

Lessons learned from an interdisciplinary evaluation of long-term restoration outcomes on 37 restored coastal grasslands in California

Justin Luong*, Daniel Press, Karen Holl

Cal Poly Humboldt

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Justin.Luong@Humboldt.edu



[@JustinCLuong](https://twitter.com/JustinCLuong)



California coastal grasslands

- 🌻 Unique summertime fog
- 🌻 Dominated by perennials and annual forbs
- 🌻 High species diversity



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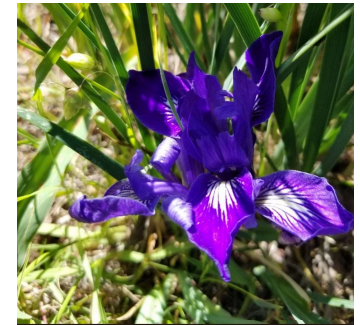
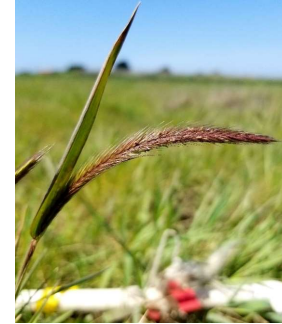
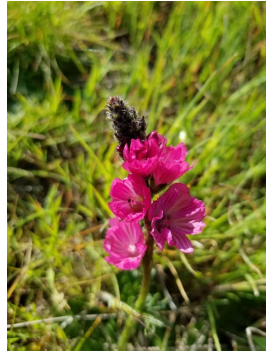
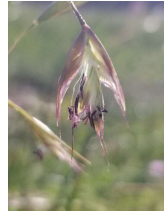
Ford and Hayes, 2007; Keeler-Wolf et al. 2007



Justin.Luong@
Humboldt.edu



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Perennialization = increased dominance & abundance of perennial species

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



Biotic homogenization = increased dominance by a few select species

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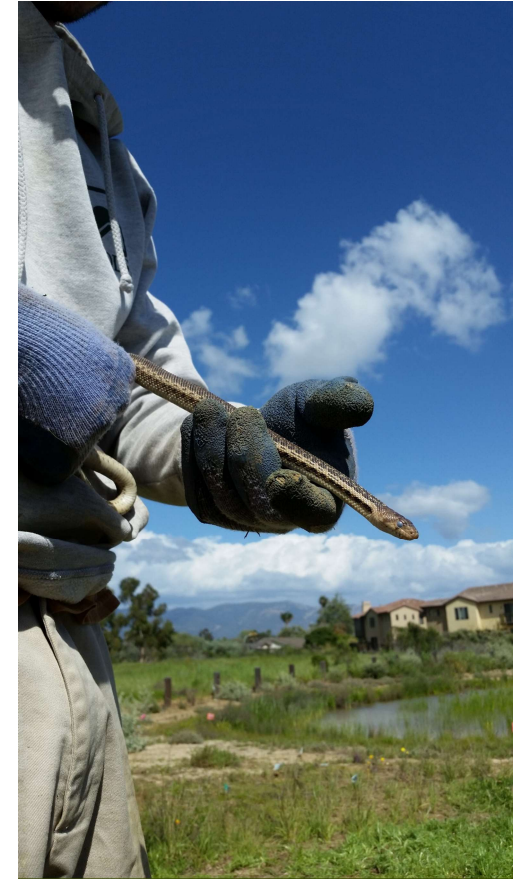
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Restoration management

- 🌻 Management practices can greatly differ depending on agency
- 🌻 Practices may differ because project goals differ
- 🌻 There are limited sources of funding for restoration
- 🌻 Grassland restoration outcomes are relatively unknown

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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

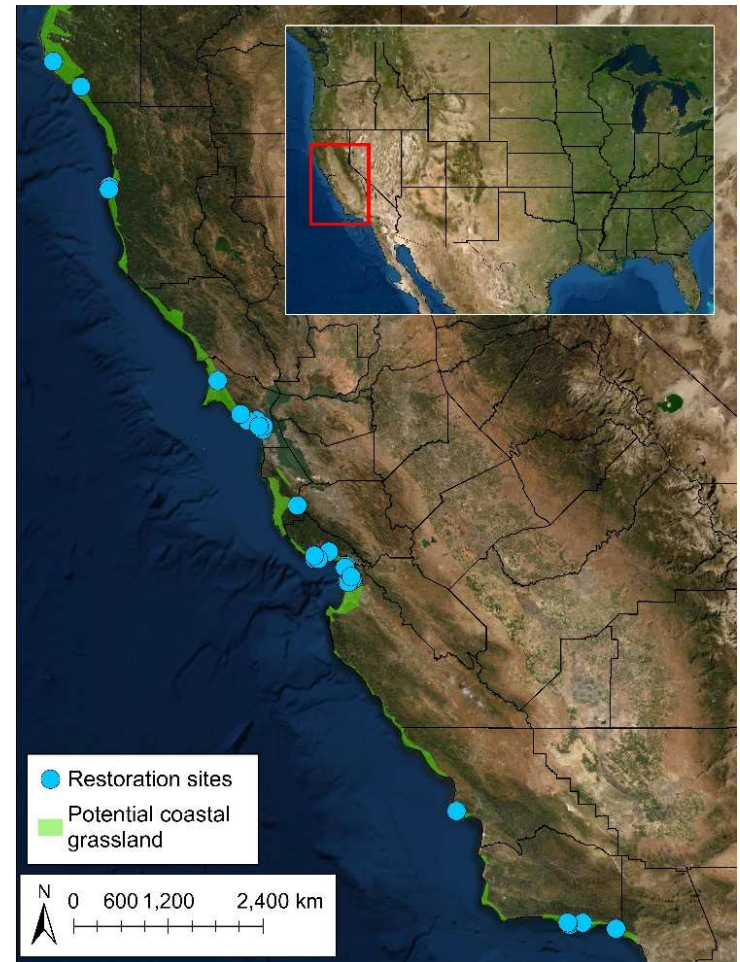
- 🌻 1000-km N-S gradient
- 🌻 Identified 37 projects (of 48 possible)

Selection Criteria:

1. At least 3 years post-planting or -seeding
2. Size ≥ 1 acre
3. Coastal grassland

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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

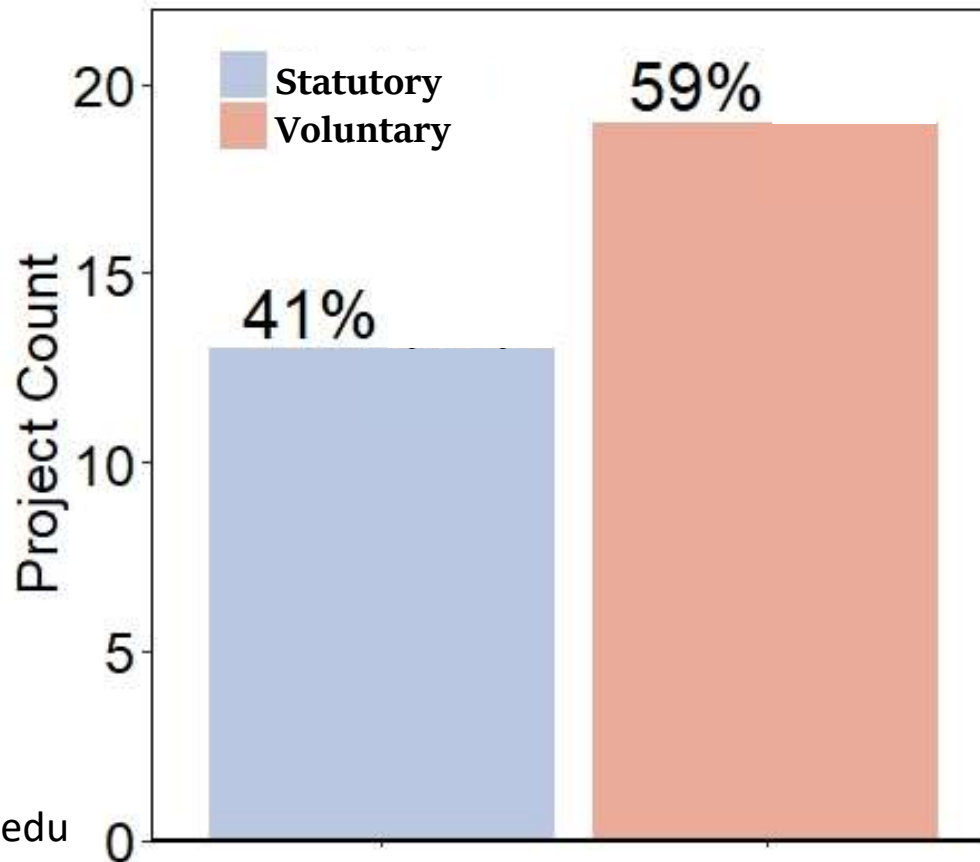
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Surveyed projects were mostly voluntary



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Barriers to achieving restoration goals

- 🌻 Invasive species management = 100%
- 🌻 Funding levels = 84%
 - 🌻 Post-implementation monitoring = 20/27 (74%)



Restoration is largely successful at reaching project goals

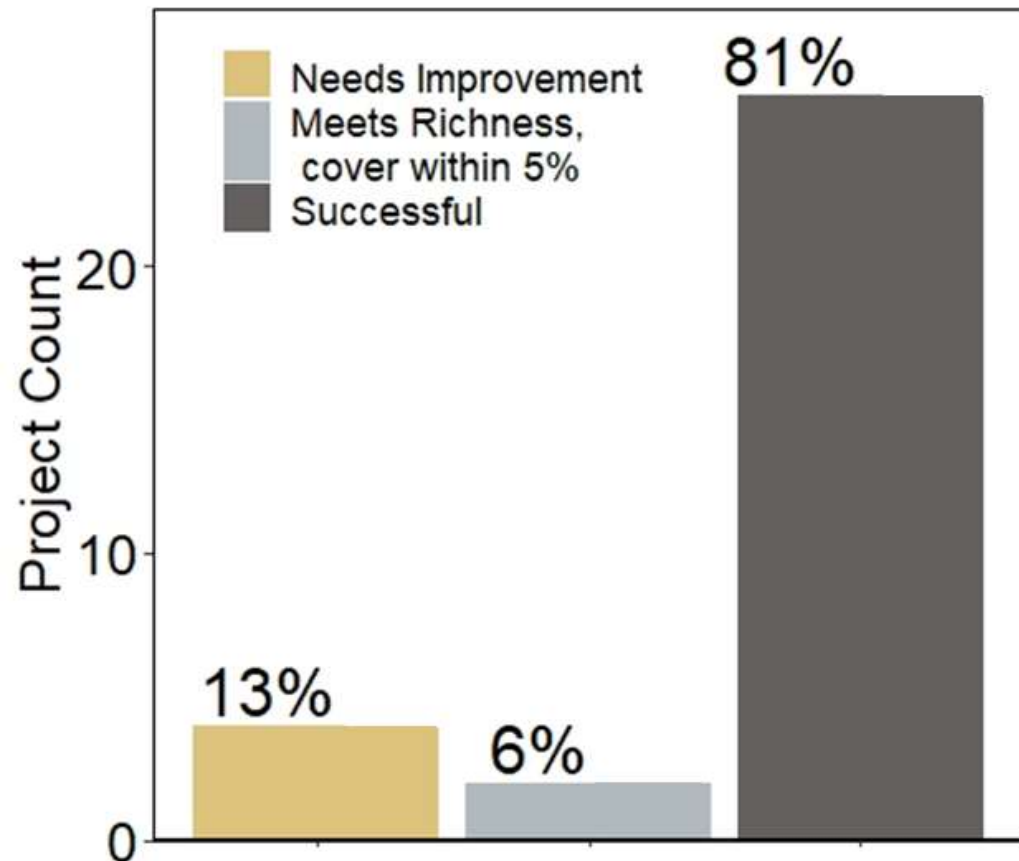
Standard performance metric:

25% native cover and 6 native species after 5 years

Project-based goals:

Varied directional goals, focused on increasing native cover or decreasing non-native cover or erosion

Standard performance metric outcomes



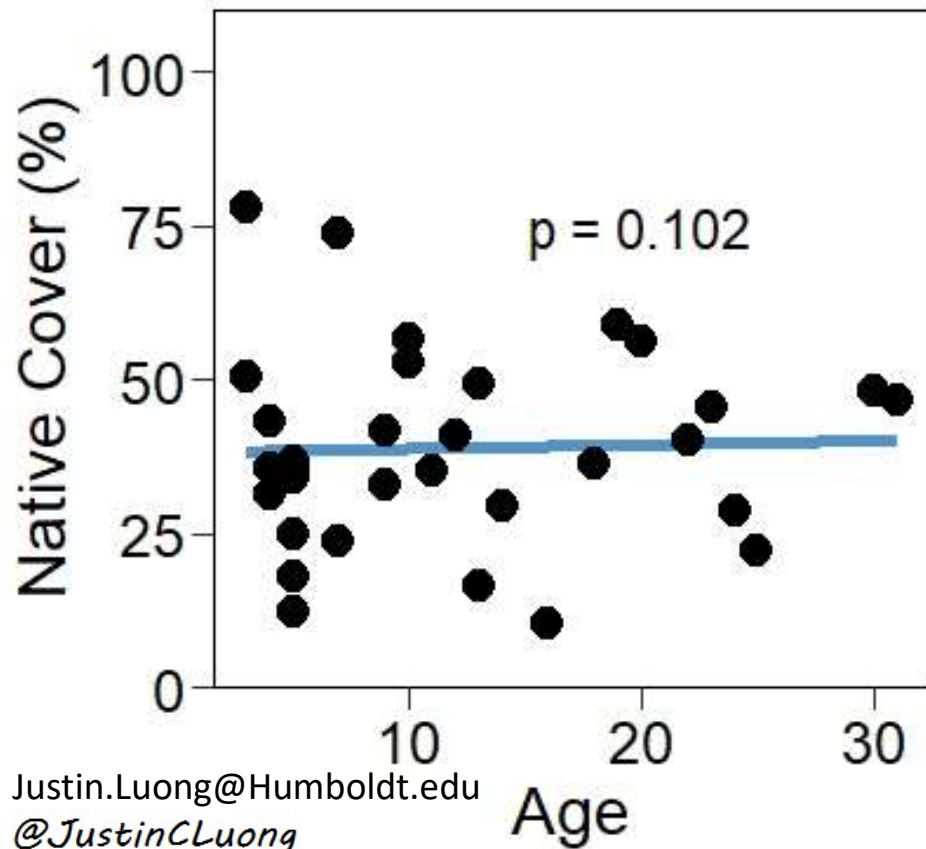
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Plant cover is relatively stable with project

age 🌻 Native cover range = 13% to 79%

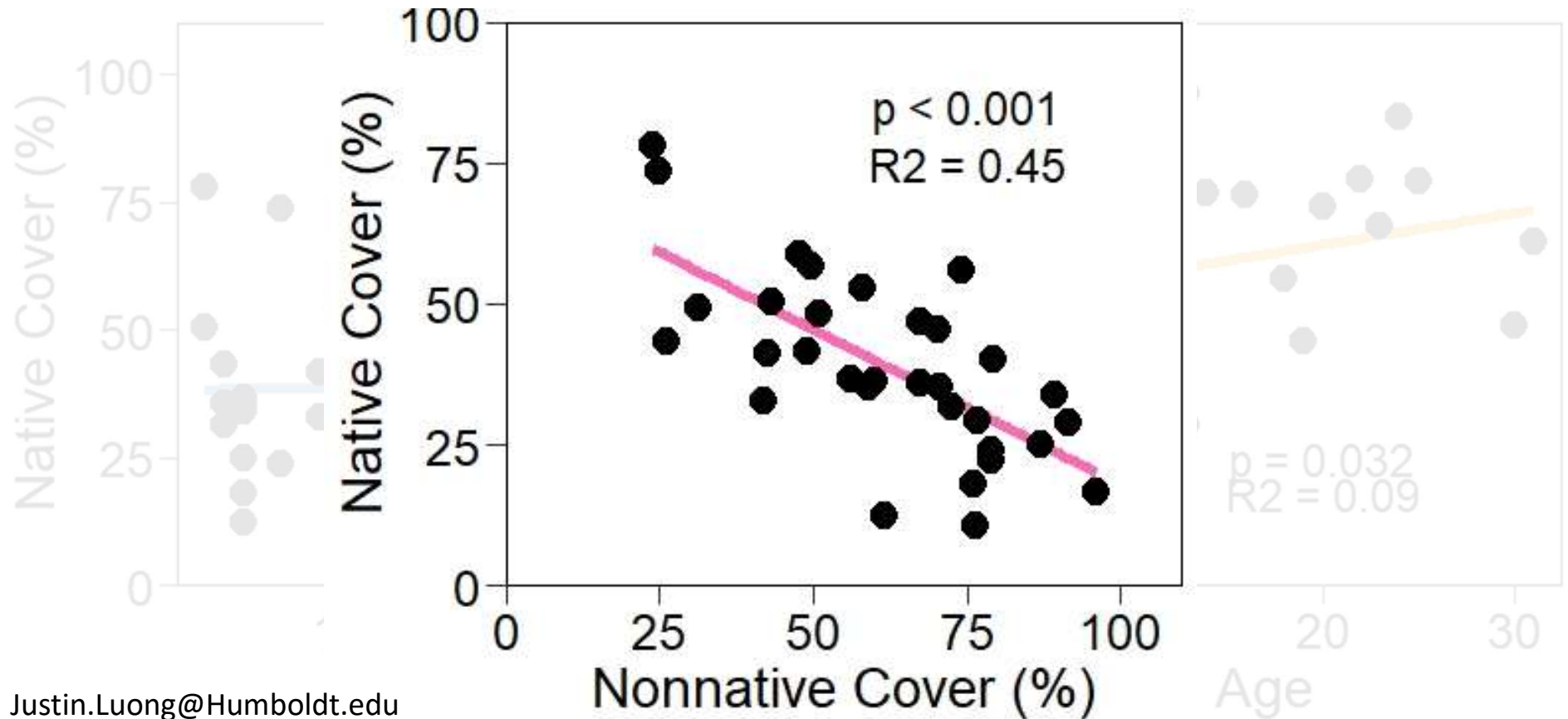
🌻 Native richness range = 5 to 60



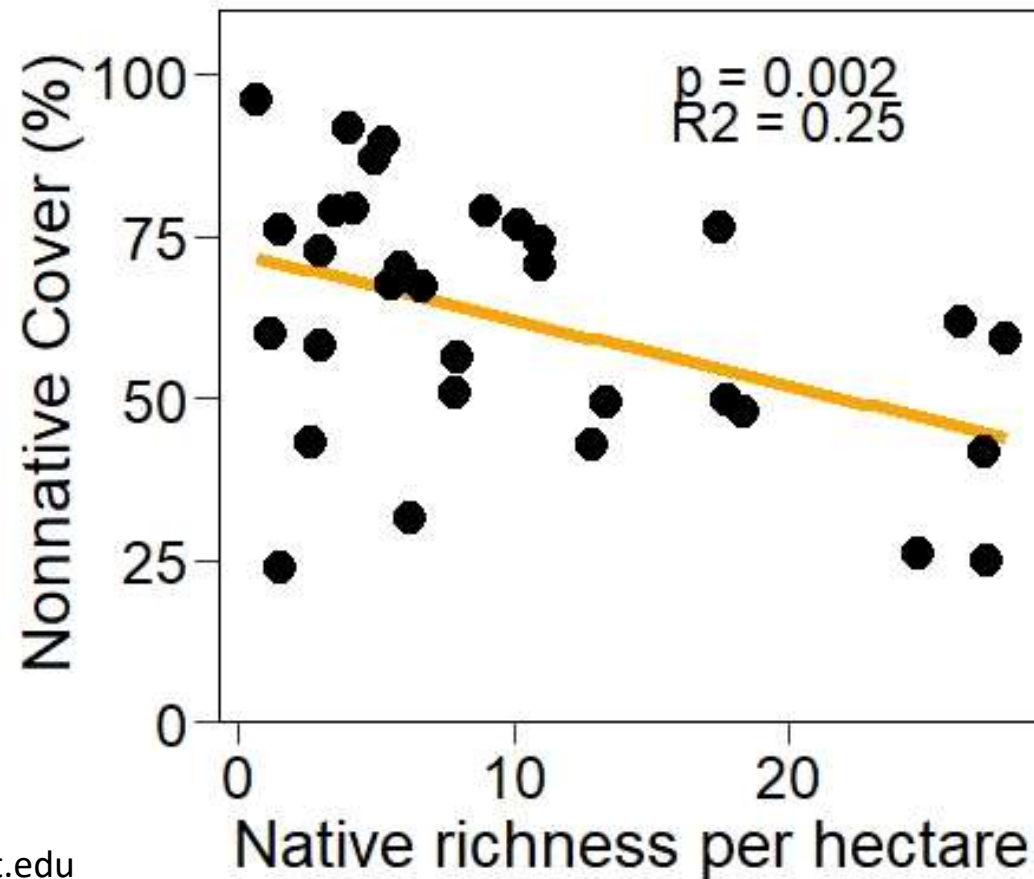
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Non-native competition strongly impacts restoration efforts



Native species richness per hectare is negatively associated nonnative plant cover



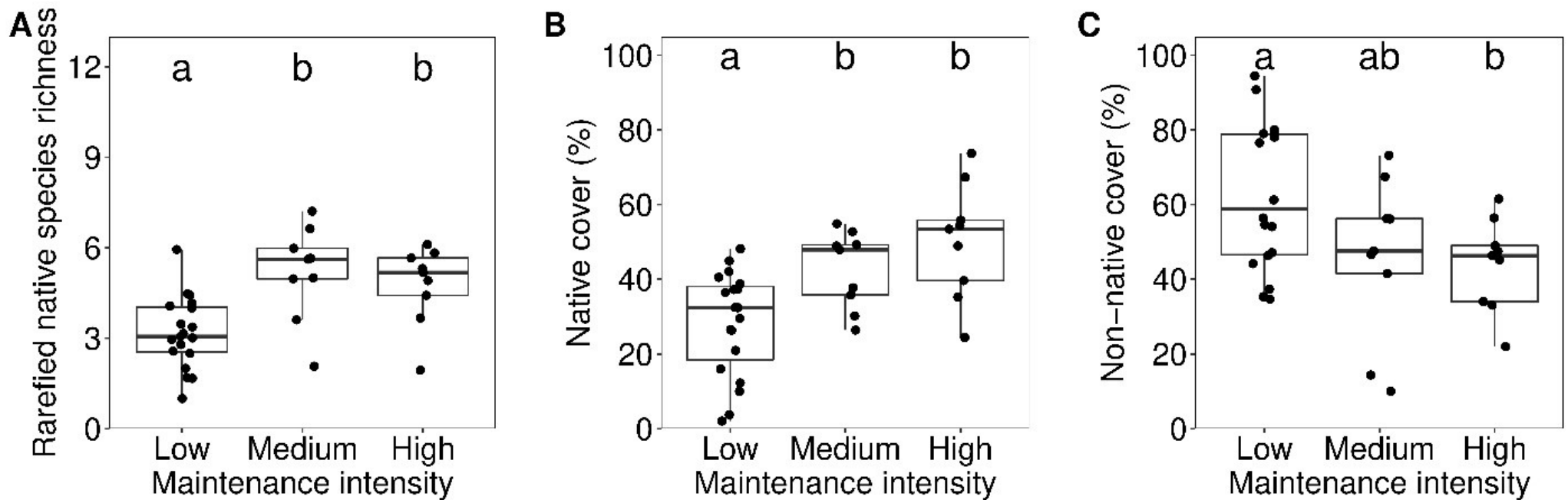
Regional biotic homogenization

🌻 **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
<i>Stipa pulchra</i> (69%)	X	X	X	X	X	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X		X	X
<i>Elymus glaucus</i> (59%)	X	X	X	X	X	X	X	X	X			X	X	X				X		X	X		X	X	X	X		
<i>Bromus carinatus</i> (50%)	X	X	X	X	X	X	X	X	X						X	X	X	X	X				X	X				
<i>Hordeum brachyantherum</i> (44%)											X	X	X	X	X						X	X	X	X	X	X	X	X
<i>Festuca rubra</i> (31%)			X	X	X	X	X	X	X						X	X	X											
<i>Achillea millefolium</i> (22%)			X		X	X	X	X	X																	X		
<i>Danthonia californica*</i> (22%)	X	X	X	X	X	X	X	X	X	X	X																	
<i>Deschampsia caespitosa</i> (17%)	X	X		X						X	X																	

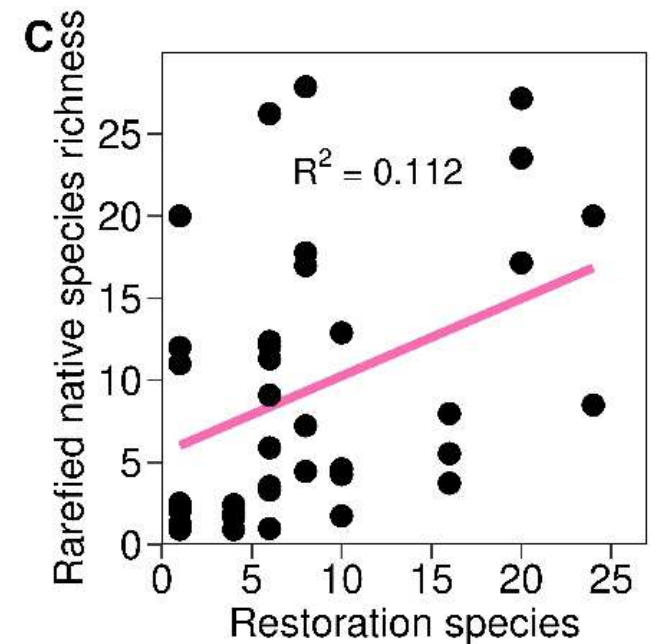
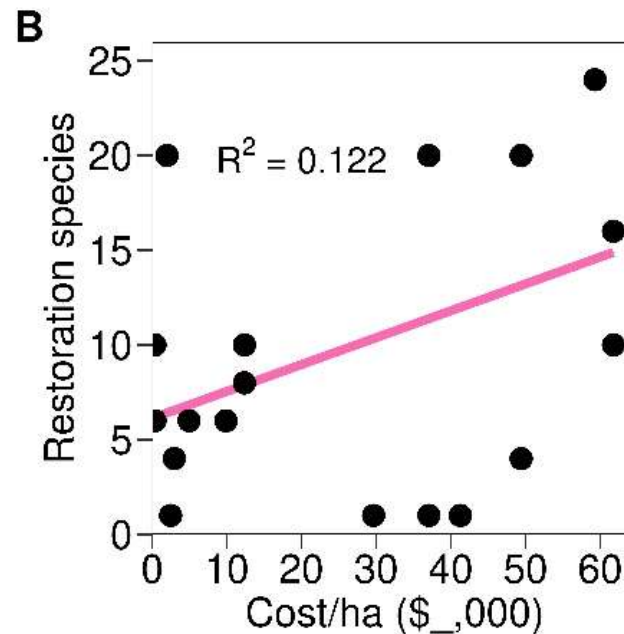
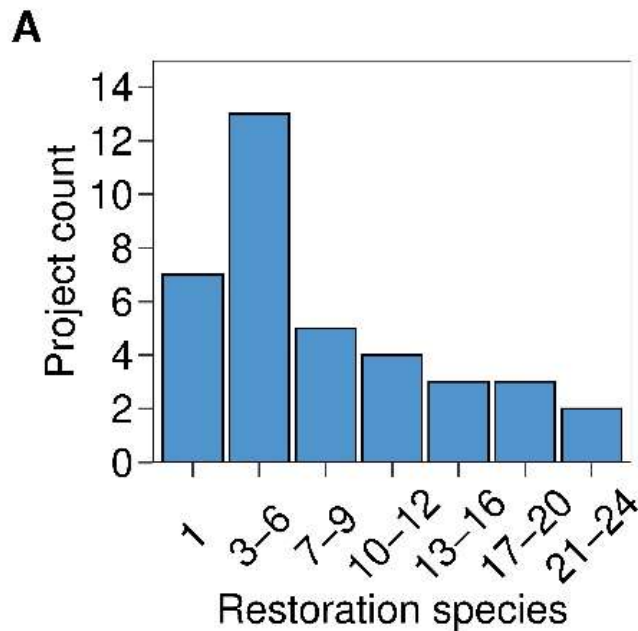
Financial cost has no direct effect on plant metrics, but higher maintenance intensity improve biodiversity



✉ Justin.Luong@Humboldt.edu

🐦 @JustinCLuong

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



✉ jluong4@ucsc.edu

🐦 [@JustinCLuong](https://twitter.com/JustinCLuong)

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
- 🌻 Risk aversion in achieving restoration goals




✉ Justin.Luong@Humboldt.edu

🐦 @JustinCLuong

Survey for Formation of Grassland Restoration Network



Justin.Luong@humboldt.edu

 [@JustinCLuong](https://twitter.com/JustinCLuong)



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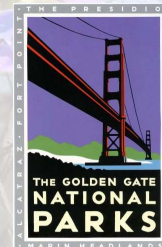
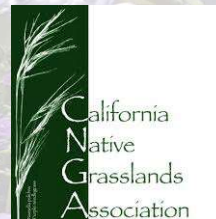


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Thank You



QR CODE for GRASS-NET Survey



Happy to take any questions

Contact Info:

Justin.Luong@humboldt.edu

Cal Poly Humboldt – Rangeland Management

 @JustinCLuong

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CALIFORNIA COASTAL GRASSLAND RESTORATION

is Successful

BUT MAY PROMOTE BIOTIC HOMOGENIZATION

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

Illustrator: Lesley Goren

