IMPACT OF INVASIVE PLANTS ON RANGELAND AND GRASSLAND ECOSYSTEMS

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IMPACTS ON HUMAN ACTIVITIES

- Lower livestock forage quality and quantity
- Physically interfere with grazing
- Compromise livestock, horse or human health
- Increase cost of managing and producing livestock
  - slow animal weight gain
  - reducing the quality of meat, milk, wool, and hides
- Impede recreation activities
- Reducing land value
ECONOMIC IMPACTS

- Noxious weeds cause more economic loss in rangeland than all other pests combined.
- Estimated impact of rangeland weeds to be at least $2 billion annually.
- Direct and indirect losses due to poisoning of cattle and sheep estimated at $340 million 20 years ago.
IMPACTS ON BIOTIC ASPECTS OF NATURAL ECOSYSTEMS

- Reduce wildlife forage
- Alter wildlife habitat
- Lower plant and animal diversity
  - natives or endangered species
In spotted knapweed-infested range, Rocky Mountain elk use reduced by 98% compared with bunchgrass-dominated sites. Elk use increased 266% with removal of invasive.

Areas dominated by leafy spurge had between 70 and 83% less forage value for bison and deer in Theodore Roosevelt National Park in North Dakota.

Leafy spurge infestations reduced most native species and decreased species richness by 75%.

Number of plant species present in California rangelands increased 35% following biological control of klamathweed.

In Montana, spotted knapweed reduced germination and establishment of the rare endemic *Arabis fecunda* and in North Dakota leafy spurge has threatened the endangered prairie fringed orchid.
Impacts of increase in rodent populations on Saguaro cactus due to buffelgrass *(Pennisetum ciliare)*
Non-native species that overcomes survival and reproductive barriers within an environment and can survive without human intervention for an extended period (>25 years). Species known as waifs are similar but do not persist for an extended time.

From Richardson et al. 2000. Diversity and Distributions, 6:93-107
Non-native naturalized species that enters, overcome environmental barriers, and spreads into ecosystems outside its native range to become a substantive member of the new community. Most invasive species are not considered significant ecological threats.
A subset of invasive species (perhaps 10%) that change the biotic or abiotic character, condition, form or nature of a natural ecosystem over a substantial area. These species are considered significant ecological threats.
Excessive users of resources
- light
- water
- CO₂ and O₂

Donors of limited resources
- nitrogen

Fire promoters and suppressors

Sand stabilizers

Erosion promoters

Colonizers of intertidal mudflats/sediment stabilizers

Litter accumulators

Salt or heavy metal accumulators

From Richardson et al. 2000. Diversity and Distributions, 6:93-107
LANDSCAPE TRANSFORMERS

- Excessive users of resources
  - light
  - water
  - CO₂ and O₂
- Donors of limited resources
  - nitrogen
- Fire promoters and suppressors
- Sand stabilizers
- Erosion promoters
- Colonizers of intertidal mudflats/sediment stabilizers
- Litter accumulators
- Salt or heavy metal accumulators

From Richardson et al. 2000. Diversity and Distributions, 6:93-107
Invasive Transformers

- Excessive users of resources
  - Light

Kudzu
Leafy spurge
*(Euphorbia esula)*
Excessive users of resources

- Water

A large tree can absorb 760 L of water a day.
Yellow starthistle
*(Centaurea solstitialis)*
DONORS OF LIMITED RESOURCES

- Nitrogen

INVASIVE TRANSFORMERS

Scotch broom
Scotch broom
(*Cytisus scoparius*)
INVASIVE TRANSFORMERS

Fire promoters or suppressors

- Suppressors
- Promoters
**THE CHEATGRASS (DOWNY BROME) STORY**

- **Impacts on fire regime**
  - Historically community composed of bunchgrasses interspersed with long-lived perennial shrubs
  - Historic fire regimes infrequent (>50 yrs) or non-existent because of insufficient biomass to carry the fires from shrub to shrub
  - With invasion, yearly fine fuel accumulation was far greater than shrub/perennial grass communities
  - Biomass accumulates over several years under arid conditions inhibiting rapid decomposition
  - Dry fuels extended fire season by one to three months
  - End result, cheatgrass fires became common, occurring at <5 yrs intervals
THE CHEATGRASS (DOWNY BROME) STORY

- **Impacts on vegetation change**
  - Native vegetation susceptible to changes in vegetation composition after a burn
  - Cheatgrass quickly filled an unoccupied resource niche following fire
  - Most native perennials unable to re-establish in cheatgrass dominated sites
  - Native perennial shrubs (e.g., big sagebrush and shadscale) are non-sprouting following fire and revegetate only through seeds. Short interval fires excludes these common shrubs of the Great Basin
  - End effect is native vegetation replaced with pure patches of cheatgrass or swaths of cheatgrass and short-lived perennial shrubs
Impacts on livestock, wildlife and economy

- Undependability of cheatgrass as a source of forage for cattle and sheep
- Reduction in native shrubs important for wildlife habitat
  - Sagebrush is the main food or shelter for 170 native bird and mammal species, including sage grouse, pygmy rabbits and pronghorn antelope.
  - Drop in rabbit population has secondary impact on birds of prey (e.g., bald and golden eagles) that utilized rabbits as food
Fires in the West

- The largest blaze in Utah history in 2007 burned the 363,000 acres. Murphy Complex fires in Idaho and Nevada burned 653,000 acres, largest burn in Idaho in 97 years.
- In Nevada, 6 million acres of sagebrush have burned since 1999.
- 397 large wildfires in Great Basin from 1995 to 2007
- BLM and USFS wildfire suppression costs exceed $1 billion/yr in 4 of 7 years from 1999 to 2006
- Suppression costs taking increasingly larger shares of agency budgets - less remains for treatment
Downy brome (cheatgrass) 
(*Bromus tectorum*)
Medusahead
(*Taeniatherum caput-medusae*)
Barb goatgrass
(*Aegilops triuncialis*)
In Hawaii, invasion of perennial grasses provides abundant fuel and increases fire frequency. This leads to dominance by more fire-tolerant non-native species.

Buffelgrass (*Pennisetum ciliare*)

Crimson fountaingrass (*Pennisetum setaceum*)
INVASIVE TRANSFORMERS

- Erosion promoters
Scotch thistle
*(Onopordum acanthium)*

Musk thistle
*(Carduus nutans)*
Spotted knapweed
(Centaurea maculosa)

Diffuse knapweed
(Centaurea diffusa)

Squarrose knapweed
(Centaurea squarrosa)

Surface water runoff increased 56%, stream sediment yields were 192% higher, and water infiltration rates were reduced in a spotted knapweed dominated site compared with adjacent native perennial grassland.
INVASIVE TRANSFORMERS

- Litter accumulators
Perennial pepperweed
(*Lepidium latifolium*)
Control of perennial pepperweed with herbicide
Winter grazing, or trampling
The Influence of Site Preparation Treatments and Herbicides on Perennial Grass Establishment in June 2006 (15 months after 2\textsuperscript{nd} seeding)

- Tillage + Roundup or 2,4-D
- Grazing + Roundup or 2,4-D
- Mowing + Fall Roundup or 2,4-D
- Burn + Roundup or 2,4-D
- Roundup or 2,4-D
- Tillage + 2,4-D
- Grazing + 2,4-D
- Mowing + Fall 2,4-D
- Burn + 2,4-D
- 2,4-D
- Tillage + Telar
- Grazing + Telar
- Mowing + Fall Telar
- Burn + Telar
- Telar
- Tillage
- Grazing
- Mowing
- Burn
- Untreated

Error bars = 95 % confidence interval

Wilson, Boelk, Kyser, and DiTomaso. Invasive Plant Science and Management 1, 17
Burn + 2,4-D + Reseeding
(4 years after treatment initiation)
Invasive Transformers

- Salt or metal accumulators/redistributors
  - Salt
  - Metals
- Tolerate soil salt concentrations from 650 to 36,000 ppm (avg. 6,000 to 8,000 ppm)
- Salt gland exudate up to 41,000 ppm in the guttation sap
- Salts deposited on the soil surface under the plant
- Cottonwood and willow inhibited by salinity >1,500 ppm
Perennial pepperweed
(*Lepidium latifolium*)
Perennial pepperweed: Salt accumulator

From Bob Blank, USDA-ARS, Reno
Halogeton [also called saltlover]  
(*Halogeton glomeratus*)
Russian knapweed
*(Acroptilon repens)*
CONCLUSION

- Impacts of invasive plants in rangelands and grasslands are substantial both economically and ecologically
- Species of primary concern are those invasives that are capable of transforming the landscape
- Management and restoration efforts need to consider the processes by which invasive plants transform landscapes and strive to develop communities resilient to invasion and change