Lessons learned from long-term restoration outcomes of California coastal grasslands

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California coastal grasslands

- 🌼 Unique summertime fog

- 🌼 Dominated by perennials and annual forbs
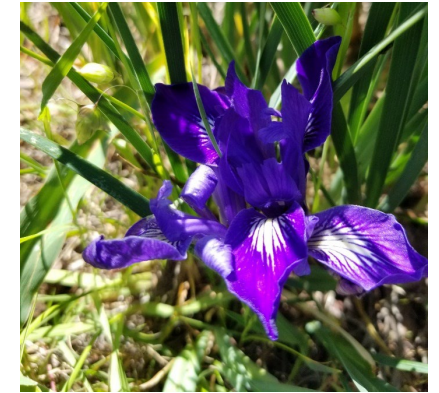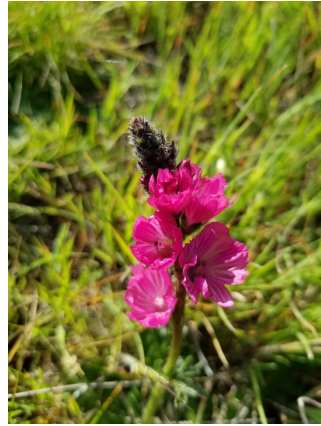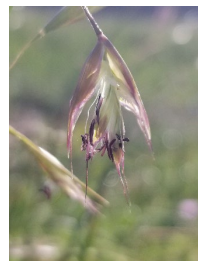
- 🌼 High species diversity

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Ford and Hayes, 2007; Keeler-Wolf et al. 2007

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3

Perennialization = increased dominance & abundance of perennial species

Lesage, Howard, Holl 2018
Holl, Luong, Brancalion 2022

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Biotic homogenization = increased dominance by a few select species

4

Variability in restoration outcomes

🌷 Grassland restoration outcomes are relatively unknown

🌷 For few projects resurveyed, outcomes are variable

🌷 Lack of funding leads to limitations during initial site assessments

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Suding 2011; Adler et al. 2013; Brudvig et al. 2017

5

Restoration management

- 🌷 Management practices can greatly differ depending on agency

- 🌷 Practices may differ because project goals differ

- 🌷 There are limited sources of funding for restoration

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Holl and Howarth 2000; Clewell and Aronson 2006
Rowe 2010; Homewood et al. 2001

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Research Questions

1. Does coastal grassland restoration meet project-based goals and a standard performance metric?

2. Is native cover related to project age?

3. What are the biggest barriers to achieving restoration goals?

4. How does funding and maintenance influence outcomes?
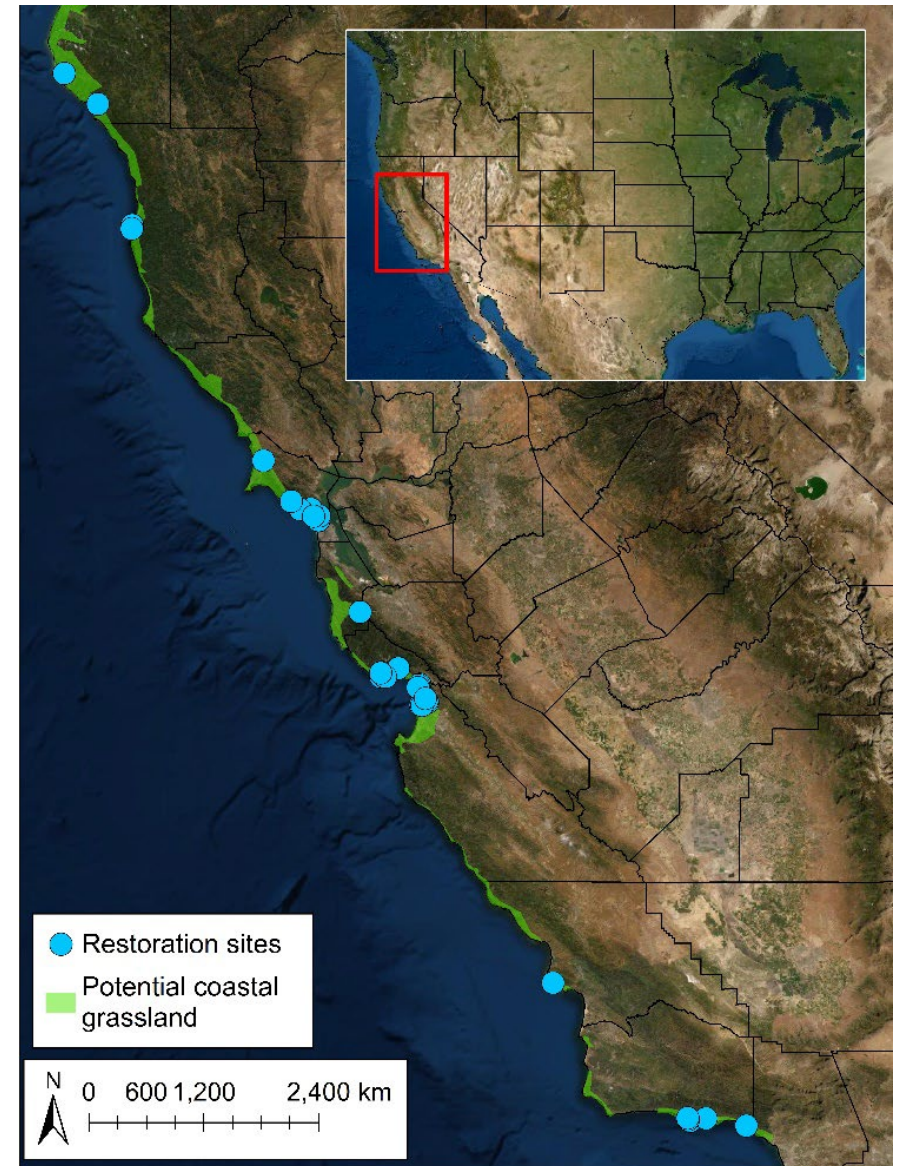
Restoration project selection

🌼 1000-km N-S gradient

🌼 Identified 37 projects (of 48 possible)

Selection Criteria:

1. At least 3 years post-planting or -seeding

2. Size ≥1 acre

3. Coastal grassland

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Restoration sites

Potential coastal grassland

N 0 600 1,200 2,400 km

Field Surveys (2019-2021)

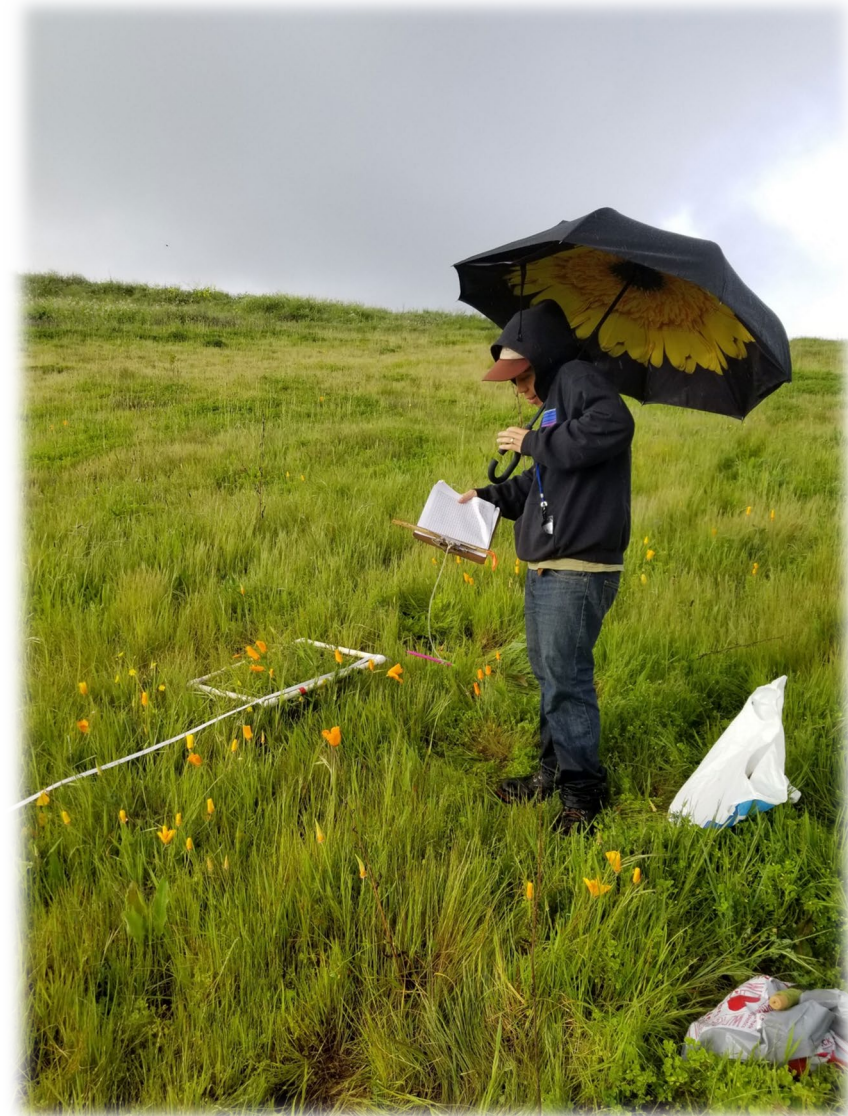🌷 Used 0.25 m² quadrats every 5-m along 50-m transects

🌷 3 – 16 transects, scaled to site size (1-32 acre)

🌷 Estimated absolute cover of all plants

🌷 Collected 3 soil samples per transect in 2019

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Semi-structured interviews and Document analysis

🌷 Reviewed project documents prior to vegetation surveys

🌷 Projects with documents = 63%

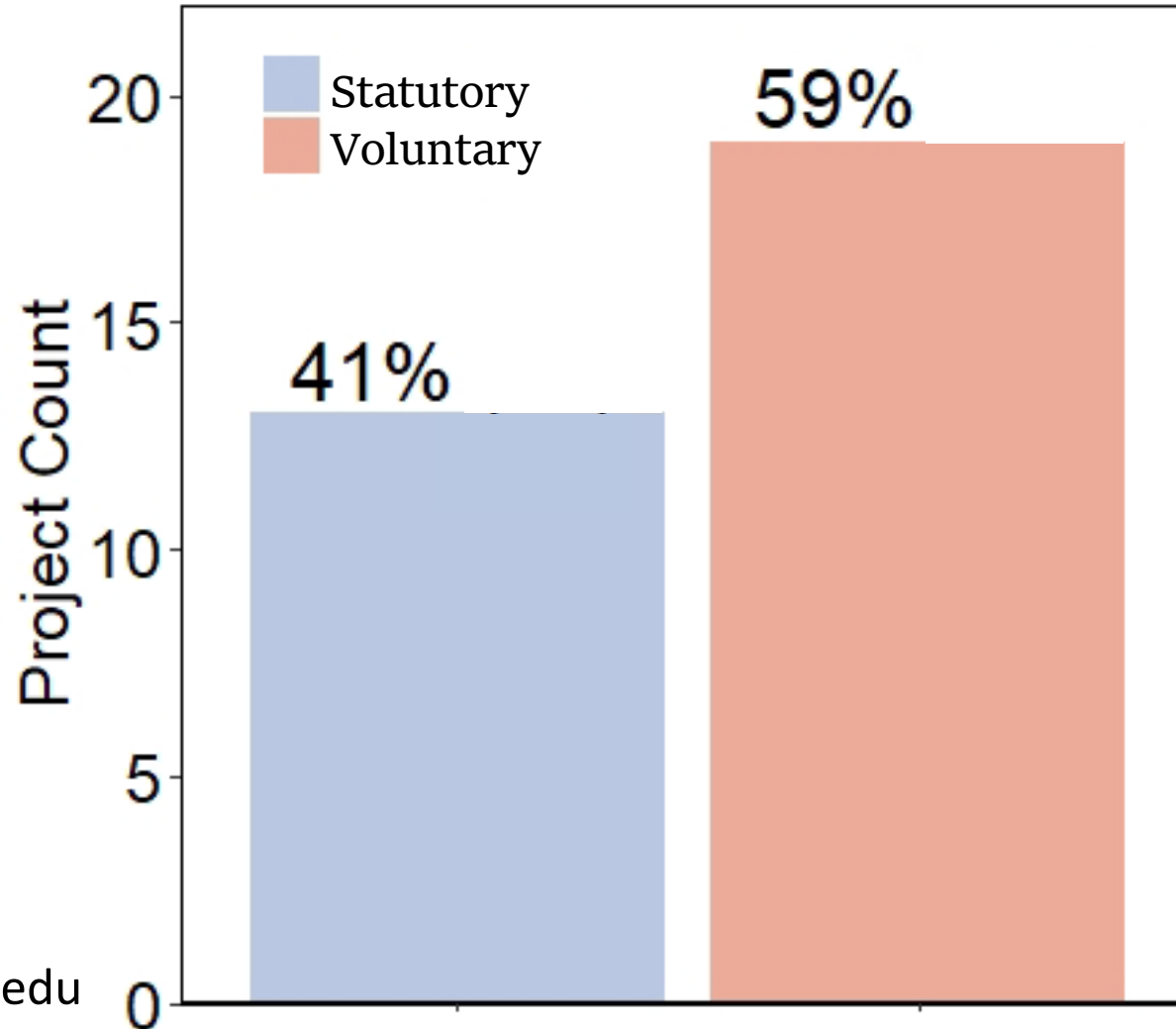🌷 Interviewed one or more practitioner from each site

🌷 Focused on resources and barriers to achieving goals, and implementation strategies

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Surveyed projects were mostly voluntary

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Barriers to achieving restoration goals

🌼 Invasive species management = 100%

🌼 Funding levels = 84%
   🌼 Post-implementation monitoring = 20/27 (74%)

🌼 Sourcing appropriate and sufficient plant material* = 34%

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Restoration is largely successful at reaching project goals
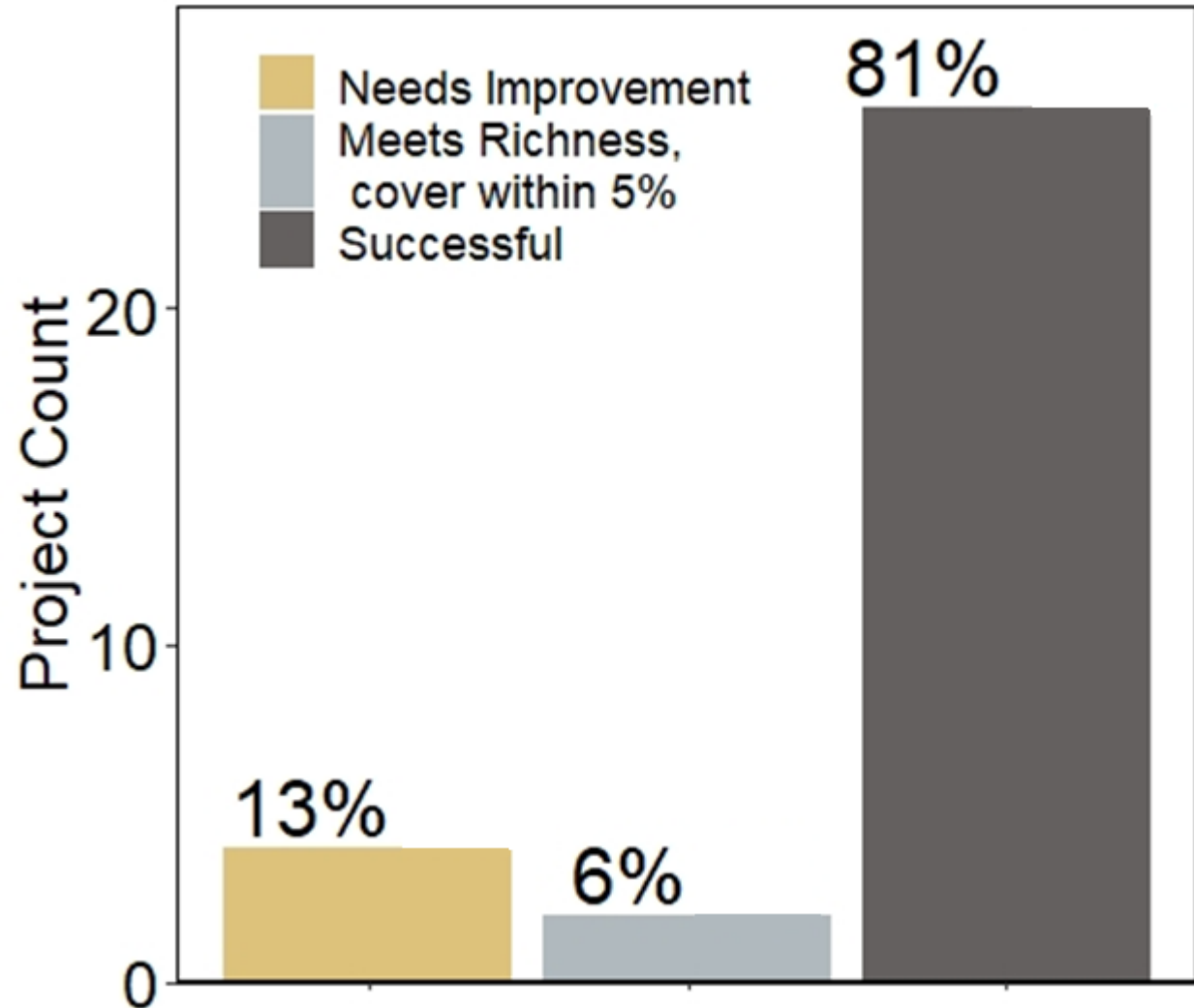
Standard performance metric outcomes

Standard performance metric:

25% native cover and 6 native species after 5 years

Project-based goals:

Varied <u>directional</u> goals, focused on increasing native cover or decreasing non-native cover or erosion

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Plant cover is relatively stable with project age

- 🌷 Native cover range = 13% to 79%
- 🌷 Native richness range = 5 to 60

p = 0.102

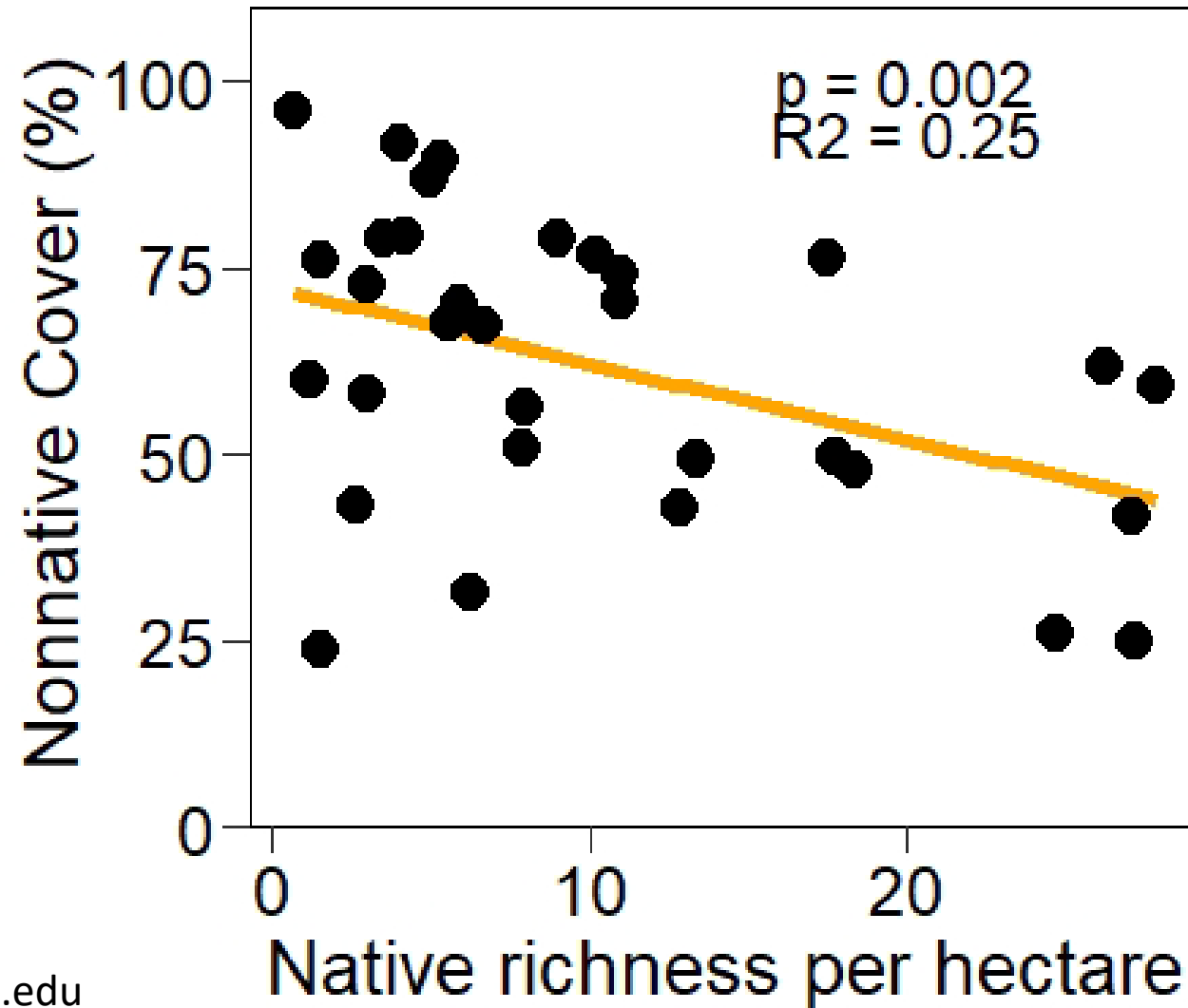✉ Justin.Luong@Humboldt.edu
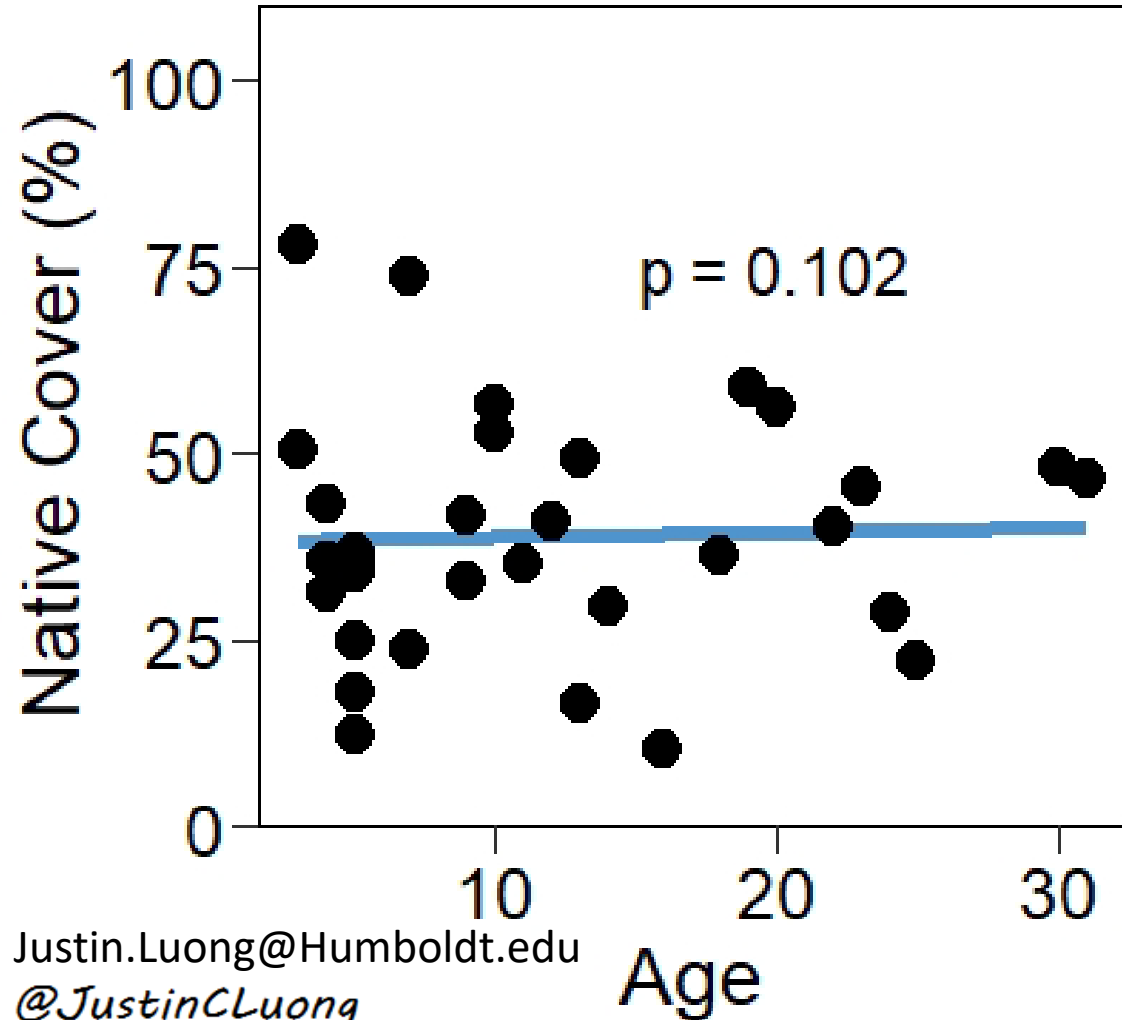
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Non-native competition strongly impacts restoration efforts
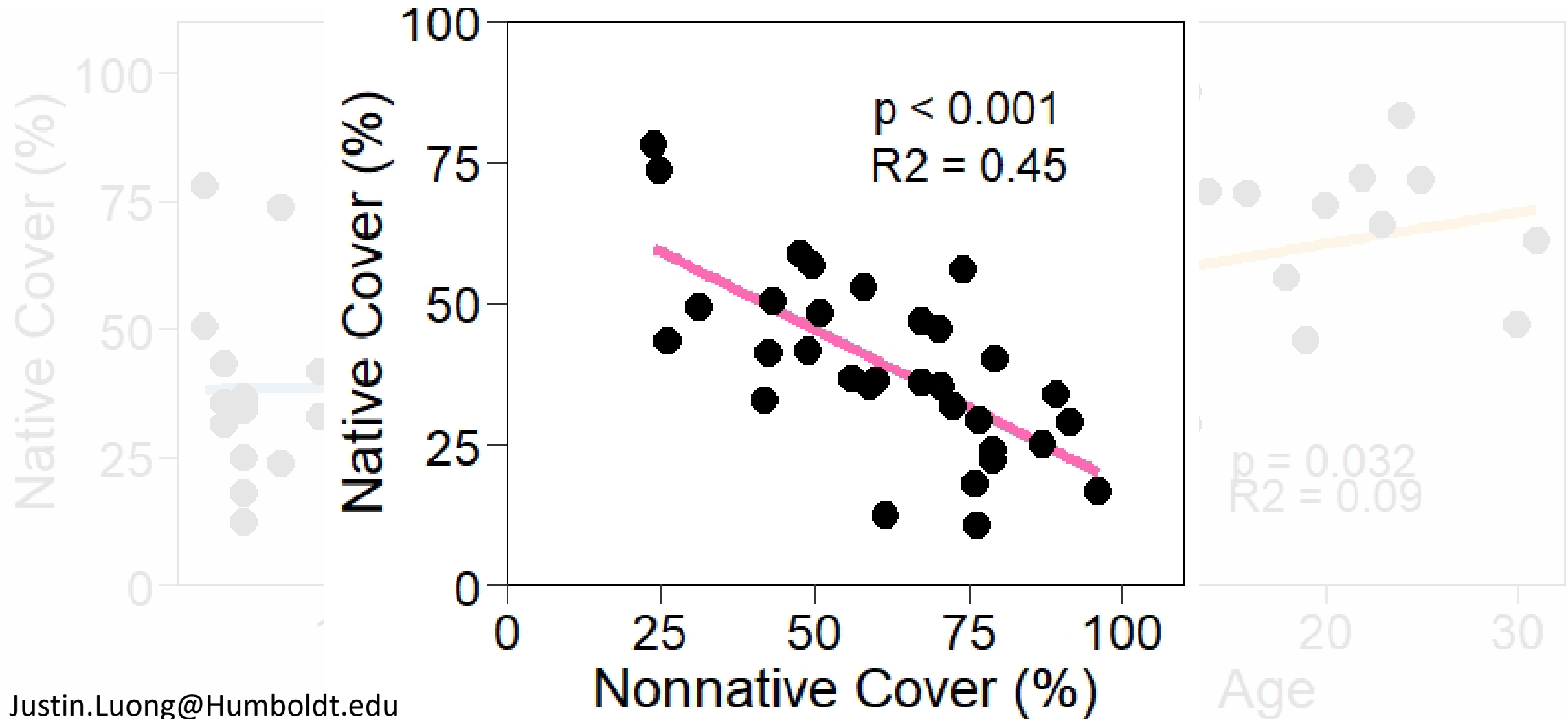
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Native species richness per hectare is negatively associated nonnative plant cover

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Regional biotic homogenization

🌼 88% of projects use species because they survive better or grow faster

	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	S1	S2
Stipa pulchra (**69**%)	X	X	X	X	X	X	X	X	X			X	X	X				X	X	X	X		X	X	X		X	X
Elymus glaucus (**59**%)	X	X	X	X	X	X	X	X	X			X	X	X						X		X	X	X	X	X		
Bromus carinatus (**50**%)	X	X	X	X	X	X	X	X	X						X	X	X	X	X			X	X					
Hordeum brachyantherum (**44**%)							X	X		X	X	X								X	X		X	X	X	X	X	X
Festuca rubra (**31**%)			X	X	X	X	X	X	X							X	X	X										
Achillea millefolium (**22**%)			X		X	X	X	X																	X			
Danthonia californica* (**22**%)	X	X	X	X	X	X	X	X	X	X	X																	
Deschampsia caespitosa (**17**%)	X	X		X						X	X																	

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17

Financial cost has no direct effect on plant metrics, but higher maintenance intensity improve biodiversity

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18
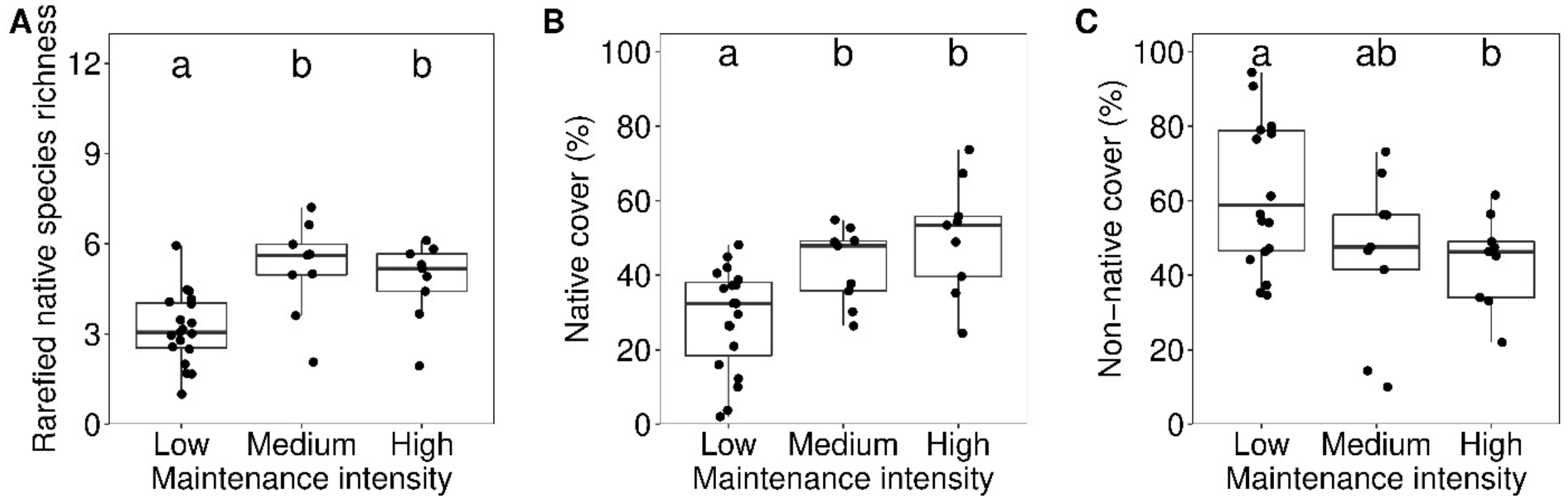
Using more species can counter homogenization but is associated with greater costs

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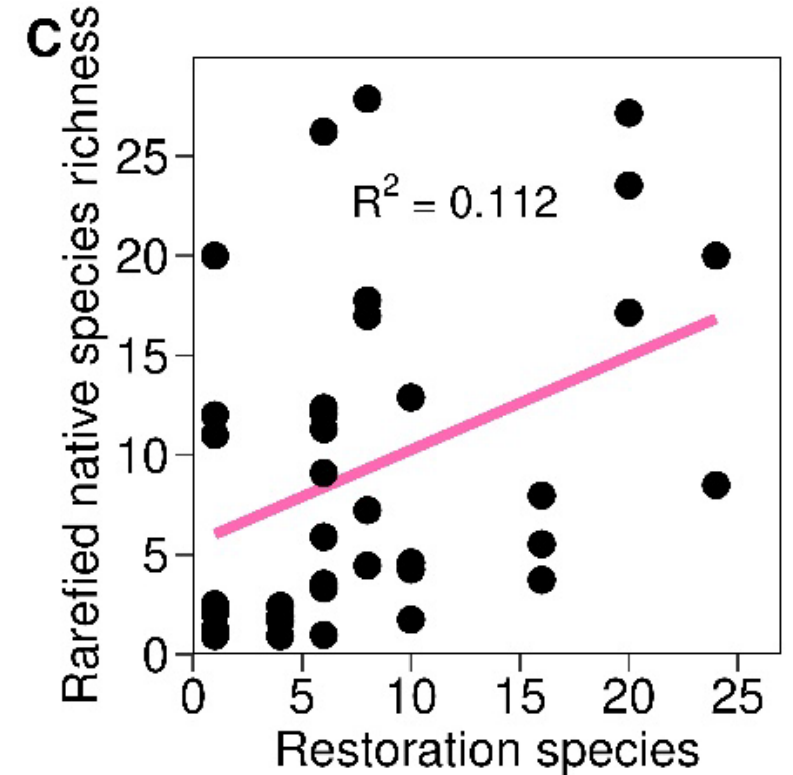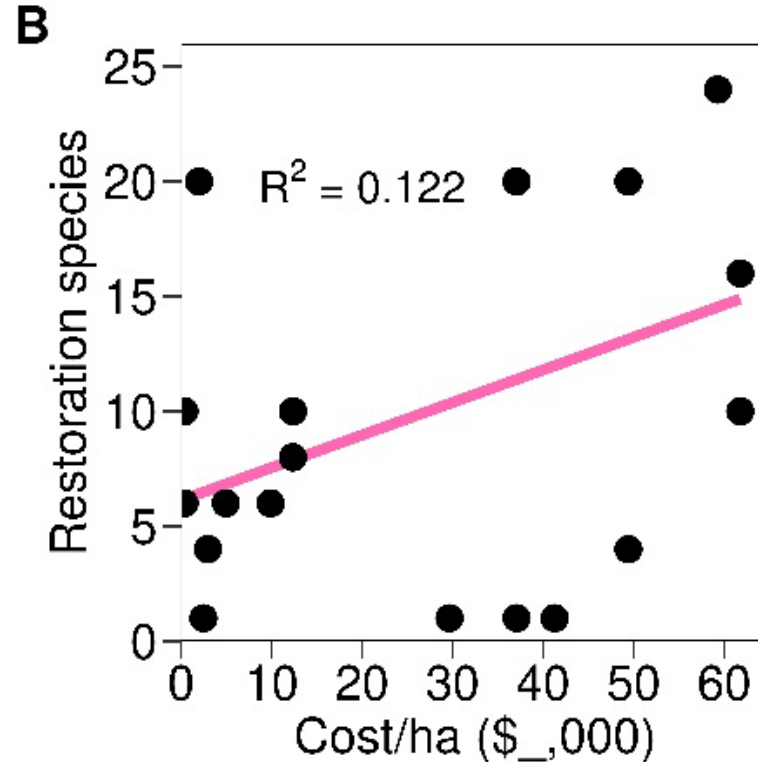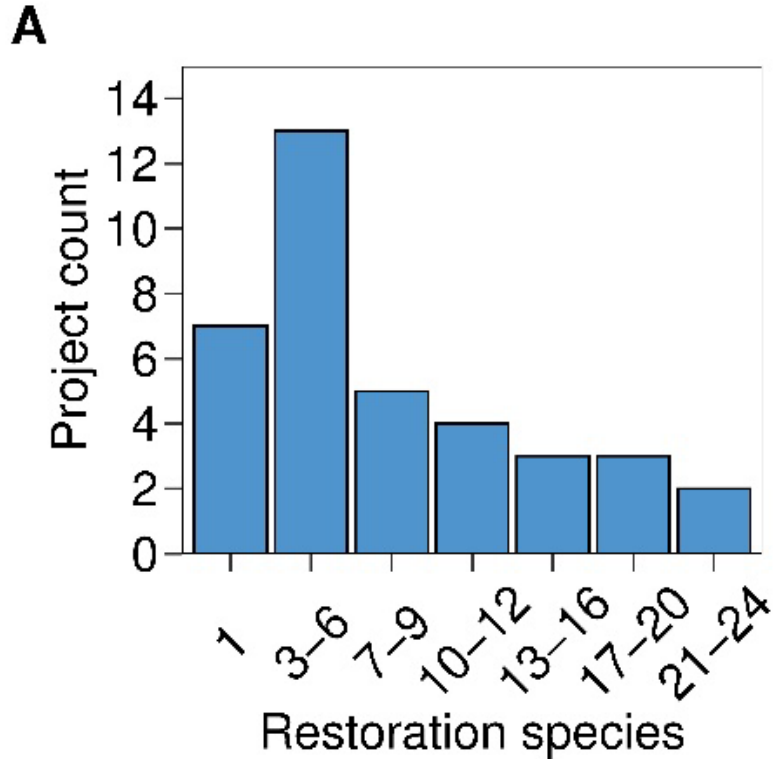
Summary: Grassland restoration is largely successful

🌷 Successful at achieving project-based goals and standard metric

🌷 Invasive species limit success

🌷 Projects indicate that they would have done more if possible

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Summary: Obstacles to increasing regional diversity

🌼 Difficulty in sourcing appropriate plant material and using new species

🌼 Risk aversion in achieving restoration goals

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Lesage, Press and Holl 2020

Survey for Formation of Grassland Restoration Network

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Acknowledgements

Thank You

Happy to take any questions

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QR CODE for GRASS-NET Survey

CALIFORNIA COASTAL GRASSLAND RESTORATION is Successful
BUT MAY PROMOTE BIOTIC HOMOGENIZATION

Authors: Justin c. Luong, Daniel M. Press, Karen D. Holl

Illustrator: Lesley Goren

ALTERED DISTURBANCE REGIMES

AGRICULTURE URBANIZATION

EXTENT OF NATIVE GRASSLANDS HAS BEEN REDUCED BY 99% DUE TO

INVASIVES

IT IS IMPORTANT TO UNDERSTAND THE Successes and Challenges OF RESTORATION PROJECTS

THE AUTHORS SURVEYED BOTH STATUTORY (LEGALLY MANDATED) AND NON-STATUTORY (VOLUNTARY) RESTORATION PROJECTS.

VEGETATION SURVERYS ANNUALLY FOR 3 YEARS

REVIEWED DOCUMENTS

37 SITES FROM HUMBOLDT COUNTY TO SANTA BARBARA COUNTY

1988 1989 1990

2015 2016

INTERVIEWED LAND MANAGERS

PROJECTS RANGED FROM 5–33 YEARS POST IMPLEMENTATION