THE IMPACTS OF HETEROGENEITY ON THE PROVISION OF RANGELAND ECOSYSTEM SERVICES IN AGRICULTURAL RESTORATION

Nancy Shackelford[1], Sam Ahler[2], Katherine Suding[2]

[1]University of Victoria, British Columbia, Canada
[2]University of Colorado, Boulder, CO, USA

TABLE OF CONTENTS

01

Background

Intro to my background, site history, and their combined influence on the project

02

Initial design

First experimental design for the site

03

Initial results

Utter. Chaos.

04

Drilling down

Spatial trends

05

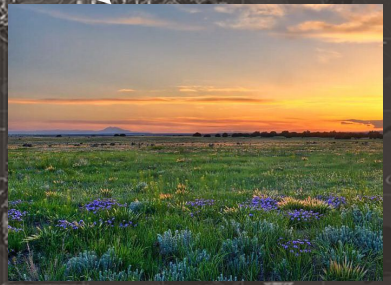
Continued Learning

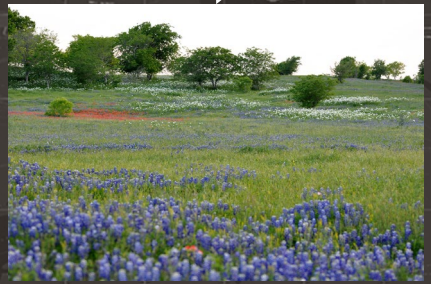
Lessons to take forward

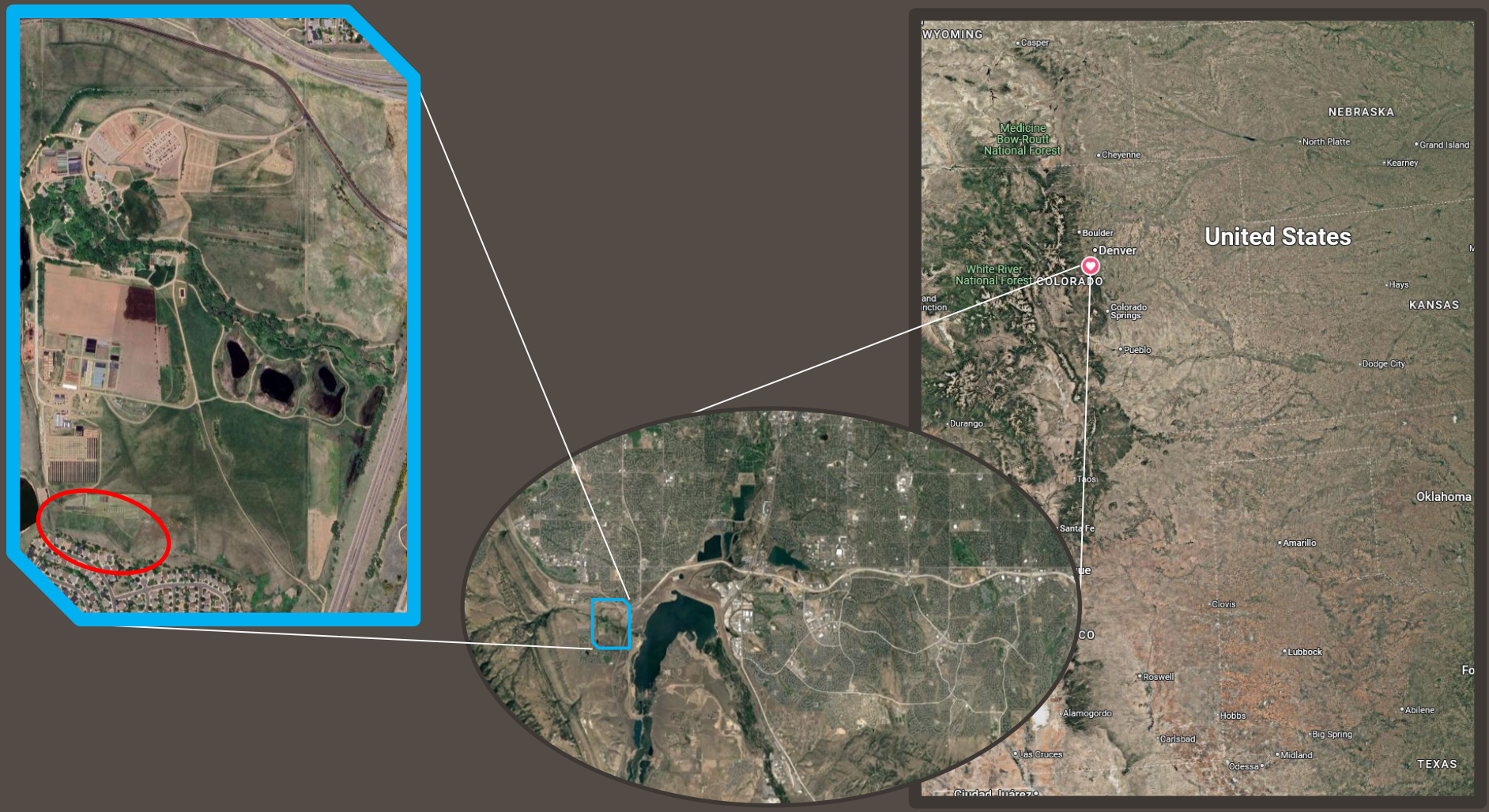
01

Background

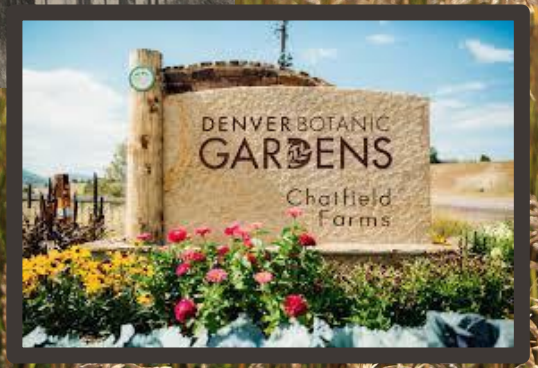
Photo: S. Baker / Hakai Magazine



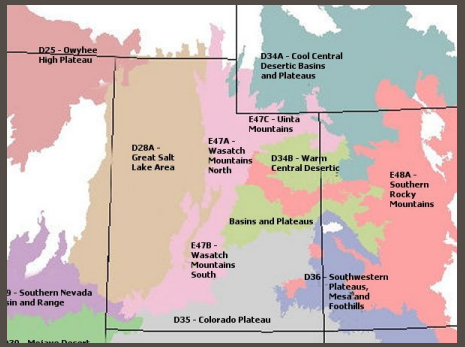



WYOMING
Casper
NEBRASKA
Medicine Bow-Routt National Forest
North Platte
Grand Island
Cheyenne
Kearney
Boulder
Denver
United States
White River National Forest
COLORADO
Hays
KANSAS
Colorado Springs
Pueblo
Dodge City
Durango
Taos
Oklahoma
Santa Fe
Amarillo
Clovis
Lubbock
Roswell
Alamogordo
Hobbs
Abilene
Carlsbad
Big Spring
Las Cruces
Midland
Odessa
TEXAS
Ciudad Juárez


GREEN ACRES

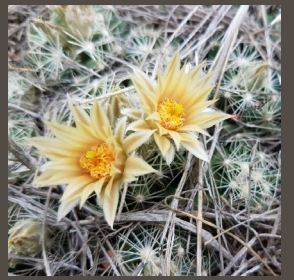

DENVER BOTANIC
GARDENS
Chatfield
Farms

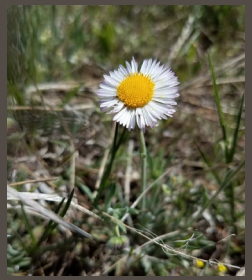

293
Spica coelestis
294. Solanum
Puma Americ
Rubis arvensis niger

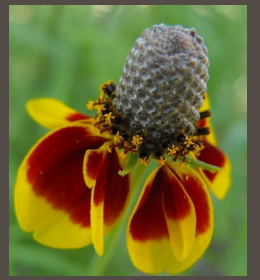

D25 - Owyhee
High Plateau
D34A - Cool Central
Desertic Basins
and Plateaus
E47C - Uinta
Mountains
D28A -
Great Salt
Lake Area
E47A -
Wasatch
Mountains
North
D34B - Warm
Central Desertic
E48A -
Southern
Rocky
Mountains
Basins and Plateaus
E47B -
Wasatch
Mountains
South
D36 - Southwestern
Plateaus,
Mesa and
Foothills
D35 - Colorado Plateau

Who will do the best?

Seed is expensive, there are more than a hundred potential species based on the many and varied sources, and the site experiences fairly extreme inter- and intra-annual variation in precipitation and temperature.







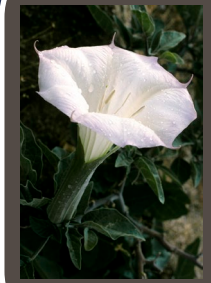
02

Initial design

Select species that don't care?

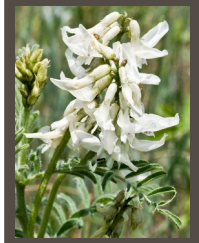
Achillea millefolium (common yarrow)

Match species to site conditions?

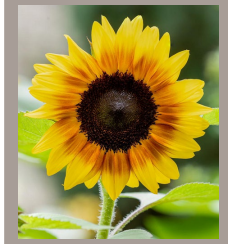


Datura discolor (desert thornapple)

Climate specialization: Rainfall tolerance

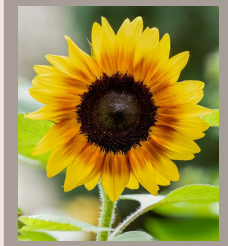


Astragalus drummondii (Drummond's milkvetch)

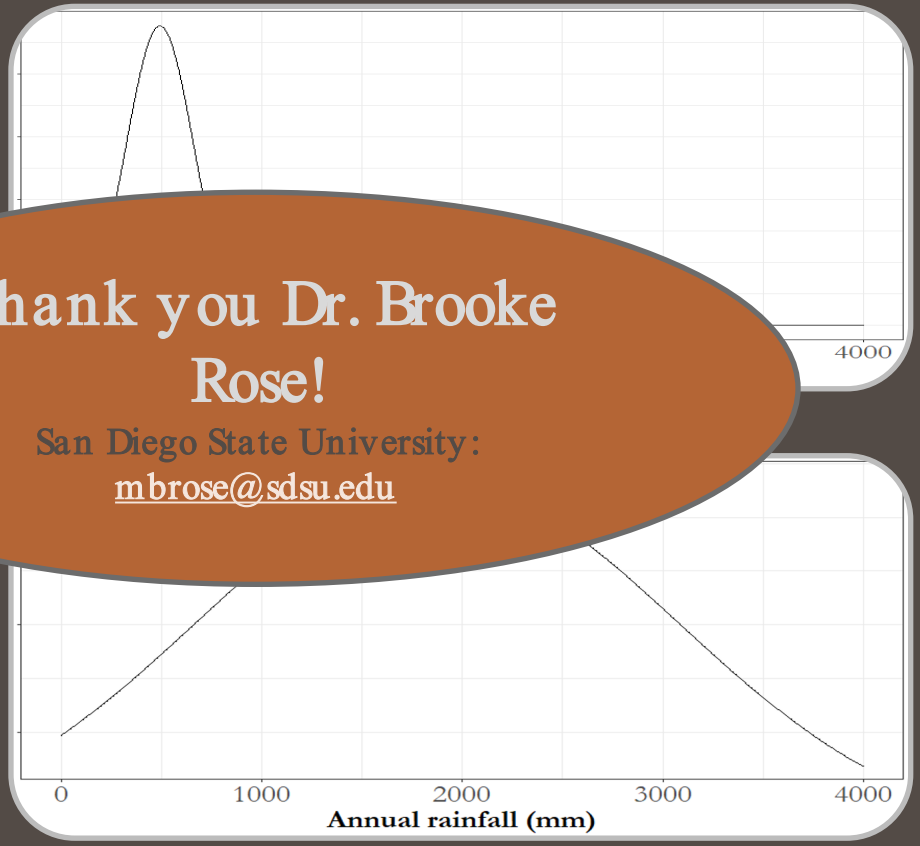


Helianthus annuus (annual sunflower)

Astragalus drummondii (Drummond's milky



Helianthus annuus (annual sunflower)



Specialist

Generalist

Thank you Dr. Brooke Rose!

San Diego State University:
mbrose@sdsu.edu

Experimental layout

- 68 rows – specialists, generalists, mixed, or none (controls)
- Randomly assigned as 100ft x 10ft rows
- Herbicided and tilled in 2018, herbicided in 2019, broadcast seeded and cultipacked in 2019, and drill seeded in 2020
- Monitored using line-point-intercept (LPI) starting in 2021
- Annual monitoring every since

Which most reliably provides ecosystem services?

RECRUITMENT

Did seeds lead to plants?

PRODUCTIVITY

Did plants grow into productive adults?

DIVERSITY

Are we enhancing native biodiversity?

INVASIBILITY

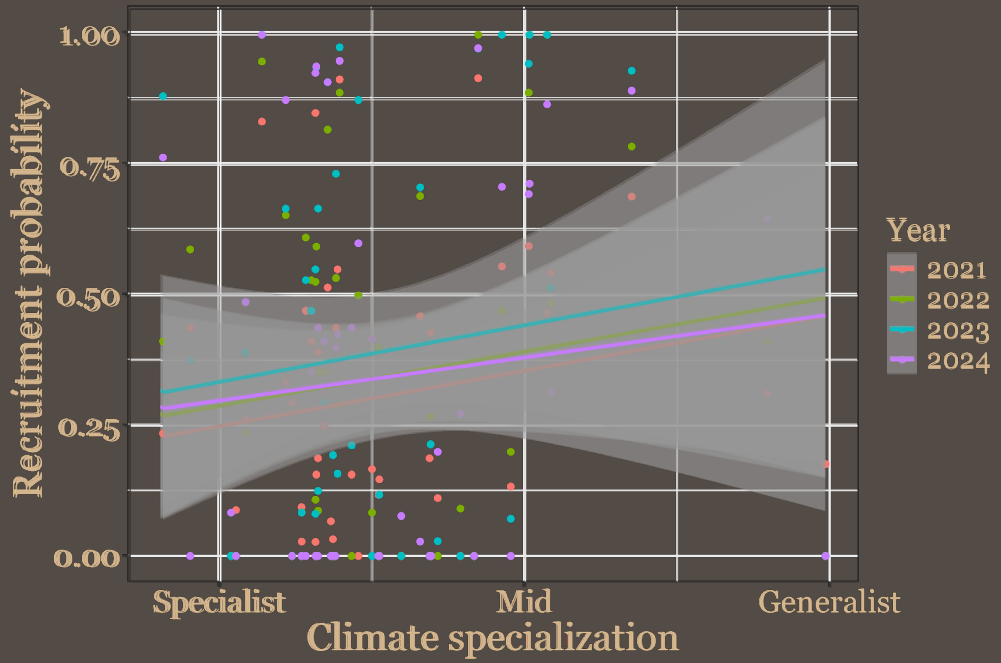
Did seeding reduce weeds?

0 3

Initial results

OVERALL: RECRUITMENT

Proportion of times a species was seeded in a row and then found in a row



2021

Helianthus annus (mid)

2022

Helianthus annus
Linum lewisii (mid)
Poa secunda (mid)

2023

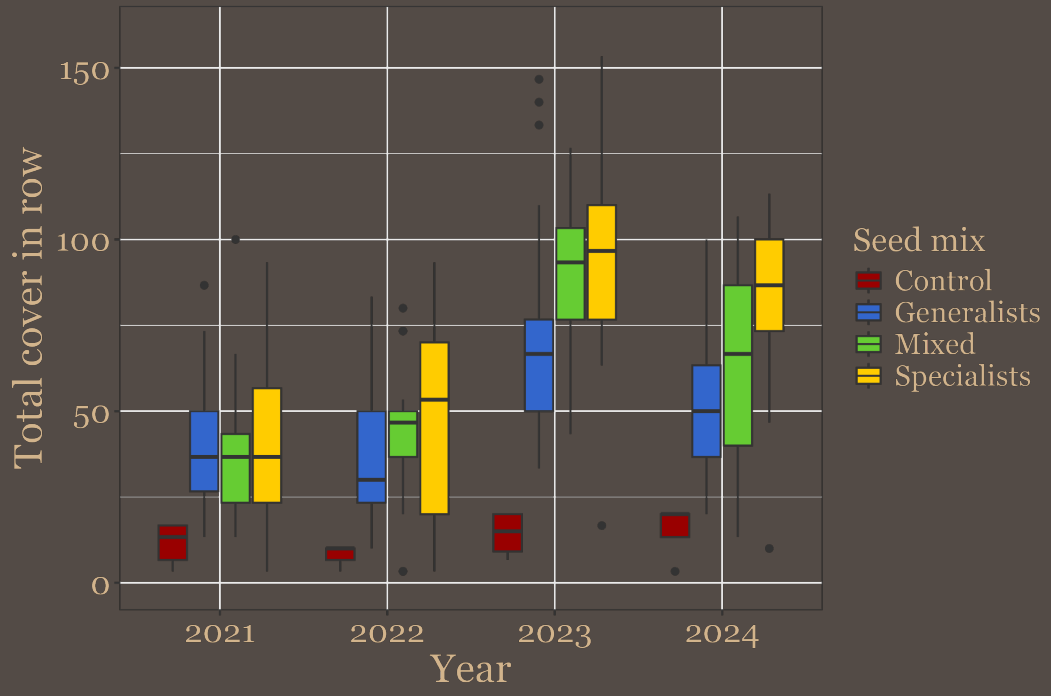
Helianthus annus
Poa secunda
Nasella viridula (specialist)
Vicia americana (mid)

2024

Nasella viridula

OVERALL: PRODUCTIVITY

Total cover in a row of seeded species, aggregated over all seeded species



2021

Helianthus annuus (mid)
Nasella viridula (specialist)
Pascopyrum smithii (specialist)

2022

Nasella viridula
Pascopyrum smithii

2023

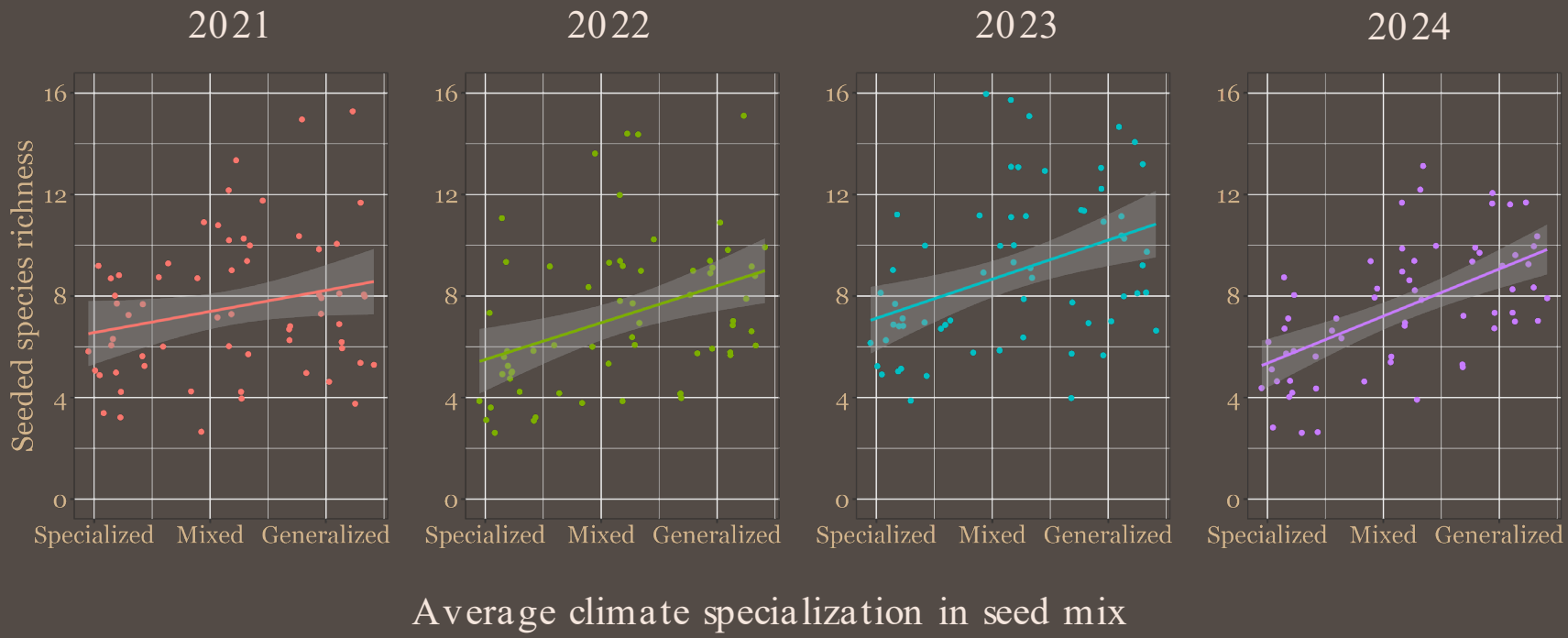
Nasella viridula
Pascopyrum smithii
Linum lewisii (mid)
Elymus trachycaulus (generalist)
Heliomeris multiflora (specialist)
Poa secunda (mid)

2024

Nasella viridula
Pascopyrum smithii
Elymus trachycaulus

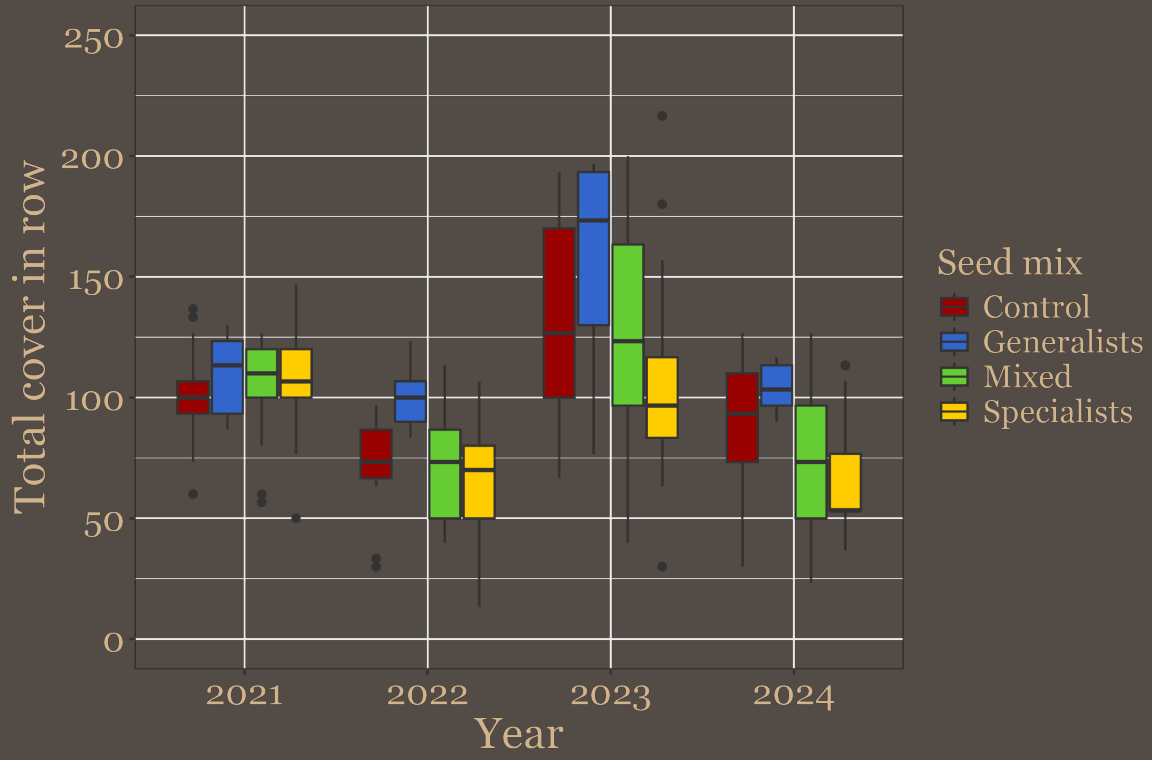
OVERALL: DIVERSITY

Are we enhancing native species biodiversity?



OVERALL: INVASIBILITY

Did seeding reduce non-native species cover?

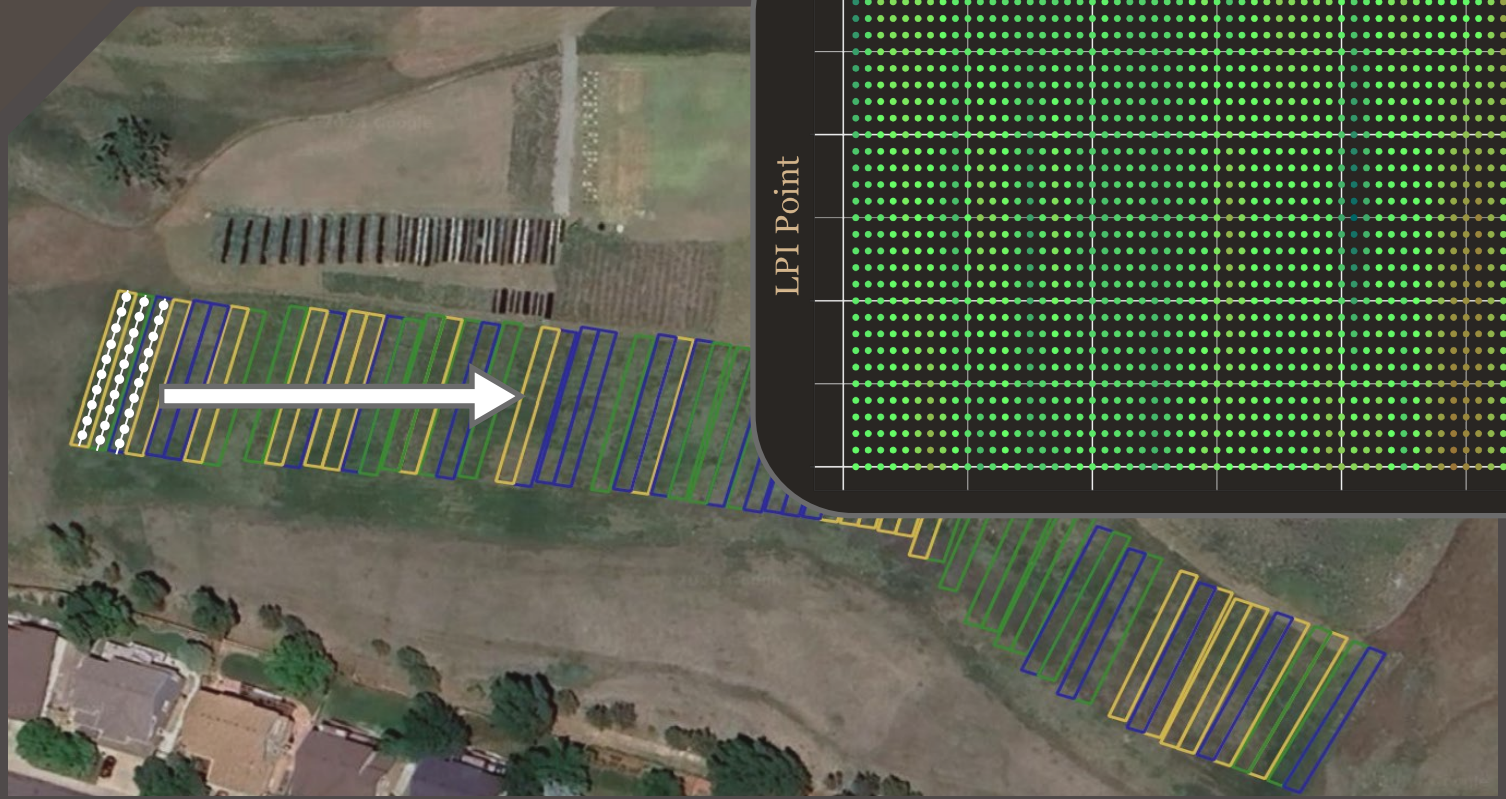


Overall (tentative) takeaway: Seed mixes with generalist species tend to have higher initial recruitment and thus higher diversity, but seed mixes with species specialized to the site conditions tend to have higher productivity, and lower invasibility through time

04

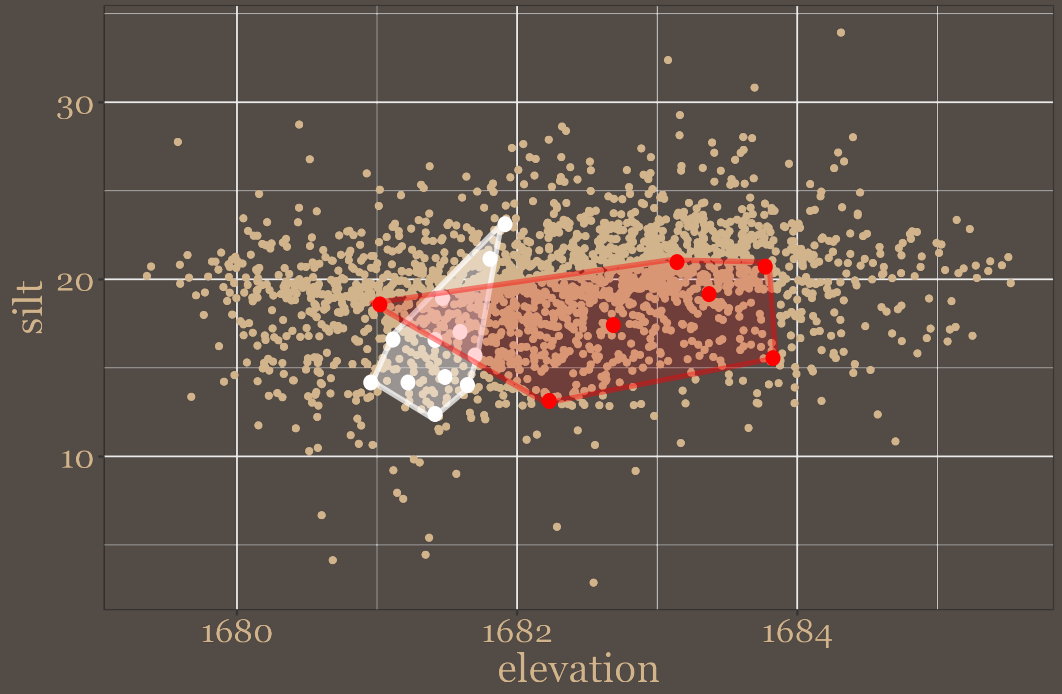
Drilling down

Site conditions are variable



SPATIAL DYNAMICS

With such high variation, do specialized species stick to their preferred microsites?

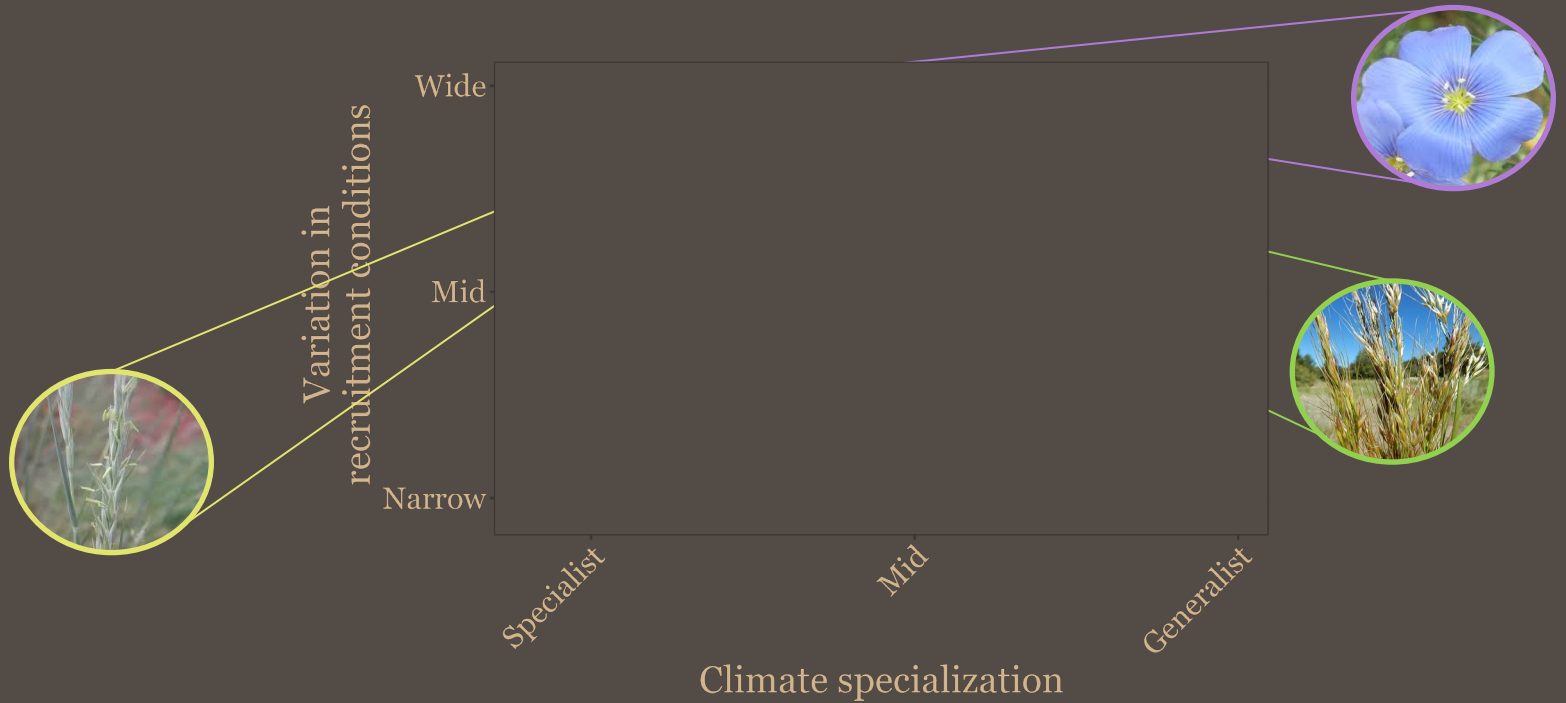


We'd expect that area covered to be smaller for specialist species, which likely have more constrained growing preferences

SPATIAL DYNAMICS

We see broader recruitment conditions for generalist species

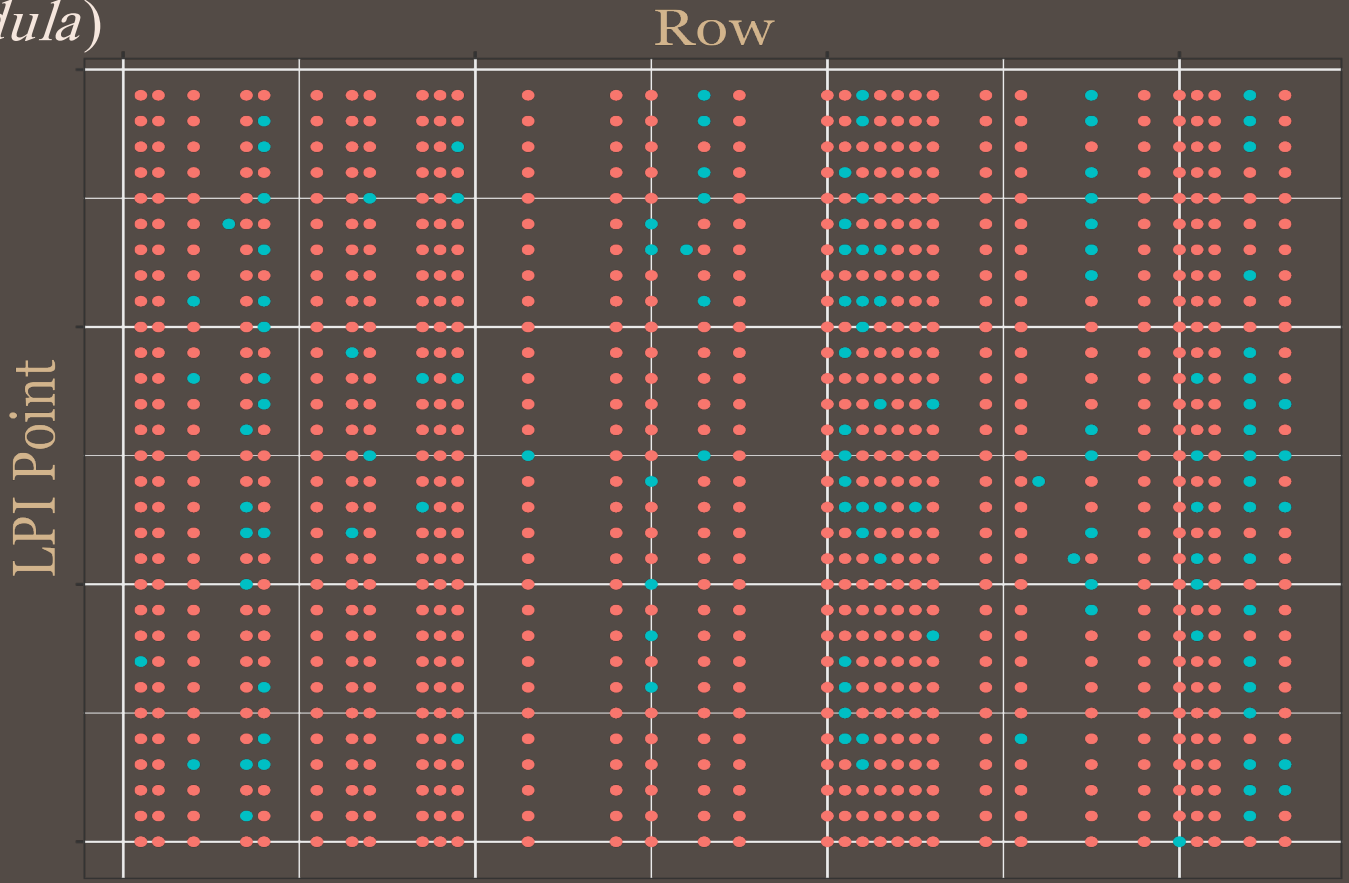
We should all take this with a grain of salt. Or a block of it.



Green needle grass (*Nassella viridula*)

2021

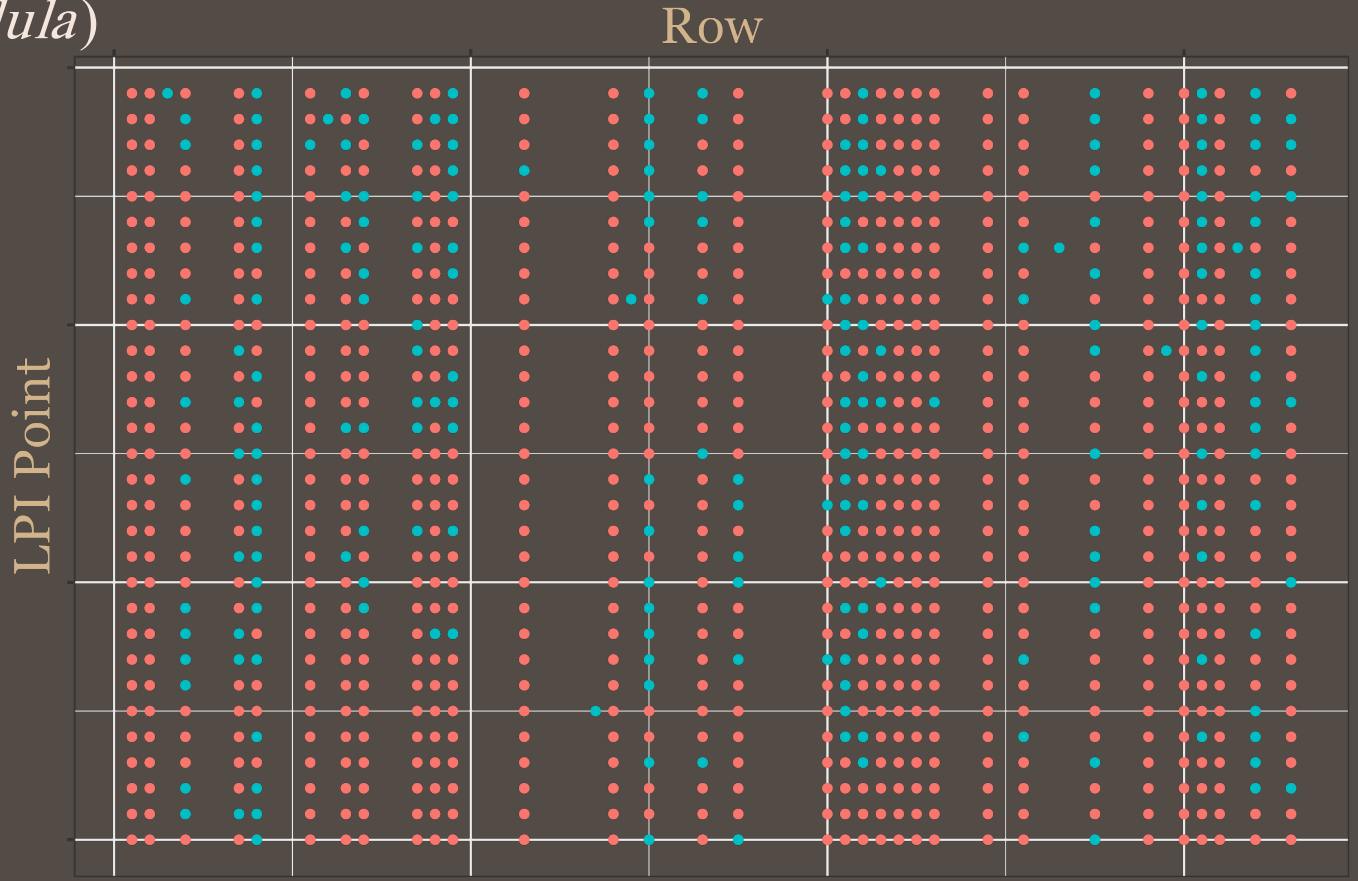
Present
- No
- Yes



Green needle grass (*Nassella viridula*)

2022

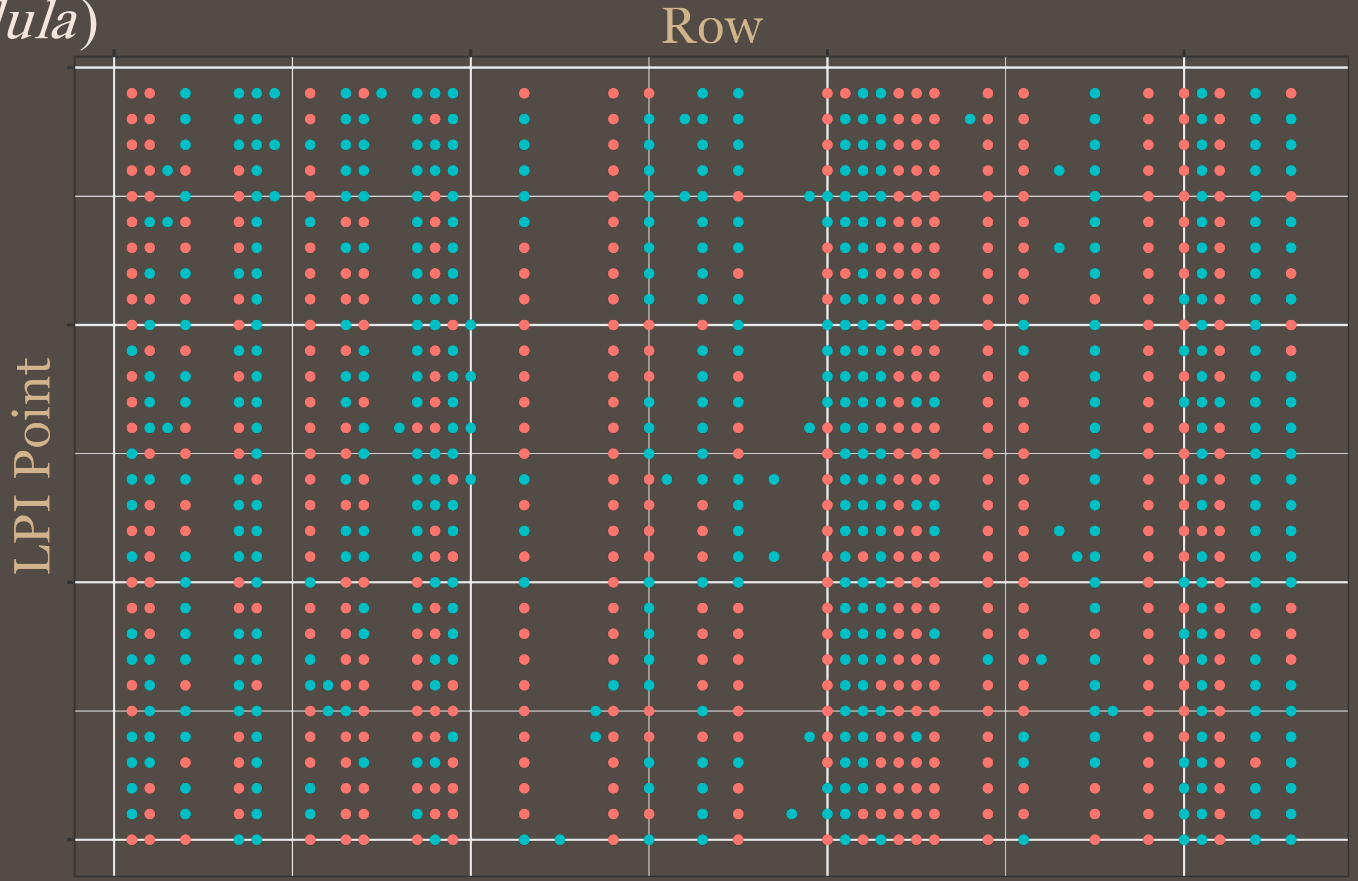
Present
- No
- Yes



Green needle grass (*Nassella viridula*)

2023

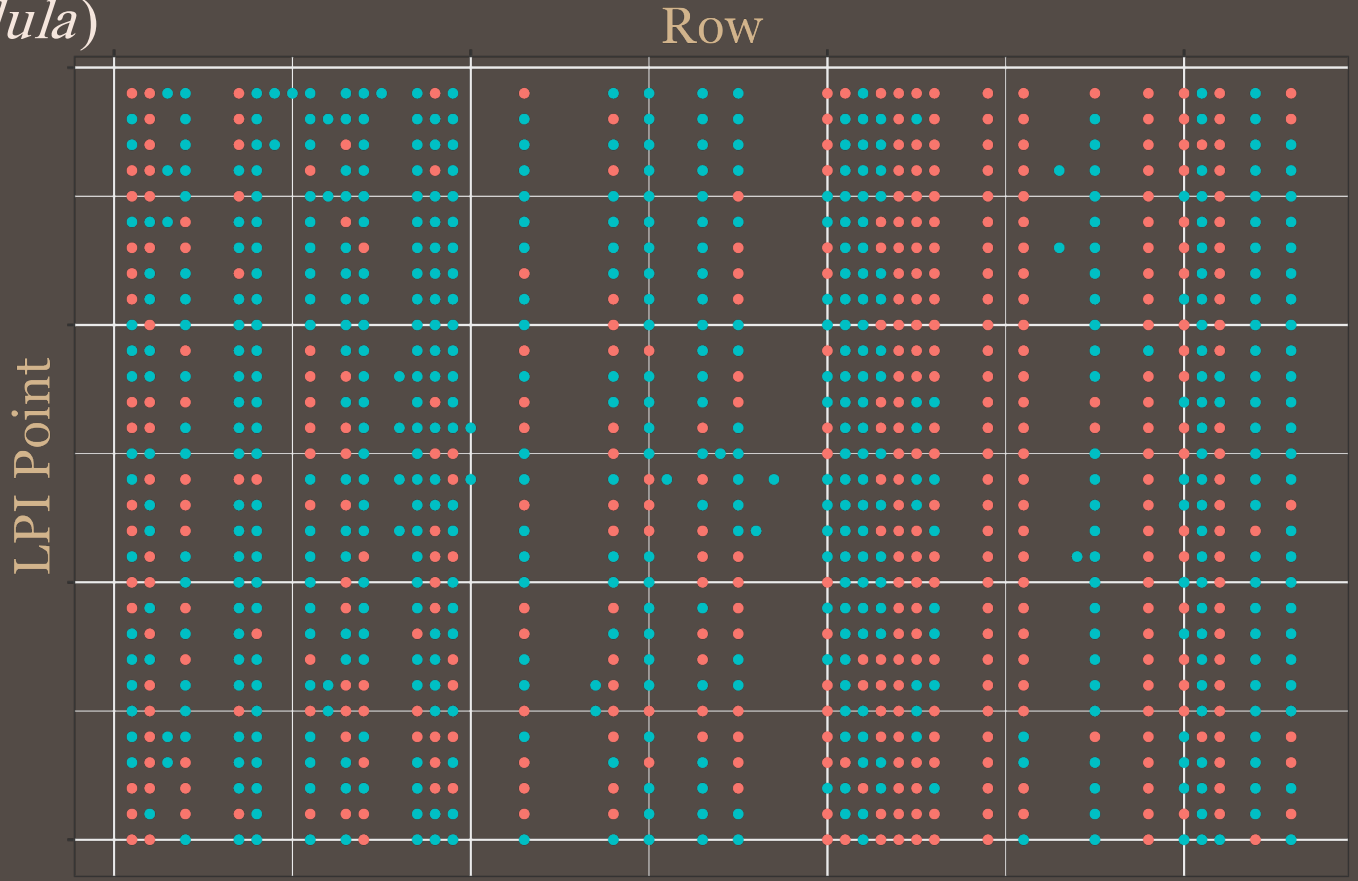
Present
- No
- Yes



Green needle grass (*Nassella viridula*)

2024

Present
- No
- Yes



05

Continued Learning

Microsite management for perennial grasses

Passive restoration in old fields often fails

Thus, our science and management are ongoing relationships

THANKS

Do you have any questions?

youremail@freepik.com
+91 620 421838
yourcompany.com