

Testing functional dispersion in revegetation seed mixes to reduce grass invasion in bulldozer fire breaks.

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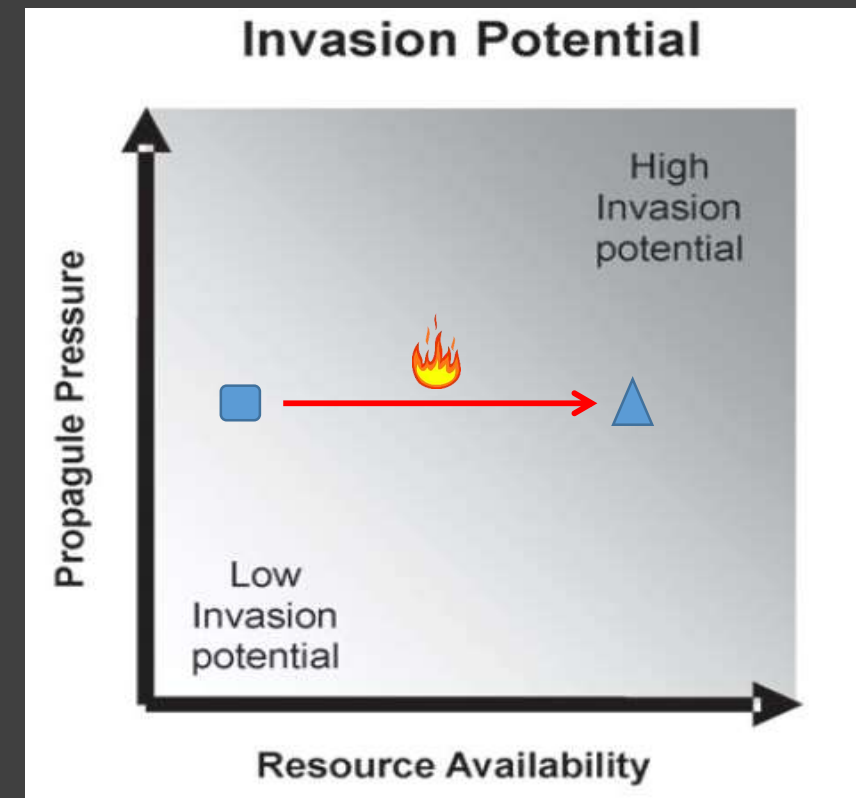
Invasion trends in CA

- Expansion of exotic annual grasses & forbs
- Decline of Coastal Sage Scrub, native grassland
 - Nitrogen deposition
 - Drought
 - More frequent & widespread fire



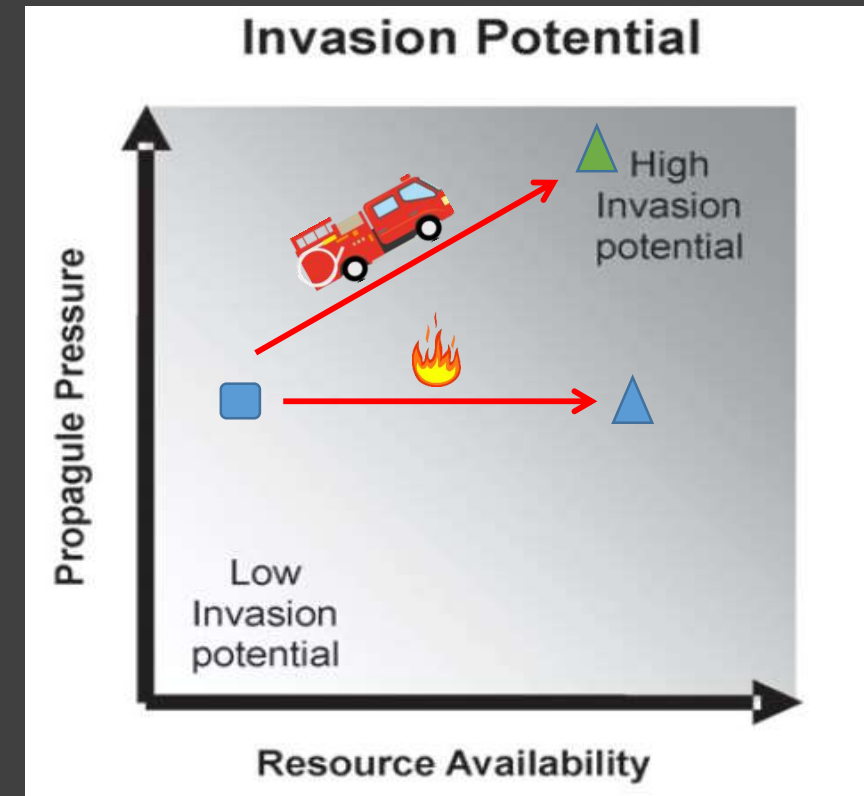
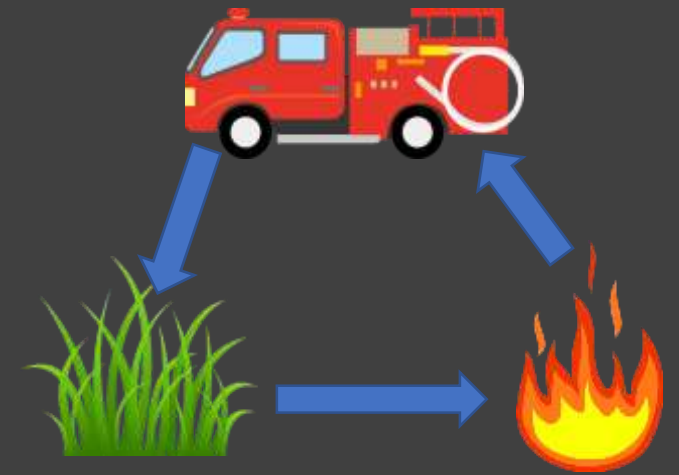
The grass-fire cycle is a positive feedback

- More grass → Increased fuel connectivity and fast regeneration rate
- Resprouters & perennials fail to reproduce before another fire
- Prolific seed production by grasses, high resources available after fire



How does firefighting fit in?

- Equipment and machines can distribute seeds between & within areas
- Disturbed areas with bare tilled ground may favor invasive grasses
- Expanding Wildland-Urban Interface
→ Increased firefighting effort
- Past mitigation options have had bad unintended consequences

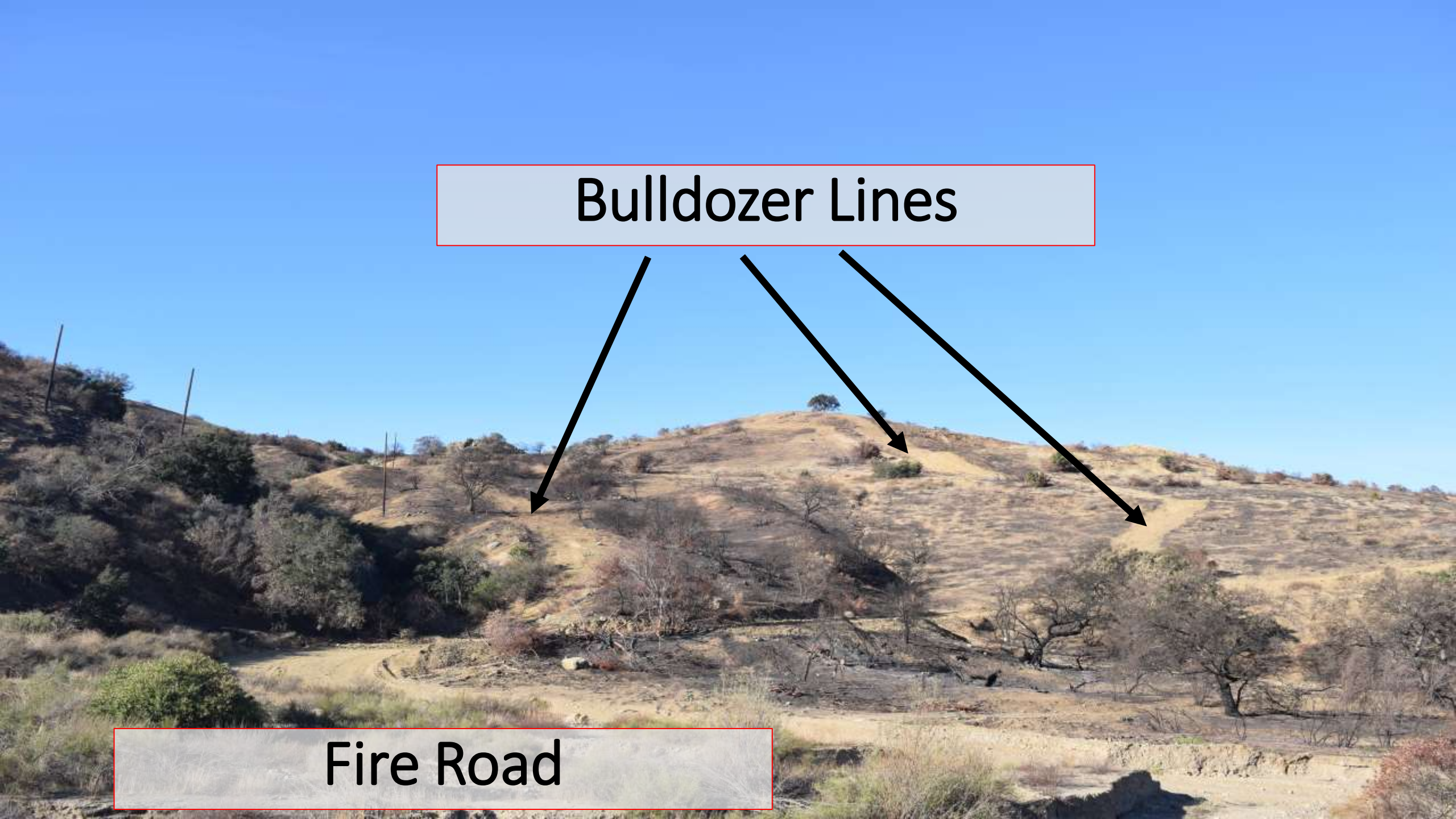


Canyon Fires I&II - 2017



Bulldozer Lines

Fire Road



A landscape photograph of a hillside. The left side of the hill is covered in dense, dark green trees and shrubs. A clear, light-colored path or fire break runs diagonally across the middle of the hill, separating the wooded area from the right side. The right side of the hill is covered in sparse, dry, brownish vegetation. The sky is a clear, pale blue.

Bulldozer fire breaks

- Contain bare ground, tilled soil, and invasive seed
- Should managers be concerned?
- If yes, what can they do about it?

Traits → Species Performance

Trait Assemblages → Community Characteristics

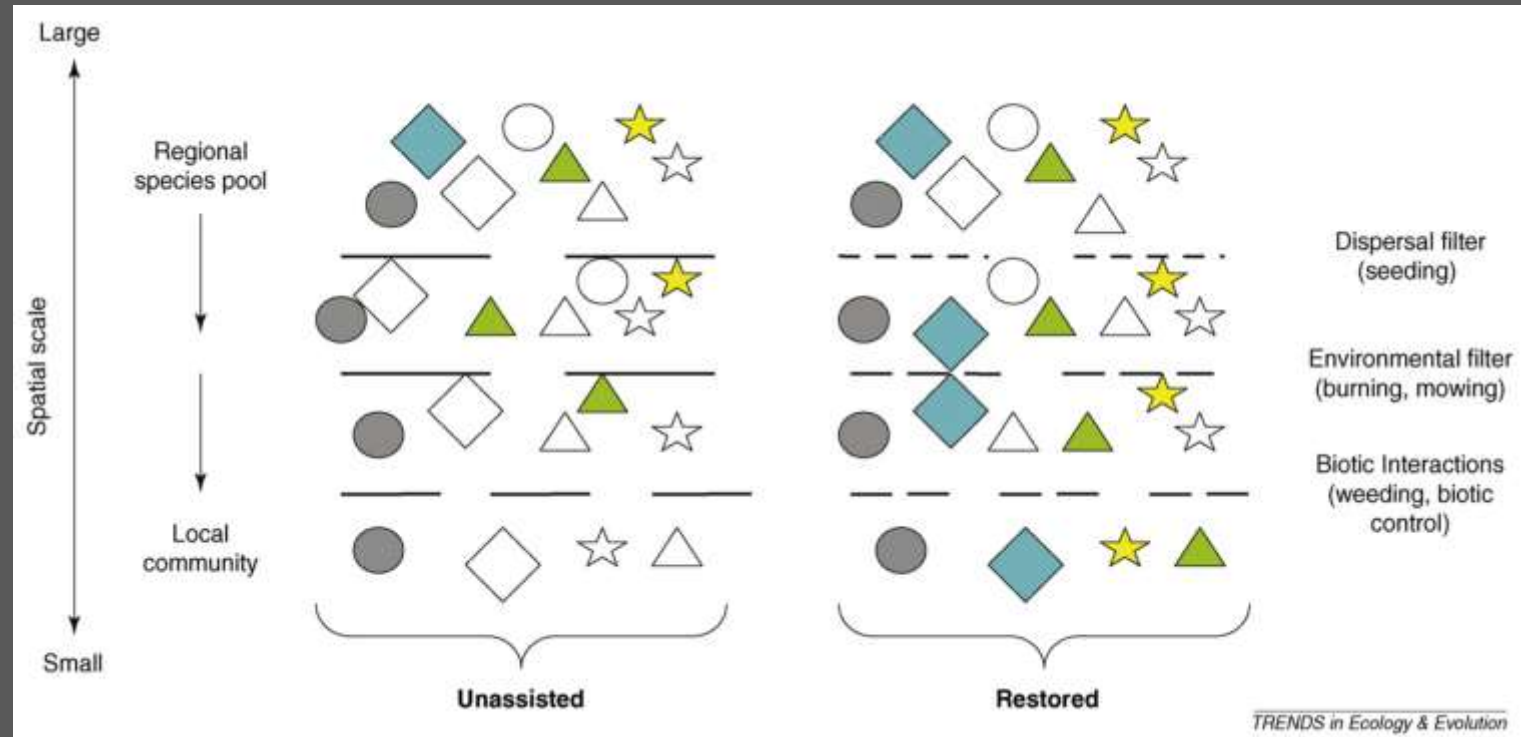
- Traits are a reflection of how species cope with the environment
- Trait assemblages reflect how communities react to the environment
- Functional diversity: number of different plant “strategies” in community
 - Niche saturation
 - Limiting similarity



What trait assemblages are best for resisting invasion?

Funk et al. 2008

Community Assembly as “Ecological Filters”



What trait assemblages are best for resisting invasion?

Trait Matching: select plants with traits as similar as possible to invaders to occupy their niche specifically.

[Limiting Similarity]

Trait Dispersion: select plants across a wide range of traits to fully use as many resources as possible, be ready for a range of conditions.

[Niche Saturation]

Research Questions

1. How do bulldozer fire breaks influence plant community composition and recovery after fire?
2. Can functional trait screening to select species improve outcomes of restoration seed mixes?



Research Questions

1. ~~How do bulldozer fire breaks influence plant community composition and recovery after fire?~~
2. **Can functional trait screening to select species improve outcomes of restoration seed mixes?**



Hypotheses

The functional trait composition of seed mixes, and their similarity or difference from invasive functional traits, will influence the effectiveness of seeding for native revegetation.

H1: Seed mixes of native species with traits matched to invaders (M) will compete more strongly with invaders, reducing invasive relative abundance but not increasing native cover or diversity much.

H2: Seed mixes of native species with a broad diversity of traits (D) will allow natives to escape competition in their niche, increasing native relative abundance and reducing invasive abundance.



Lath house trait screening

Native Spp:

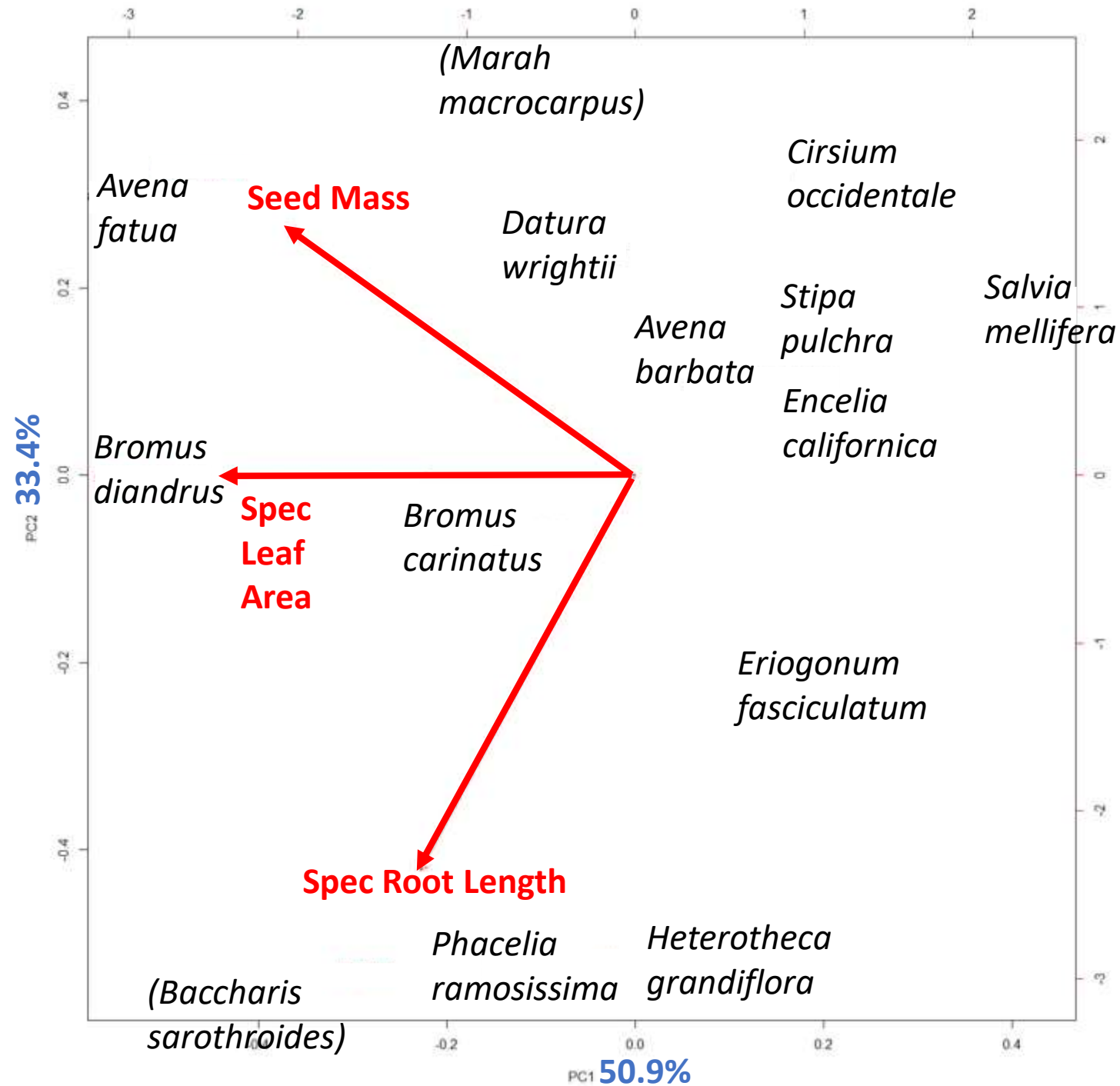
- *Marah macrocarpus*
- *Bromus carinatus*
- *Cirsium occidentale*
- *Phacelia minor*
- *Encelia californica*
- *Stipa pulchra*
- *Baccharis sarothroides*
- *Eriogonum fasciculatum*
- *Datura wrightii*
- *Salvia mellifera*
- *Heterotheca grandiflora*

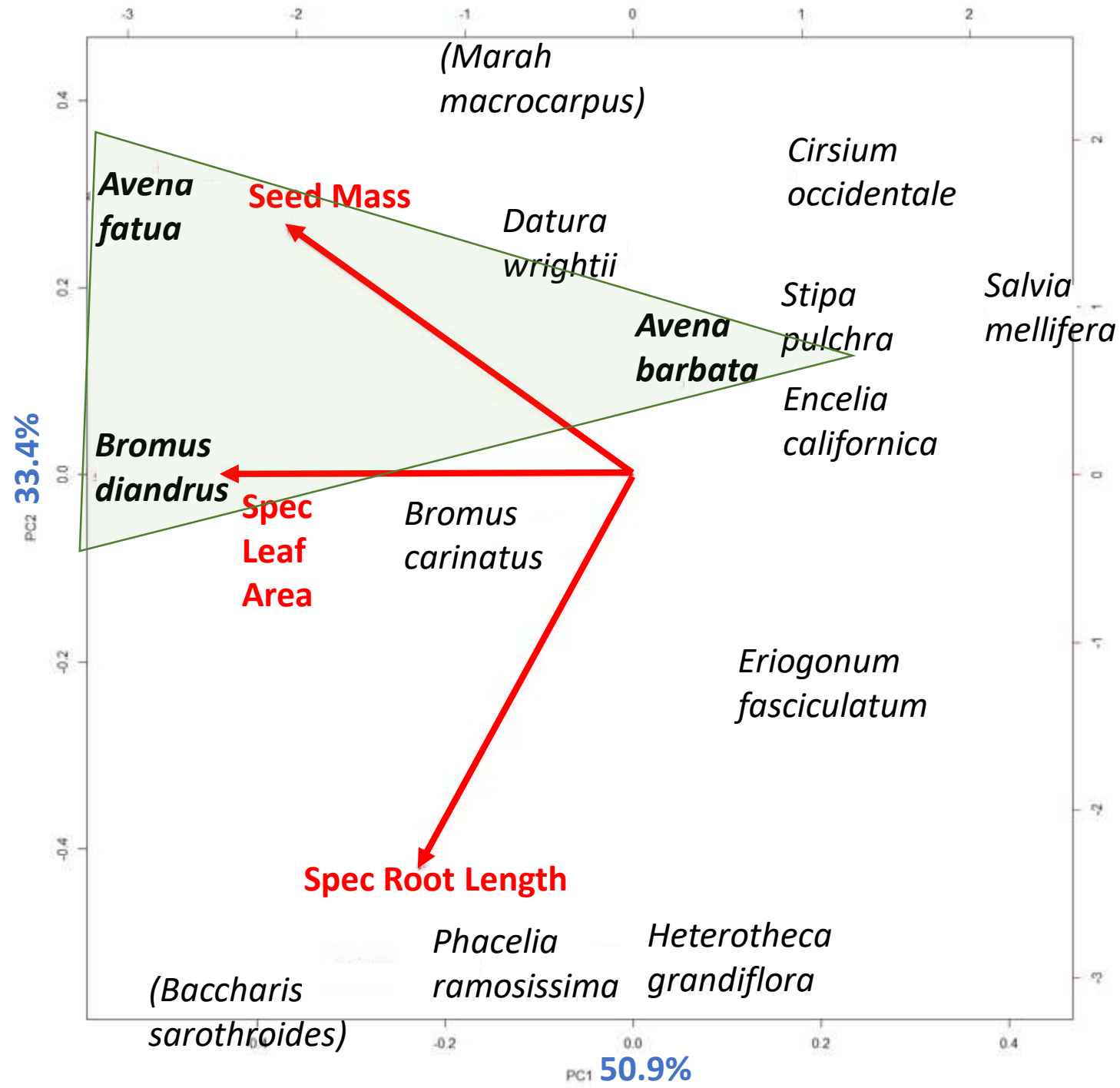
Invasive Spp:

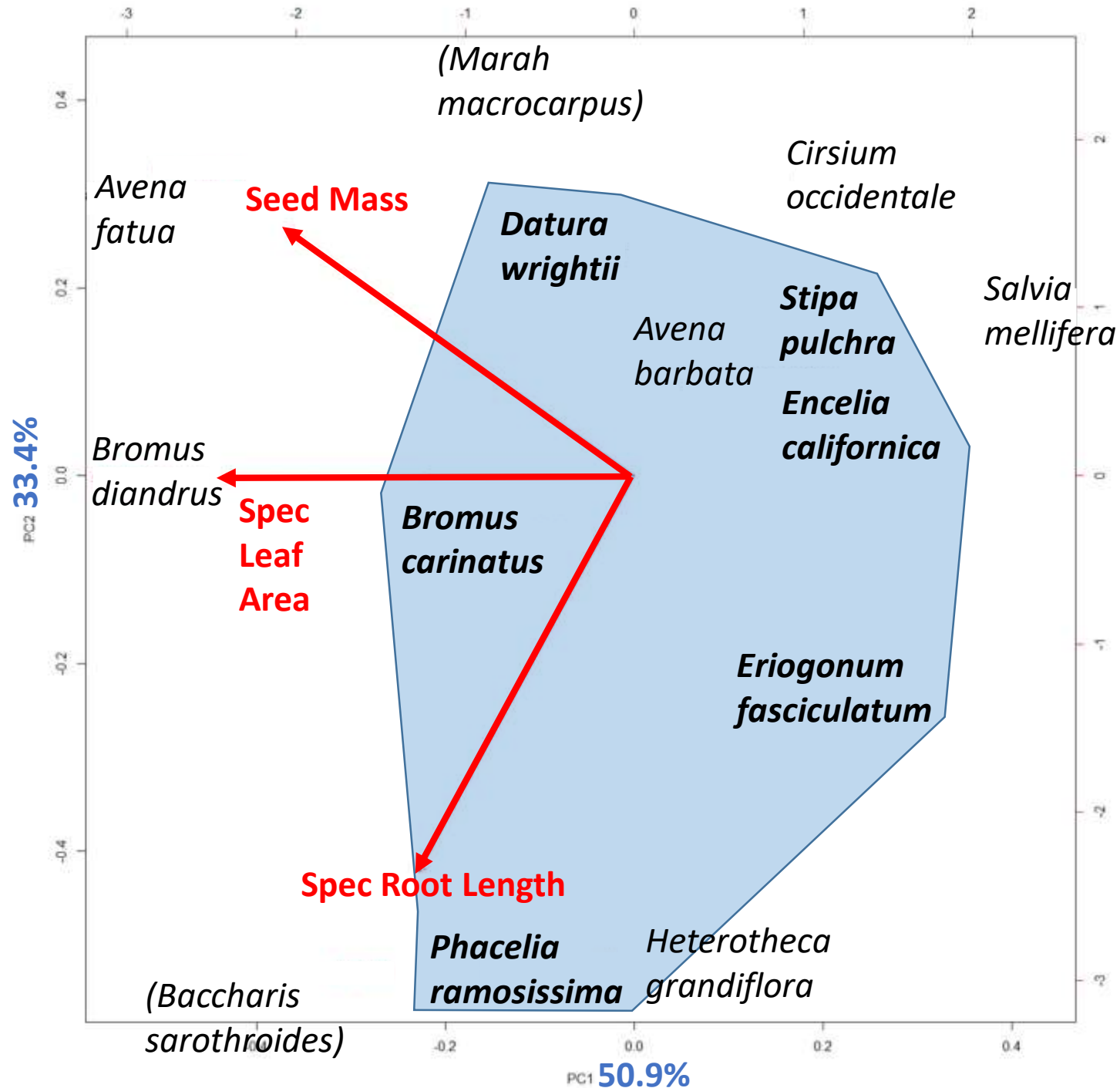
- *Avena fatua*
- *Avena barbata*
- *Bromus diandrus*

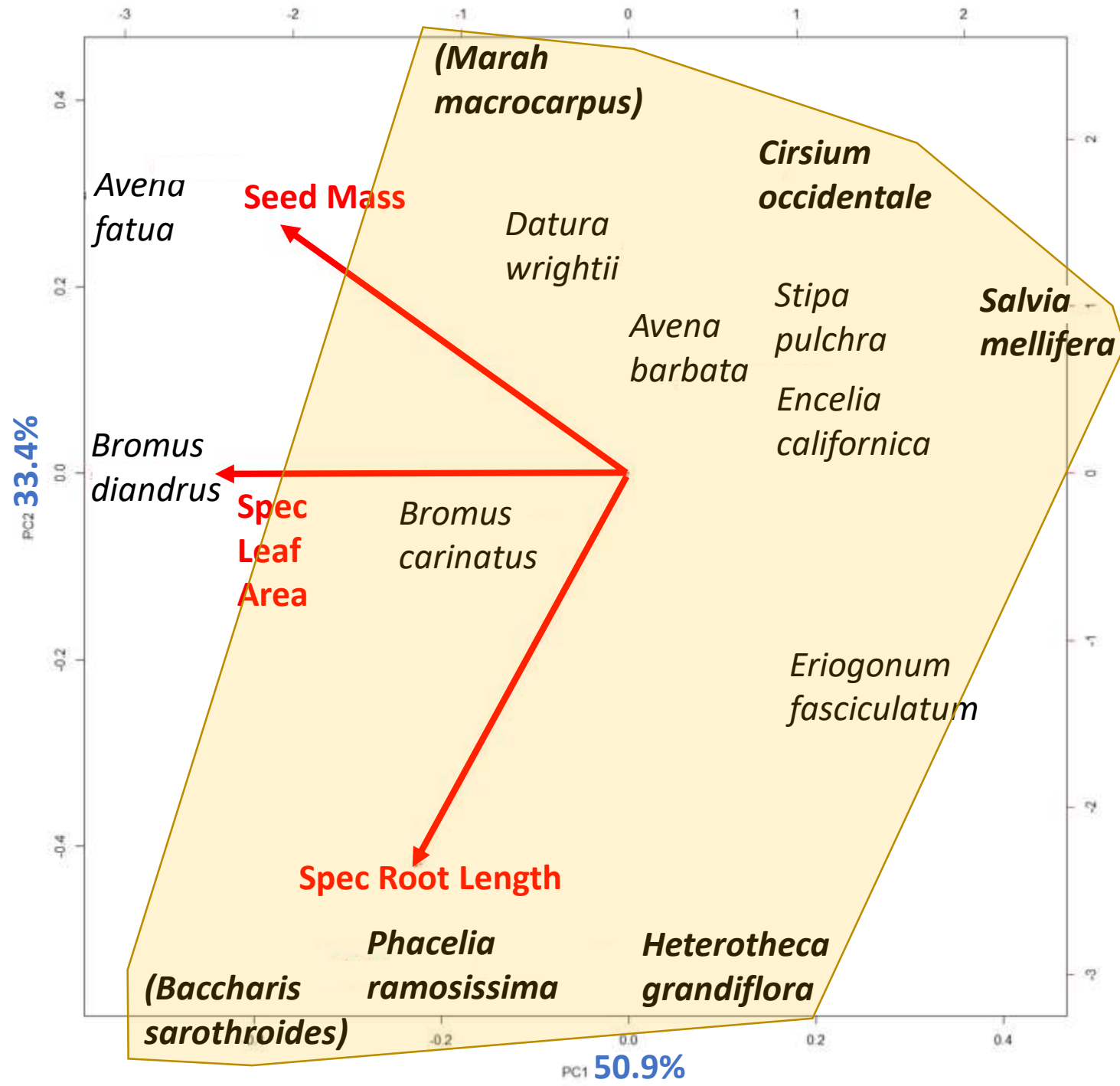
Traits Screened:

- Specific Leaf Area
- Specific Root Length
- Seed Mass









Sampling Design

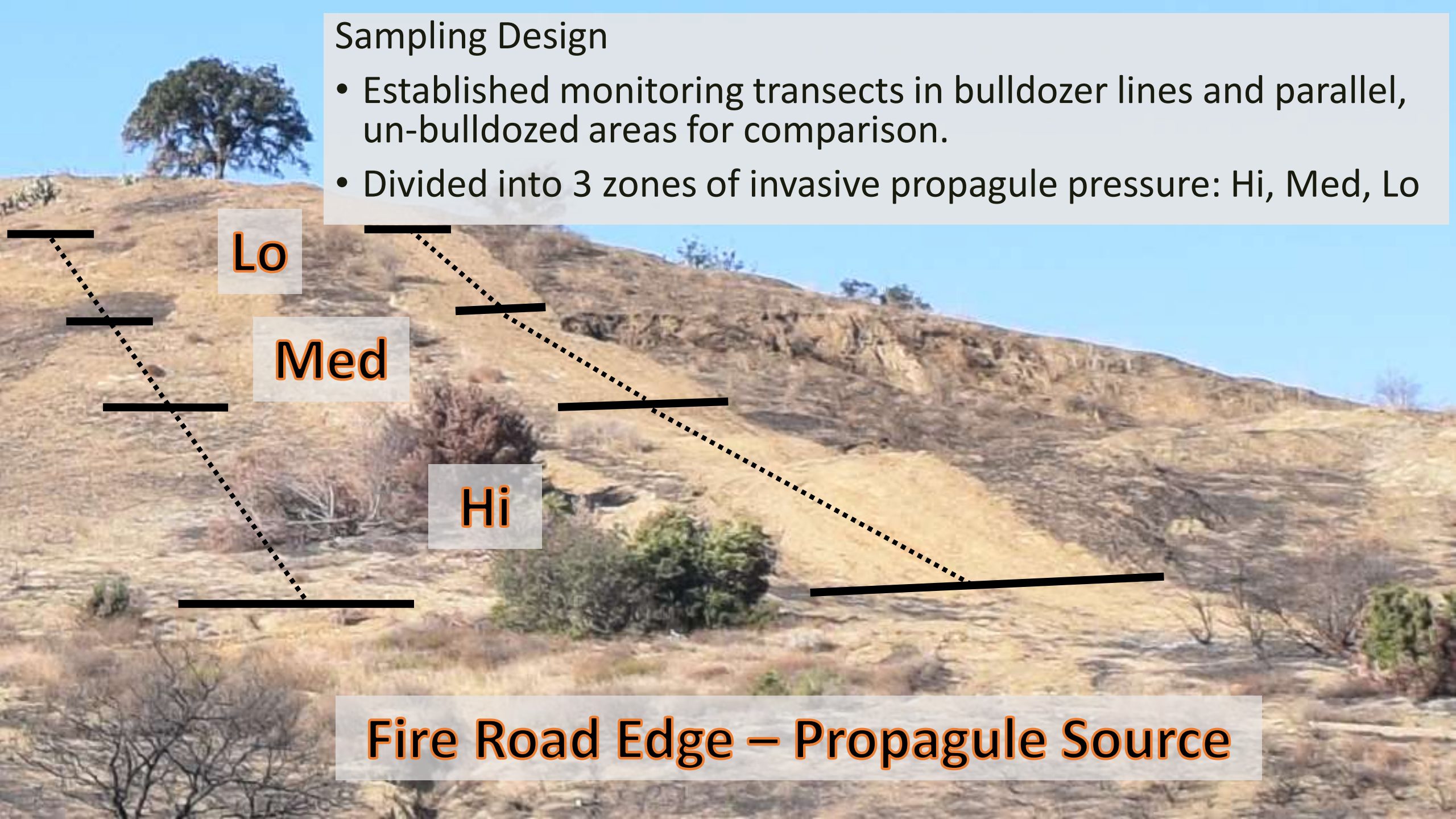
- Established monitoring transects in bulldozer lines and parallel, un-bulldozed areas for comparison.
- Divided into 3 zones of invasive propagule pressure: Hi, Med, Lo

Lo

Med

Hi

Fire Road Edge – Propagule Source



- Divided each zone into 3 subplots; 9 per transect
- Mowed $\frac{1}{2}$ of each subplot in spring 2018
- Seeded $\frac{1}{3}$ of each zone in dozer lines with each of 2 seed mixes (D, M)

Lo

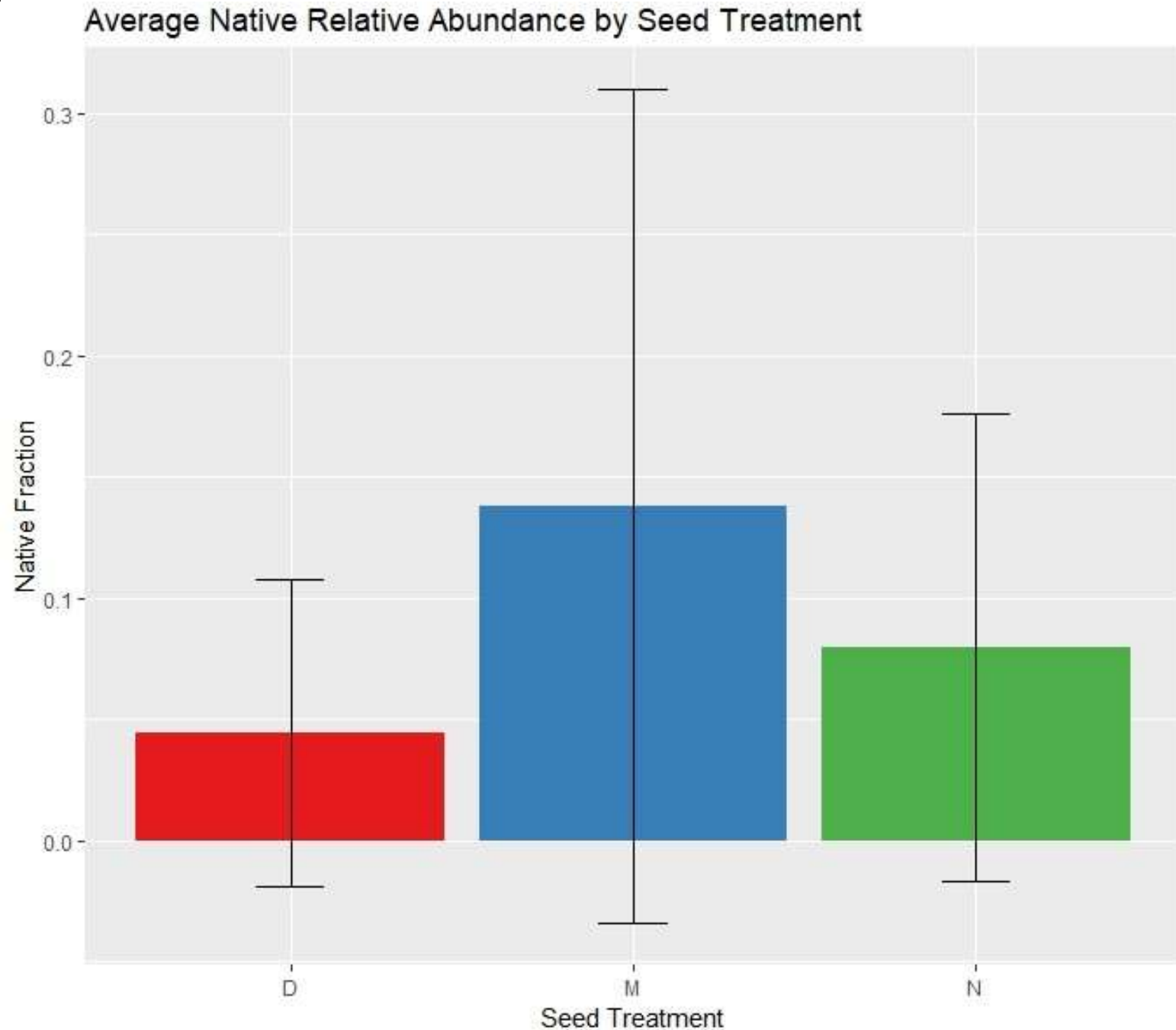
Med

Hi

Fire Road Edge – Propagule Source

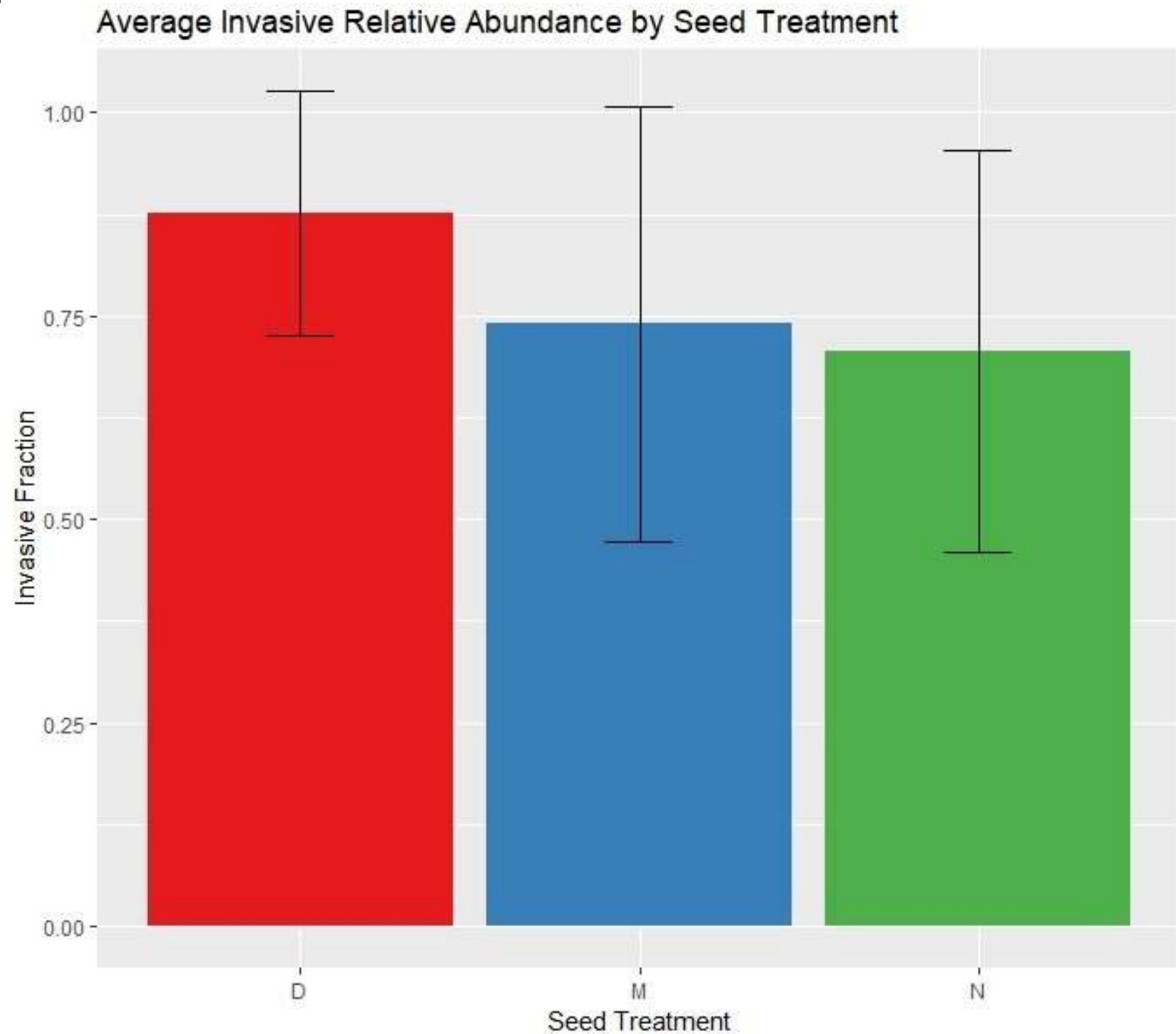
Results: Seed Mixes

- Seed mix plots were not significantly different from unseeded plots
- The two seed mixes were significantly different from each other, with mix M having higher native relative abundance and diversity



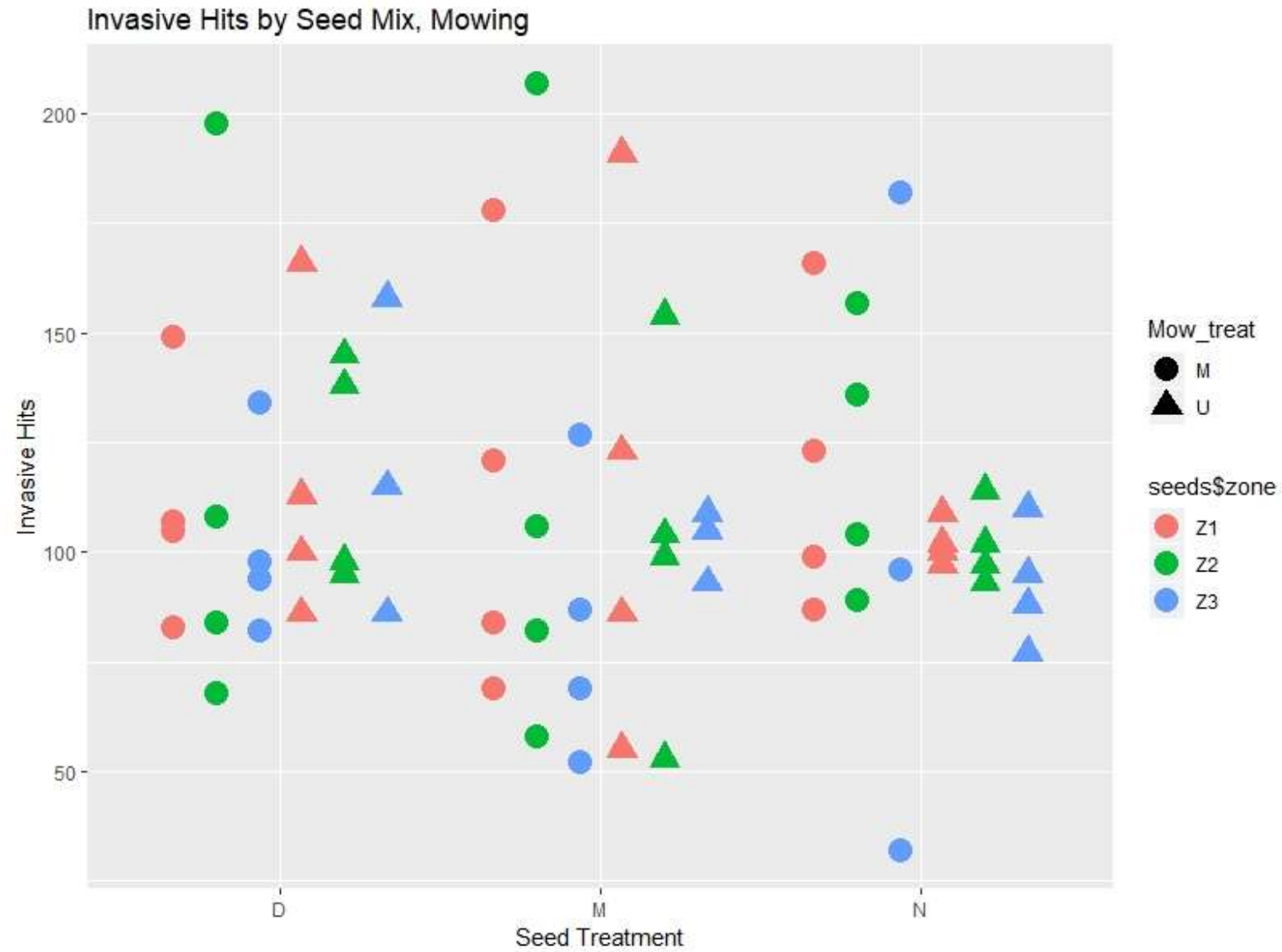
Results: Seed Mixes

- Seed treatments did not significantly influence invasive relative abundance



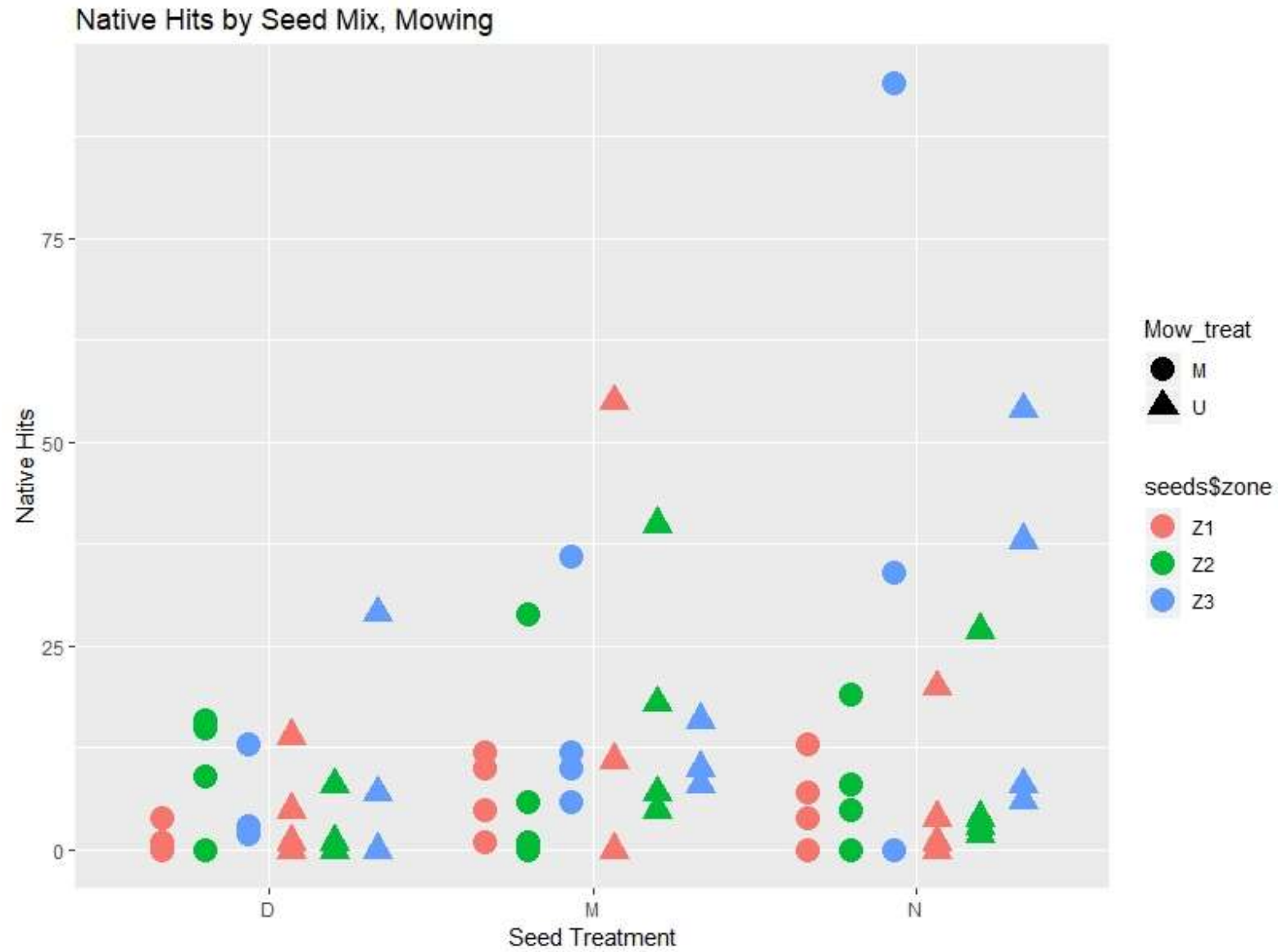
Results: Mowing

- Mowing did not significantly influence invasive hits.
- The distance from the fire road was inversely related with invasive relative abundance and positively related with native relative abundance in 2018.
- Zones (fire road distance for seed plots) were not significant for any variable in 2019.



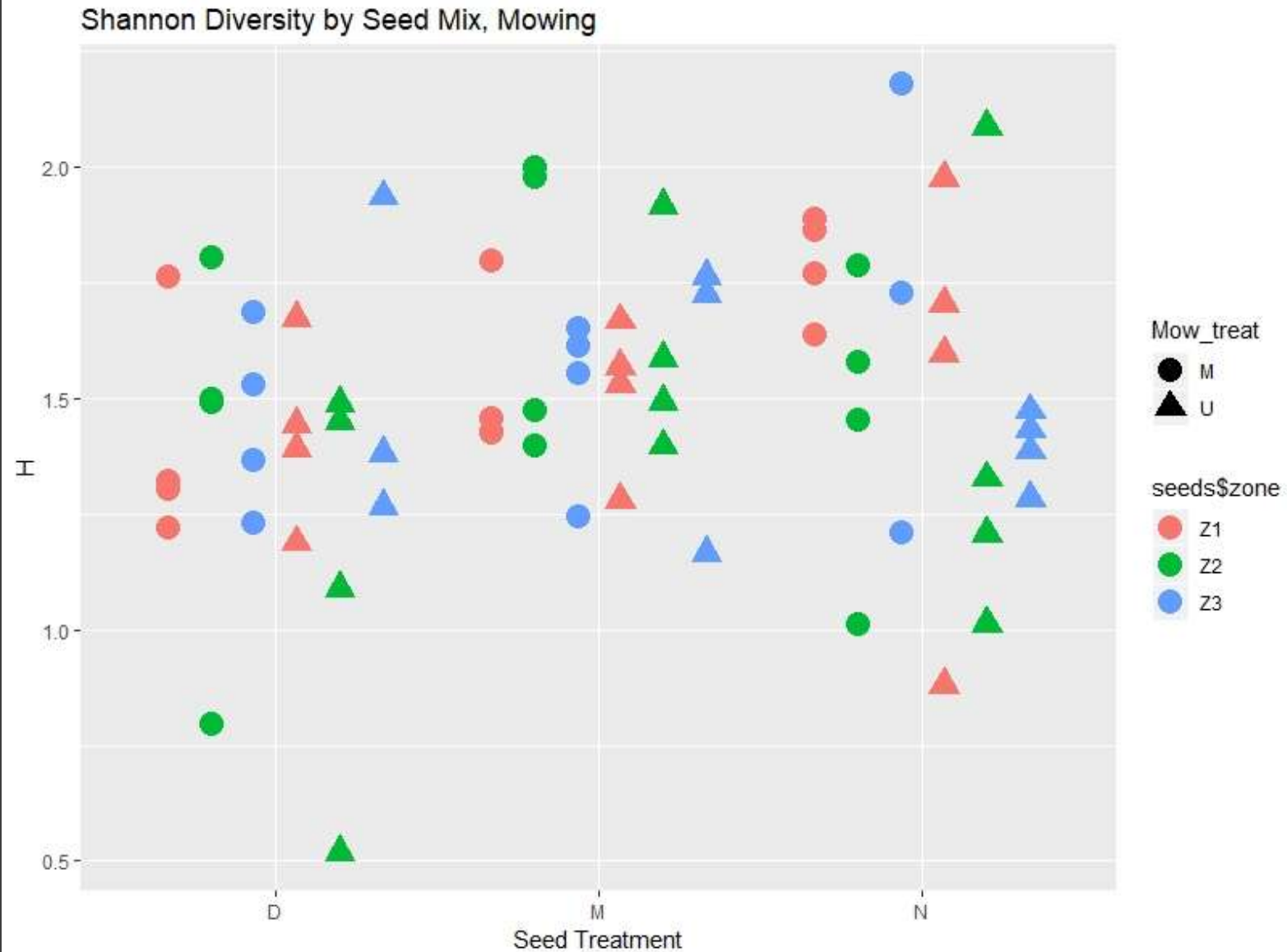
Results: Mowing

- Outlier native hits were excluded from statistical analysis because they represented large native shrubs that survived the fire.
- Mowing did not significantly influence the number of native plant hits in 2019.



Results: Mowing

- Shannon Diversity also does not show any significant relationship with mowing treatments
- Mix M had higher Shannon Diversity than mix D, but not significantly more than unseeded plots (N).



Lessons Learned

- Spatial patterns in bulldozer lines from 2018 were weaker in 2019, but still significant.
- Mowing did not occur until the second year after fire – allowed seed bank to establish?
- Seeding did not occur until the second year after fire – more competition from invasives?
- Plots seeded with the trait-matched mix had more natives but no influence on invasives
→ overall strategy of annual grass-like species seems favored in these conditions

Next Steps

- Repeat mowing 2019 – could native perennials benefit more than annuals from repeat mowing?
- Plant community monitoring 2019/2020 – after two years, what seeded species have recruited and persisted? Will seeded native perennials make up a larger fraction?
- Information sharing through management-oriented brochures, publications, presentations



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