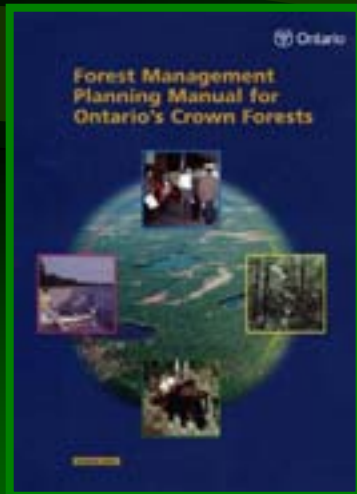


# “Modelling Ontario’s Stand Succession and Yield” (MOSSY)



*Al Stinson*

*Ontario Ministry of Natural Resources*

# Partners

- **Forestry Futures Trust - Enhanced Forest Productivity Science Program**
- **Forest Co-op**
  - Tembec
  - Abitibi
  - Buchanan Forest Products
  - Domtar
  - Bowater
  - MNR



# Development Team

- Margaret Penner
- Dan Kaminski
- Murray Woods
- Brian Naylor
- Dave Nesbitt
- Fred Pinto

# Advisory Team

- Al Stinson
- Tom Moore
- Colin Arlidge
- MNR Regional Planning staff
- MNR Science & Info Staff

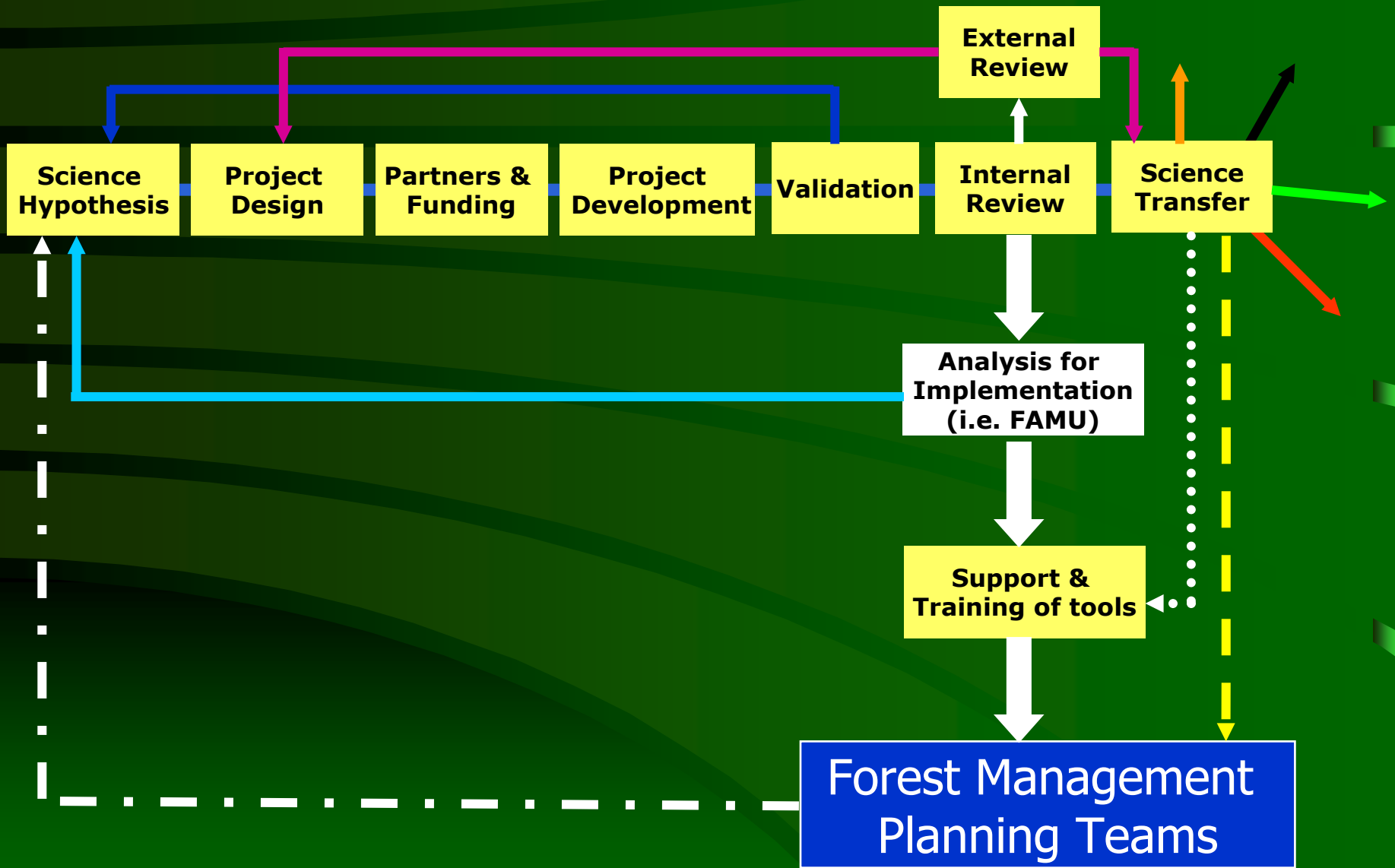
# What is MOSSY?

User-friendly software with the aim of:

- providing data-based tools to FMP teams for developing **yield curves** and **natural succession** rules.
- reducing the individual error and bias in these critical inputs (yield and succession) used in resource modelling and strategic decision making.



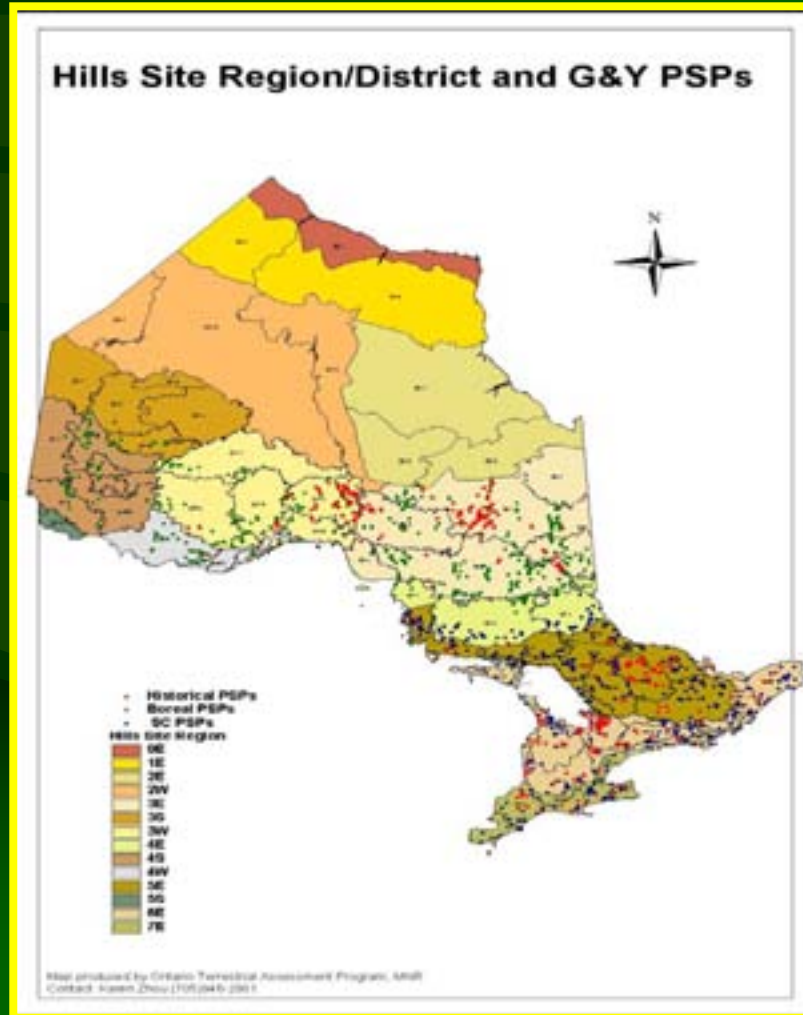
# Science Tool Development Pathway



# Construction Methods

- Utilized Ontario (and neighbouring province's) temporary and permanent sample plot data

**1553**  
**remeasured**  
**plots with 6,140**  
**remeasurement**  
**intervals**



**Validation:**

**Succession:**  
**20% of PSPs**

**G&Y: New plots**

# Construction Methods

- Utilized Ontario (and neighbouring province's) temporary and permanent sample plot data
- Developed, for Standard Forest Unit **yield curves**, a series of equations to predict:
  - density,
  - height,
  - basal area, and
  - volume



# Yield Curve Status

- PJ1 (Pure Pj)
- PJ2 (Upl Conifer Mx)
- SP1 (Upland Spruce)
- SF1 (Spruce-Fir)
- SB1 (Lowland Spruce)
- PO1 (Poplar)
- BW1 (White Birch)
- PWUS (Pine Shelterwood)
- HDUS (Hwd Shelterwood)
- BY1 (By Shelterwood)
- MW1 (Mixedwood1)
- MW2 (Mixedwood2)

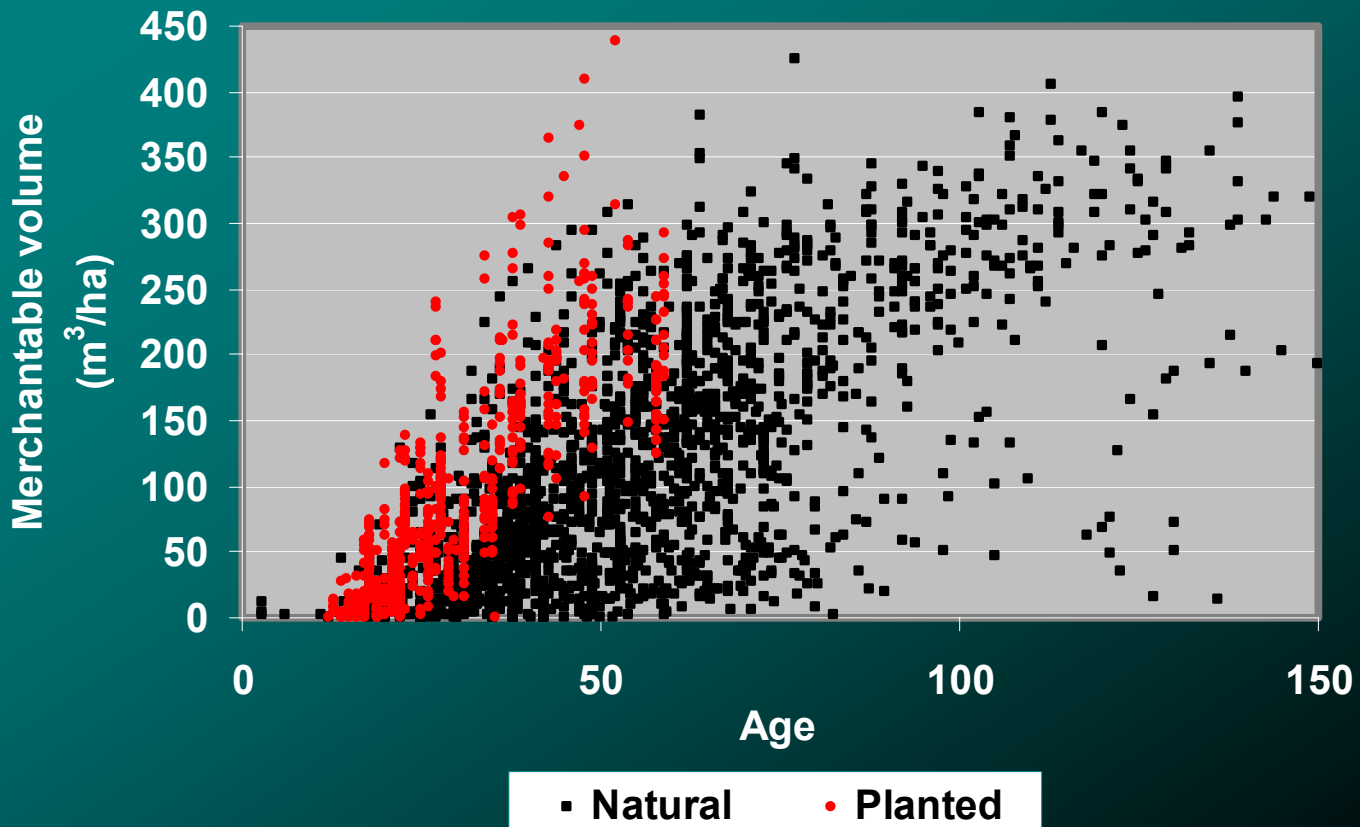
## BA Growth Rates

- Hwd Selection

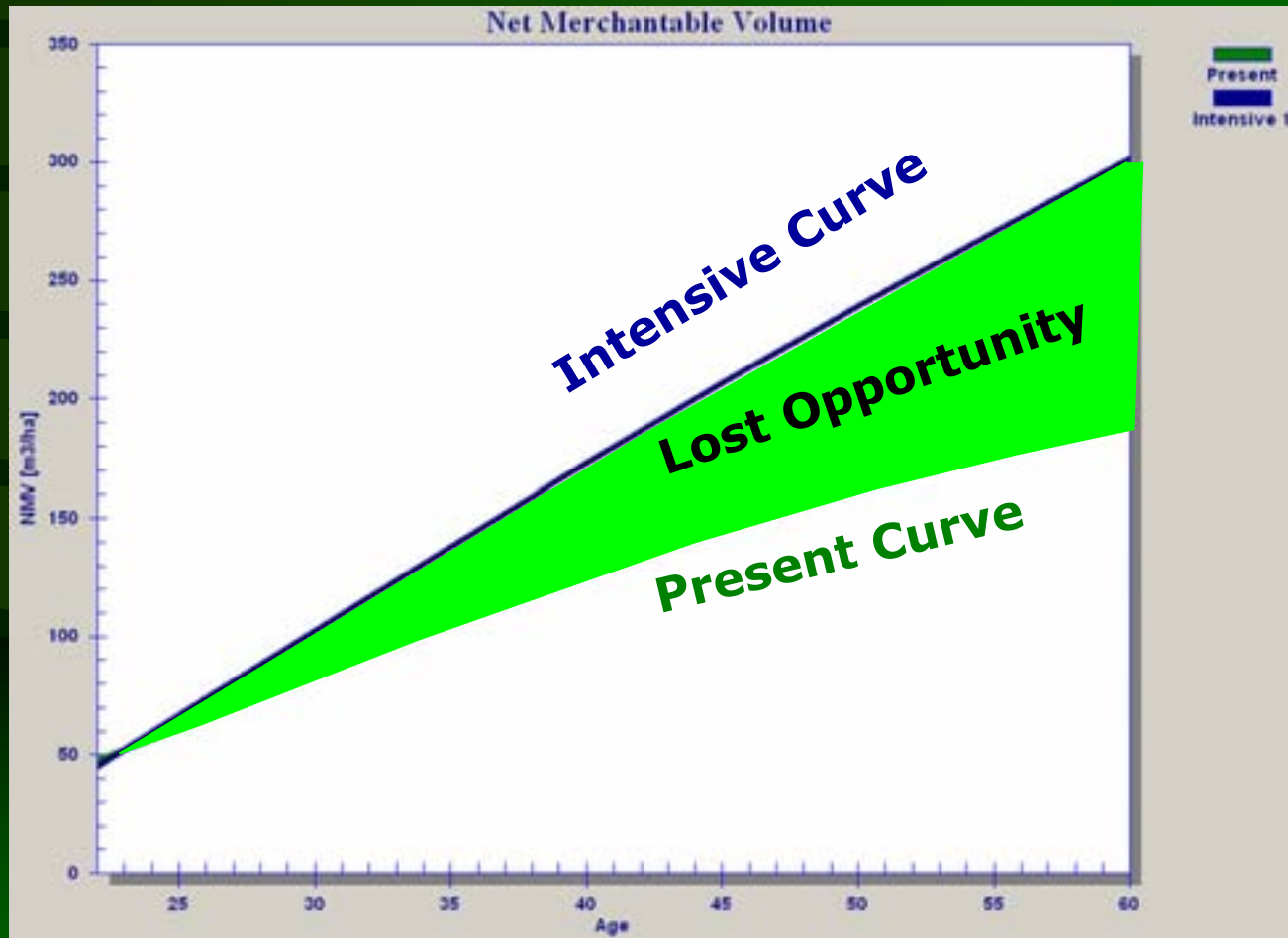


# Defensible Gains

## PJ1 Forest Unit



# Defensible Gains



# PJ1 Yield Curve

Mossy - Modelling Ontario's Stands for Succession & Yield - succdemo\_Mossy.mdb

File Edit Project Tools View Window Help

Project Workspace

- Mossy Projects
  - Tutorial
    - Project Configuration
    - Source Data
    - Succession
    - Yield Curves
      - BW1
      - By1
      - CE1
      - HE1
      - LCT
      - LWMw
      - MHBE
      - MHCON
      - MIDHD
      - MW1
      - MW2
      - MW3
      - OAK
      - PJ1**
      - PJ2
      - PO1
      - PR1
      - PwOR
      - PwST
      - PwUS4

succdemo\_Mossy.mdb

Yield Curve Parameters

Forest Unit or Species: PJ1

GLSL Ecosite: 15

Chart Y axis: NMV

Intensity Thinning

Net Merchantable Volume

	Intensity	SpComp	Stk	Sc	Regen Delay/Acceleration
1	FRSNT	PJ.81PO 8PW 4SB 2MS 1BW 1PR 1OR 1BF 1SW 0CE 0PS 0	0.77	1.5	

Output Window

Status Error

For Help, press F1

NUM

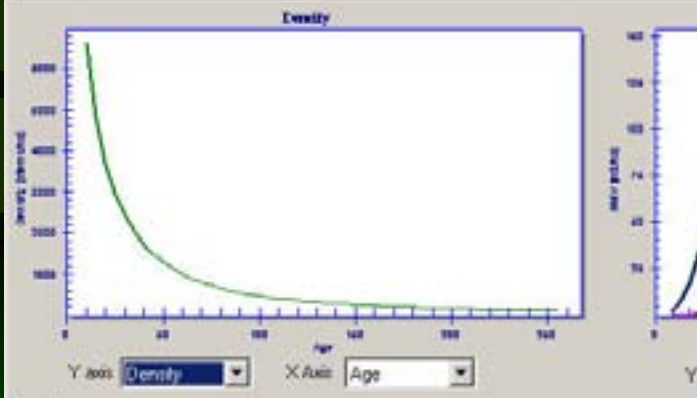
# YC Details and Product Summary for PJ1

**Yield Curve Details**

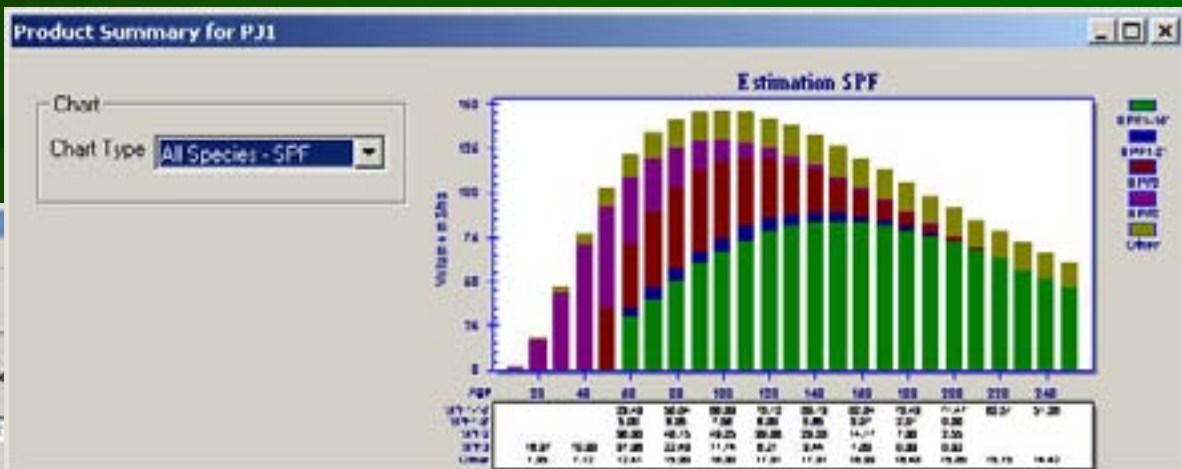
File View

SpComp      Stk      S

PJ1BPO	BPW	45B	2MS	10W	1PR	1CR	10F	15W	0CE	0PS	0	0.77	1.5
--------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	---	------	-----



Age	Stocking	Height (m)	Density (stems/ha)	Ba (m <sup>2</sup> /ha)	DBHq (cm)	GTV (m <sup>3</sup> /ha)	GMV (m <sup>3</sup> /ha)	NM (m <sup>3</sup> /ha)	(m <sup>3</sup> /ha)	(m <sup>3</sup> /ha)	(m <sup>3</sup> /ha)	(m <sup>3</sup> /ha)	(m <sup>3</sup> /ha)	(m <sup>3</sup> /ha)
1	10	3.6	6606	8.95	4.15	13.72	2.31	2.18	2.04	0.07	0.04	0.02		
2	15	5.9	4019	12.05	5.64	30.31	8.57	8.13	7.46	0.30	0.16	0.09		
3	20	8.1	3725	14.39	7.01	49.19	19.32	18.32	16.64	0.76	0.39	0.23		
4	25	10.0	2980	16.14	8.30	68.33	33.58	31.79	28.88	1.42	0.72	0.43		
5	30	11.7	2443	17.43	9.53	86.57	49.71	47.04	42.17	2.23	1.13	0.64		
6	35	13.3	2040	18.30	10.71	103.32	66.27	62.63	55.92	3.11	1.59	0.84		
7	40	14.7	1730	19.08	11.85	118.33	82.14	77.51	68.99	3.98	2.06	1.00		



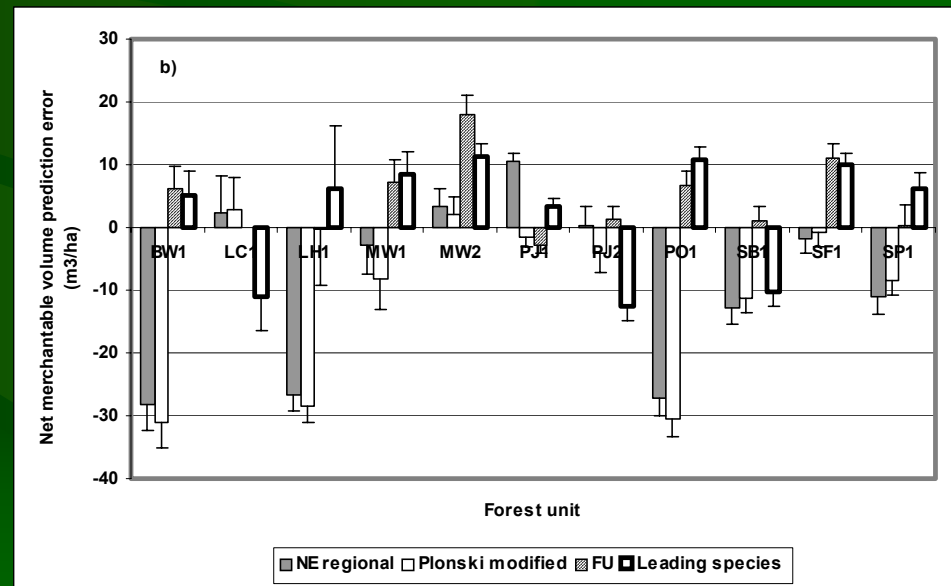
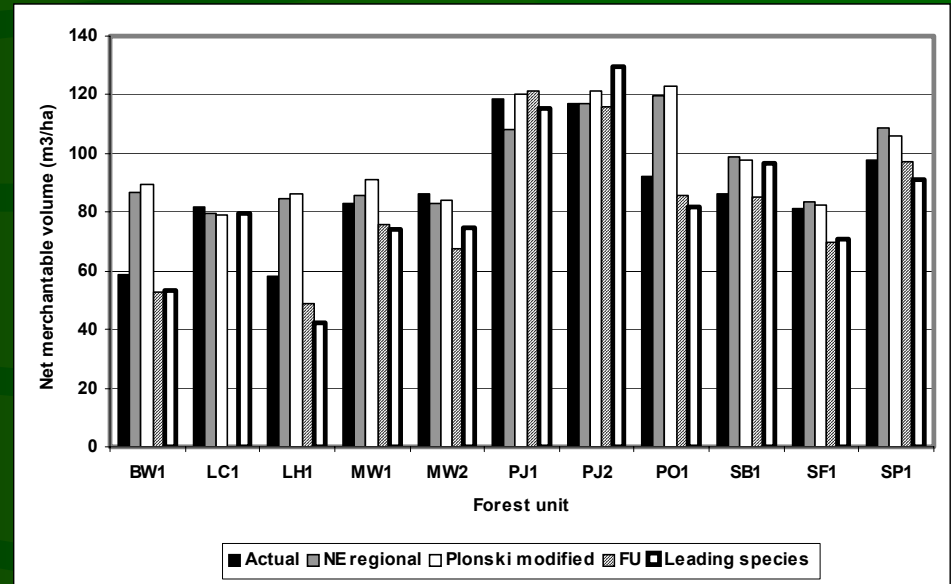
Age	All Species - SPF					Spruce				
	SPF1-16'	SPF1-8'	SPF2	SPF3	Other	SPF1-16'	SPF1-8'	SPF2	SPF3	SPF
1	10	0.00	0.00	0.00	2.06	0.13	0.00	0.00	0.00	0.02
2	15	0.00	0.00	0.00	7.59	0.55	0.00	0.00	0.00	0.09
3	20	0.00	0.00	0.00	16.97	1.35	0.00	0.00	0.00	0.23
4	25	0.00	0.00	0.00	29.27	2.52	0.00	0.00	0.00	0.43
5	30	0.00	0.00	0.00	43.08	3.95	0.00	0.00	0.00	0.64
6	35	0.00	0.00	0.00	57.11	5.52	0.00	0.00	0.00	0.84
7	40	0.00	0.00	0.00	70.39	7.12	0.00	0.00	0.00	1.00
8	45	0.00	0.00	26.25	56.11	8.64	0.00	0.00	0.35	0.75
9	50	0.00	0.00	34.93	57.80	10.05	0.00	0.00	0.44	0.73
10	55	0.00	0.00	44.07	57.47	11.71	0.00	0.00	0.52	0.68

# Yield Curve Validation Efforts - NMV

The average actual and predicted net merchantable volume

## Conclusion

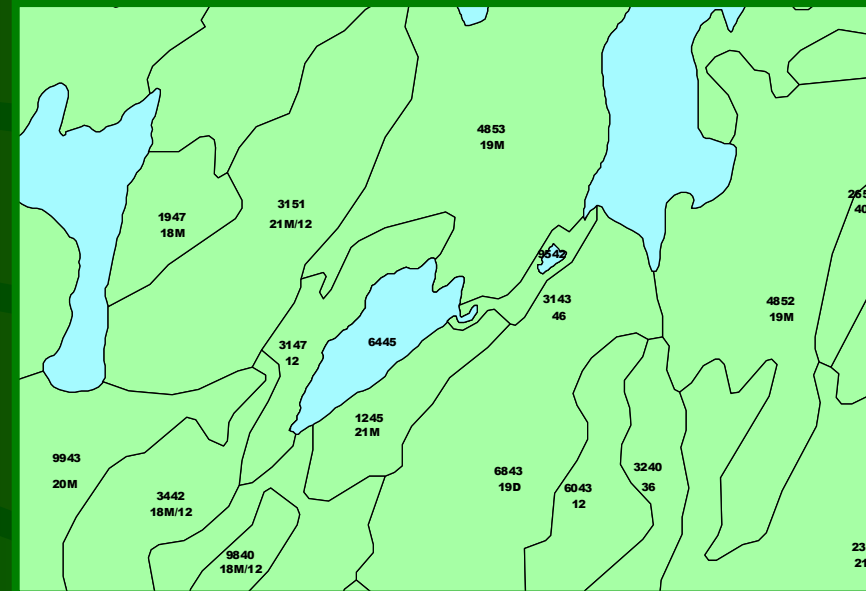
- In general, the forest unit approach had the lowest average prediction error for net merchantable volume



A positive prediction error indicates an underprediction

# Succession Model

- A model to predict species change over time for non stand replacing disturbances for the AOU
- Can be applied at the stand or FU level
- Calculates the percentage change by various inventory attributes (i.e., FU, Age-class, Wg, etc.)



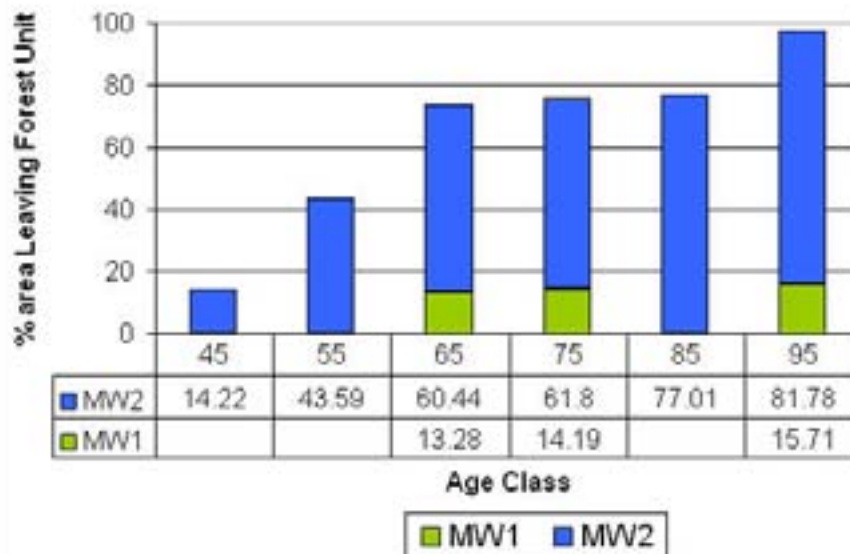
# Approach

- Evaluated different approaches to modelling species change over time:
  - Scientifically credible
  - All species
  - Within limits of available resources
  - Compatible with FMP process and needs

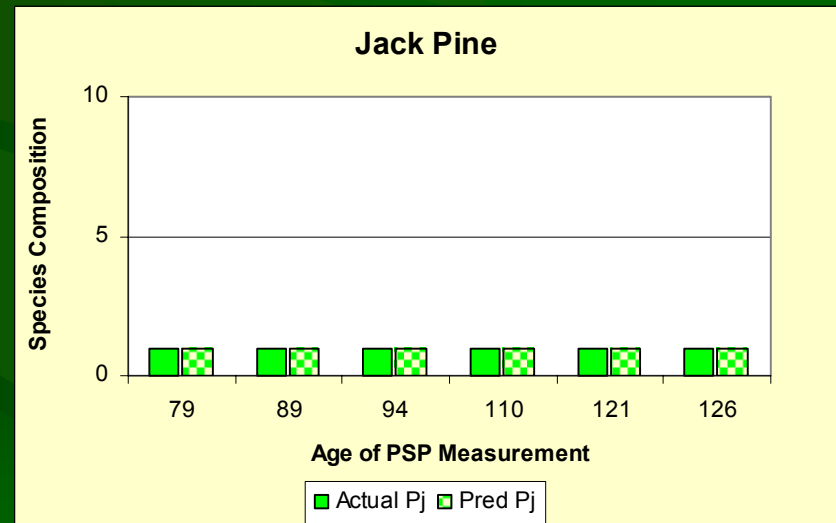
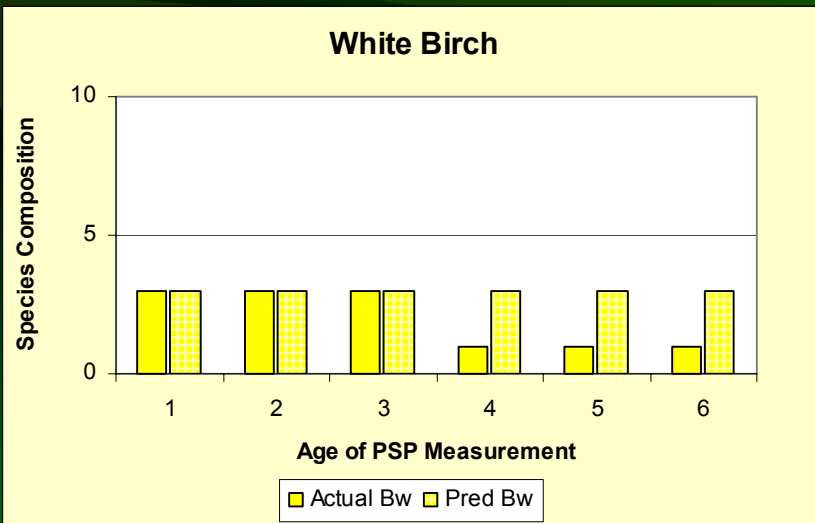
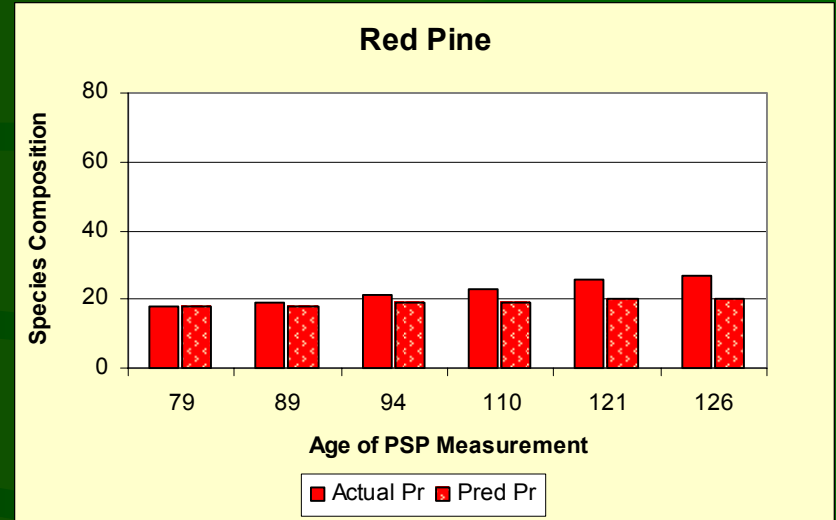
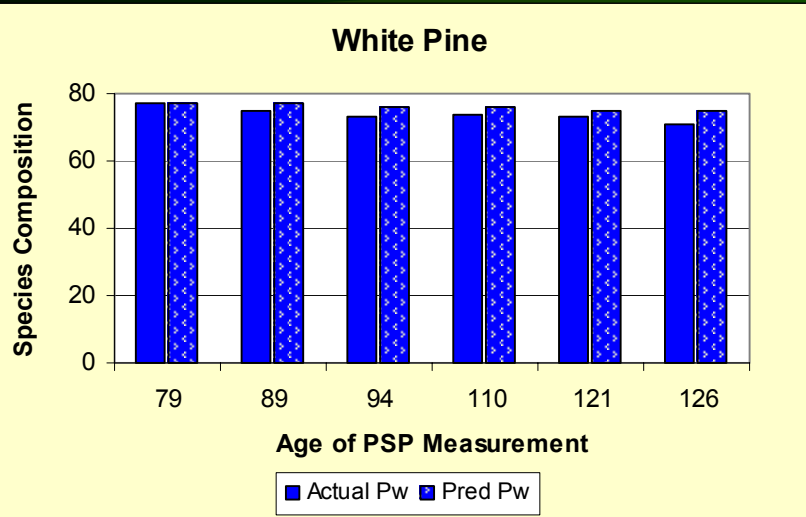
	ROWID	Interval	Ht	Age	Stk	Wg	Sc	Fu	PlanFu	Ba	SppComp
	11	0	16	56	0.3	BW	2	BW1	BW1	6.67	BW 80BF 10CE 10
	11	10	17.7	66	0.28	BW	2	BW1	BW1	6.6	BW 78BF 13CE 9
	11	20	19.15	76	0.2	BW	2	MW2	MW2	4.69	BW 65BF 23CE 12
	12	0	27	71	0.5	PO	1	PO1	PO1	17.58	PO 60BW 20PW 10SB 10
	12	10	28.29	81	0.44	PO	1	MW2	MW2	16.04	PO 56PW 27SB 14BW 3
	12	20	29.91	91	0.52	PW	1	PW1	PW1	22.08	PW 53PO 35SB 12BW 0
	13	0	12.8	121	0.3	SB	3	SB1	SB1	10.12	SB 80CE 20
	13	10	14.11	131	0.33	SB	3	LC1	LC1	11.26	SB 68CE 32
	13	20	14.85	141	0.36	SB	3	LC1	LC1	12.42	SB 58CE 42
	14	0	14	101	0.5	SB	2	MW2	MW2	17.8	SB 30BF 20BW 20PO 20SW 10
	14	10	15.32	111	0.4	SB	2	MW2	MW2	14.61	SB 35PO 22BF 16BW 16SW 12
	14	20	16.15	121	0.35	SB	2	MW2	MW2	12.93	SB 37PO 22BF 15SW 13BW 13
	15	0	19	81	1	PJ	2	PJ1	PJ1	26.04	PJ 70PO 20SB 10
	15	10	19.65	91	0.78	PJ	2	MW1	MW1	20.23	PJ 55PO 31SB 15
	15	20	20.65	101	0.52	PO	2	MW1	MW1	17.67	PO 43PJ 38SB 19
	16	0	21.6	76	1	PO	3	PO1	PO1	29.31	PO 80BW 10PJ 10
	16	10	22.75	86	0.79	PO	3	PO1	PO1	23.58	PO 85PJ 14BW 1
	16	20	23.8	96	0.73	PO	3	PO1	PO1	21.48	PO 80PJ 20BW 0
	17	0	20.8	96	0.5	PJ	2	MW1	MW1	12.95	PJ 40BW 20PO 20SB 20
	17	10	21.04	106	0.36	PO	2	MW1	MW1	12.19	PO 29PJ 26SB 23BW 22
	17	20	21.73	116	0.3	PO	2	MW1	MW1	9.88	PO 38PJ 31SB 31
	18	0	13.8	111	0.5	SR	2	SR1	SR1	18.32	SR 90CF 10
	18	10	15.13	121	0.49	SB	2	SB1	SB1	18.26	SB 82CE 18
	18	20	15.91	131	0.48	SB	2	LC1	LC1	18.29	SB 73CE 27
	19	0	22	81	0.6	PO	3	MW2	MW2	17.76	PO 40SB 30BW 20PJ 10
	19	10	23.3	91	0.49	PO	3	MW1	MW1	14.68	PO 41SR 41PJ 18

Forest Unit Before Succession	Intensity	Age of Succession	Forest Unit After Succession	Age	Intensity	Proportion that Succeeds	Stand Count	Area (m2)
BW1	Present	45	MW2	65	Present	14.22	8	1601316
BW1	Present	55	MW2	75	Present	43.59	25	5269722
BW1	Present	65	MW1	85	Present	13.28	7	1802897
BW1	Present	65	MW2	85	Present	60.44	56	8208798
BW1	Present	75	MW1	95	Present	14.19	8	1170522
BW1	Present	75	MW2	95	Present	61.8	37	5098744
BW1	Present	85	MW2	105	Present	77.01	20	5128030
BW1	Present	95	MW1	115	Present	15.71	2	219404.4
BW1	Present	95	MW2	115	Present	81.78	3	1142062

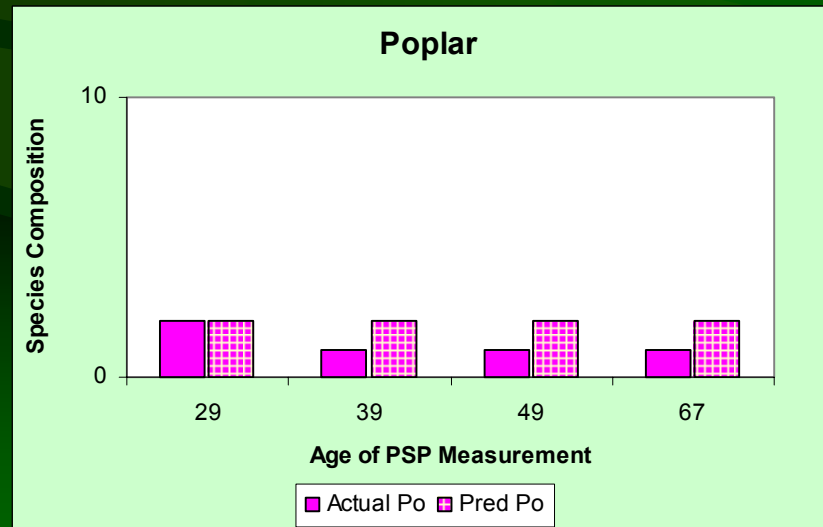
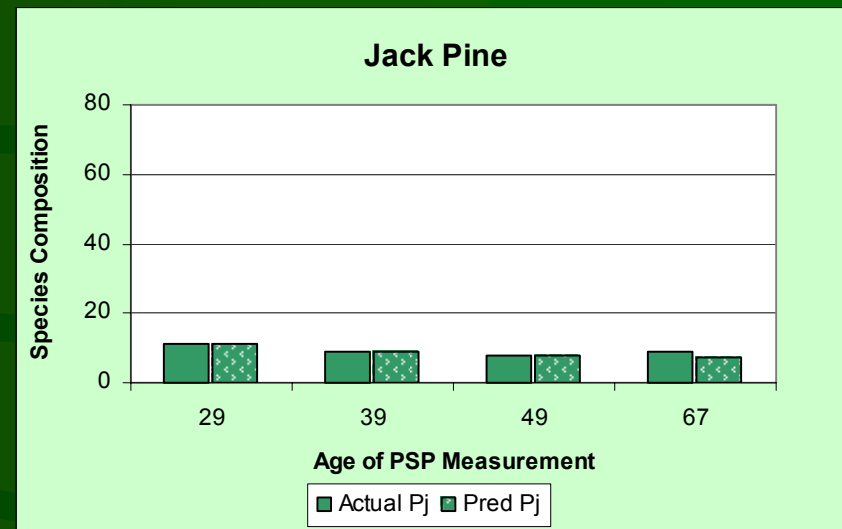
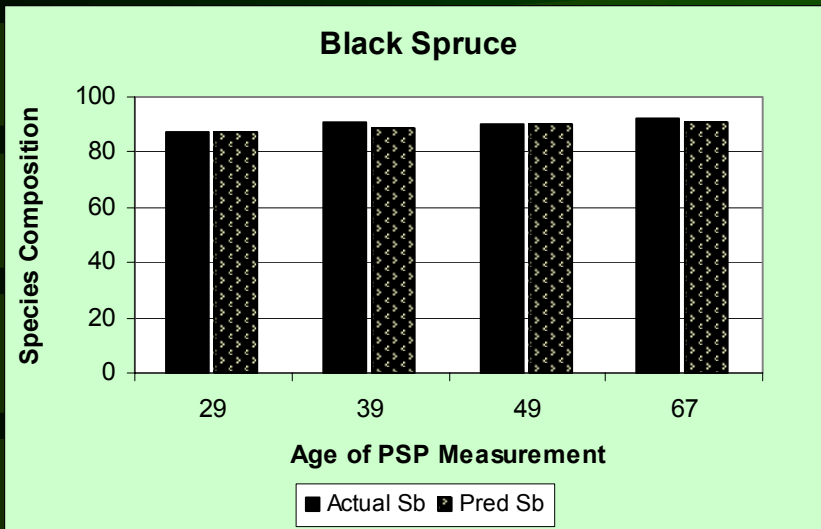
### BW1 Forest Unit



# Validation Example of a White/Red Pine Stand



# Validation Example of a Black Spruce Stand





# Update 2006/2007

## REVIEW

- Consultation with potential users.
- External scientific review.
- Review conducted by professors from UBC, Lakehead and Laval universities.
- Methods used were found to be satisfactory for succession.
- Suggested using remeasured PSPs for Growth and Yield.
- EFPSF funds approved.

# Questions

