

The use of dendrochronology to detect spruce budworm outbreaks


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Disturbances in the Boreal Forest

- major forest disturbances
 - fire
 - insect outbreaks 
 - other natural events: windthrows, floodings
- affect forest stand dynamics
 - mortality
 - change species composition

Spruce Budworm

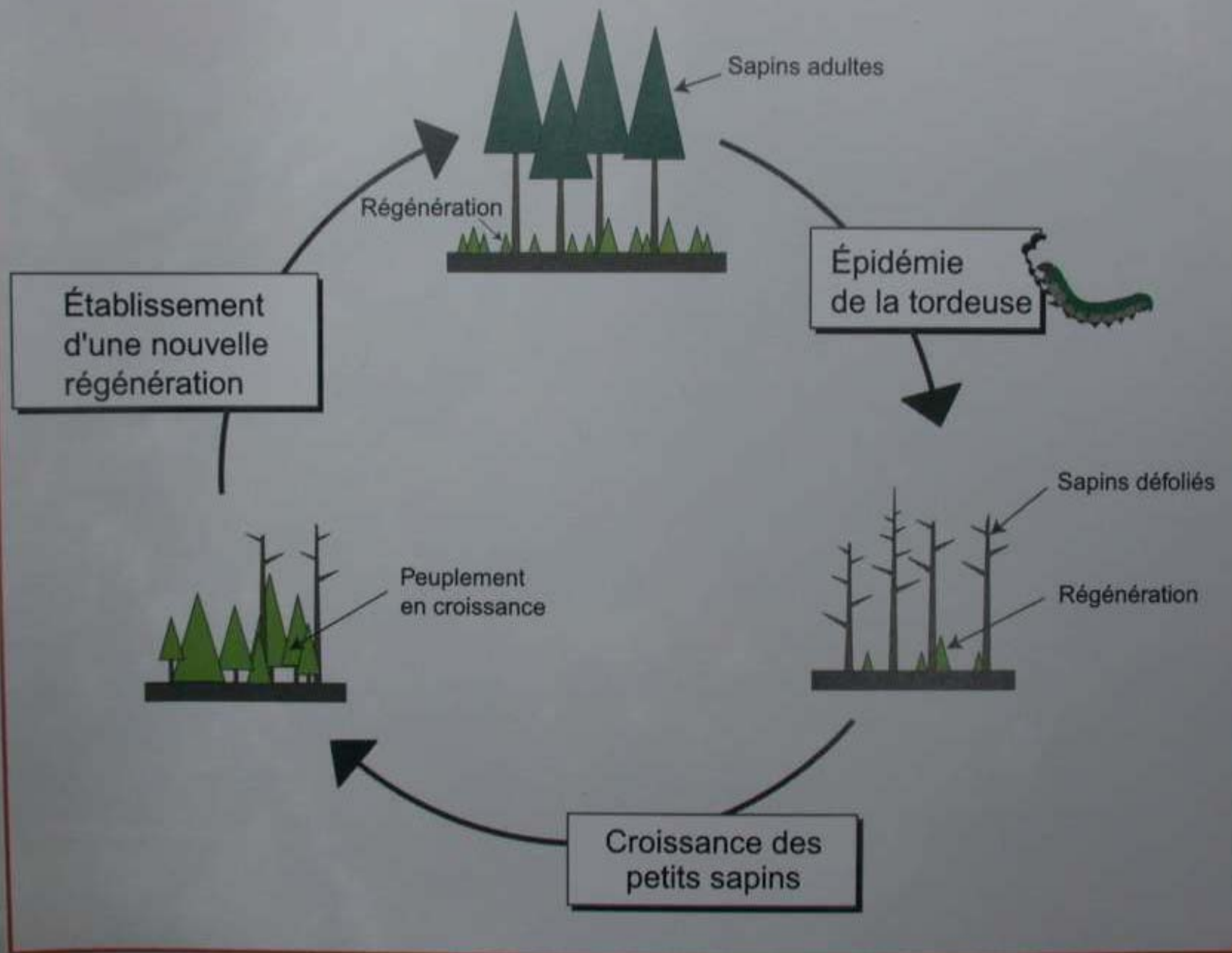
- feeds on recent needles, buds, flowers
- balsam fir most affected
- increased severity of the outbreaks during 20th century



Spruce budworm



- outbreaks (abitiabi)
 - 1919-1929
 - 1930-1950
 - 1970-1989
- growth reduction:
 - 0-3y delay
- volume ↓
- 57 million ha affected



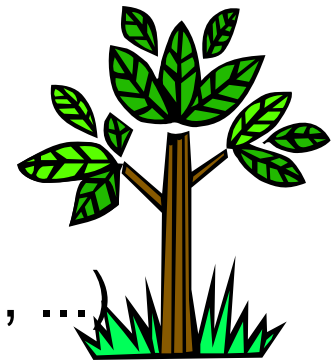
Objectives

- impact of spruce budworm on host trees
 - *Abies balsamea*, *Picea glauca*, *P. mariana*
- correlation between 3 tree species
- cross date dead host trees
- relate dead material to last spruce budworm outbreak

Methods

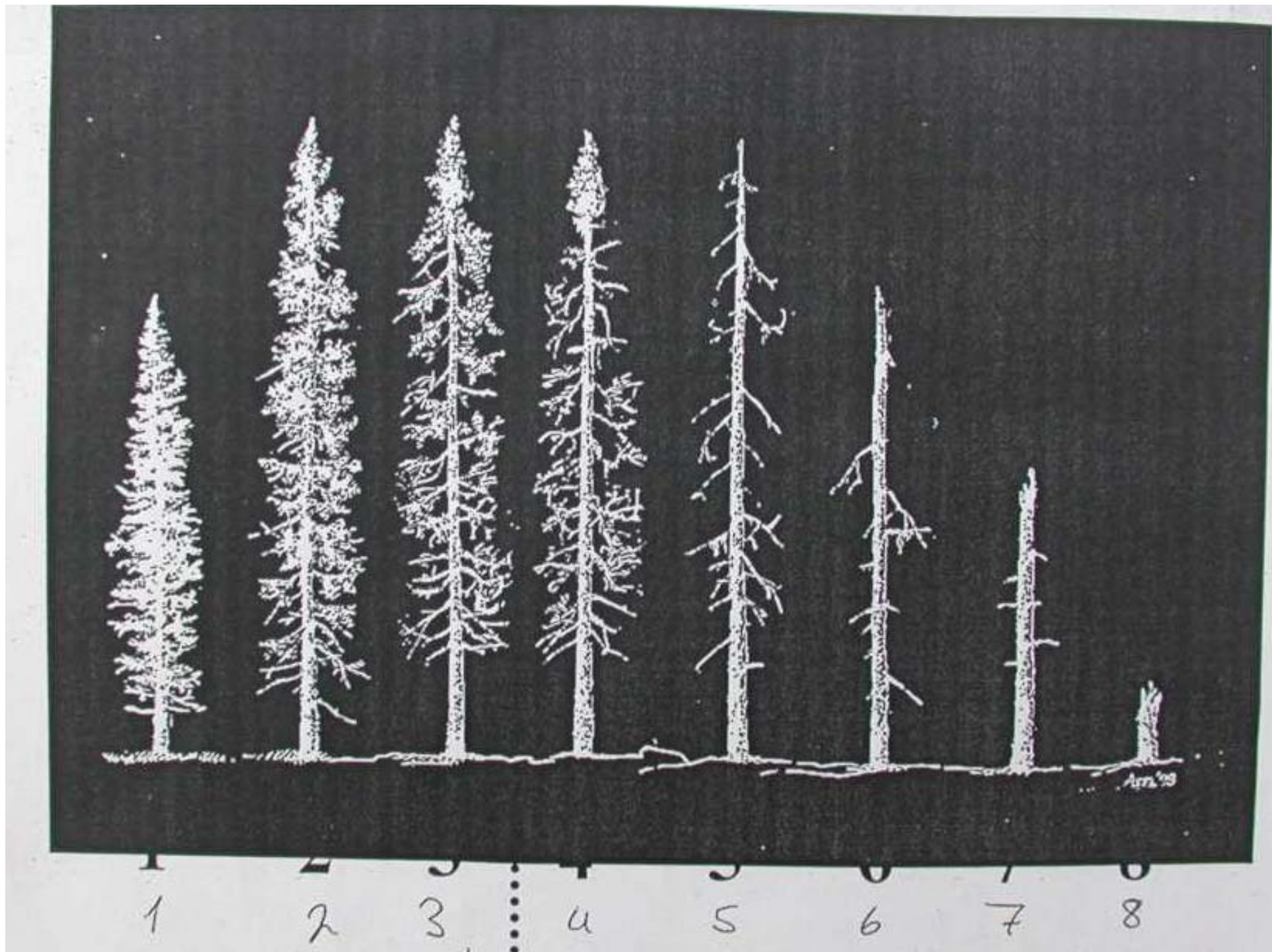
1. Field

- located in the 1760 fire, ancient cuttings present
- overstory : mixed boreal forest
 - Balsam fir **13 trees sampled**
 - White and black spruce **14 trees sampled**
 - White birch (*Betula papyrifera*)
 - White cedar (*Thuja occidentalis*)
- dense understory :
 - Acer spicatum, Ferns (*Athyrium felix-femina*, ...)
- deadwood
 - Balsam fir **13 disks**
 - White spruce **3 disks**



2. Dead wood analysis

- field classification of decomposition state
 - visual criteria
 - 8 snag classes
 - 4 classes downed debris
- comparison: decomposition state vs time of death



3. Outbreak period detection

- consecutive growth reductions
- quantify growth reduction
 - (outbreak, impact programs)
- comparison to non-host spp.

4. Chronology building process

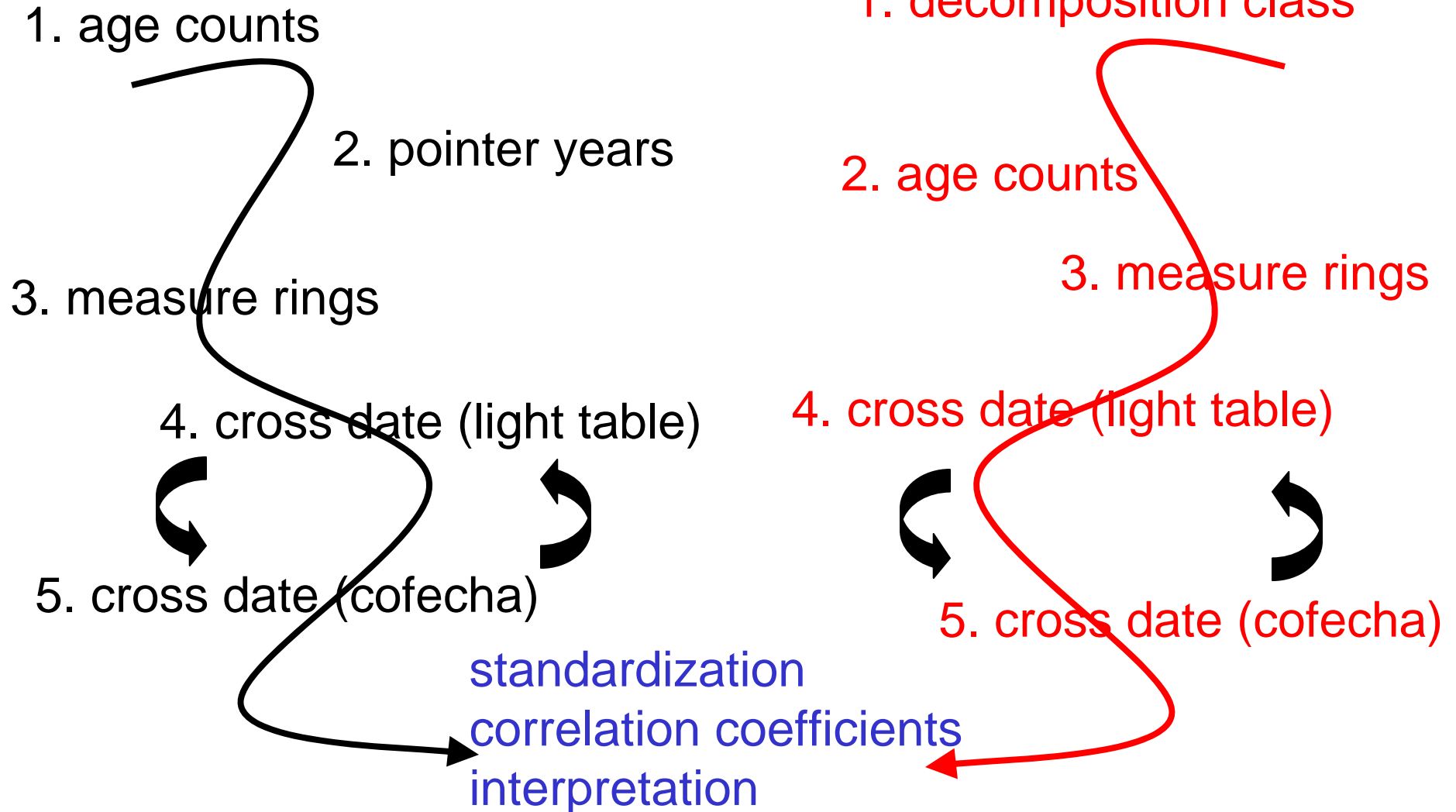
Cores

1. age counts
2. pointer years
3. measure rings
4. cross date (light table)
5. cross date (cofecha)

standardization
correlation coefficients
interpretation

Dead Wood

1. decomposition class
2. age counts
3. measure rings
4. cross date (light table)
5. cross date (cofecha)



Results



Within-species comparison Cross dating results (Cofecha)

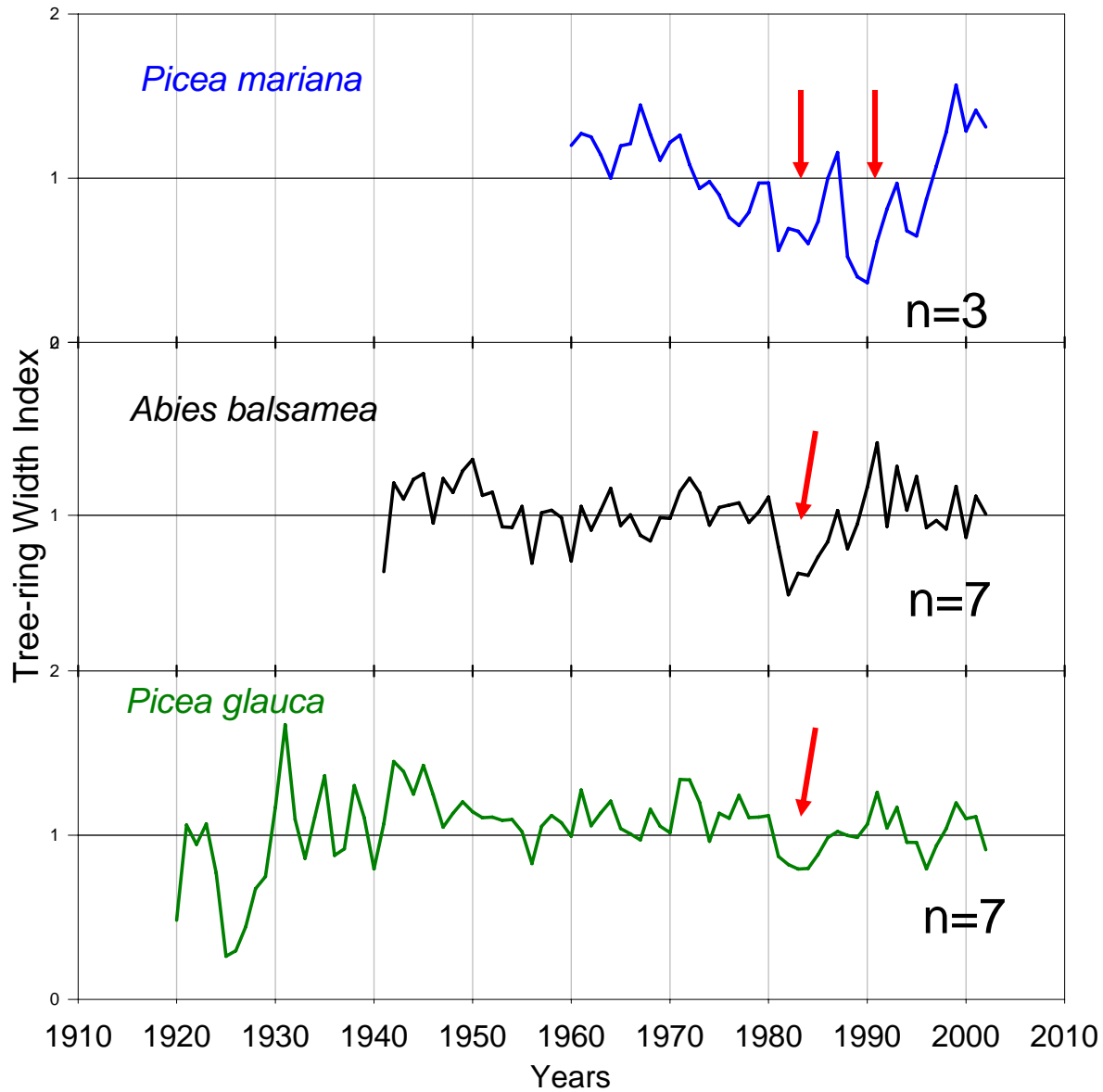
<i>series</i>	<i>species</i>	<i>corr. coef.</i>	<i>years</i>	<i>total y</i>	<i>flag</i>
3	Picea mariana	0.425	1949- 2002	54	1
7	Picea glauca	0.485	1880- 2002	123	1
7	Abies balsamea	0.69	1932- 2002	71	no
7	dead Abies b.	0.51	1914- 2000	86	no

Among-species comparison cross dating results (Matrix)

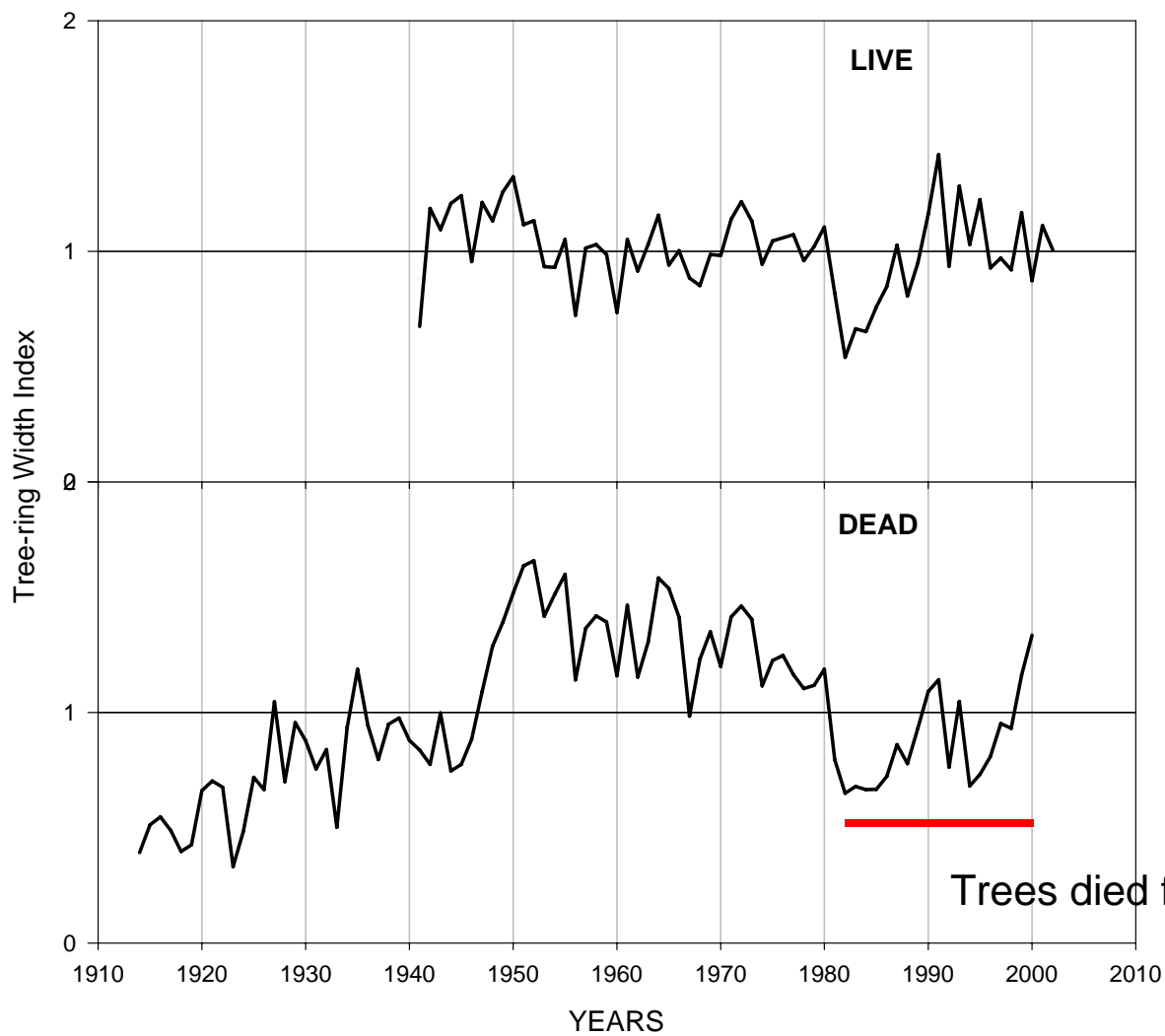
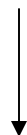
	Dead	Abies b.	Picea g.	Picea m.
Dead	1.00	0.497*	0.659*	0.328*
Abies b.		1.00	0.736*	-0.17
Picea g.			1.00	0.17
Picea m.				1.00

Period: 1949-2000

Spruce and Fir Chronologies

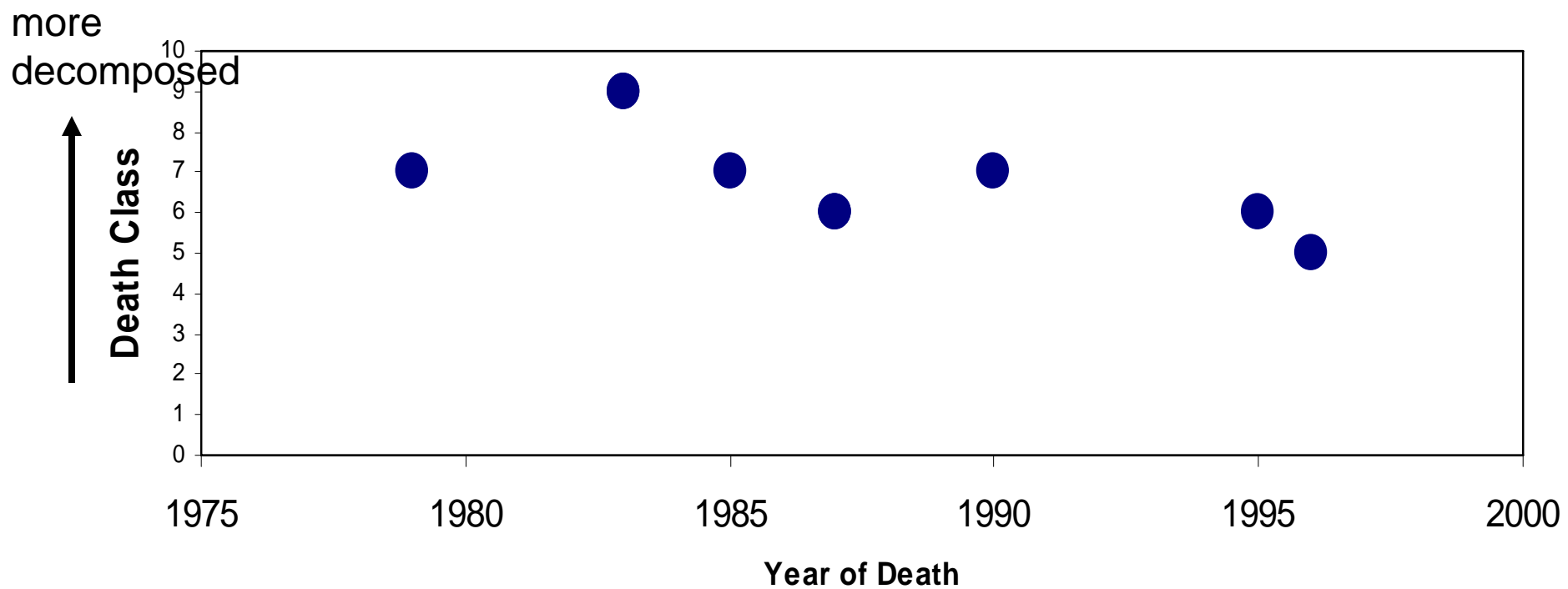


Abies balsamea chronologies



Trees died from 1979-2000

Decay Class from Field Observation vs Chronology Date-of-death



Results and Conclusions

- last outbreak detected in 3 species
 - 1980s
 - toward end of ‘literature’ outbreak period for Abitibi
- can date death of trees even with short chronologies (64 y average)
- building chronologies: need multiple lines of information

If time were not a factor...

- non-host tree species (white cedar)
- more trees, more regions
- use of additional criteria for cross dating
 - e.g., light rings, dark rings
- older trees

Many thanks to:

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- Bernard and field week organizers
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