Limitations and solutions to sharing knowledge about invasive species research and management between academia and land management

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Gaps in knowledge sharing

https://www.hamptonthink.org/read/academias-other-diversity-problem-class-in-the-ivory-tower

Overview of this talk

- Key barriers to information sharing
- Chinese privet (*Ligustrum sinense*) and acacia (*Acacia* spp.) case studies
- Using environmental restoration courses to bridge gap between academia and land management

Photo: Sj.jamali

Key barriers to information sharing

- Scientific journals are expensive to access
- Limited time to synthesize and interpret research
- Researchers aren't credited as highly for publications in applied journal that would be most relevant to land managers
- Academic careers measured by publication in high impact journals rather than more accessible formats

Mismatch between scientific and management needs (Funk et al. 2020)

- Seedbank as reservoirs for native and non-native species
- Mechanisms of species dispersal
- **Life history of invasive species**
- Invasive species impact on native species
- Influence of climate change on invasive species
- **Invasive species distribution and ranges**
- Alterations to successional trajectories of native habitat by invasive species

Life history of an invasive species

- Chinese privet (*Ligustrum sinense*)
- Introduced to US in 1852
- Large number of fruits
- Long-distance seed dispersal
- High germination rates
- Clonal growth form
- Shade tolerant

http://tncweeds.ucdavis.edu/worst/ligustr.html

http://www.weedsbluemountains.org.au/images/silvereye_190.jpg

Chinese privet management efforts

Prescribed fire

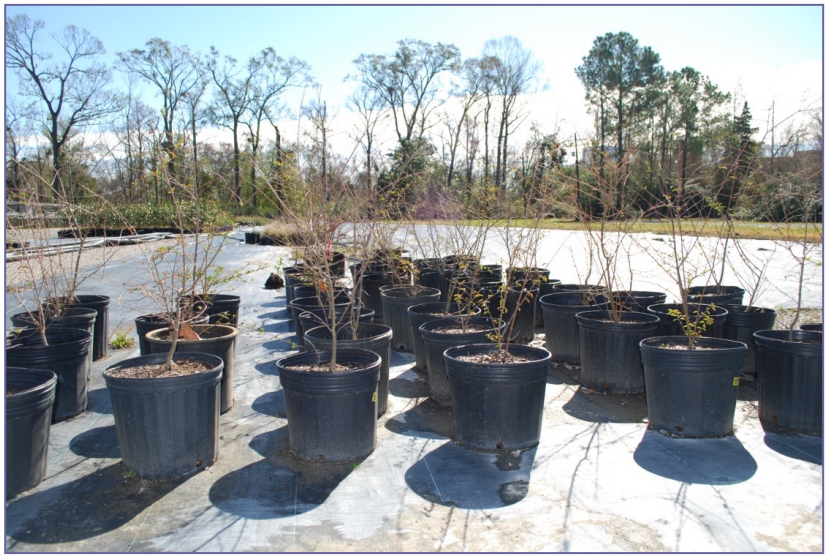
Prolonged flooding

Manual removal

Herbicide application

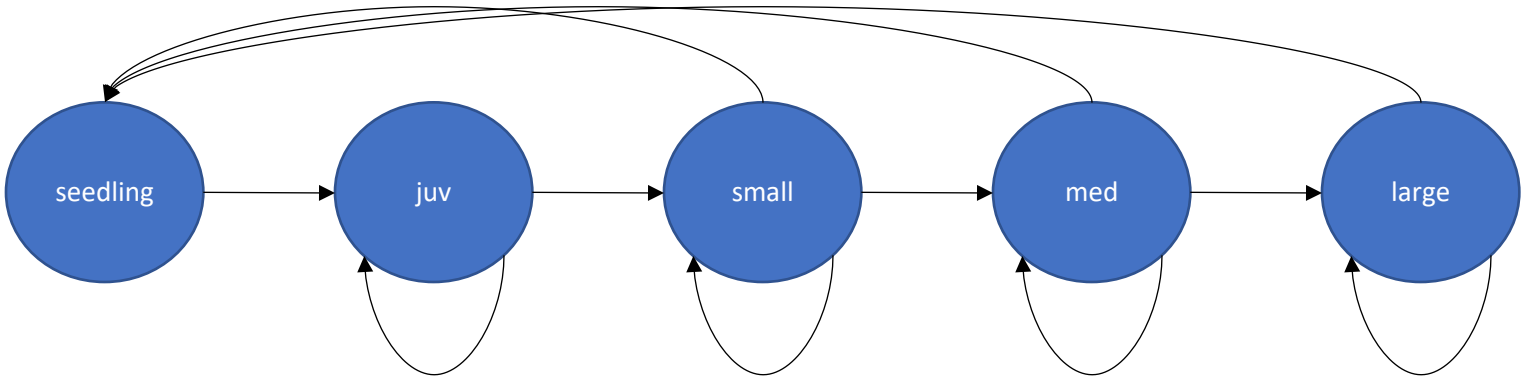
Life history features relevant to management

- Age at first reproduction
- Fecundity (potential reproductive capacity)
- Fruit/seed production
- Germination rates
- Life span



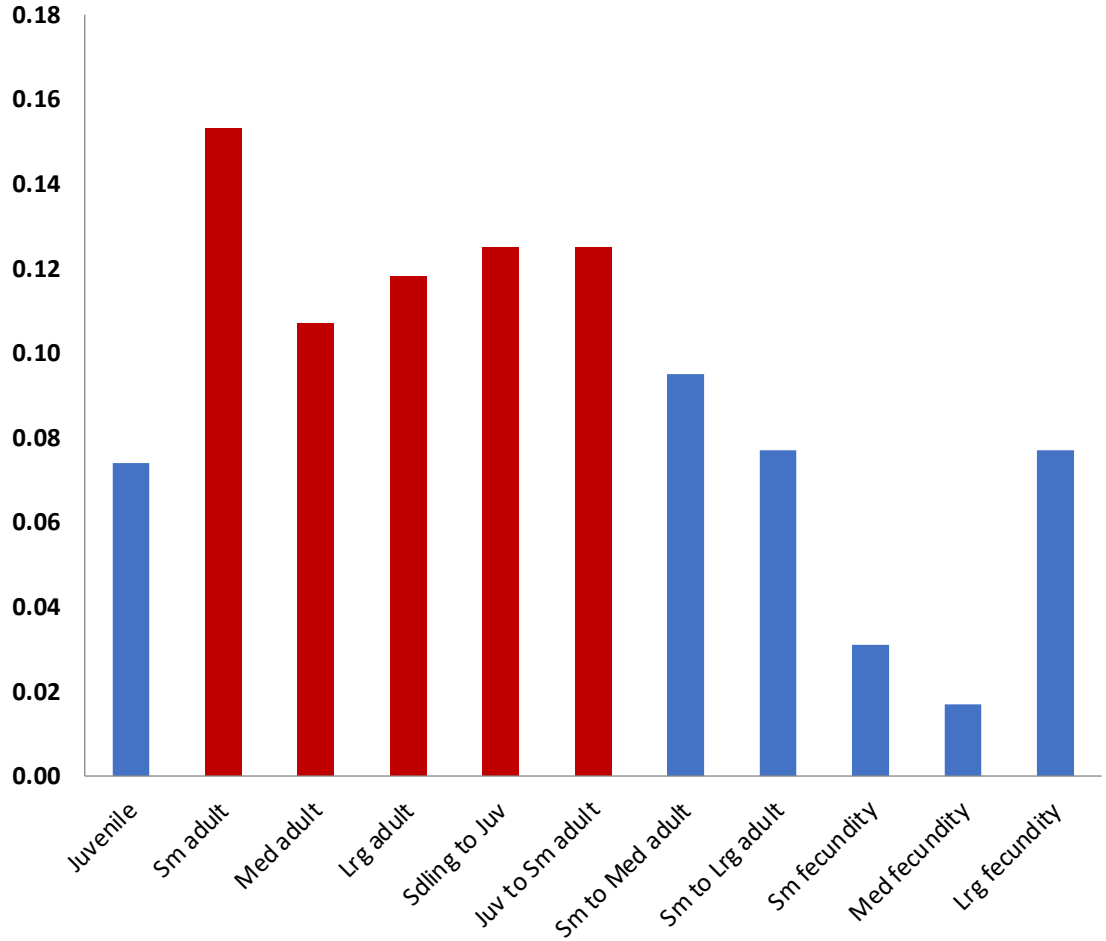
Stage-based matrix projection model

- Finite rate of increase (λ) of Chinese privet populations
- Life stages that contribute most to population growth
- Life stages that should be targeted for management



1-year life cycle graph

Elasticity analysis



Perturbation analysis

- Simulate variety of management techniques
- Reduce contribution of stages, transitions, fecundities
- Herbicide application/manual removal
- Seed-eating biocontrol
- Integrated management techniques

Seed-eating biocontrol

- *Ochyromera ligustri* found in Florida attacking seeds of Chinese privet (Cuda and Zeller 1998)

50% reduction in fecundity	50% reduction small adult fecundity, eliminate med and large adult fecundity	Eliminate seedlings
$\lambda = 1.36$	$\lambda = 1.04$	$\lambda = 0.89$

Photograph by: J.F. Butler, University of Florida

Integrated management techniques

<u>Simulation 1</u>

- Reduce seedling and juvenile transitions 50%
- Reduce small adult stage 50%
- Reduce large adult fecundity 50%
- $\lambda = 1.13$

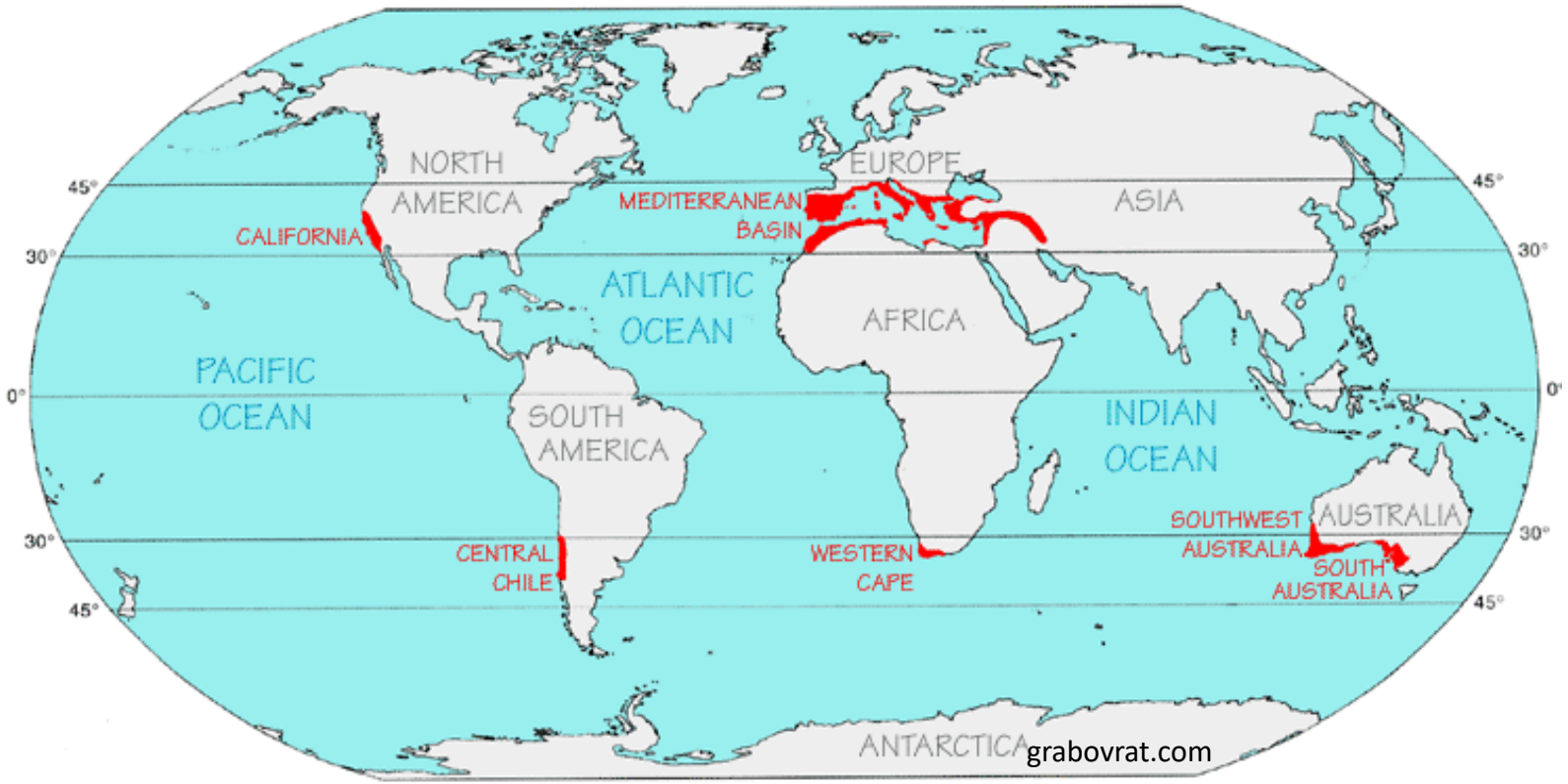
<u>Simulation 2</u>

- Reduce seedling and juvenile transitions 50%
- Reduce small adult stage 50%
- Reduce large fecundity and stage 50%
- $\lambda = 1.04$

Researching a species life history has relevance for both research and management

- Life history characteristics clarify population growth
- Models help streamline management
- Targeting fecundity alone not effective
- Seed-eating biocontrol alone not a viable option
- Removal of seedlings, juveniles, and small adults promising
- Models predict best management techniques

Invasive species distribution and range

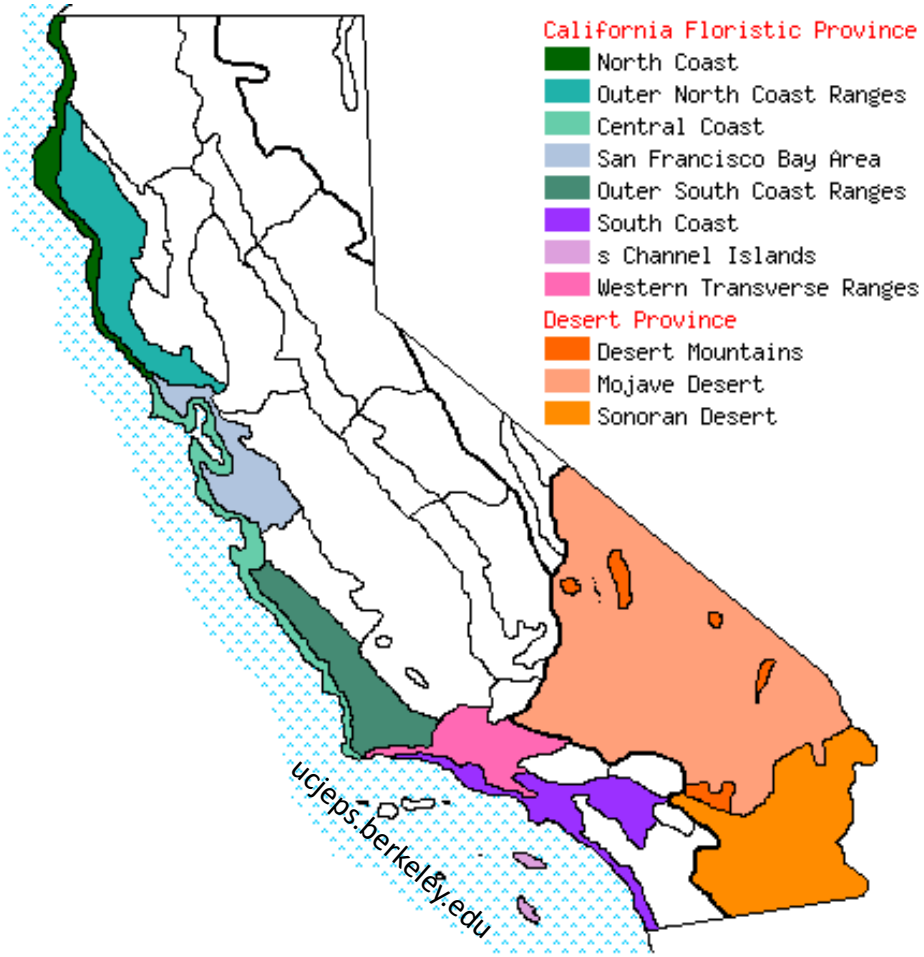


23 Invasive

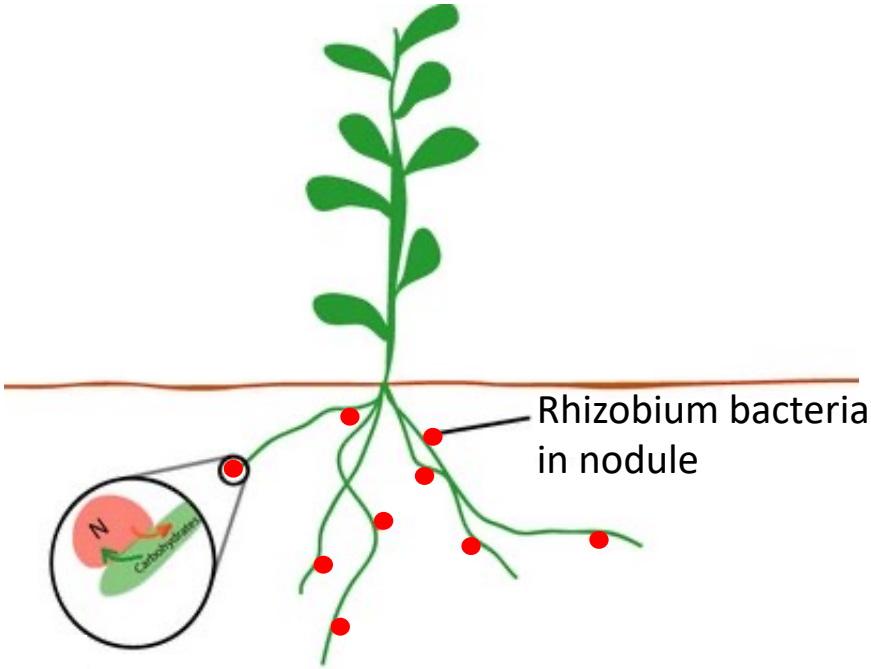
48 Naturalized

315 Non-Invasive

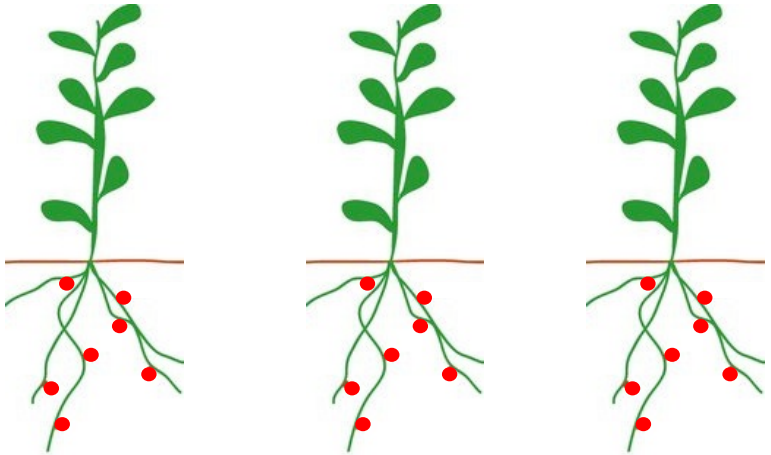
Acacias in California



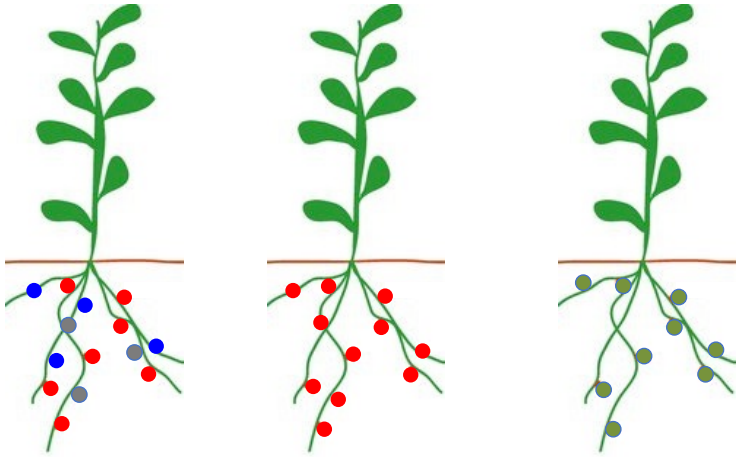
Host promiscuity in legume-rhizobia symbiosis



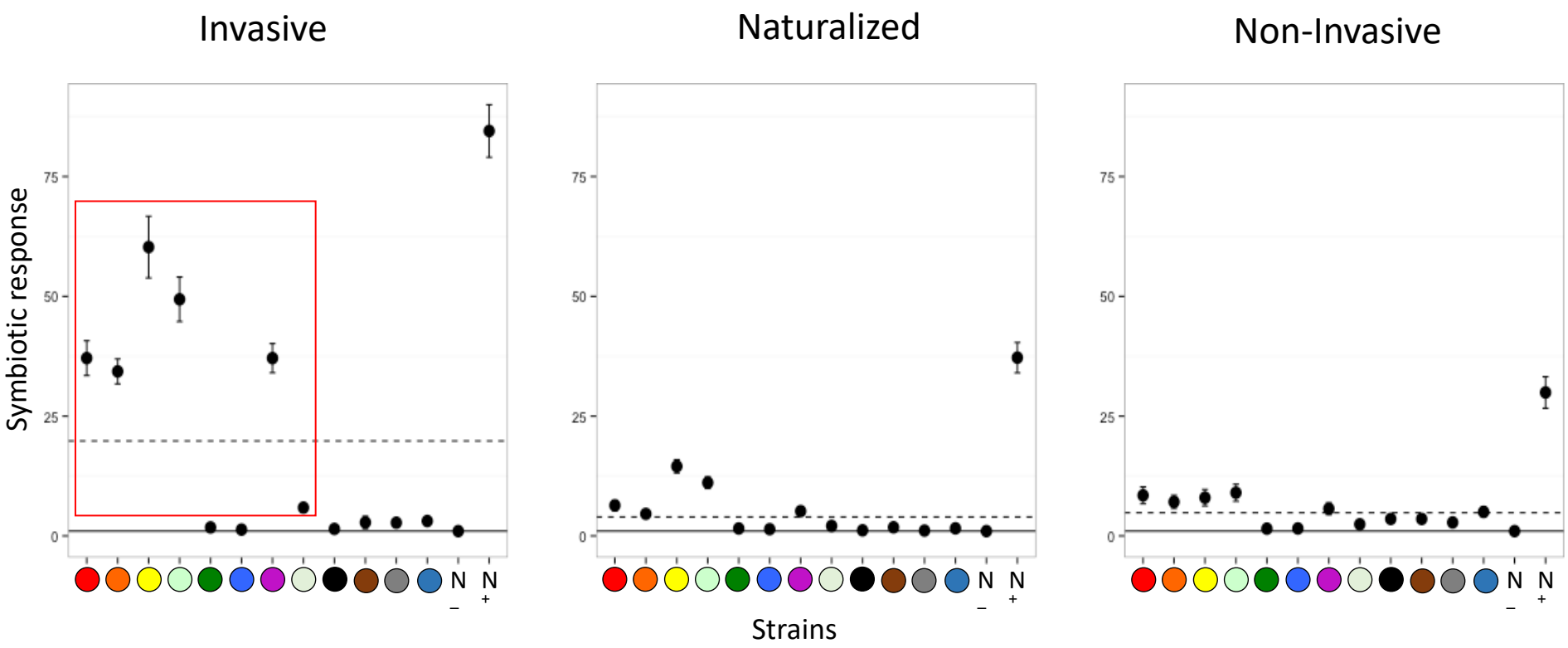
Specific hosts



Promiscuous hosts



Symbiotic response



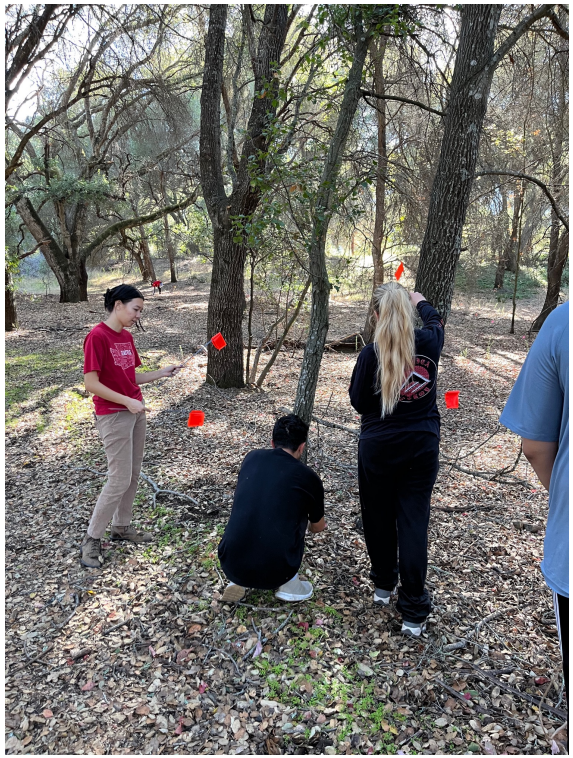
Implications for invasion and restoration

Educating and involving future restorationist/academics in partnerships

SJSU and Stanford Conservation Program Project Overview

- Students work in groups to develop ecological question
- Students visit site to collect data
- Students report findings in a scientific manuscript format and present results to class
- Empowers students to engaged with learning process, take ownership of ability to develop and see through a research project
- Identify relevance of research to habitat restoration
- Network with project managers to help careers

Broadening opportunities for underserved students to engage in ecosystem restoration



Project Overview

- Student participate in habitat surveys at sites invaded by *Eucalyptus globulus* and *Acacia dealbata*
- Survey plant, mammal, bird, and soil characteristics, make management recommendations, develop planting plans, and monitor sites
- 3-year-long project that will help integrate land management with academia
- Educate future restoration leaders about the importance of collaboration across research/management

Broadening Opportunities for Underserved Students to Engage in Ecosystem Restoration

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This project is a unique collaboration between San José State University's (SJSU) **Environmental Restoration** students and **Midpeninsula Regional Open Space District** (Midpen) to increase access for students to natural areas and engage them in environmental restoration while working to conserve Midpen's natural resources.

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Tower Hall at San José State University

SJSU Environmental Restoration students setting up a vegetation survey.

Project Motivation

Field-based inquiry provides a unique opportunity for students to connect with natural areas and enhance their understanding of ecological processes. Students in particular who engage in field work during the course of their education reportedly value this experience in the context of career aspirations and indicate that their learning experiences have been more effective when conducted in the field. **This project has two primary goals**:

- Increase access for students from San José State University (SJSU), a Hispanic- and Minority-Serving Institution to Midpen lands.
- Leverage student learning in environmental restoration courses to address science-based questions about habitat restoration.

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Aligning Missions

This project promotes Midpen's mission to "acquire and preserve a regional greenbelt of open space land in perpetuity, protect and restore the natural environment, and provide opportunities for ecologically sensitive public enjoyment and education".

- Engaging college students in environmental restoration practices will facilitate a new generation of land stewards that value, promote, and preserve open space for future generations
- Engaging students in applied science directly related to the restoration of these lands can help improve the long-term protection and restoration of the

Solutions for bridging the gap

- Surveying land managers to determine key priorities (Matzek et al. 2014)
- Open-access journals (Funk et al. 2020)
- Increasing two-way sharing of knowledge
  - Workshops/Conferences/Symposia
  - Networking between academics and managers
  - Improving communication strategies of results
  - Developing new ways to communicate science
  - Educating and involving future restorationist/academics in partnerships

Acknowledgements

Midpeninsula Regional Open Space District

NSF