



Introduction to Ontario's Growth and Yield Program



John Parton, R.P.F.

Provincial Growth and Yield Coordinator
Biodiversity and Monitoring Section

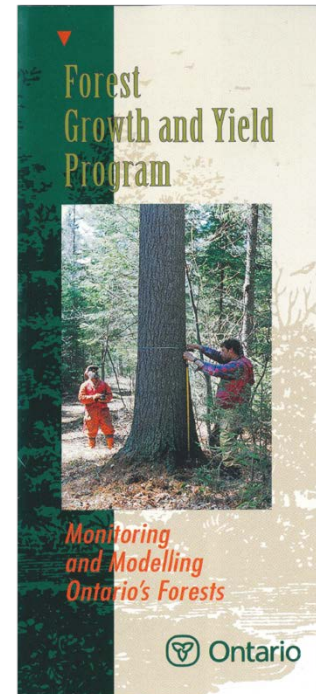
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Why Bother

- It is no mystery what Growth and Yield does—it collects mountains of data—but why?
- Most G&Y programs are commissioned to consistently and accurately predict the productivity and quality of forests under any resource management regime
- They accomplish this by supplying high quality data, models, and information products base on empirical evidence
- Management system drives data needs

Why is a G&Y Program Important?

- Ontario's FMP framework relies on informed predictions of the forest's current and future response to today's actions
- Because of tree longevity, slow growth rates, and the small area harvested annually, actions taken now may not produce noticeable effects for decades
- A planning process that achieves its desired benefits far into the future produces heavy reliance on models, indicators of sustainability, and long-term monitoring



What is Growth and Yield Science?

- Science that:
 - Supports a sustainable, predictable, and affordable, wood supply
 - Reduces uncertainty associated with forest management decisions
 - Provides the link between area of harvest (AHA), and volume
- A means for developing decision support tools that consistently and accurately predict the quality, quantity and dynamics of forested ecosystems under any management scenario

In Other Words...

- Growth and yield provides the basis for forest planning and silvicultural investment. Forest inventory provides data on the area and location of forest resources; growth and yield provides current volume estimates and long-term predictions of how Ontario's forest will develop
- Sustainability rest on our ability to **reasonably** predict the future and **respond** accordingly

How Good Do We Need to Be?

- Growth and yield models used to support forest management decisions must be able to accept broad-scale (i.e., forest inventory) data as input
- Spatial resolution is low, with strata average yield through time being the primary focus
- Stand specific prediction with the smallest error is not the objective
- Predictions are for 150–200 years

Baskerville Was Asked:

1. Are our methods of obtaining data appropriate;
2. Is our data reliable and appropriate for management; and
3. What data provides a check on the validity of OMNR's forecasts of future wood supply

In Baskerville's Words (1986)...

- “The link between area of harvest, and volume recovered by harvesting that area, is crucial to the successful design and implementation of forest management.” ... “In the OMNR, this linkage between area of harvest and volume of harvest needs substantial improvement.”
- “Decisions are choices among forecasts about the future, thus the quality of forest management hinges largely on the accuracy of forecasts used in its design.”



FORESTRY KNOWLEDGE RETENTION

Condition 42: Growth and Yield Program

Background:

MNR's Class EA and Timber EA Hearing (1987-1992)

- The provision of a “predictable and continuous wood supply” was a topic of considerable interest during the hearing.
- Forests for Tomorrow (FFT) argued that MNR was failing to meet the Crown Timber Act’s definition of sustained yield management and argued that allowable cuts in some management units were too high to sustain.
- During the hearing, MNR concluded that practitioners needed more comprehensive growth and yield information and began to develop a provincial strategy.
- MNR told the Board that it would spend \$10 million on permanent sample plots.

EA Board Decision (1994)

- EA Board concluded that:
 - “More important to us . . . is the knowledge that the timber is harvested at a pace that permits regeneration of the resource. . .” (EA Board decision, p. 157)
 - “MNR told us it would improve growth and yield information from existing data, conduct new field work using old sample plots and newly established permanent plots and develop new models for predicting growth and yield. It is especially important to understand how a certain species of tree on a given site will respond to particular treatments”. (EA Board Decision, p. 404)

Not Just Timber (Anymore)

- Our class exemption under the EA Act was tightly scoped to timber. Board was forward thinking and identified that a G&Y Program was a necessary prerequisite to Forest Management
- But...we did write a Provincial Wood Supply Strategy which repeatedly points out the lack of G&Y information – a deficiency identified by the Canadian Parks and Wilderness Society and the Wildlands League

Same Data – Multiple Purposes

- Permanent Sample Plots (PSPs), the life blood of G&Y programs, are the basis for developing, testing, and evaluating forest prediction models. But that is not their only value:
 - Favourite source for many non-timber applications. For example, for forest habitat supply modelling since we manage most non-timber forest values by manipulating forest composition and structure
 - Preferred means of studying stand dynamics, regeneration and mortality
 - PSP data is used to calibrate carbon models and to evaluate the impact of climate change

Legal Context

- Implement and support and a provincial program that provides information on forest growth and yield as influenced by: **climate change, site, forest structure, silvicultural treatments and other natural events**
- “A sound understanding of natural and ecological systems and how our actions affect them is key to achieving sustainability” (SEV)



Growth & Yield

Ministry of Natural Resources and Forestry

Year	Event
1920s	First PSPs established
1930s to 1950s	Industrial plot networks established
1950s	Provincial government sample plots established
1950s to late 1980s	Ad-hoc research sample plots established
1989	Launch of “new” G&Y initiative
1989 to 1992	Workshops to create a provincial G&Y program implementation plan
1992	Provincial G&Y program establishes PSPs
1994	EA Term and Condition 100 declares provincial G&Y program a legal requirement
1998	PGP design developed ➔ Forest Ecosystem Science Co-op in 1999

Memory Lane...



Looking Beyond Our Borders

Jurisdiction	Number of plots	Number of trees	Number of individual tree measurements
British Columbia	20,840	1,081,583	2,682,837
Alberta	1,757	325,260	1,046,167
Saskatchewan	1,547	207,482	283,426
Manitoba	411	90,002	183,364
Ontario	1,489	159,626	194,316
Quebec	100,260	5,479,685	5,853,192
New Brunswick	2,499	221,616	503,946
Nova Scotia	2,587	121,990	430,754
Prince Edward Island	1,200	29,635	29,635
Newfoundland and Labrador	939	86,376	86,376
Yukon	257	12,594	12,594
Total	133,786	7,815,849	11,306,607

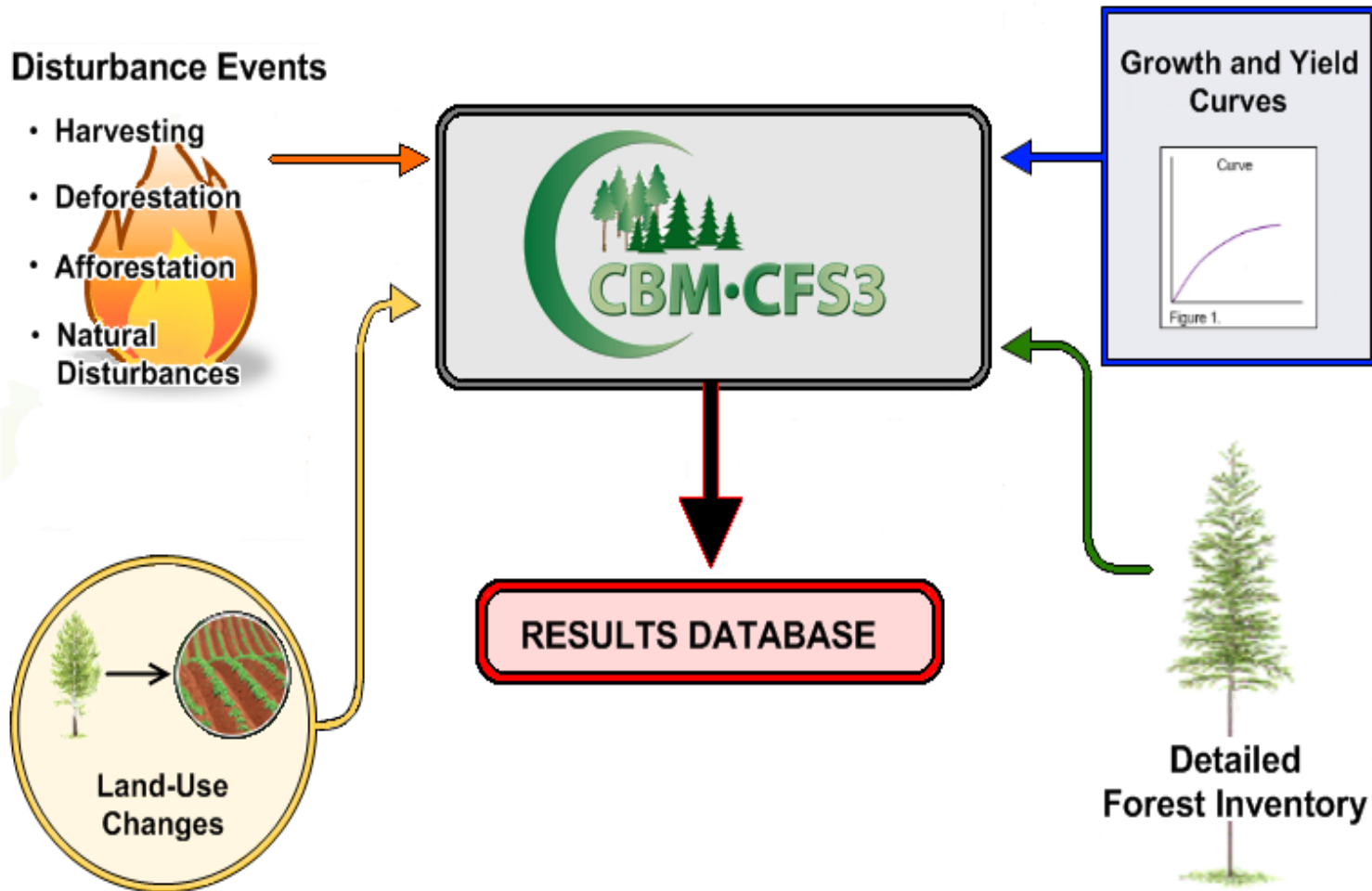
Getting To The Pith

- There are five major themes of G&Y programs:
 1. Calculation of wood supply
 2. Silviculture decision support
 3. Forest inventory
 4. Modelling of stand dynamics
 5. Monitoring
- The ideal system for each of these applications differ, there is no one-size-fits-all solution
- Accurate predictions of future volumes are primarily a function of mortality (not growth). Modelling mortality requires short remeasurement cycles and large plots



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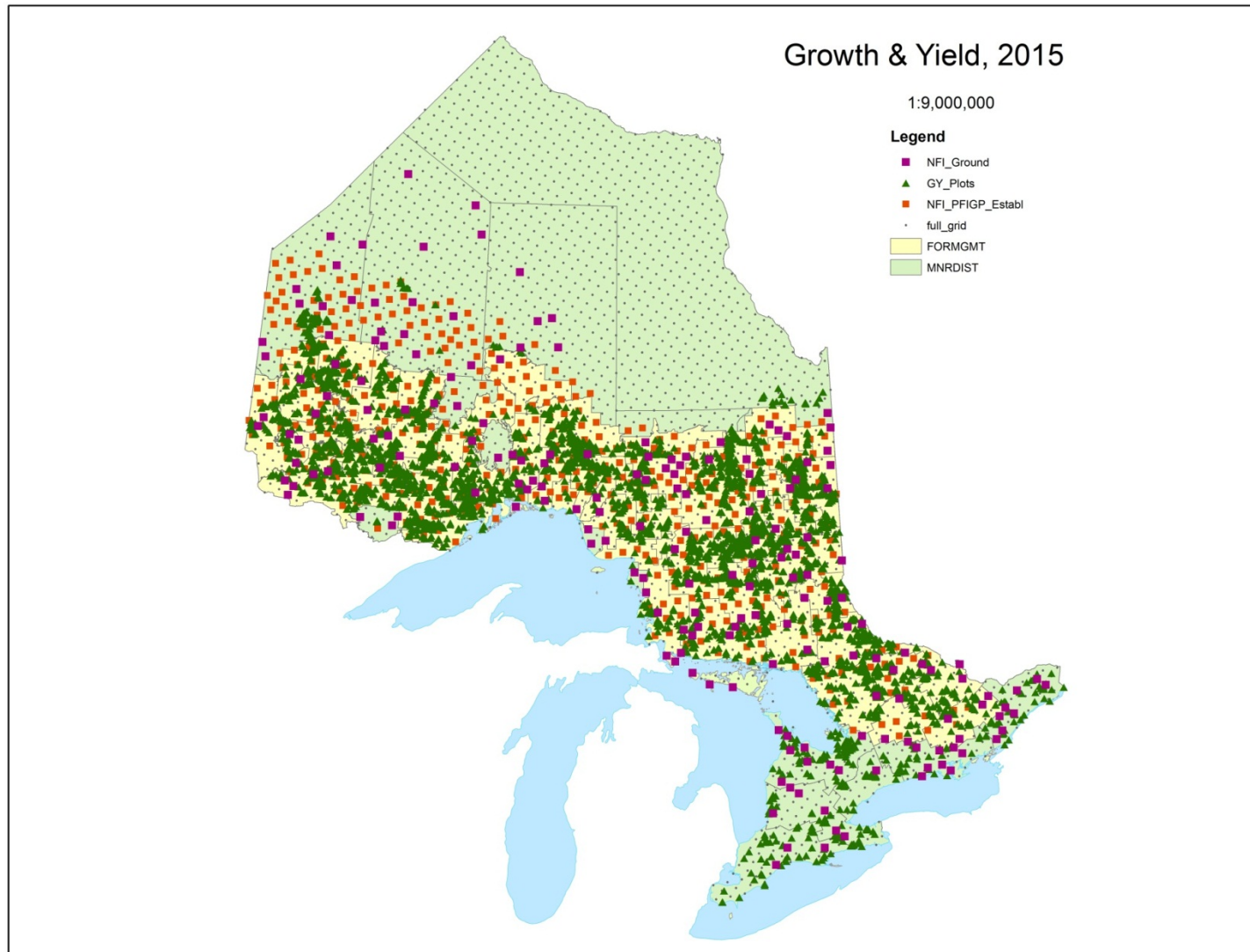


“High Quality” Data by Design

- Multiple designs (plot networks) sharing a planned 5 – 10 year remeasurement cycle
- All designs are complimentary (include a base set of protocols and attributes)
- Methods are standardized, documented, sound, and current – informed by both present and anticipated uses
- Measurement protocols are consistently communicated, tested, and validated via QA

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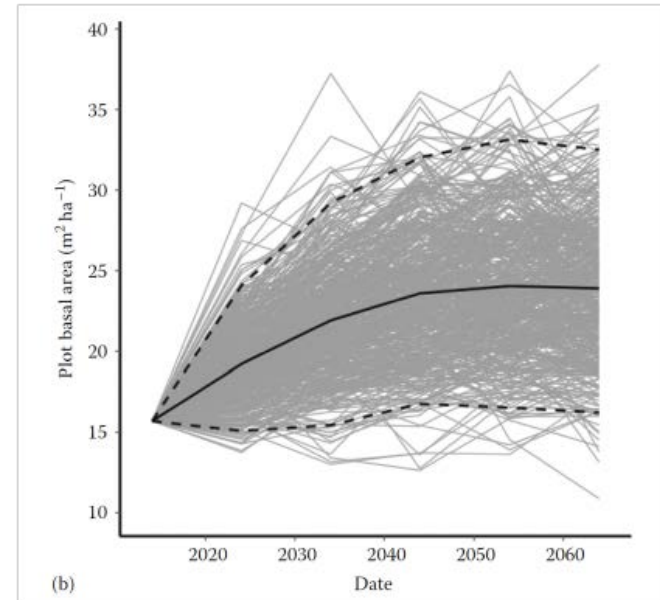
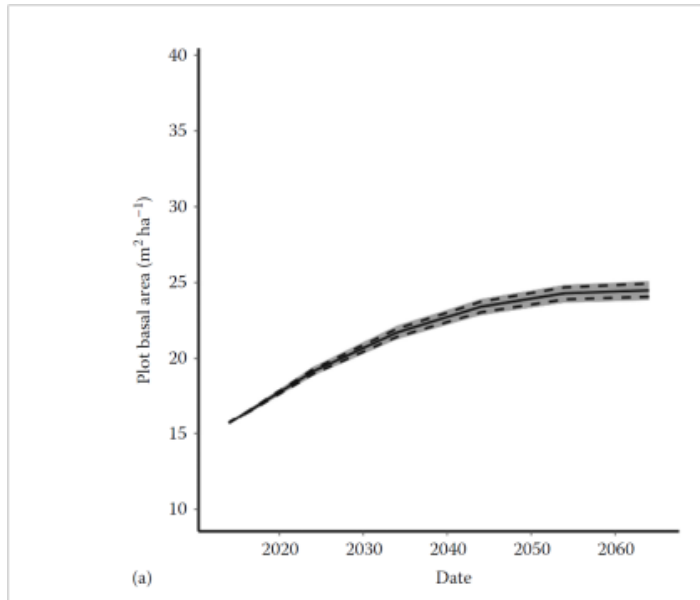
Gaps and Challenges

- Growth and yield models applicable to uneven-aged management are “effectively” lacking
- Forest management for uneven-aged stands is hampered by: (1) historic lack of interest in uneven-aged management; (2) scarcity of suitable data; and (3) difficulties in developing prediction models that link to other parts of the planning system (e.g., inventory)

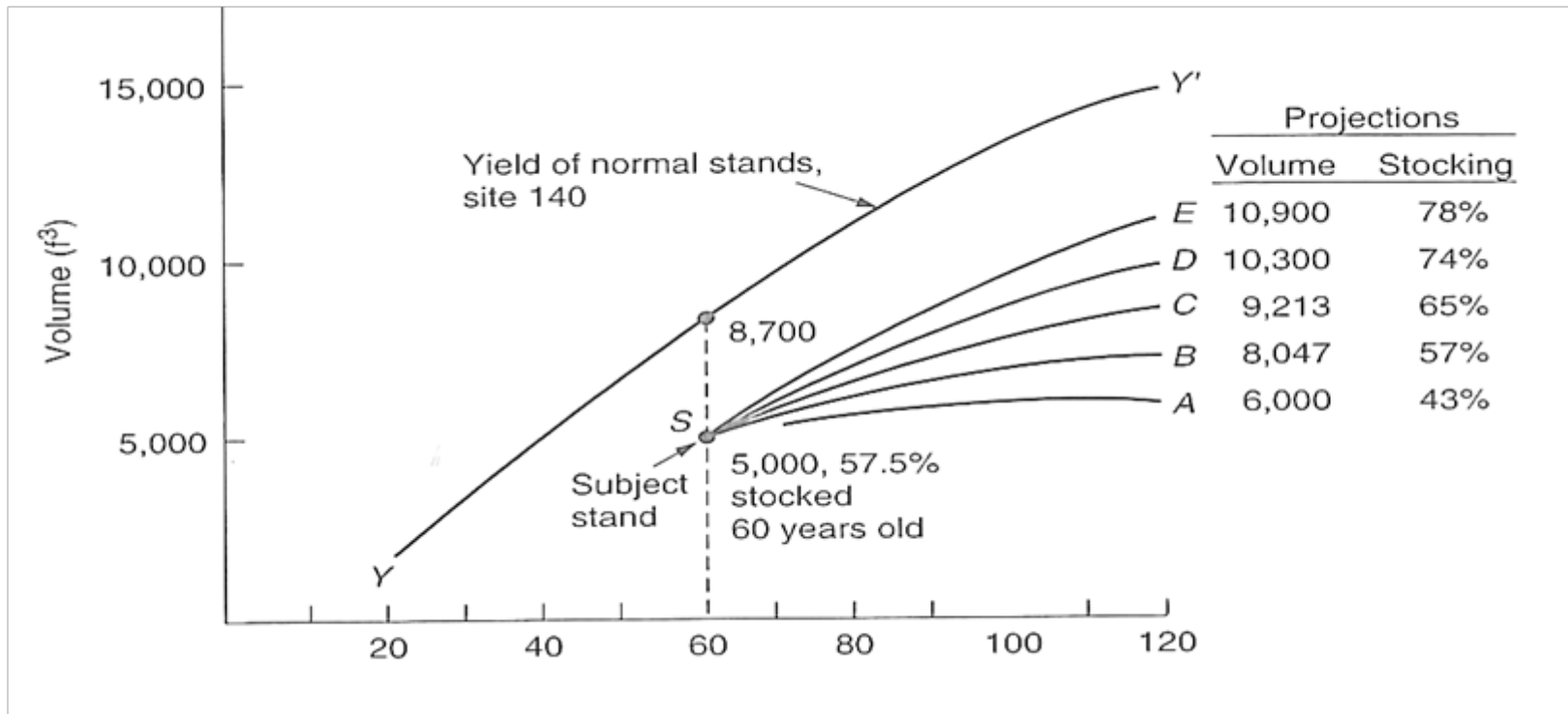
Are We Done Yet?

- “50-100 randomly distributed plots will probably be adequate for monitoring and forecasting within one stratum.” (Synnott, 1979)
- “It is not possible to define the number of PSPs required from purely statistical criteria. Experience suggests that ~100 plots may be sufficient unless there is evidence for distinctly different growth patterns on part of the geographic range.” (D Alder, 1980)

How Good Are We?



Which Development Path?



Some Years in Review

Table 1. Ontario Permanent Growth Plots (PGPs) established and remeasured by the Forest Ecosystem Science Co-op (FESC) and the MNRF between 1999 and 2015 and Permanent Sample Plots (PSPs) established and remeasured by the OMNFR from 1980. The PGPs are primarily located in the boreal region.

YEAR	FESC PGPS		MNRF PGPS		BOREAL PSPS		SOUTH CENTRAL PSPS		SOUTH PSPS	
	Estab	Remeas	Estab	Remeas	Estab	Remeas	Estab	Remeas	Estab	Remeas
2003	445	-	26	2	-	28	-	13	-	-
2004	289	80	28	68	7	139	-	29	-	3
2005	188	245	45	20	12	81	4	6	-	16
2006	119	498	-	12	5	16	-	7	-	4
2007	239	436	11	11	4	22	1	-	-	7
2008	22	432	-	55	3	24	-	9	-	24

Show Me the Money

- Program resourcing in 1994 was \$1,973,000 salary and \$1,735,000 ODOE (\$3,708,000 total)
- In 2018, ~ \$600,000 in salary and \$439,436 in ODOE (\$1,039,436 total or 28% relative to 1994 - not adjusted for inflation). Assuming an annual rate of 2%, current funding is ~ 17%
- In 1994, 384 PSPs established. In 2016, 69 PSPs measured or ~ 18% of the 1994 total

We Have Moved the Yard Sticks

- Forest Growth Models
 - Density Management Diagrams
 - FVS^{Ontario}
- Forest Yield Models
 - Benchmark Yield Curves / MIST
- Taper Models
- Site Index Models
- Height Diameter Models
- Total Age to BH Age
- Diameter Distribution Models
- Succession Models
- State of the Forest Indicator Reports

