Exploring new approaches to managing jack pine in Kirtland's warbler country

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Background

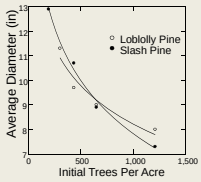
- KW on the verge of extinction in early 1980's
- Managers developed high-density, opposing-wave plantations that provided high quality breeding habitat.
- Planting of ~4000 acres/yr of these plantations has been instrumental in recovering KW.

Synopsis of the Problem

- In order to keep creating KW habitat you have to harvest existing forest stands.
- In order to harvest you have to have timber to sell
- Throughout most of the KW program "parent" stands were easy to sell:
  - 60+ years old with larger trees
  - often contained red pine
  - markets for jack pine were better
- Managers are soon going to have to try selling the earliest KW plantations
  - 40-50 years old smaller trees
  - pure jack pine
  - markets for jack pine roundwood are stagnant, chip markets are terrible

Tree Spacing

- Traditional plantation spacing = 6’ x 8’ or 900 trees per acre
- KW Plantation Spacing = 4’ x 6’ or 1800 trees per acre
- Tree density is inversely related to tree size – the more trees per acre the smaller the average tree size



Data from: Clark and Saucier. 1989. Forest Prod. J. 39 (7/8):42-48.

Forest Products

- Sawtimber: trees 6” diameter or greater
- Pulpwood: trees 4” diameter or greater
- Chips: trees < 4” diameter

Representative stumpage prices:

	Red Pine	Jack Pine
Sawtimber	$150/MBF	$24/MBF
Pulpwood	$45/cord	$22/cord

23-year old KW plantation

60 year old natural origin jack pine

Recent DNR Timber Sales for KW*

Sale	Pulp (cd/ac)	Saw (MBF/ac)	Total (cd/ac)	Selling Price ($/ac)	Notes
Good Buy	12.9	7.3	27.4	$2,457	RP dominated
F32	13.7	3.6	20.8	$1,320	60%RP/40%JP
West 290	10.1	0.1	10.3	$380	JP with some oak
Ants	7.2	0.1	7.4	$262	JP with some aspen
Big Creek	13.1	0.3	13.7	$488	JP with some oak
Toothpick	5.8	0.2	6.2	$177	JP with some RP
Fairview	7.6	0.4	8.4	$179	JP, 20% merchantable
Sec27	6.9	0.0	6.9	$202	JP, 40% merchantable
RP 2 sales	13.3	5.4	24.1	$1,888	
JP 6 sales	8.4	0.2	8.8	$282	

Costs of Plantation Establishment: ~$300/ac (~$500/ac if replanting is needed)

*Thanks to Tim Greco, Dale Ekdom and Doug Bates, MDNR

Approach

- Field data collection from existing KW plantations to characterize:
  - Biomass production
  - Merchantable volume production
  - Nutrient budgets
- Use field data to calibrate growth and yield model (FVS) for high-density jack pine plantations in the NLP.
- Use the calibrated model to project future output of forest products from KW plantations under varying scenarios:
  - Business as usual
  - Extended rotations
  - Short rotations
  - Thinning

Field Methods

"Space for time substitution"
sampled 39 KW plantations ranging in age from 2 years to 52 years

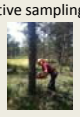

2 y

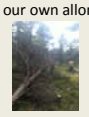

12 y


22 y


52 y

Destructive sampling to develop our own allometric biomass equations

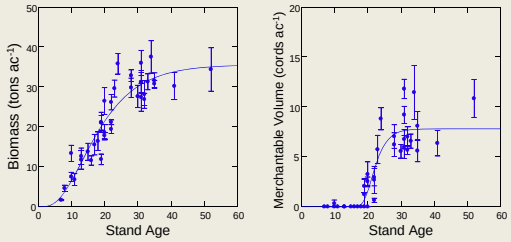




Plot measurements of tree diameters and heights to estimate harvestable biomass and volume

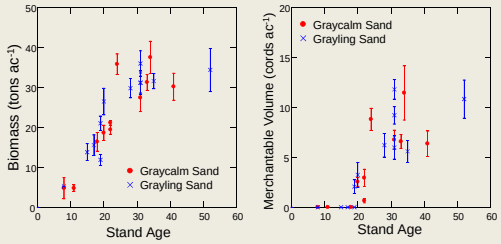
Sampling of soil, forest floor and vegetation for nutrient budgets

Biomass and Volume Production



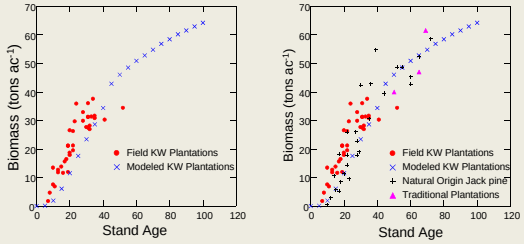
- Biomass and volume follow sigmoidal curves
- Lots of variability in volume
- Volume is all pulpwood – almost no sawlogs
- 1963 KW stand on a 6 x 8 ft spacing

Biomass and Volume by Soil Type



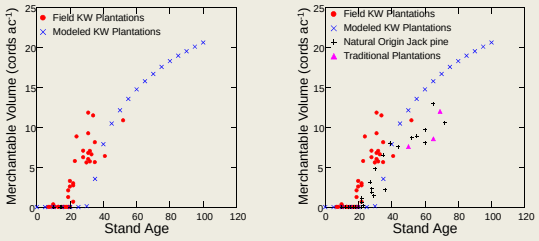
- Soil type (as mapped by NRCS) does not explain variability in biomass or volume

FVS Model Performance - Biomass



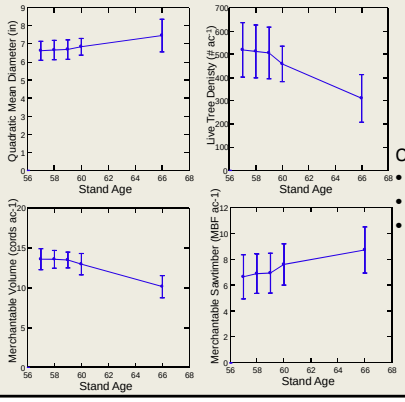
- KW plantations and natural-origin jack pine follow the same trajectory for biomass production
- Calibrated FVS appears to be doing a good job of predicting actual biomass production

FVS Model Performance - Volume



- Volume production in FVS lags field data early
- Late volume production in FVS seems unrealistic.

Tree Growth and Mortality in 1 Older Stand



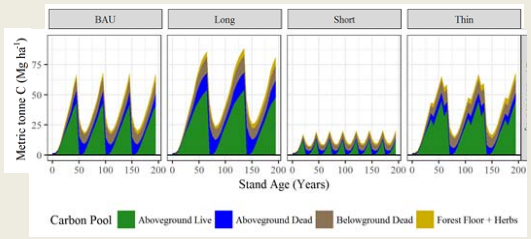
Over 9 years:

- 40% of trees died
- 13.5 to 10 cords/ac
- 7 to 9 MBF/ac

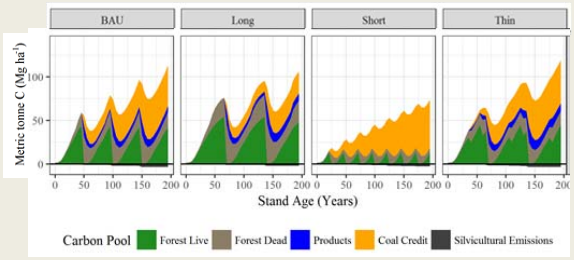
Stand Level Modeling Scenarios

- Business as Usual: plant and whole tree harvest jack pine at 4’ x 6’ spacing on a 50-year rotation
- Extended Rotation: plant and whole tree harvest jack pine at 4’ x 6’ spacing on a 70-year rotation.
- Short Rotation: plant and whole tree harvest jack pine at 4’ x 6’ spacing on a 25-year rotation.
- Thinning: plant and whole tree harvest jack pine at 4’ x 6’ spacing on a 70-year rotation; thin at 40 and 60 years.

Modeling Results Biomass Pools



Modeling Results - Carbon



Modeling Results – Forest Products

The following mix of products are produced under each scenario over a 200-year timeframe (per rotation)

	Biomass (tons/ac)	Pulpwood (cords/ac)	Sawtimber (MBF/ac)
50-y Rotation	40.9 (10.2)	39.4 (9.9)	0.0
70-y Rotation	11.3 (3.9)	47.7 (16.7)	5.0 (1.8)
25-y Rotation	82.4 (10.3)	0.0	0.0
Thinning (70 y)	40.7 (14.3)	55.7 (19.5)	2.9 (1.0)

Upcoming Work 2017

- Finalize FVS calibration and validation.
- Complete nutrient budgets for WTH management of jack pine.
- Initiate field thinning trials:
  - 2 soil types
  - 3 age classes (10-15, 20-25, 30-35)
  - Two intensities (cut 1 leave 2, cut 2 leave 5)
- Extrapolate modeling of jack pine to regional scale under varying management scenarios

Nutrient Budgets

- Purpose is to assess the long-term sustainability of BAU management and of short rotation management.
- Estimate all inputs and outputs of N, P, Ca, Mg and K for jack pine management
- Inputs
  - Atmospheric deposition (NADP)
  - N Fixation (literature range)
  - Mineral weathering (literature, geochemical model)
- Outputs
  - Harvest removals (biomass sampling)
  - Hydrologic leaching (lysimeter sampling of recent clearcuts)

Scenarios for Regional Modeling

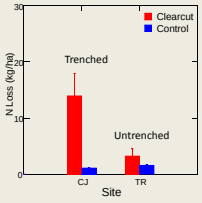
- Business as Usual
  - Not 50-y rotation – will be shorter!
  - Harvest 4000 ac of the oldest jack pine available – given what criteria?
- Extended Rotations
  - Hold KW plantations for 70 years
  - Expand KW program into new areas (red pine, oak)
  - What criteria for choosing expanded acreage?
- Mixed Rotations
  - Manage a fraction of current KWMA on short rotation (25 y)
  - Hold remainder of KWMA stands for 70 years
  - What criteria do we use for assigning short vs extended rotations?
- Mixed Rotations + Thinning
  - Manage a fraction of current KWMA on short rotation (25 y)
  - Hold remainder of KWMA stands for 50-70 years, with a post-warbler row thinning.
  - What criteria do we use for assigning short vs extended rotations + thinning?

Summary Thoughts

- Inherently low value of jack pine means that any attempts to enhance financial returns through extending rotations or thinning do not seem viable.
- Could extended rotations and/or thinning make sense financially by reducing costs for plantation establishment?
- Would be additional ecological benefits if we could reduce the amount of trenching and planting

Ecological Benefits of Natural Regeneration

- Ecological Forestry – emulate timing, intensity and effects of natural disturbance regime.
- Natural regeneration will produce a patch structure more similar to wildfire.
- Trenching and planting is very disruptive to the soil system – promotes nitrification which accelerates nutrient losses and may affect plant community composition



Summary Thoughts Continued

- When you find yourself in a hole, stop digging – experimental habitat working group.
- For 2067 and beyond, adding red pine to KW plantations appears to be the most certain, low-cost way to improve financial returns from timber sales
- For the near term we have 100,000+ acres of high-density jack pine plantations on the landscape, what is the best strategy for managing these?