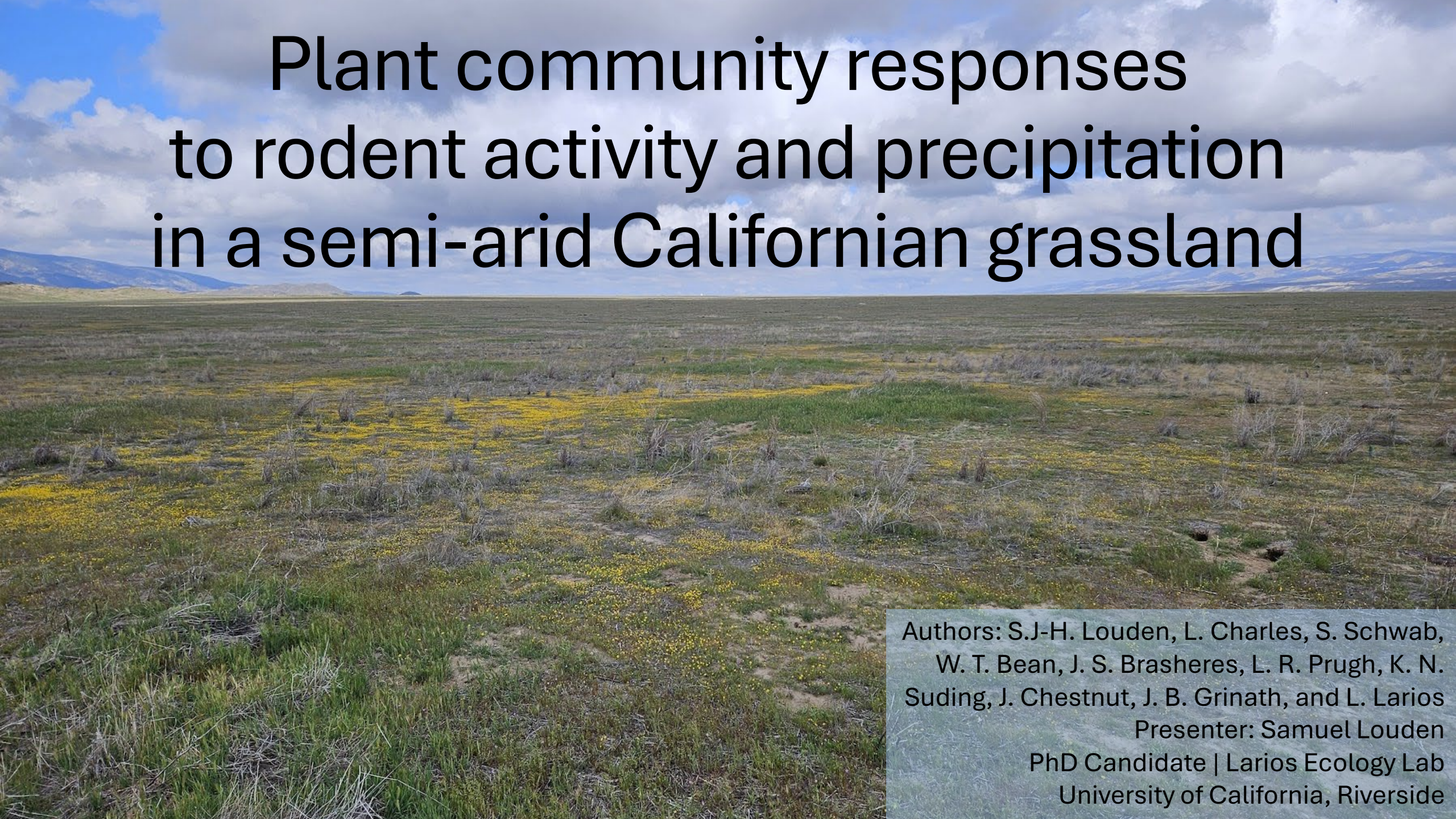
Plant community responses to rodent activity and precipitation in a semi-arid Californian grassland



Authors: S.J-H. Louden, L. Charles, S. Schwab, W. T. Bean, J. S. Brasheres, L. R. Prugh, K. N. Suding, J. Chestnut, J. B. Grinath, and L. Larios
Presenter: Samuel Louden
PhD Candidate | Larios Ecology Lab
University of California, Riverside

Acknowledgments

2017 – present

- Larios Ecology Lab (UC Riverside)
  - Loralee Larios*
  - Lachlan Charles*
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  - Clarissa Rodriguez
  - Stuart Schwab*
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  - Dirk Plunkett
  - BryAnna Wertz
  - Ariana Firebaugh-Ornelas
- Spatial Wildlife Ecology Lab (Cal Poly SLO)
  - Tim Bean*

2007 - 2017

- Laura Prugh*
- Justin Brasheres*
- Kathleen Suding*
- Joshua Grinath*
- John Chestnut*
- CPEP crew

Special thanks

- Bureau of Land Management

California grasslands

- Distinguished by Mediterranean climate
- Highly diverse across taxonomic groups
- Heavily altered by human activity

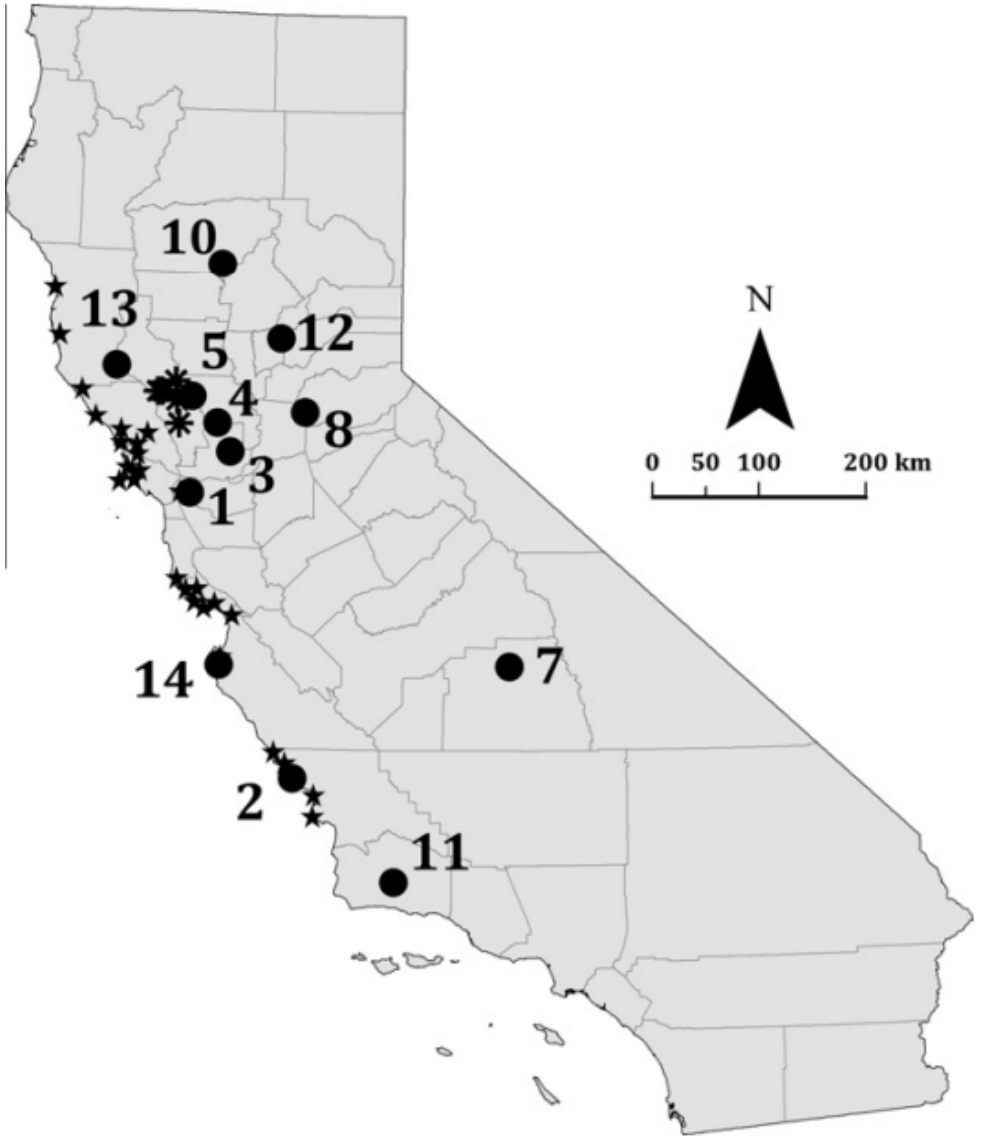
Eviner 2015; Map by P. Welch, CISR

Grazing management in California grasslands

- Coincides with established rangelands in northern and coastal California

Sheep grazing in East Bay Regional Park District; PC: L. Larios

Cattle grazing in Browns Valley, CA; PC: L. Larios



Stahlheber and D'Antonio 2013

California grasslands

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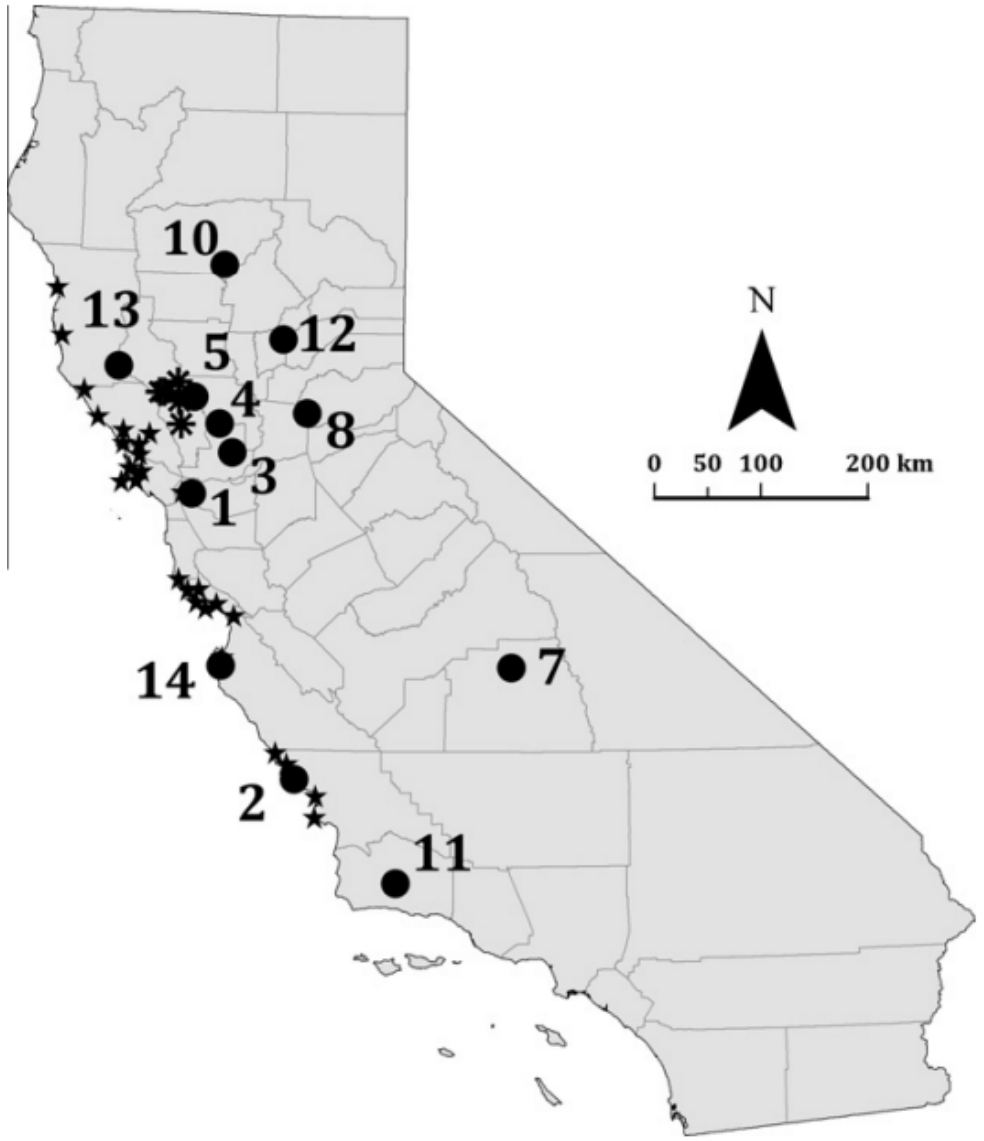
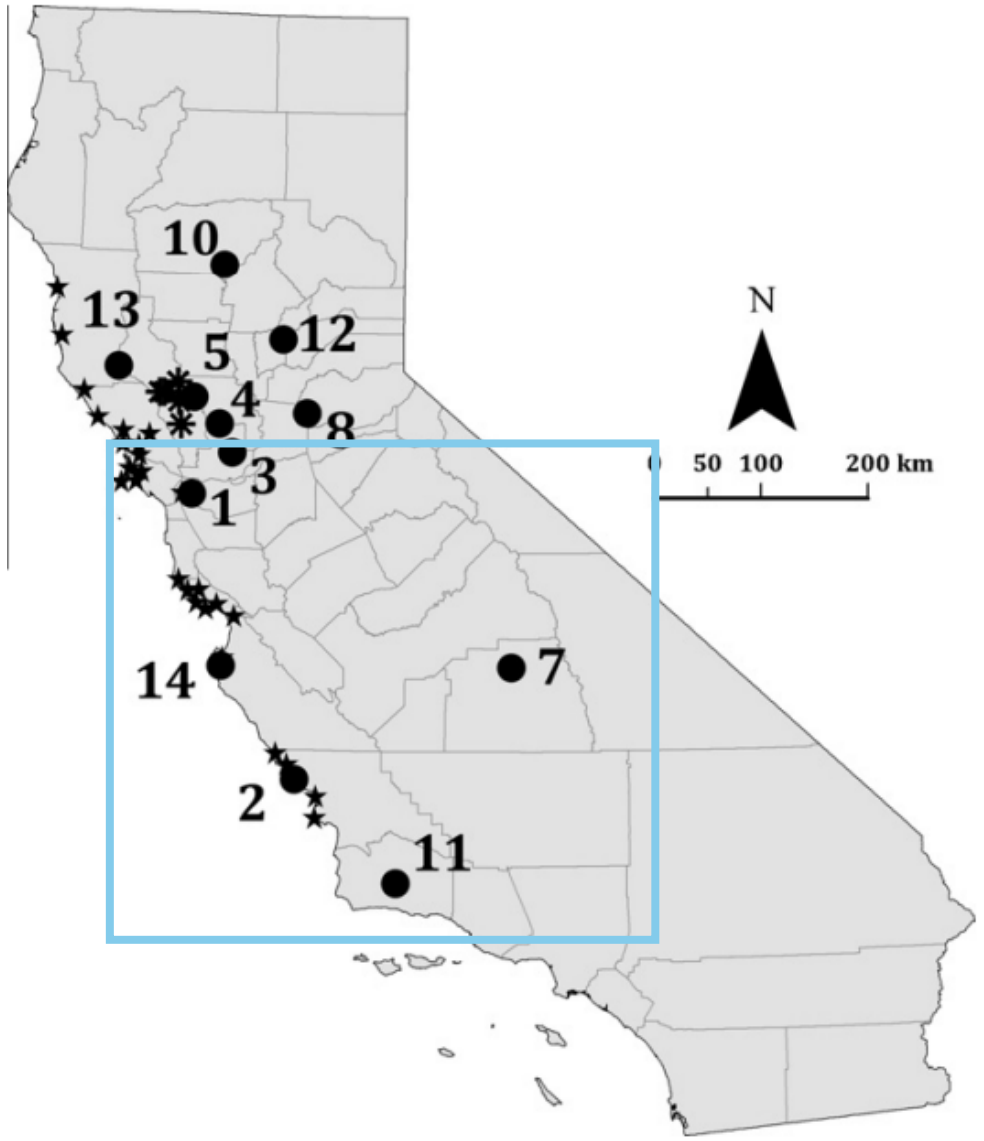
- **Grazing as a management strategy, particularly in established rangelands.**



Stahlheber and D'Antonio 2013

California grasslands

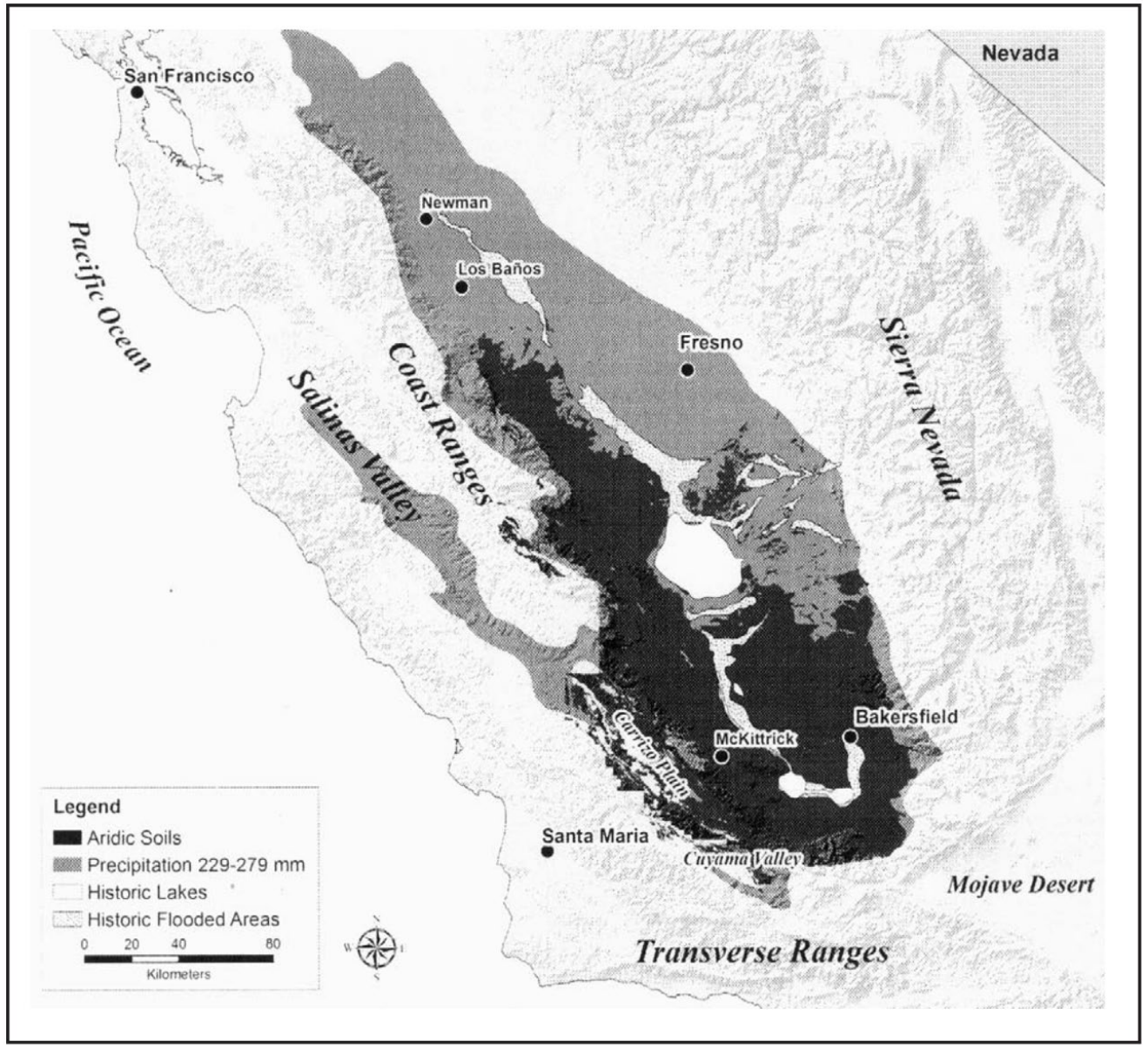
- Distinguished by Mediterranean climate
- Highly diverse across taxonomic groups
- Heavily altered by human activity
- Grazing as a management strategy, particularly in established rangelands.
- But what about southern, inland grasslands?



Stahlheber and D'Antonio 2013

San Joaquin Desert

- Some of the most arid valley grasslands occurred (or used to occur) in the western and southern San Joaquin Valley.
- Distinguished by low rainfall, and only during winter months.
- In the spring, native forb cover competes with non-native grass cover.



Germano *et al*. 2011

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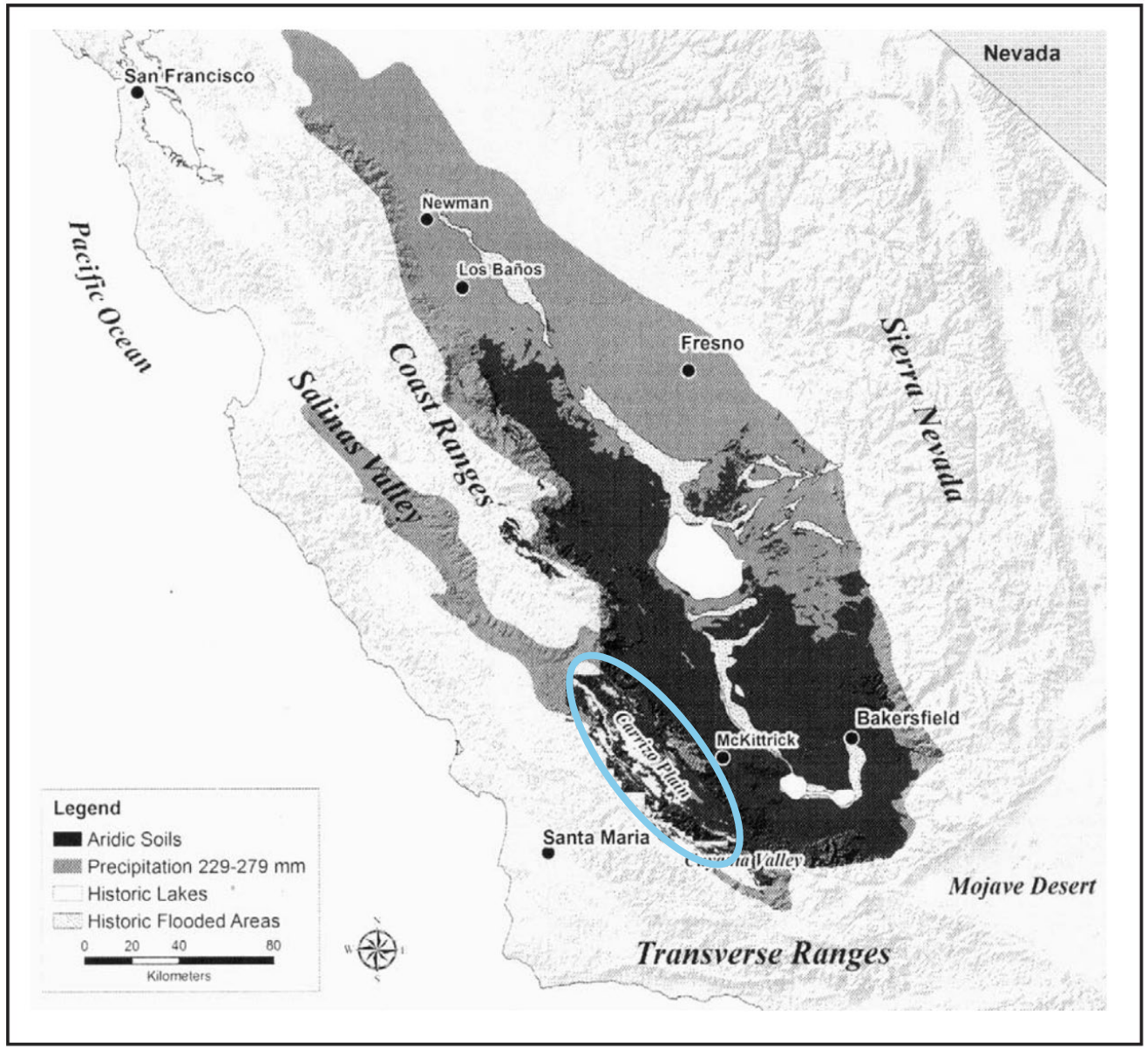


Germano *et al*. 2011

Carrizo Plain National Monument

Native

Lasthenia minor
PC: Neal Kramer

Trifolium gracilentum
PC: Steve Matson

Festuca microstachys
PC: Robert Preston

Amsinckia tessellata
PC: Steve Matson

Lepidium nitidum
PC: Steve Matson

Pectocarya penicilliata
PC: Steve Matson

...and ~75 more!

- Largest intact remnant of the San Joaquin Desert ecosystem.

Non-native

Bromus rubens
PC: Steve Matson

Hordeum murinum
PC: Ron Vanderhoff

Erodium cicutarium
PC: Steve Matson

Sisymbrium irio
PC: Jennifer Mo

Schismus arabicus
PC: James Bailey

...and ~10 more.

And moooore?

Built-in conservation grazing (and more!)

- The giant kangaroo rat (GKR) plays several essential roles in this ecosystem.

Dipodomys ingens
PC: Mark Chappell

Burrowing activity frequently shifts soil on burrow mounds (biopedturbation)

“Dots” are empty pit caches ready for seeds

“Hay pile” of *Bromus rubens* seeds

GKR clear entrances and burrow mounds of vegetation

Mooooooore for us?

...by an endangered rodent species.

- Extirpation of native animals can have lasting impacts on already sensitive ecosystems.

Dipodomys ingens
PC: Mark Chappell

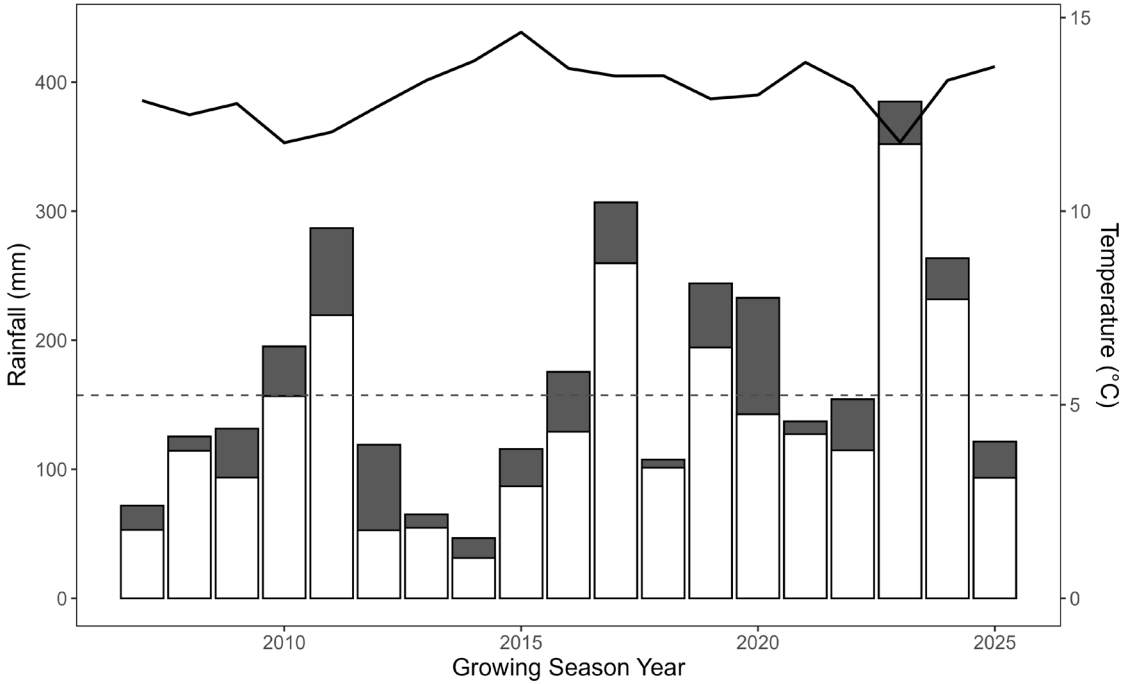
Burrowing activity frequently shifts soil on burrow mounds (biopedturbation)

“Dots” are empty pit caches ready for seeds

“Hay pile” of *Bromus rubens* seeds

GKR clear entrances and burrow mounds of vegetation

What are the effects of water availability and rodent activity on long-term plant community dynamics?



- Context: Rainfall is highly variable between and across years.

Bean and Larios 2021

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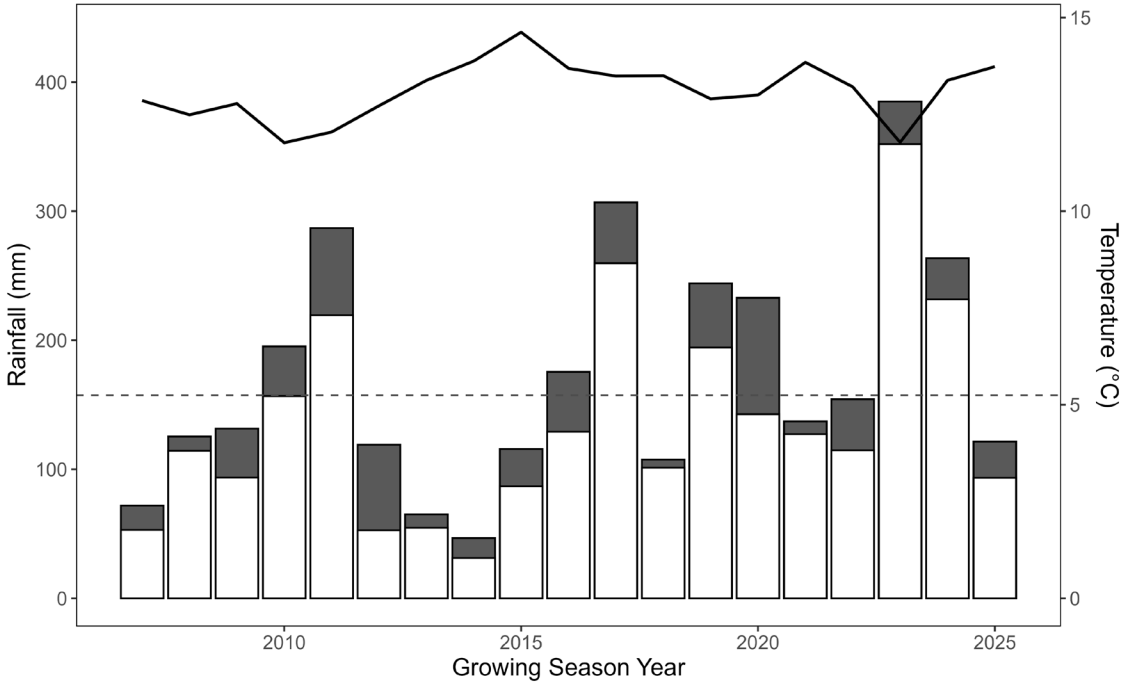

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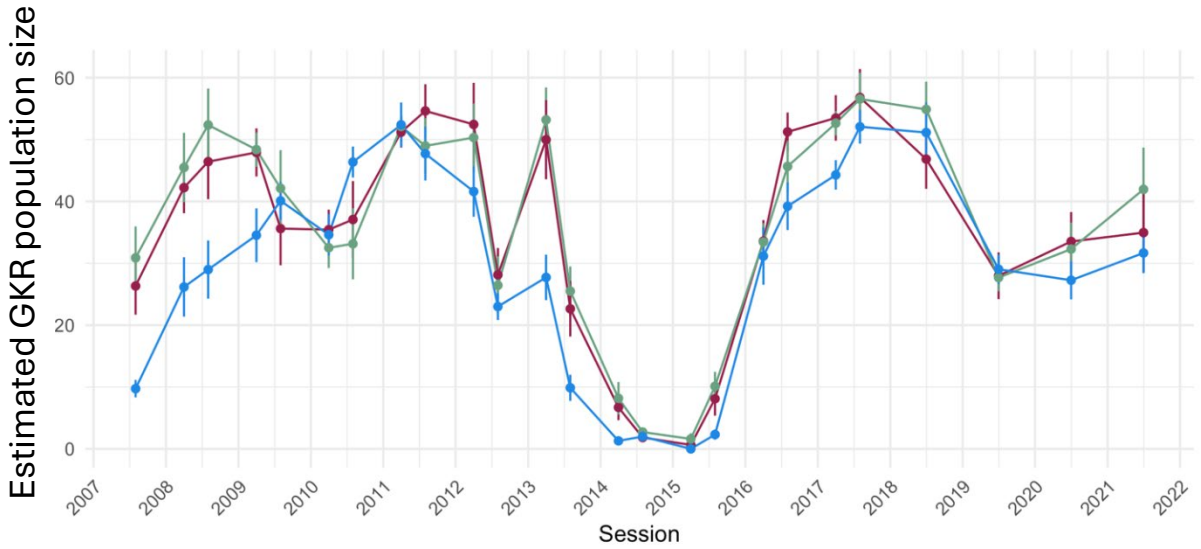

- GKR populations fluctuate as they track rainfall.

Bean and Larios 2021

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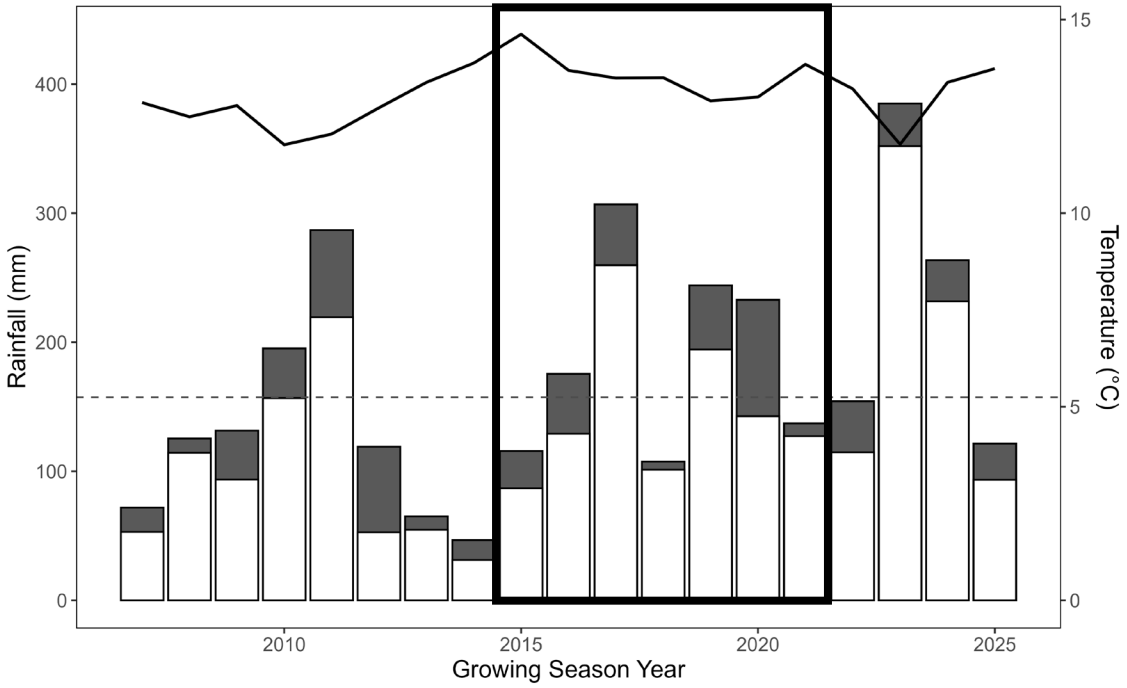

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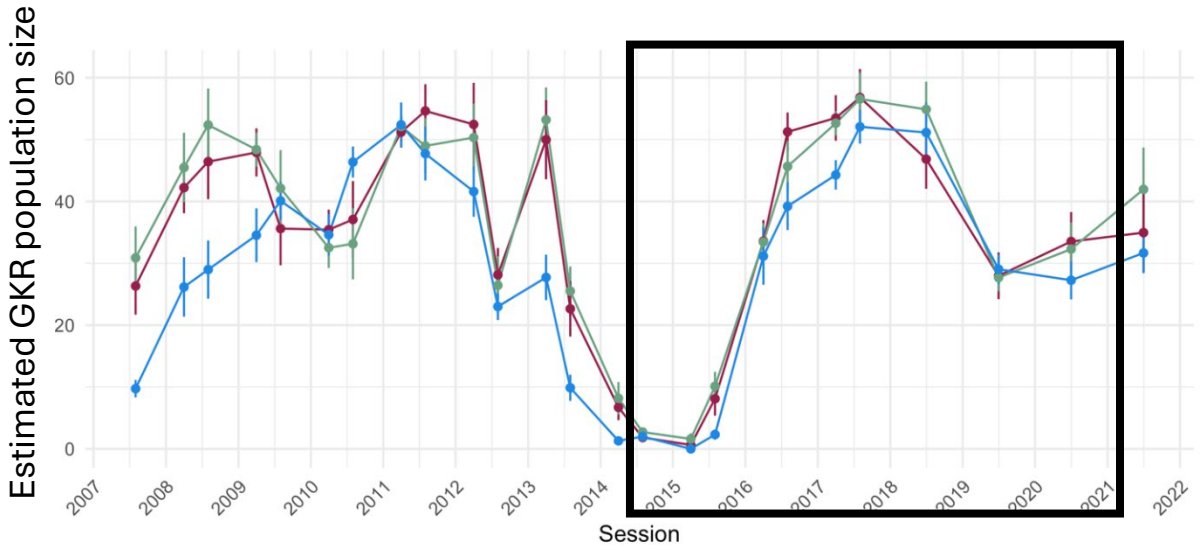

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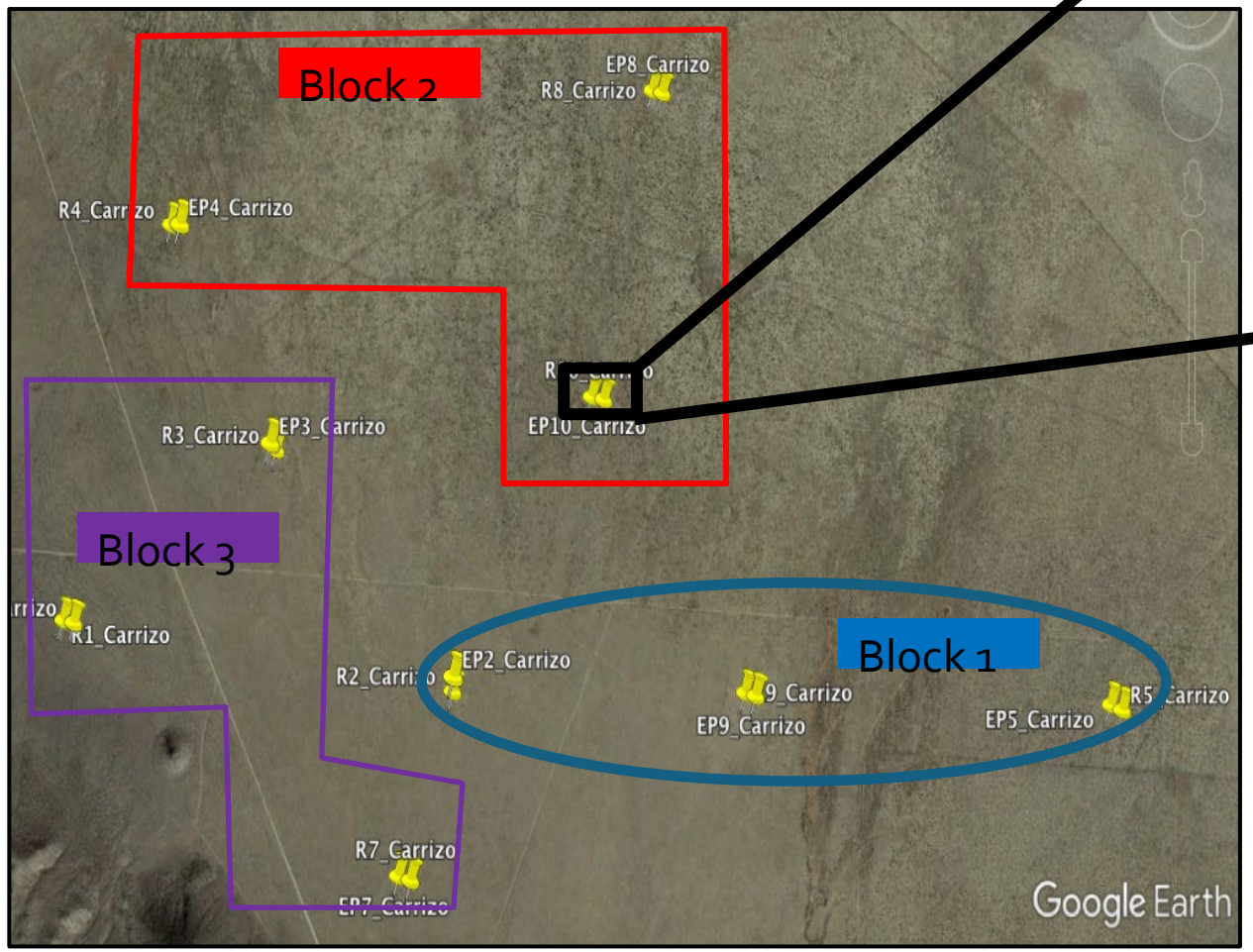
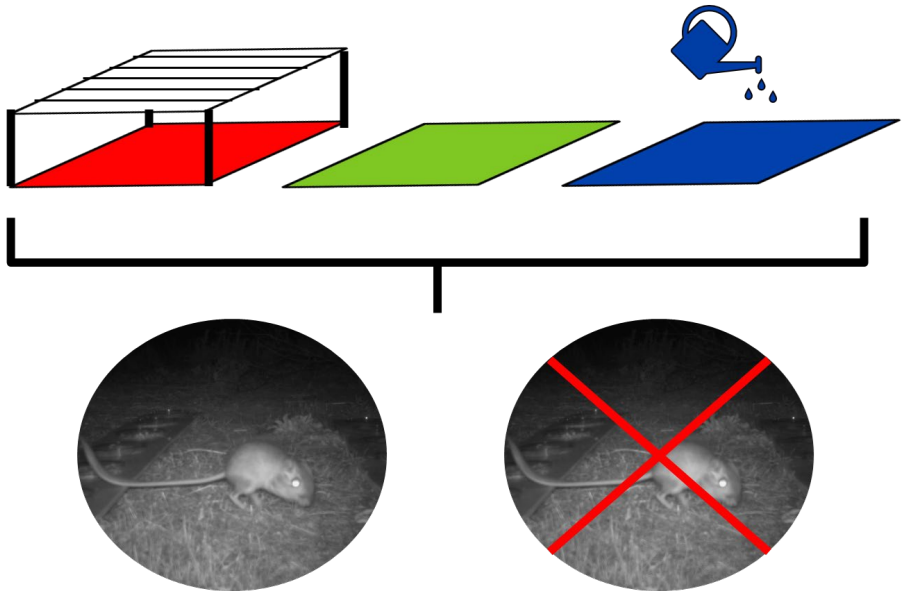
Bean and Larios 2021

Carrizo Plain Ecosystem Project



Layout of experimental plots in Center Well pasture, Carrizo Plain National Monument; P.C.: Lachlan Charles

Example of paired Exclosure*Irrigation (left) and GKR*Shelter (right) plots

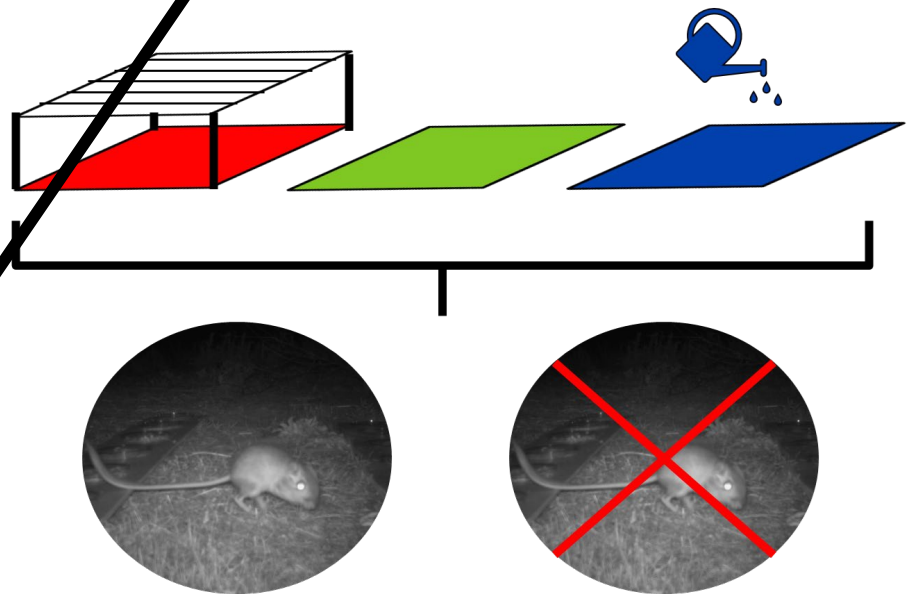


Graphic depicting all combinations of factorial design

Carrizo Plain Ecosystem Project

Apparent effects of GKR on either side of exclosure fencing;
GKR absent | GKR present

Example of paired Exclosure*Irrigation (left) and GKR*Shelter (right) plots



Graphic depicting all combinations of factorial design

Annual community sampling

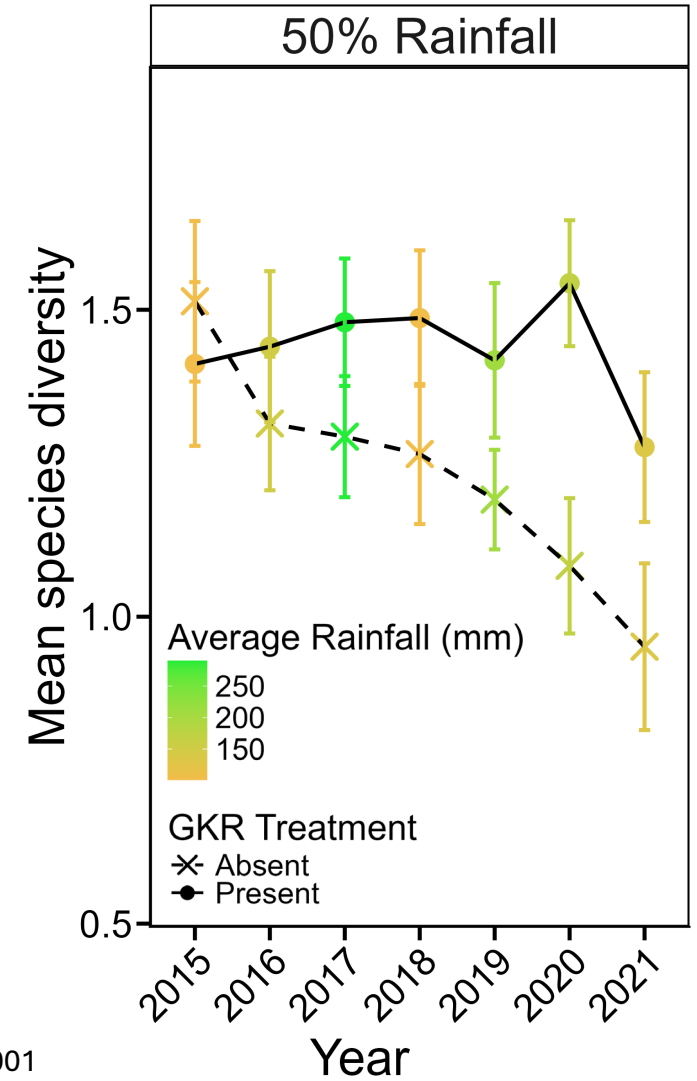
- We census plant community composition annually at established 1 x 1-m subplots (n = 288 per year).
- We record species at first and second “hit” at each of 81 points on a pinmap.
- We perform all sampling in spring (March and April) during peak biomass.

Overhead view of exclosure plot

One of our 1 x 1-m subplots

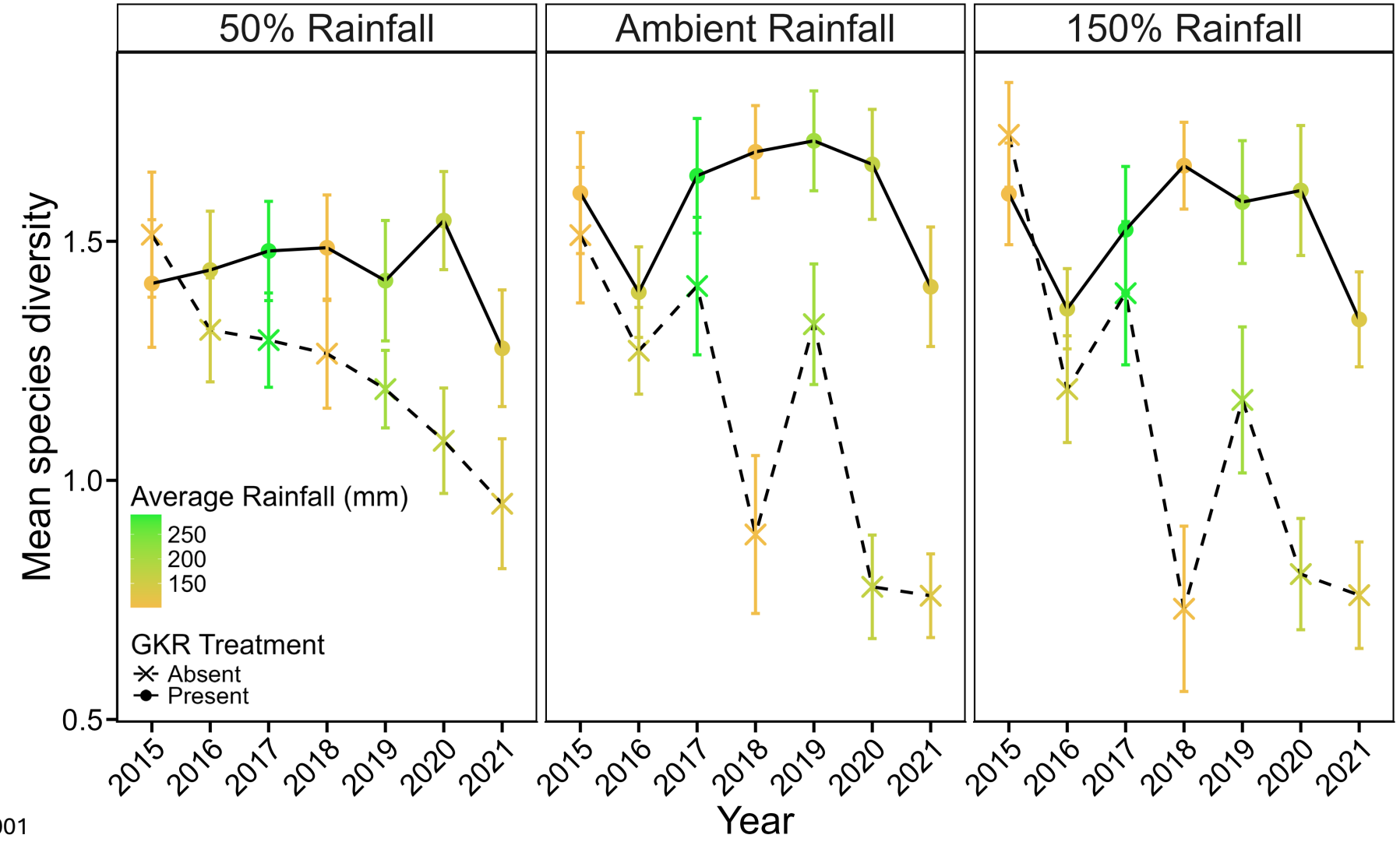
Plant community sampling using 81-point pinmap

GKR maintain plant diversity under reduced rainfall



LMM: $F_{12,37}$= 4.08, P < 0.001

GKR maintain plant diversity under reduced rainfall and across a rainfall gradient



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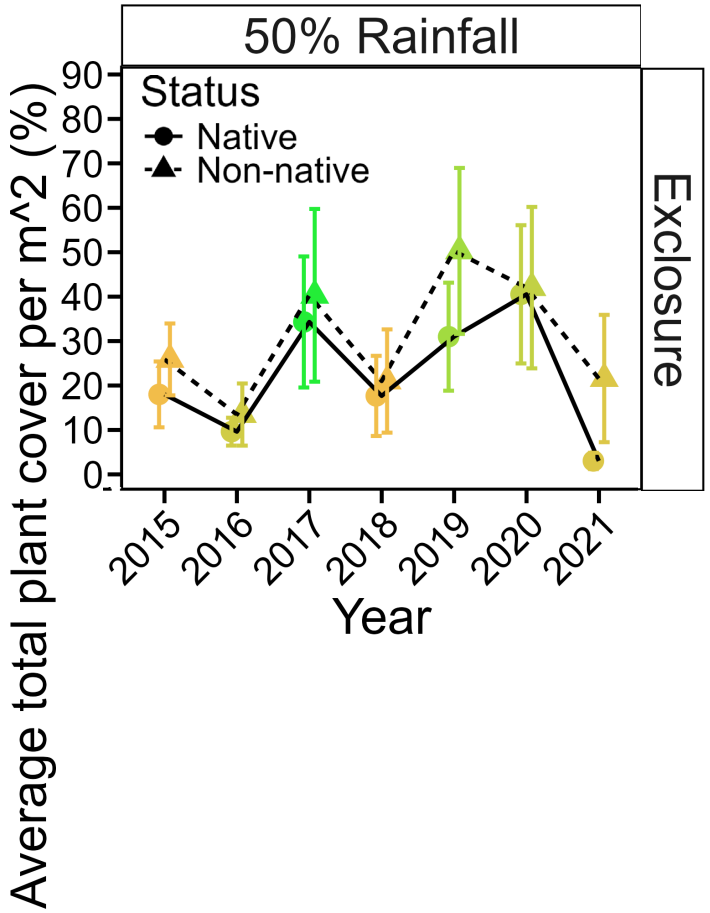
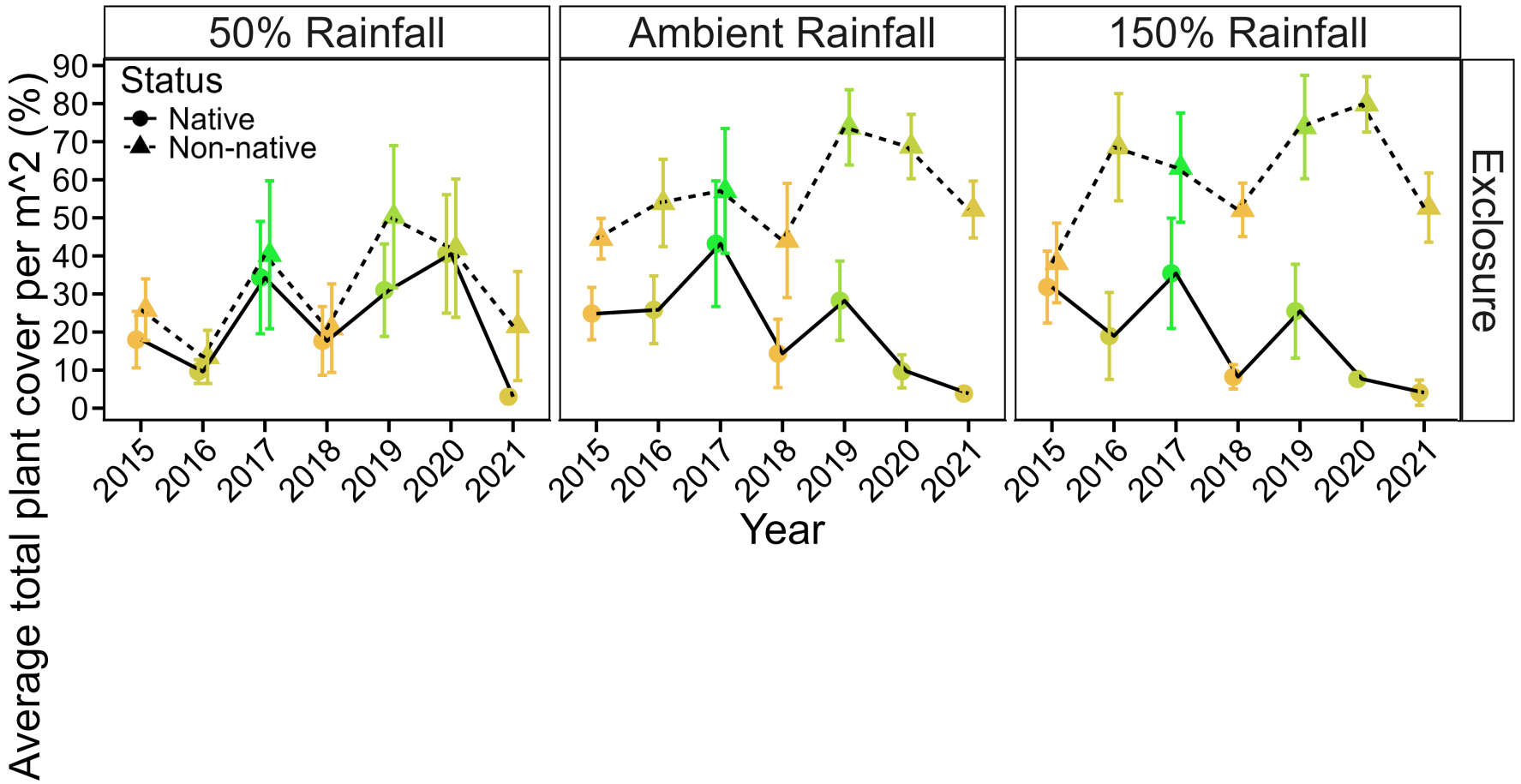
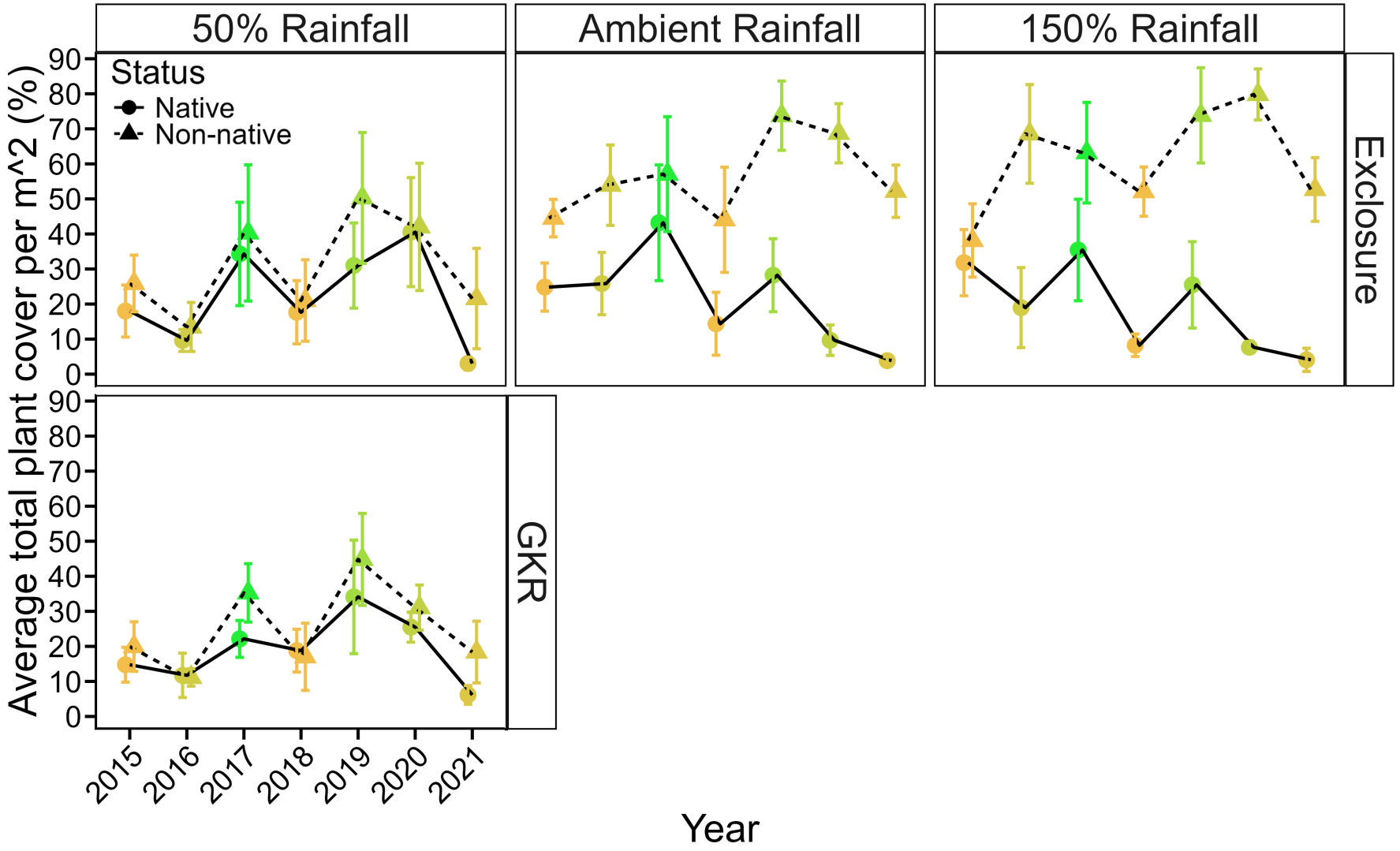
Reduced rainfall limits plant abundance



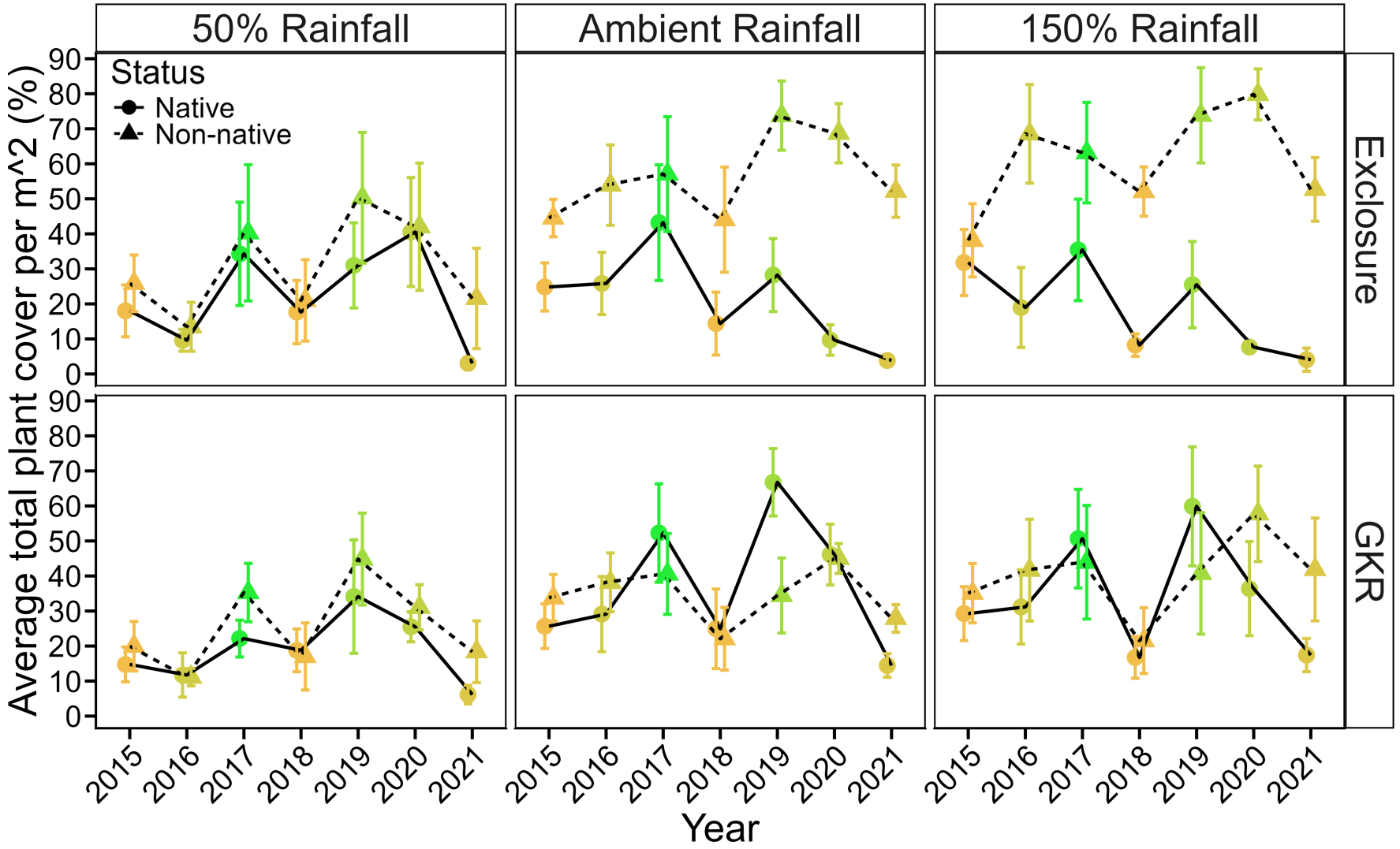
Higher rainfall increases non-native cover



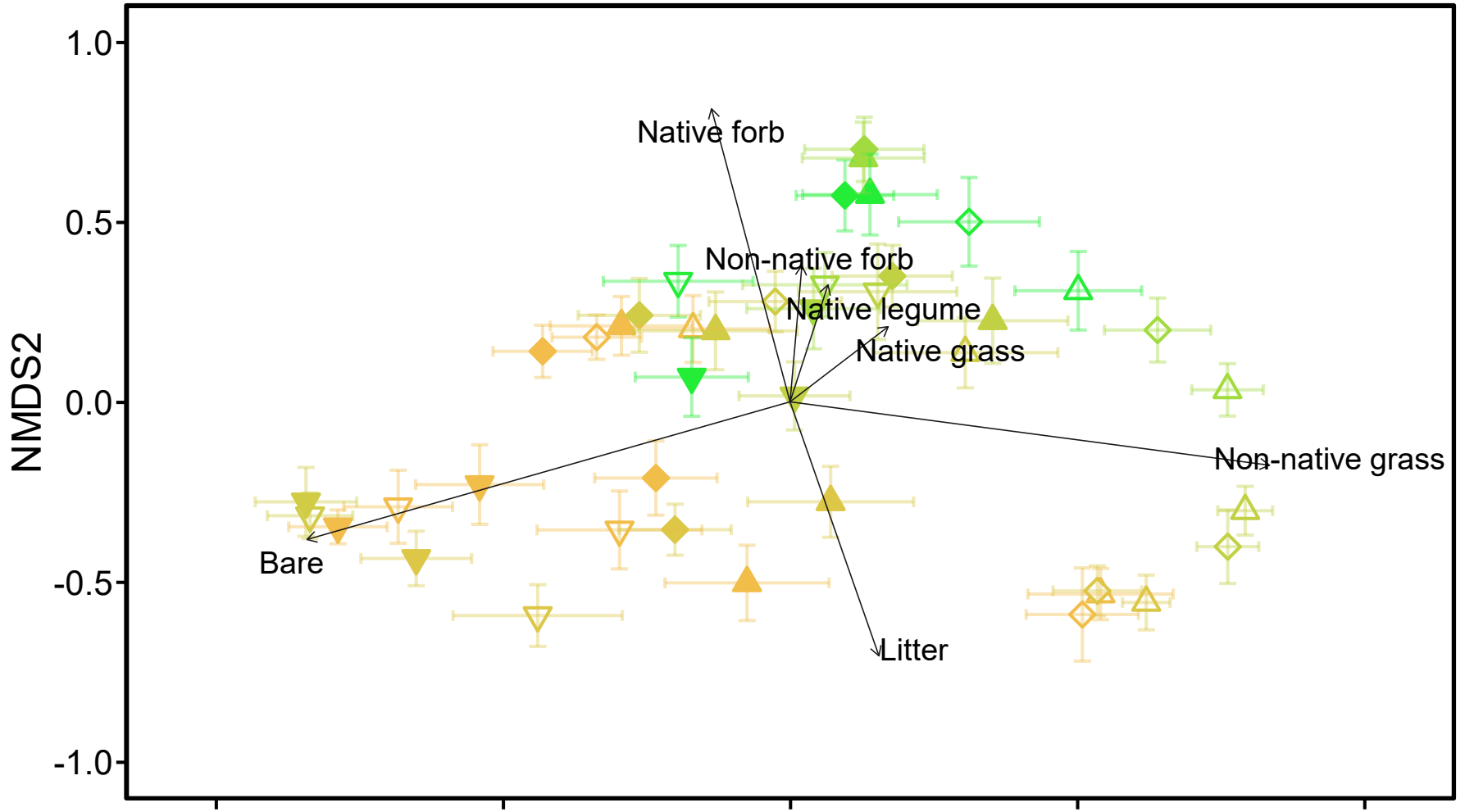
Reduced rainfall mutes GKR effects on non-native cover…



…but GKR effectively reduce non-native cover under ambient and high rainfall conditions



GKR and rainfall interactively influence community composition



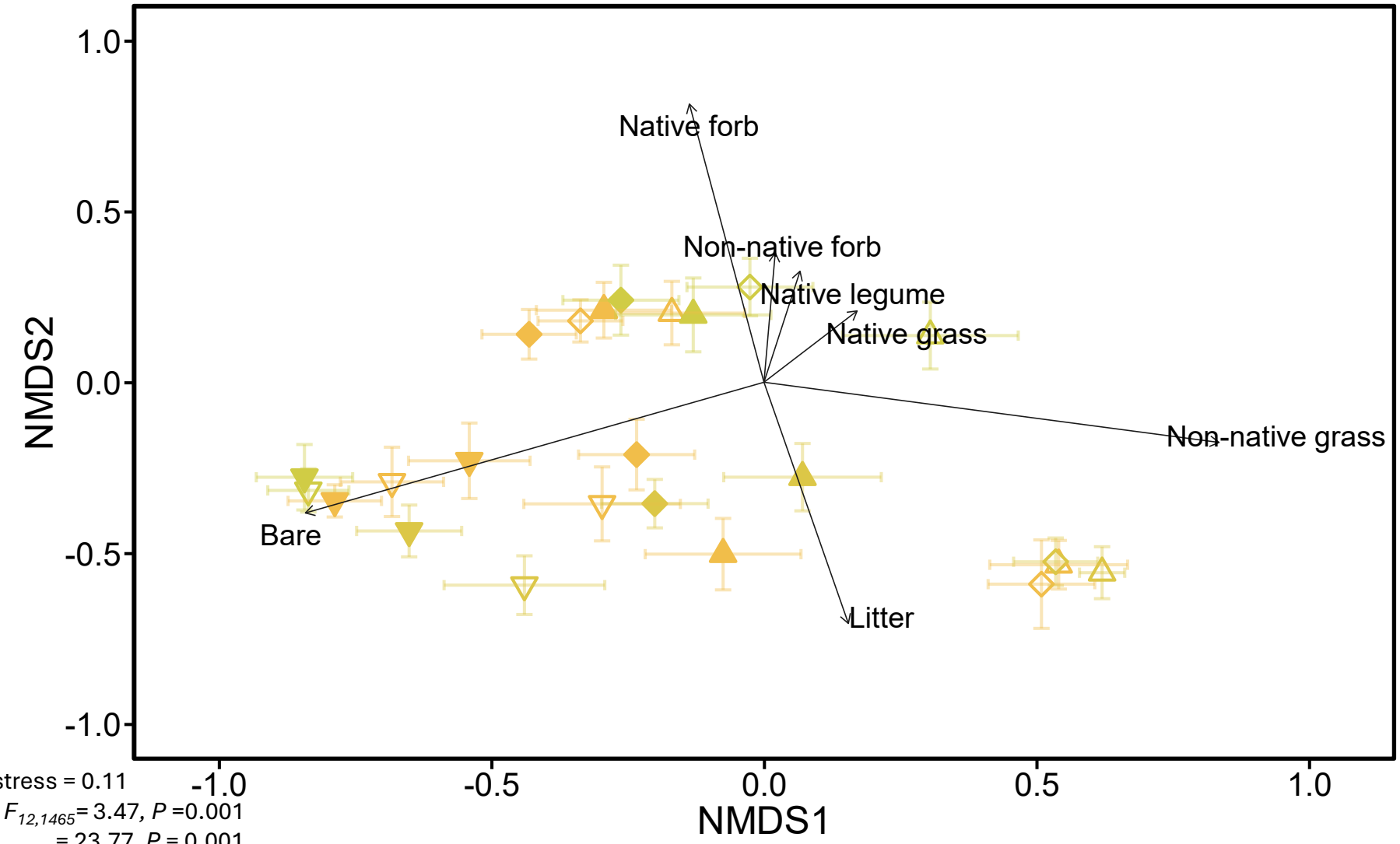
Average Rainfall (mm)
250
200
150

GKR Treatment
○ Absent
● Present

Precipitation Treatment
◇ Ambient Rainfall
△ 150% Rainfall
▽ 50% Rainfall

NMDS: k = 3, stress = 0.11
PERMANOVA: $F_{12,1465}$ = 3.47, P =0.001
Betadisper: $F_{41,1470}$ = 23.77, P = 0.001

Lower rainfall reduces plant cover



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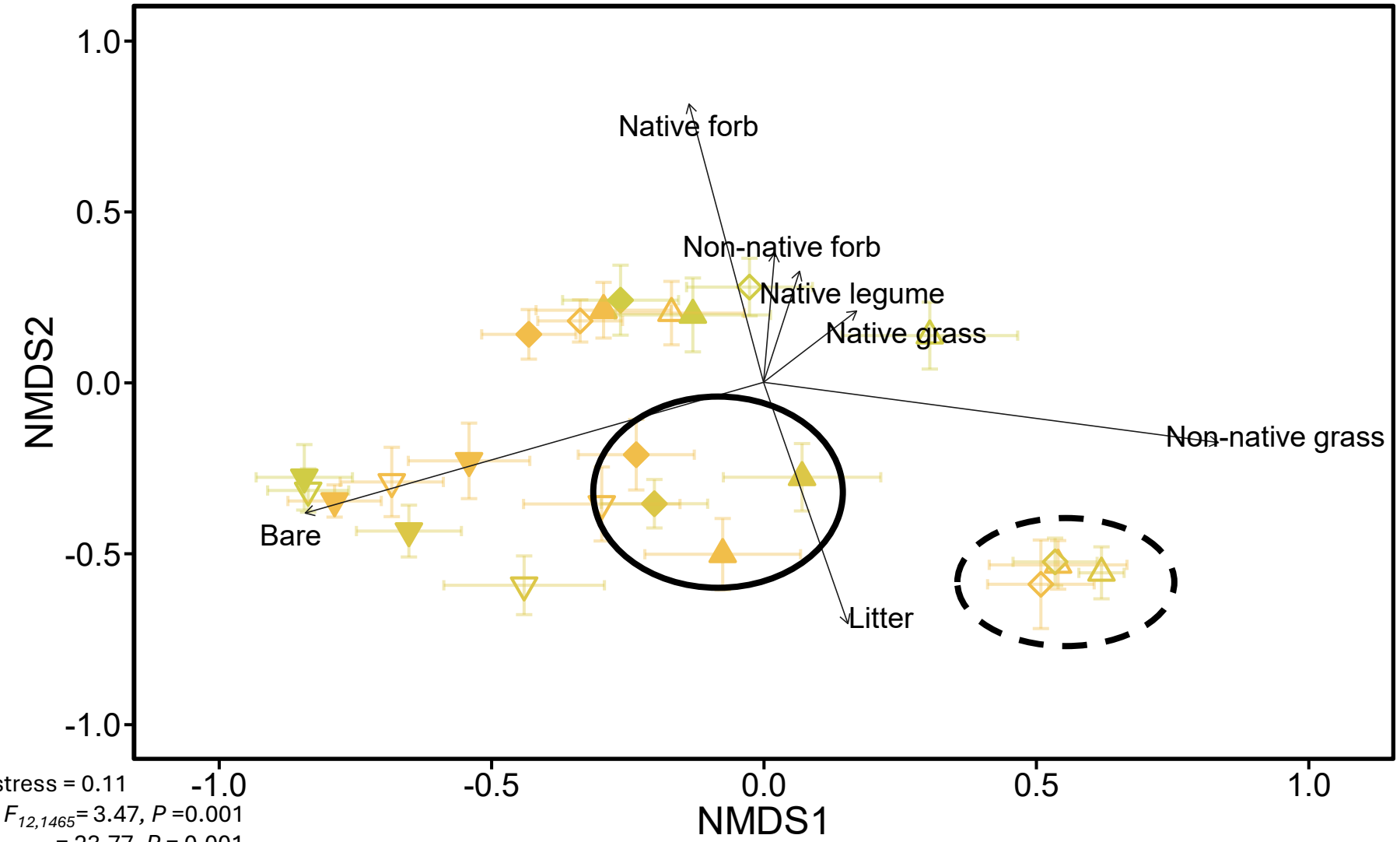
Lower rainfall reduces plant cover with some distinction between GKR treatments



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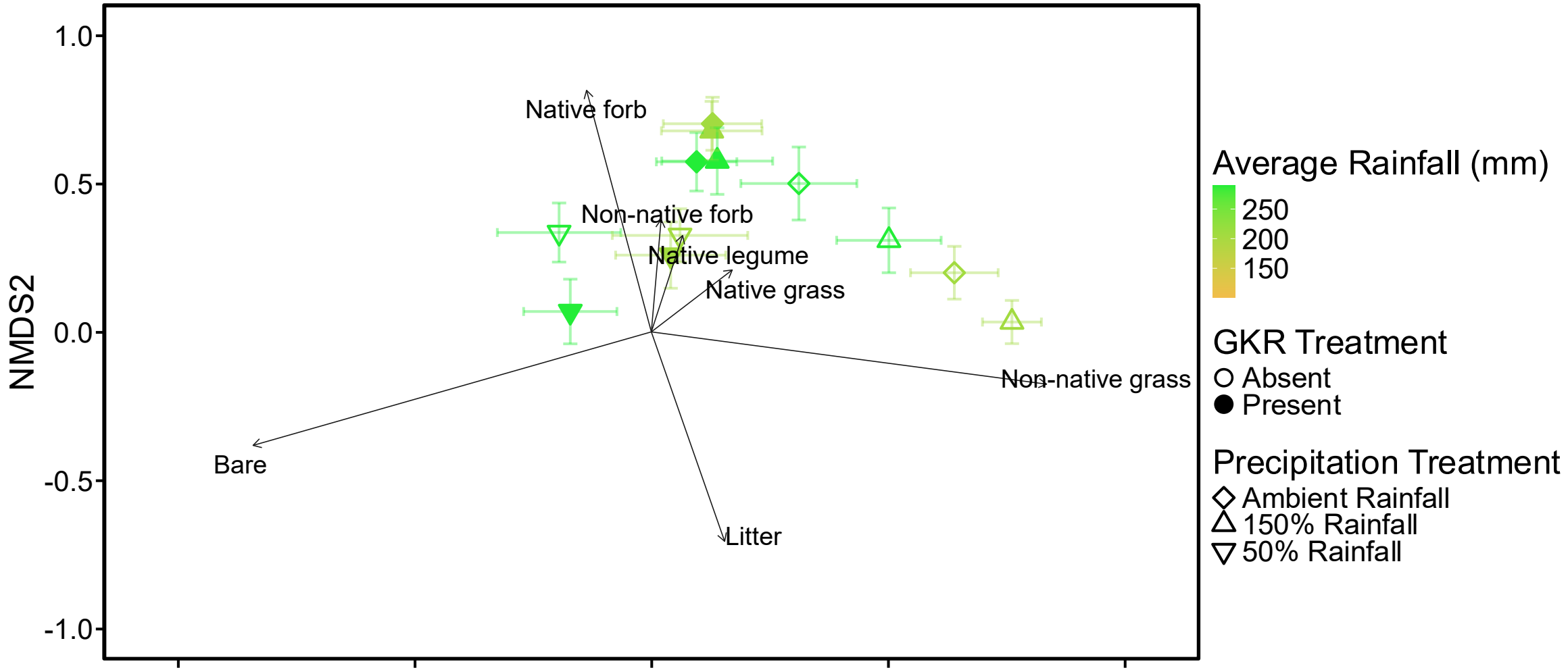
Higher rainfall promotes native composition



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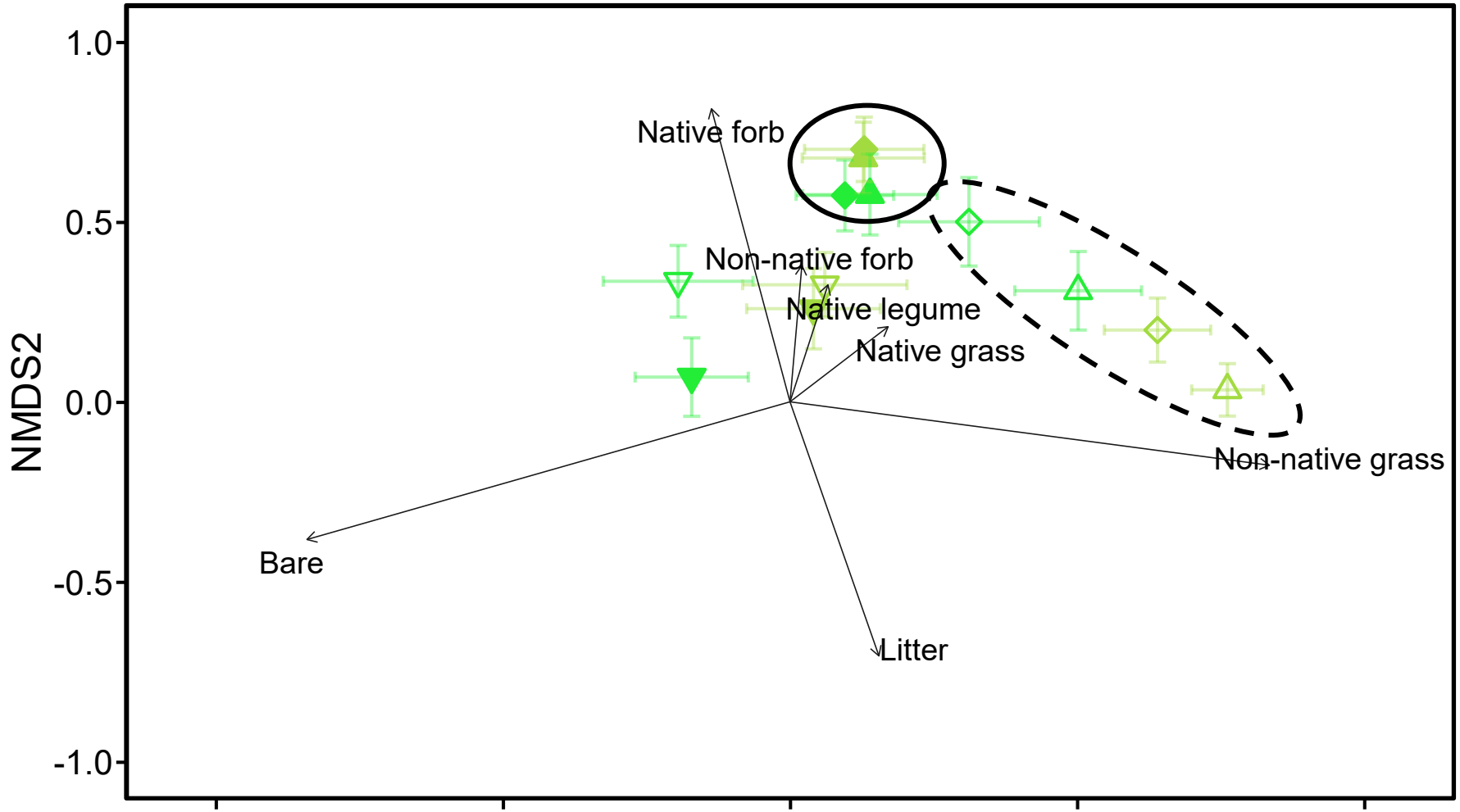

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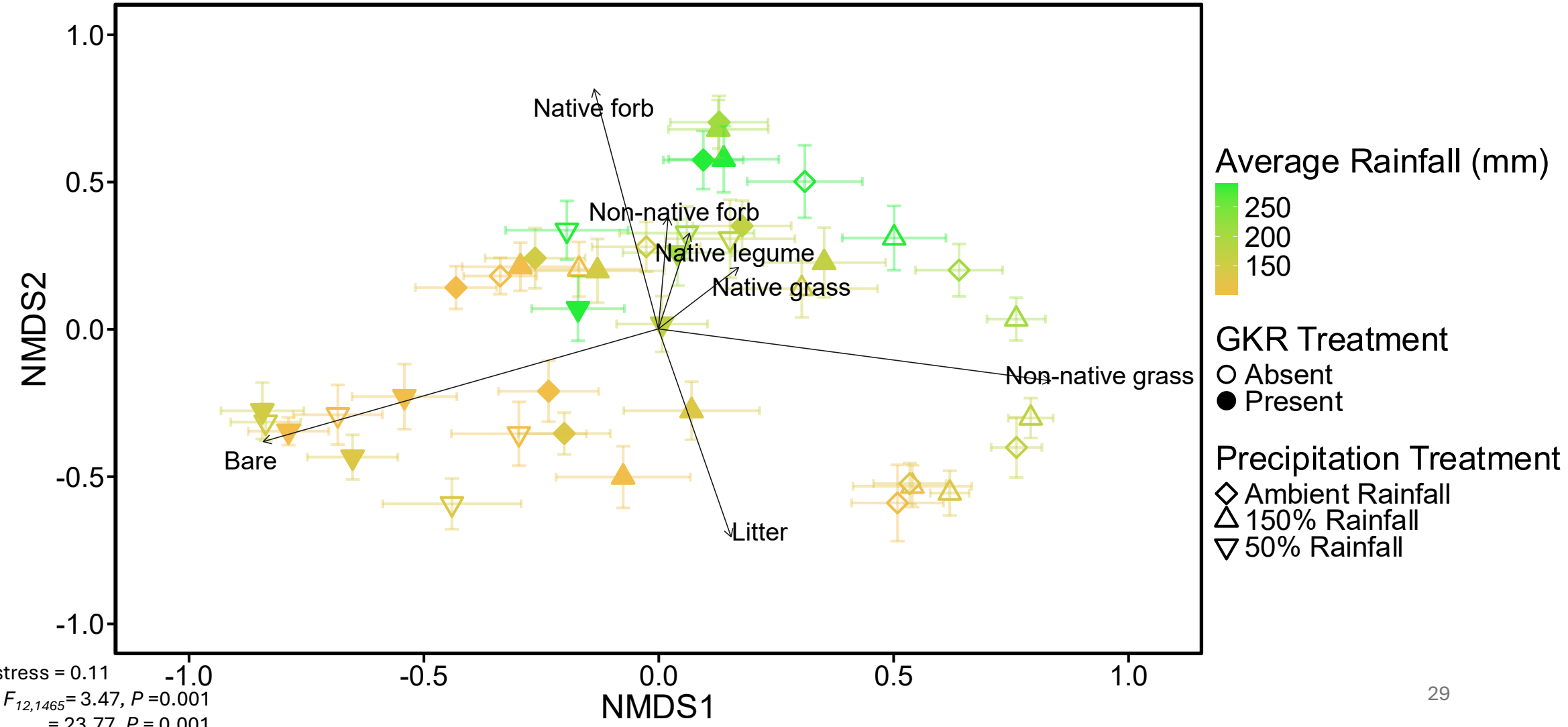
GKR plots support native species while exclosure plots favor non-native species



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Key takeaways

- The crucial roles played by GKR become increasingly prevalent as growing season rainfall increases.
- Though low rainfall limits overall plant species abundance, GKR can maintain plant species diversity across multiple years of drought.
- Native animal species can provide benefits associated with conservation grazing in addition to other essential contributions to their local habitat.
- Extirpation of an essential, native animal species can result in dominance of non-native and invasive plant species in this system.


2024-09-03 22:15:54 M 1/3 21°C
Questions?
HYPERFIRE 2 COVERT
RECONYX