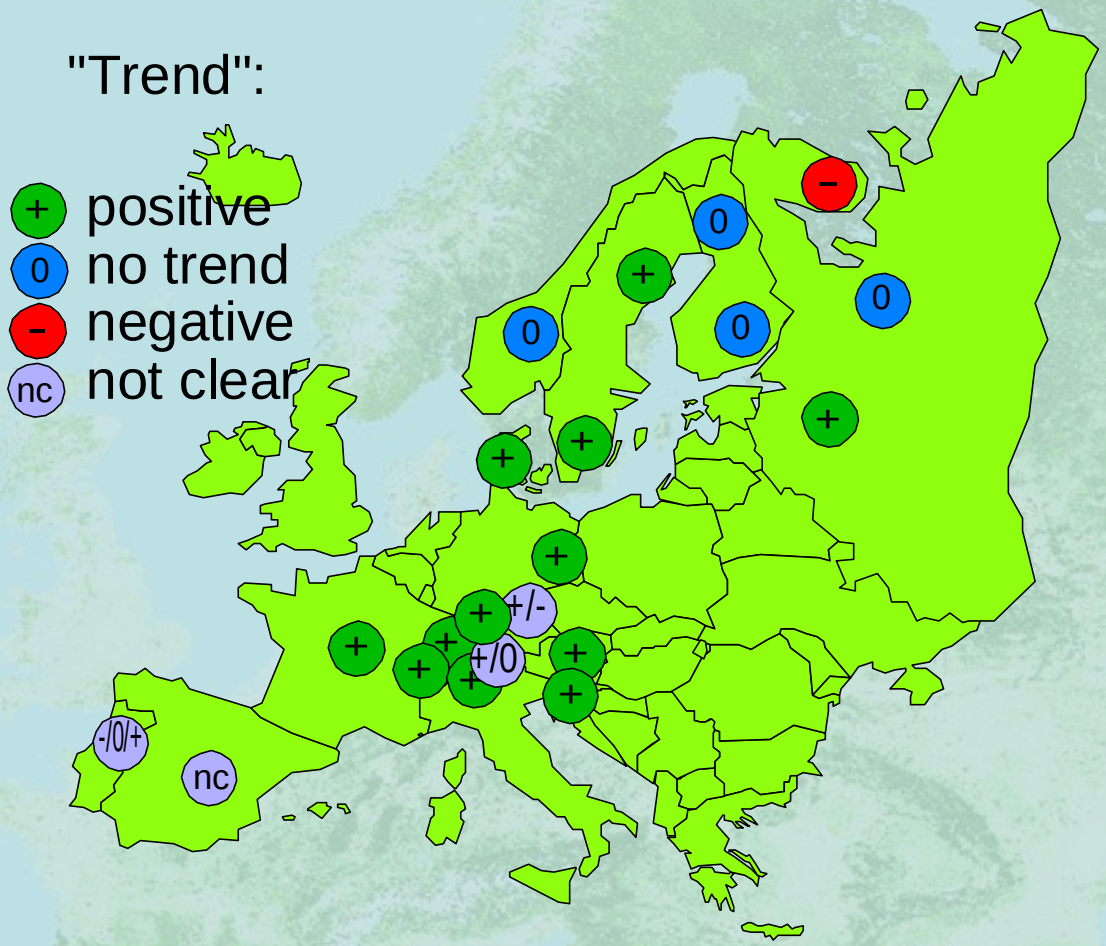
History and present situation of forestry:

- the forests
- the **ecological** conditions
- the economic conditions
- the social conditions



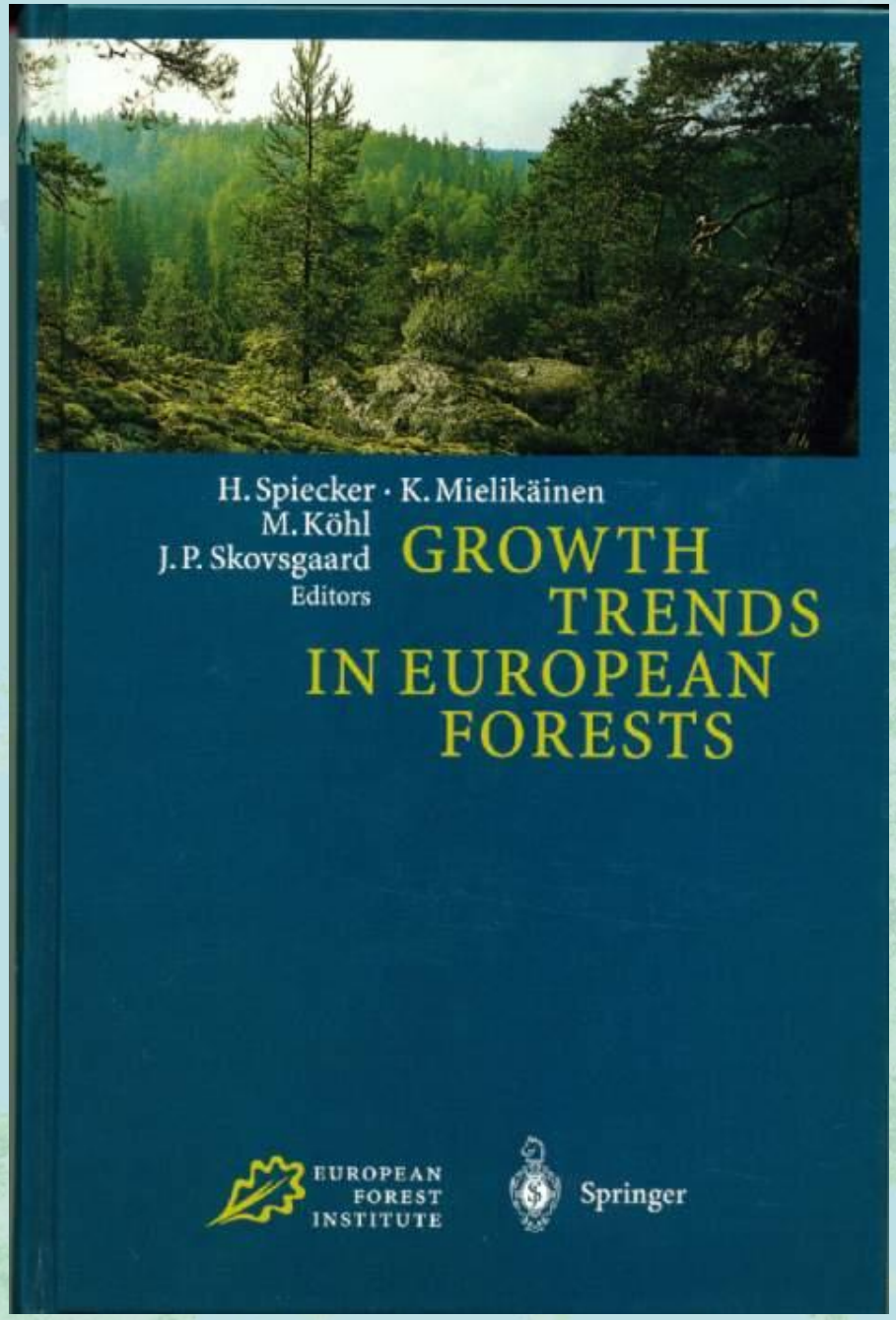

Volume Increment [m³ ha⁻¹ a⁻¹]
25
20
15
10
5
0
20
40
60
80
100
age [years]

Growth Trends in European Forests



European Forest Institute

source Spiecker et al. 1996


H. Spiecker · K. Mielikäinen
M. Köhl
J. P. Skovsgaard
Editors
GROWTH TRENDS IN EUROPEAN FORESTS
EUROPEAN FOREST INSTITUTE
Springer

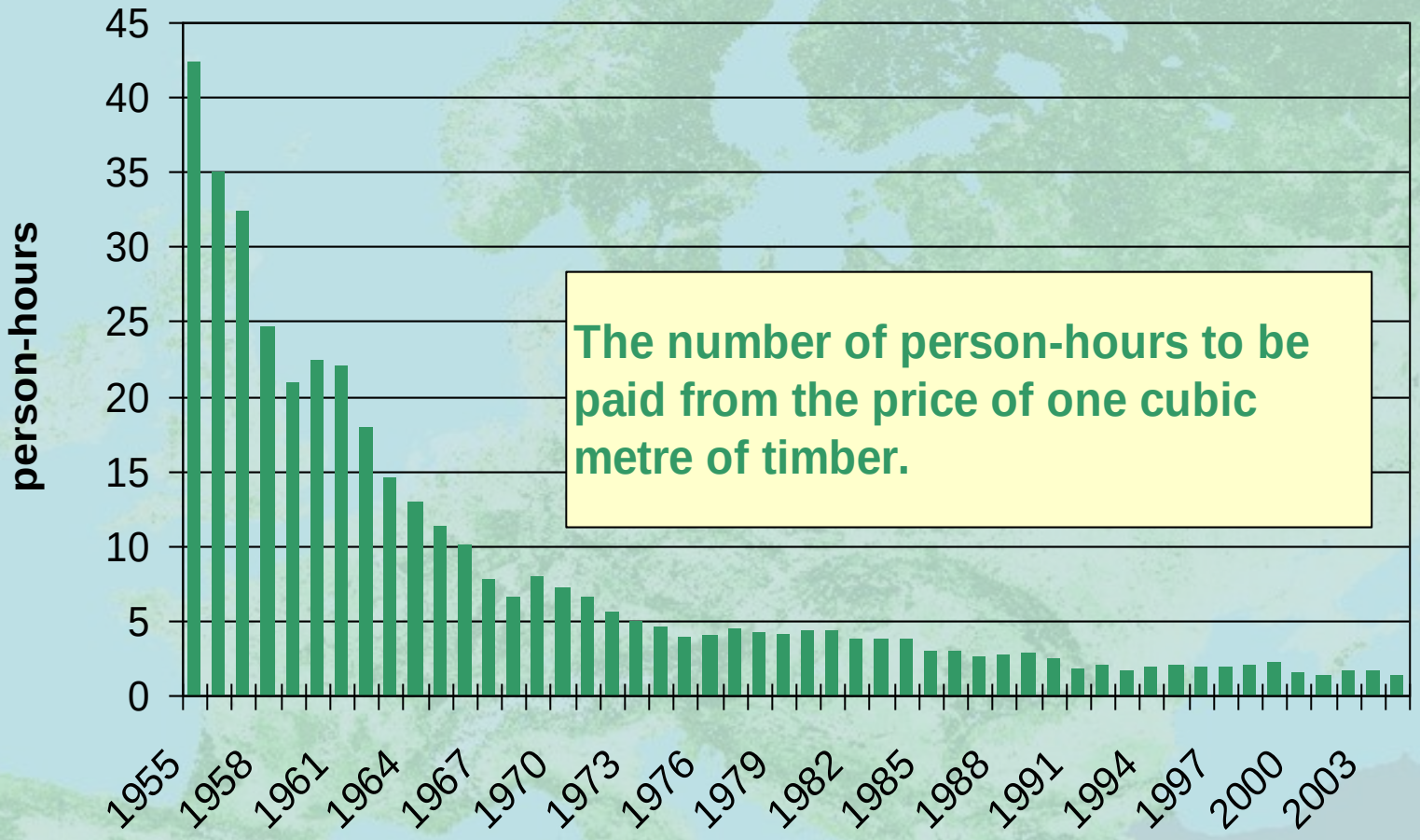
Deer Population:

Tendency to reduce high density;
impact on natural regeneration!

History and present situation of forestry:

- the forests
- the ecological conditions
- the **economic** conditions
- the social conditions

Timber value in person-hours



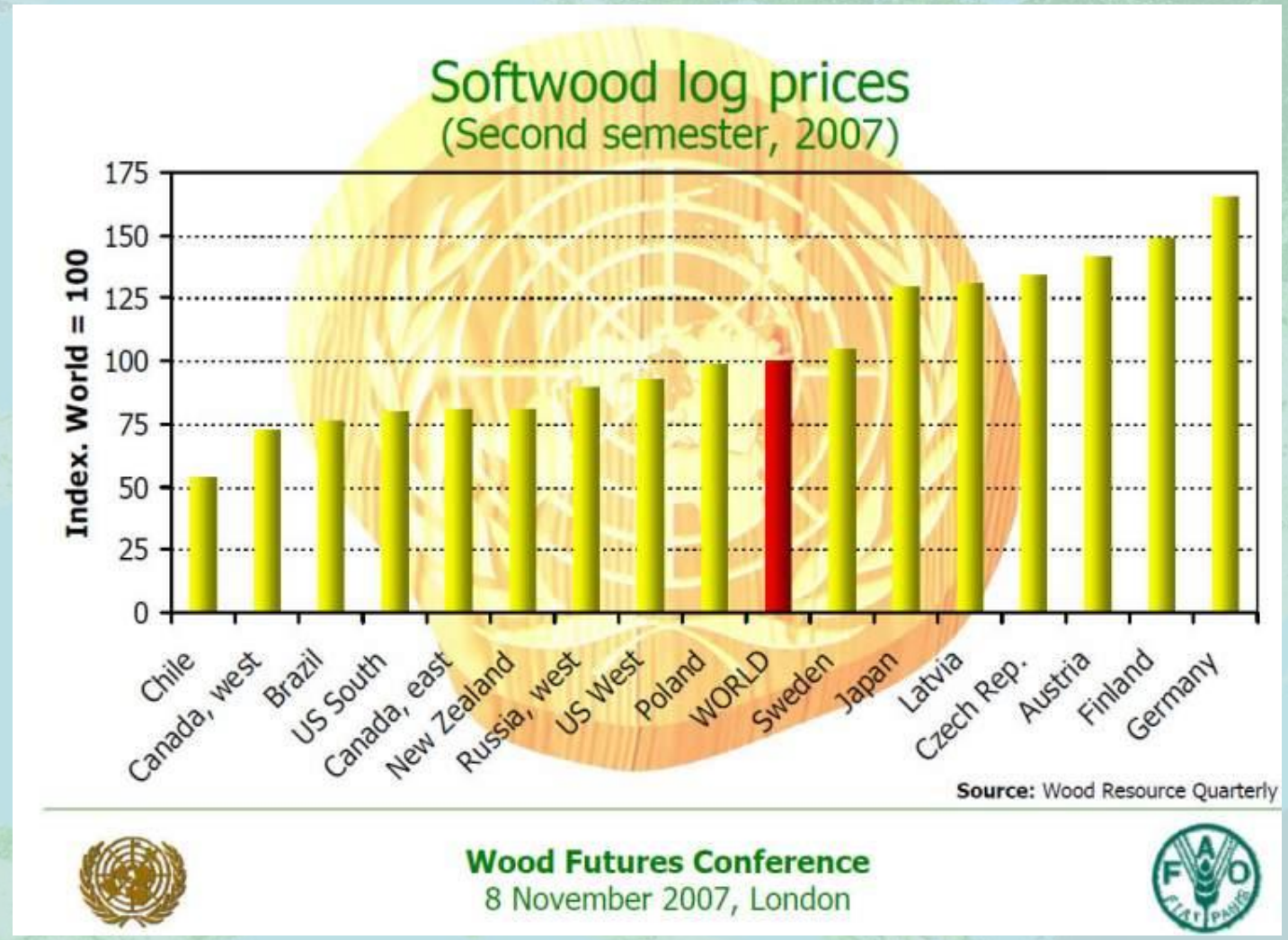
generally unfavorable economic situation of forestry:

- rather low but increasing price of forest products
- high fluctuation of timber price
- high labor cost

conclusions for forestry:

- less labor input
- more valuable forest products
- more flexibility to adjust to changes

Comparison of softwood prices 2007



How to increase the value of timber?

Quality is defined by the consumer!

Examples for typical timber quality criteria:

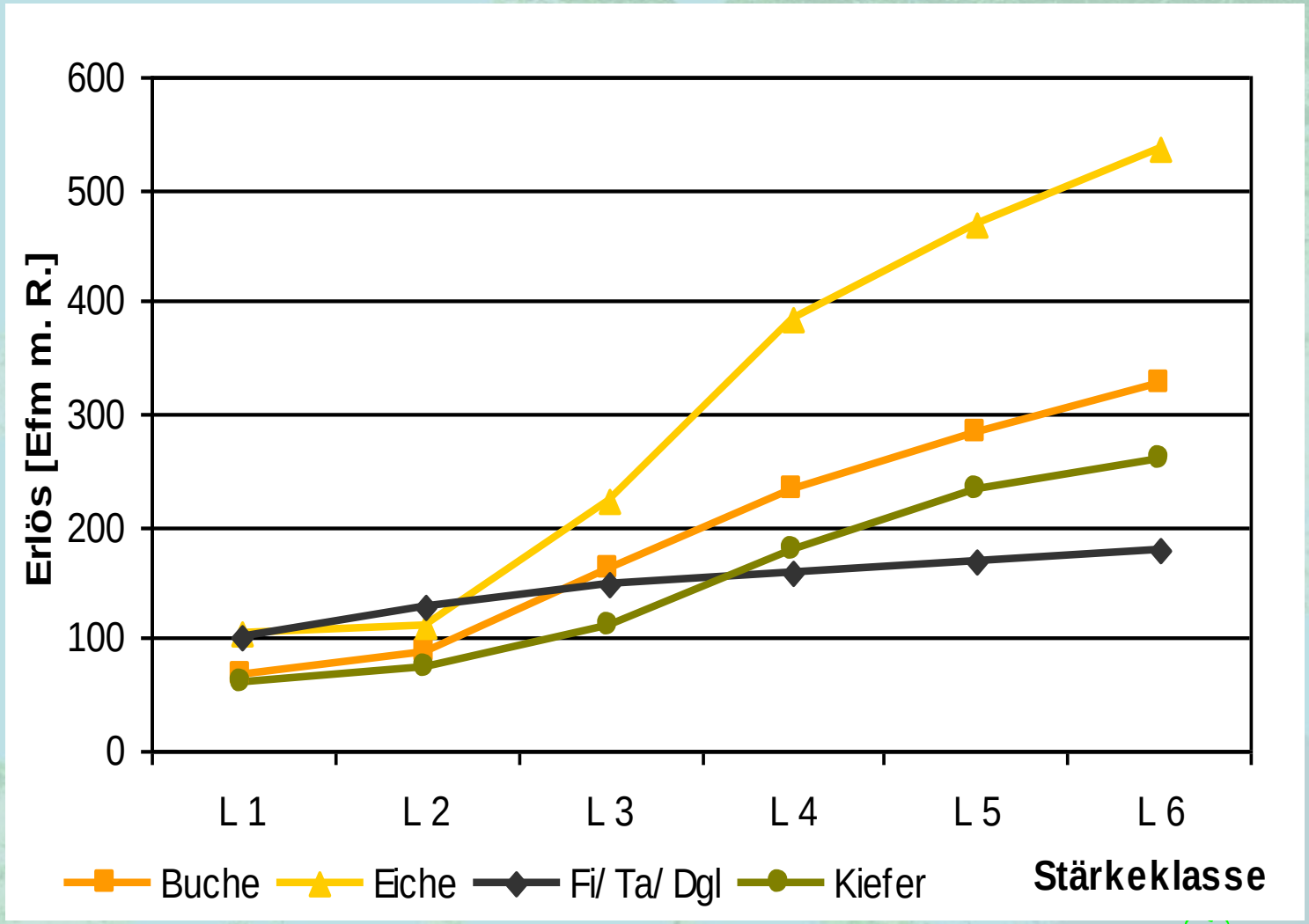
-dimension
(e.g. important for veneer)
- branches
- taber
- straightness
- spiral grain
- wood density
- ring width
- others

Quality can make a difference!

In the state of Rheinland-Pfalz for example 0,3 % of the removed volume, yield 10% of the net return!

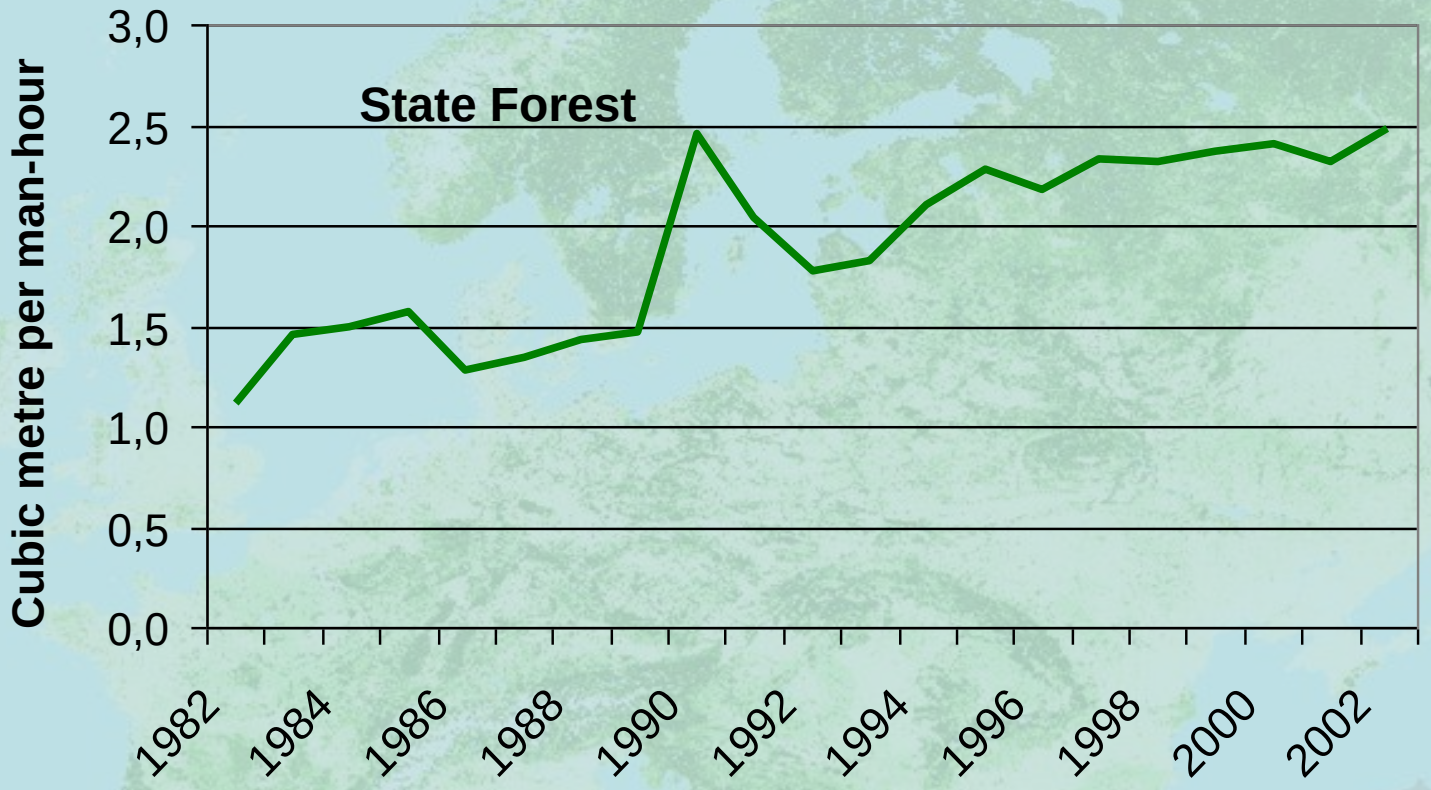
source: oral communication. Wilhelm)

Timber price and diameter



Harvesting:

harvesting productivity per work hour




- work and machinery input
- quality of work
- information and education

Logging operations and road constructions:

Road net: 40m per ha

Tendency to reduce activities
because of high cost of construction and maintenance

Avoidance of damages to soil and stands by logging operations

History and present situation of forestry:

- the forests
- the ecological conditions
- the economic conditions
- the **social** conditions

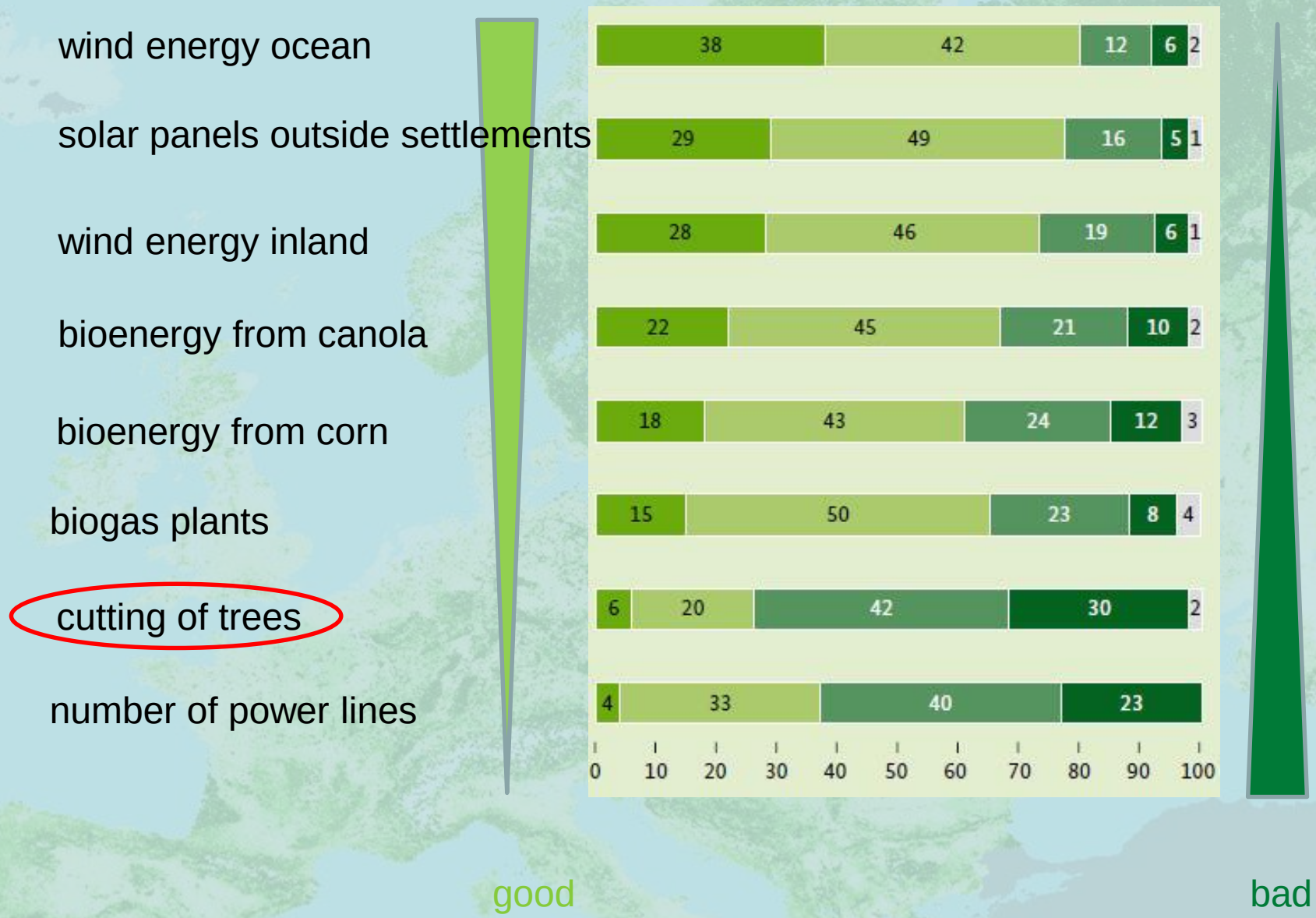
Changes in values and perceptions:

- the value of timber as a resource decreased for a long time and recently increased again

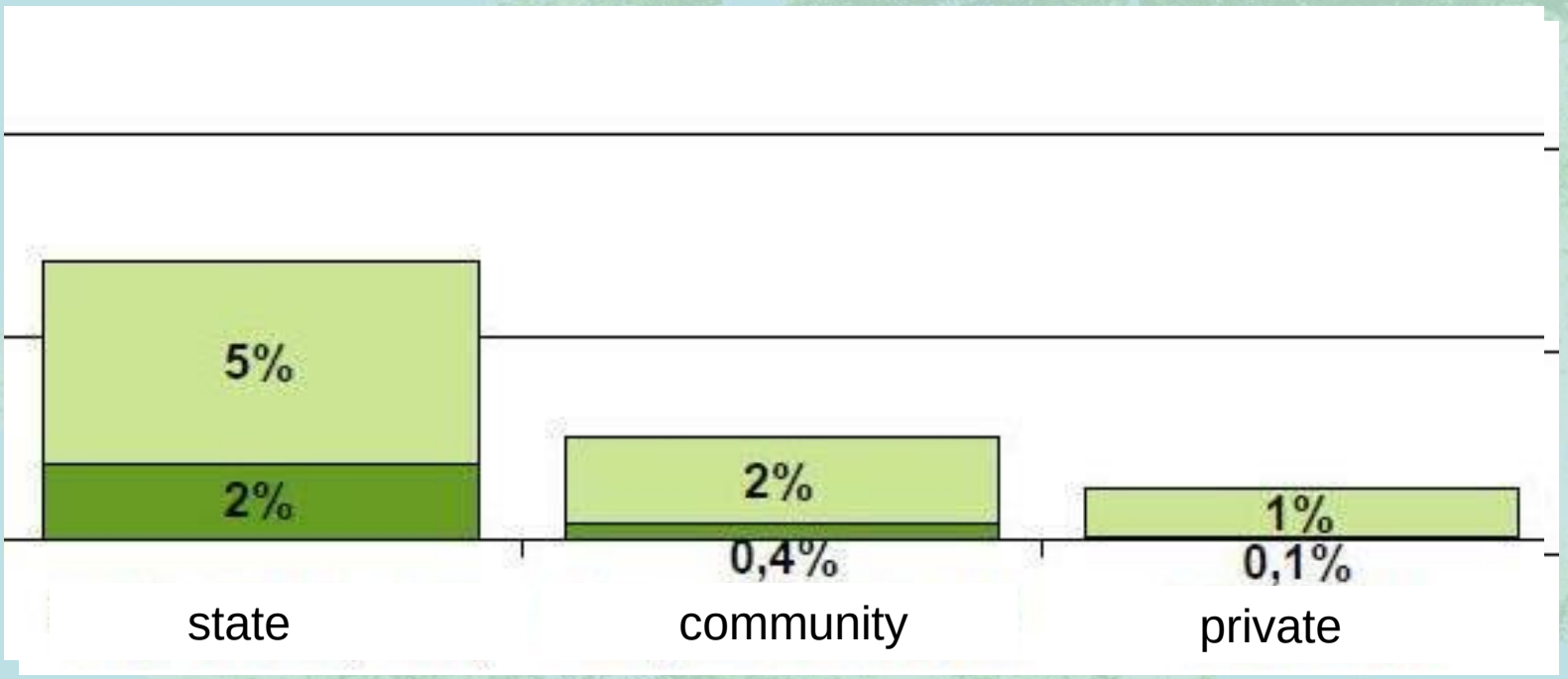
- ecological values (such as habitats, wilderness, water quality, climate protection) increased

- recreational values increased

Acceptance of measures for creating renewable energy, which change the landscape



Restrictions in timber harvesting in Germany by ownership:



strictly protected

some restrictions

Consequences for forest management:

- reduction of costs
- higher wood quality (price)
- higher stability
- higher ecological quality (diversity)

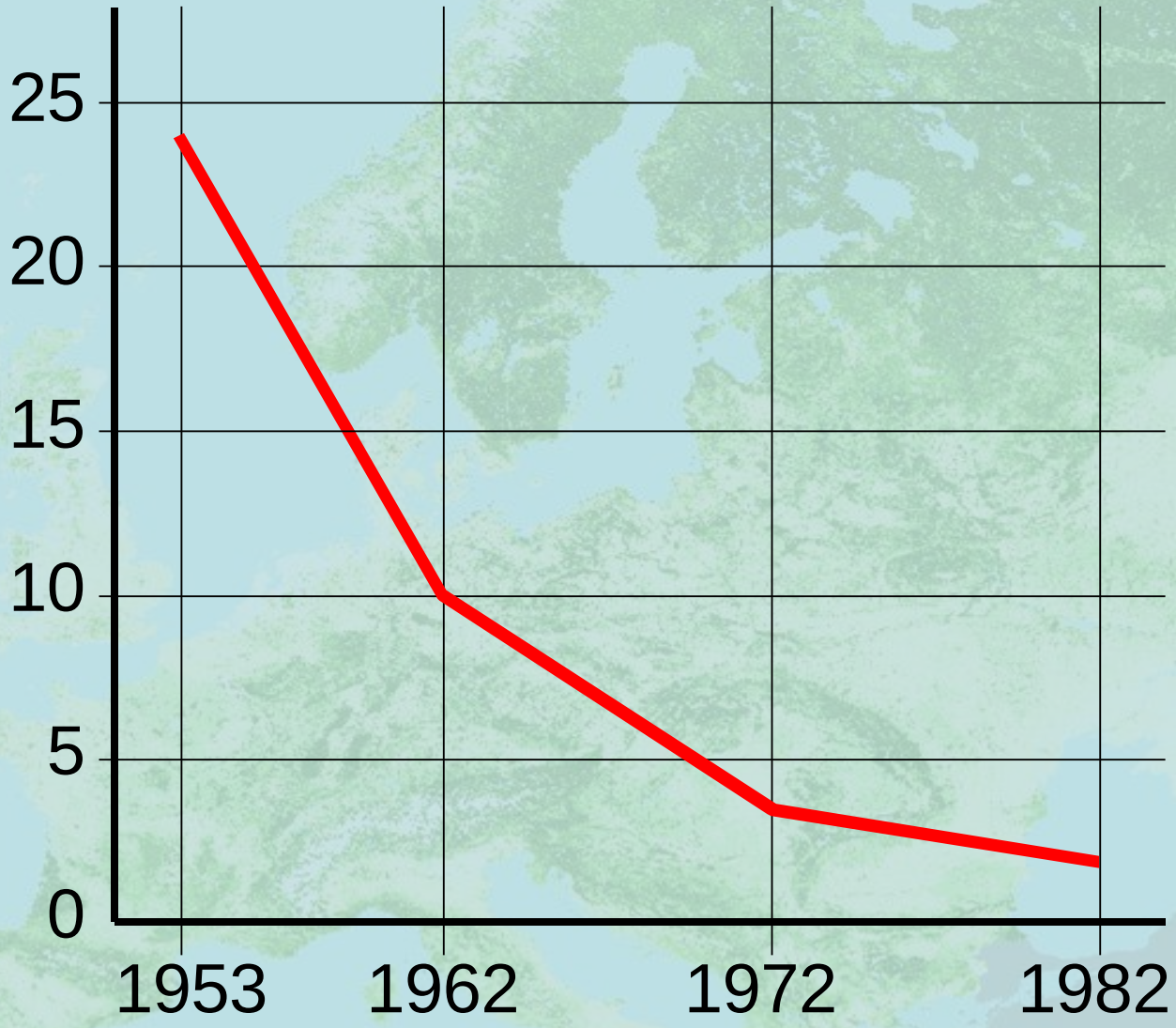
Regeneration:

when planting:

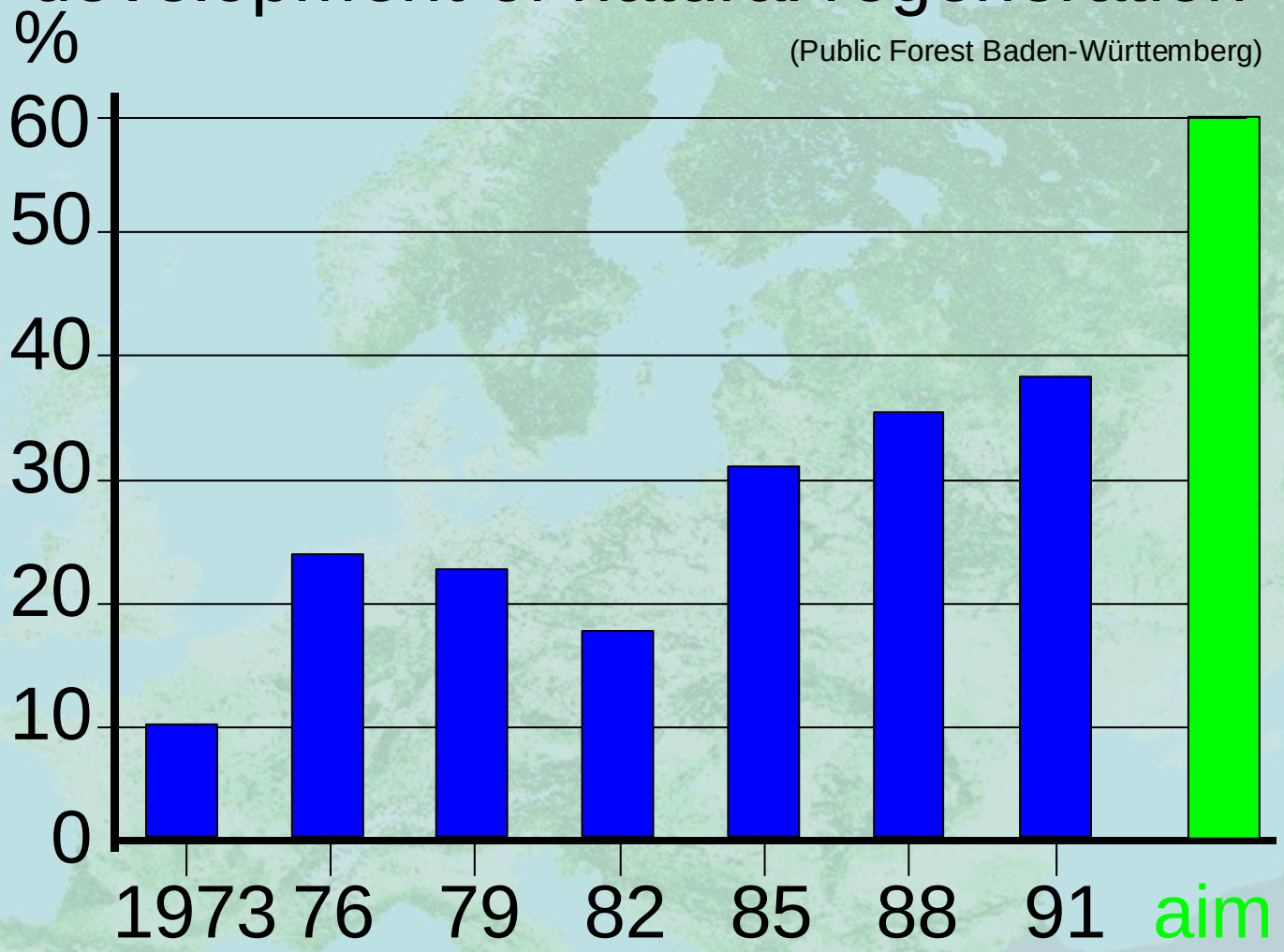
- less plants per ha
- less weed control
- larger plants
- no replanting of small areas where planting has failed
- more natural regeneration (use of natural processes)

hours per ha for stand regeneration

(pubic forestBaden-Württemberg)



development of natural regeneration



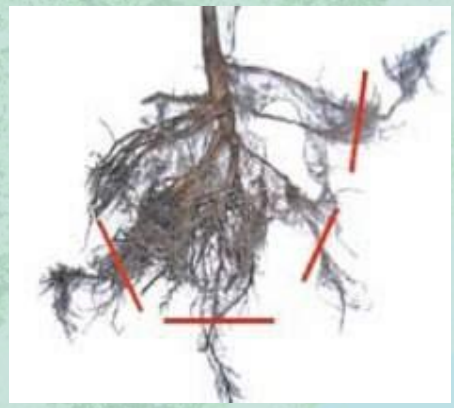
Support of minority species: natural regeneration

Advantages of natural regeneration:

- Less planting cost
- shelter of seed trees reduces heat, frost and drought
- good development of roots
- early differentiation in size of the trees
- good start for mixed forests

Advantages of planting/seeding:

- Controlled genetic quality
- fast regeneration in time
- controlled spacing
- less weed control needed when using bigger plants
- weed control only when risk that plant will be topped by the weed.



Genetics

- site adapted species
- provenance

Decision tools for defining **the spacing**

The space occupied by a tree depends on the dimension of the tree!

Most important is the dimension of the tree at the time when it is cut!
This is generally the time of maximum crown expansion!

Decision tools for defining **the spacing**

The dimension of the tree at the time when it is cut determines:

- initial spacing
- selection of future crop trees
- trees to be pruned
- trees to be released

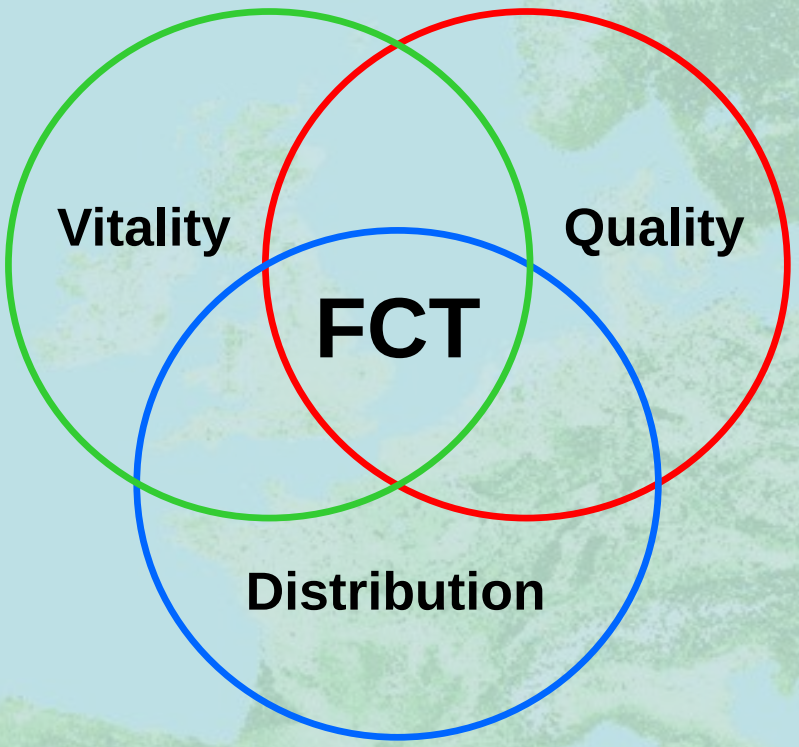
Increasing management efficiency:

Concentration of the management activities on the most important trees:

the future crop trees

Measures: thinning

Criteria for selecting future crop trees (FCT)



1. Vitality/Stability:
Crown dimension (relative to neighbour),
Stem dimension (relative to neigbour).

2. Quality:
Bole: branchless bole, stem shape, damages,
Crown: no dead branches, no forks, symmetric crown
In protection forests: protective effect!

3. Spatial distribution:
Distance, spatial arrangement

Decision tools for defining **the spacing**

How to determine the space occupied by a tree?

- crown projection area
  & uncovered area

-basal area in yield tables

(carrying capacity of the site)

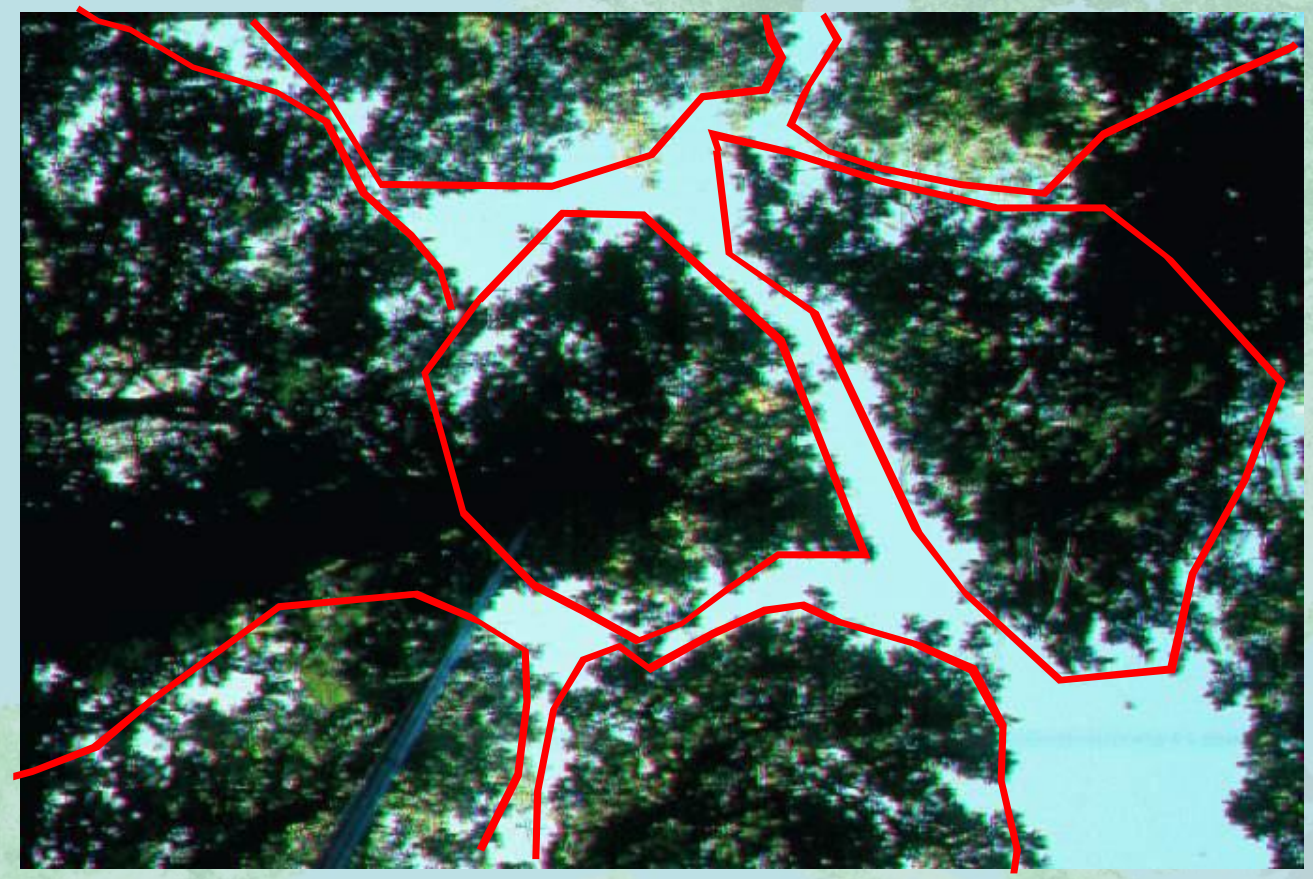
Initial spacing

Spacing criteria:

- **cost for planting**
- **risiks (reduced number of crop trees)**
- **biomass production losses**

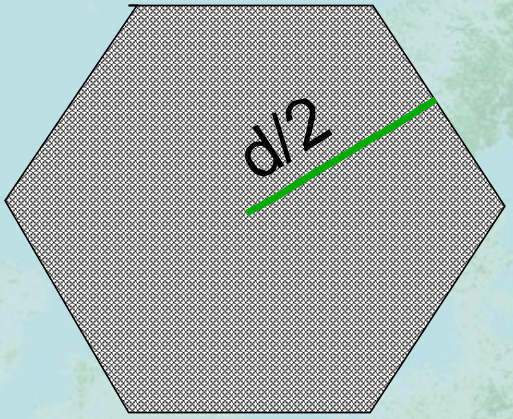
Measures: spacing & thinning

Crown dimension: Area required



Calculation of tree distance

tree distance (d) and area occupied (F)



$$d = 2 \times \sqrt{\frac{F \times \sqrt{3}}{6}}$$

example:

area (F) (m^2)	**distance (m):**
100	10,75
125	12,01

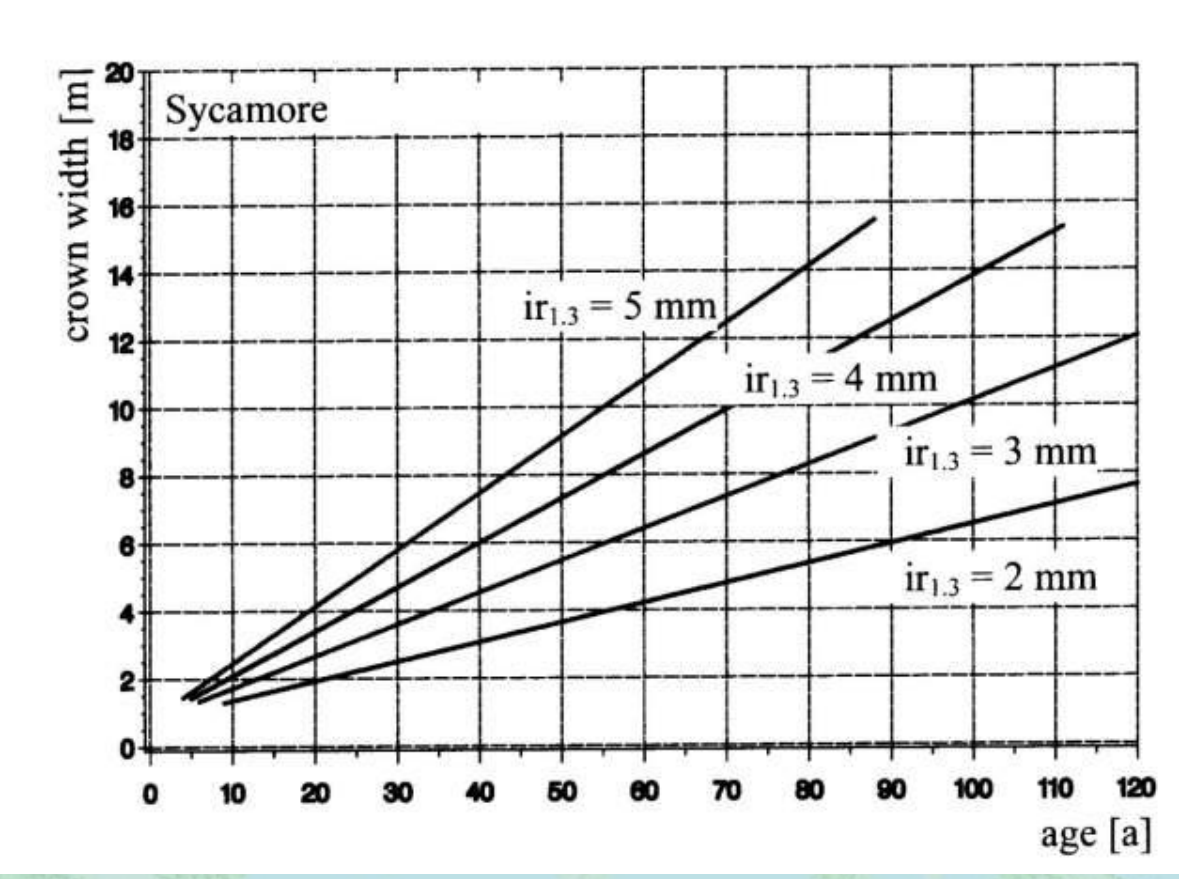
distance (a) between rows equilateral triangle:

$$a = \sqrt{0,75 \times d^2}$$

Source:: Heinrich Spiecker, unpublished

Measures: spacing & thinning

Modeled Crown width for different levels of mean radial increment



(Spiecker et.al 2009)

Examples for number of
future crop trees per ha assuming a
diameter of about 60 - 70 cm:

- Valuable Broadleaves: 50 per ha
- Oak 80 per ha
- European beech: 80 per ha
- Norway spruce: 200 per ha

Simple rule for spacing:

- Valuable Broadleaves: $d_{1.3}$ x 25
- Oak $d_{1.3}$ x 20
- European beech: $d_{1.3}$ x 20
- Scotts pine: $d_{1.3}$ x 15

Examples for decision tools:

The development of number of trees per ha:

Minimum distance to the next neighbor:

Decision tool for cherry

$d_{1.3}$ [cm] x 25

e.g.: $d_{1.3}$ = 20 cm;

→ min. distance = 5.0 m

Impact of **spacing** on dimension and quality

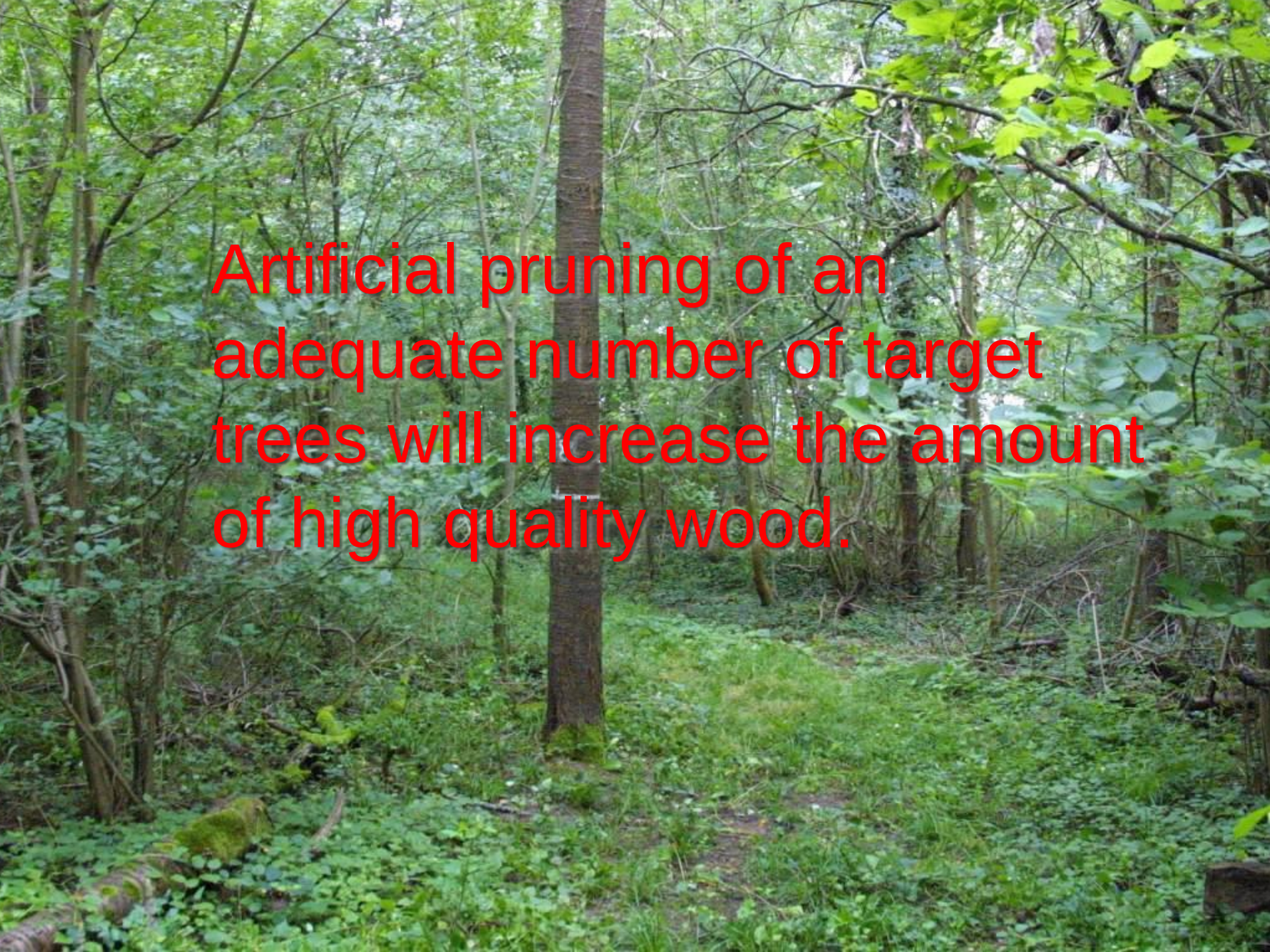
- diameter growth
- natural pruning
- tree and stand stability
  storm, drought
- biodiversity

Pruning

Sslitary tree

natural pruning

artificial runing


Artificial pruning of an adequate number of target trees will increase the amount of high quality wood.

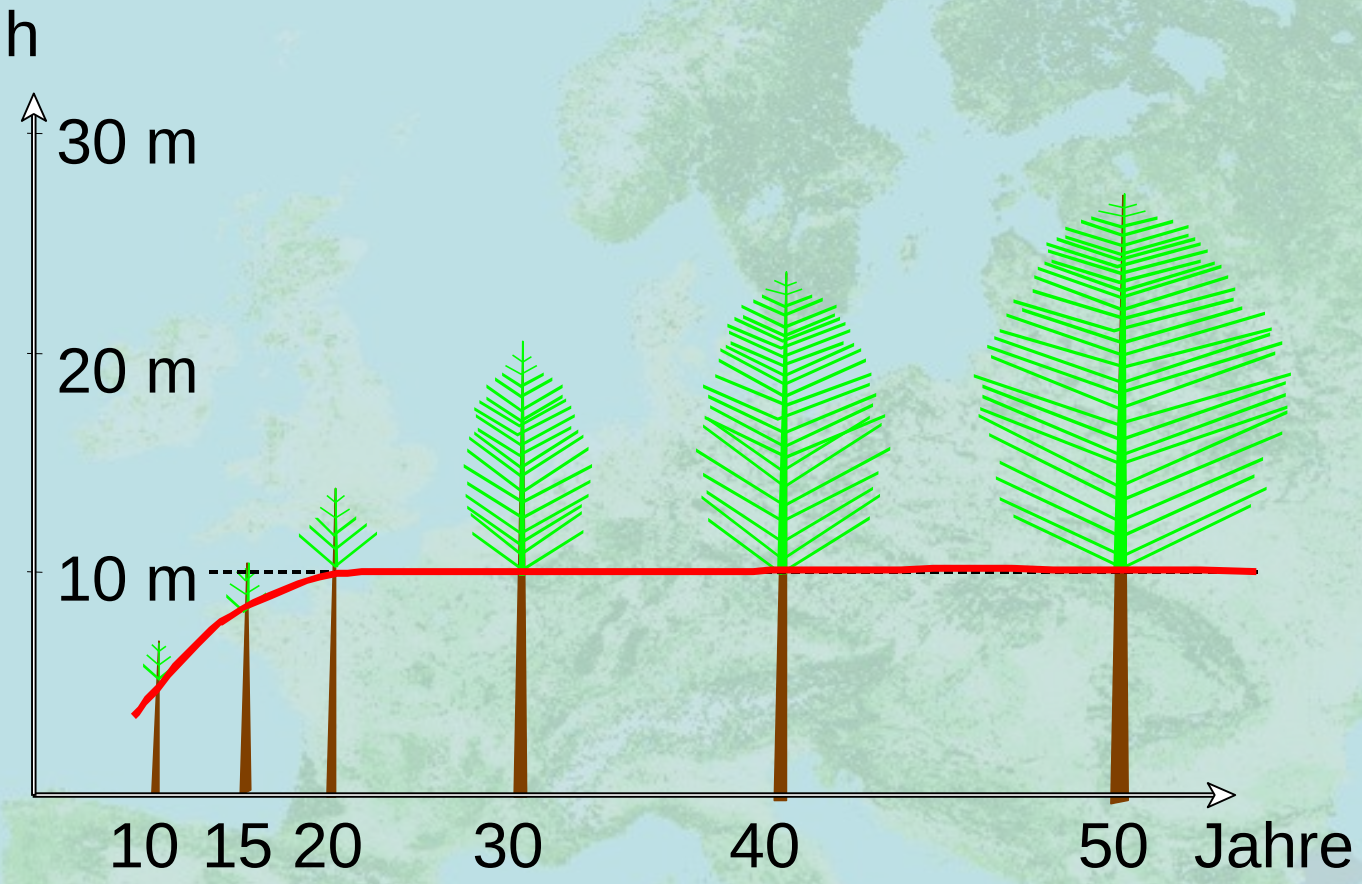
Pruning tools

Pruning of Douglas fir

Selective pruning: see Springmann et al. (2011) Forest Ecology and Management 261, 764-769.

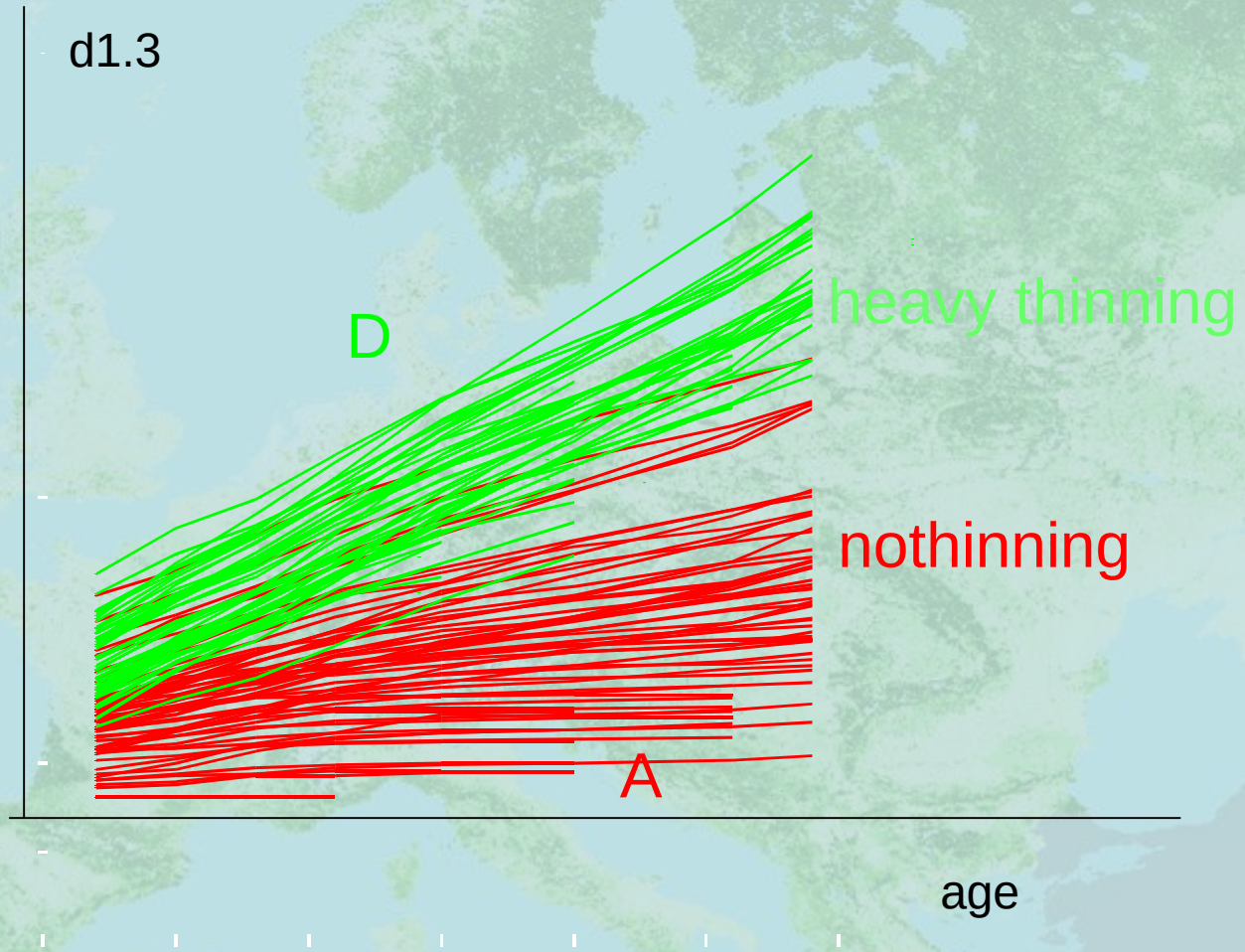
Examples for decision tools:

Scheme for describing the pruning process



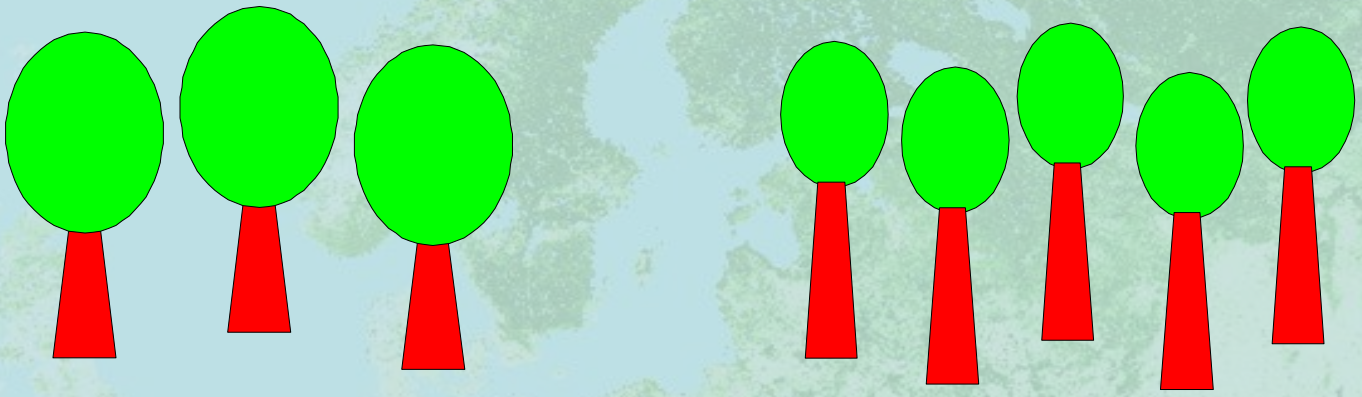
Spiecker M. and Spiecker H. 1988: Erziehung von Kirschenwertholz. AFZ (20): 562-565

Thinning effects on diameter growth of oak



Spiecker 2008

less crop trees with larger cowns?



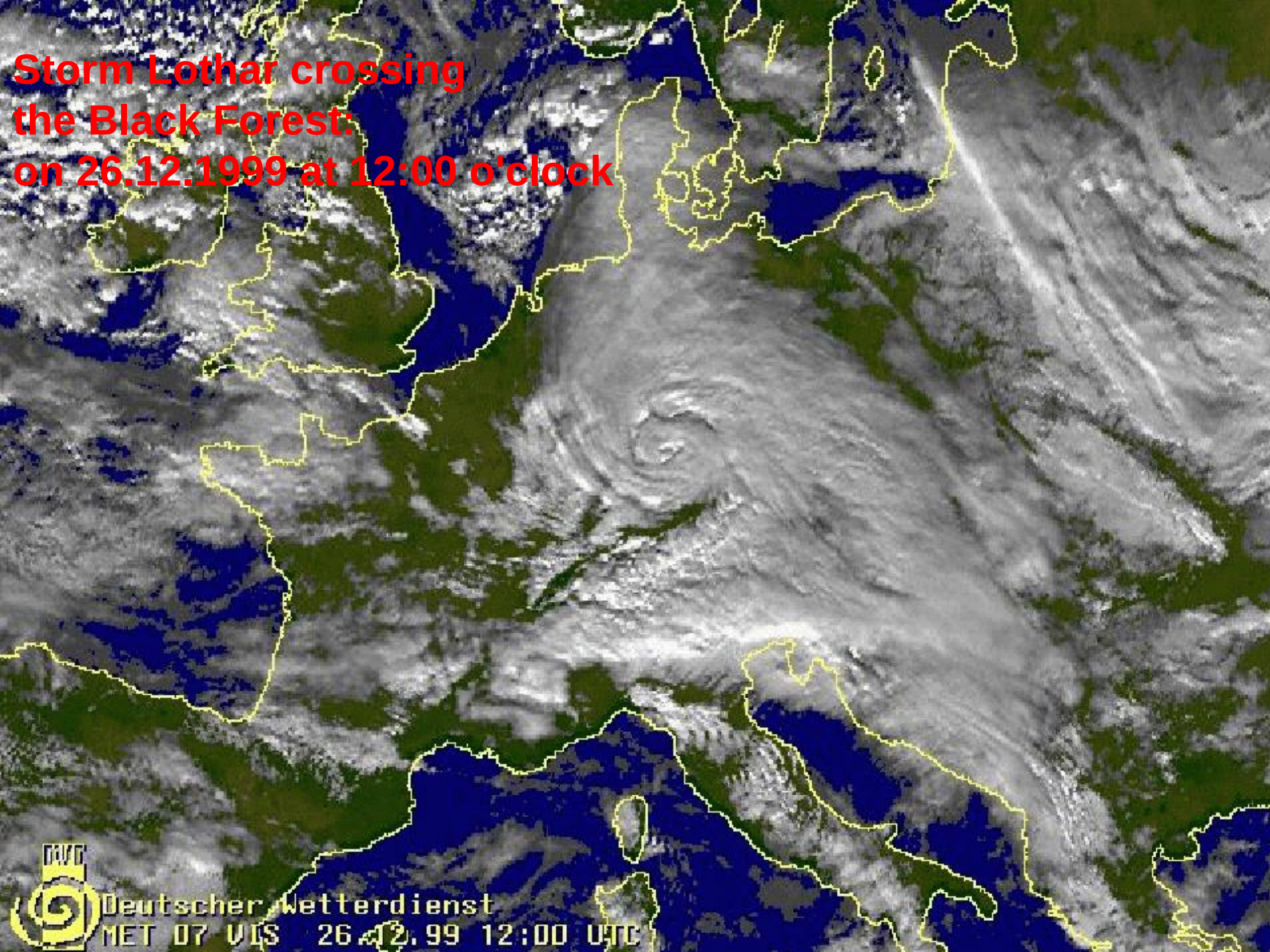
- Meeting the selection criteria

- wood volume of branch free bole per ha

Reduction of risks:

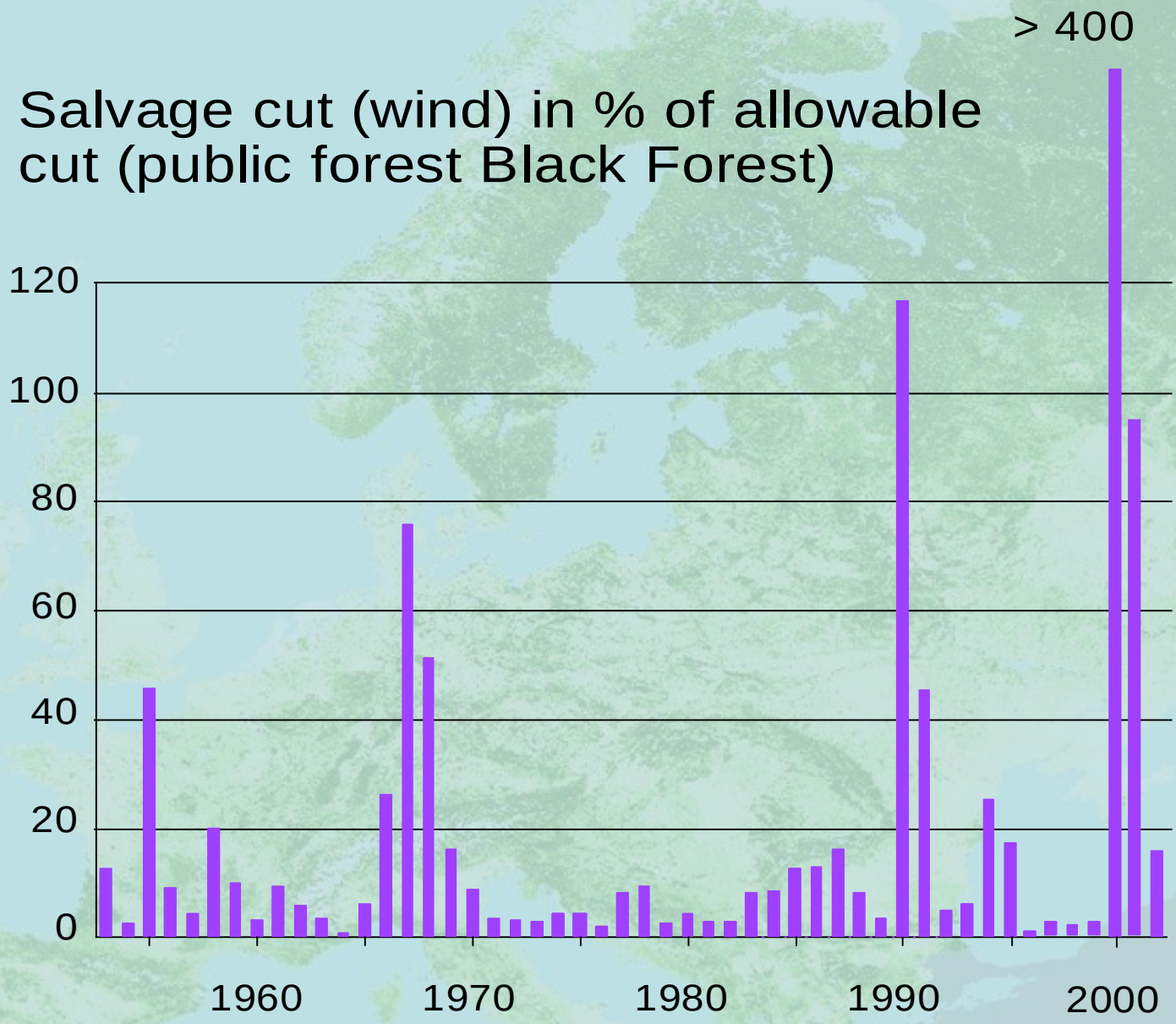
main causes of forest damages:

- storm
- snow
- desiccated trees/insects/fungi
- fire


Storm Lothar crossing
the Black Forest:
on 26.12.1999 at 12:00 o'clock
Deutscher Wetterdienst
MET 07 VIS 26.12.99 12:00 UTC

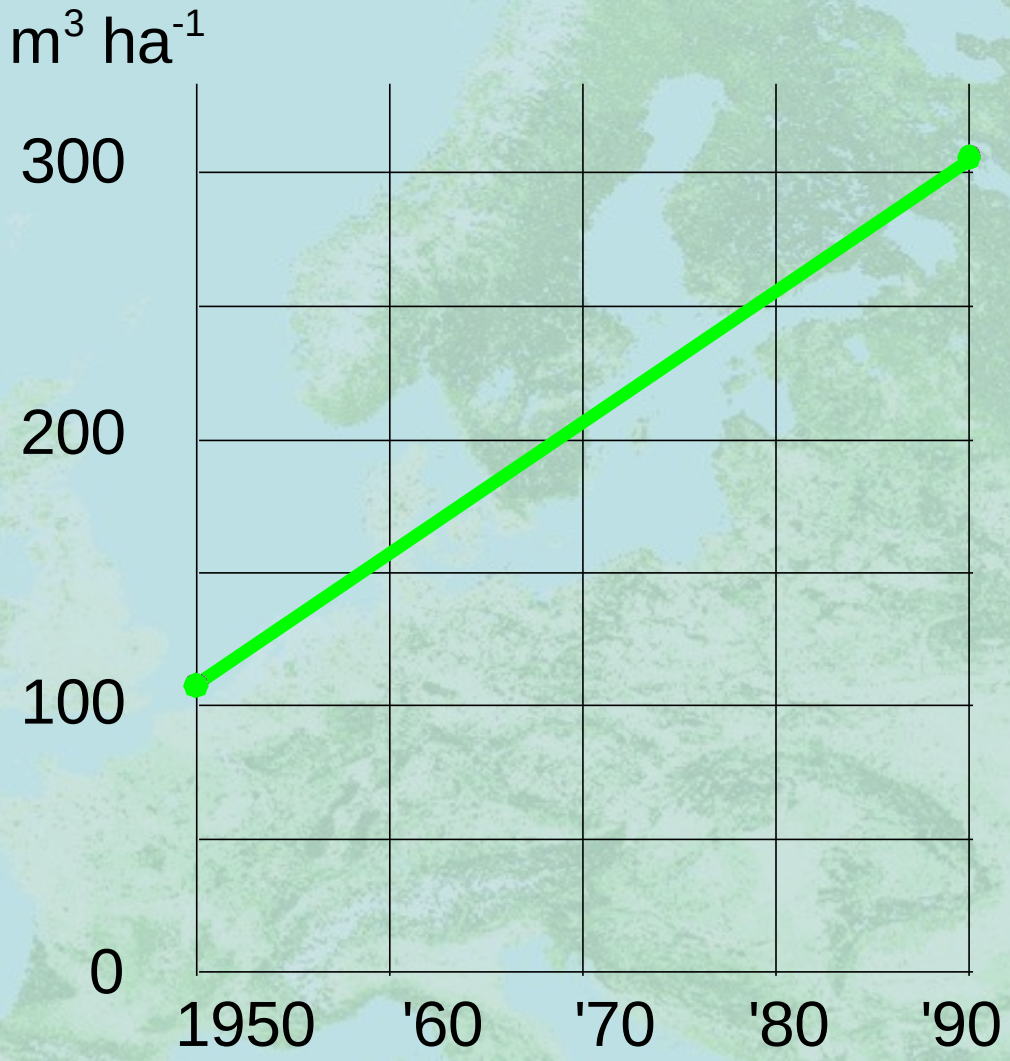
Spiecker unveröffentlicht

Salvage cut (wind) in % of allowable cut (public forest Black Forest)



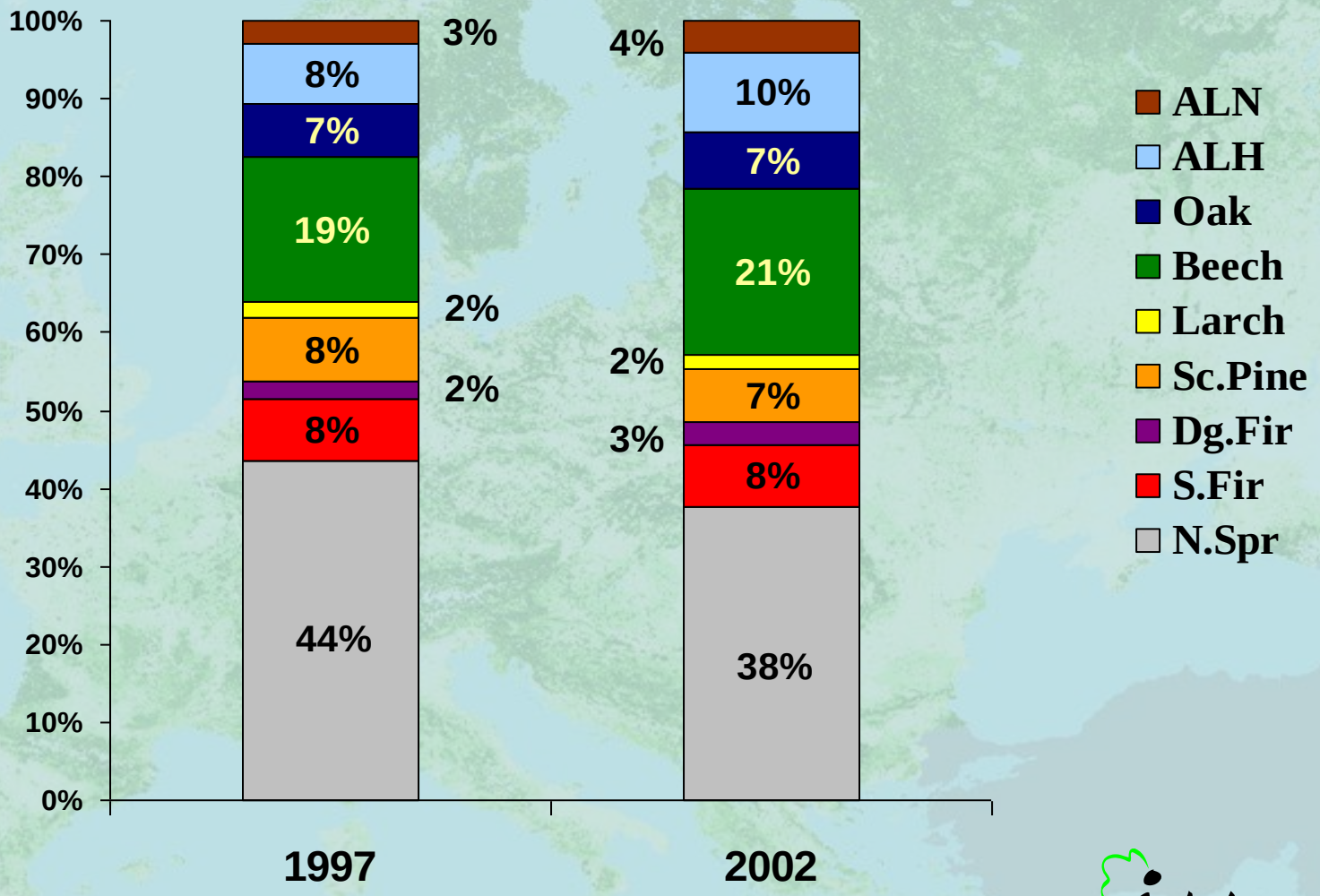
source: Forststatisitische Jahrbücher

Growing stock (former W. Germany)



Source: Weck 1961 and BWI 1990

Change in tree species composition in Baden-Württemberg 1987- 2002



Closer to Nature Forestry?

Three Principles of Close to Nature Forest Management

Tree species composition:
native and site adequate species

Forest structure:
ecological stability, biodiversity

Management:
application of self-regulating processes

Ecological Impact of Close to Nature Forestry

Nutrient balance in conifer forests:

- often higher acidification
- nutrient cycling is slowed down
- accumulation of organic matter

In conifer Forests Susceptibility to

- windthrow
- snow damage
- bark beetles
- fungi is relatively high

Ecological Impact of Close to Nature Forestry

Biodiversity in conifer forests:

less diversity in pure coniferous forests
is a generally accepted hypothesis

Water quality in conifer forests:

higher acidity in surface water
transpiration rate is lower
while interception is higher

What are the results of close to nature forestry:

Ecological aspects

- ecological risk
- long-term site fertility (nutrient cycling etc.)
- biodiversity
- water quality

Economic aspects

- cost of managing (harvesting etc.)
- wood characteristics

Economic Impact of Close to Nature Forestry

Criteria:

- net present value (profitability)
- cash flow (liquidity)
- risk
- flexibility

Relevant impacts:

- wood quantity
- wood dimension and quality
- length of the production period
- establishment, tending and harvesting cost

actual changes in species composition:

less: conifers
spruce! (not fir)
more: broad leafed species
beech, maple, alder, cherry etc.

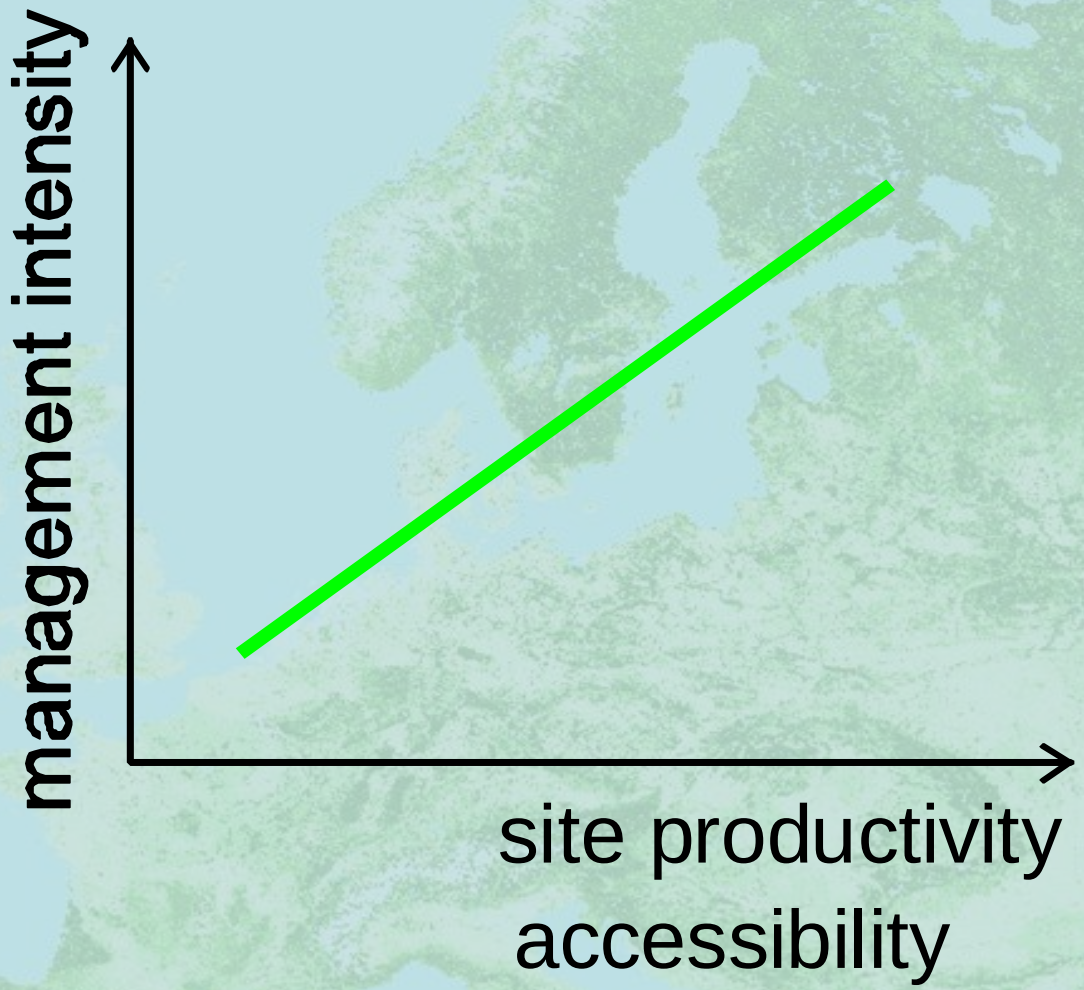

Selective thinning may be applied to favor preferred tree species or to improve wood quality

less crop trees with larger cowns?

tree quality	+
dimension	+
branchiness	+
harvesting costs	+
stability	+
diversity	?
aesthetic value	?
volume ha^{-1} of branch free bole	-

Differentiation of Management Intensity:

- **regional**
  accessibility of the stand, site productivity
- **tree**
  value of the tree (site adapted species and provenance, wood price, ecologic value, esthetic values etc.)


management intensity
site productivity
accessibility

Protection of Biotops and Endangered Species:

untouched forest area
-Bannwald- Baden-Württemberg:

73 forests
0.25% of total forest land
average size 43 ha
total 3.300 ha

Aspects of Biodiversity:

genetic diversity
species diversity
(mixed forests)
structural diversity
dead wood

EU policy is promoting biodiversity and closer to nature forest management:

delayed harvest

changed forest type

Spiecker unveröffentlicht

Conclusions I

The choice of the management option depends on:

- site conditions, stand conditions, etc.
- ownership
- economic conditions
- political conditions

No one single optimal management option!

Conclusions II

As management has long-term impacts we have to deal with

- changing economic conditions
- changing ecologic conditions
- changing values and perceptions
- changing political conditions
- improvement of knowledge/technologies

Conclusions III

Uncertainty:

Management strategies need to be flexible!

Strategies should allow various options for the future


Thank you for your attention!