Dynamics of mixedwood stands, as influenced by natural disturbance and succession

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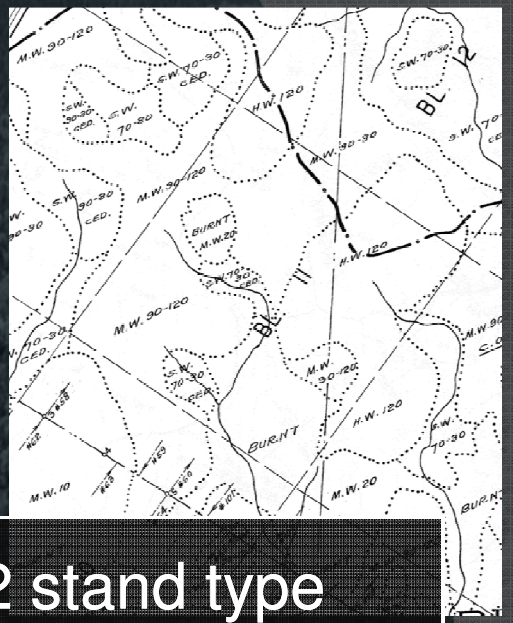
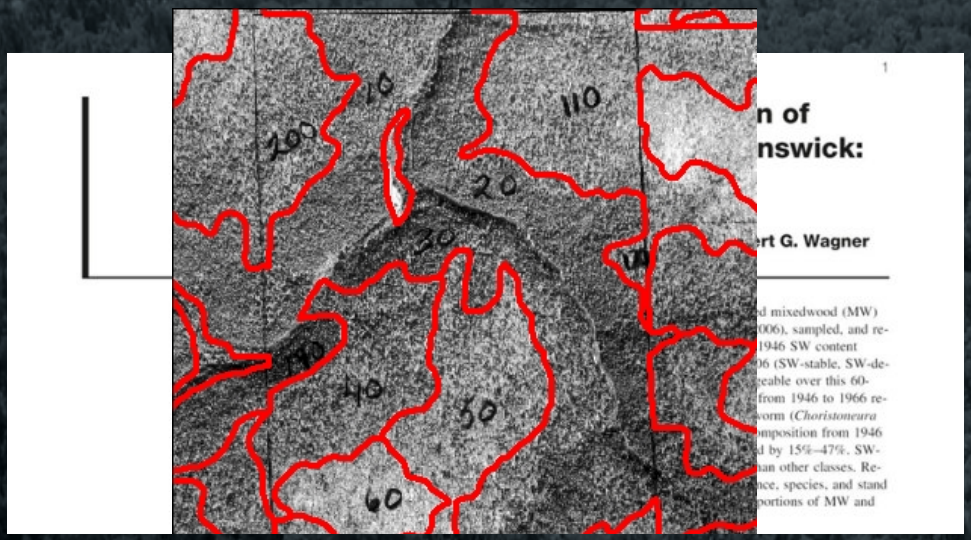
Background

- Etheridge et al. 2005 and 2006
  - JDI's Black Brook District
  - 1945 cruise maps vs. 2002 GIS inventory
  - Mixedwood area reduced from 37% (1945) to 19% (2002)



1945 Stand Type (Unharvested)	% Area by 2002 stand type			
	SWCE	SW	MW	HW
SWCE (4700 ha)	**58**	18	10	14
SW (25420 ha)	23	**29**	18	30
MW (11840 ha)	13	13	**18**	56
HW (8470 ha)	50	4	9	**37**

Objectives



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d mixedwood (MW)
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1946 SW content
06 (SW-stable, SW-de-
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from 1946 to 1966 re-
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d by 15%–47%, SW-
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portions of MW and

Effects … disturbance on growth and succession of mixedwood stands in northwest
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[1]Corresponding author E-mail: luke.amos…
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1) Categorize patterns of change in softwood-hardwood content for unharvested stands from 1946-2006.

2) Relate patterns of change to stand and site characteristics and past disturbance

Ecol. Appl. (submitted)

3) Identify periods of natural disturbance that influenced mixedwood dynamics.

4) Effect of disturbances on composition and stand dynamics.

Stand Selection

1946 % Softwood	ha	2006 % Softwood 0	10	20	30	40	50	60	70	80	90	100
0	25	100	0	0	0	0	0	0	0	0	0	0
10	278	77	15	0	8	0	0	0	0	0	0	0
20	551	75	20	0	0	0	0	5	0	0	0	0
30	695	46	33	18	0	0	0	0	0	0	0	3
40	650	42	27	14	2	8	0	0	0	0	0	0
50	825	36	18	14	12	6	0	0	2	0	4	0
60	827	15	15	8	12	15	8	2	2	6	7	5
70	1081	10	8	12	9	10	6	5	6	20	30	8
80	1878	3	3	3	8	4	5	6	3	8	24	34
90	1383	0	0	0	4	5	0	0	7	9	18	57
100	2472	0	9	8	0	0	0	0	0	10	7	66

MW

SW

-40

-20/30

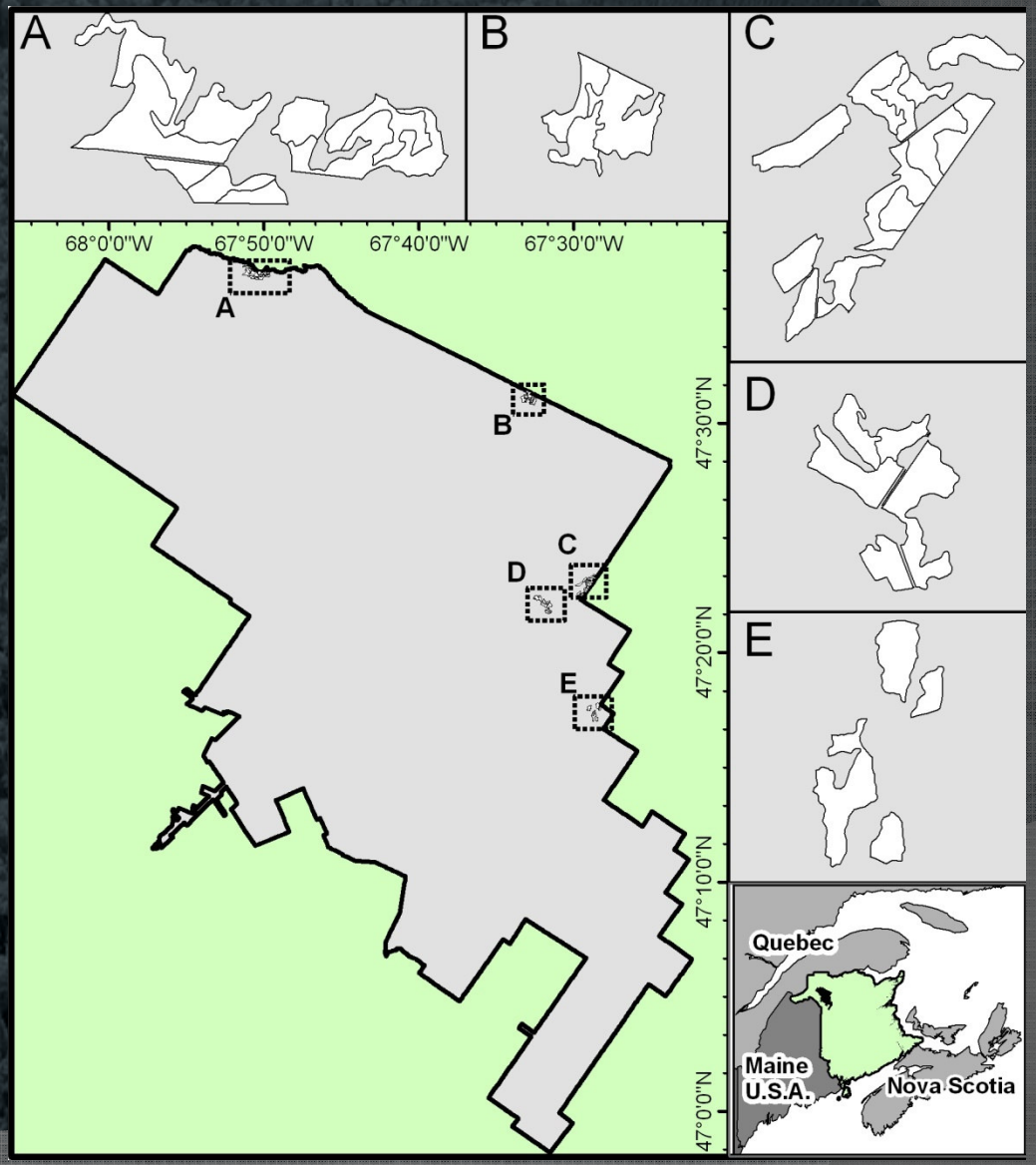
0-10

+20-30

Sample classes based on SW composition and amount of change from 1946-2006

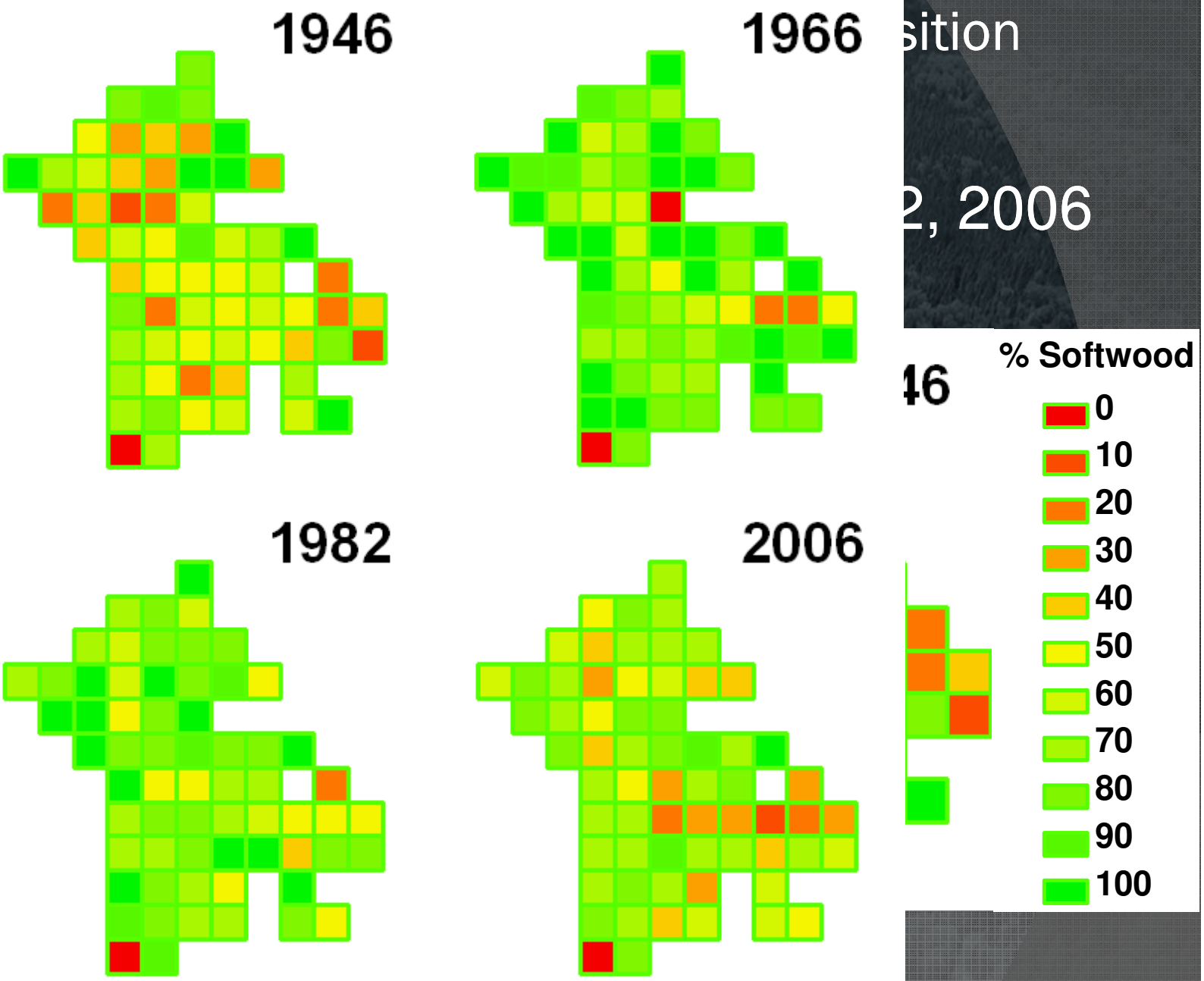
Study Locations

- Located using:
  - Historical harvest records
  - Input from JDI
  - Aerial photographs



Determ
change

- Ae
- 32
  - C
  - S
- 50
- Me
  - S
  - H
  - C

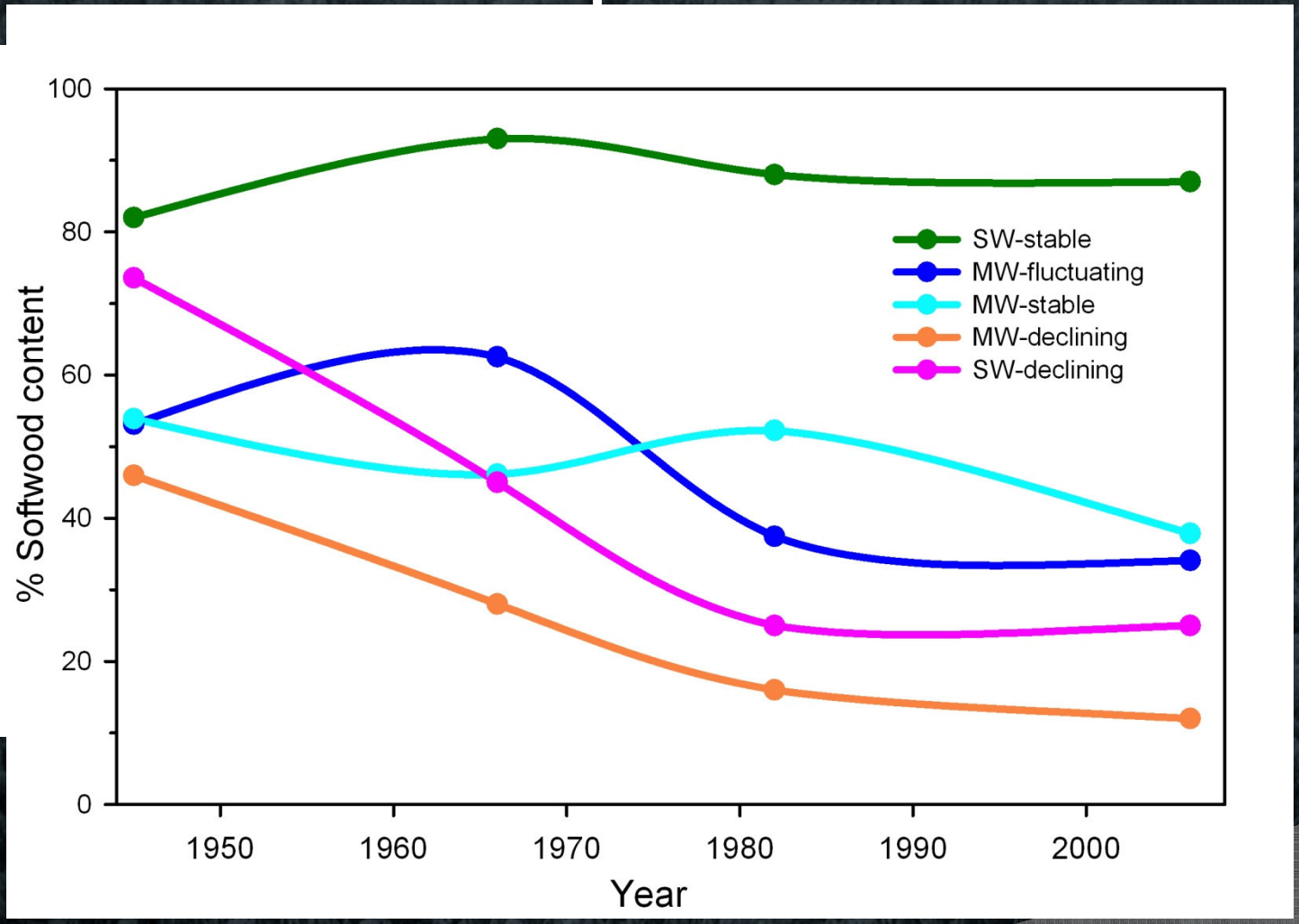


sition

2, 2006

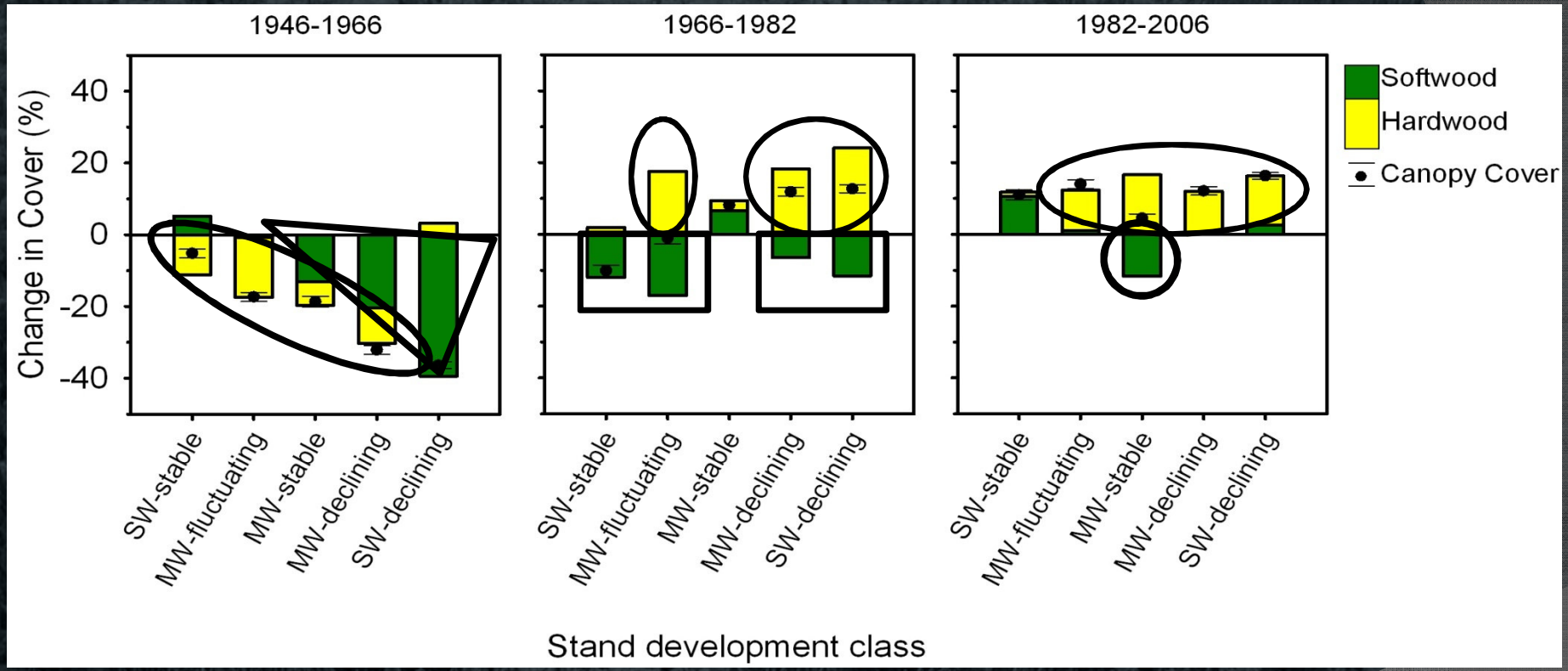
46

Stand development classes



Grouped into classes based on 1946 softwood content and change in softwood content over time

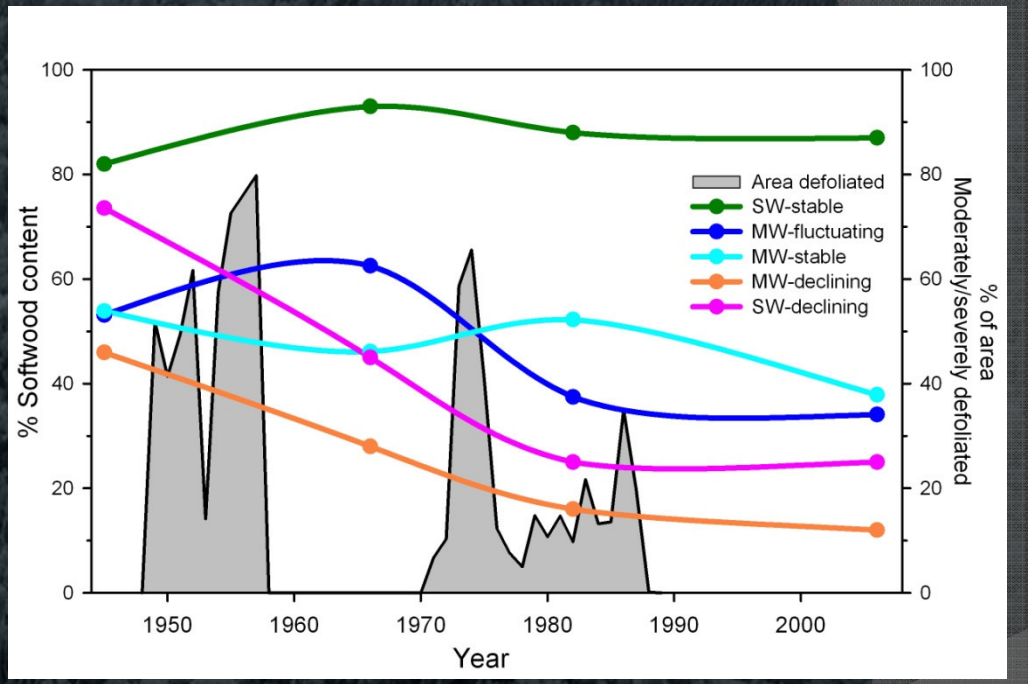
Change in cover



- Reductions in softwood cover – Spruce budworm?
- Reductions in hardwood cover – Birch dieback?
- Increase in hardwood cover – Promotion of hardwoods?

Differences?

- Spruce budworm
  - 1950's
  - 1970's/1980's
- Other Disturbances
  - Break up of fir stands (origin 1870s)
  - Birch dieback
  - Wind
- Stand response



Geographical attributes

	Stand Development Class				
	SW-stable	MW-fluctuating	MW-stable	MW-declining	SW-declining
Aspect (º)	285±2a	238±5a	145±15b	145±14b	189±5c
Elevation (m)	358±26a	404±10b	319±7c	441±5b	423±6b
Ecosite					
5	2	2	5	0	0
7	2	6	1	5	9

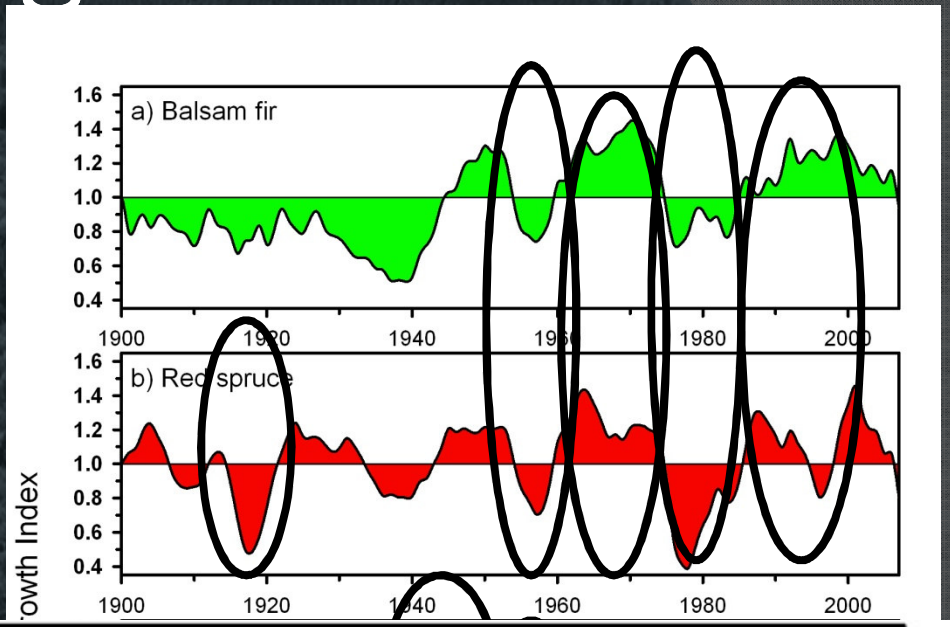
a,b,c denote differences among groups ($P<0.05$)
Ecosite 5 – moderate nutrient regime, well drained
Ecosite 7 – rich nutrient regime, well drained

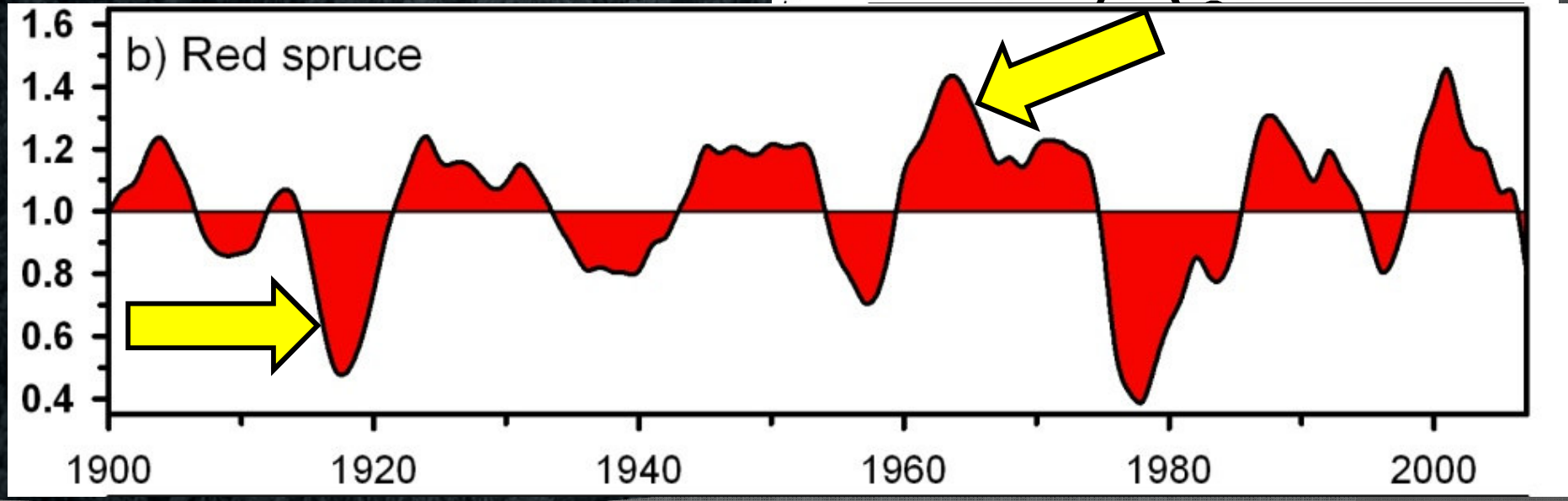
Growth Data

- Growth analysis
  - ~ 1000 Cores
    - Red and white spruce
    - Balsam fir
    - Yellow birch
    - Sugar and red maple
  - Stand origin and intervening disturbances
  - Growth loss and growth releases

Growth chronologies

- Growth Index
  - Detrending removes short term fluctuations
  - Focuses on long term changes in growth
  - < 1 reduced growth
  - > 1 increased growth



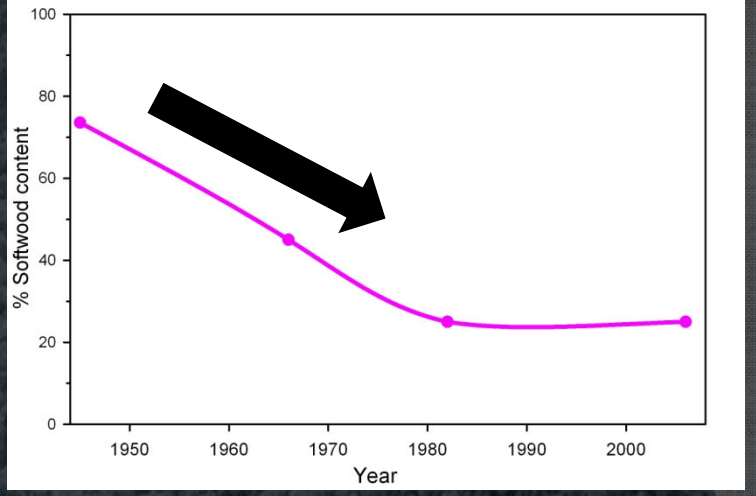


SW-declining

< 0.9 – reduced growth

>1.1 – increased growth

>0.9-1.1 – normal growth



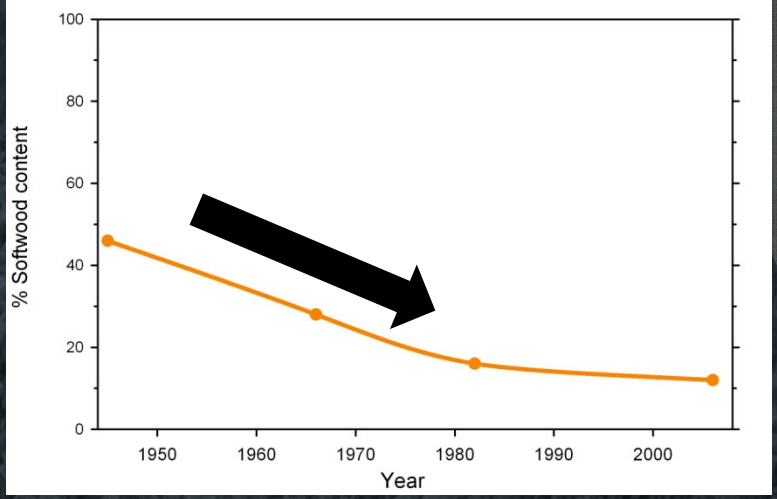
	Pre SBW	SBW 1910s	Post SBW	Birch Decline	Post Decline	SBW 1950s	Post SBW	SBW 1970s	Post SBW
Yellow Birch	1.02	0.96	0.88	0.81	1.00	1.15	0.97	1.03	1.00
Sugar maple	0.94	1.23	0.82	0.98	1.18	0.97	1.02	0.85	1.08
Red Spruce	1.02	0.79	0.99	0.86	1.11	0.85	1.17	0.66	1.06
Balsam fir	1.15	0.66	0.88	1.09	0.98	0.94	1.11	0.81	1.03

Establishment	32	19	15	17	6	4	8	0	0
Release	21	9	26	4	13	6	15	4	2

MW-declining

Higher sugar maple content

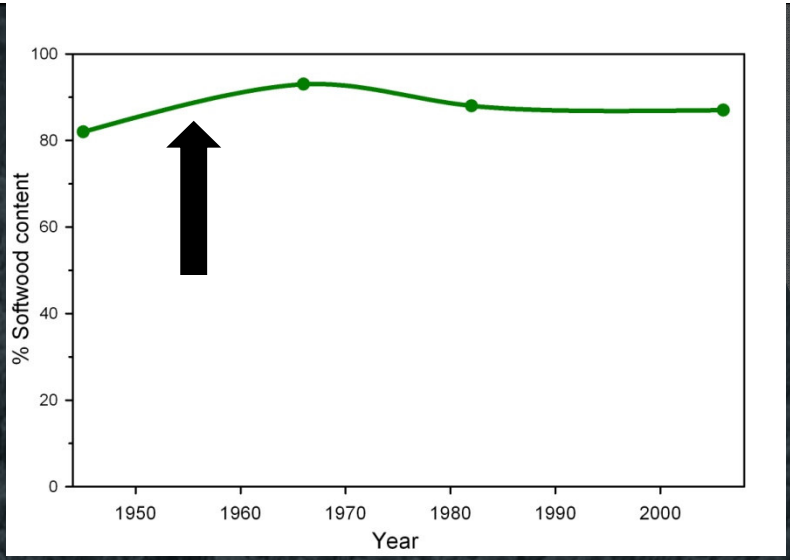
Mortality of spruce-fir



		Pre SBW	SBW 1910s	Post SBW	Birch Decline	Post Decline	SBW 1950s	Post SBW	SBW 1970s	Post SBW
Yellow Birch		0.99	0.94	0.96	0.89	1.04	1.04	0.99	1.07	0.97
Sugar maple		1.05	0.98	0.95	0.95	1.09	1.15	1.01	0.92	0.99
Red Spruce		1.05	0.66	1.11	0.65	1.25	0.89	1.14	0.67	1.04
Balsam fir		1.04	1.06	0.73	1.01	0.76	0.62	1.07	0.80	1.07
Establishment		35	15	21	9	12	0	9	0	0
Release		27	5	24	9	11	11	11	0	2

SW-stable

High red spruce content

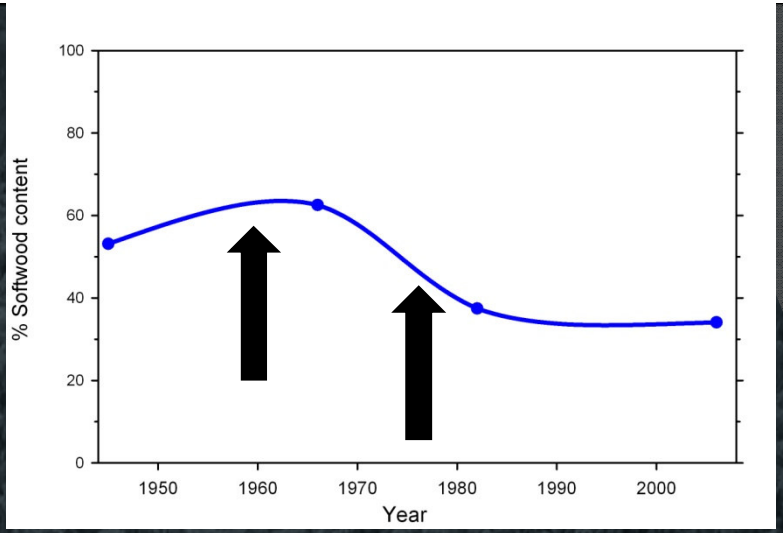


		Pre SBW	SBW 1910s	Post SBW	Birch Decline	Post Decline	SBW 1950s	Post SBW	SBW 1970s	Post SBW
Yellow Birch		Insufficient samples								
Sugar maple		Insufficient samples								
Red Spruce		0.99	0.82	1.16	1.20	1.03	0.83	1.17	0.72	1.04
Balsam fir		0.79	0.80	1.11	1.05	0.89	0.71	1.13	0.86	1.01

Establishment		56	3	28	10	0	0	3	0	0
Release		26	10	13	33	10	5	0	3	0

MW-fluctuating

Birch dieback
Little impact by 1950s SBW
Greater impact by 1970s SBW



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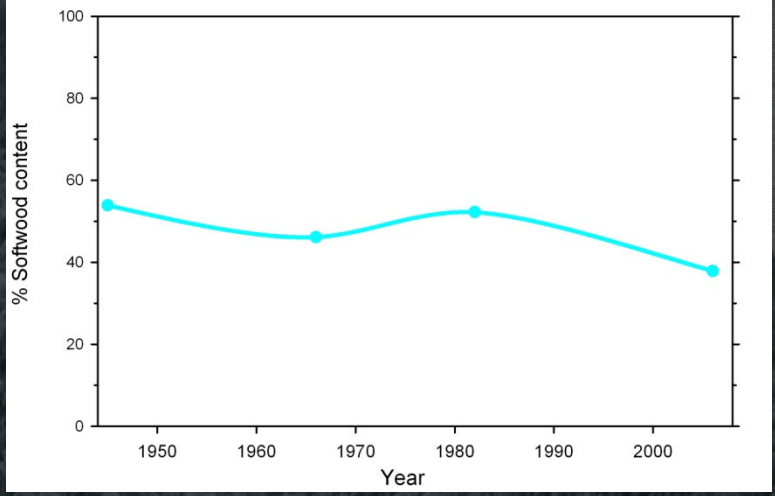
Red Spruce		0.99	0.89	1.04	0.88	1.11	0.91	1.13	0.77	1.07
Balsam fir		0.90	0.93	0.76	0.97	0.87	0.95	1.11	0.75	1.03

Establishment		41	12	22	14	3	2	5	0	0
Release		27	5	24	9	11	11	11	0	2

MW-stable

Little change in composition over time
Impacted by birch dieback and SBW
Both HW/SW released over time



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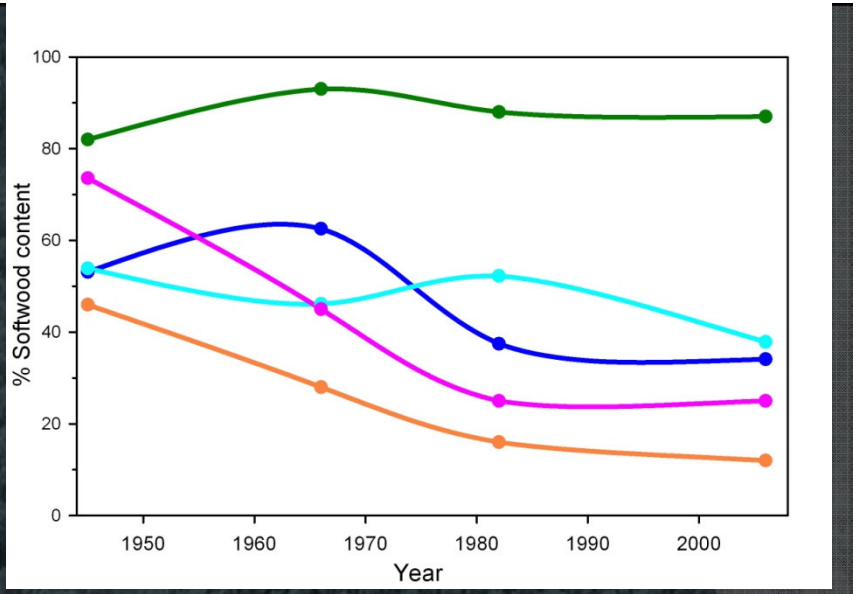
Sugar maple		0.94	1.20	1.02	0.96	1.04	1.05	0.97	0.98	0.99
Red Spruce		1.04	0.81	1.11	0.78	1.19	0.80	1.10	0.76	1.11
Balsam fir		0.80	1.03	1.02	1.00	1.11	0.69	1.02	0.83	1.06

Establishment		24	8	23	19	16	5	5	0	0
Release		16	5	10	17	19	7	17	3	5

Summary



- Difference in classes
  - Interactions between disturbances
    - SBW and birch dieback
  - Age related mortality balsam fir (origin 1870s)
- Stand response following disturbance
  - Promotion of hardwoods (Declining MW and SW)
- Balsam fir (cyclical) vs. red spruce (long-lived)

Management implications

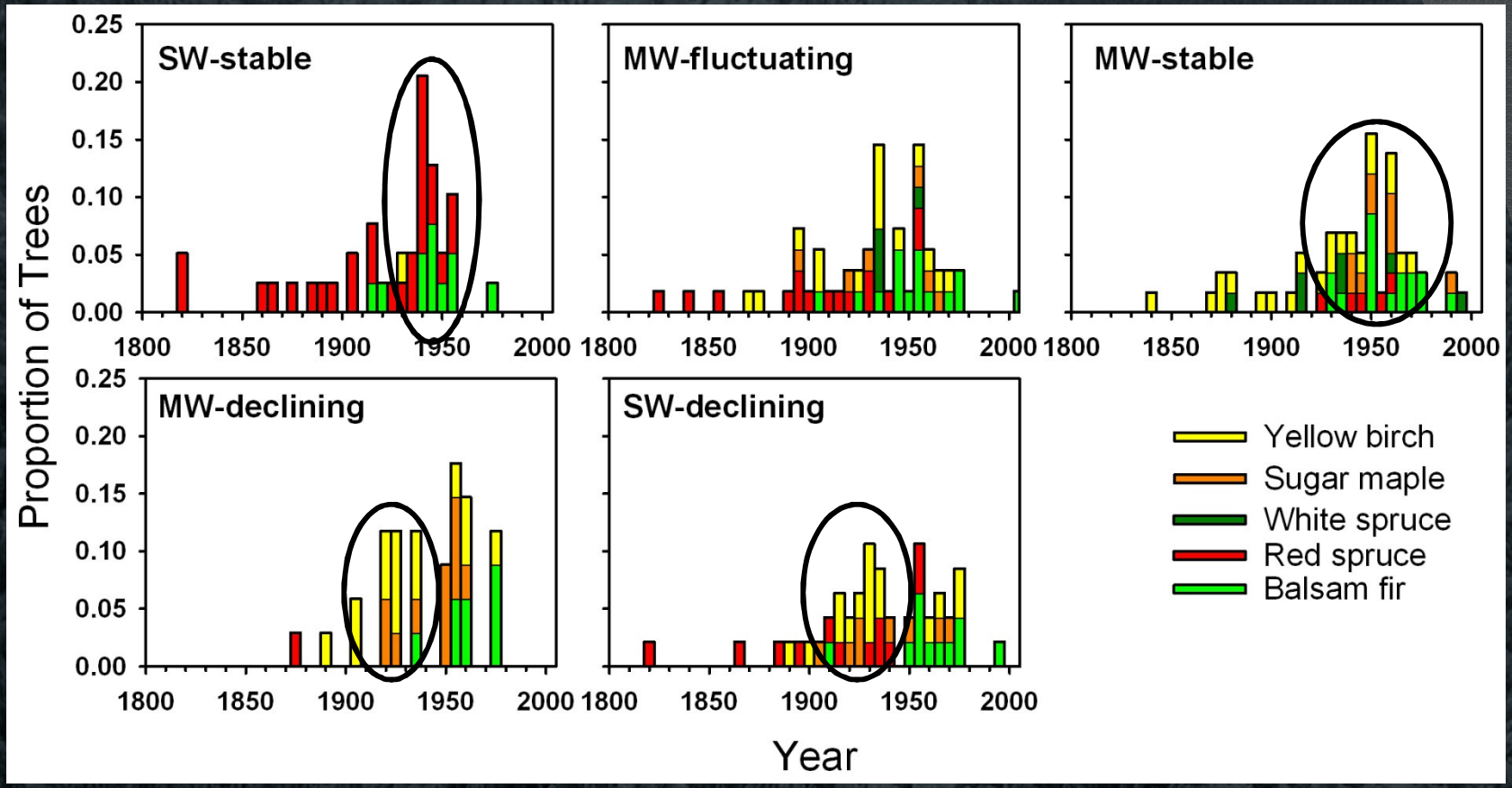
- MW have highly variable development patterns
- Maintaining MW in static proportions dictated by past conditions may be faulty
- Transitional nature of balsam fir dominated mixedwoods versus the stable nature of red spruce mixedwoods

Acknowledgements

- Dave MacLean - Supervisor
- Bob Wagner, Jeremy Wilson – Advisory committee
- J.D. Irving Ltd.
- NSERC – IPS
- SFMN
- CFS

Questions?

Growth releases



Release initiated by break up of balsam fir

Younger trees and mixture of softwood and hardwood

Release of mostly hardwoods prior to 1950