How Have Changing Environmental Conditions Affected a Postfire Cohort of Aspen Seedlings Twenty-five Years After the 1988 Yellowstone Fires?

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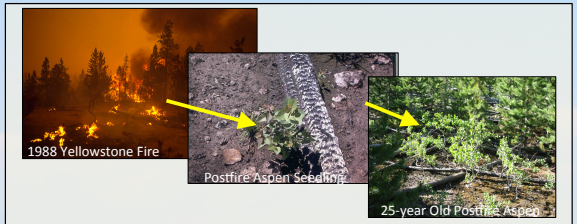


Disturbances Catalyze Change

- Disturbances reorganize plant communities.
- Seedling aspen recruited prolifically in burned lodgepole pine forest following the 1988 fires.
  - Up to 15km from prefire aspen distribution and 500m higher in elevation (Turner et al. 2003).
- Aspen range expansion or eventual elimination?
  - Whether seedling aspen persist or perish likely depends on
    - Climate (Brown et al. 2006),
    - Ungulate browsing (Romme et al. 2005),
    - Competition with conifers (Kaye et al. 2005).

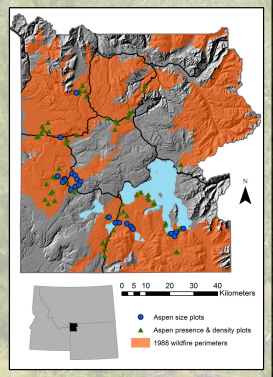
Question and Hypotheses

- **How do presence, persistence, and size of aspen seedlings vary across the postfire landscape? What factors explain these patterns?**

  Expectations: Aspen will have declined in abundance and grown more slowly in locations:
  1. Far from prefire aspen and at higher elevations,
  2. Where competition with lodgepole was higher,
  3. Where browsing pressure was higher,
  4. With less fertile soil

Methods

- **Aspen presence and density**: resampled 72 widely distributed 0.25ha plots in postfire lodgepole pine forest last sampled in 1999 (Turner et al. 2004).
- **Aspen size**: resampled 22 smaller plots previously sampled in 1996-1998 & 2000 (Romme et al. 2005).



Results

- **Aspen presence** and **density** declined (1999 to 2012).
  - 1999: Present at 62% (45) of plots, mean = 522 stems/ha. More likely present with warmer temperature.
  - 2012: Persisted at 58% (26) of original 45 plots, mean = 280 stems/ha. Persisted on more fertile soils.

Factors correlated with probability of aspen presence (1999) and persistence (2012)

	1988 Burn Severity	Mean G.S. Temp	Lodgepole Pine ANPP	Infertile Rhyolite Soil	Less Infertile Rhyolite Soil	More Fertile Andesite Soil	Elevation
1996	+	+	+	-			-
2012			+		+	+	

- **Aspen size** increased slowly (1996-2013).
  - 1996: Mean height = 30cm (min = 3.5cm, max = 96cm). Mean basal diameter = 7mm. Larger aspen on more basic soils.
  - 2013: Mean height = 59cm (min = 4cm, max = 323cm). Mean basal diameter = 9.7mm. Larger aspen in areas with low lodgepole density, far from prefire aspen distribution.
  - Browsing declined from 85% of stems to < 3% of stems.

Factors correlated with aspen height (1996, 2000, 2013)

	Log (Total N)	Soil pH	Lodgepole Pine Density	Dist. To Prefire Aspen
1996	-	+		
2000		+		+
2013	+	+	-	+

Factors correlated with aspen basal diameter (1996, 2000, 2013)

	Log (Total N)	Soil pH	Lodgepole Pine Density	Dist. To Prefire Aspen
1996		+		-
2000		+		-
2013	+	+	-	

Lewis Canyon Aspen Seedling

Discussion

- Colonizing aspen are persisting.
  - **Could warming facilitate aspen range expansion?**
  - **Could reduced browsing allow aspen to grow to tree size?**
  - **Could lodgepole pine crowd aspen out?**

Aspen in Dense Lodgepole Pine

Future of Postfire Colonizing Aspen?

- Aspen re-sprout.
- **After subsequent fire, could aspen outcompete lodgepole pine?**
  - 2000 Boundary Fire re-burned post-1988 lodgepole stands.
  - Post-1988 aspen seedlings now two meters tall.
  - Lodgepole pine sparse.

Aspen Following the 2000 Boundary Fire

Literature Cited

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