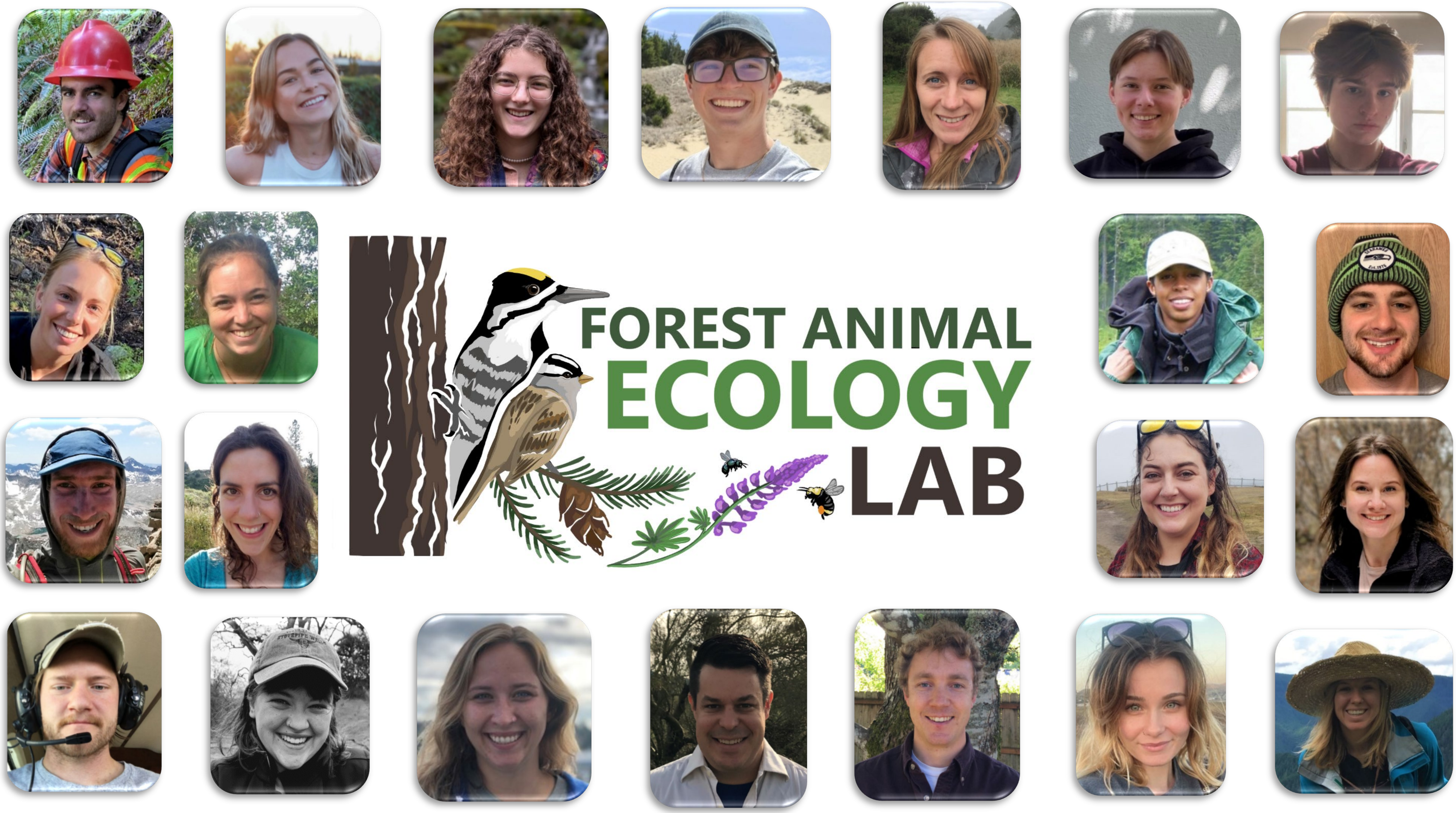
Evaluating the response of native bees to fuel-reduction treatments in managed conifer forests

Dr. Jim Rivers
Megan Sampognaro

College of Forestry
Oregon State University


FOREST ANIMAL
ECOLOGY
LAB

Many people contributed to making this project a success

Dr. Katie Moriarty

Co-Principal Investigator

Dr. Jake Verschuyl

Co-Principal Investigator

EST. 1969 W. M. BEATY & ASSOCIATES, INC.

SIERRA PACIFIC INDUSTRIES

Collins

Bennie Johnson, Stu Farber, Cedric Twight, Kevin Roberts, Dustin Hixon, Mike Jones, Kristina Wolf, and many field and lab technicians

Pollinators are critical for supporting human food security and the functioning of natural ecosystems

~75% of agricultural crops benefit from pollinators

OperationBee.com

Pollinators support >300,000 flowering plant species

There are ~4000 native bee species found in the U.S.

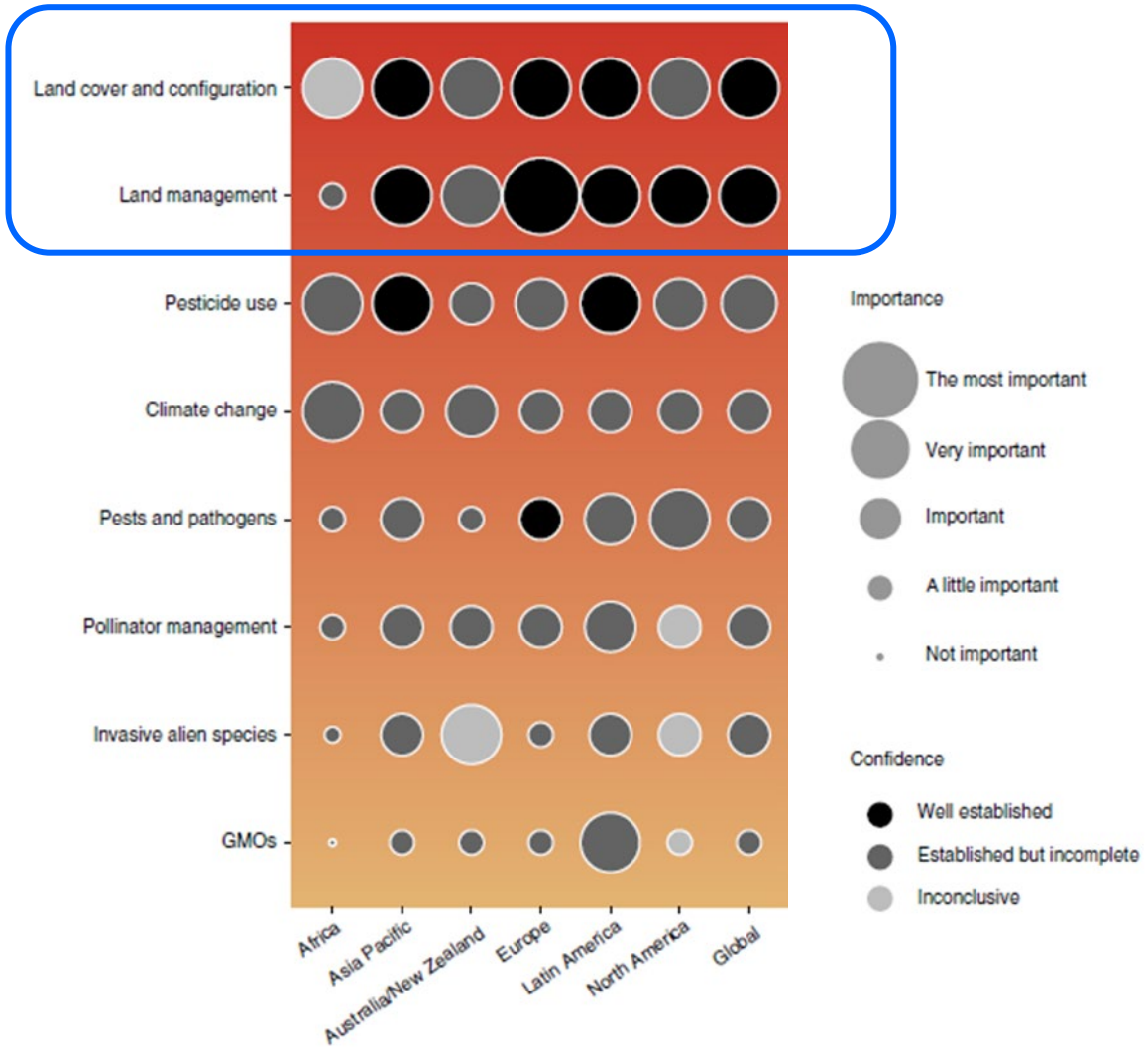
Images courtesy of Oregon Department of Agriculture

Floral rewards and nesting sites are crucial resources needed by bee communities

Bees get their food from plants in bloom

Most bee species nest underground

Long-term pollinator declines have led to widespread concern



Dicks et al. (2021) *Nature Ecology and Evolution*

Major knowledge gaps exist for forest pollinator research

A Review of Research Needs for Pollinators in Managed Conifer Forests

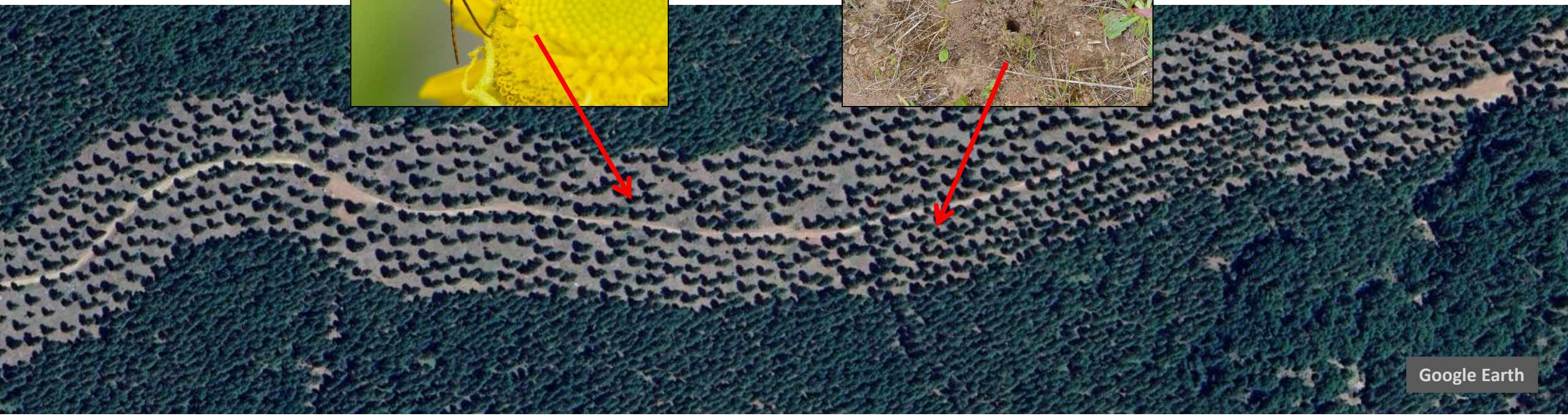
James W. Rivers, Sara M. Galbraith, James H. Cane,
Cheryl B. Schultz, Michael D. Ulyshen, and Urs G. Kormann

J. For. 116(6):563–572
doi: 10.1093/jofore/fvy052

Key take-home:

Information is lacking regarding how forest management practices influence insect pollinators

Our study evaluates how shaded fuel breaks influence native bees and their key resources



Our work addresses two research themes at the intersection of wildfire hazard and wildlife habitat

Theme	FPRs	Article	Critical Monitoring Questions
6. Wildfire Hazard	14 CCR § 1038, 1051.4, 1052.4	Article 2. Timber Harvesting Plan	Are the FPRs and associated regulations effective in... (b) treating post-harvest slash and retaining wildlife habitat structures, including snags and large woody debris? (c) managing fuel loads, vegetation patterns and fuel breaks for fire hazard reduction?
	14 CCR § 913.4 [933.4, 953.4]	Article 3. Special Prescriptions	
	14 CCR § 917 (937, 957)	Article 7. Hazard Reduction	
9. Wildlife Habitat: Cumulative Impacts	14 CCR § 919, 939, 959	Article 9. Wildlife Protection Practices	Are the FPRs and associated regulations effective in… (a) characterizing and describing terrestrial wildlife habitat and ecological processes? (b) avoiding significant adverse impacts to terrestrial wildlife species?

Megan Sampognaro

M.S. Defense | Sustainable Forest Management

Friday, August 22nd | 11am
PFSC 315 / Zoom*

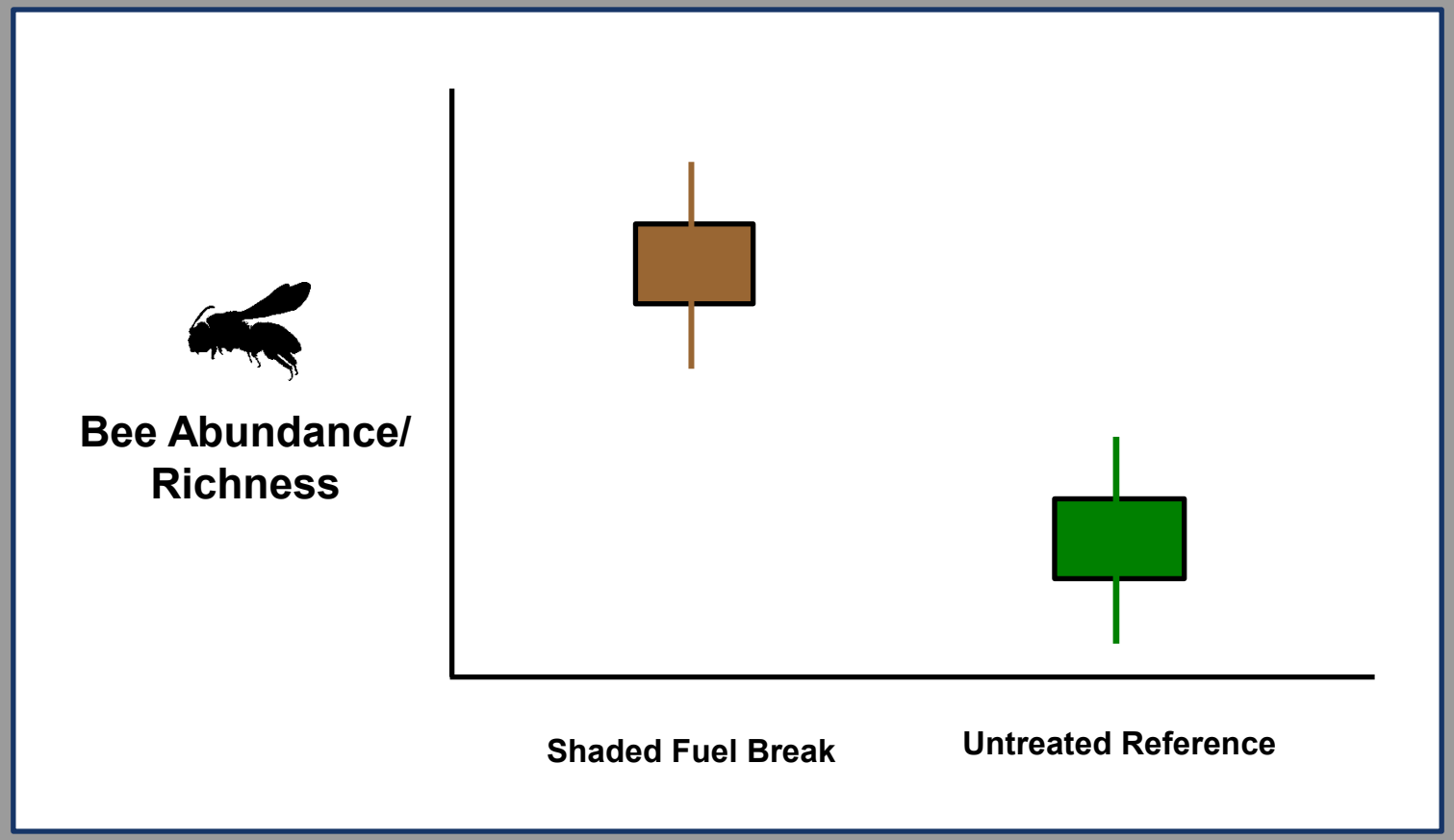
Evaluating Native Bee Community Response to Shaded Fuel Break Treatments in Managed Forests of Northern California

Megan is earning her M.S. degree in Sustainable Forest Management with Dr. Jim Rivers

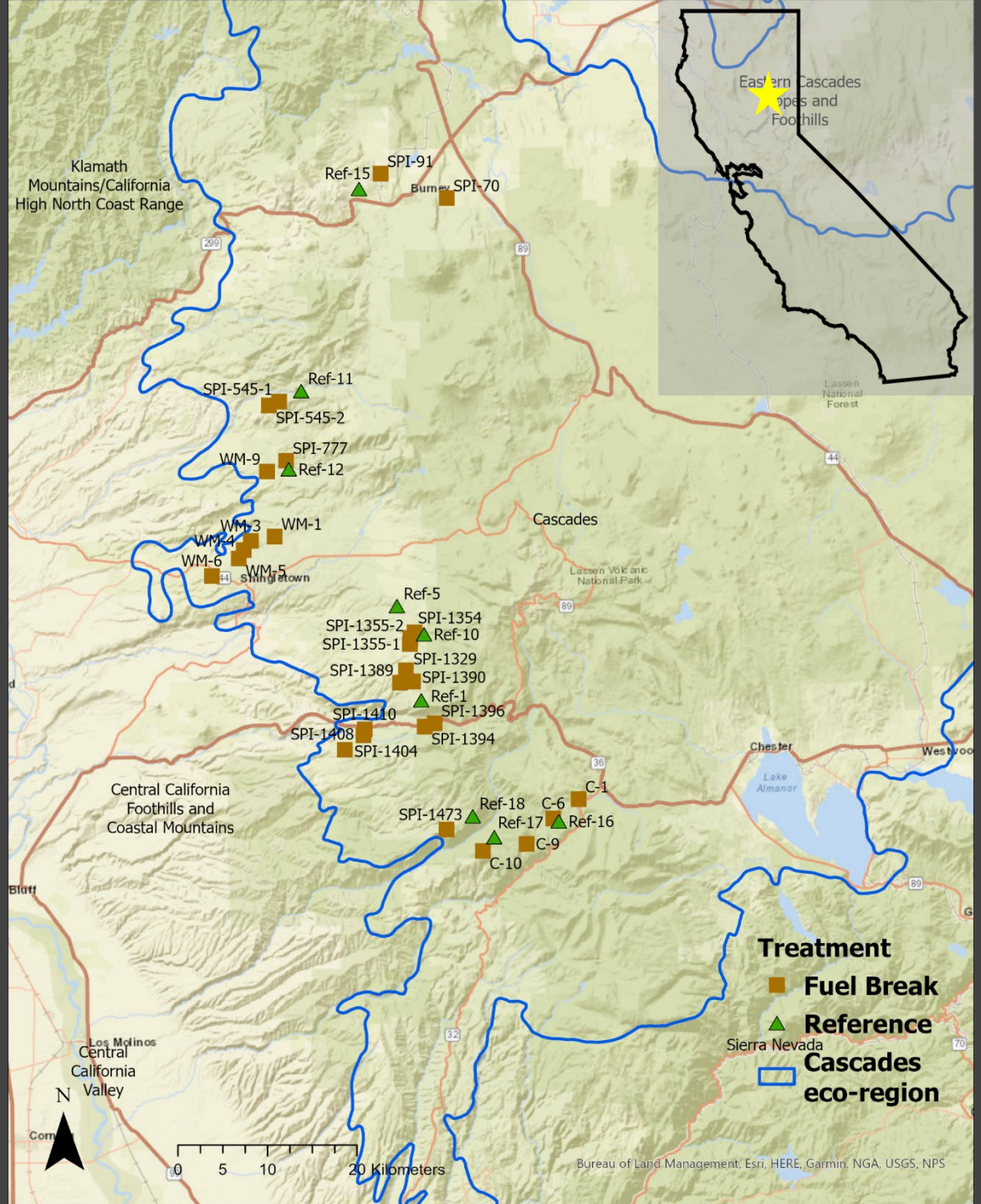
**Please email FERMDept@oregonstate.edu for Zoom information and/or accommodations for disabilities*

Oregon State University
College of Forestry

Hypothesis: Bee abundance/richness will be affected by fuel break treatments



Landowners:



Site Selection Criteria

- Sites along forest roads
- > 2 km from previous fires in the last 10 years
- > 1 km from logging in the last 10 years

Study sites:

n = 27 fuel breaks

n = 9 untreated reference sites

Shaded fuel breaks

Untreated reference sites

We sampled bees on 4 subplots at each study site

Timed Netting

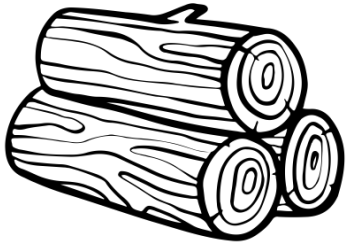
Blue Vane Traps

Colored Pan Traps

We surveyed site-scale vegetation on 4 transects per site

Canopy cover

Woody debris

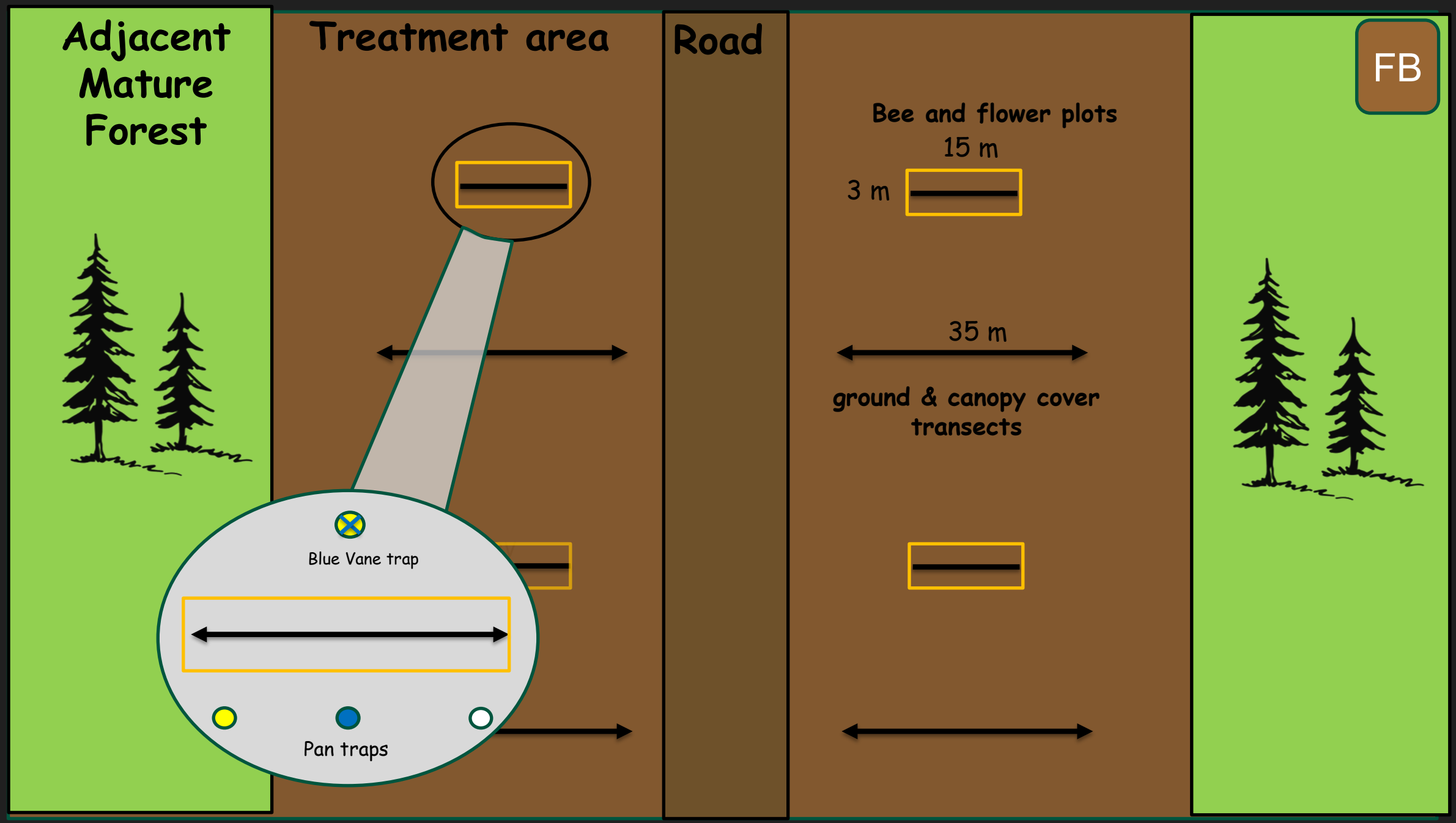


Grass, ferns and forbs

35m transect

Shrub cover

Bare ground


Adjacent Mature Forest
Treatment area
Road
FB
Bee and flower plots
15 m
3 m
35 m
ground & canopy cover transects
Blue Vane trap
Pan traps

Accomplishments from the 2023-24 field seasons

Field effort by year

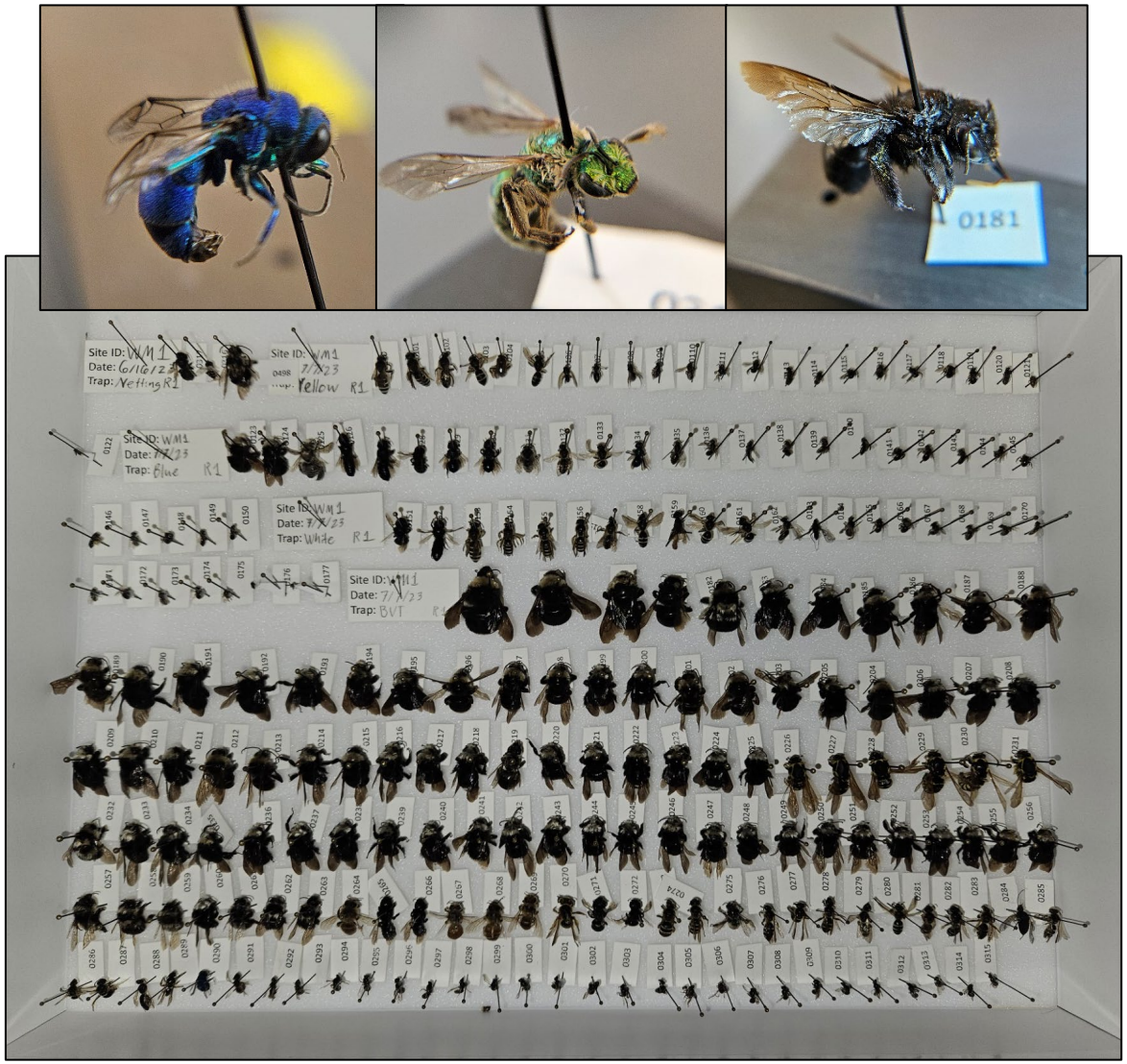
- 2023: 252 person-days in field
- 2024: 216 person-days in field

Sampling extent

- 2 rounds of netting + floral resources
- 2 rounds of passive trapping
- site-scale vegetation measures

Captured 17,144 bees of 171 species

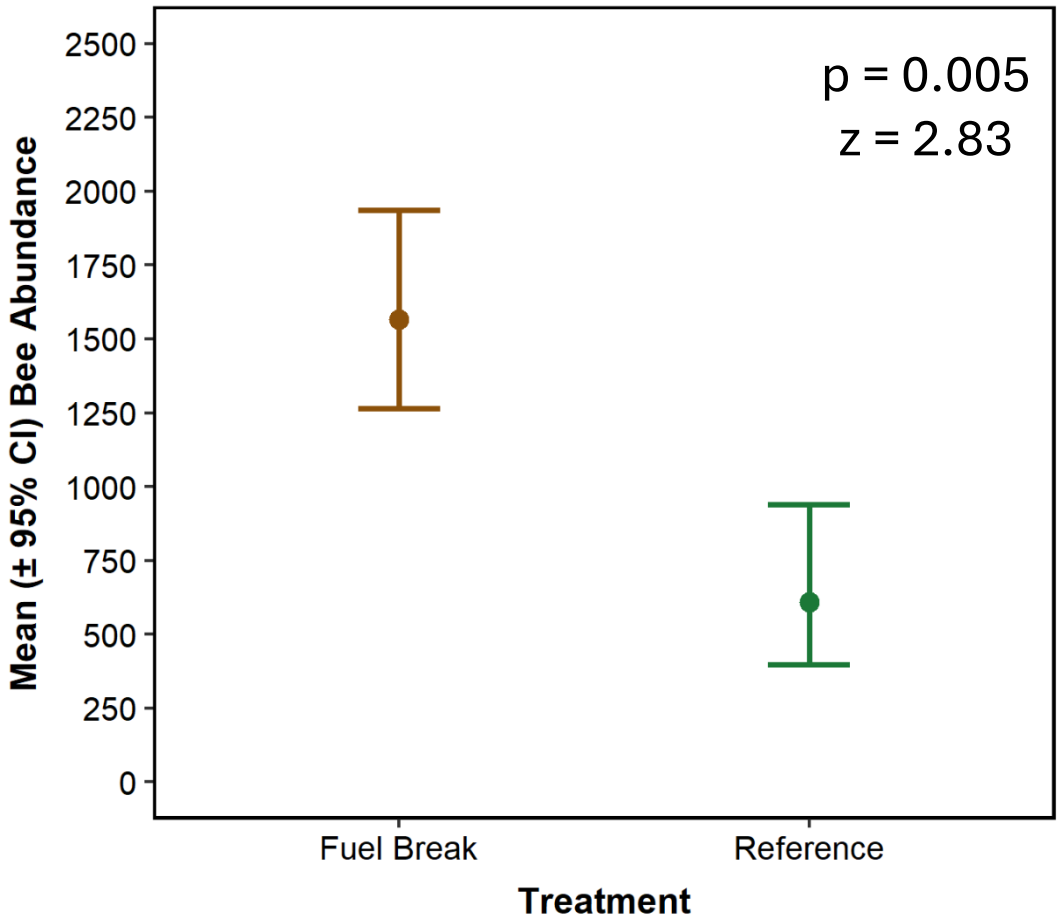
- 12,560 bees in 2023 (73% of total)
- 4,584 bees in 2024 (27% of total)

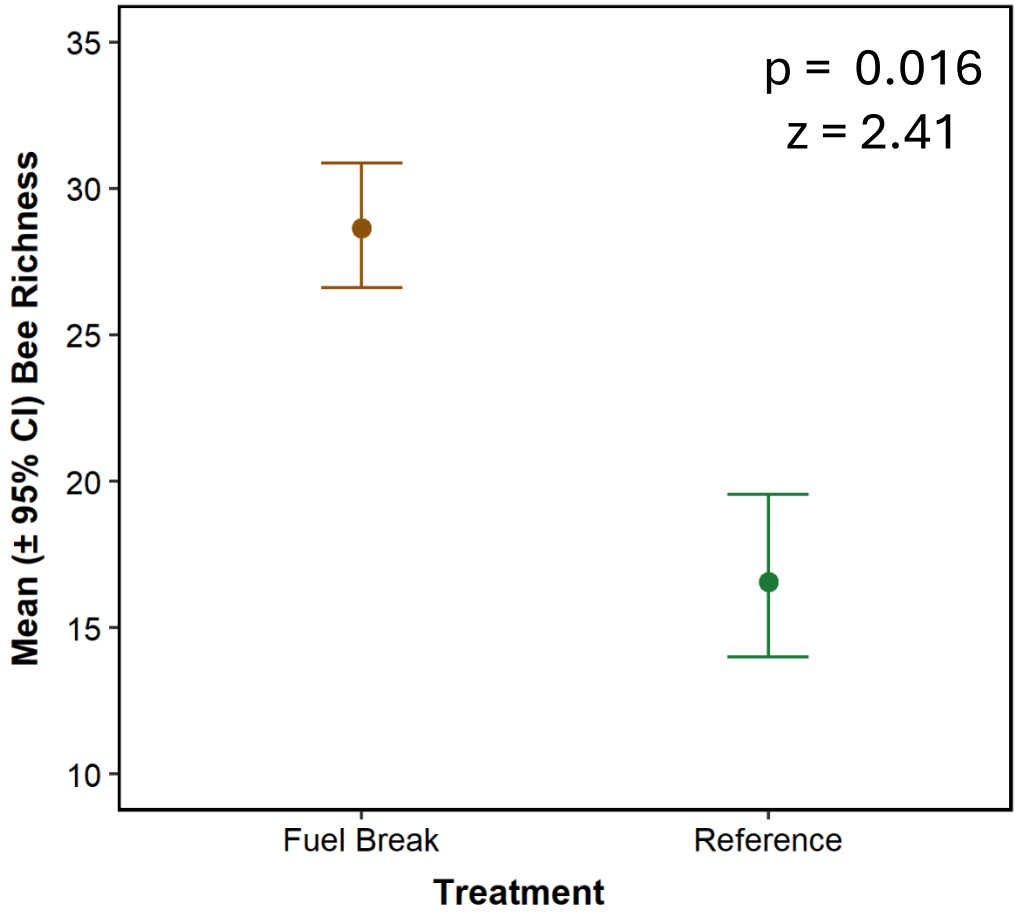


Images courtesy of M. Sampognaro and J. O'Sullivan

Sampognaro 2025 (M.S. thesis, Oregon State University)

There were 4× more bees and 1.3× more bee species in fuel breaks



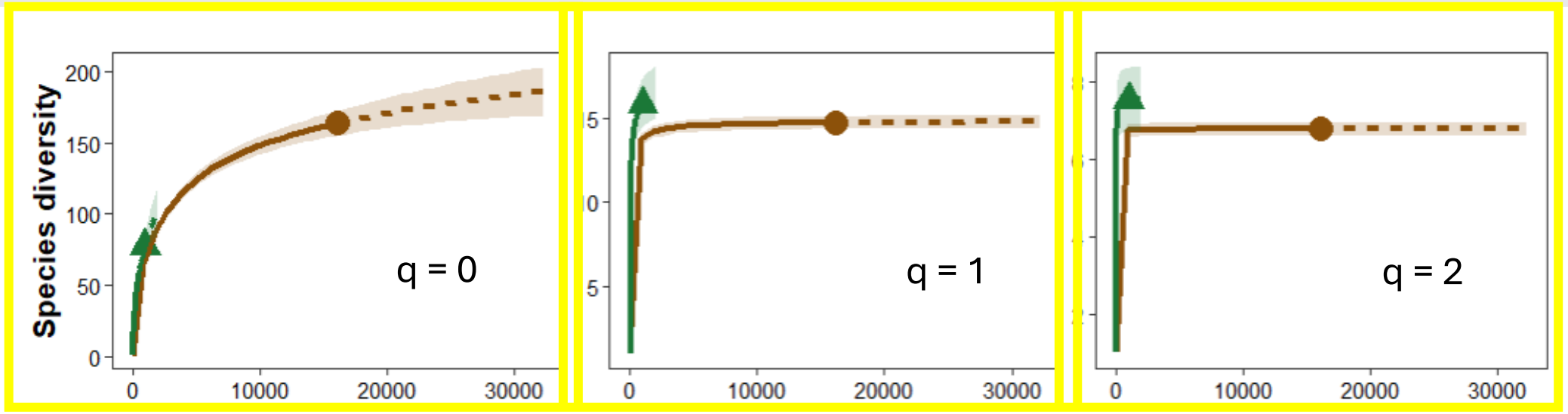


Sampognaro 2025 (M.S. thesis, Oregon State University)

Estimating differences in diversity between treatments

Species Richness	Shannon Diversity	Simpson Diversity
q = 0	q = 1	q = 2
More influence from rare species	Balanced influence from rare and common species	More influence from dominant species

Shannon diversity greater in reference sites



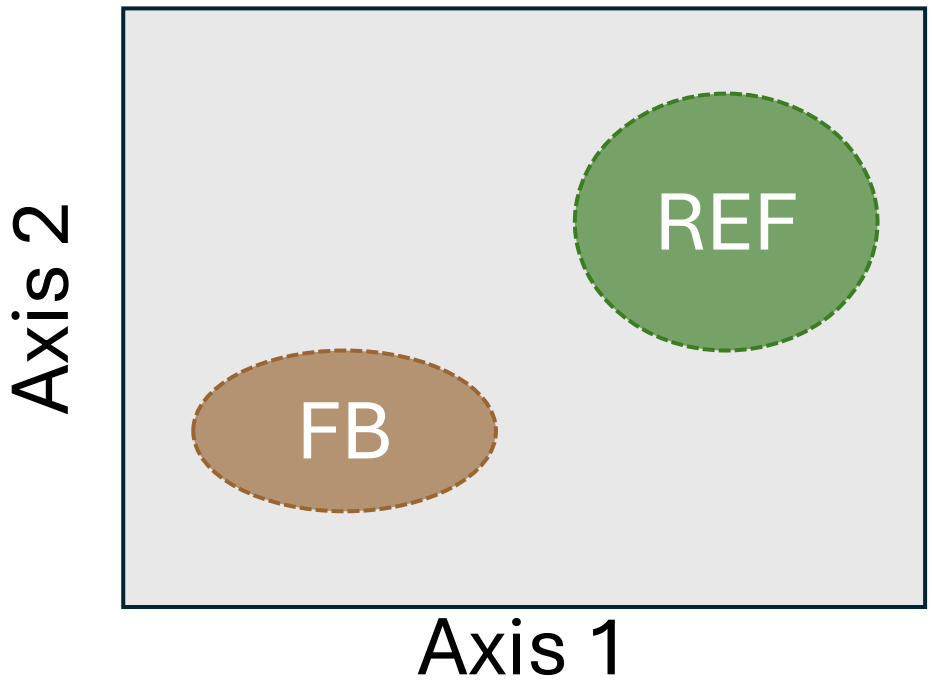
Treatment	Diversity	Hill #	Observed richness	Estimated diversity	Lower CI	Upper CI
Fuel break	Species richness	q = 0	164	90.9	88.4	93.4
	Shannon diversity	q = 1	---	14.2	13.8	14.6
	Simpson diversity	q = 2	---	6.8	6.5	7.0
Reference	Species richness	q = 0	77	102.0	84.6	119.5
	Shannon diversity	q = 1	---	16.5	14.8	18.1
	Simpson diversity	q = 2	---	7.5	6.9	8.2

Sampognaro 2025 (M.S. thesis, Oregon State University)

Nonmetric Multidimensional Scaling

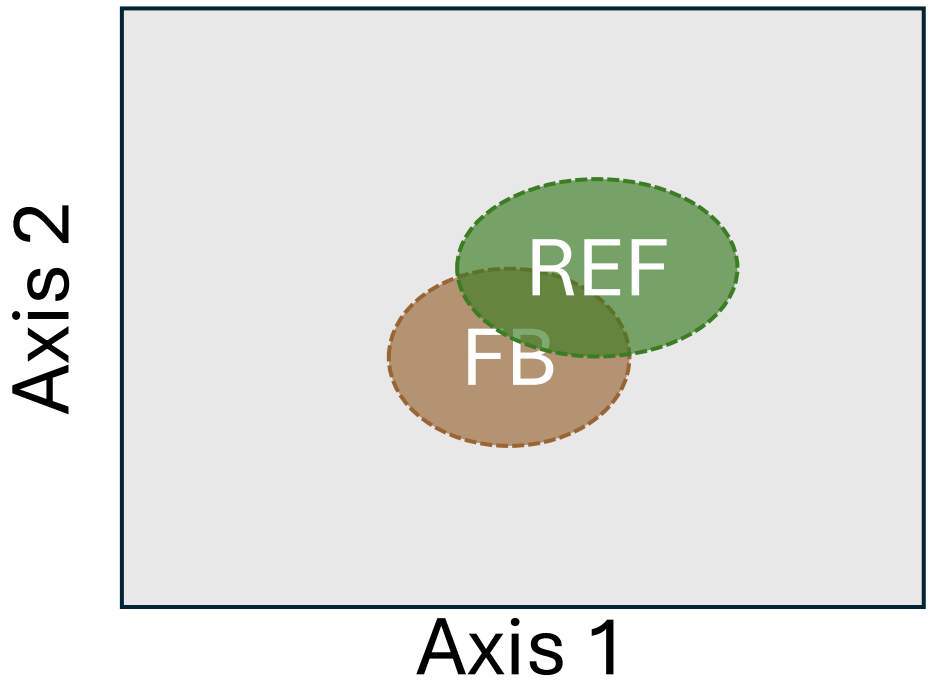
Do bee communities vary between treatment types?

Communities differ

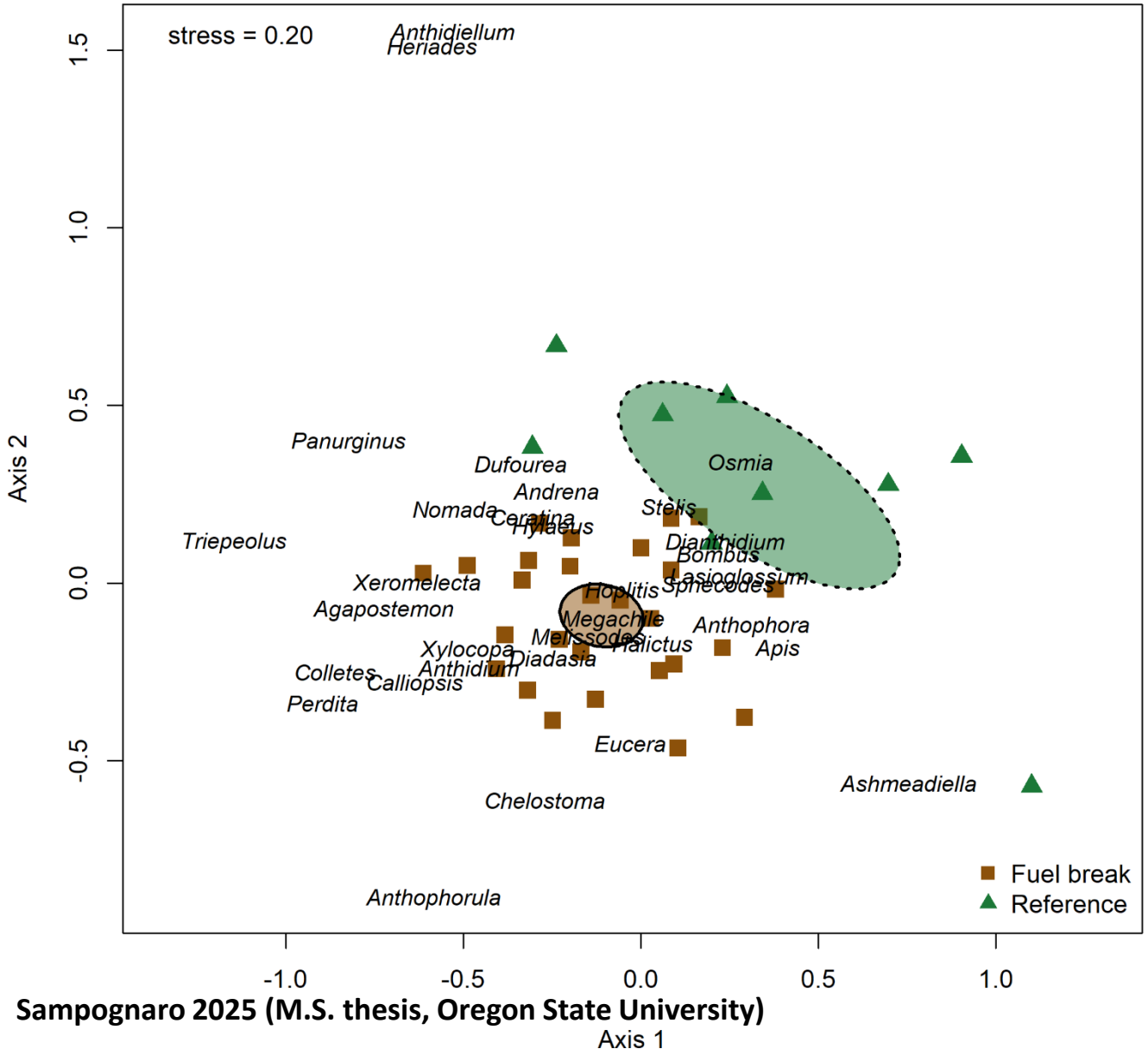


Example figures

Communities similar



Fuel breaks and untreated areas support different bee communities



Sampognaro 2025 (M.S. thesis, Oregon State University)

Fuel Breaks

More ground-nesting bees!

Reference sites

More stem and cavity nesters!

Unpublished data; do not copy or distribute

Indicator species analysis

Gosh, I just love fuel breaks!

Indicator value

Specificity:
Is a particular species restricted to one treatment type?

Fidelity:
How often was a species detected across all sites in a particular treatment?

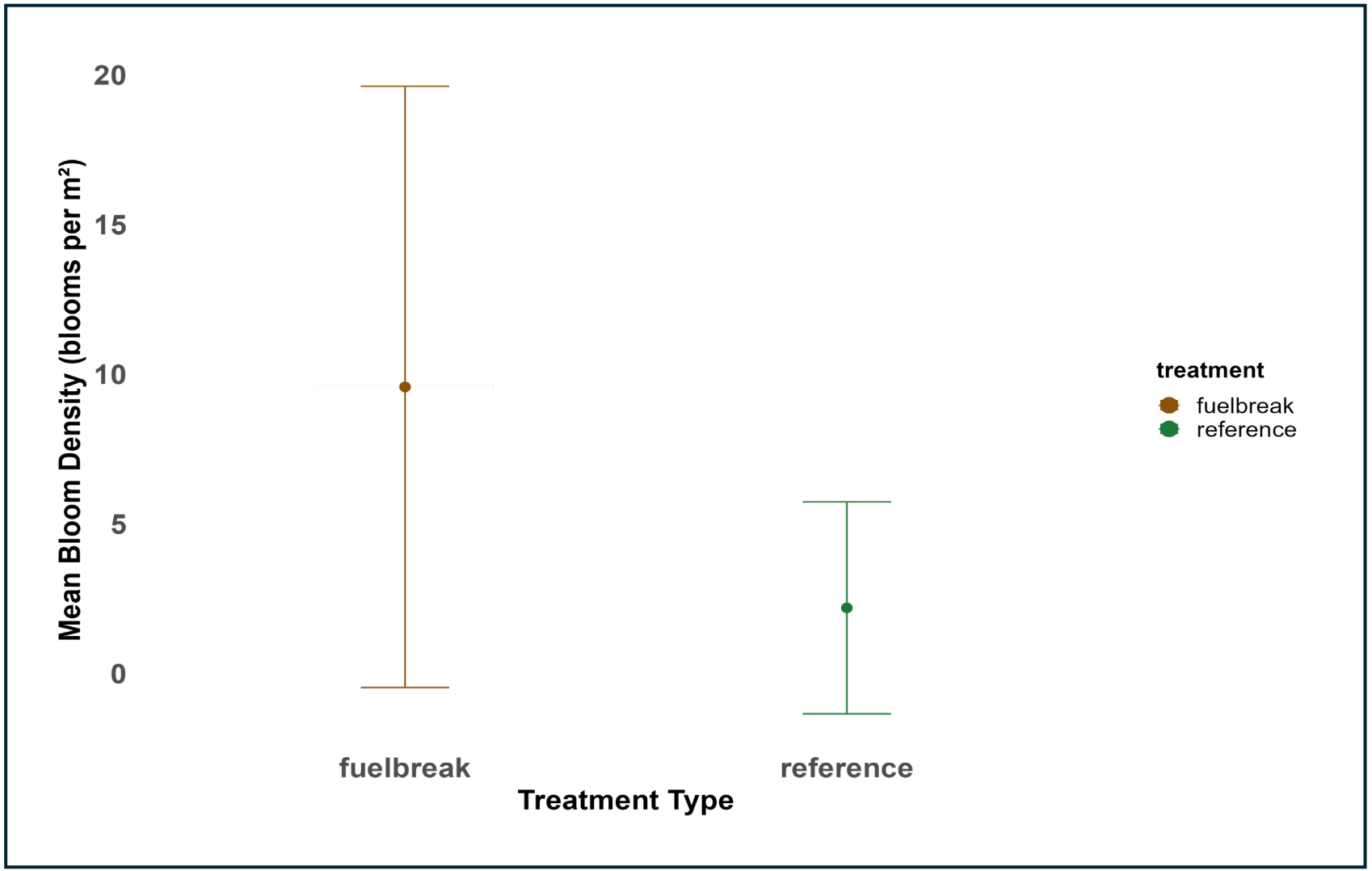
Reference sites, so cool!

Indicator species were detected for both treatment types

Treatment	Species	Indicator Value	Specificity	Fidelity	p
Shaded fuel break	*Halictus farinosus*	0.938	0.990	0.889	0.003
	Lasioglossum incompletum	0.903	1.000	0.815	0.001
	Melissodes lupina	0.950	0.936	0.963	0.001
	Xylocopa tabaniformis	0.861	1.000	0.741	0.005
Reference	*Osmia penstemonis*	0.745	1.000	0.556	0.002

Sampognaro 2025 (M.S. thesis, Oregon State University)

Bloom density was 5.5× greater in fuel breaks



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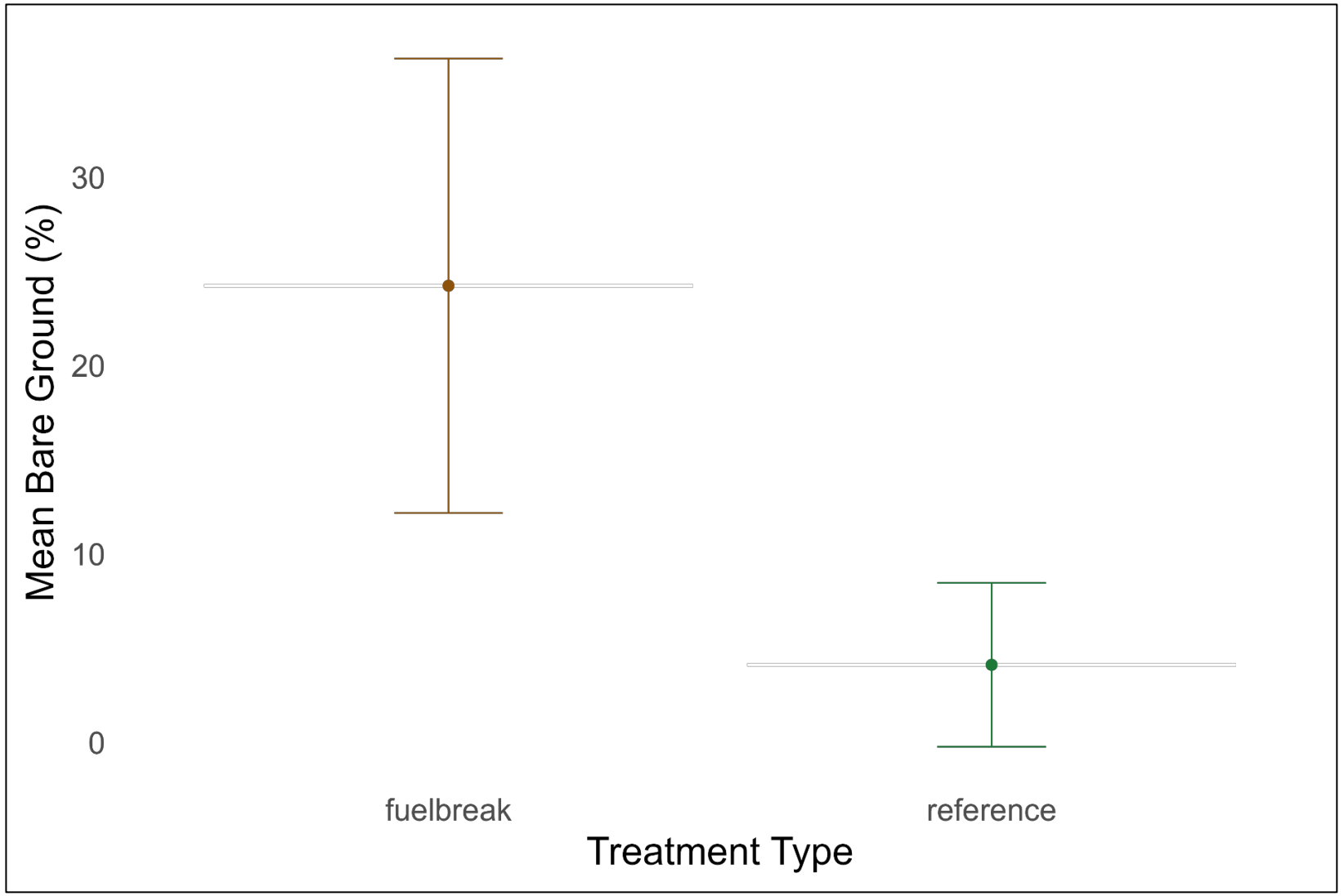
Bare ground was 6× greater in fuel breaks



Sampognaro 2025 (M.S. thesis, Oregon State University)

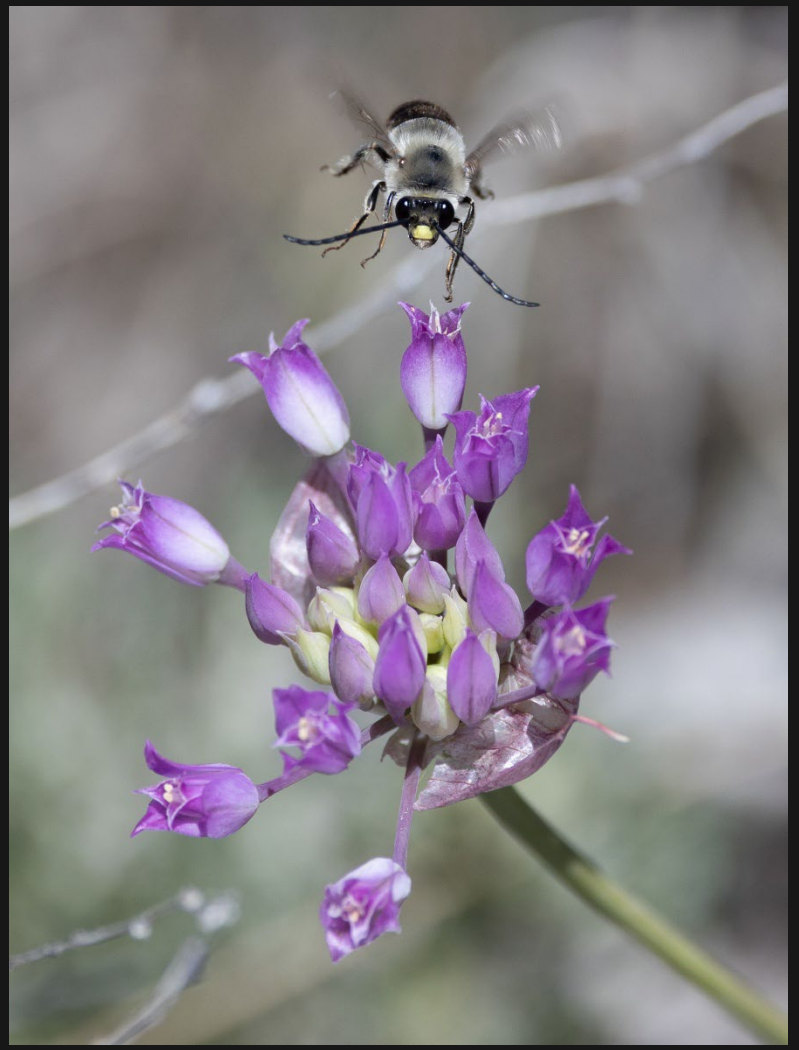
Summary of findings

Fuel breaks had 4× as many bees and 1.3× as many species

Similar Hill numbers between treatments, but reference sites had greater Shannon diversity

Different treatments had different bee communities

Bees benefit from fuel break creation



More flowers = More food

More bare ground = Ground nesting resources

Untreated mature forests also support bees

Greater canopy cover = Cooler forests

More woody debris = Cavity nesting resources

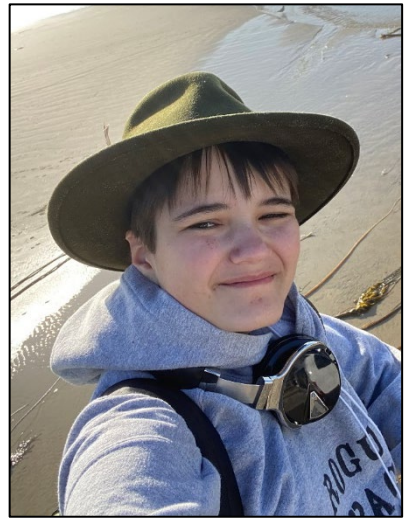
Take-home message:

Areas treated as shaded fuel breaks harbor robust bee communities

A win-win for fire management and pollinator conservation!

We have had 18 undergraduates and young professionals involved in our research

Sophia Gutierrez
2024 OSU URSA-Engage Program



Christoph Anderson
2024 CoF Mentored Employment Program

Images courtesy of M. Sampognaro, C. Anderson, and S. Gutierrez

We undertook field tours with stakeholders on 1-2 July 2024

Dustin Hixon from W.M. Beaty helping process bees

Handout from the tours

Evaluating native bee response to fuel-reduction treatments in managed conifer forests

Project Objectives

- *Quantify the native bee communities that use shaded fuel breaks and contrast them with bee communities in untreated reference areas.*
- *Evaluate the extent to which local floral resources and the time since treatment influence native bee communities in shaded fuel breaks.*

Background

- Nearly 90% of the world's flowering plants and 35% of agricultural crops benefit from animal pollinators, especially native bees.
- Forests are home to many native bee species, but our understanding of how forest management influences bee communities is still in its infancy.
- Given the expanding footprint of wildfire in western North America, quantifying how bee communities respond to fuel-reduction treatments has become a research priority.

Insect pollinators – such as this native long-horned bee - are a critical element of biodiversity and provide key ecosystem functions, ultimately providing hundreds of billions in ecosystem services annually across the globe.

*Bumble bees (*Bombus *spp.) are often found in managed forests, and they were one of the more abundant groups that were captured within shaded fuel break sites in our study.*

Approach and Preliminary Findings

- We are sampling 26 shaded fuel break sites and 8 reference sites during the 2023-2024 bee flight seasons.
- We use passive traps and netting off flowers to quantify bee diversity, and we measure floral resources and habitat characteristics as study covariates.
- In 2023 alone we captured nearly 14,000 insect specimens, the majority of which were native bees. We captured > 4.3x more specimens, on average, in shaded fuel break sites relative to reference sites.
- Formal specimen identification will take place in fall 2024, yet preliminary observations indicate a wide diversity of bee families, genera, and species are present.

Dr. Jim Rivers, OSU College of Forestry
jim.rivers@oregonstate.edu

Megan Sampognaro, OSU College of Forestry
megan.sampognaro@oregonstate.edu

We've been sharing our findings in diverse venues

Past presentations

- Western Forest Graduate Research Symposium (Apr 2023)
- OSU Environmental Club (Mar 2024)
- Western Forest Graduate Research Symposium (Apr 2024)
- OSU Spring Poster Symposium (May 2024)
- Lassen Field Station Research Symposium (Jun 2024)
- FORTE: Academic Onboarding for OSU Students (Sep 2024)
- ORTWS/OSAF Joint Conference (Feb 2025)
- L. Stokes Alliance for Minority Participation Conference (Apr 2025)
- Confluence Research Symposium (Apr 2025)

Upcoming presentations

- Society of American Foresters (Oct 2025)
- Entomological Society of American (Nov 2025)
- Entomological Society of American (Nov 2025)

Fire and Its Influence on the Ecology and Conservation of Insect Pollinators

Location: Oregon Convention Center, C120-122, OCC

Organizer: Jim Rivers – Oregon State University

Organizer: Clayton Traylor – Temple University

Organizer: Megan Sampognaro – Oregon State University

Organizer: Michael Ulyshen – USDA-Forest Service

Member Symposium

ENTOMOLOGICAL SOCIETY OF AMERICA

SAF

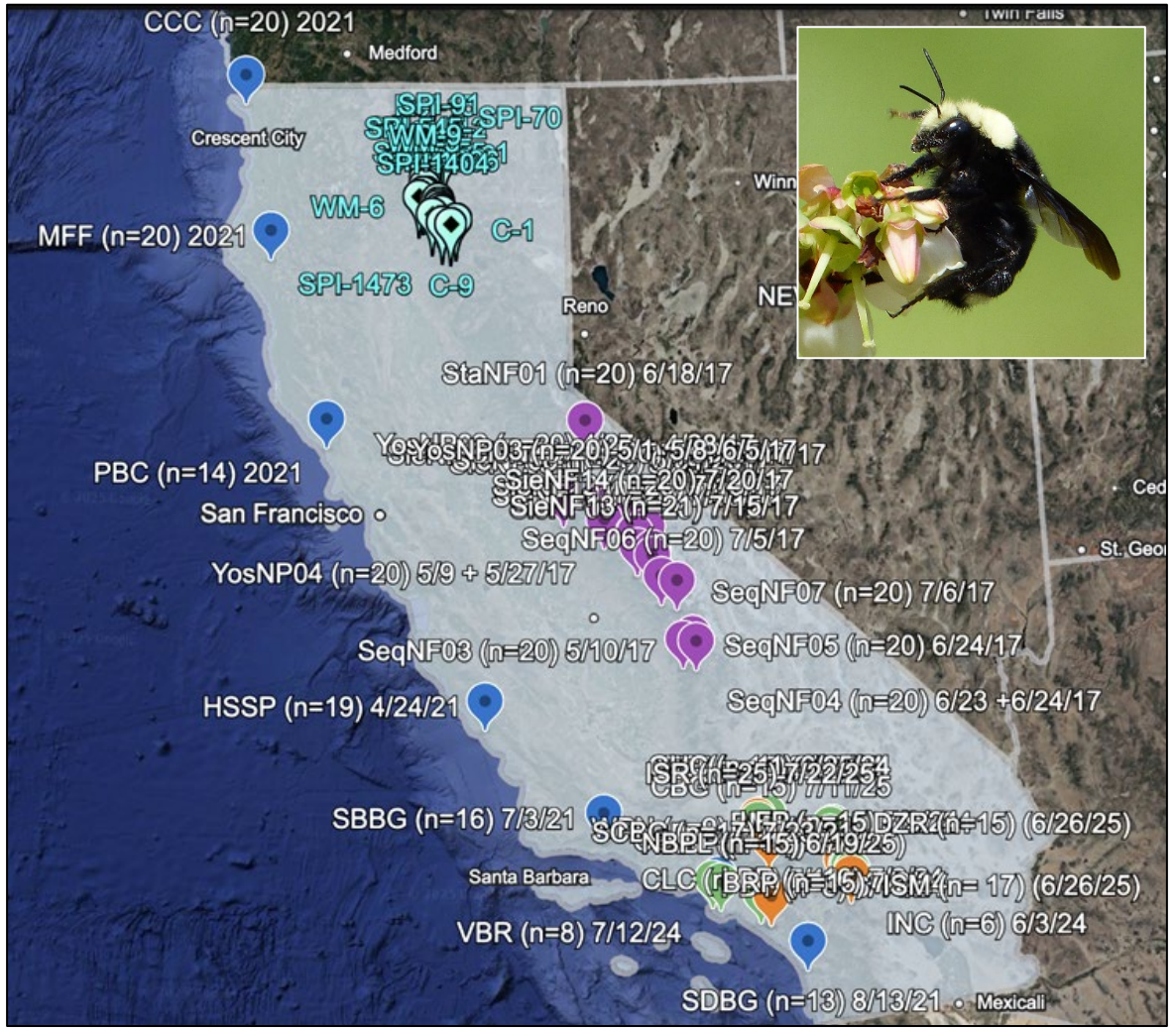
We are leveraging project specimens for a large-scale study of genetic patterns in *Bombus vosnesenskii*

Blanca Peto

UC, Riverside

Dr. Hollis Woodard

UC, Riverside



Project timeline and the final steps to project completion

Activity	2024	2025			
	W	Sp	Su	F	W
Final specimen prep and identification					
Data analysis and thesis writing					
ORTWS-OSAF conference presentation					
WFGRS conference presentation					
Megan Sampognaro M.S. defense					
Project update to CalFire EMC					
Final report to CalFire EMC					
Additional conference presentations					
Submission of journal articles					

= completed

= in process