Effects of canopy openings on adjacent forest matrix

Justin E. Arseneault

Department of Forestry and Natural Resources, Purdue University, 715 State Street, West Lafayette, IN, 47907

jearsene@purdue.edu

Abstract – Do canopy gaps affect matrix?

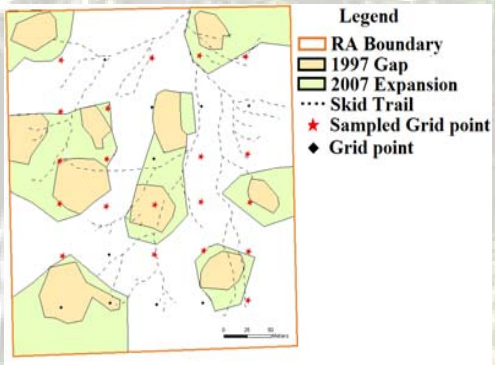
- **Objective #1**: Conduct a decadal review of disturbance-based silviculture effects in terms of forest growth and regeneration
- **Objective #2**: Determine if responses in canopy opening gaps differ from those in adjacent forest matrix

Introduction – Lack of "disturbance-based" silviculture knowledge and research

- **Premise:** Forest species adapt to natural disturbance regimes that occur in their ecosystem[1,2]
- **Conclusion:** Silviculture producing patterns within limits of natural variability maintain ecosystem processes and biodiversity[3]
- **Problem:** "Disturbance-based" systems relatively recent and effects not well understood

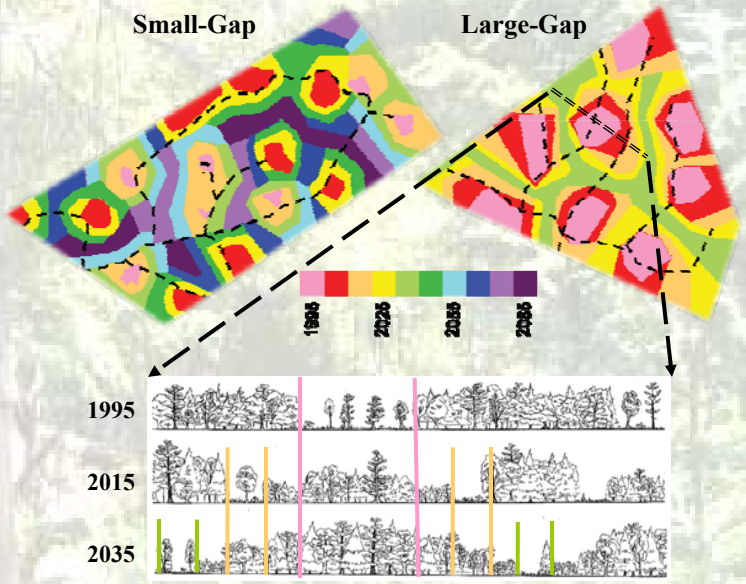
Materials and Methods – Acadian Forest Ecosystem Research Program (AFERP)

- **Site:** Penobscot Experimental Forest, Bradley, Maine.
- **Design:** Complete randomized block
  - 9 experimental units (8.7 to 11.3 ha)



- **Data used:**
  - Overstory and saplings: Species, DBH, Condition
  - Regeneration: Species and Density
  - Importance Values (IV)

Treatment	Disturbance Frequency (yr^{-1})	Area Treated in Harvest	Gap Regeneration Period	Compositional Goal
Large-Gap	2% (1st 50 years only)	20%	10 yr	mid-successional
Small-Gap	1%	10%	20 yr	late-successional
Control	natural only	0%	Natural	natural succession



Result – Gaps affect adjacent matrix

- Balsam fir, hemlock, and red maple dominated all strata and treatments
- Red maple replaced balsam fir as most dominant species in gap strata for seedlings and saplings
- No overstory or sapling differences in forest matrix across all treatments.
- White pine generally increases in edge and gap relative to matrix

Change in Importance Values ([Rel. Freq + Rel. Dom. + Rel. Dens.] / 3)

Treatment	Overstory		Sapling		Seedling		
	Edge	Gap	Edge	Gap	Matrix	Edge	Gap
Small Gap							
Aspen	-	+	++	+++	0	0	+
Birch	-	0	0	0	0	+++	+
White Pine	0	+++	++	+++	+++	+++	+++
Red Maple	+	0	--	+++	+	0	0
Spruce	+	+++	0	+++	0	0	0
Fir	-	+	0	---	---	---	--
Hemlock	0	+	+	+++	++	++	++
Large Gap							
Aspen	0	0	0	++	0	0	+++
Birch	0	0	-	0	0	+++	0
White Pine	0	0	+++	++	+++	+++	+
Red Maple	0	0	+++	+++	+	+++	-
Spruce	-	--	0	0	0	++	0
Fir	+	++	0	--	--	--	-
Hemlock	0	--	0	---	++	++	+++

Δ IV: 0 – 5 = 0 5 – 10 = - | + 10 – 20 = -- | ++ >20 = --- | +++

Discussion / Conclusion – Gaps affect adjacent matrix. More research needed.

- **Treatments:**
  - Gaps impact adjacent forest matrix
  - Largest effect is on sapling recruitment
  - Favored compositional goal species, but also competitors
  - Low power, but observations consistent with knowledge of species responses in Acadian forest
  - Evidence sufficient for further investigation
- **Practical Implications:**
  - Disturbance-based systems differ from traditional silviculture
  - Implementation varies over time/space, which changes proportion of forest matrix affected by gaps
  - These studies valuable for development and calibration of growth models.
  - Understanding canopy openings = better design and implementation of disturbance-based systems

References

[1] Hessburg, P.F., Smith, B.G., Salter, R.B., 1999. Detecting change in forest spatial patterns from reference conditions. Eco. App. 9, 1232-1252.

[2] McRae, D.J., Duchesne, L.C., Freedman, B., Lynham, T.J., Woodley, S., 2001. Comparisons between wildfire and forest harvesting and their implications in forest management. Environ. Rev. 9, 223-260.

[3] Raymond, P., Bédard, S., Roy, V., Larouche, C., Tremblay, S., 2009. Review, classification, and potential application to forests affected by partial disturbances. J. For. 107, 405-413.

Background image: Dr. John Ranson. http://earthobservatory.nasa.gov/blogs/fromthefield/2009/08/page/3/