

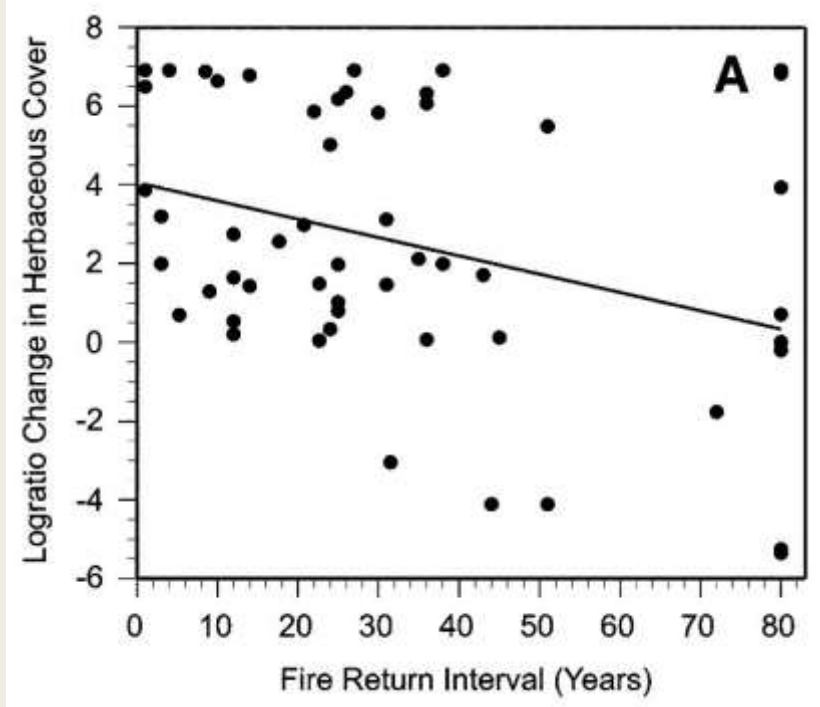
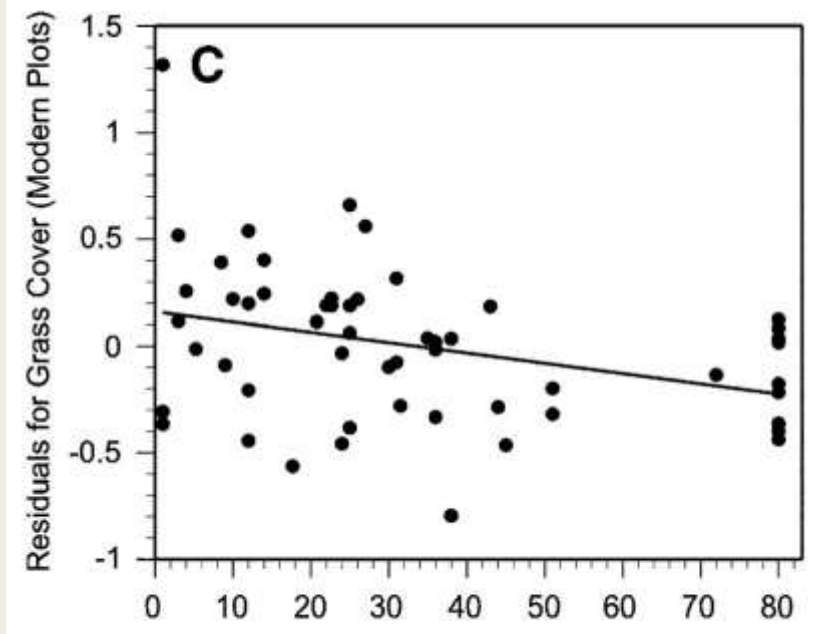
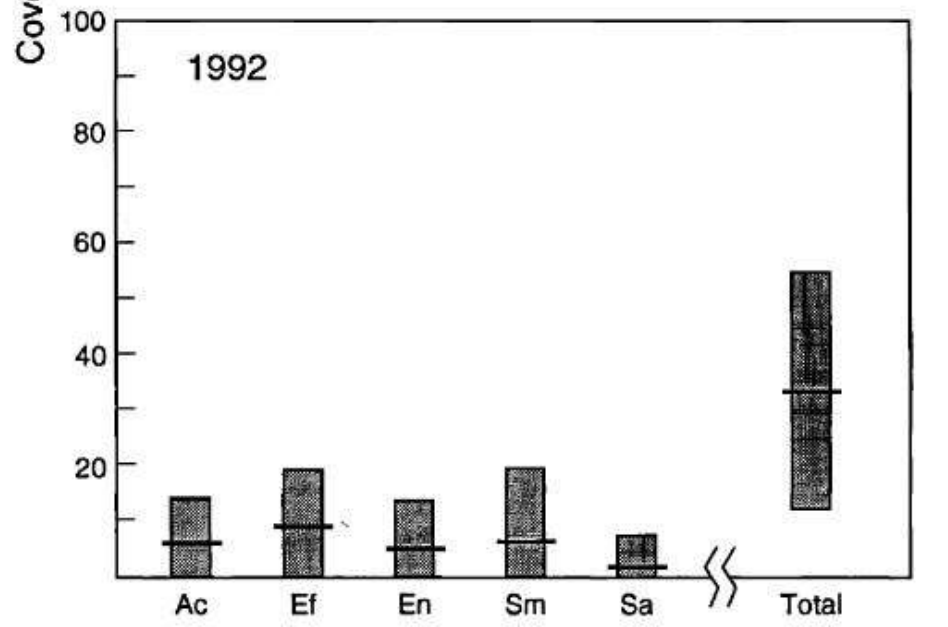
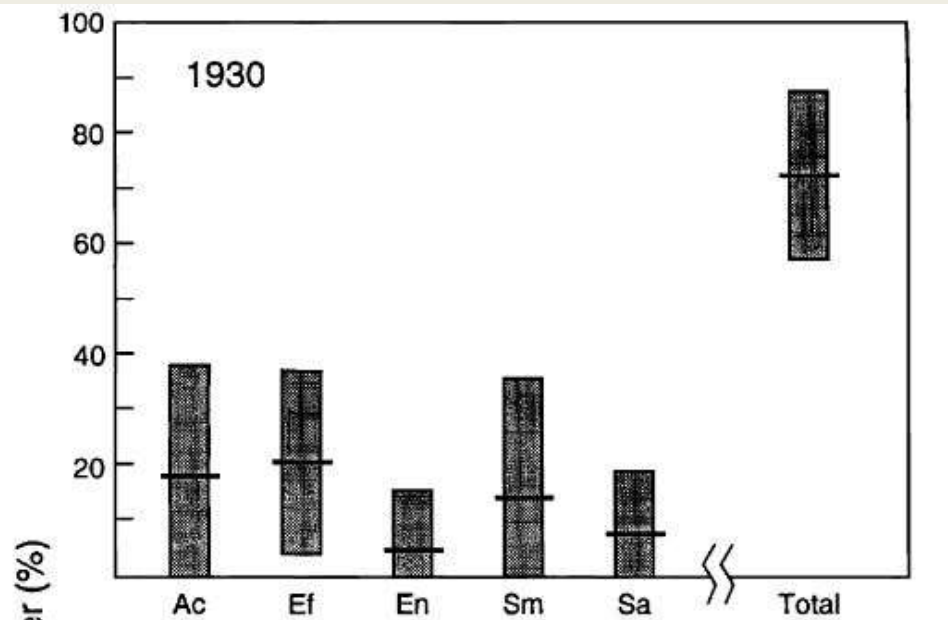
*Competitive seeding in fire breaks  
to suppress postfire invasion in  
Coastal Sage Scrub*

NOAH TELLER



# Invasion trends in California

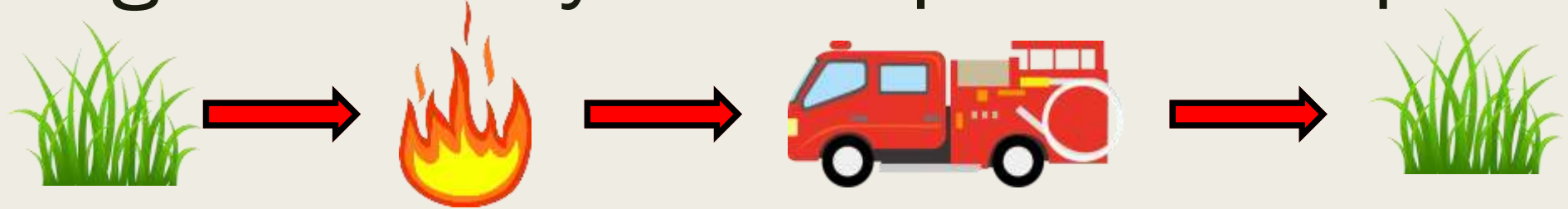
- Expansion of exotic annual grasses & forbs
  - *Bromus, Avena, Hordeum spp.*
  - *Centaurea & Brassica spp.*
  - Many others
- Declining Coastal Sage Scrub, native grassland
  - Changed fire return interval
  - Air pollution & N deposition
  - Expanding Wildland Urban Interface (WUI)



Left: Minnich & Dezzani 1998

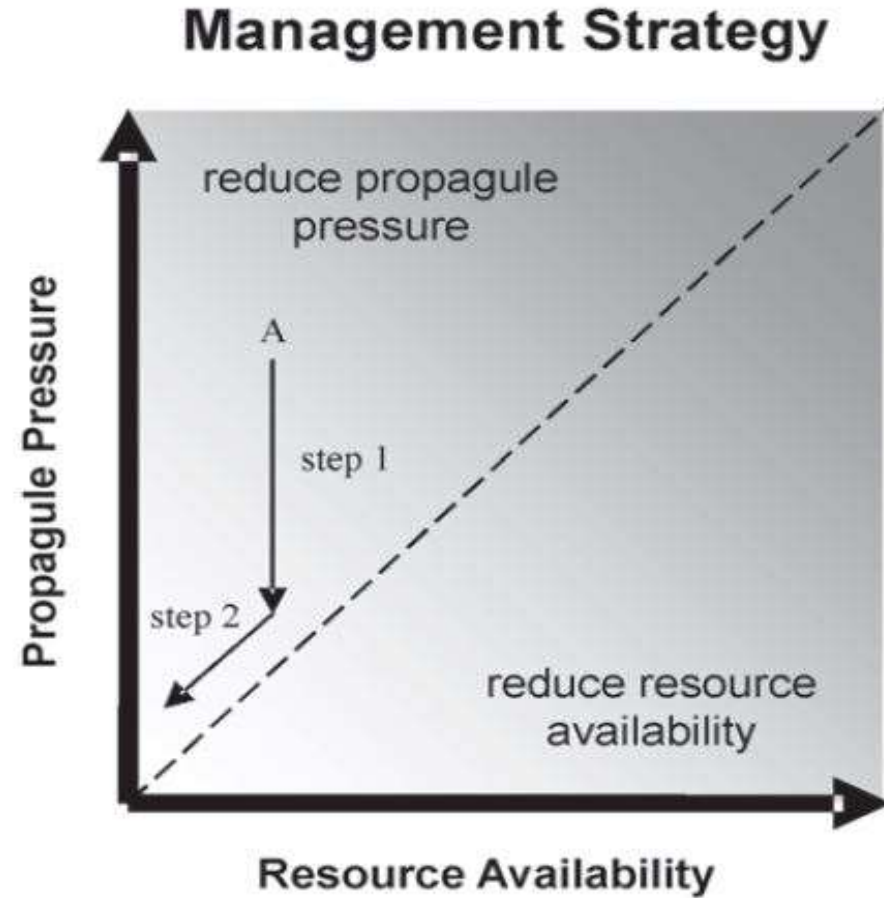
Right: Talluto & Suding 2008

# The grass-fire cycle is a positive loop



- D'Antonio & Vitousek 1992: Grass invasion likely to accelerate under global change conditions
- Bar-Massada et al. 2014: Expanding WUI increases ignitions and exotic spp. introductions
- Development along the WUI necessitates firefighting to protect life & property
- Firefighting disturbances may favor invasive grasses

# Reducing Invasion Risk



Brooks 2008,  
With edits

**Figure 14-1**—Main factors influencing invasion potential and a recommended management strategy to most efficiently minimize invasion potential. (Adapted from Brooks 2007a.)

# Canyon Fires I&II - 2017



# Dozer lines:

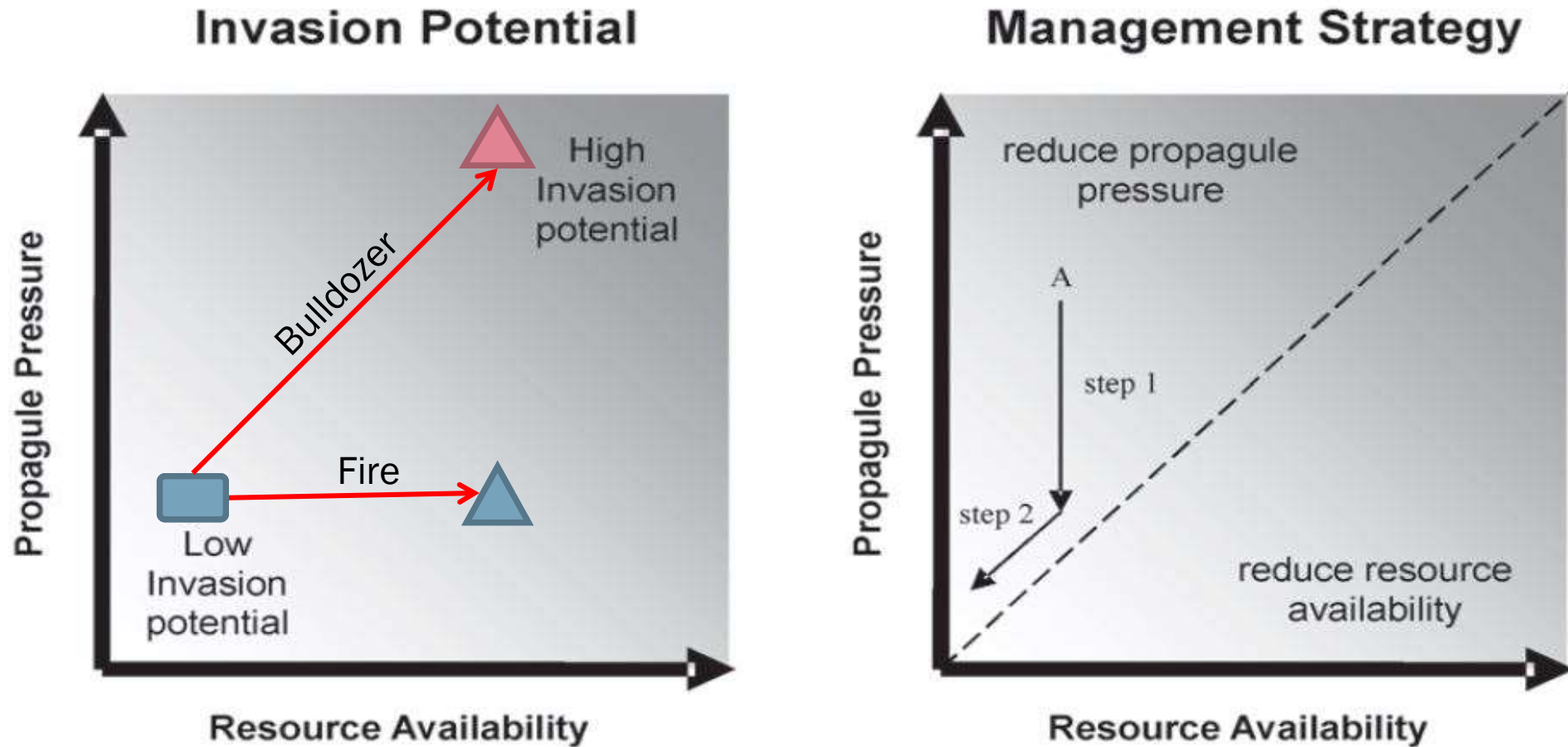
- Bare ground
- Tilled soil
- Invasive seed







# Reducing Invasion Risk



Brooks 2008,  
With edits

**Figure 14-1**—Main factors influencing invasion potential and a recommended management strategy to most efficiently minimize invasion potential. (Adapted from Brooks 2007a.)

# Objectives

1. Characterize invasion risk from bulldozer fire breaks
2. Investigate new methods of revegetation species selection to improve native survival, invasion resistance
3. Provide data & guidance to facilitate species selection for managers

# Traits → Species

# Trait Assemblages → Communities

- Biodiversity: number/relative abundance of species
- Functional diversity: number/relative abundance of traits
- Traits are a reflection of how species cope with the environment
  - Coastal Sage Scrub: drought deciduous, fire resprouters
  - Rainforest: evergreen, efficient light capture, vertical growth
- Trait assemblages reflect how communities react to the environment
  - Frequent fire: seroteny, heat triggers, resprouting
  - Could they also predict characteristics like invasion resistance?

# What trait assemblages are best for resisting invasion?

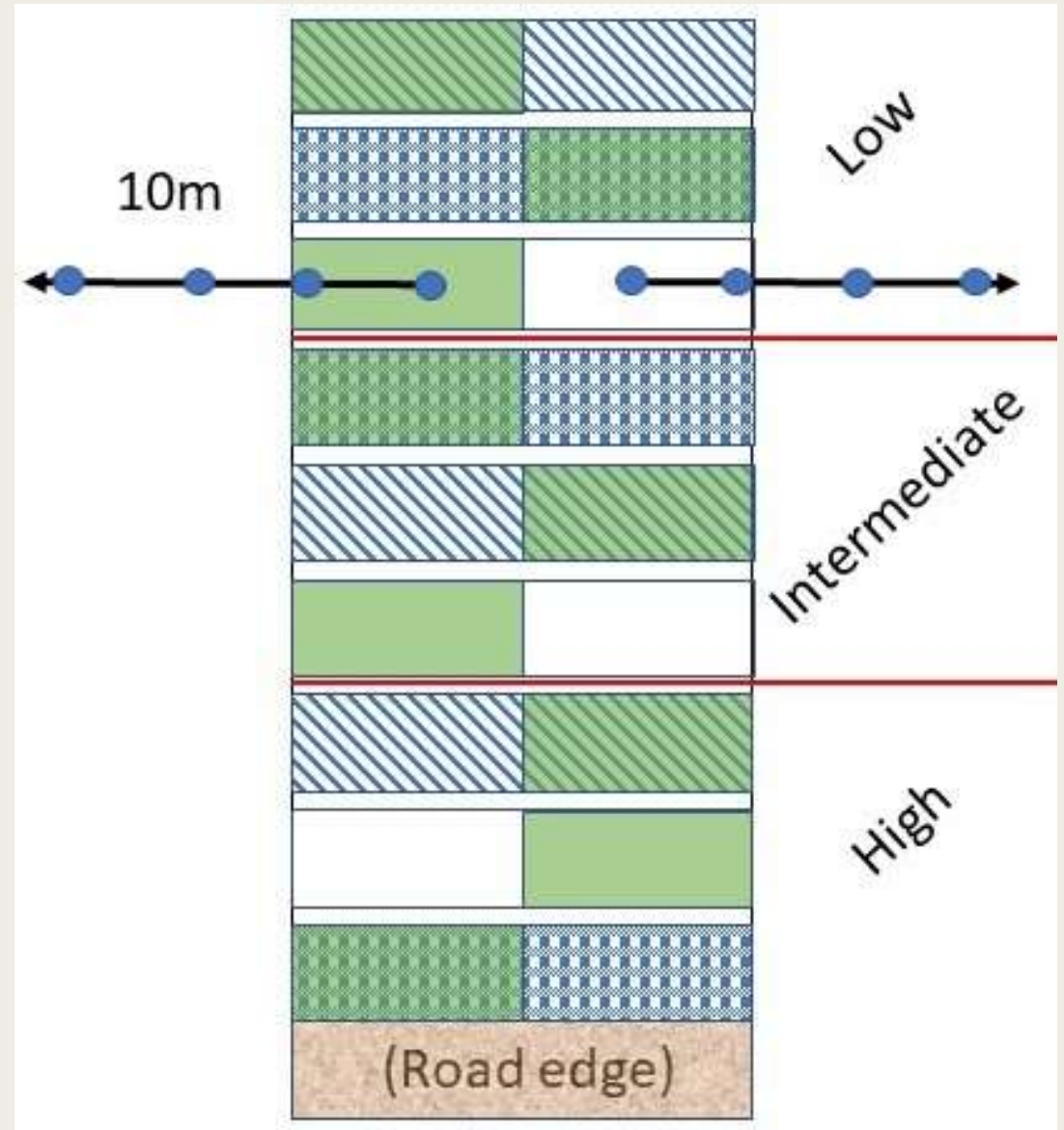
- **Trait Matching:** select plants with traits as similar as possible to invaders to occupy their niches specifically.
- **Trait Dispersion:** select plants across a wide range of traits to fully use as many resources as possible.

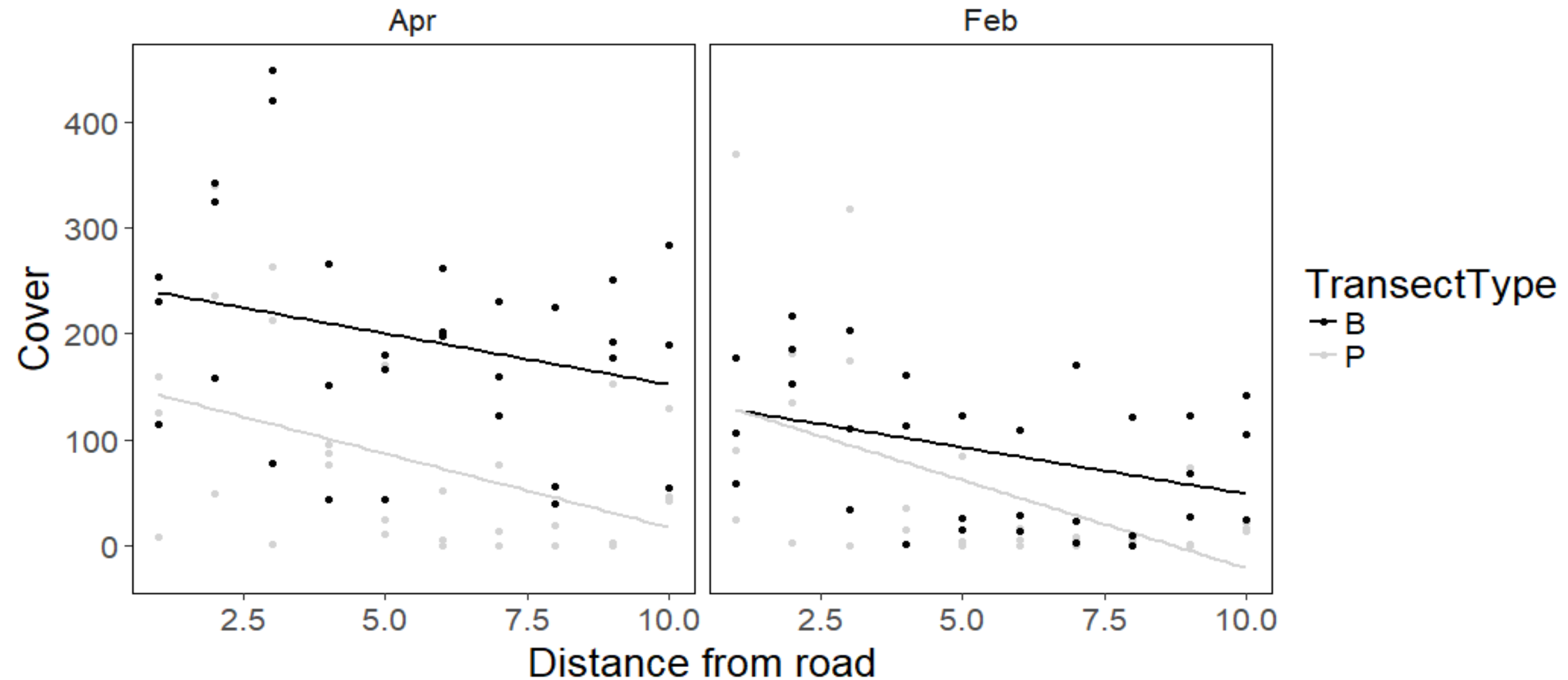
# Hypotheses

- H1: Bulldozer lines present an elevated risk of invasion
- H2: Trait matching revegetation species to invaders will provide improved invasion resistance in the first year after sowing, but low native survival in year 2-3.
- H3: Trait dispersion among revegetation species will provide improved native survival in year 2-3, but lower invasion resistance in the first year after sowing.

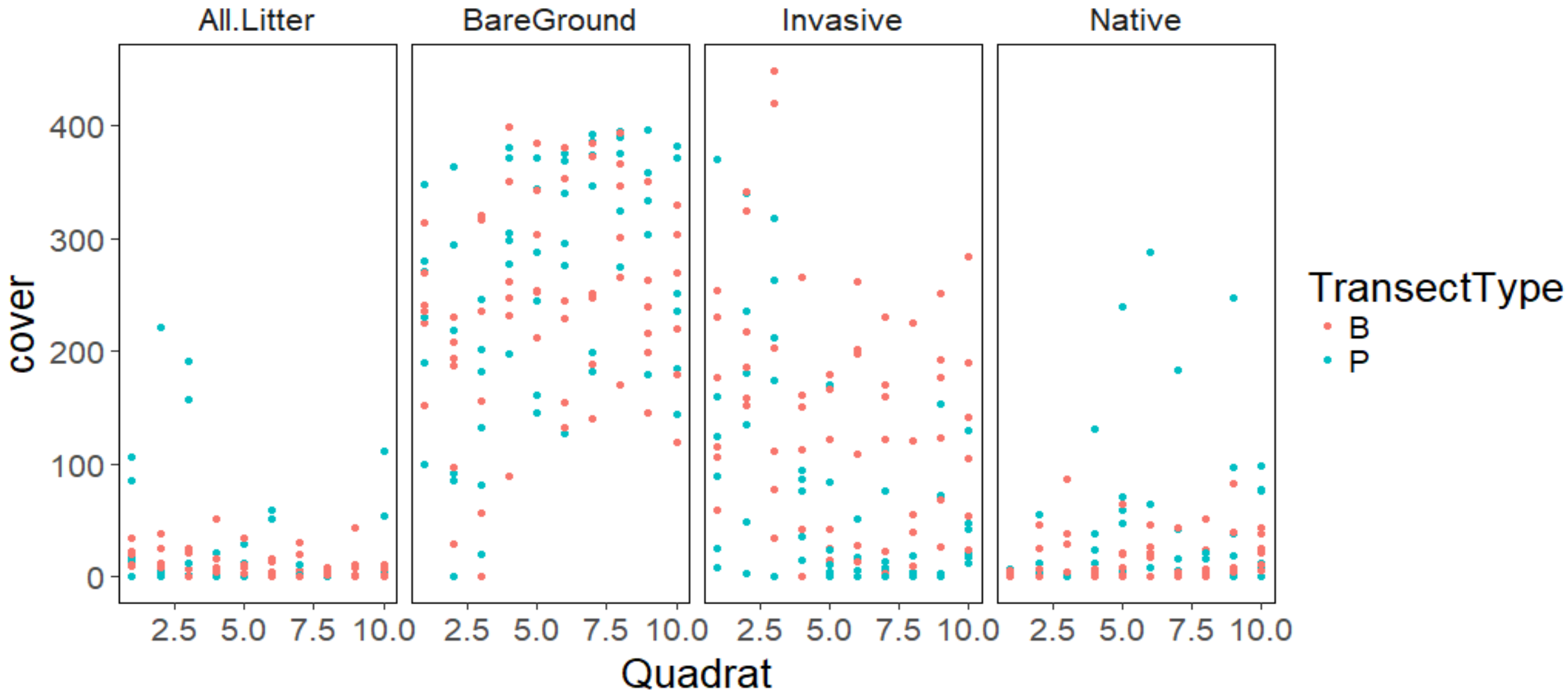
# Plot layout:

- 3 zones of invasive propagule pressure
- Seed traps to characterize seed rain
- Green: mowing in Spring 2018
- Texture: Match mix, Diverse mix, control
- 5 Dozer lines & 5 parallel transects





ANOVA showed significant effects on invasive cover by Quadrat (proxy for distance from road,  $p=0.0002$ ) and Time ( $p=0.0006$ ). The effect of Transect Type was moderately significant (Bulldozed vs. Parallel,  $p=0.0564$ ).



ANOVA showed significant effects on invasive cover by Quadrat (proxy for distance from road,  $p=0.0002$ ) and Time ( $p=0.0006$ ) in April. The effect of Transect Type was moderately significant (Bulldozed vs. Parallel,  $p= 0.0564$ ).



# Candidate species

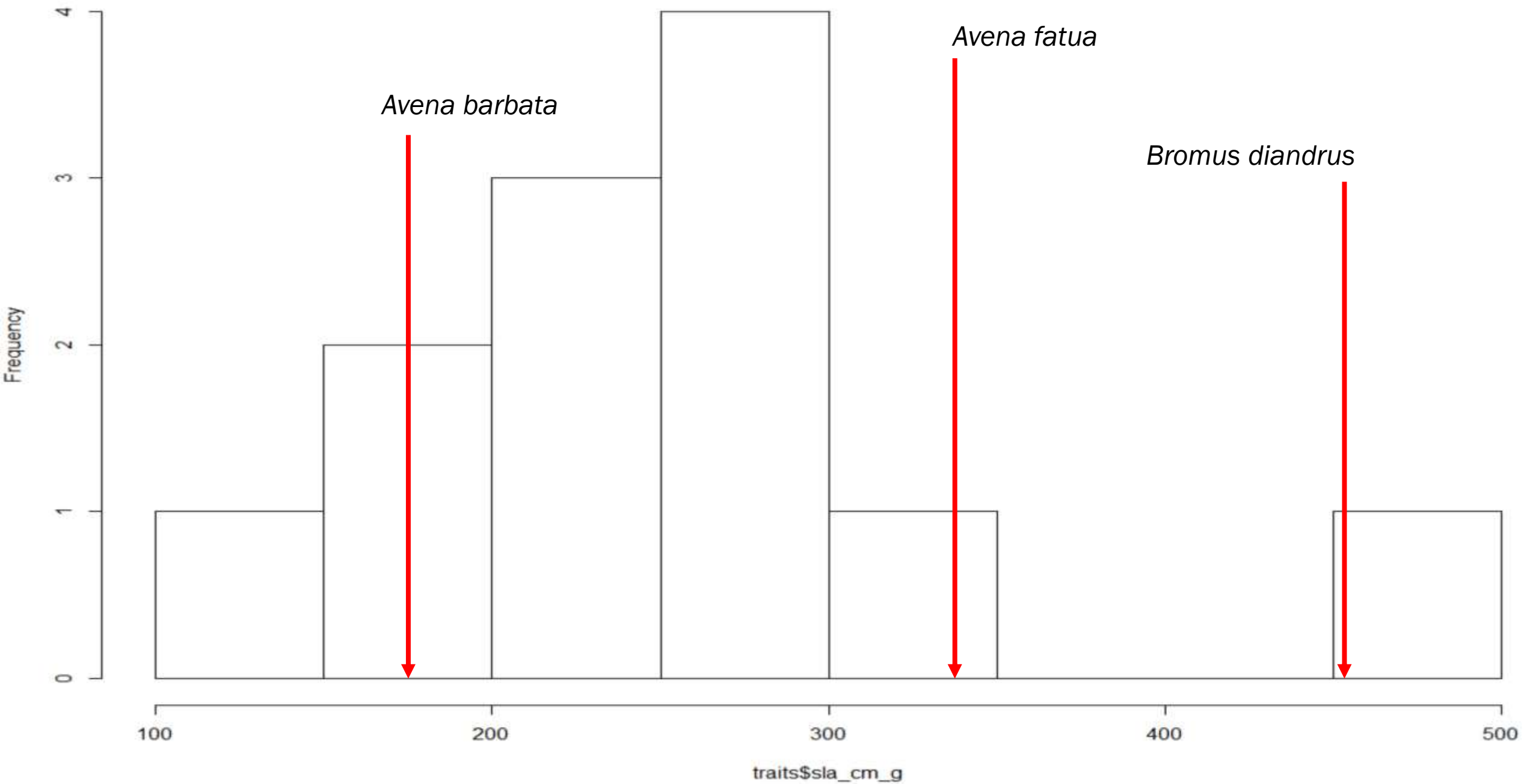
- *Marah macrocarpus*
- *Bromus carinatus*
- *Cirsium occidentale*
- *Phacelia minor*
- *Encelia californica*
- *Stipa pulchra*
- *Baccharis sarothroides*
- *Eriogonum fasciculatum*

- *Datura wrightii*
- *Salvia mellifera*
- *Heterotheca grandiflora*

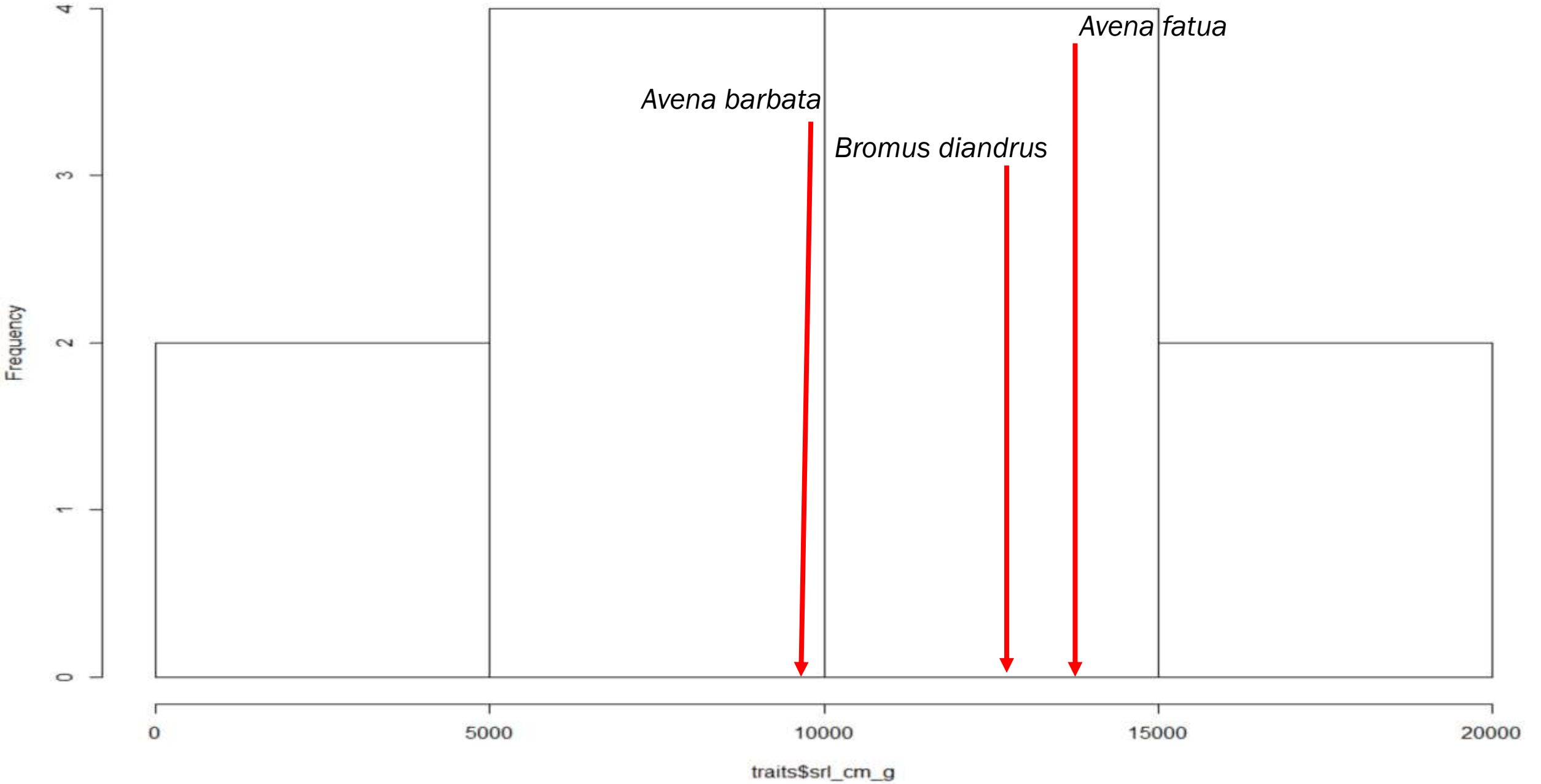
To compete against:

- *Avena fatua*
- *Avena barbata*
- *Bromus diandrus*

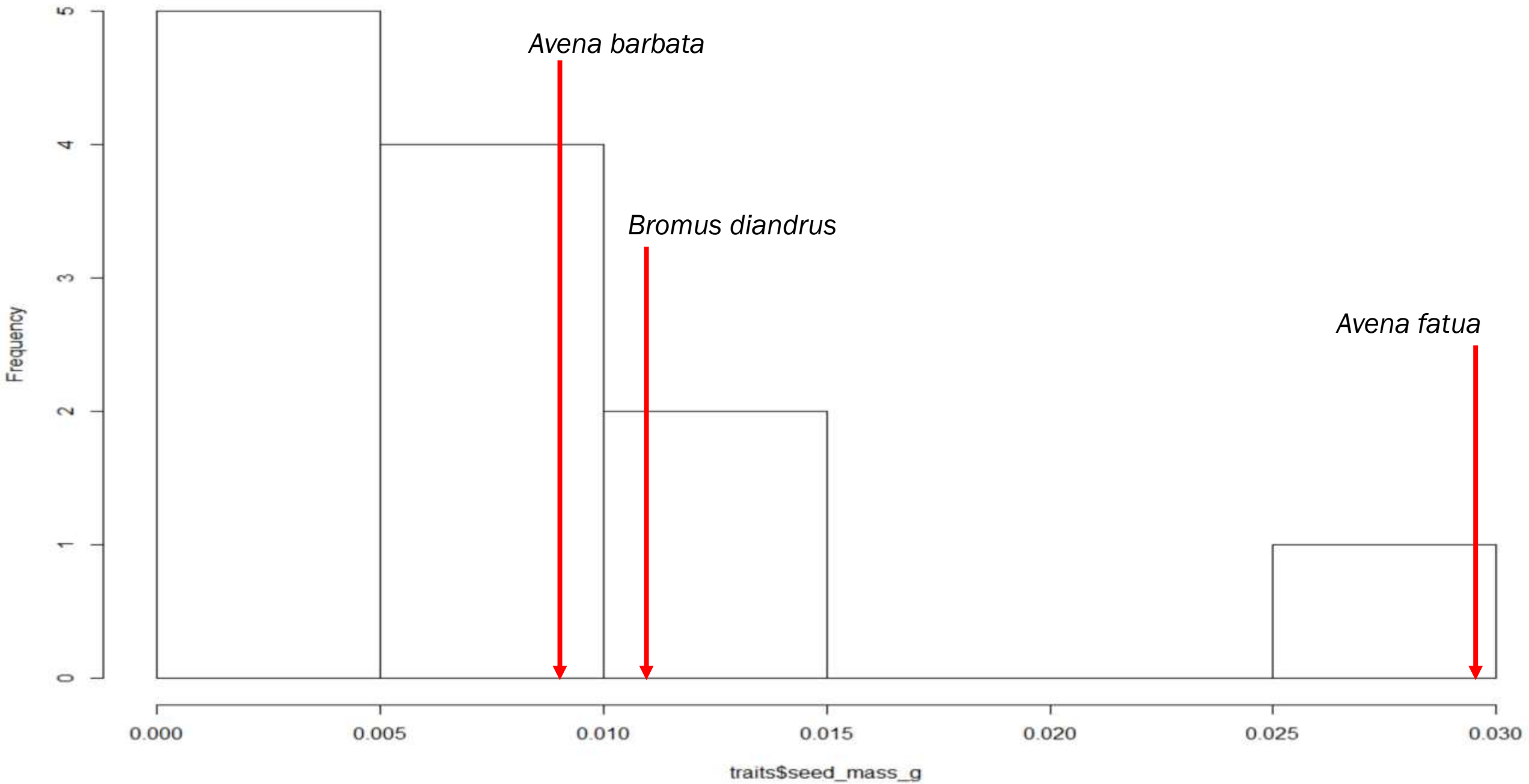
Histogram of traits\$sla\_cm\_g

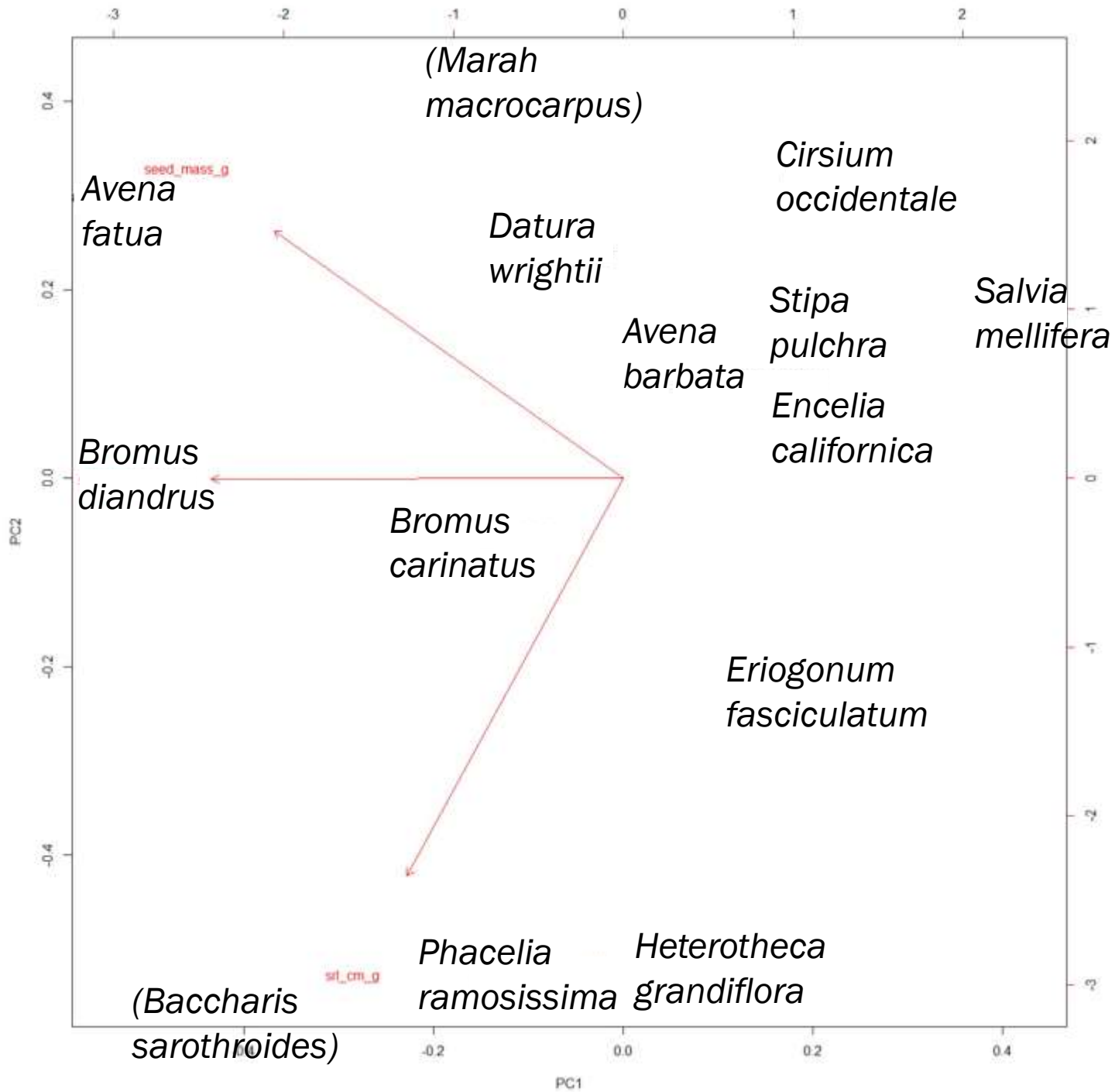


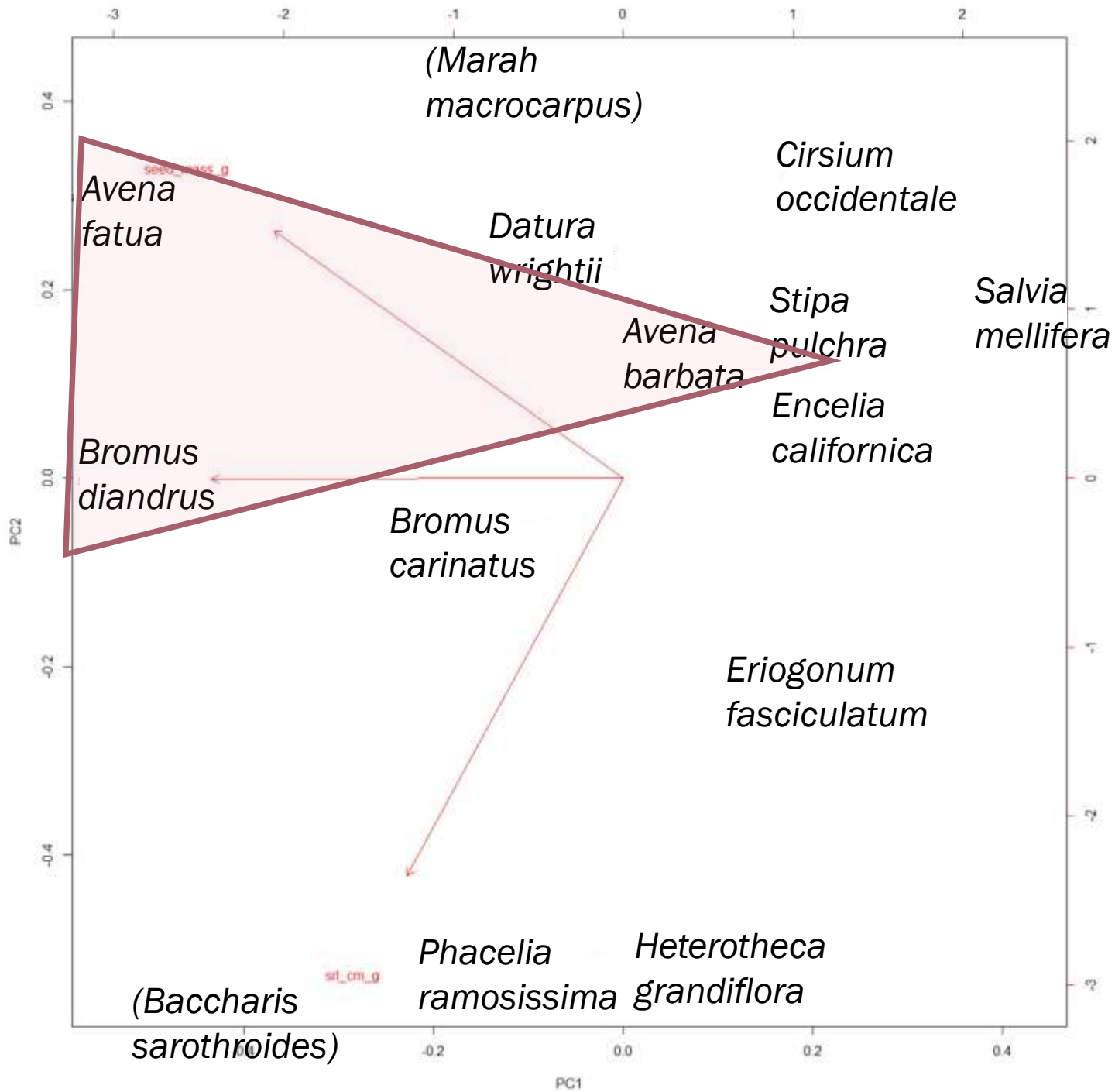
Histogram of traits\$srl\_cm\_g



Histogram of traits\$seed\_mass\_g







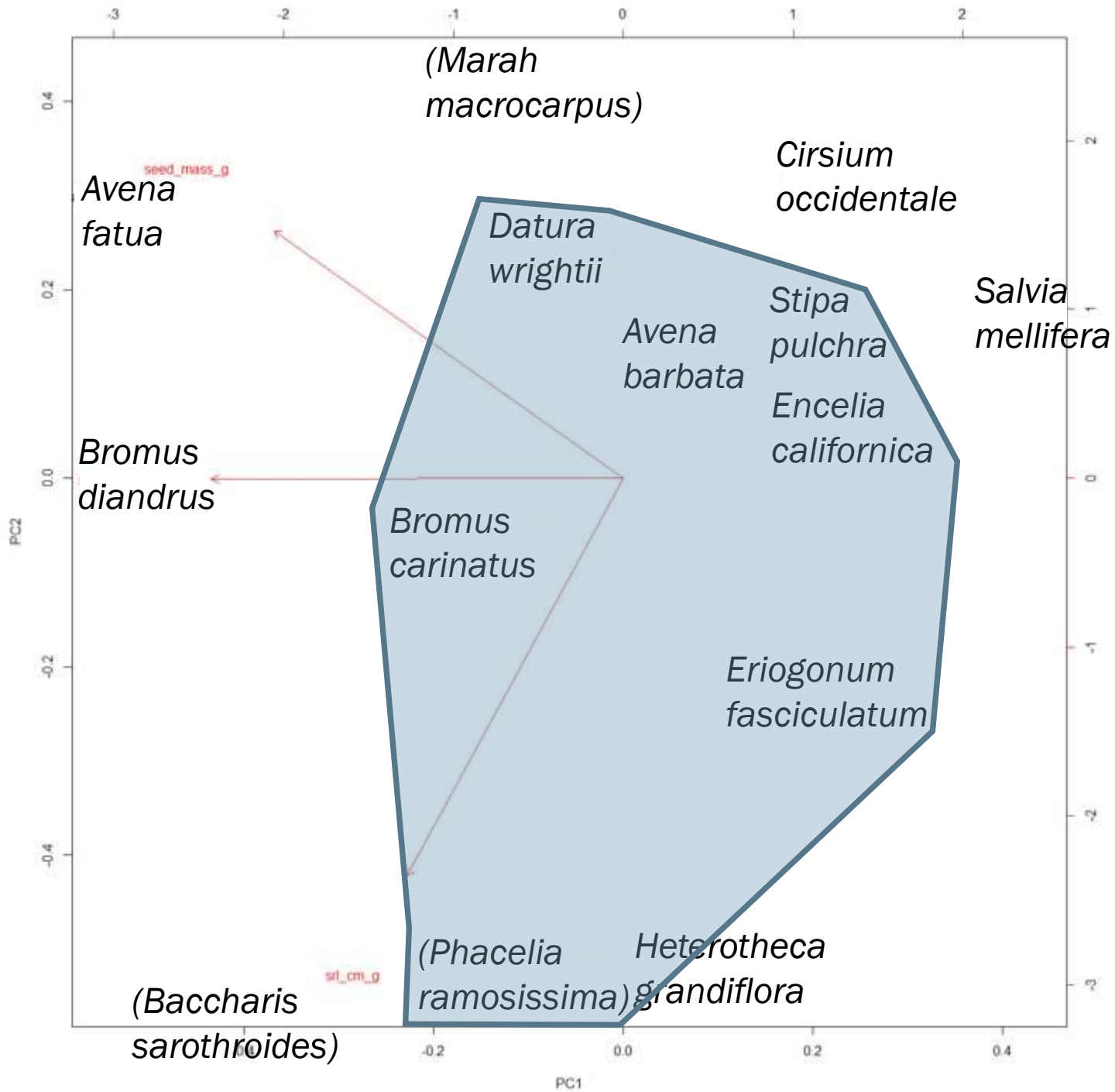
# Seed Mixes

## Mix L (Trait matched):

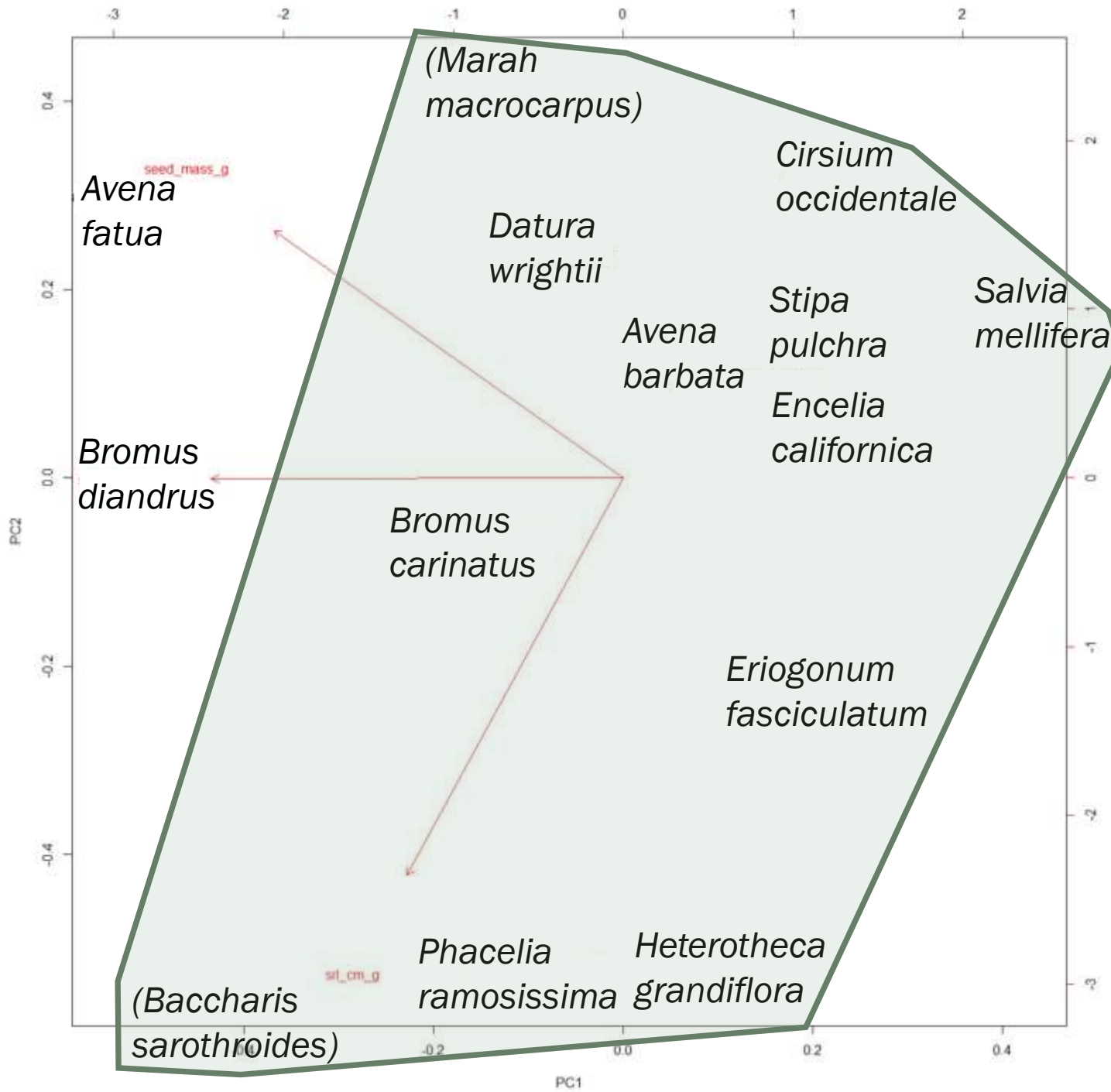
- Bromus carinatus
- Eriogonum fasciculatum
- Stipa pulchra
- Datura wrightii
- Encelia californica
- Phacelia minor

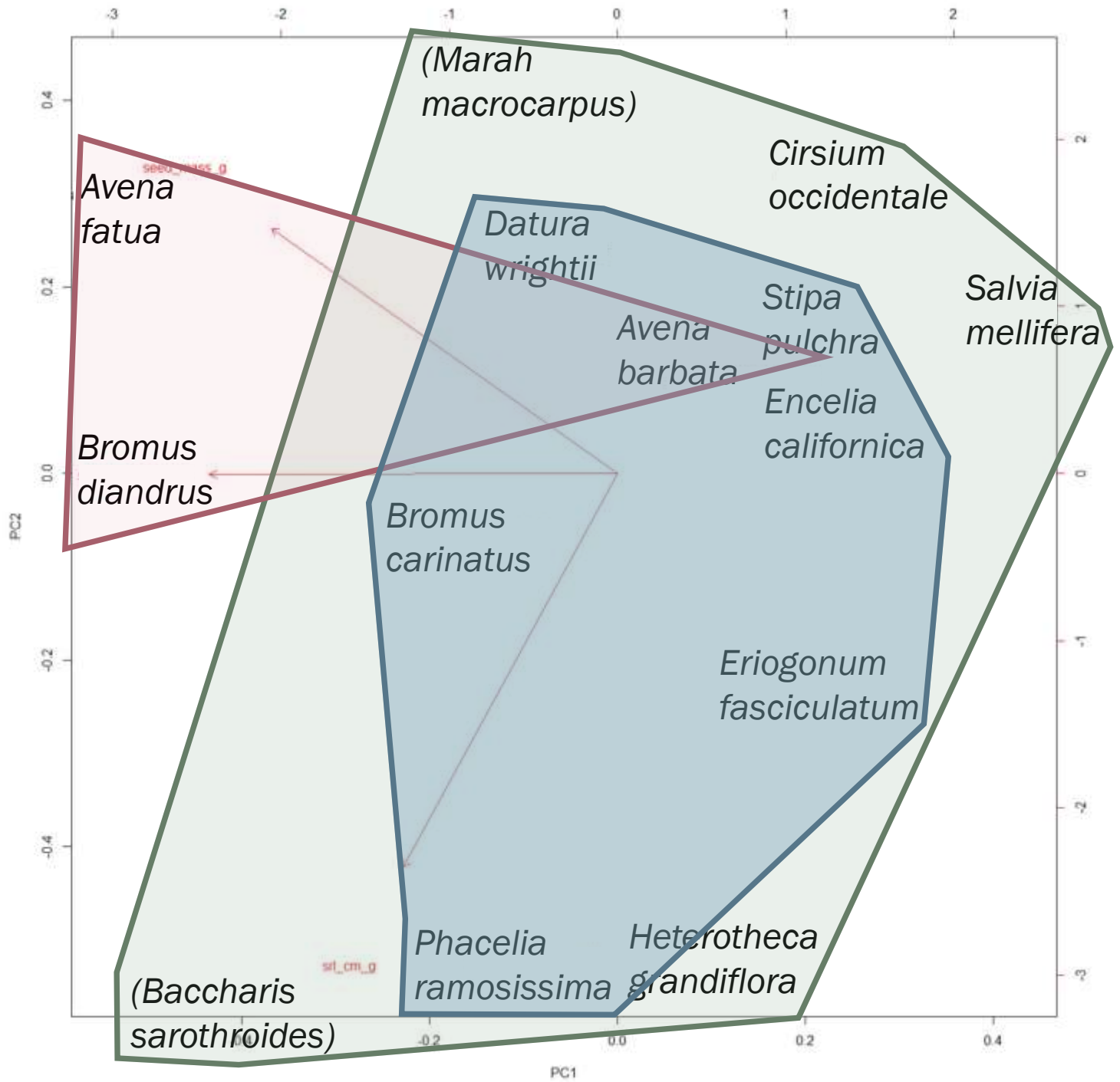
## Mix H (Trait dispersed):

- Cirsium occidentale
- Salvia mellifera
- Bromus carinatus
- Heterotheca grandiflora
- Marah macrocarpus
- Baccharis sarothroides









# Seed deployment & Next steps

- Seeding rate 16 lb/ac
- Seeding by hand, with blasting sand mixed in for weight
- Plant community monitoring 2019/2020
- Information sharing through functional trait profiles, publications, presentations



# Thank you!

- Funding: USDA Western Integrated Pest Management Ctr. Graduate Student Grant
- Undergrads extraordinaire Erika Hernandez, Esther Choi, Jovana Durovic, Darren Ching, Devin Tran, Jasnoor Malhotra, Jessica Du
- Shirin Tolle, collected seeds pro bono
- S&S Seed company, provided trait screening seeds free of charge
- Lorelee Larios (PI); Soren Weber, Miguel Solis, Renee Stewart