Ecological effects of invasive plants on forest ecosystems

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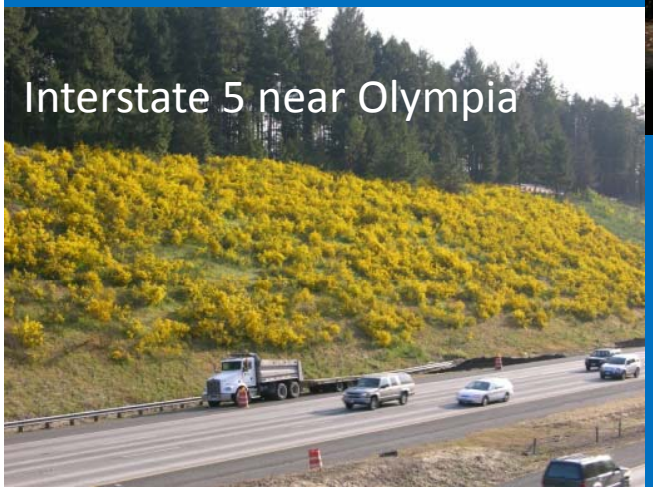
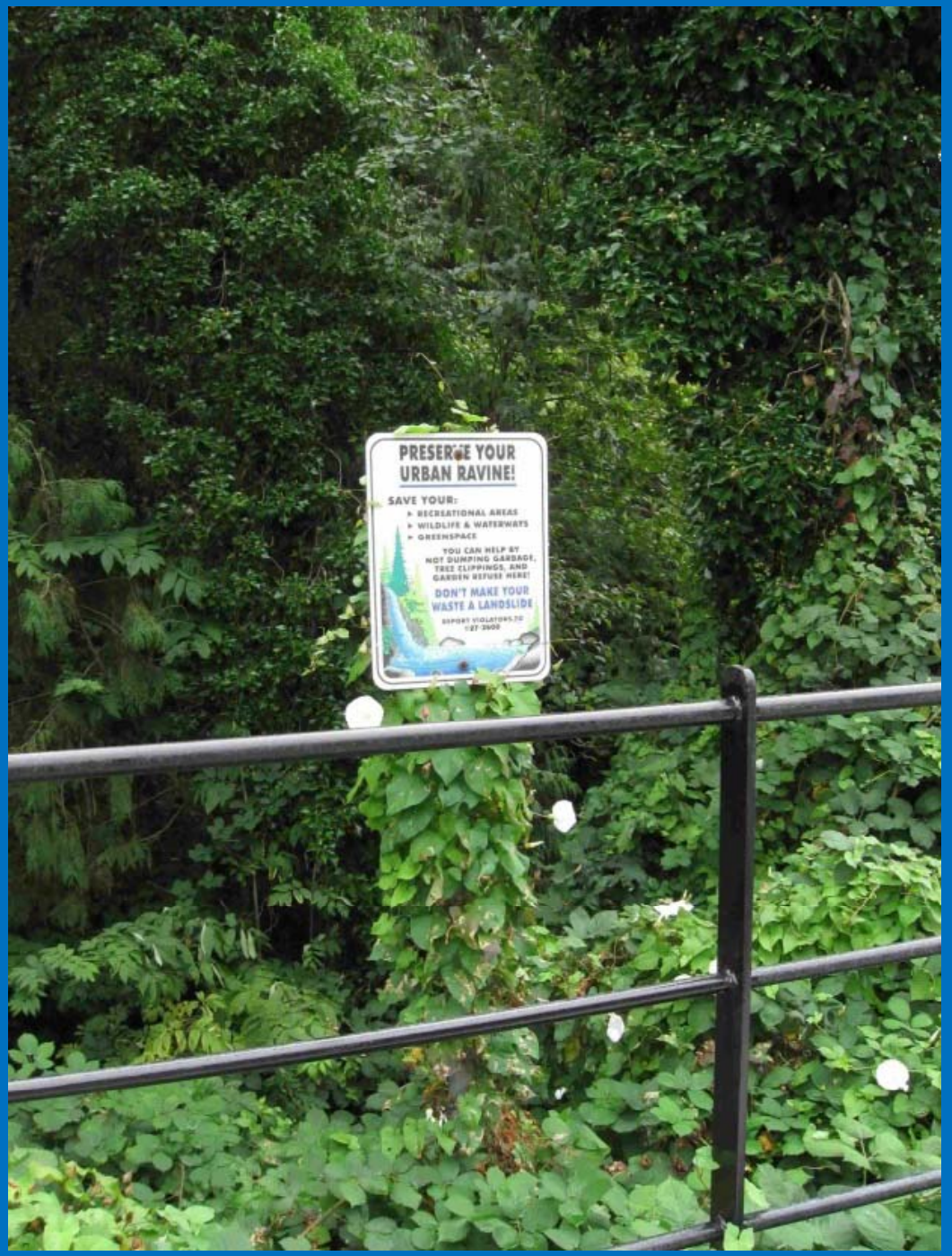
Reutebuch: Skagit River


Interstate 5 near Olympia


TNC: Giant knotweed

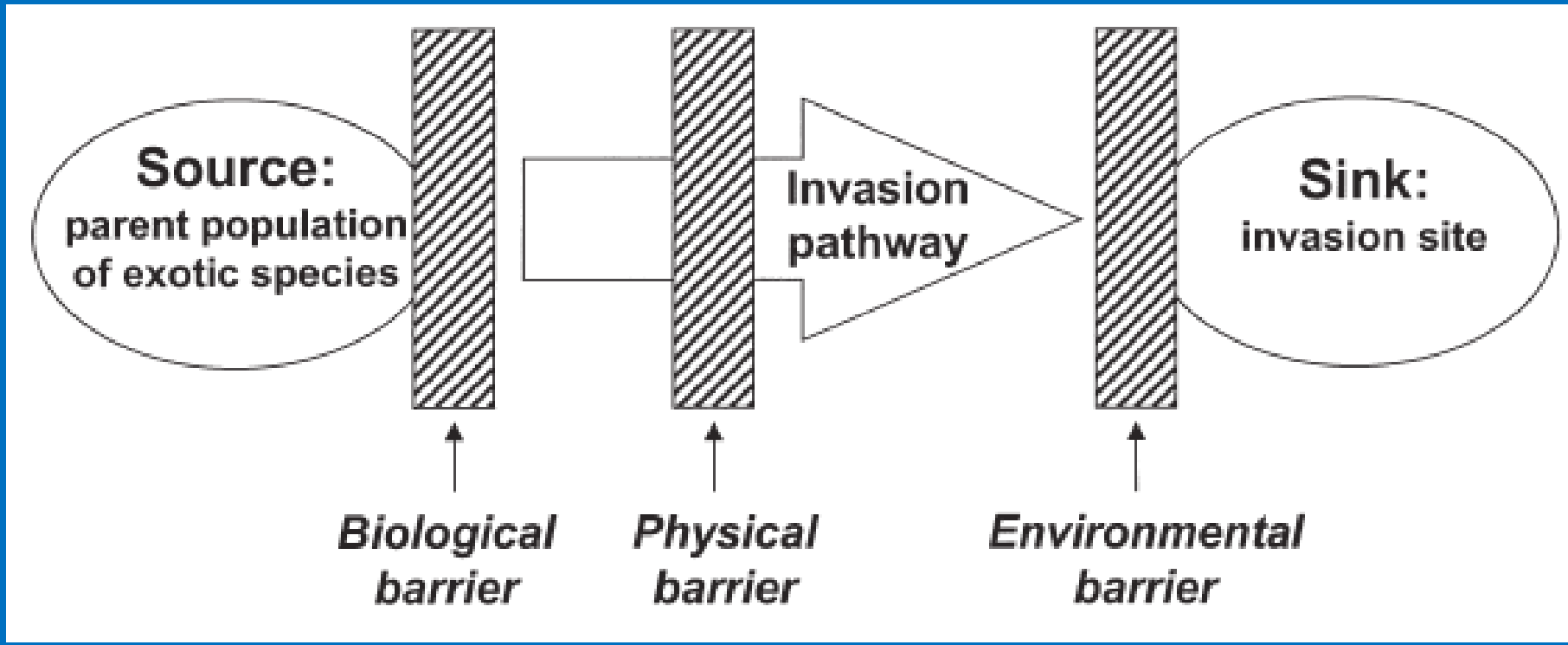
Topics

- Invasion vectors & facilitators
- Ecological changes
- Mitigation approaches



Invasion vectors & facilitators

Disturbance can overcome physical and environmental barriers to invasion



Parendes and Jones 2000

Wildfire

High-severity wildfires provide an important mechanism for continued spread of invasive plants in the West

- Create extensive openings
- Enable less competitive species to reproduce

Roads and streams

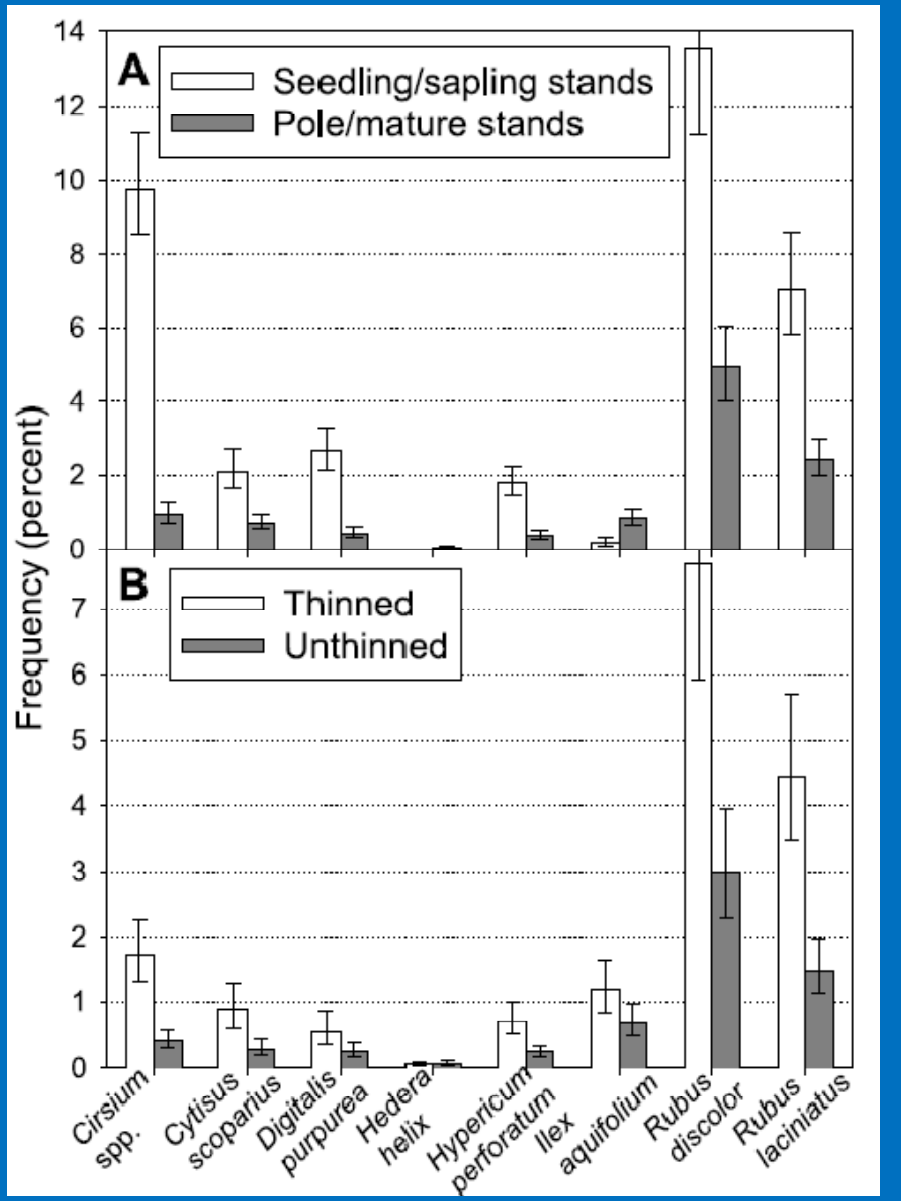
- Act as corridors for propagule transport, provide habitat, and provide reservoirs of propagules

- Exotic species most common in areas with high light and high road use

Parendes and Jones 2000

Forest management

- Frequency of invasive species increased with decreasing stand density from clearcutting or thinning (Gray 2005)
- Richness of invasive species was greatest in thinned stands (Bailey et al 1998)



Wind dispersal

- Halpern et al.: Forest seed banks of the Olympic Peninsula were dominated by non-native, wind-dispersed species

- *Senecio sylvaticus*:
  - found on virtually all PNW forest sites
  - population explodes 2 yr after forest harvesting, then declines

Halpern et al 1997, 1999

Wildland-urban interface

Discarded plant debris on public lands : a common source of invasive species

Ecological changes

James Dollins: kudzu, Savannah River Site

Fire frequency & behavior

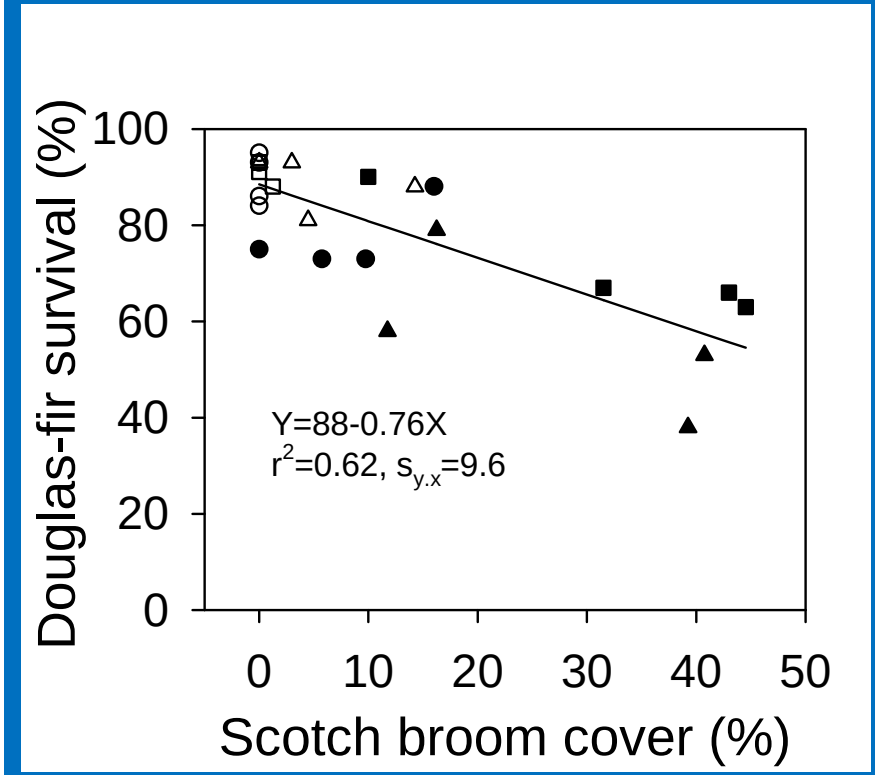
English ivy: ladder fuels
(nps.gov)

False brome: flashy fuels
(OSU Extension Service)

Shade-tolerant invasive species are changing the fuel structure of Douglas-fir forests

Competitive exclusion by Scotch broom

Douglas-fir mortality linked to soil water depletion by broom



Harrington & Schoenholtz 2010

Competitive exclusion by giant knotweed

Native species richness was negatively correlated with stem density of giant knotweed

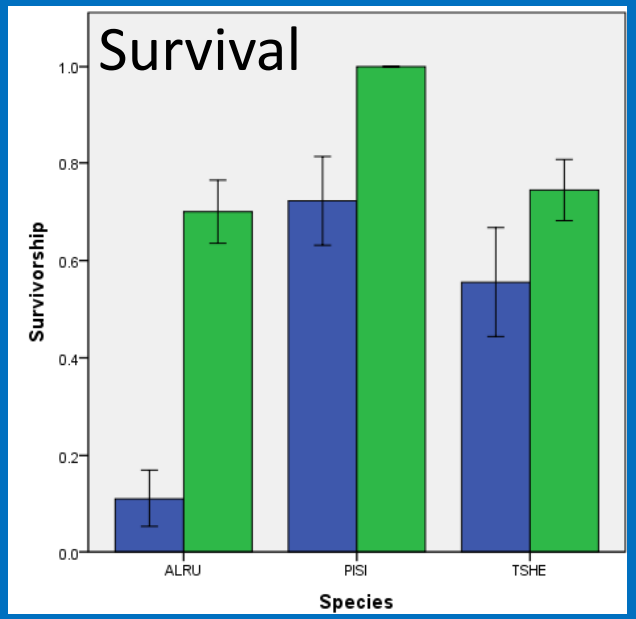
Urgenson et al. 2009

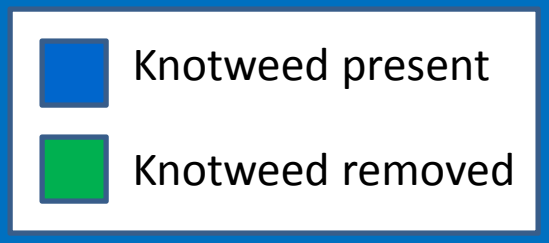
Competitive exclusion by Japanese knotweed

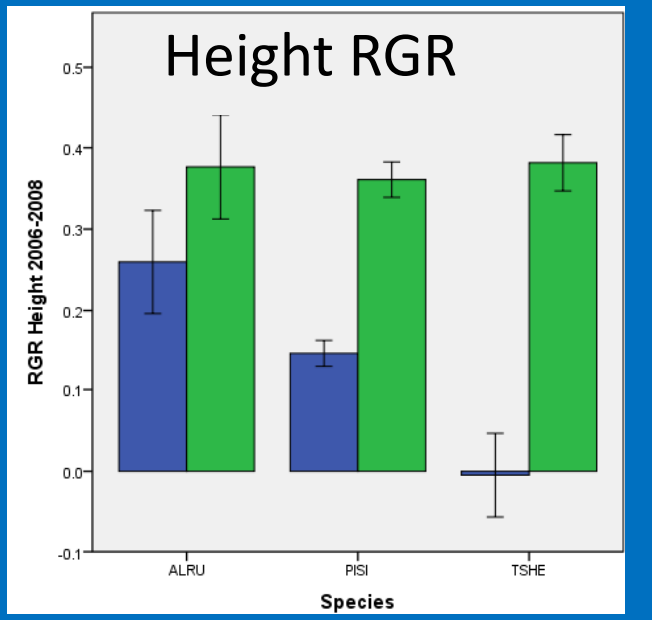
Two-year responses:

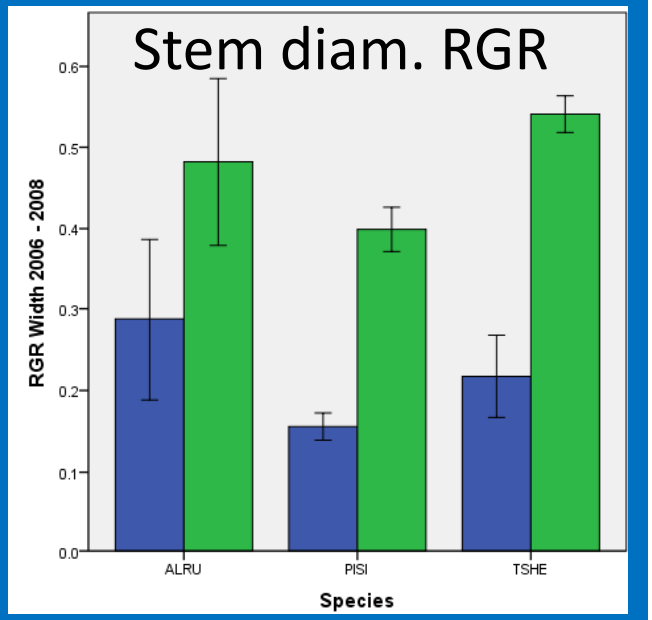
- ALRU: survival and growth↓
- PISI, TSHE: growth ↓

Shade tolerant species surviving … for now.









Urgenson, UW, in progress

Altered soil chemistry under Scotch broom

Favors broom regeneration over native species

Variable	Change
Total carbon	Increased
Total nitrogen	Increased
C:N	No change
Nitrification	Increased
N mineralization	Increased
Achillea biomass	Decreased

Haubensak & Parker 2004

Variable	Change
Total carbon	Increased
Total nitrogen	Increased
C:N	No change
Inorganic phosphorus	Decreased
C:P	Increased
pH	Decreased

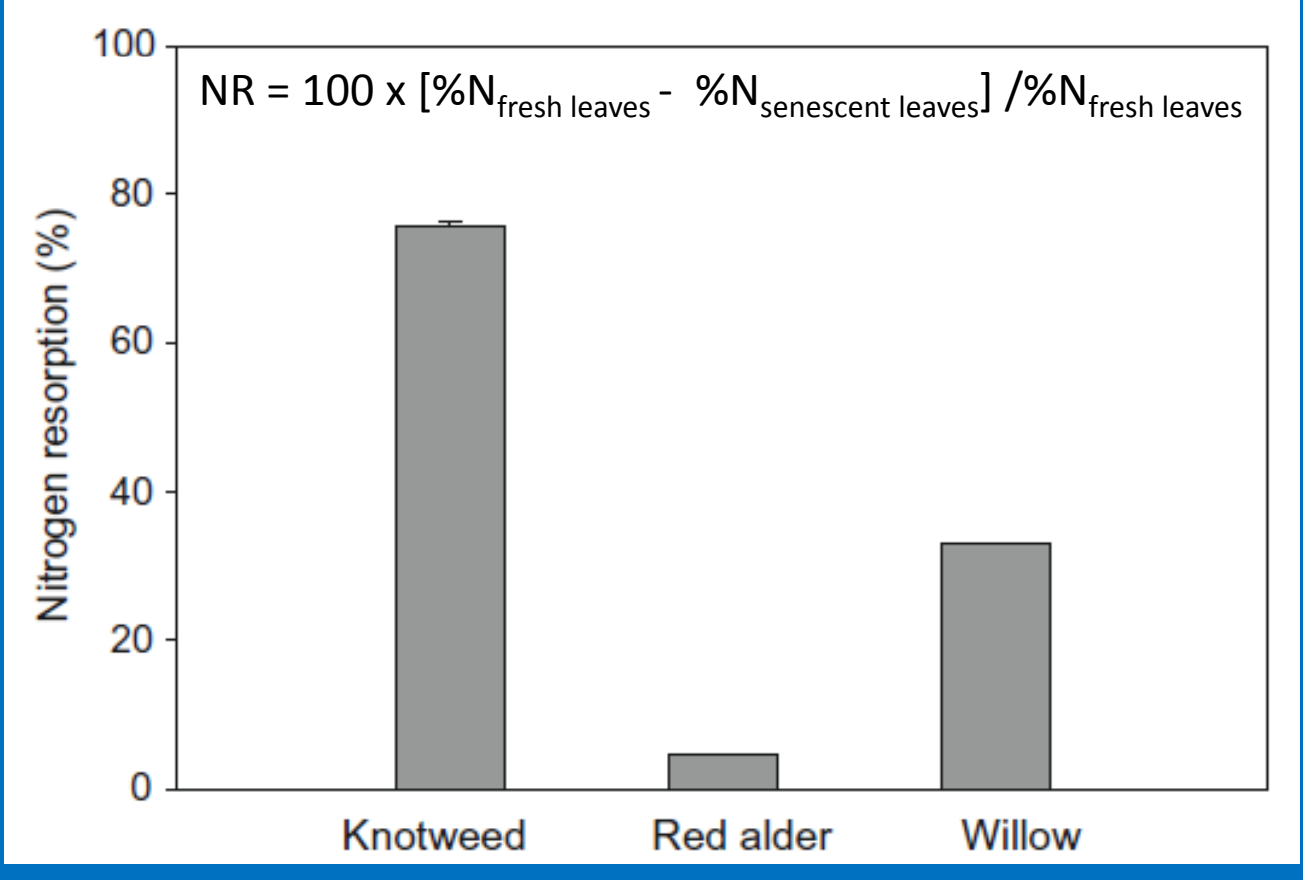
Caldwell 2006

Altered riparian chemistry under giant knotweed

Reduced input of native litter

\+ Higher nitrogen resorption by knotweed at senescence

= Poorer quality inputs for aquatic consumers

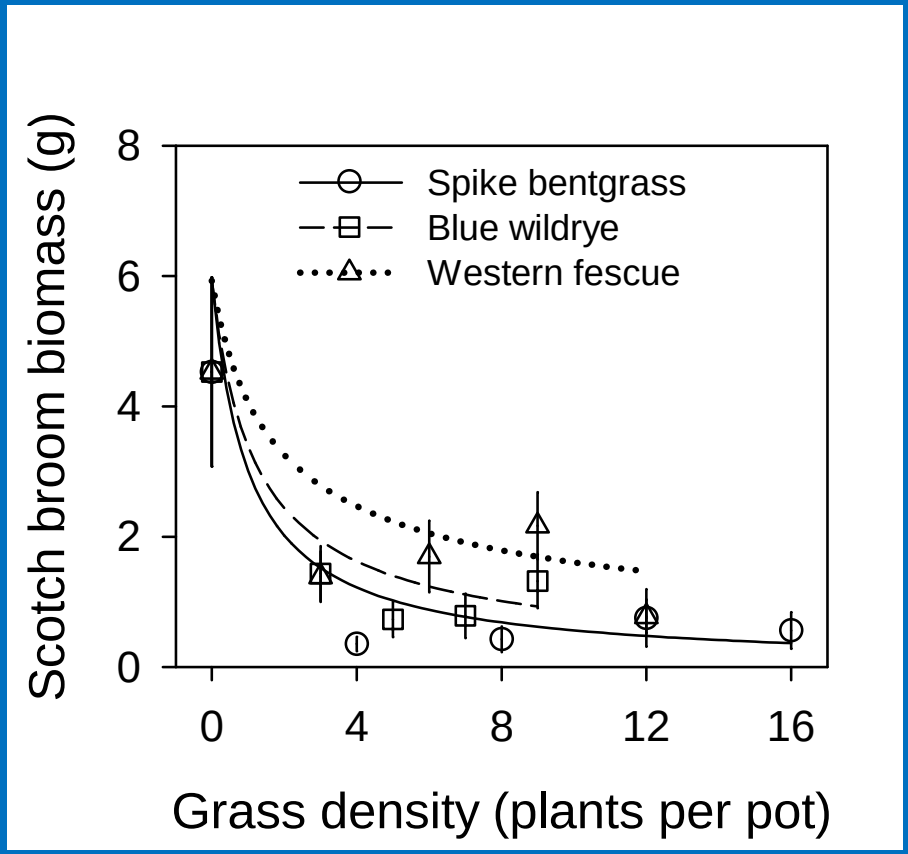


Urgenson et al. 2009

Mitigation approaches

Competitive exclusion

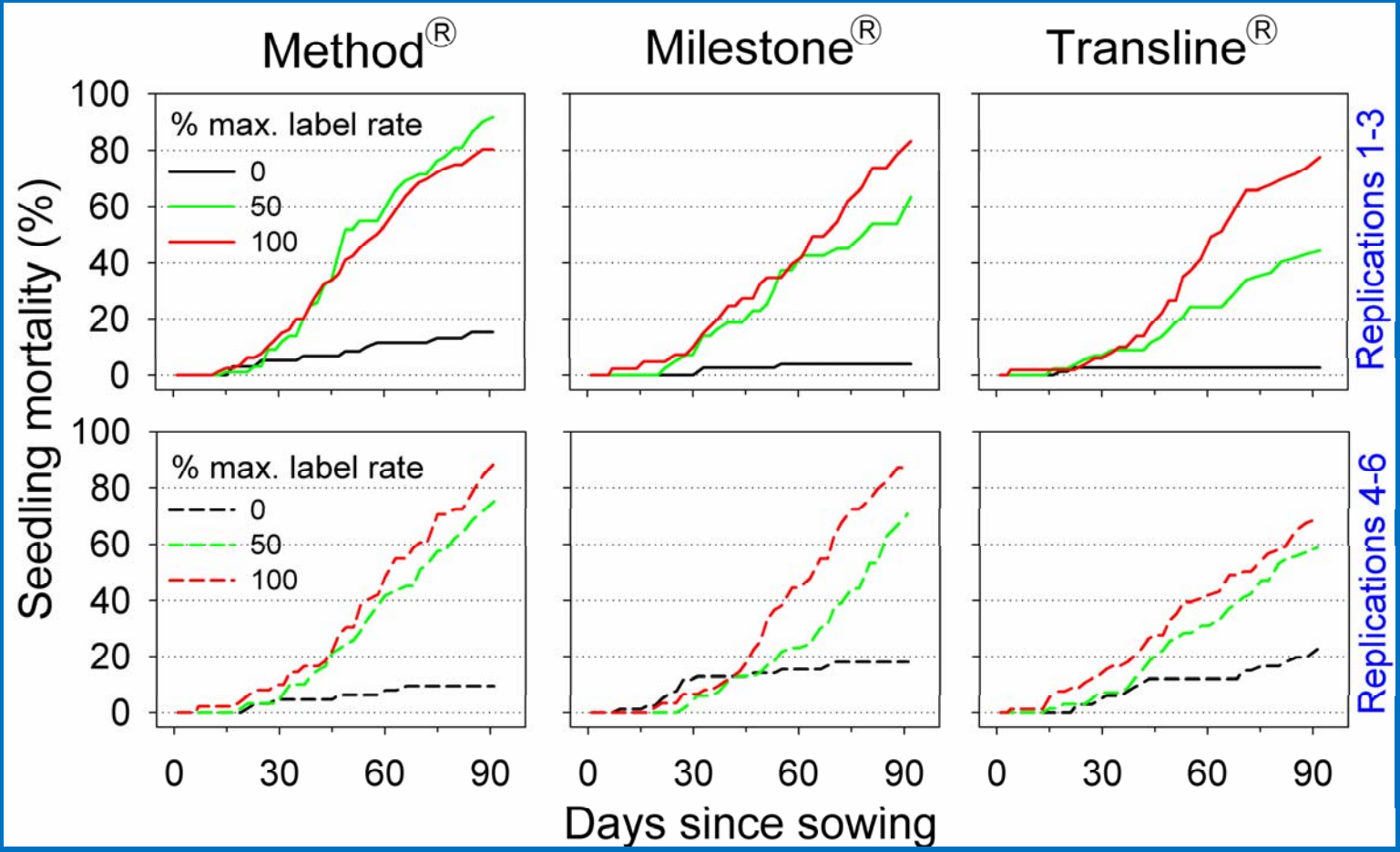
- Native grasses inhibited development of Scotch broom seedlings
- Prompt reforestation with site preparation, large stock, and close spacing



Harrington 2011

Promising herbicide treatments

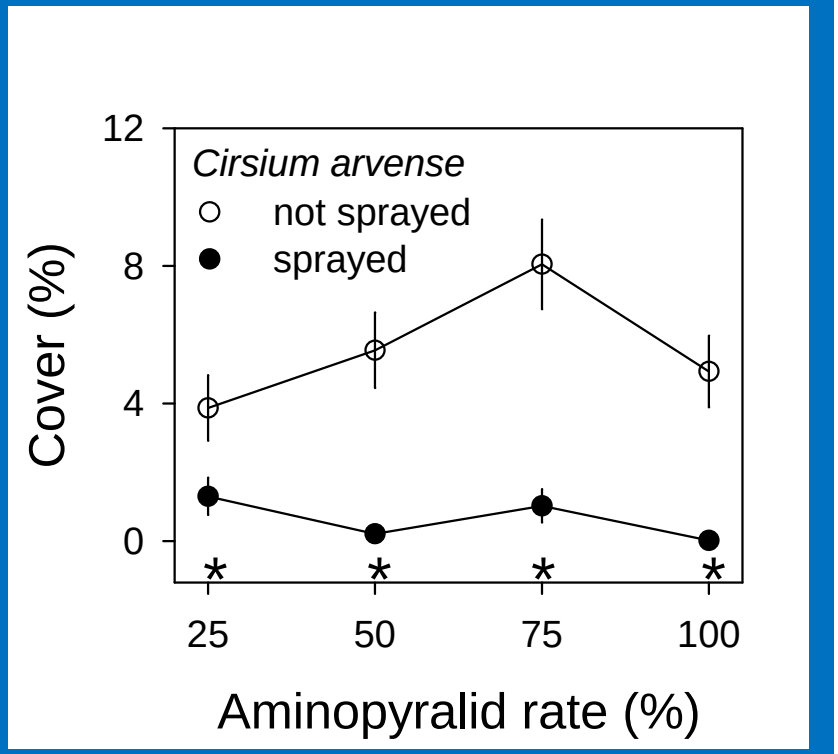
Newer herbicide treatments provide tools for controlling seedbank-origin Scotch broom

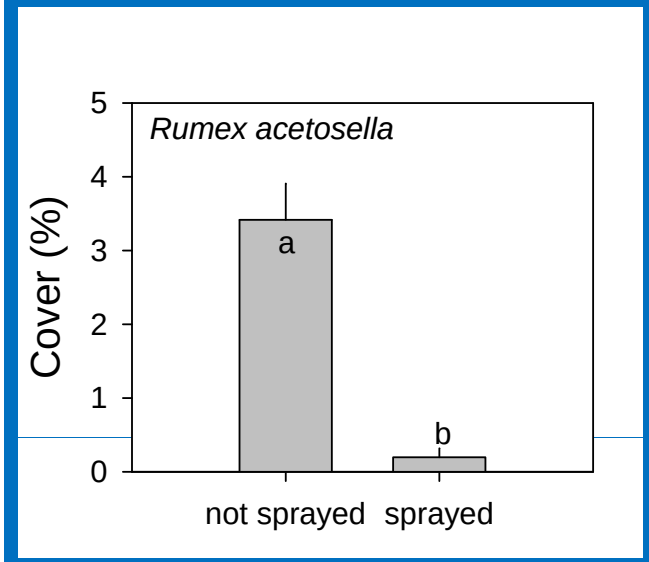


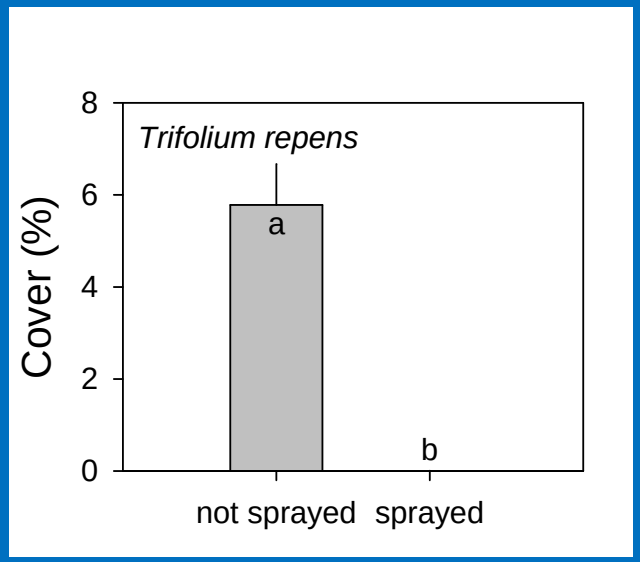
Harrington, WSWS 2011

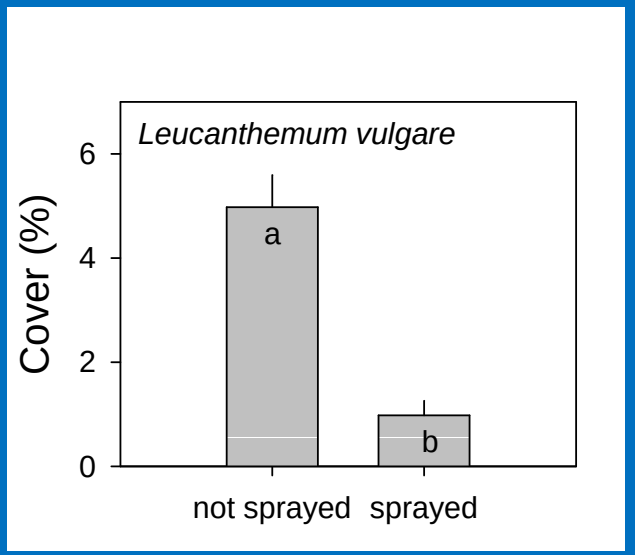
Promising herbicide treatments

Aminopyralid is effective on many broadleaf invasive species







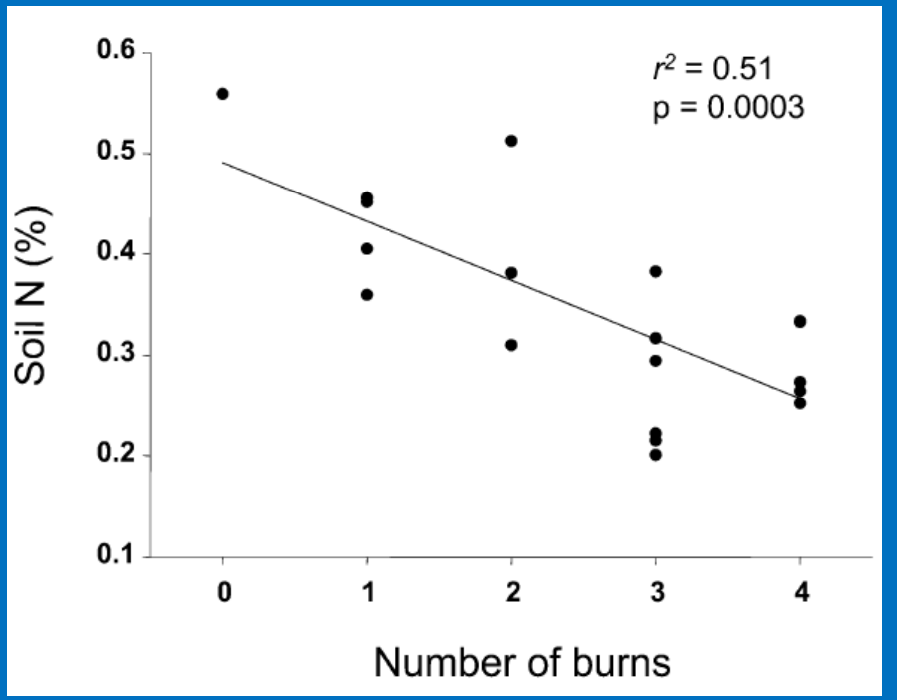


Harrington et al., WSWS 2011

Prescribed fire for prairie restoration

- Reduced number of Scotch broom germinants by 68%
- Repeated burning reduced soil N to pre-broom values

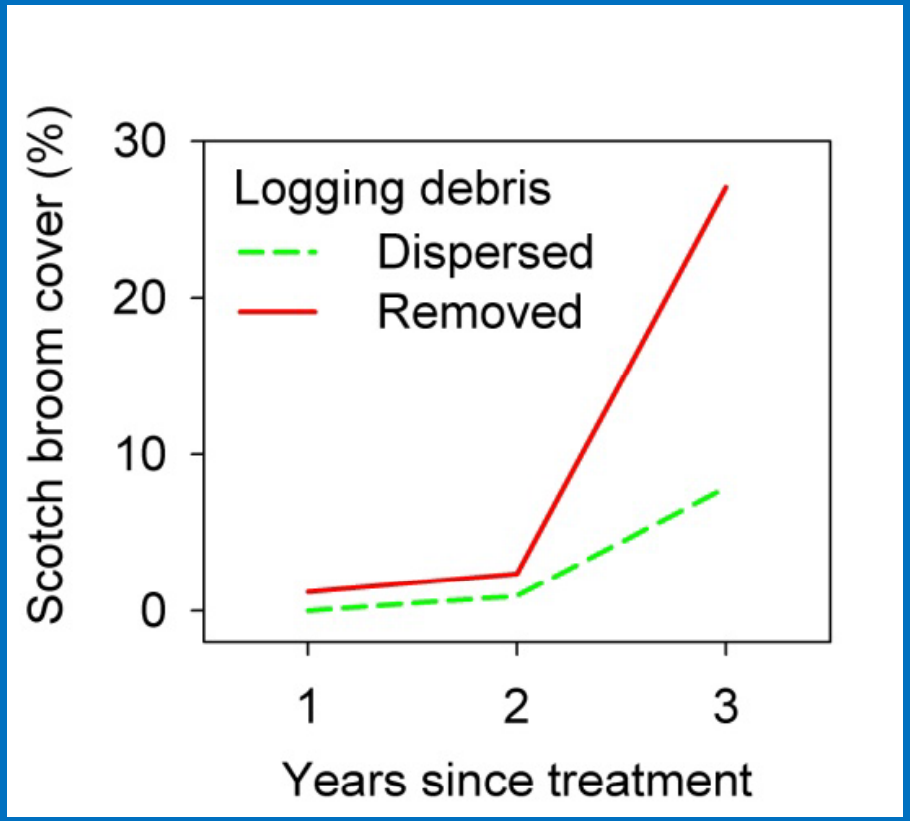

Dave Peter: Fort Lewis, 13th Division Prairie

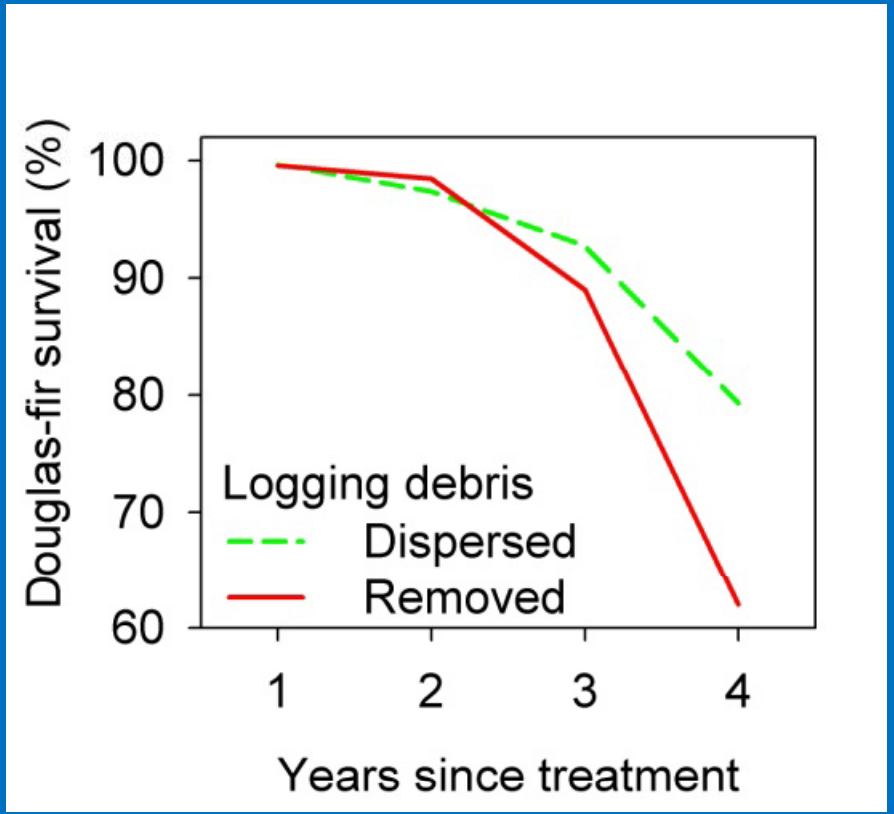


Haubensak et al. 2004

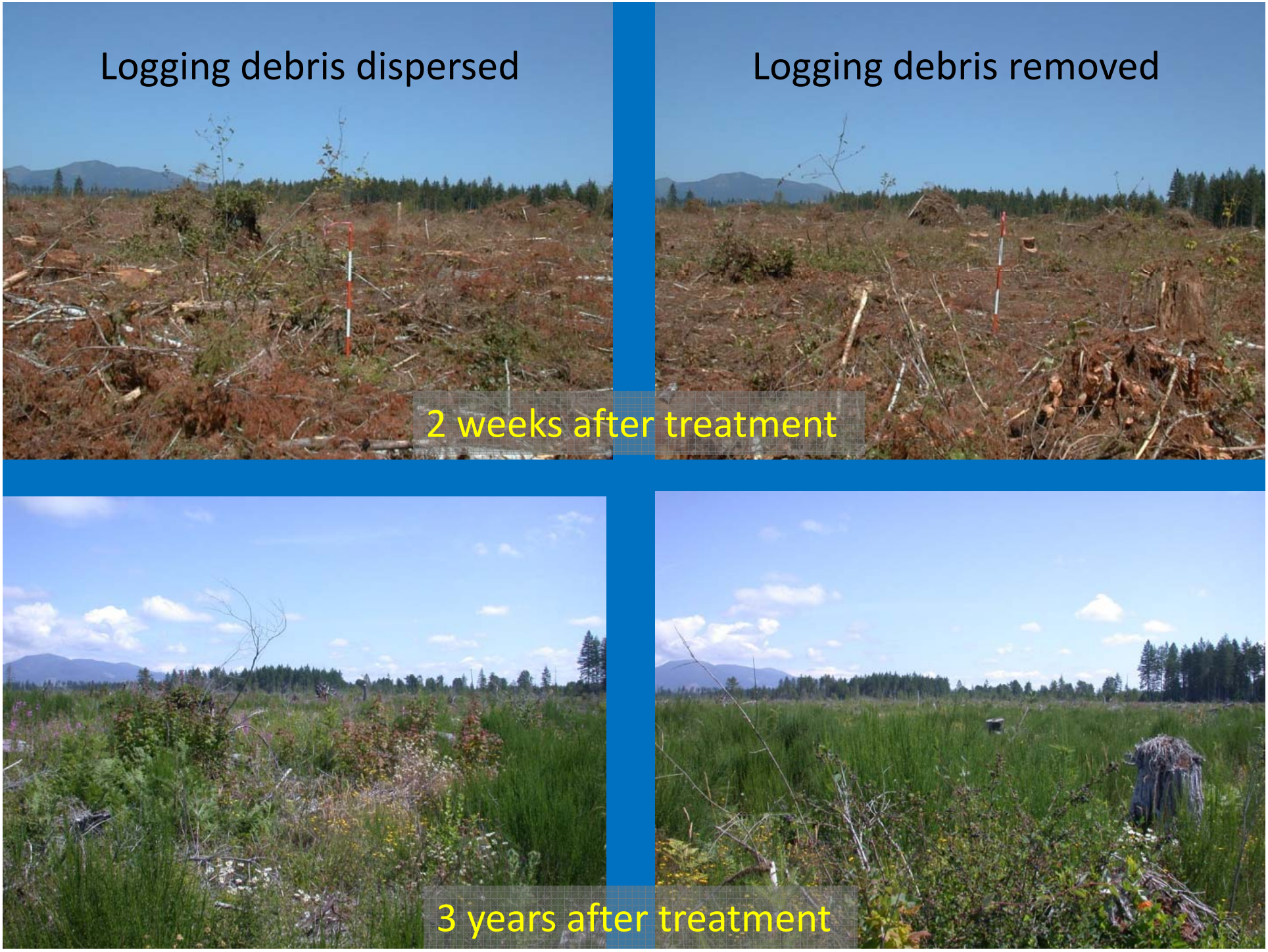
Prevention via forest debris

Debris reduced development of Scotch broom





Harrington & Schoenholtz 2010


Logging debris dispersed
Logging debris removed
2 weeks after treatment
3 years after treatment

Summary: effects

- Plant invasions are symptomatic of disturbance:
  - Wildfire
  - Corridors
  - Forest management
- Invasive plants:
  - Alter fuel regimes
  - Exclude native plants
  - Change soil chemistry
- Impacts to forest ecosystems:
  - Reduced biodiversity
  - Reduced productivity
  - Reduced resilience

Summary: mitigation approaches

- Manage forest disturbances wisely:
  - Treat plant invasions when they are small
  - Use best forestry technology: targeted herbicide treatments, large planting stock, close spacing
  - Limit invasion opportunities: avoid exposed soils, open canopies
- Exploit species' weaknesses:
  - Germination requirements
  - Seedling susceptibility
- Establish quarantine reaches and buffers to protect sensitive areas

Mike Newton


Questions?