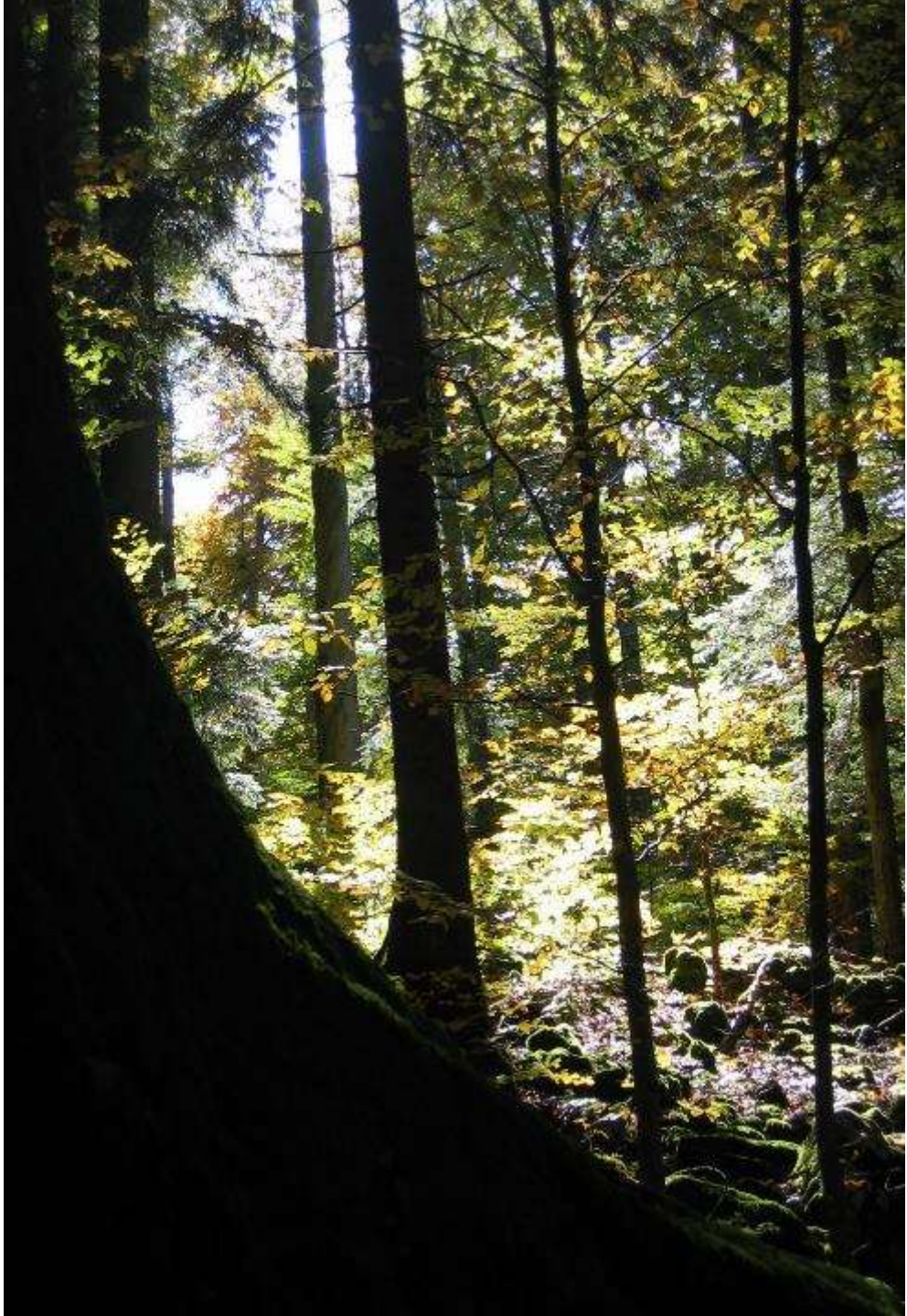
Integrating practitioners into academic research for improving of close-to-nature forestry

ProSilva 30th Anniversary Conference

Radlje ob Dravi, Slovenia

Dr. Peter Ammann (Fachstelle Waldbau, Switzerland)



The competence center of sylviculture Fachstelle Waldbau (FWB-CCS)

- Part of the "Forest training Centre Lyss"
  - Education of foresters since 1969
- Founded in 2011; 2 x 40% pensum
- Pascal Junod, 40%, specialist for uneven-aged forests and for marteloscopes; 60% forest service Neuchâtel
- Peter Ammann, 40%, specialist for natural processes and thinning concepts («biological rationalisation»); 50% forest service Aargau and 10% self-employed (thinning)

The competence center of sylviculture Fachstelle Waldbau (FWB-CCS)

Partners

Switzerland / Federal states / Practitioners
WSL / ETHZ / HAFL / BZW's / Sylv. organisations

Main task

Transfer of knowledge / exchange of experiences

Products

Consulting	Further education	Research plots	Publica-tions

http://www.waldbau-sylviculture.ch

Content

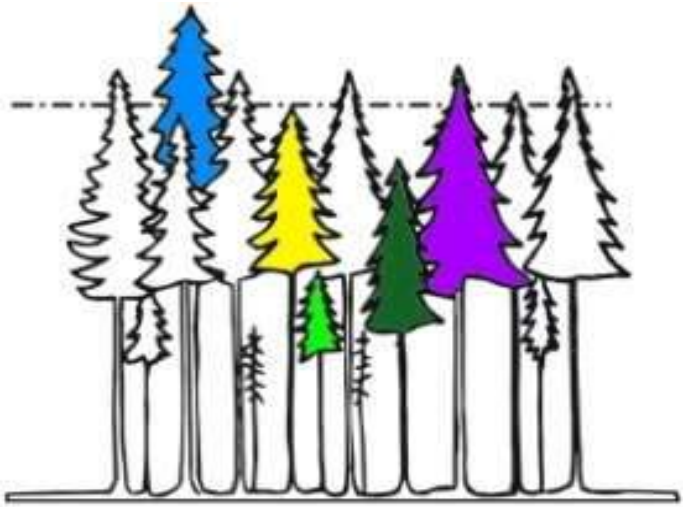
- History of thinning in Switzerland
- Conclusions; «biological rationalisation»
- Adaptation to climate change (case study)

Site conditions (Aargau, Switzerland):

- 300-700m asl (hills)
- (800)-1’000-1’500 mm annual rain(snow)fall
- Deep (fresh-humid) soils
- Mean increment: 12m3/y

History of thinning

- Basis for close-to-nature sylviculture: know natural processes
- In young stands: Self-thinning
- Result: Social classes ("natural law")



Social classes (Kraft 1884)

predominant	*vorherrschend*
dominant	*herrschend*
codominant	*mitherrschend*
dominated	*beherrscht*
suppressed	*unterdrückt*

History of thinning

Before 1933: Low thinning, negative selection

+ Respecting self-thinning = natural vitality
- No or only litte influence on dominant stand
- Cutting of trees, which would disappear anyway
- Homogenisation ("cleaning")

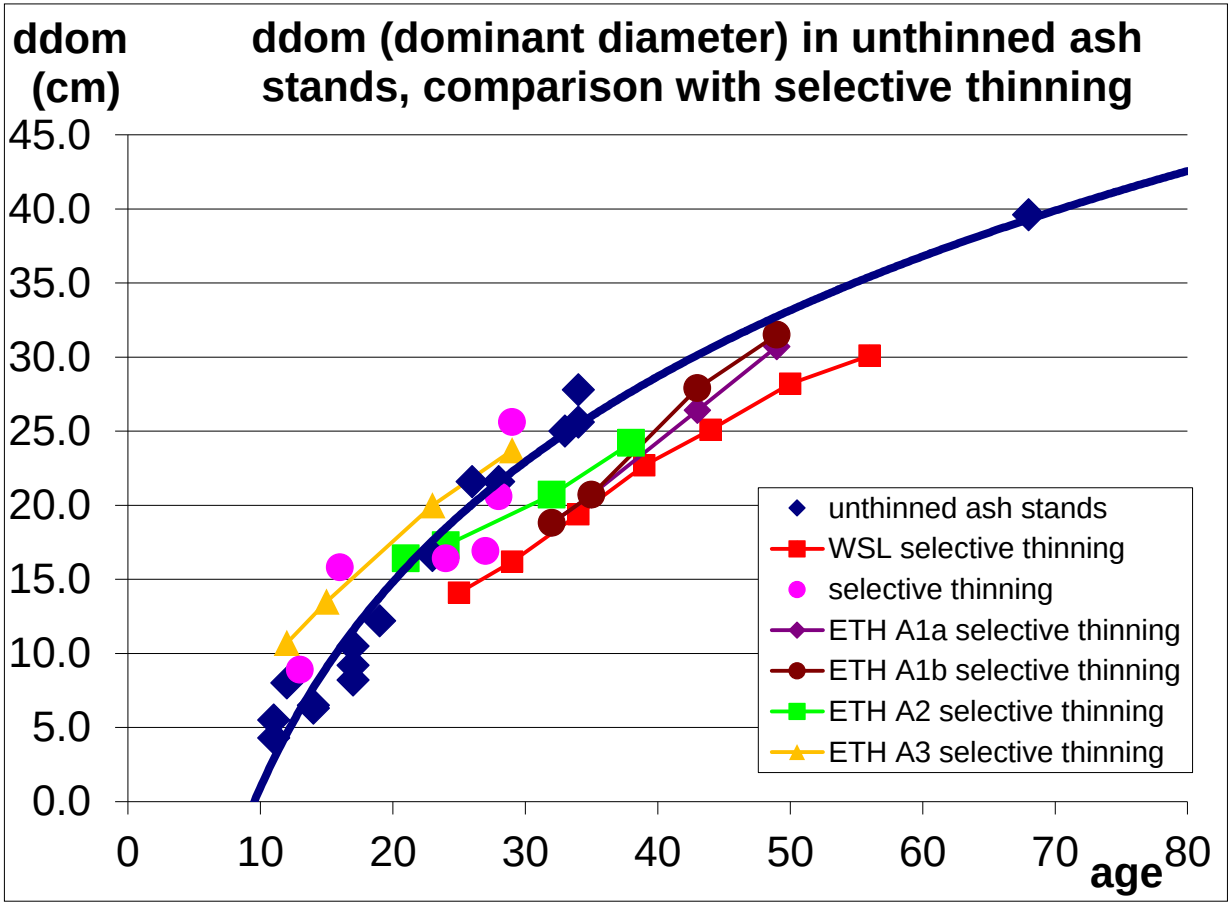
History of thinning

SCHÄDELIN 1933: Selective thinning (positive selection)

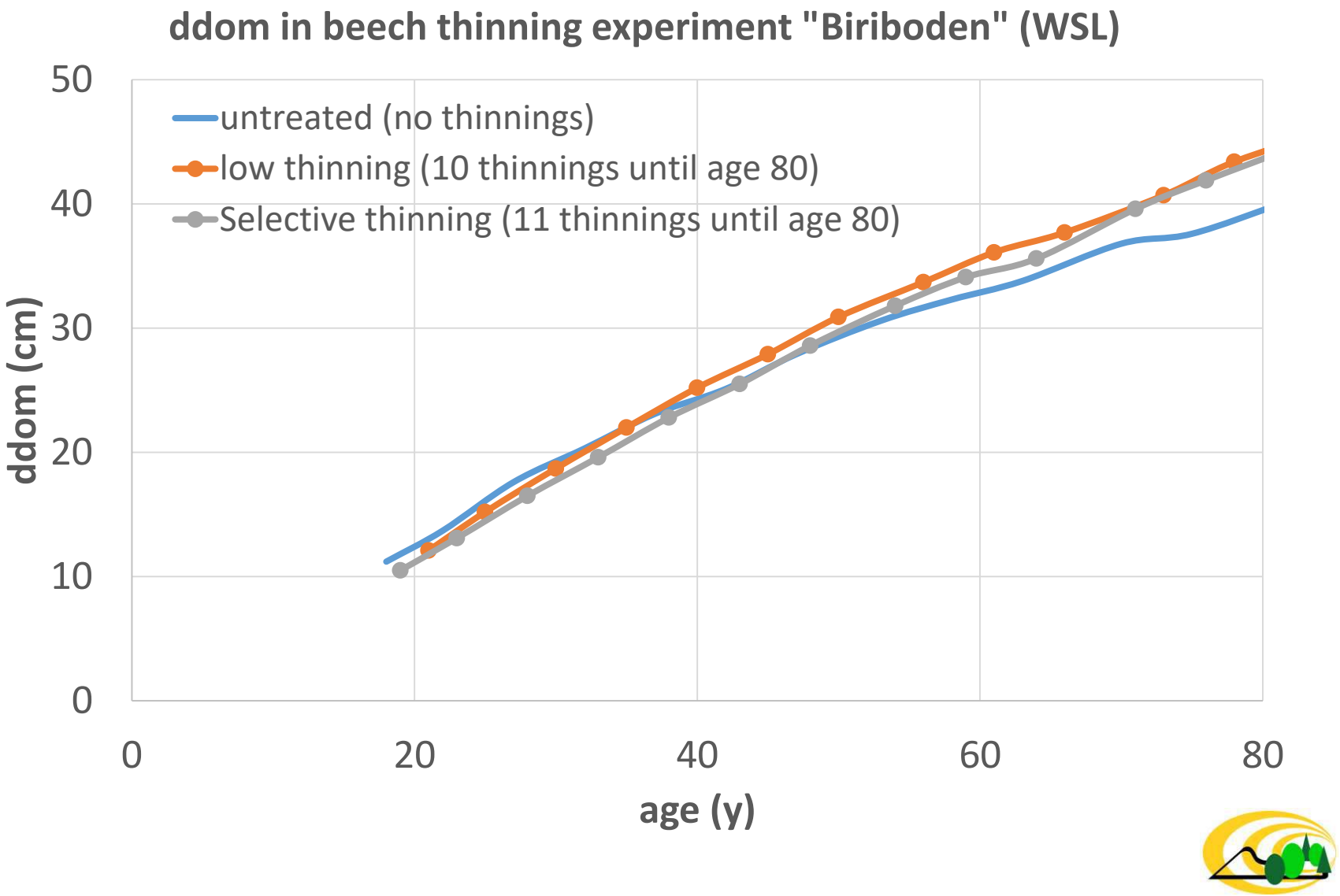
+ Positive selection is more effective than negative s.
+ Base of all later concepts (value timber), until today
- Too many elite trees/selected and favoured trees
  - LEIBUNDGUT (ETHZ 1940-1979): Nothing new…; 5000 elite trees/ha
- Dynamic selection, every time new, change of elite trees
- Extremely high tending costs
- Extreme homogenisation
- Devitalisation of stands through permanent selection (with quality as 1. criterion)

Comparison ddom ash stands (DBH100): Untreated stands and selective thinning

- Ash stands, excellent site conditions
- Datas before 2003 (no Chalara fraxinea)
- Stands with selective thinning with lower ddom than stands without thinning…!?



Comparison ddom in beech stands

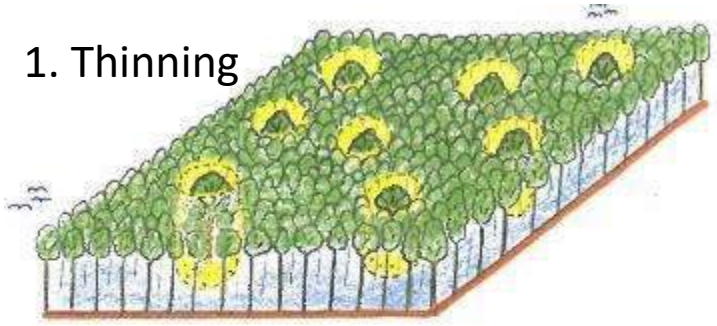


History of thinning

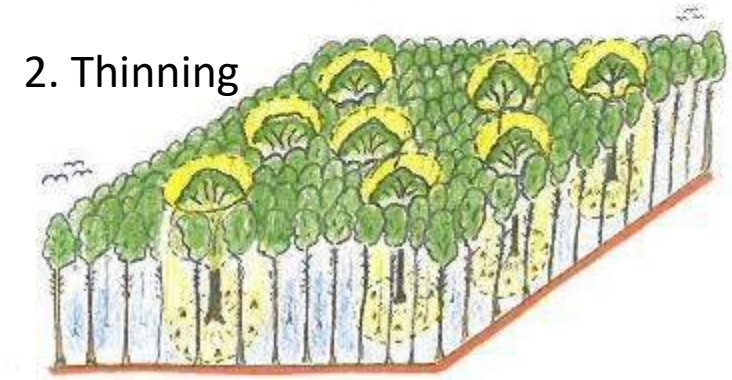
ABETZ 1975: Crop tree thinning (in final distance)

+ Effective, efficient, purpuseful

- Primary too short distances = too many crop trees (D, CH)
- Too much importance on distance and distribution
- In young stands (before crop tree thinning), the traditional methods were practiced (cleaning, selective thinning of Schädelin).



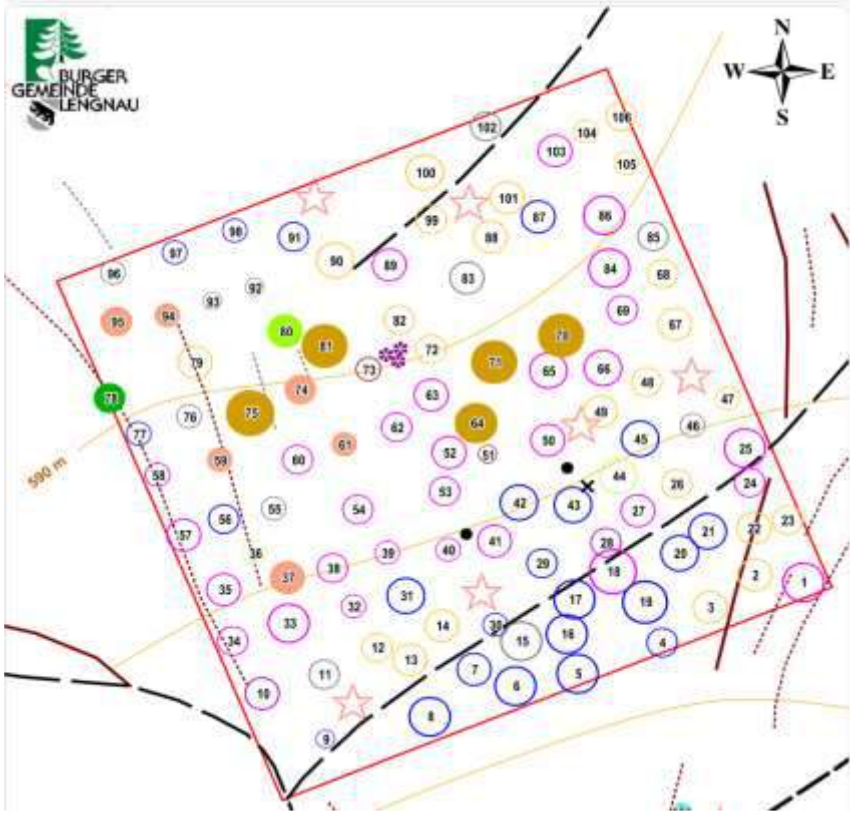
Crop trees and "matrix"



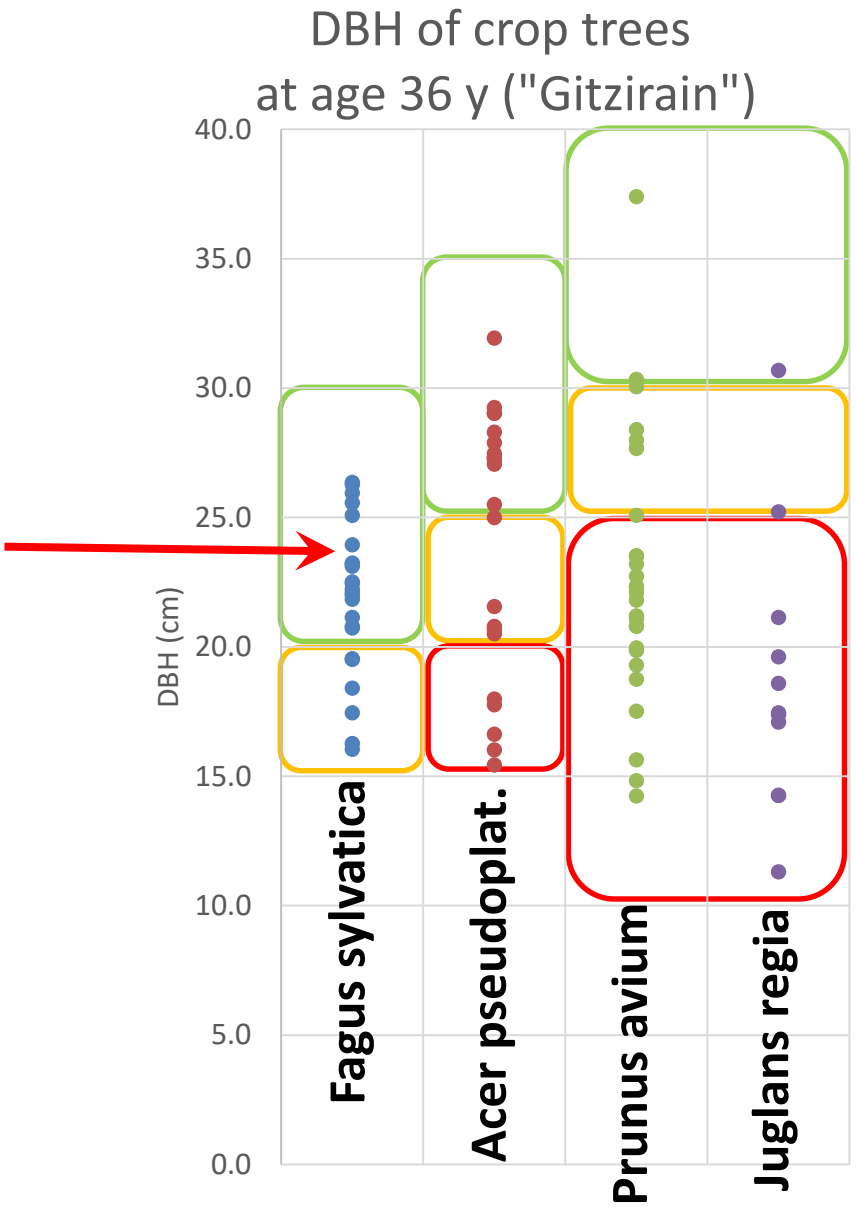
Picture: WILHELM and RIEGER (2013)

Example of Gitzirain (Forestry Training Center Lyss)

- Study stand of the school
- Regeneration of 1983 (storm damage)
- Age: 36 years, 1 ha
- Beech, sycamore, cherry, walnut, a.o.
- 7 Crop tree thinnings
- Too many crop trees (106/ha)
- Selection criterions:
  - Tree species
  - Stem quality
  - Perfect distances / distribution
- One generation of Swiss foresters is educated like this….



Example of Gitzirain: Results 2019



- Relation age / DBH depending on tree species = Potential for increment
  - good
  - suboptimal
  - bad
- Why? The wrong crop trees were (often) selected
- Many (pre)dominant trees (beech) were cut to favour dominated or suppressed (cherry, walnut)

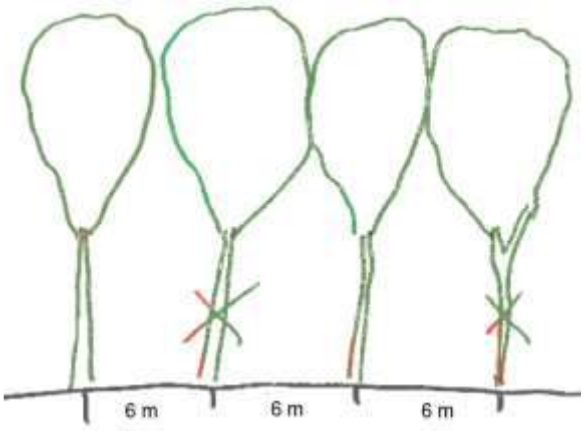
History of thinning

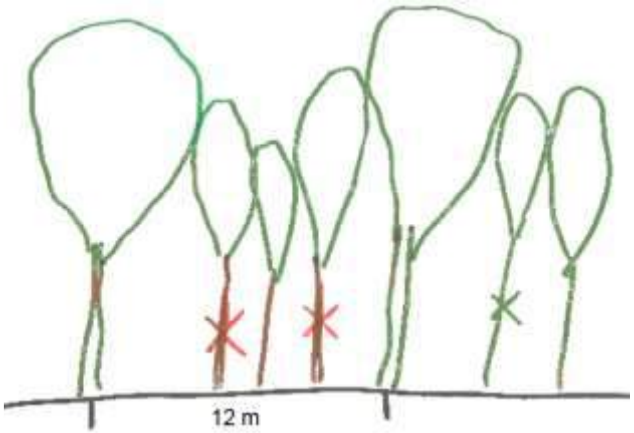
Switzerland, after 1975:

Crop tree thinning (in semi-final distance)

e.g. spruce 8m final distance = 4m semi-final dist.

- 4x more crop trees; costs are much higher
- The number of high vitality-trees is limited (ATP..)
- Moment of change (to final distance) is too late, normally
- Homogenisation
- Dosing of thinnings is difficult





History of thinning

Switzerland, after 1975:
Crop tree thinning with "additional tending measures"

- Crop tree thinning, but without respecting of "matrix" (auxiliary stand)
- Some positive, some negative selection between the crop trees
- This is the ultimate homogenisation
- Very expensive
- Reduction of diameters

Costs of traditional thinning in Switzerland:
50 - 100 hours/ha. 1 h = 50 Euros = 55 CHF
After 5 – 6 thinnings ca. 30'000 CHF/ha

History of thinning
from 1996 (SCHÜTZ, AMMANN) «Biological rationalisation»

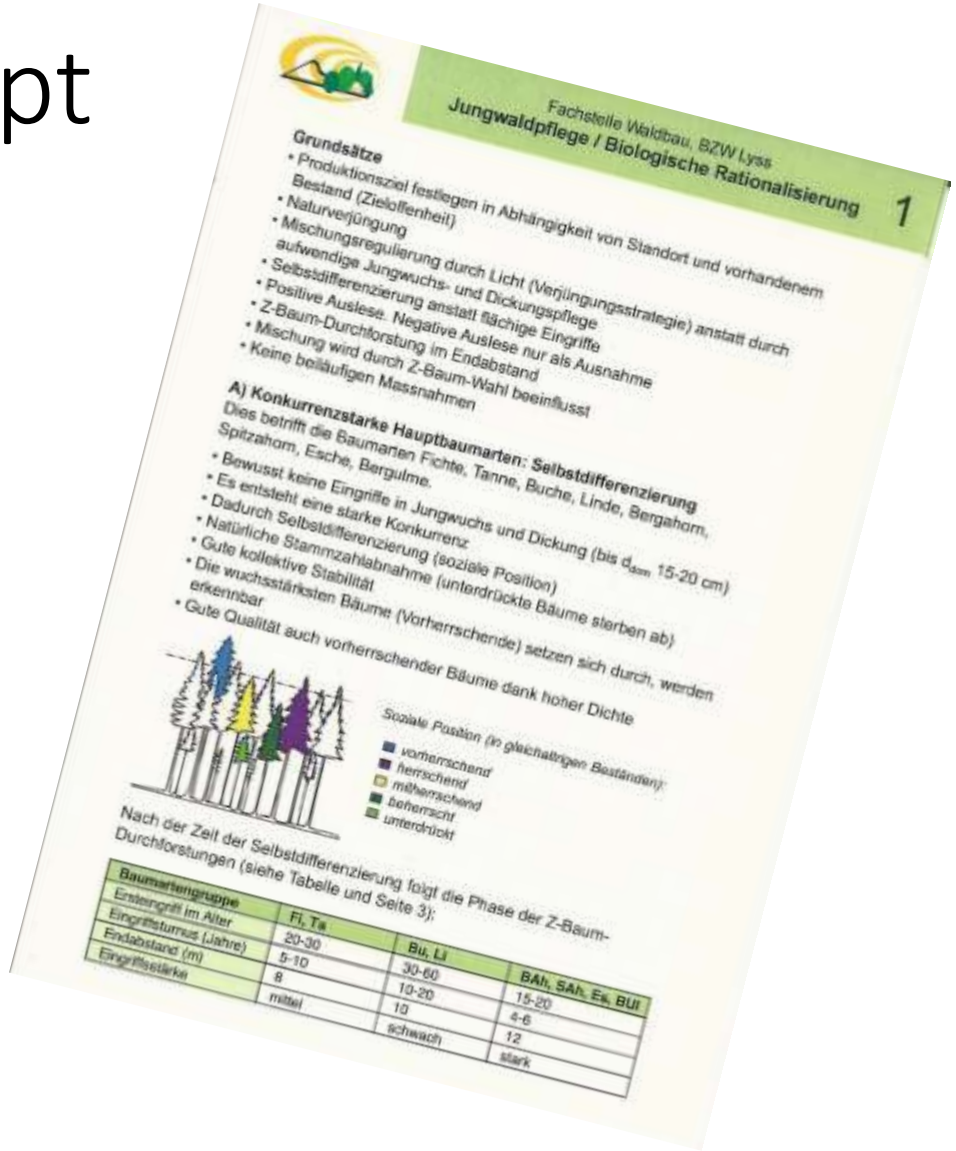
- SCHÜTZ: Biological rationalisation = «principle of concentration» + «automation of nature»
- AMMANN: Analysis of the natural development of untreated young stands – biological rationalisation of sylviculture for spruce, ash, sycamore and beech (90 untreated stands, age 10-100)

Conclusions / thinning concept

- Natural regeneration (normally)
- Self thinning / self differentiation
  - Natural mortality, stem number decreasing, visibility
  - High density = education, quality (also predominants)
  - Find out the trees of high vitality
- Thinning concept
  - Crop trees of high vitality
  - Final distance (or more)
  - Free distribution
  - Selection criterions: **1. Vitality > 2. Quality > 3. Distance**

Thinning concept

- Difference between highly and weakly competitive tree species:
  - Beginning of thinning
  - Tending cycle
  - Strength of thinning



Fachstelle Waldbau, BZW Lyss

Jungwaldpflege / Biologische Rationalisierung 1

Grundsätze

- Produktionsziel festlegen in Abhängigkeit von Standort und vorhandenem Bestand (Zielöffenheit)
- Naturverjüngung
- Mischungsregulierung durch Licht (Verjüngungsstrategie) anstatt durch aufwendige Jungwuchs- und Dickungspflege
- Selbstdifferenzierung anstatt flächige Eingriffe
- Positive Auslese. Negative Auslese nur als Ausnahme
- Z-Baum-Durchforstung im Endabstand
- Mischung wird durch Z-Baum-Wahl beeinflusst
- Keine beiläufigen Massnahmen

A) Konkurrenzstarke Hauptbaumarten: Selbstdifferenzierung

Dies betrifft die Baumarten Fichte, Tanne, Buche, Linde, Bergahorn, Spitzahorn, Esche, Bergulme.

- Bewusst keine Eingriffe in Jungwuchs und Dickung (bis d_{dom} 15-20 cm)
- Es entsteht eine starke Konkurrenz
- Dadurch Selbstdifferenzierung (soziale Position)
- Natürliche Stammzahlabnahme (unterdrückte Bäume sterben ab)
- Gute kollektive Stabilität
- Die wuchsstärksten Bäume (Vorherrschende) setzen sich durch, werden erkennbar
- Gute Qualität auch vorherrschender Bäume dank hoher Dichte

Nach der Zeit der Selbstdifferenzierung folgt die Phase der Z-Baum-Durchforstungen (siehe Tabelle und Seite 3):

Baumartengruppe	Fi, Ta	Bu, Li	BAh, SAh, Es, BUl
Eingriff im Alter	20-30	30-60	15-20
Eingriffsturnus (Jahre)	5-10	10-20	4-6
Endabstand (m)	8	10	12
Eingriffsstärke	mittel	schwach	stark

Highly competitive species (~shade tolerant)

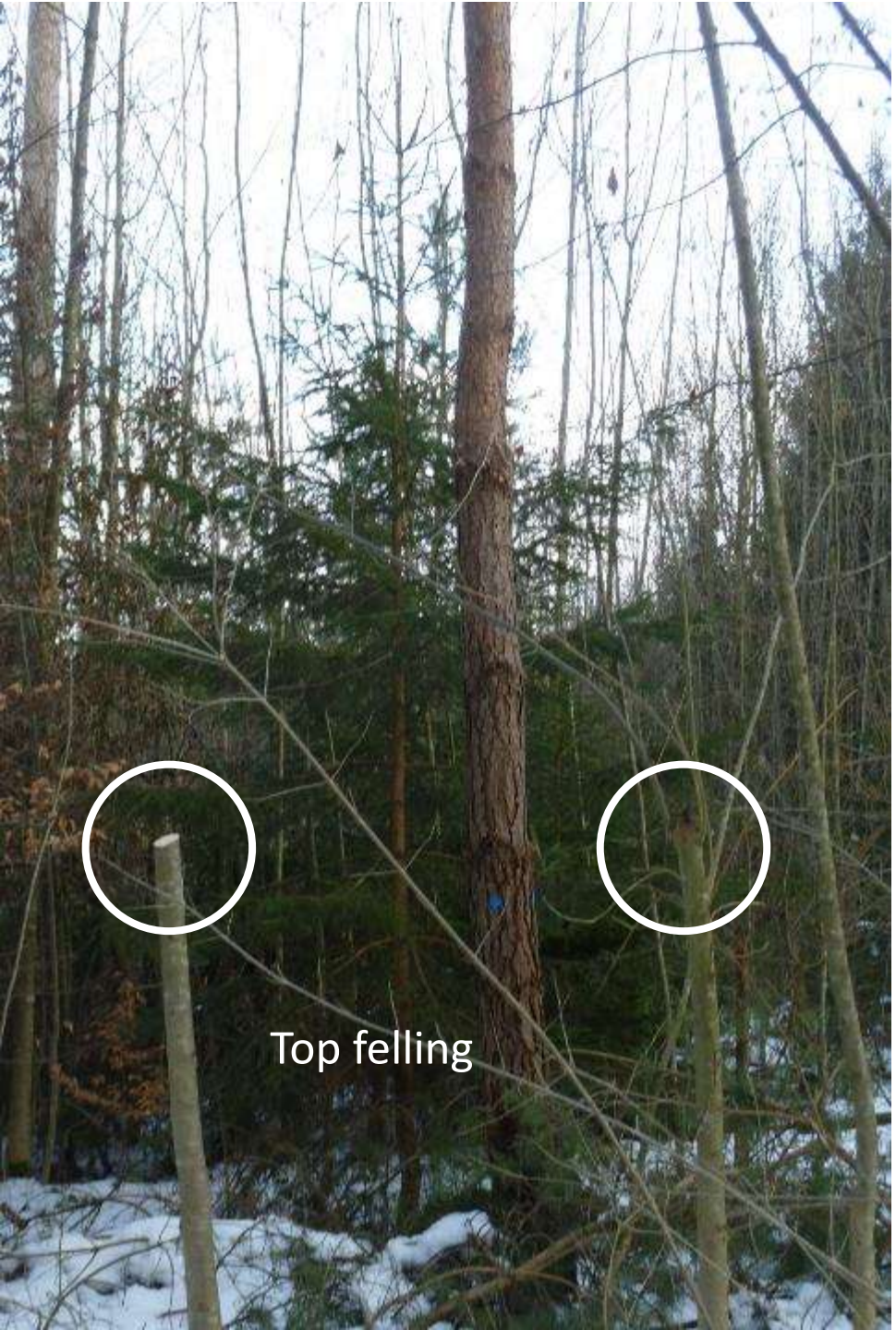
Tree species	Picea abies Abies alba	Fagus sylvatica Tilia spez.	Acer pseudoplat. Acer platanoides Fraxinus excelsior Ulmus spec.
First crop tree thinning (age)	20-30	30-60	15-20
Tending cycle (years)	5-10	10-20	4-6
Final distance (m)	8	10	12
Strength of thinning	medium	weak	strong

Weakly competitive species (~light demanding)

Tree species	Pinus sylvestris	Larix decidua, Pseudotsuga menz. Alnus glutinose Betula pendula	Quercus spez.	Prunus avium Juglans regia
First crop tree thinning (age)	5-10	5-10	5-10	5-10
Tending cycle (years)	4-6	4-6	4-6	2-3
Final distance (m)	10	12	15	15
Strength of thinning	medium	strong	medium	very strong

Phased begin of crop-tree-thinning depending on tree species

- 1.+2. Intervention only for larch, oak
- 3. intervention for larch, oak = 1. intervention for spruce, beech


Top felling


Acer, Ulmus 16


Fagus sylvatica (27)

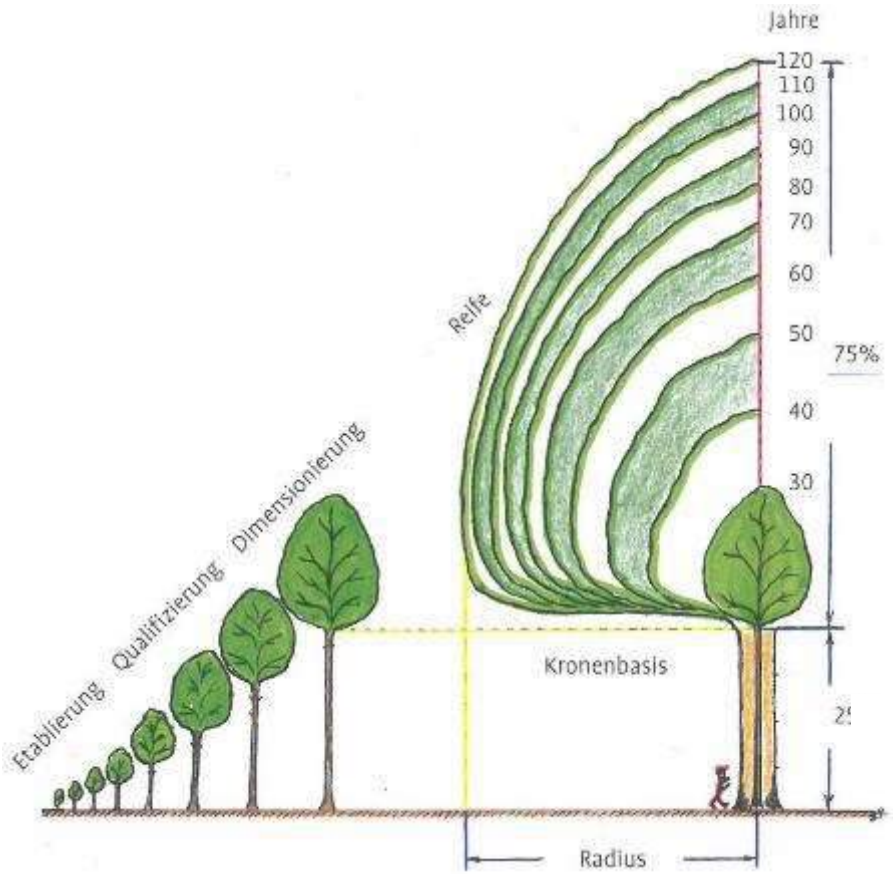

Prunus avium 10 – 13 - 16

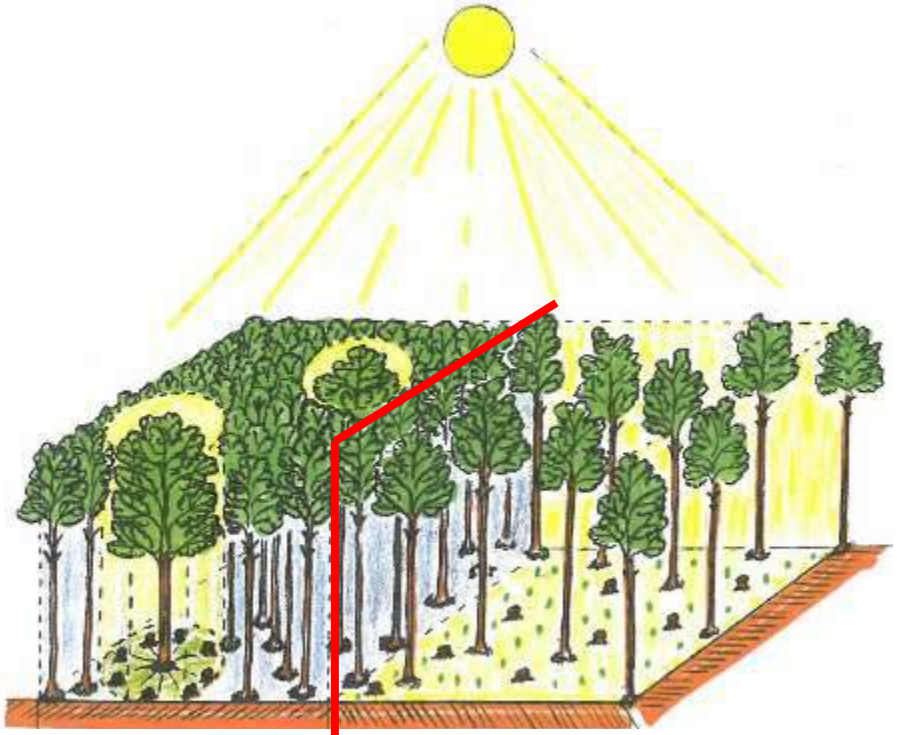
Acer (Quercus) 19 – 24 - 29)


Acer platanoides
Age: 51, mean diameter: 47cm
Thinning was finished at age 44

Concepts are similar to Wilhelm / Rieger (2013): Q/D-strategy = to **q**ualify / to **d**imension

- Some very descriptive terms and definitions



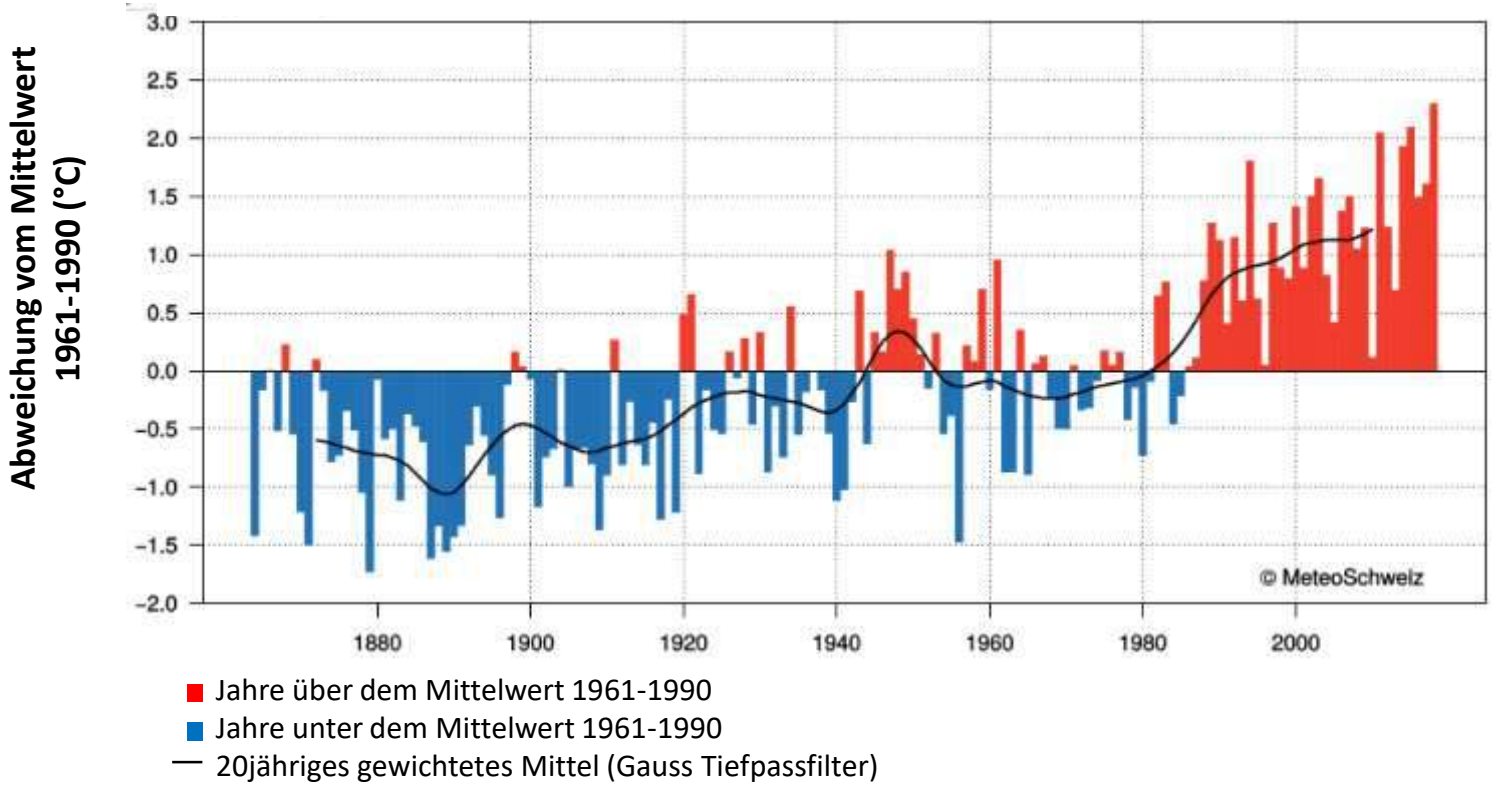


Crop tree th --- selective th./ cleaning

Climate ist changing rapidly…

Mean annual temperatur 1864-2018 in Switzerland

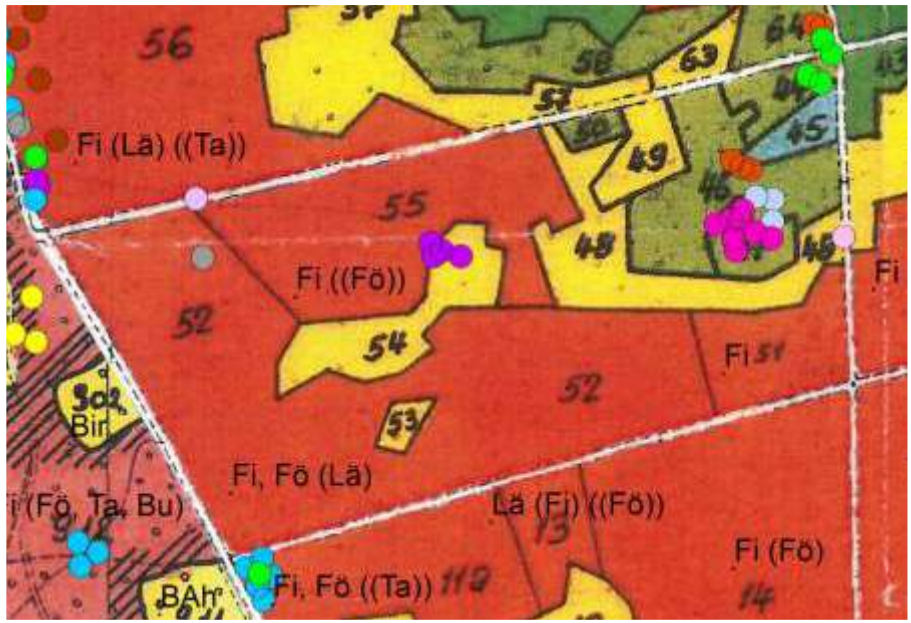
(Measuring stations: BAS, BER, CHD, CHM, DAV, ENG, GVE, LUG, SAE, SIA, SIO, SMA)



Quelle: https://www.meteoschweiz.admin.ch/home/klima/klimawandel-schweiz/temperatur-und-niederschlagsentwicklung.html (19.2.19)

Case study adaptation to climate change "Baden"

- 550m asl.; 1’000 mm of rain/y; deep, humid, acid soil
- Case study about area of 7.5 ha
- Part of storm damage area (1999) of totally 45 ha.
- Situation before «Lothar»:
  - Old stands: 100% Conifers
  - Very few beech (sec. stand)
  - 1980-90: Planting of spruce
  - 1990–1999: Natural regeneration (Femel)
  - 26.12.1999: Storm «Lothar»



Case study adaptation to climate change "Baden"

- After the storm:
  - Harvesting
  - Natural regeneration
  - *Age 2y: Protection of Larch in final distance against deer (not necessary!)*
  - Age 8y: First crop tree thinning (5-10 hours/ha)
    - only larch, pine, oak (if present)
    - Ca. 30 crop trees/ha
  - Age 17: Second Crop tree thinning (9.5 h/ha)
    - Planning/reconstruction of skid trails; cutting of skid trails (4.5 h/ha)
    - Crop trees are again larch, pine, oak; some birch, aspen, no spruce or beech (5.0h/ha)

Case study adaptation to climate change "Baden"

Case study adaptation to climate change "Baden"

Case study adaptation to climate change "Baden"

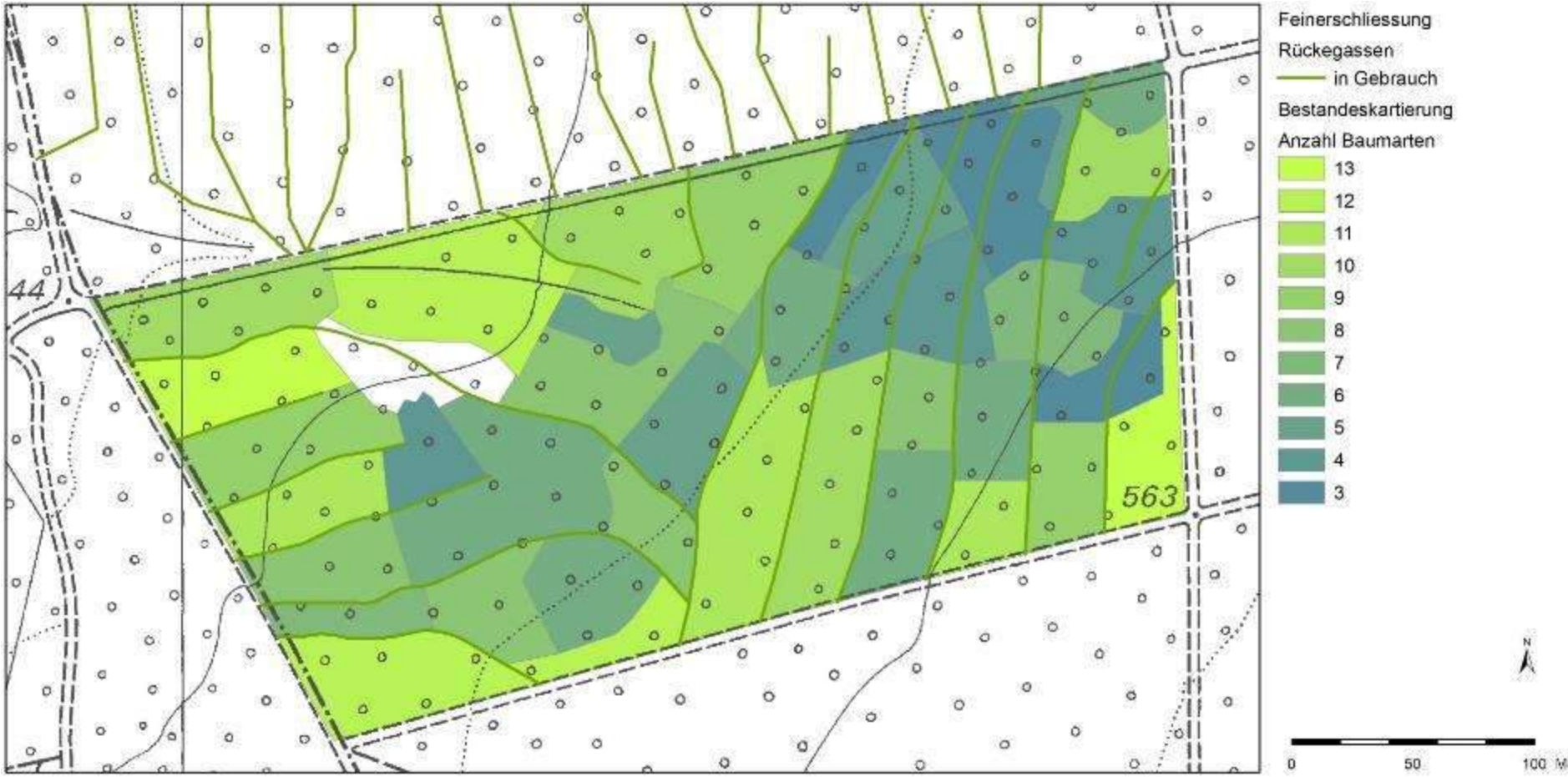
Case study adaptation to climate change "Baden"

- Result:
  - 20 tree species
  - Important species for future are present

Tree species	%	Number of crop trees
Picea abies	36.9	biomass production only
Larix decidua+kaempferi	16.2	200
Pinus sylvatica	6.2	40
Abies alba	0.2	8
Pseudotsuga menziesii	0.2	9
Total Nadelholz	59.5	
Betula pendula	12.7	30
Salix caprea	10.4	not yet
Populus tremula	2.7	5
Alnus glutinosa	3.5	15
Fagus sylvatica	6.7	not yet
Quercus robur	0.3	40
Acer pseudoplatanus	2.8	unfit because of site conditions
Fraxinus excelsior	0.1	unfit because of site conditions
Prunus avium	0.2	unfit because of site conditions
Carpinus betulus	0.8	not yet
Total Laubholz	40.2	
davon Pioniere	29.3	
Pinus strobus		1
Sorbus aucuparia		
Salix spez.		
Tylia cordata		1
Pyrus communis		2
future tree species		
maybe future tree species		

Case study adaptation to climate change "Baden"

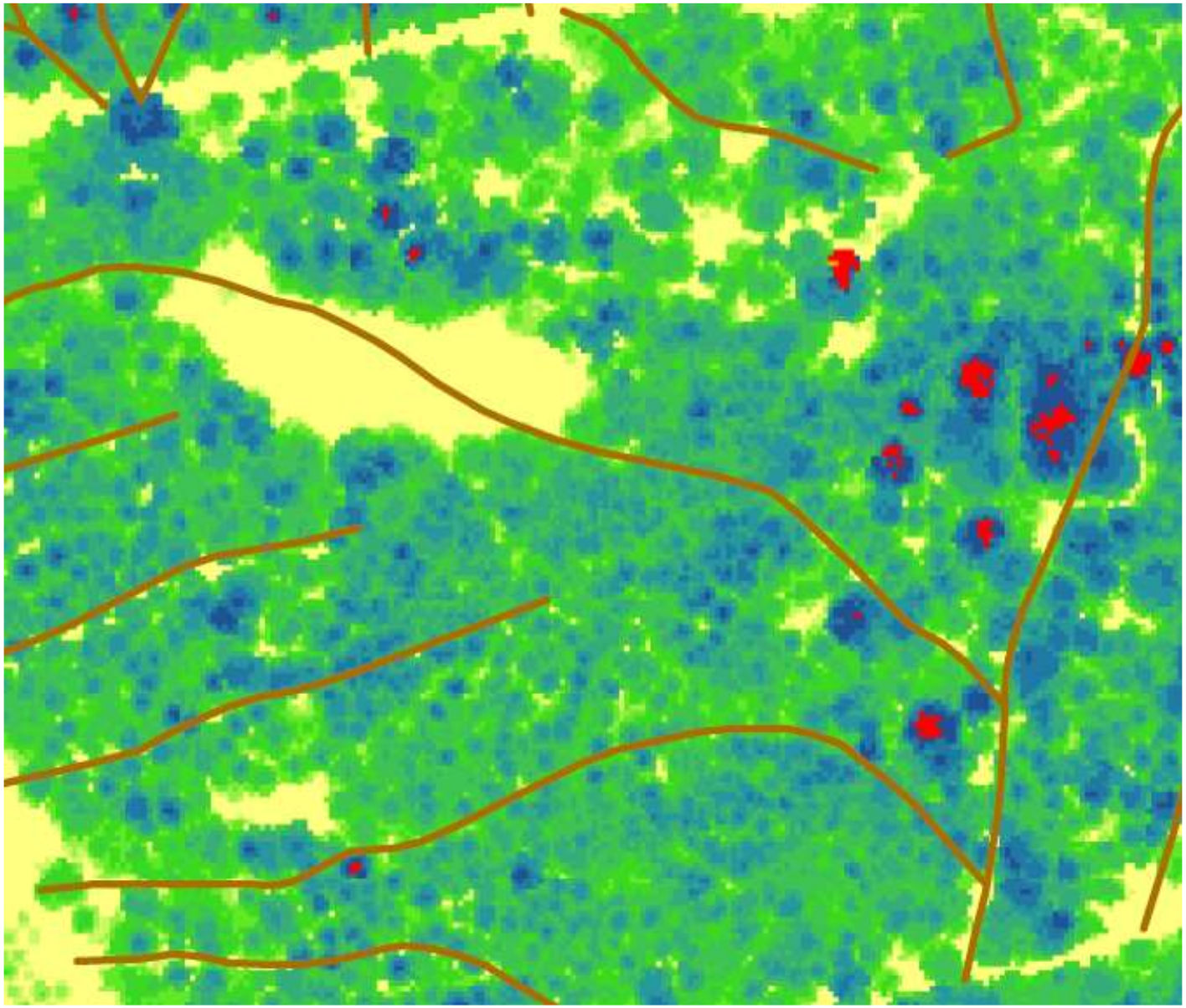
Number of tree species



What's about output (products) and structure in this young, 20years old stand??

- We want forest products:
  - Non-timber (recreation, nature / biodiversity)
  - Timber
- Need of "thick" trees – where are they?
  - Beech of former secondary stand (DBH 30-50cm) «habitat trees»
  - Willow, Aspen, Birch (max. DBH 25-35cm)
  - Larch (max. 25-30cm)
- These are also the highest trees (around 20m)…
- …and important elements for structure

Height of vegetation (LiDAR, m)



Elements of actual (20y) and future structure:

- Intensive mixture with different rotations / lifespan
  - willow 30y, birch 60y, larch 100y, spruce?!?
- Different densities (natural regeneration)
- Gaps
- Fast growing pioneers species
- «Wolf trees»/Habitat trees
- No cleaning, no negative selection, no plantation
- No homogenisation
- Tending with crop trees:
  - crop trees get favoured, no intervention between

Learn from nature

- Fast climate change needs fast adaptation (20years)
- «Close to nature»-adaptation (Input: 15-20h/ha)
- Sylvicultural system should allow the regeneration of light demanding tree species
- Not only "continuos cover forests" (which is a very fascinating sylviculture in times of climate stabiliy…)
  - Often, after 20-30 years of conversion, forests have lots of regeneration of shade-tolerant species

Learn from nature

- How to "imitate storm-damage"?
  - Progressive felling (Femel) with variation of dimensions
  - Shelterwood system with short regeneration period
  - = fast regeneration progress
  - Precondition: Shadow, dark conditions!
- Combination of all types of sylvicultural systems


Thank you!