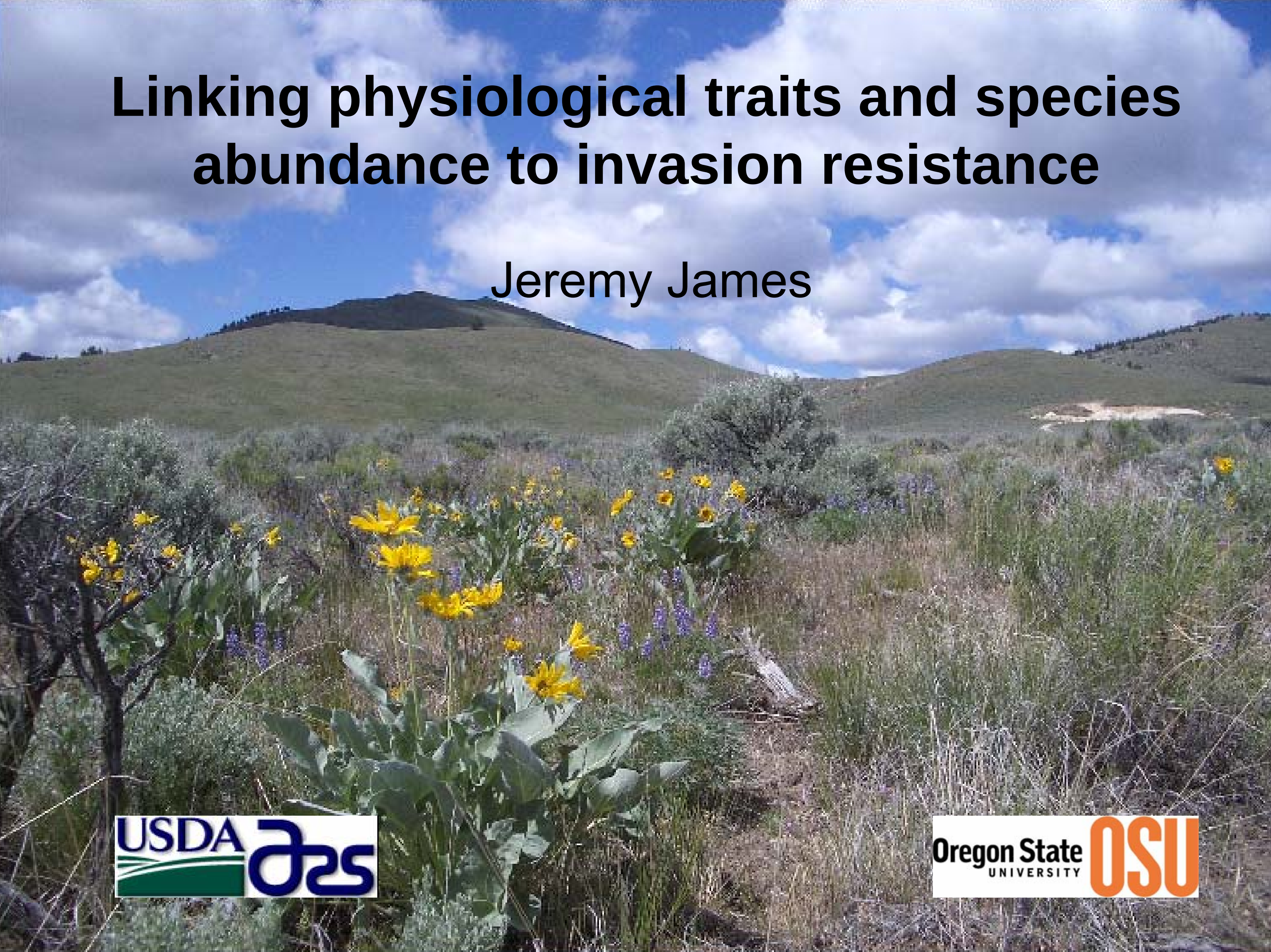

Linking physiological traits and species abundance to invasion resistance

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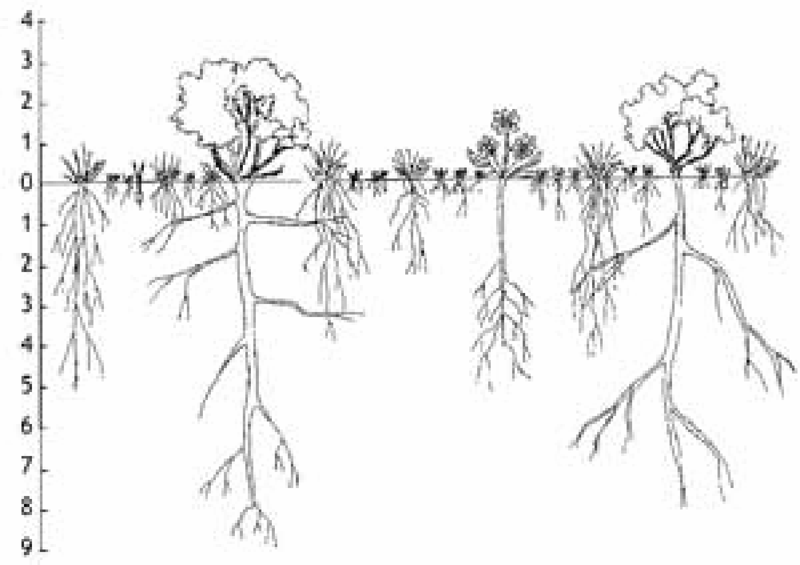
Framework

- Plant community composition influences ecosystem properties
- Much emphasis on effects of functional group diversity on ecosystem properties
- Invasive plant management can be improved by managing plant communities based on functional traits as opposed to functional groups

Outline

- An example of how functional traits influence ecosystem properties (N capture and invasion)
  - Traits related to N capture
  - Trait effects on ecosystems are moderated by species abundance
- What traits might be important to consider when revegetating areas prone to weed invasion?
  - At the seedling stage traits affecting initial growth rate important
- Conclusions and future directions

Functional group diversity, nitrogen capture and invasion resistance



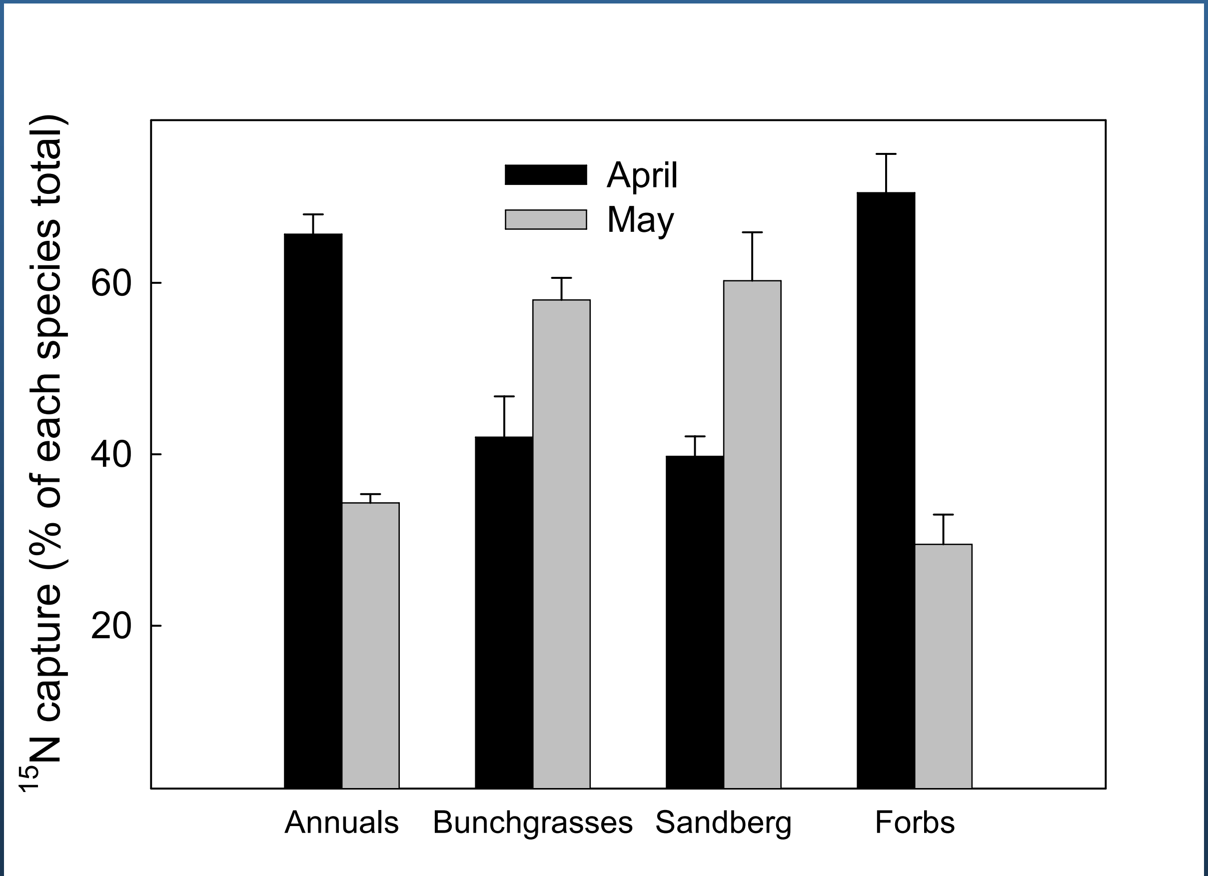
Study site

Group	Code	Common Name	Scientific Name
Annual	BRTE	cheatgrass	*Bromus tectorum* L.
Annual	TACA	medusahead	*Taeniatherum caput-medusae* (L.) Nevski
Bunchgrass	PSSP	bluebunch wheatgrass	*Pseudoroegneria spicata* (Pursh) A. Löve
Bunchgrass	ELEL	bottlebrush squirreltail	*Elymus elymoides* (Raf.) Swezey
Bunchgrass	POSE	Sandberg's bluegrass	*Poa secunda* J. Presl
Forb	LOTR	nineleaf biscuitroot	*Lomatium triternatum* (Pursh) Coult. & Rose
Forb	CRIN	grey hawksbeard	*Crepis intermedia* Gray

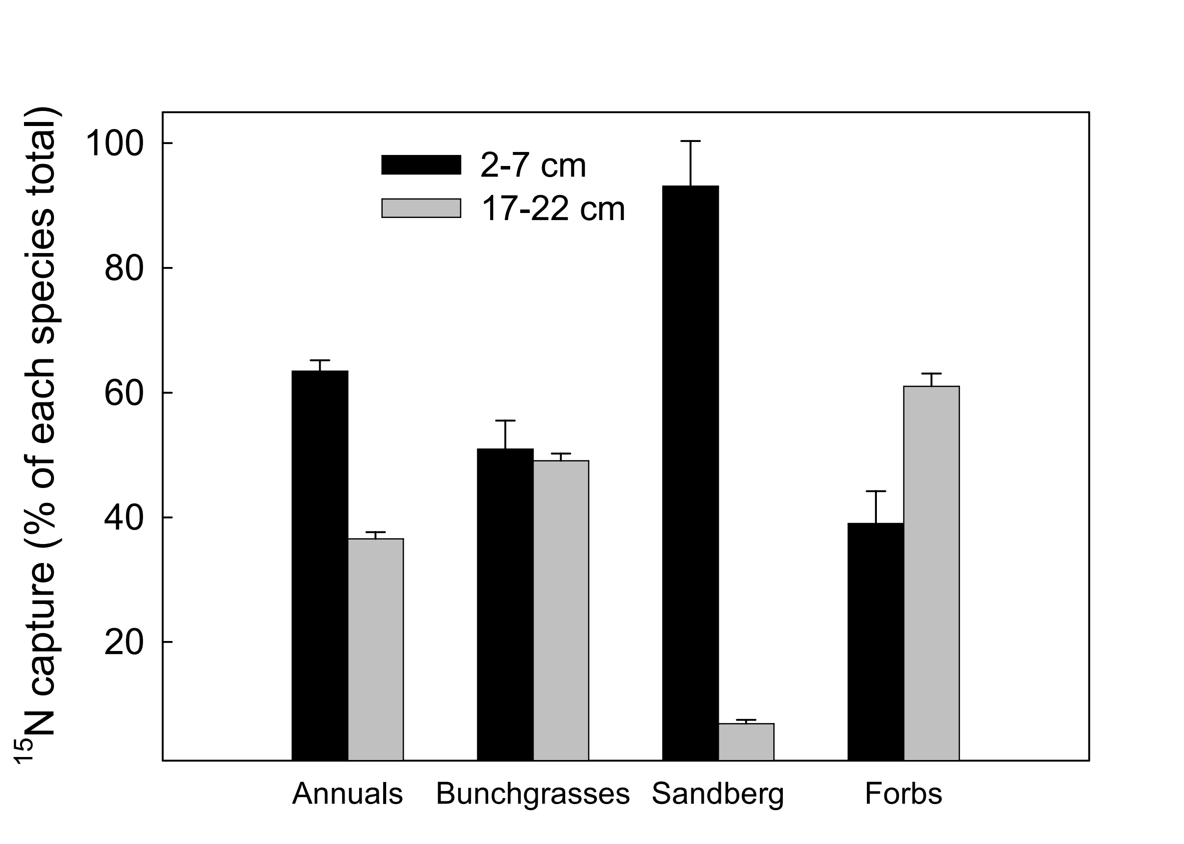
Experimental design

- ^{15}N was injected into soils around 7 study species
- Injections were made:
  - 3 times during the growing season (April, May June)
  - At 2 soil depth (2-7 cm, 17-22 cm)
  - Using 2 forms of N (NH_4^+, NO_3^-)
- Removal plots
  - Medusahead establishment in plots where different functional groups removed

N partitioning through time



N partitioning by soil depth

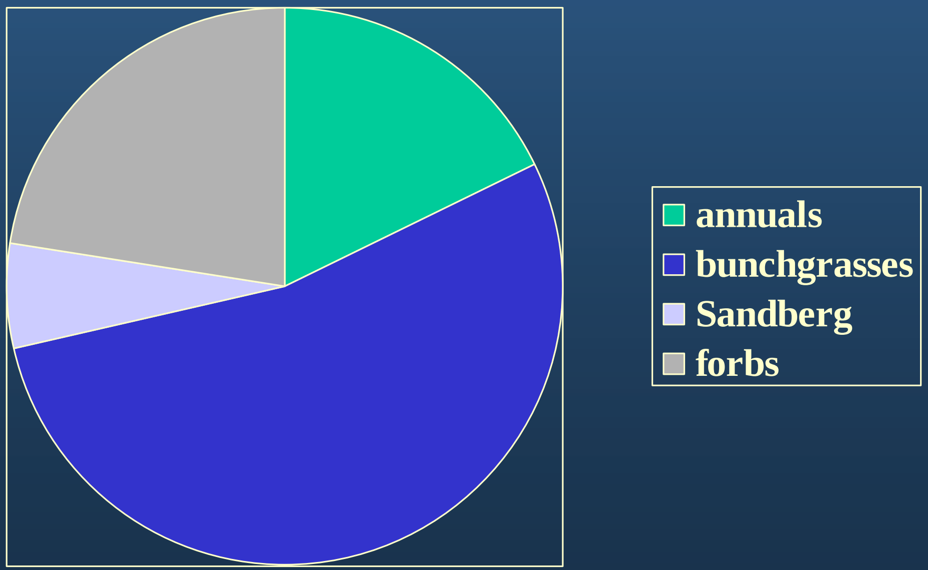


Integrating N uptake patterns and species abundance

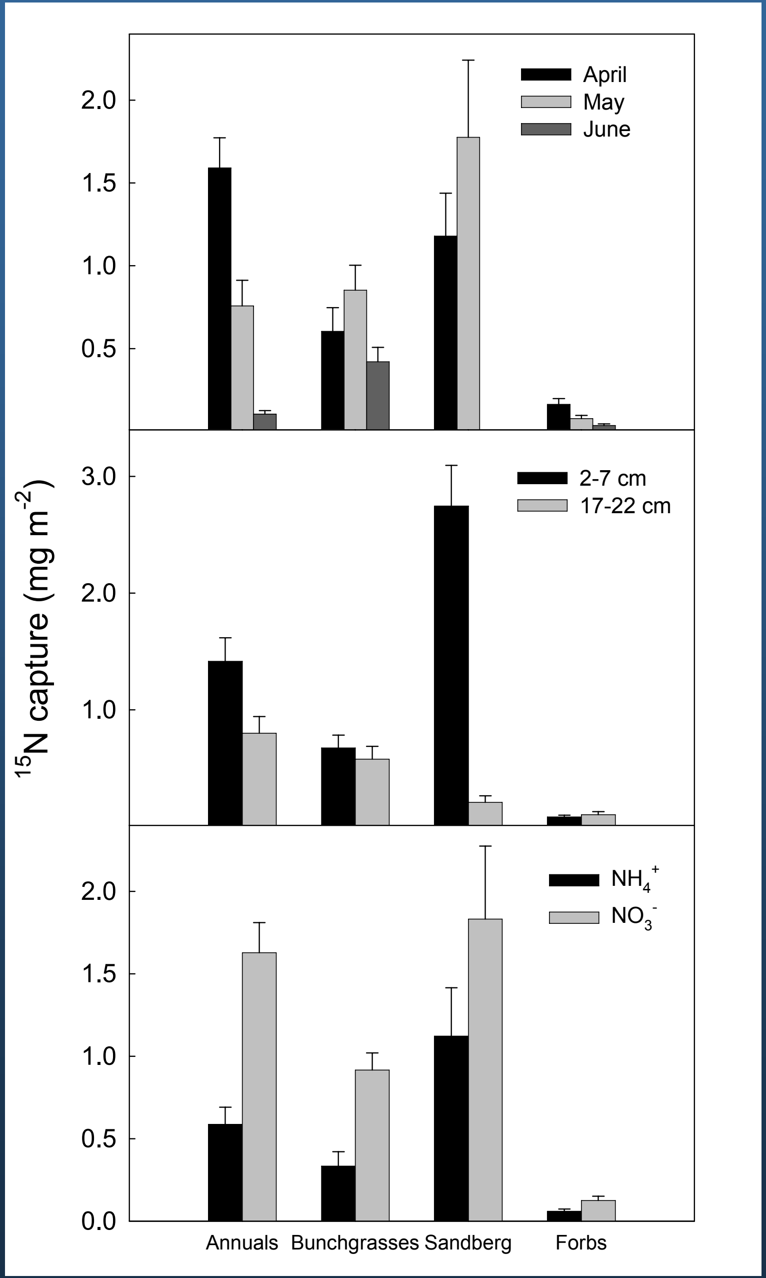
Influence on ecosystem = trait × abundance

Portion of community biomass

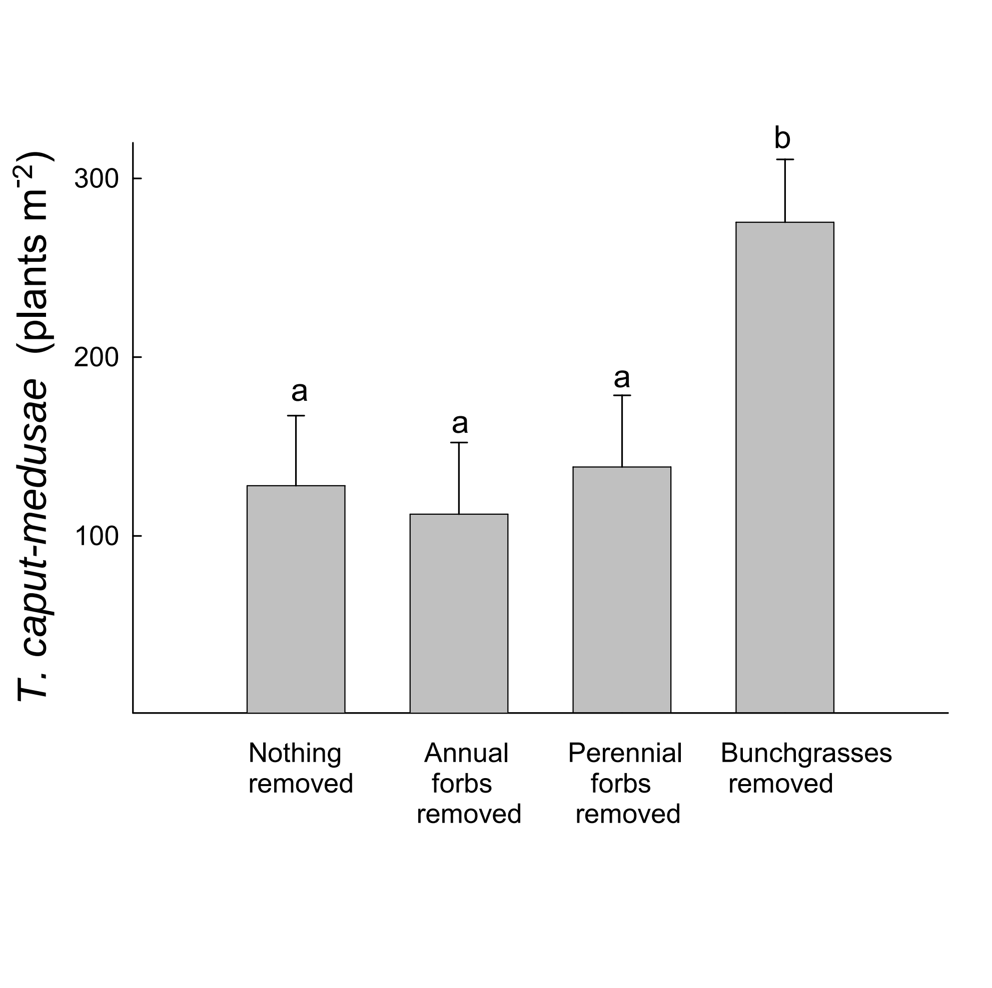
Nitrogen uptake ×



Total N capture



Removal plots



A trait based approach for managing invasives

- Conventional groupings encompass a wide range of trait differences
- Different traits likely influence different ecosystem properties
- Effective invasive plant management requires an understanding of traits allowing invaders to outperform natives

Trait variation of desirable species

- Do you want to:
  - maximize trait variation
  - maximize a trait

What traits should be considered?

- Relative growth rate (RGR) is a key trait to consider
- Invasives often have a higher RGR
- Seed → seedling stage
  - Plant size
  - Resource capture
- Influences competitive interactions and survival

Native grass

Invasive grass

Components of RGR

- RGR (mg g^{-1} d^{-1}) has two components
  - Leaf area ratio (LAR, m^2 kg^{-1}), the amount of leaf area per unit total plant mass

  - Net assimilation rate (NAR, g m^{-2} d^{-1}), the rate of dry mass gain per unit leaf area

RGR (mg g^{-1} d^{-1}) = LAR (m^2 kg^{-1}) x NAR (g m^{-2} d^{-1})

Decomposition of LAR

Leaf area ratio (LAR, $m^2\ kg^{-1}$), the amount of leaf area per unit total plant mass, can increase by:

1. Adding more leaf biomass
   - Leaf mass ratio (LMR) amount of leaf mass per unit plant mass
2. Making more leaf area per unit biomass
   - Specific leaf area (SLA) amount of leaf area per unit leaf mass

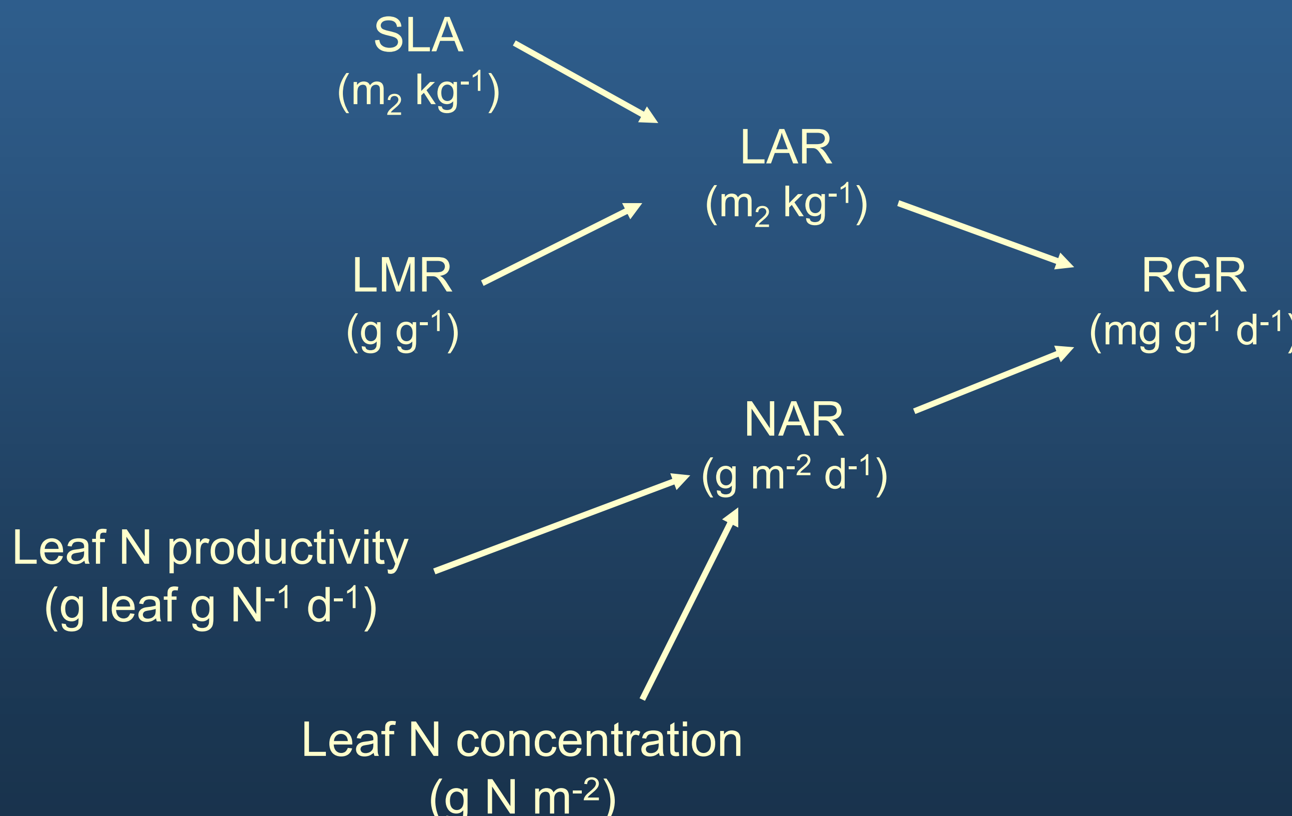
LAR = SLA x LMR

Decomposition of NAR

- NAR (g m^2 d^{-1}) rate of dry mass gain per unit leaf area

- Is the net balance of:
  - Photosynthetic carbon gain per unit leaf area minus carbon loss through respiration
  - Influenced by how efficiently plants use nitrogen (leaf N productivity) and how much N is allocated to leaves.

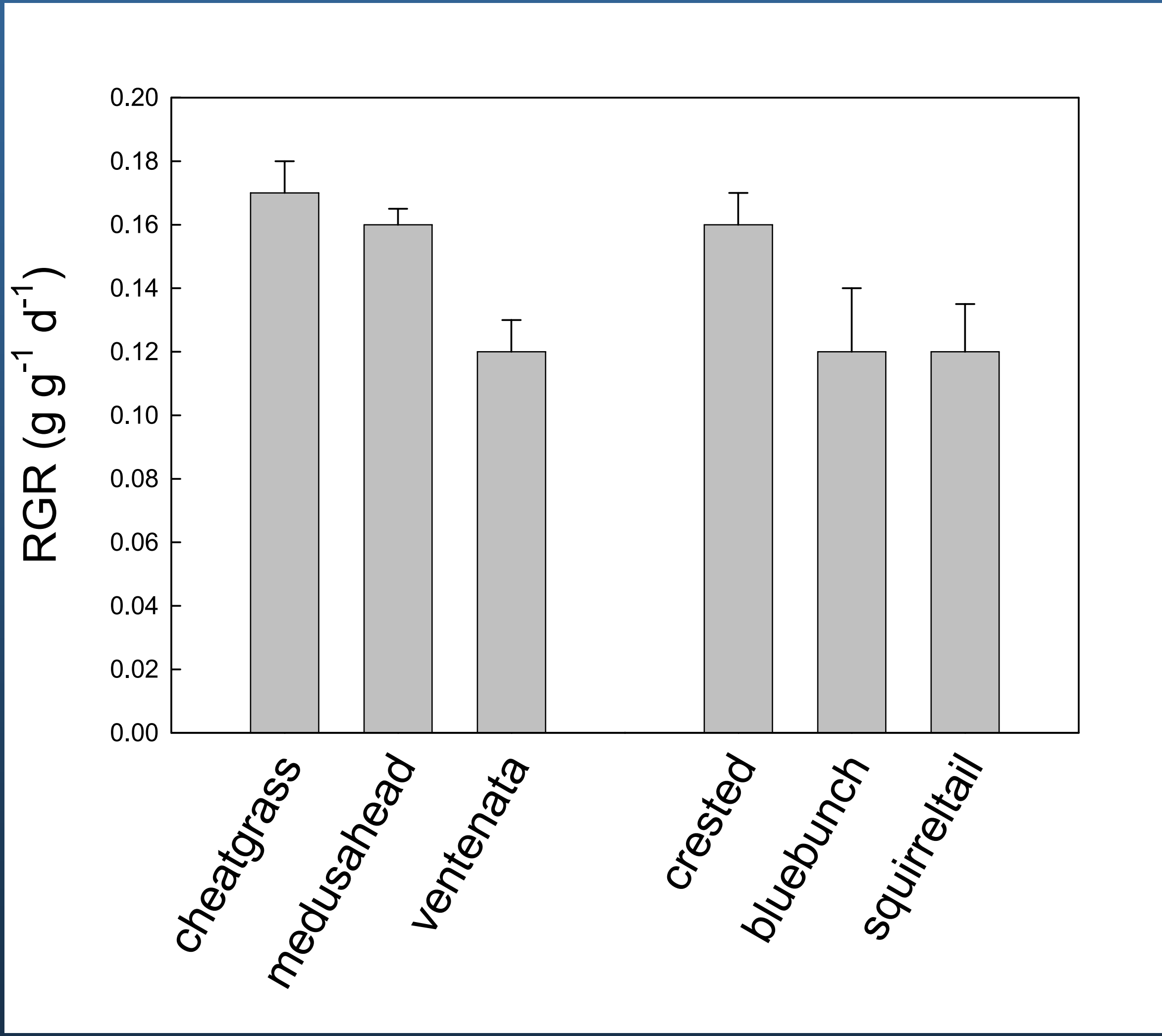
Traits driving RGR variation



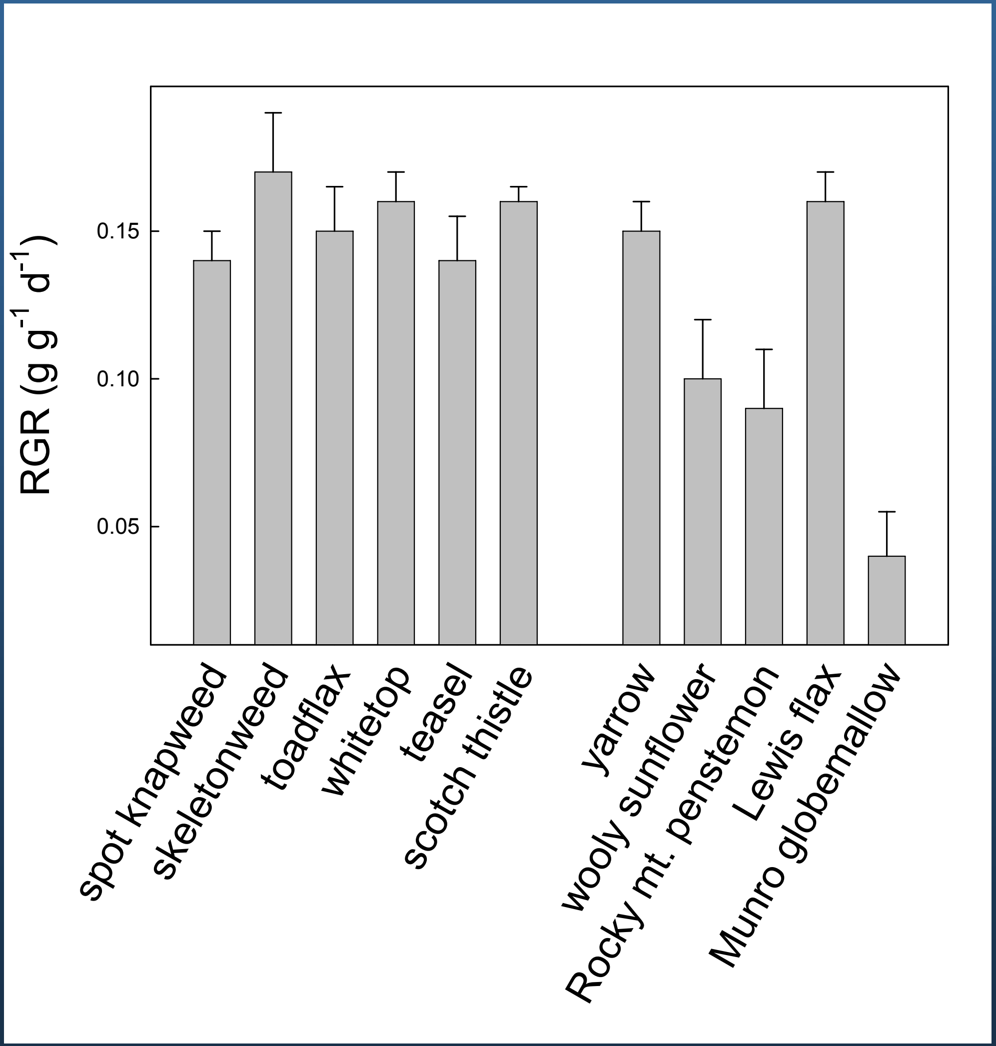
Approach

- Use model to examine RGR traits in 3 invasive annual grasses, 3 perennial bunchgrasses, 6 invasive forbs, 6 desirable forbs

RGR variation among grasses

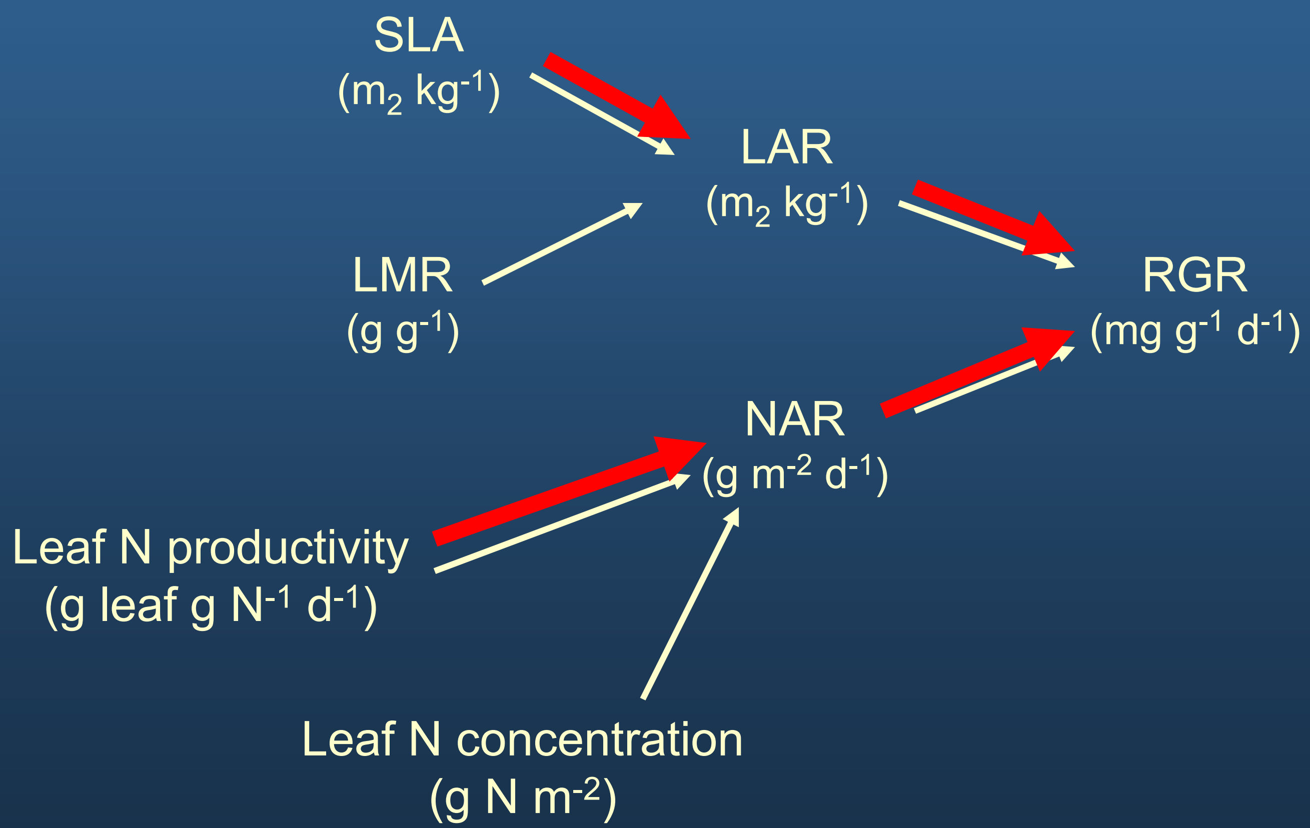


RGR variation among forbs



Traits driving RGR variation

Invasive vs. desirable grasses



Toward trait-based management of invasives

- This involves identifying:
  1. The specific ecosystem property or processes that we want to manage/ traits of the invader
  2. The traits likely to have the largest impact on the property or processes
  3. Trait variation and abundance in your desirable species pool
     - May only need to consider a handful of traits to maximize invasion resistance

Traits to consider in desirable species pool

1. Get biomass established and get it fast
   - Target species with high RGR
     - High SLA and high nitrogen productivity
2. Select species that differ in phenology
3. Select species that differ in root distribution

Questions and comments