Biodiversity in natural and managed early seral forests of southern Oregon

Final Report: Fall 2022

MEG KRAWCHUK (OSU, PI)

MATT BETTS (OSU), **MARK SWANSON** (WSU), **JIM RIVERS** (OSU),

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GRAHAM FRANK (OSU, PHD STUDENT)

How well does the early-seral stage of production-oriented forests support biodiversity associated with its closest natural counterpart?

- Four taxa: Birds, bees, ground beetles, plants
- Biodiversity = Diversity and composition
- Comparison among sampling strata
- Associations with environmental gradients

2-5 yr

6-10 yr

17-20 yr

Intensive Mgmt.



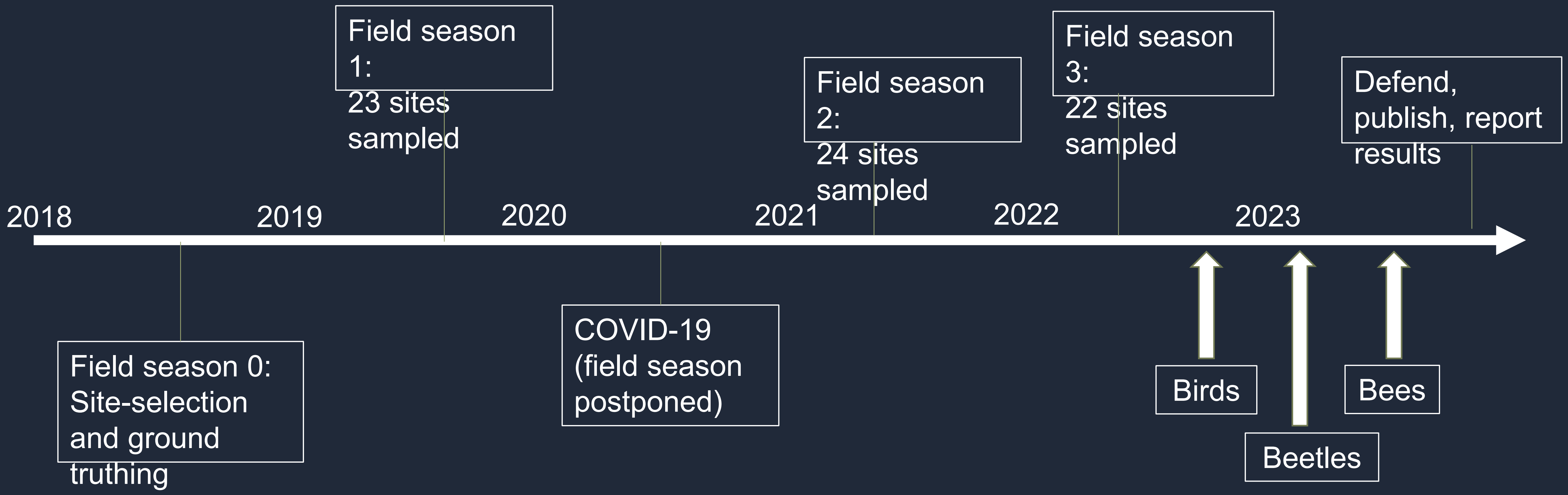
Stand-Repl. Fire

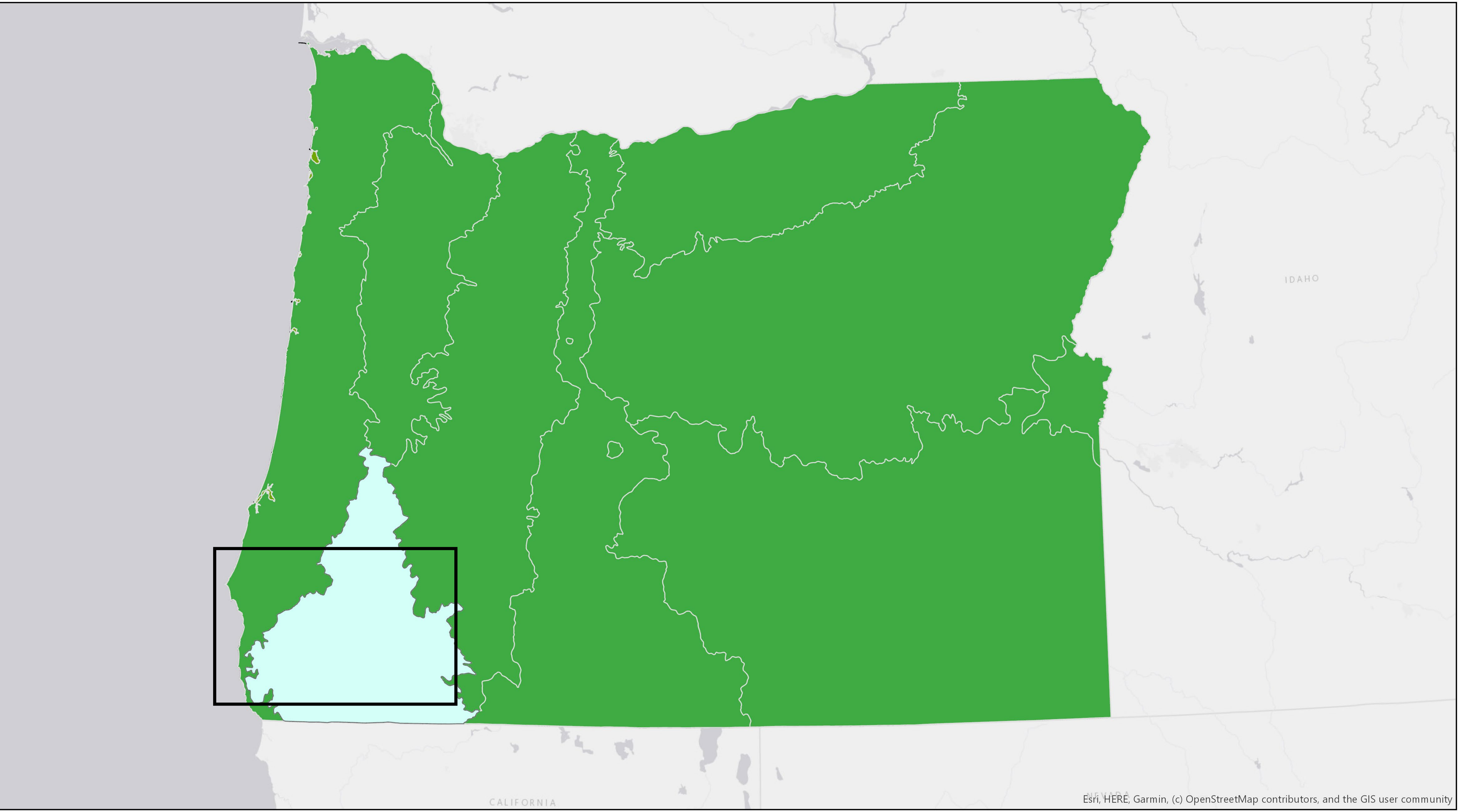


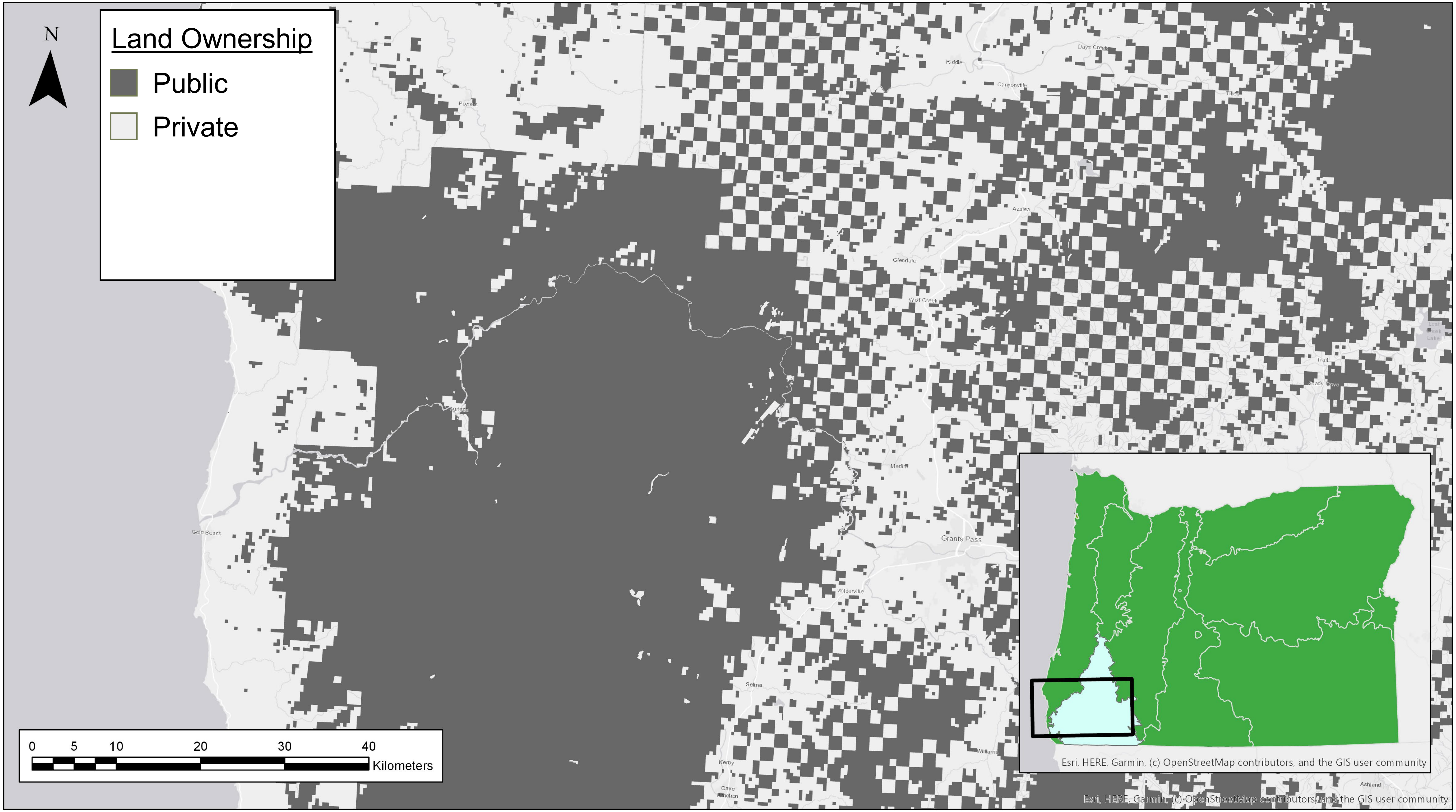
Postfire Salvage

Timeline

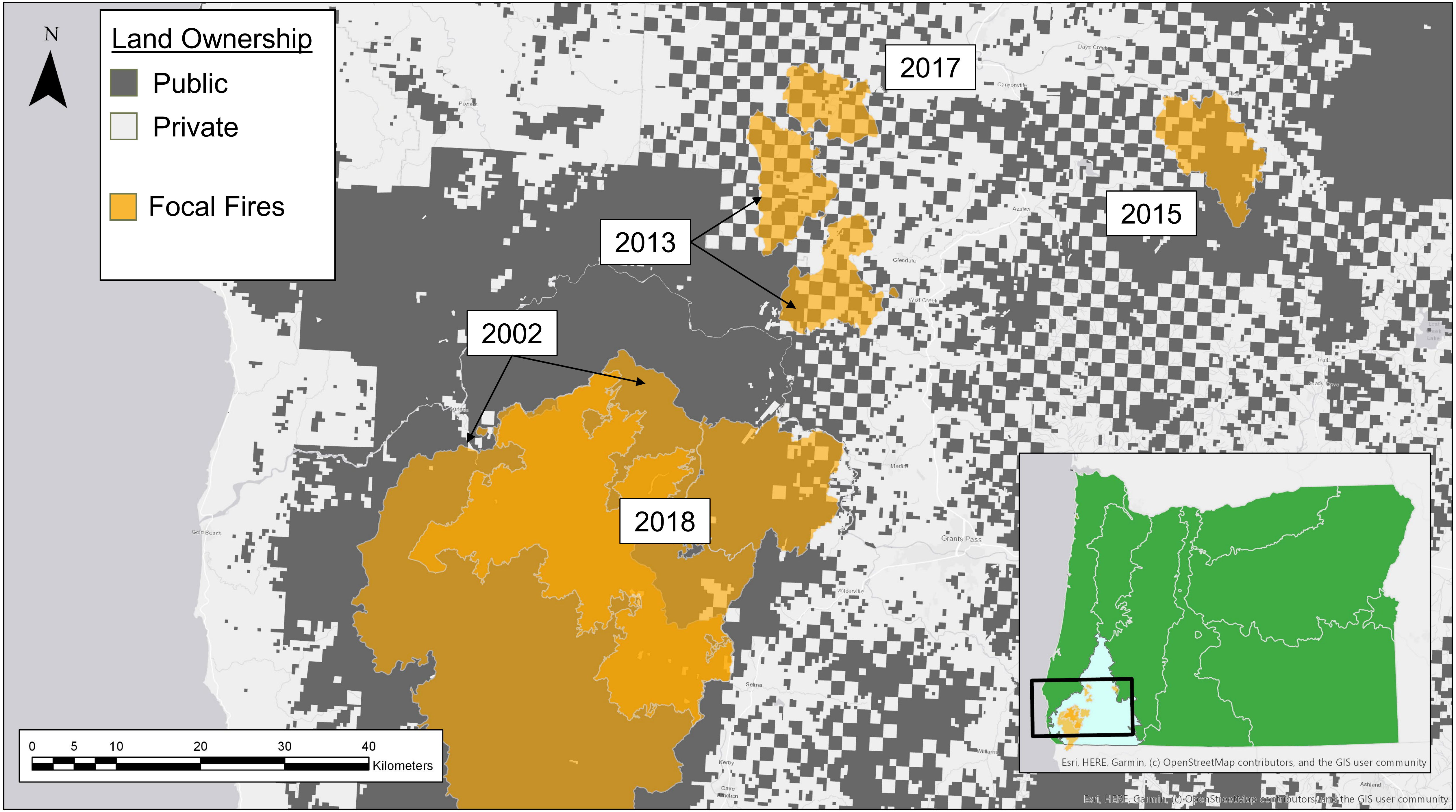
Expected completion: Summer / Fall 2023
(final year funded by NCASI)

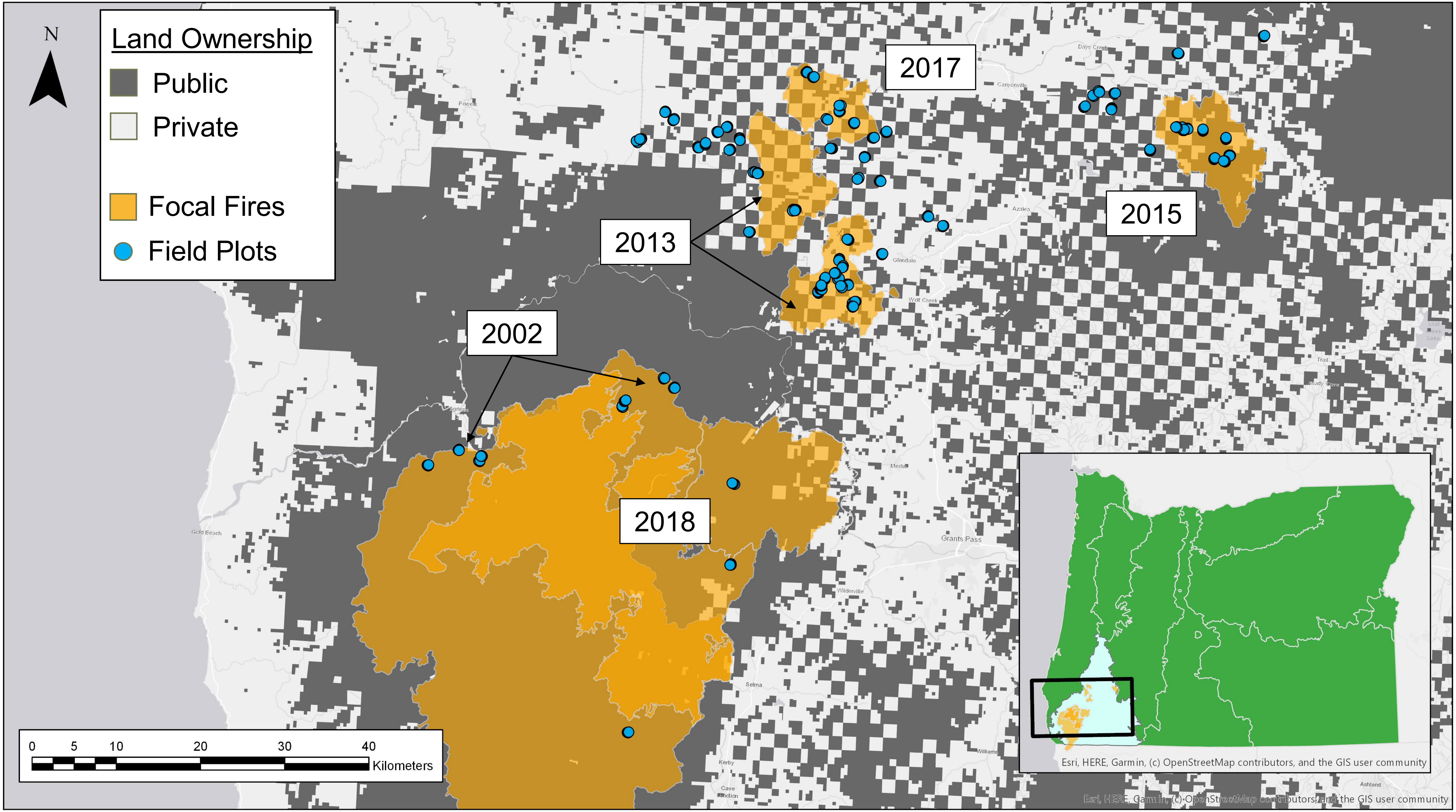



IDAHO
CALIFORNIA
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community



N
Land Ownership
Public
Private
0
5
10
20
30
40
Kilometers
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Grants Pass
Gold Beach
Glendale
Azalea
Canyonville
Riddle
Wolf Creek
Merlin
Wilderville
Selma
Kerby
Ashland
Trail
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community


N
Land Ownership
Public
Private
Focal Fires
2017
2015
2013
2002
2018
Grants Pass
0 5 10 20 30 40
Kilometers
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community



N
Land Ownership
Public
Private
Focal Fires
Field Plots
2017
2015
2013
2002
2018
0
5
10
20
30
40
Kilometers
Grants Pass
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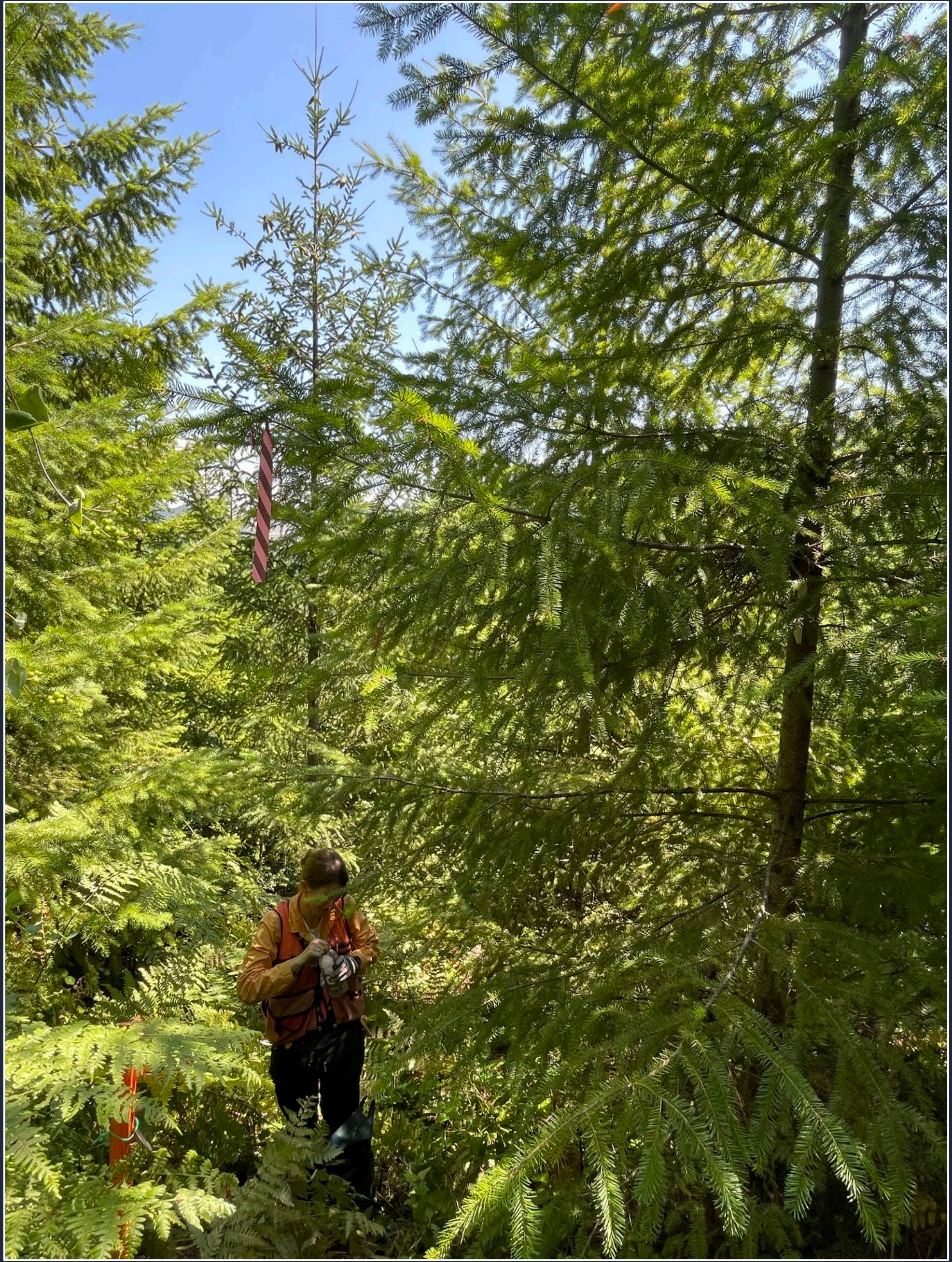
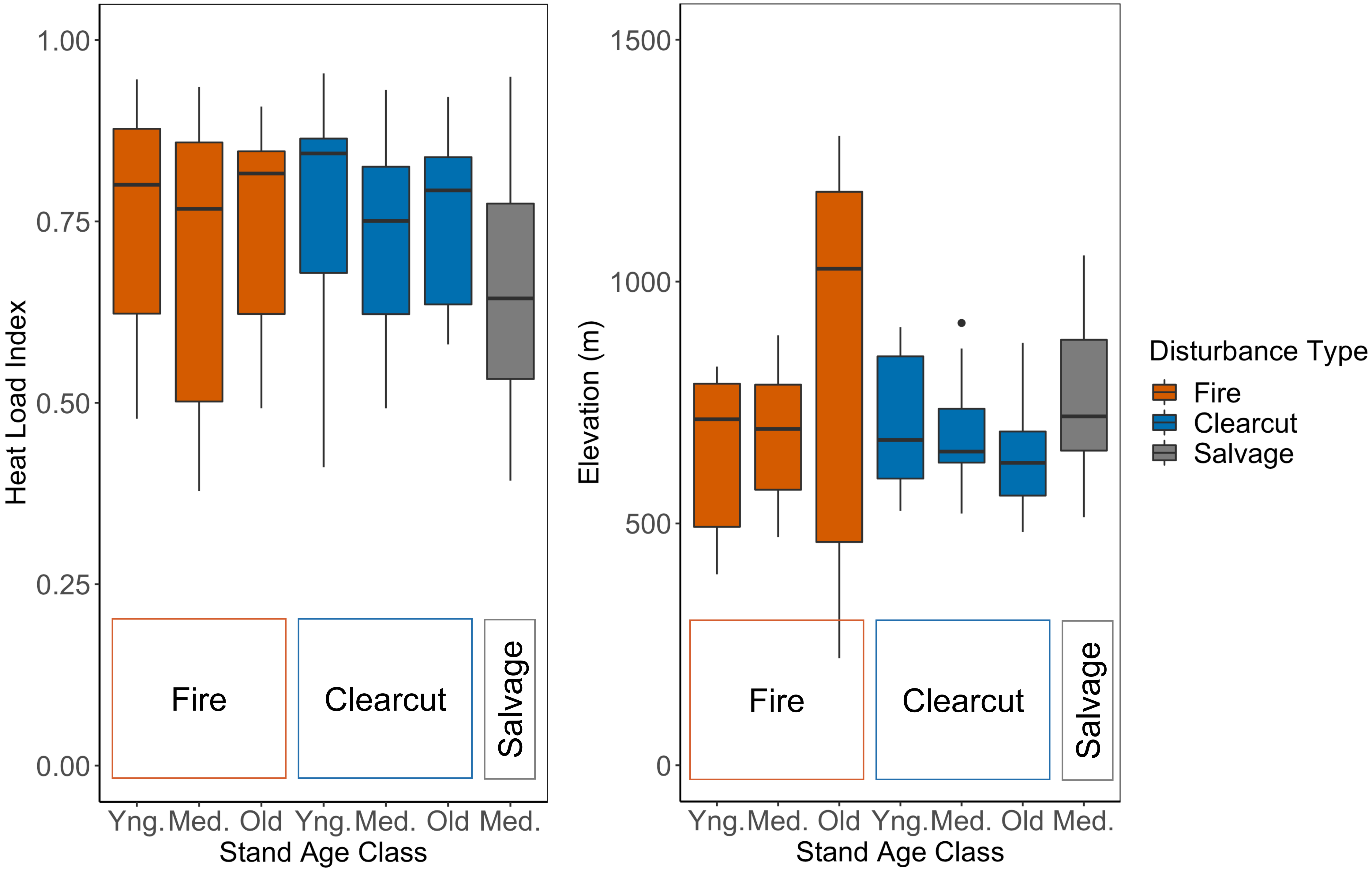
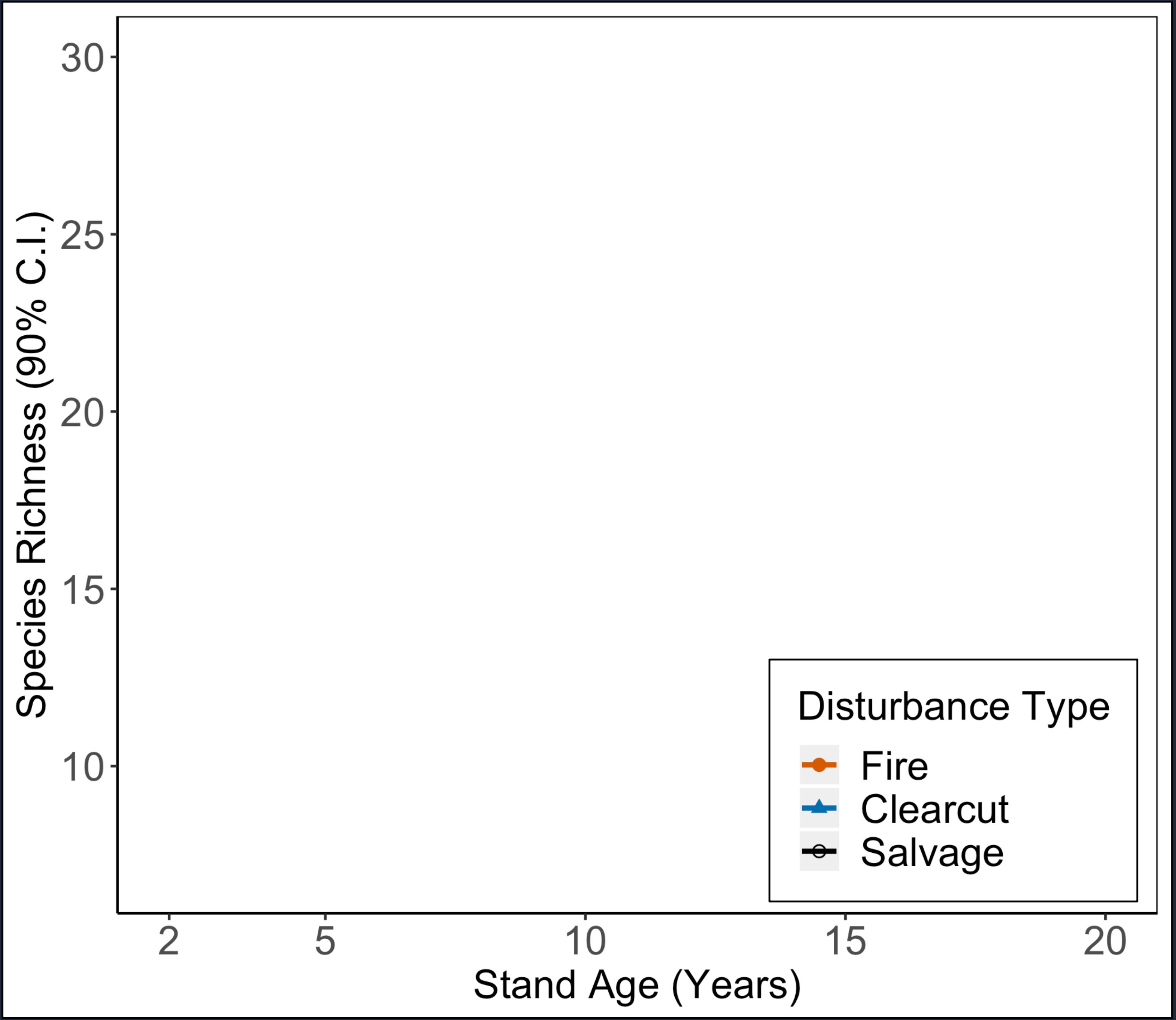
Summer sampling

Summer sampling





1.00
0.75
0.50
0.25
0.00
Heat Load Index
Fire
Clearcut
Salvage
Yng. Med. Old Yng. Med. Old Med.
Stand Age Class
1500
1000
500
0
Elevation (m)
Fire
Clearcut
Salvage
Yng. Med. Old Yng. Med. Old Med.
Stand Age Class
Disturbance Type
Fire
Clearcut
Salvage

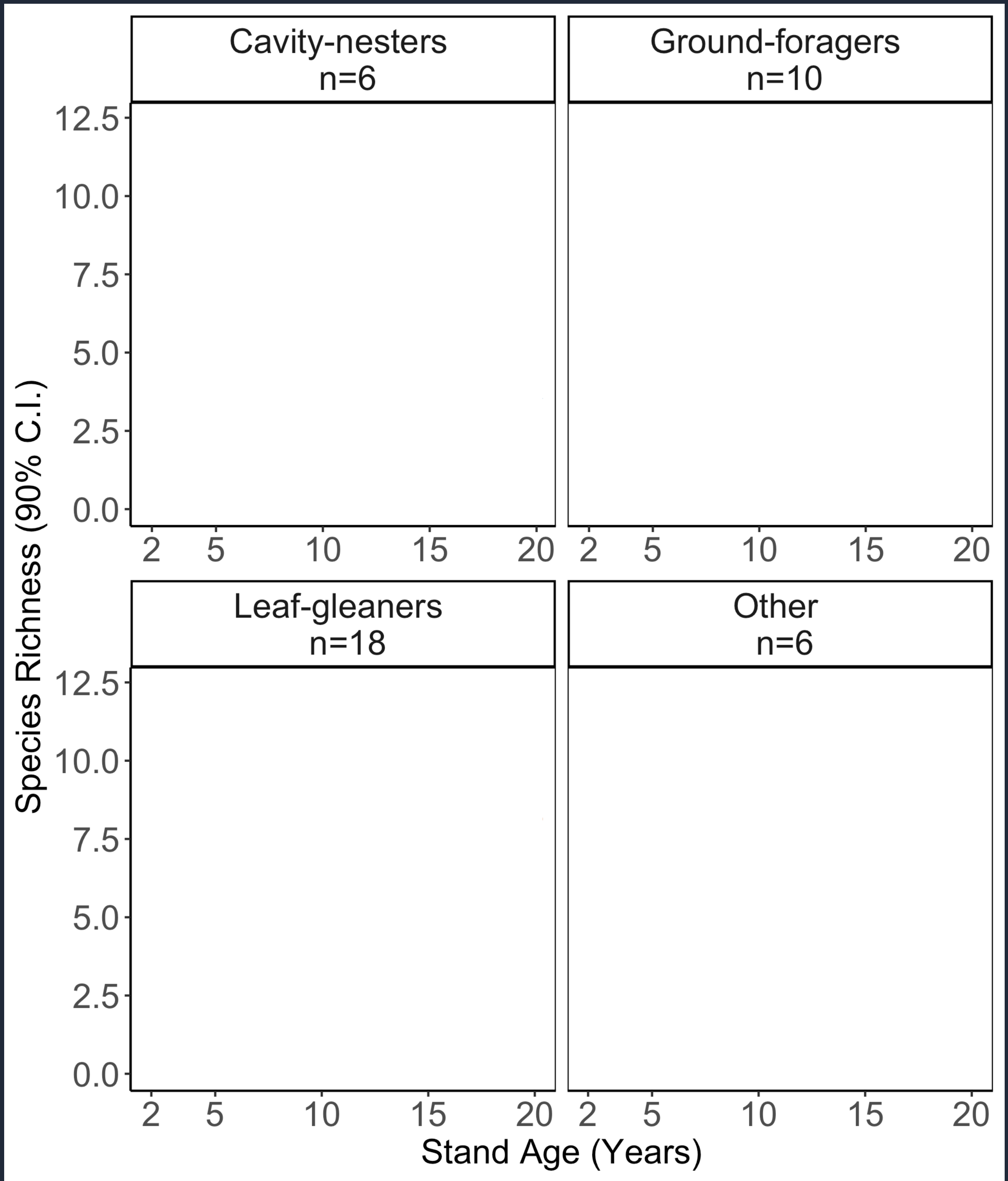


Species Richness (90% C.I.)
30
25
20
15
10
2
5
10
15
20
Stand Age (Years)
Disturbance Type
Fire
Clearcut
Salvage

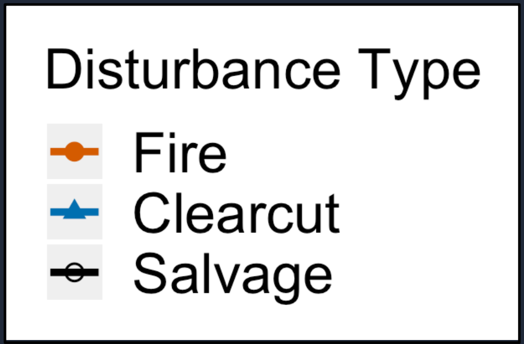

Matt Davis, McCaulay Library


Kristen Carr, McCaulay Library


Jesse Amesbury, McCaulay Library


Cavity-nesters
n=6
Ground-foragers
n=10
Leaf-gleaners
n=18
Other
n=6
0.0
2.5
5.0
7.5
10.0
12.5
2
5
10
15
20
Species Richness (90% C.I.)
Stand Age (Years)


Daniel Irons, McCaulay Library


Disturbance Type
Fire
Clearcut
Salvage

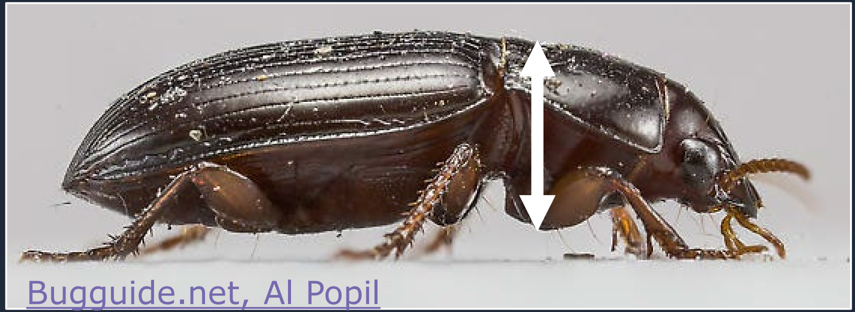
Carabids

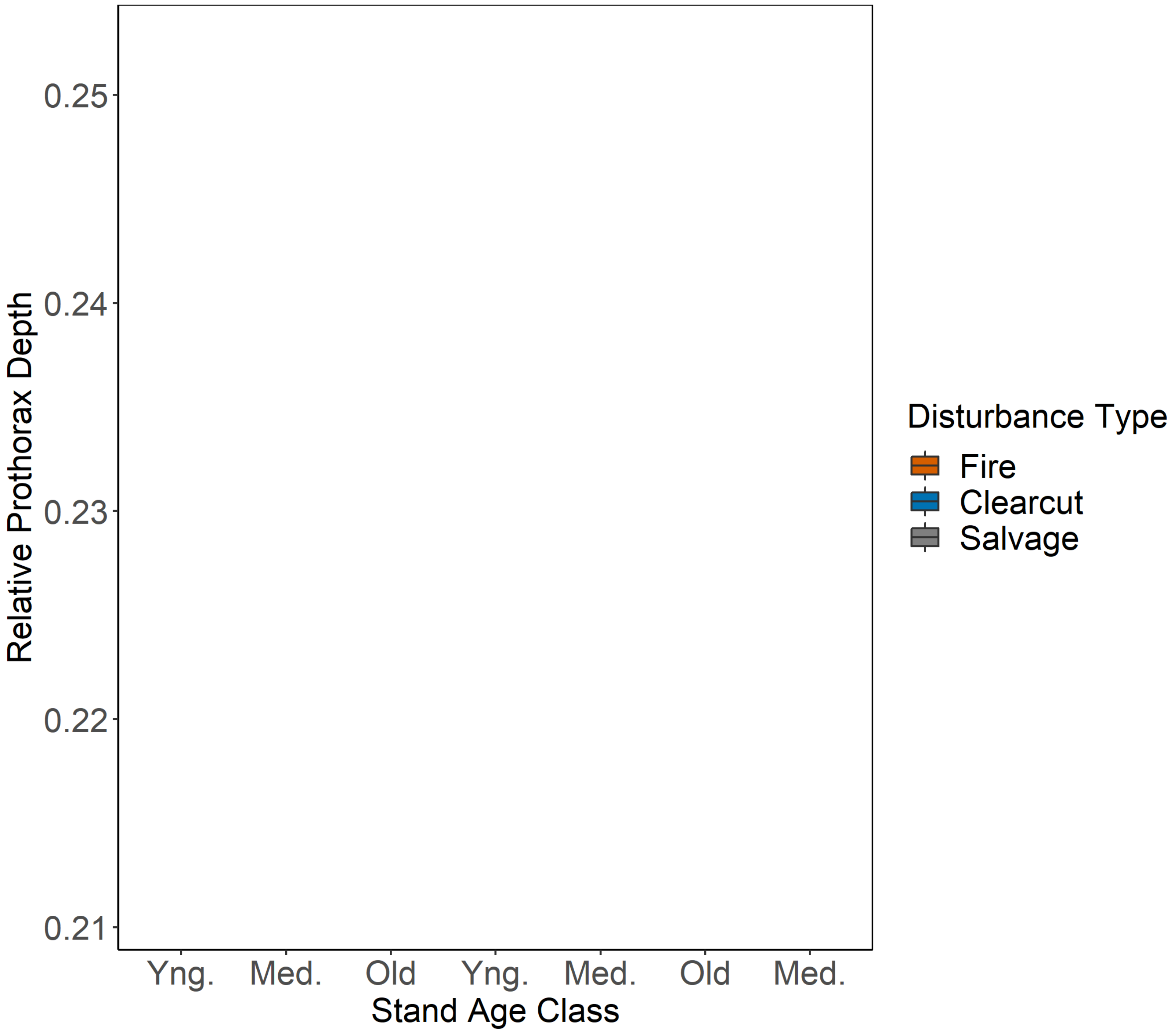
- Taxonomic work complete

  5858 individuals, ~40 species, 22 genera

- Gradient from “weedy” disturbance-adapted species, to forest holdovers
- Range of dispersal and foraging strategies

Carabids


Bugguide.net, Al Popil


0.25
0.24
0.23
0.22
0.21
Relative Prothorax Depth
Yng.
Med.
Old
Yng.
Med.
Old
Med.
Stand Age Class
Disturbance Type
Fire
Clearcut
Salvage

Bees and floral resources

~10,000 individual bees over three field seasons

Taxonomic work slated for completion by January

Jenna Stillman

Undergraduate thesis on exotic plants

Sarabeth Pearce-Smith – OSU Honors College, CoF Natural Resources major


Kristen Carr, McCaulay Library

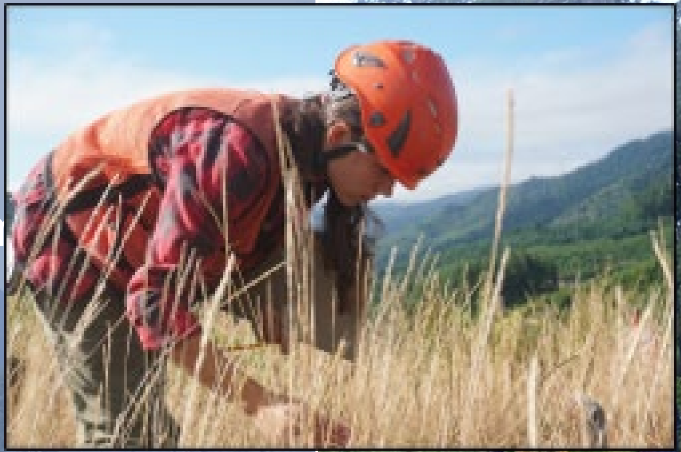
Thank you!

Funding
FWHMF Program (OSU CoF)
NCASI
BLM
OSU CoF Mentored Employment Program

Site Access
BLM, USFS, Weyerhaeuser, Manulife, Roseburg Forest Products, Chinook Forest Management

Field Crew & Lab Techs
Rya Rubenthaler, Ken Burton, Kait Wright, Alan Moss, Cara Kildall, Helen Payne, Cassidy Lee, Skye Greenler, Logan Bradley, Meghan Sullivan, JP Pow, Emma Tate, Brycen Rogers, Nick Esser, Lucinda Boyle, Daniel Spence

Bee Taxonomy: Linc Best
Carabid Taxonomy Training: Jim LaBonte



Final Progress Report

Assessing the response of aquatic biota to alternative riparian management practices

Dana Warren - Oregon State University

Ashley Coble - NCASI

Many project collaborators

Presentation outline

(Development of our research program at OSU)

1. Study questions and conceptual framework
2. Identifying patterns
3. Exploring relationships that link patterns to key metrics
4. Developing hypotheses based on relationships
5. Testing hypotheses
    - In observational studies
    - In experimental studies
        - Gap study
        - Riparian Alternatives Study

Management implications?

1. Study Questions and Conceptual Framework

A focus on LIGHT

Why light?

- Stream biota (fish) are affected by more than just habitat
- Stream light can be a key control on primary production (and therefore the rest of the food web)
- Stream light influences stream temperature
- High quality food resources that respond to increasing stream light (algae) that shows up disproportionately in higher trophic levels

1. Study Questions and Conceptual Framework

Broader contextual questions

- How important is light to stream ecosystems in Oregon?
- How much does light vary within and among streams in Oregon?

Observational studies
Explore pattern. . .

1. Study Questions and Conceptual Framework

Broader contextual questions

- How important is light to stream ecosystems in Oregon?
- How much does light vary within and among streams in Oregon?
- Would management that affects riparian forest cover and changes stream light affect streams and stream biota?
    - ”positive” effects of changing light?
    - “negative” effects of changing light?
- Can we use what we learn about the influence of changing canopy cover and associated influences on light to inform riparian management?

1. Study Questions and Conceptual Framework

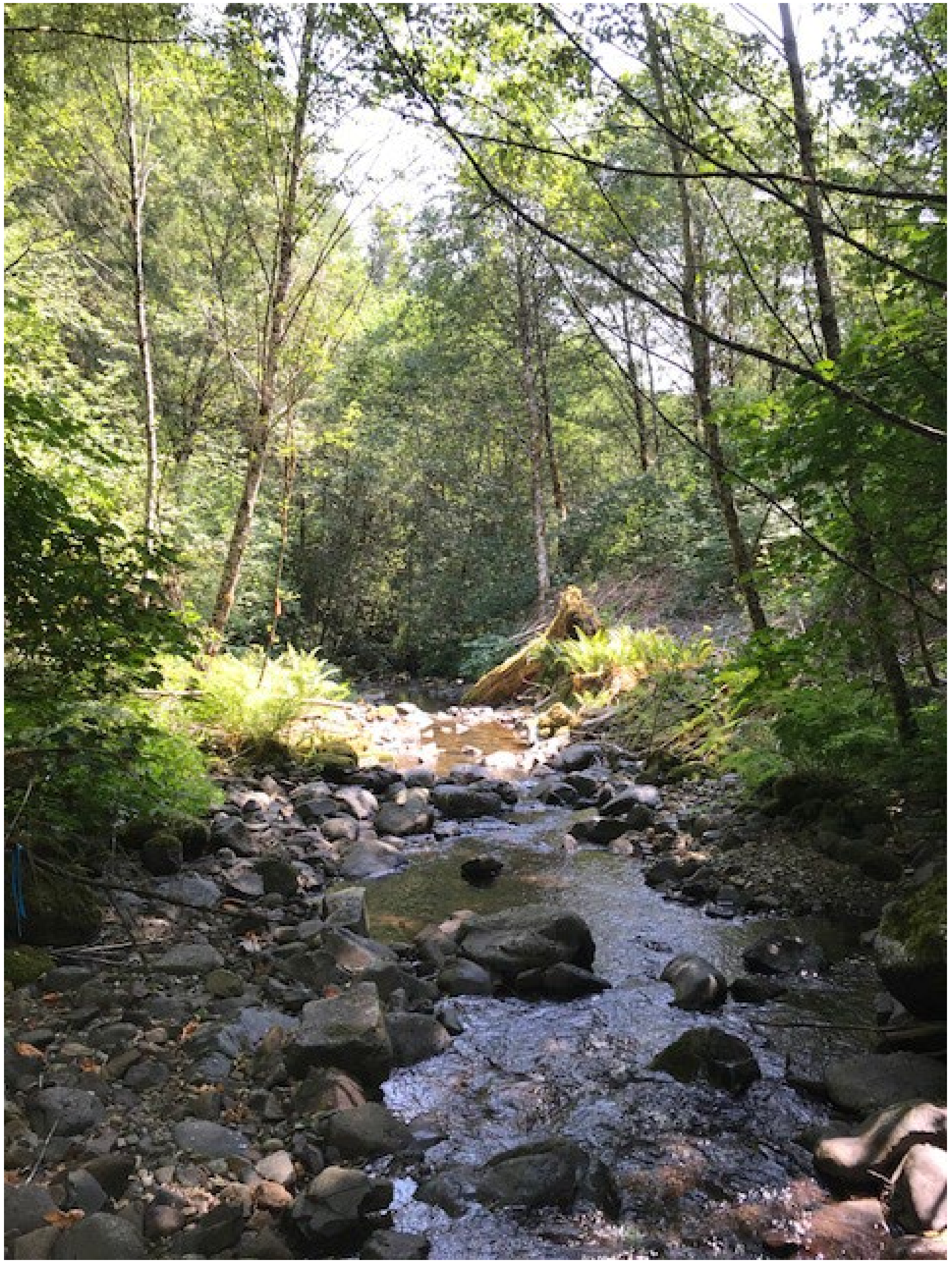
Broader contextual questions

Experimental studies
Explore Process. . .

- Would management that affects riparian forest cover and changes stream light affect streams and stream biota?
  - ”positive” effects of changing light?
  - “negative” effects of changing light?

- Can we use what we learn about the influence of changing canopy cover and associated influences on light to inform riparian management?

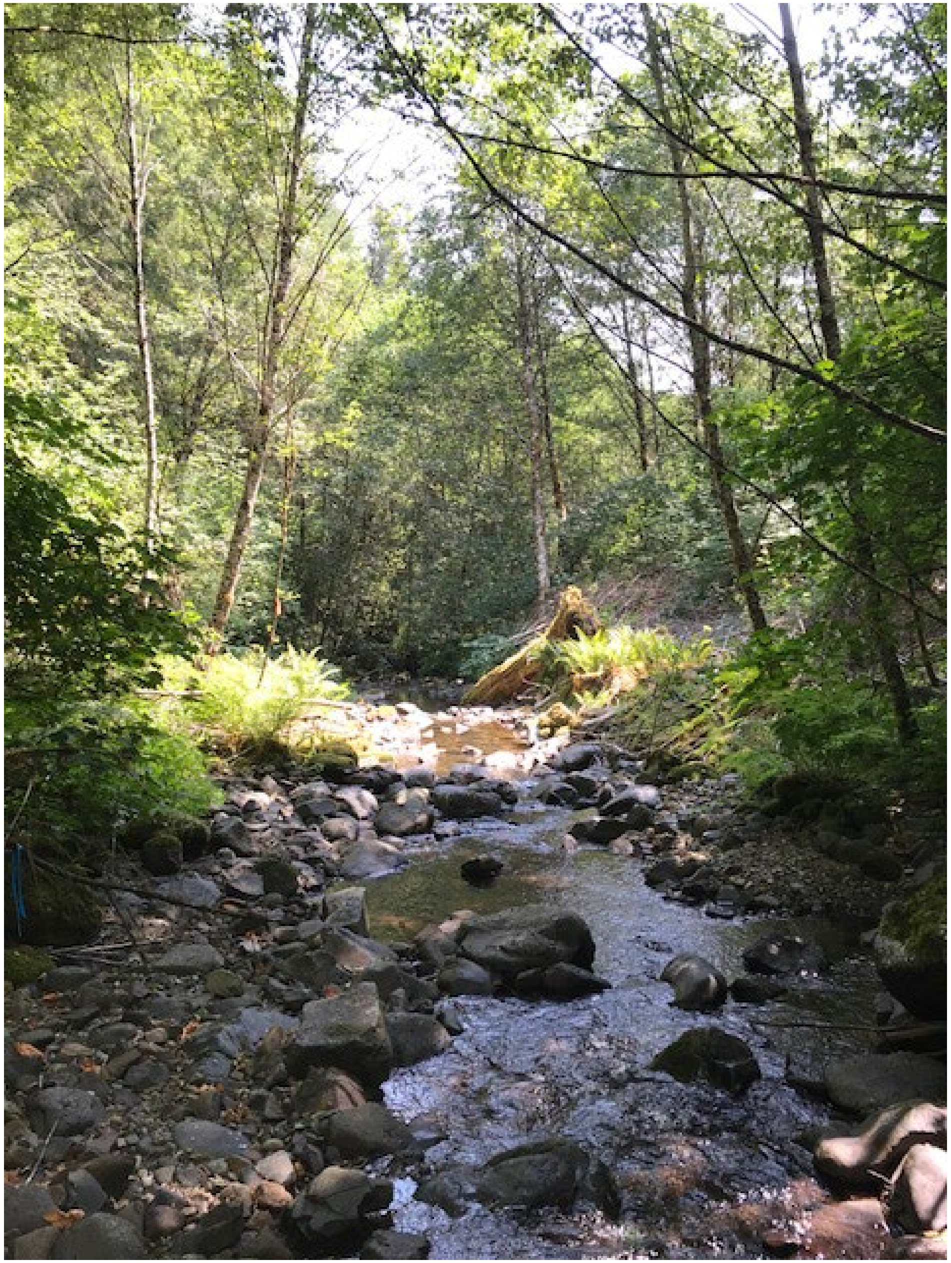
2. Identifying patterns



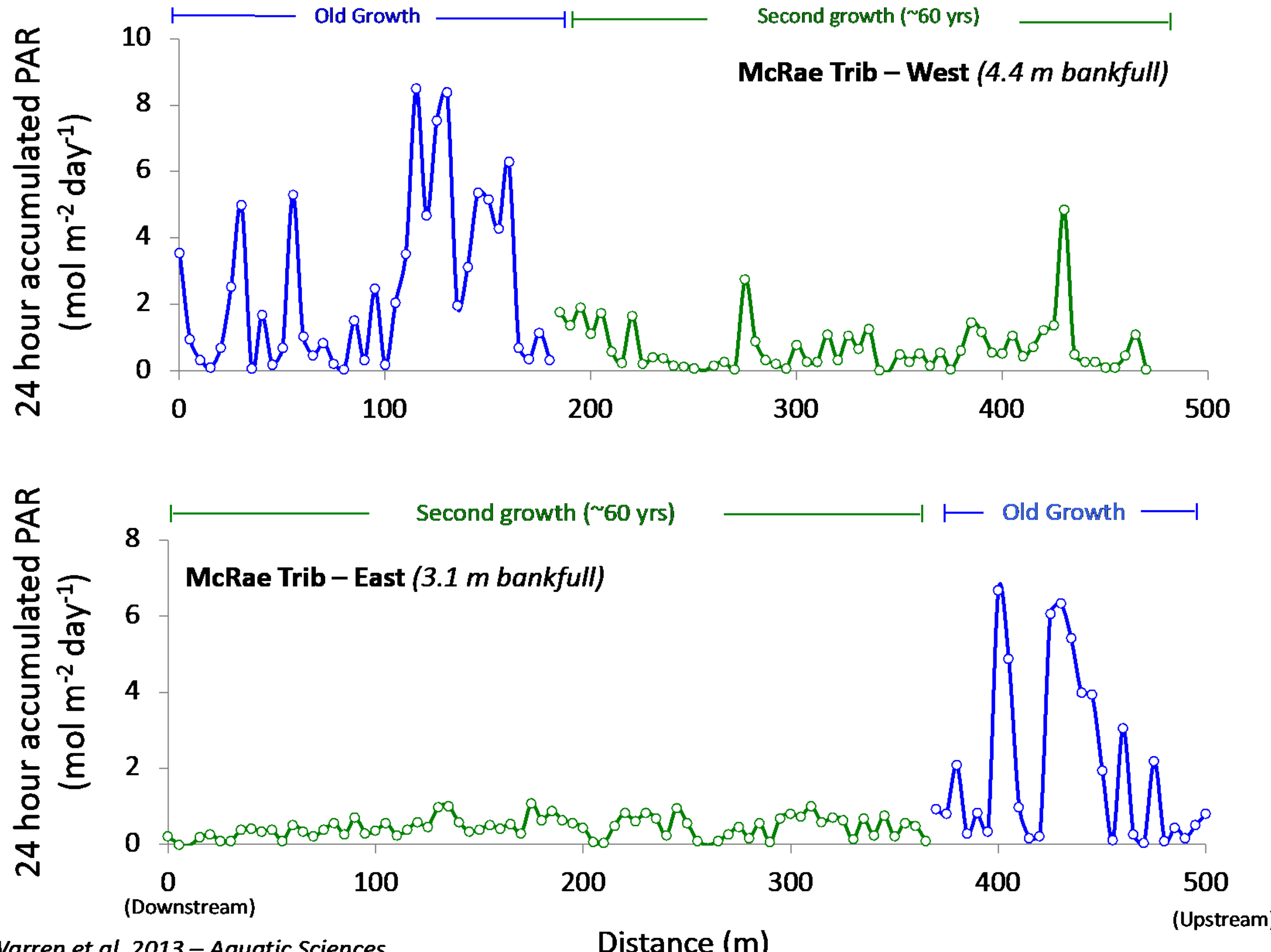
2. Identifying patterns

Patterns in stream light

- Spatial
- Temporal

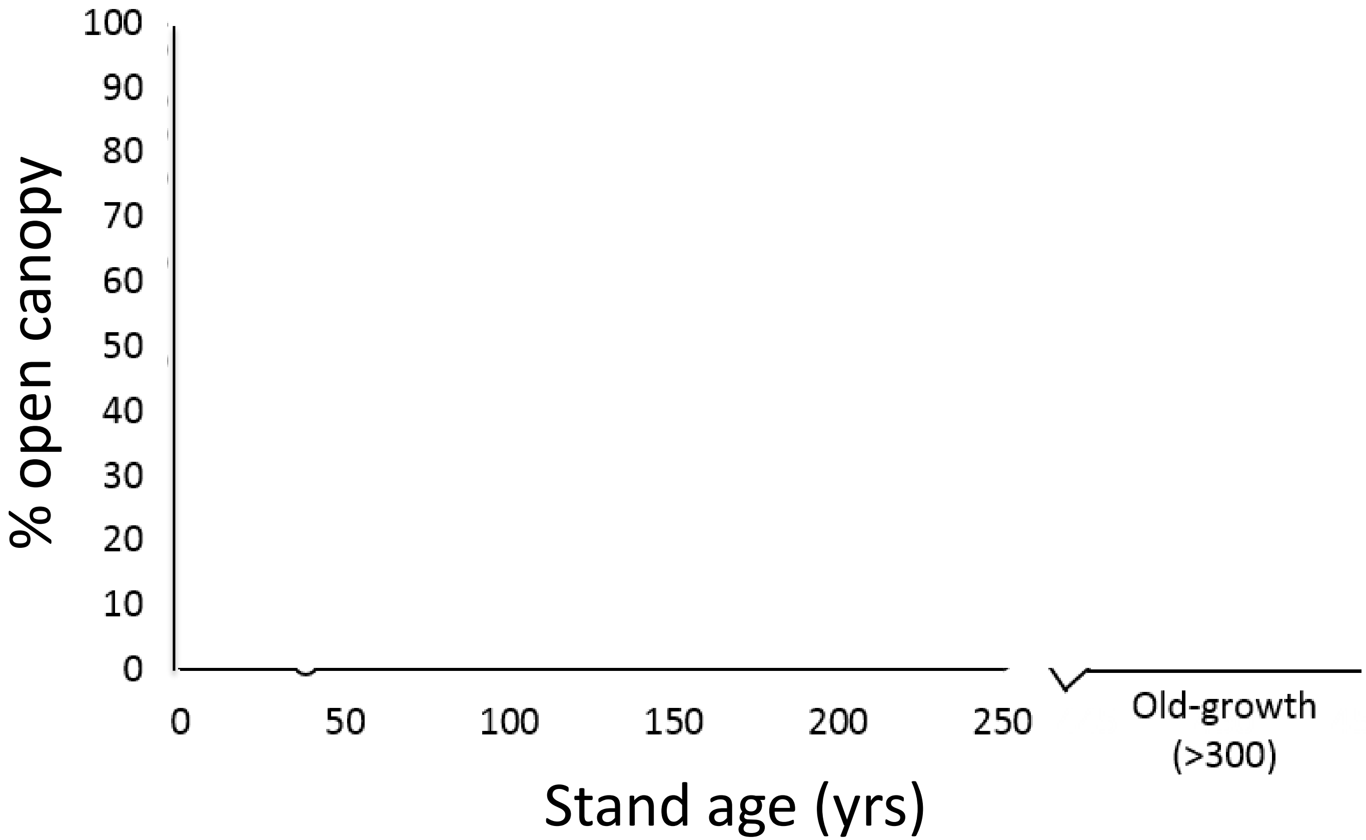


2. Patterns of light in streams - SPATIAL



Warren et al. 2013 – Aquatic Sciences

2. Patterns of light in streams - TEMPORAL



Kaylor, Warren, & Kiffney 2017 – Freshwater Science

Take home messages (1)

1. Light is spatially variable in streams – and far more variable in late-succession forests

2. Late succession forests have more light on average than mid-succession forests in PNW forests

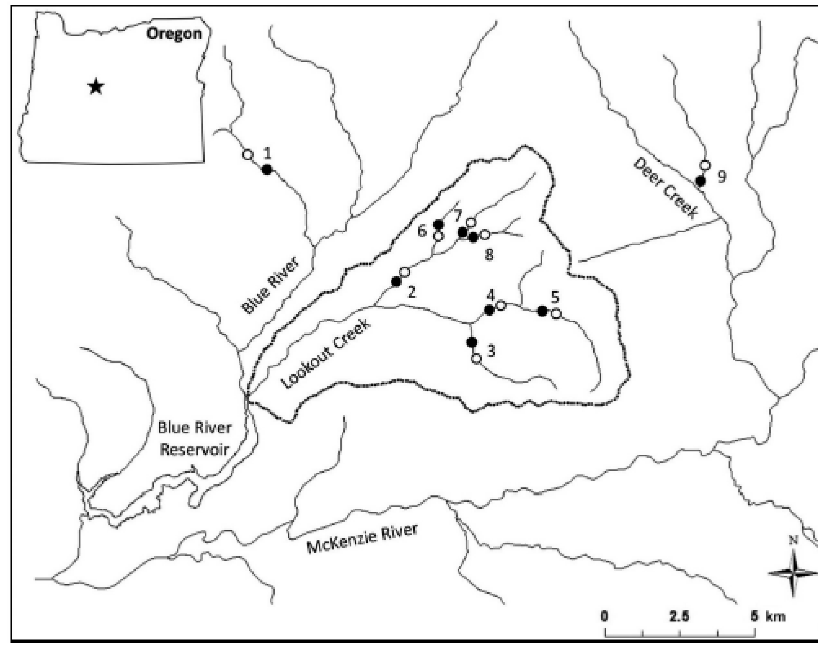
3. The greater light in late-succession forests is a result of periodic canopy gaps

3. Exploring relationships that link patterns to key metrics

esa ECOSPHERE

Linking riparian shade and the legacies of forest management to fish and vertebrate biomass in forested streams *

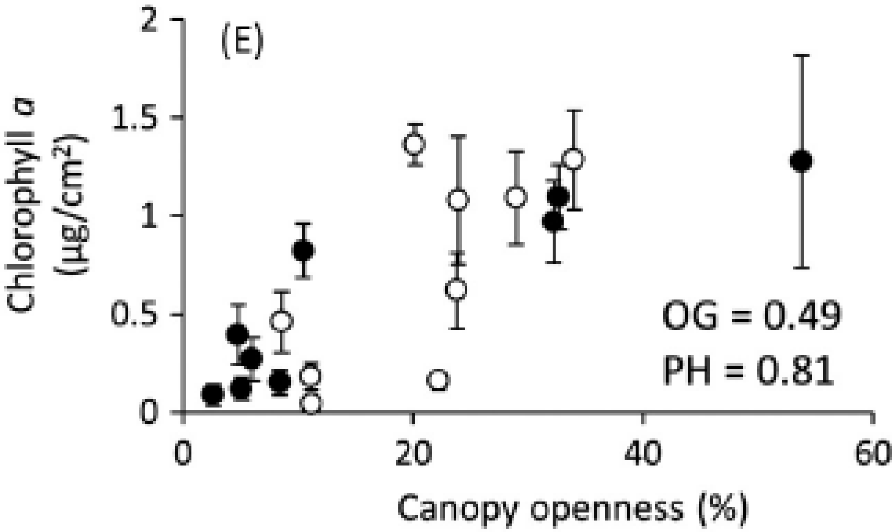
Matthew J. Kaylor[1,†] and Dana R. Warren[1,2]



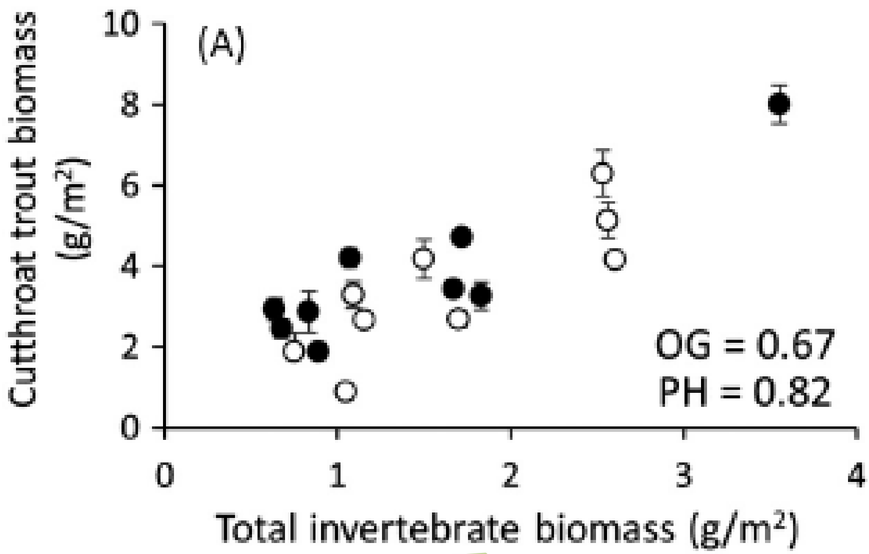
Citation: Kaylor, M. J., and D. R. Warren. 2017. Linking riparian shade and the legacies of forest management to fish and vertebrate biomass in forested streams. Ecosphere 8(6):e01845. 10.1002/ecs2.1845

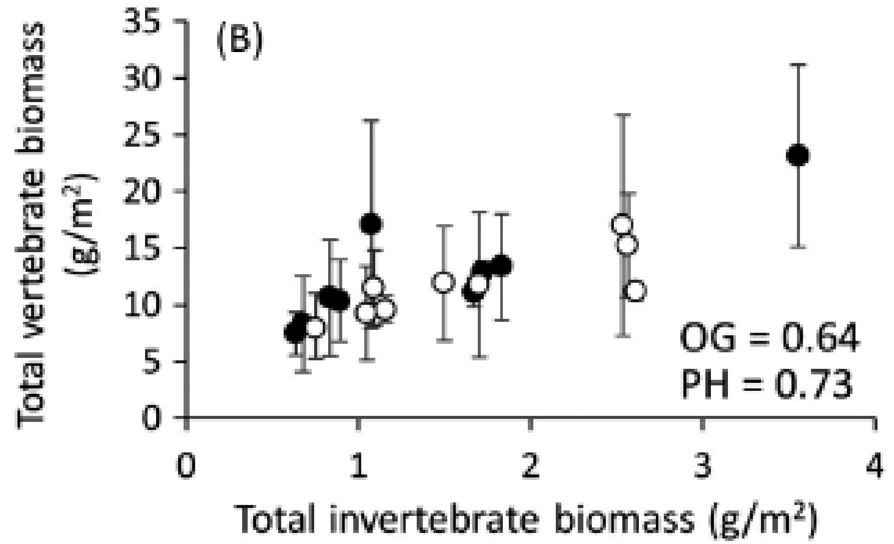
*FWHMF funded project

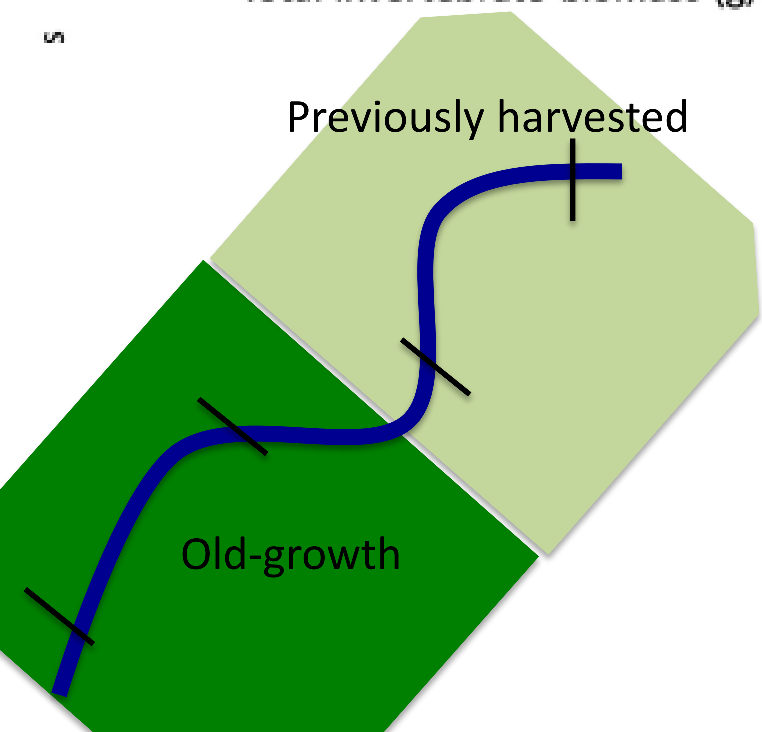
Relationships with and among algae and stream biota

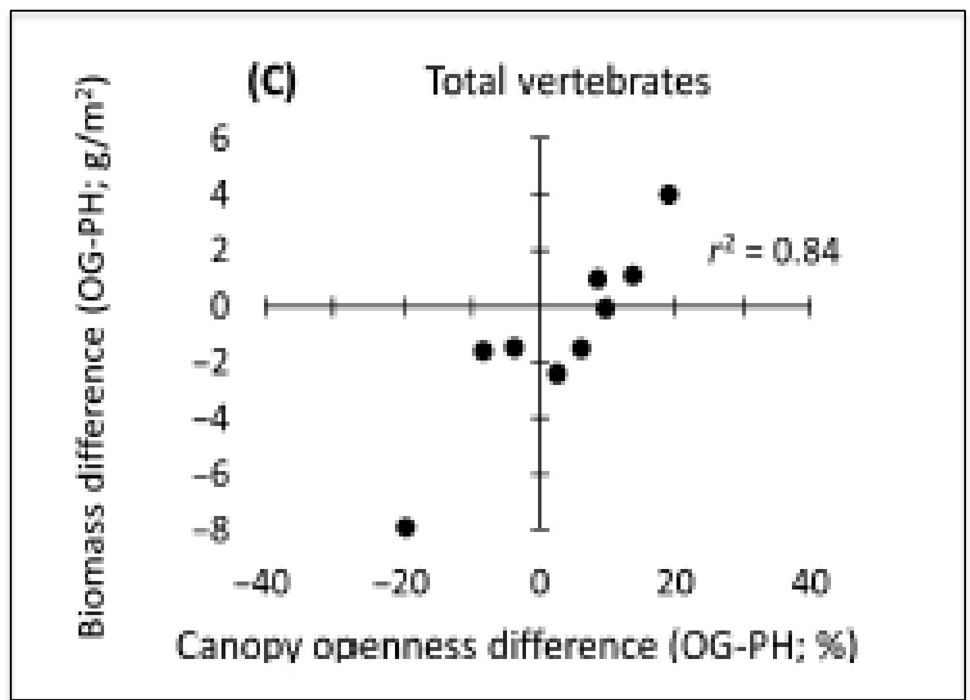


Relationships with and among algae and stream biota









Take home messages (2)

1. Streams with closed canopy mid-succession riparian forests are largely light limited

2. Local increases in stream light can create hotspots of primary production and nutrient demand

3. Stream reaches with more light have, **on average**,
   - More algae
   - More macroinvertebreates
   - More fish

4. Developing hypotheses based on relationships

Moderate increases in light that create reductions in canopy cover lead to increases in the abundance and or biomass of higher trophic levels in streams through bottom-up processes

- At local scales
- And over time

5. Testing Hypotheses

1. Shading Study (Local scale)
2. Gap study (<100 m reaches; one gap)
3. Riparian Alternatives study (300m reaches; variable changes)

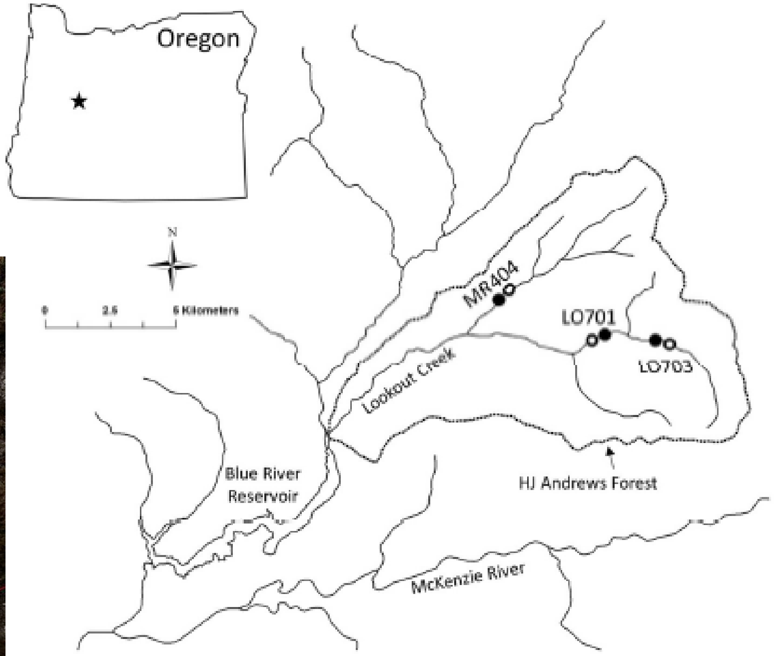
Experiment 1 - Shading

NRC Research Press

ARTICLE

Aquatic food web response to patchy shading along forested headwater streams

Emily D. Heaston, Matthew J. Kaylor, and Dana R. Warren *

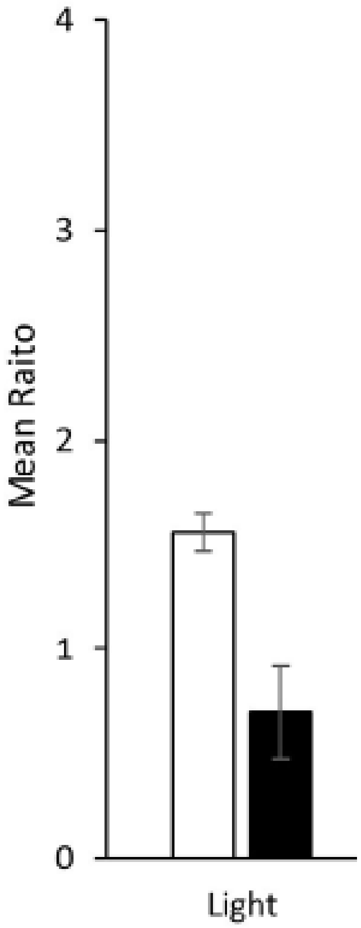


Can. J. Fish. Aquat. Sci. 00: 1–10 (0000) dx.doi.org/10.1139/cjfas-2017-0464

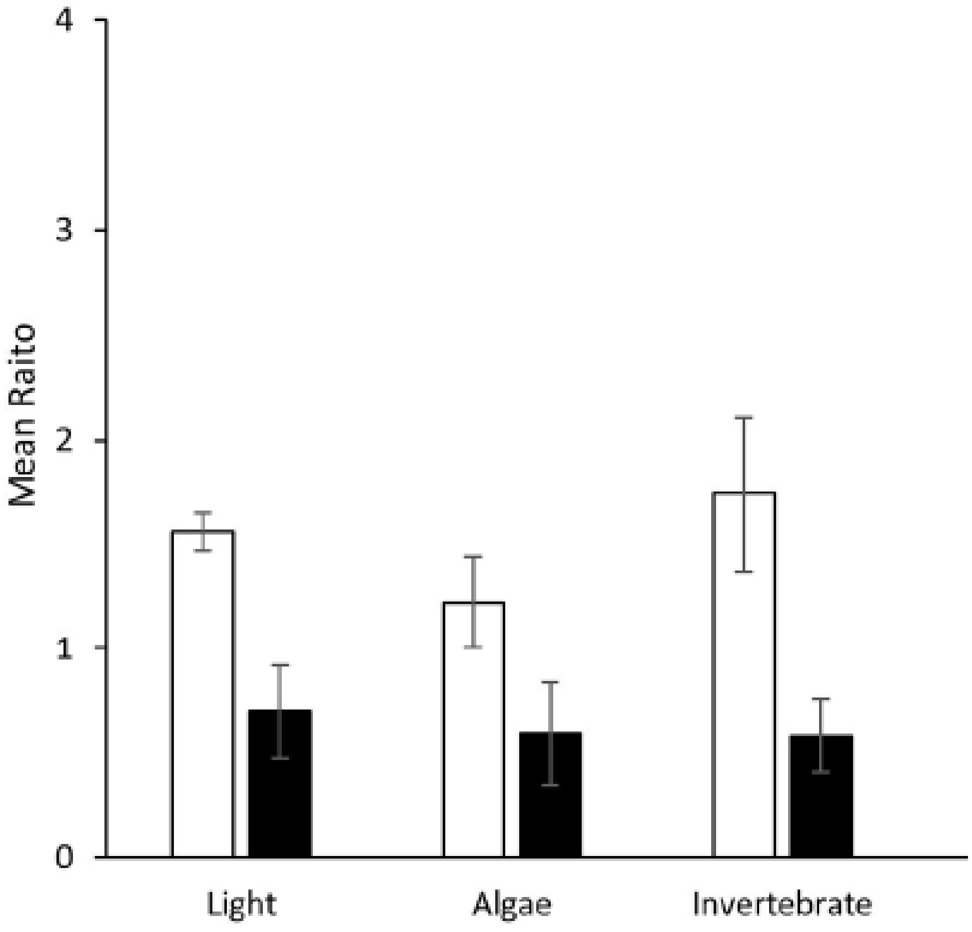
Published at www.nrcresearchpress.com/cjfas on 2 March 2018.

*FWHMF funded project

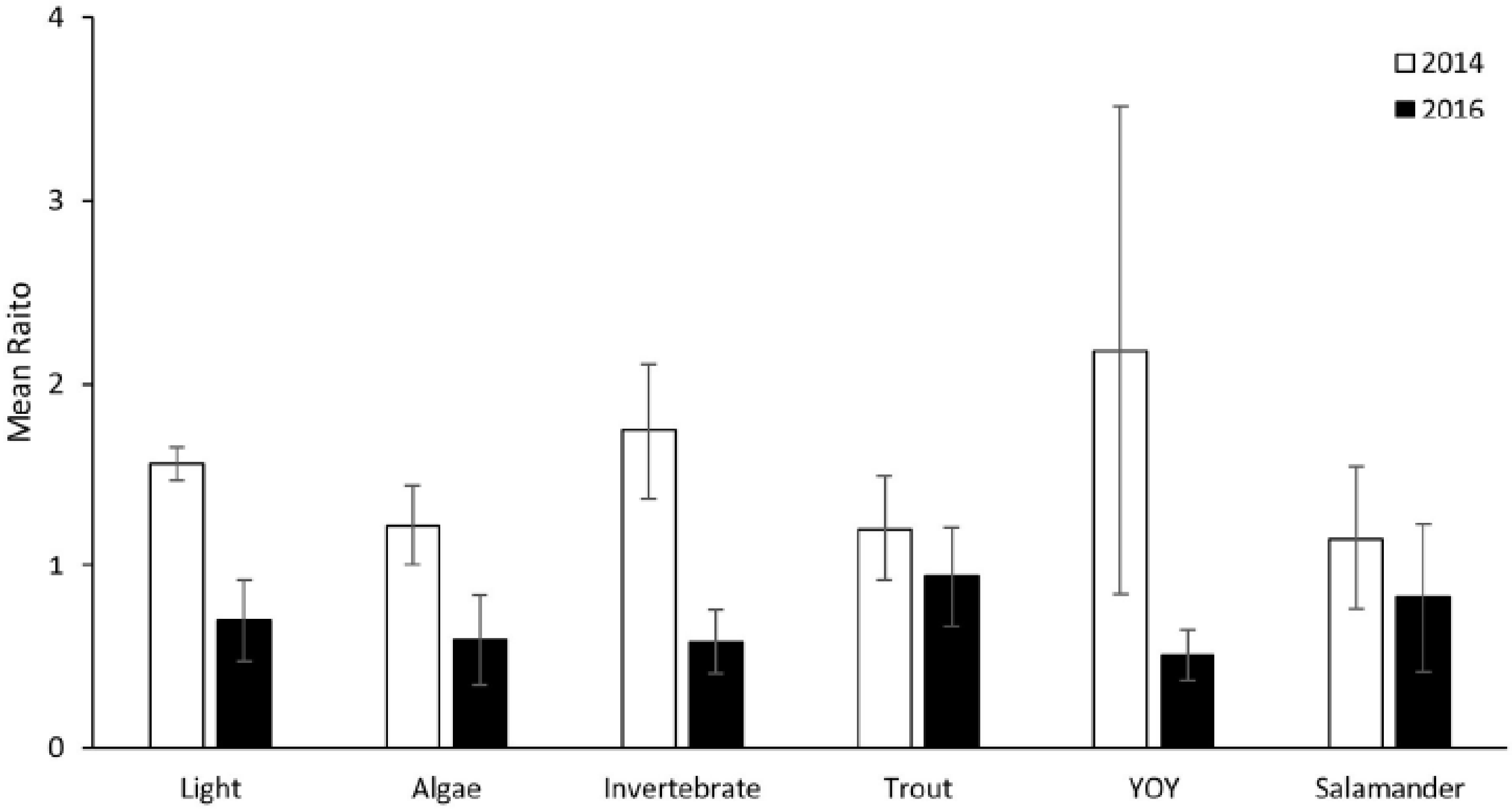
Experiment 1 - Shading



Experiment 1 - Shading



Experiment 1 - Shading



Take home messages (3)

1. Patchy shading over part of the stream reduces streambed algae at local and reach-scales

2. Declines in stream light also lead to reach-scale declines in stream macroinvertebrates, fish, and salamanders

Experiment 2 - Gaps

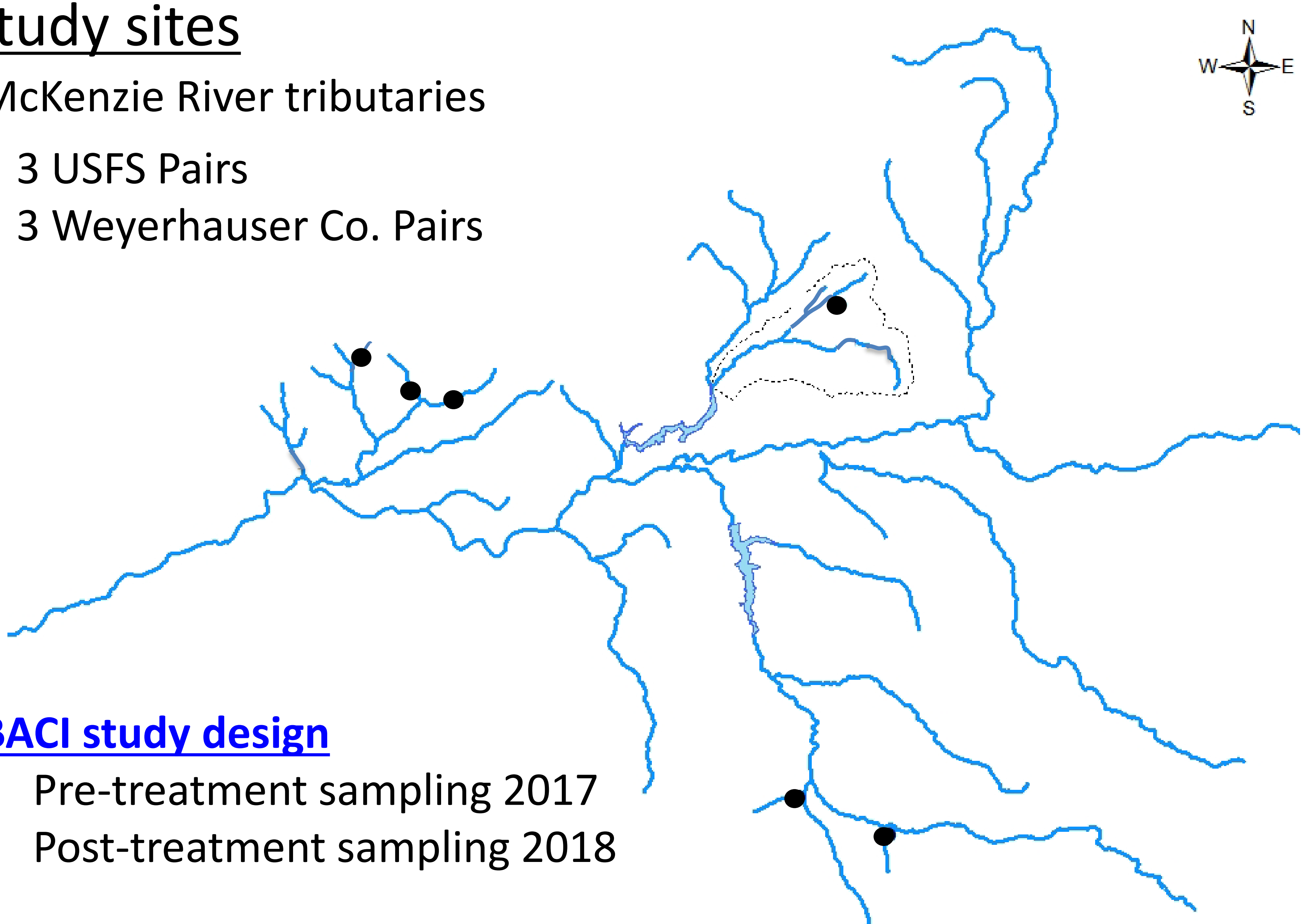
Experiment 2 - Gaps

Study sites

McKenzie River tributaries

3 USFS Pairs

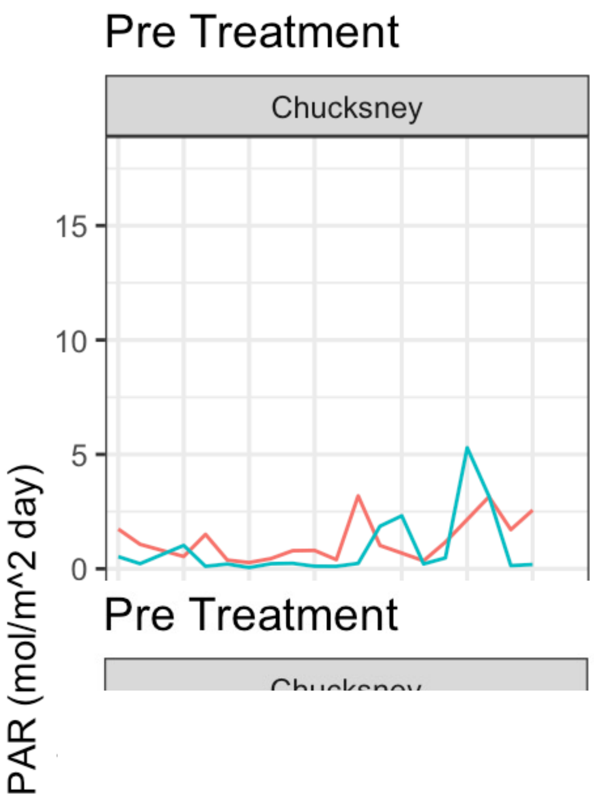
3 Weyerhauser Co. Pairs



BACI study design

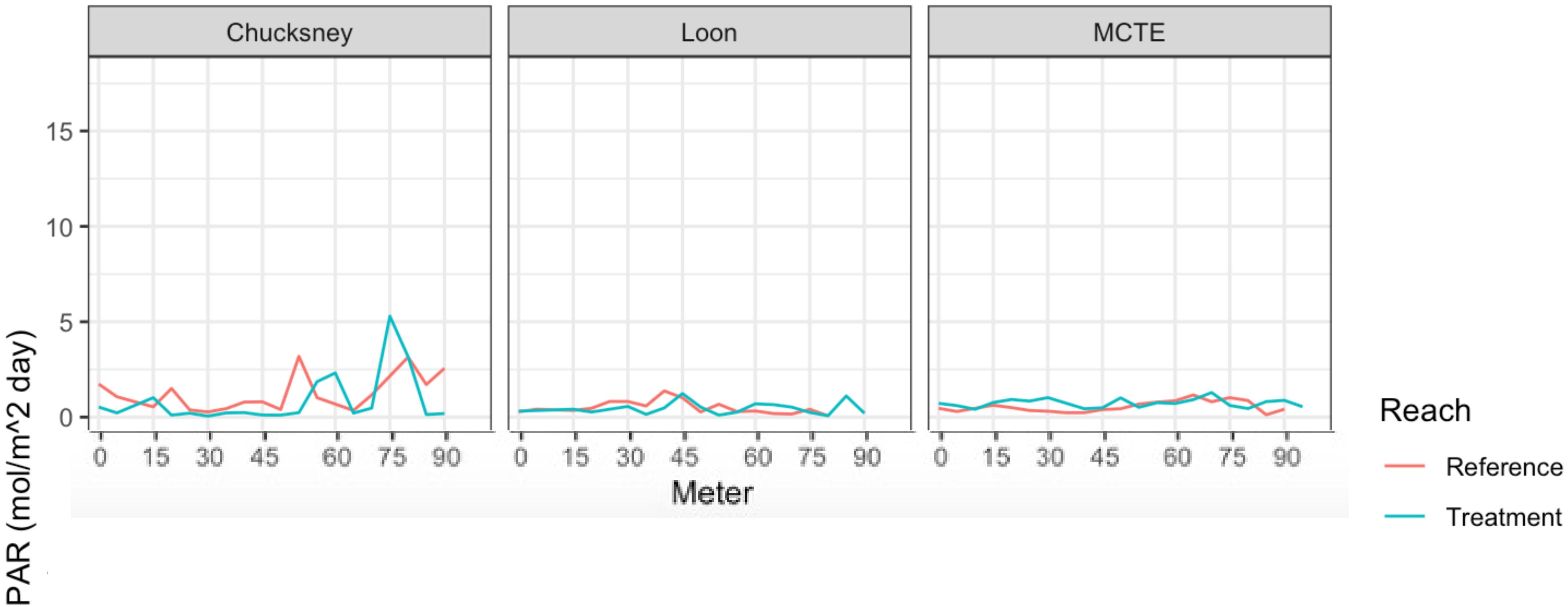
- Pre-treatment sampling 2017
- Post-treatment sampling 2018

Light


Pre Treatment
Chucksney
15
10
5
0
PAR (mol/m^2 day)
Pre Treatment
Reach
Reference
Treatment

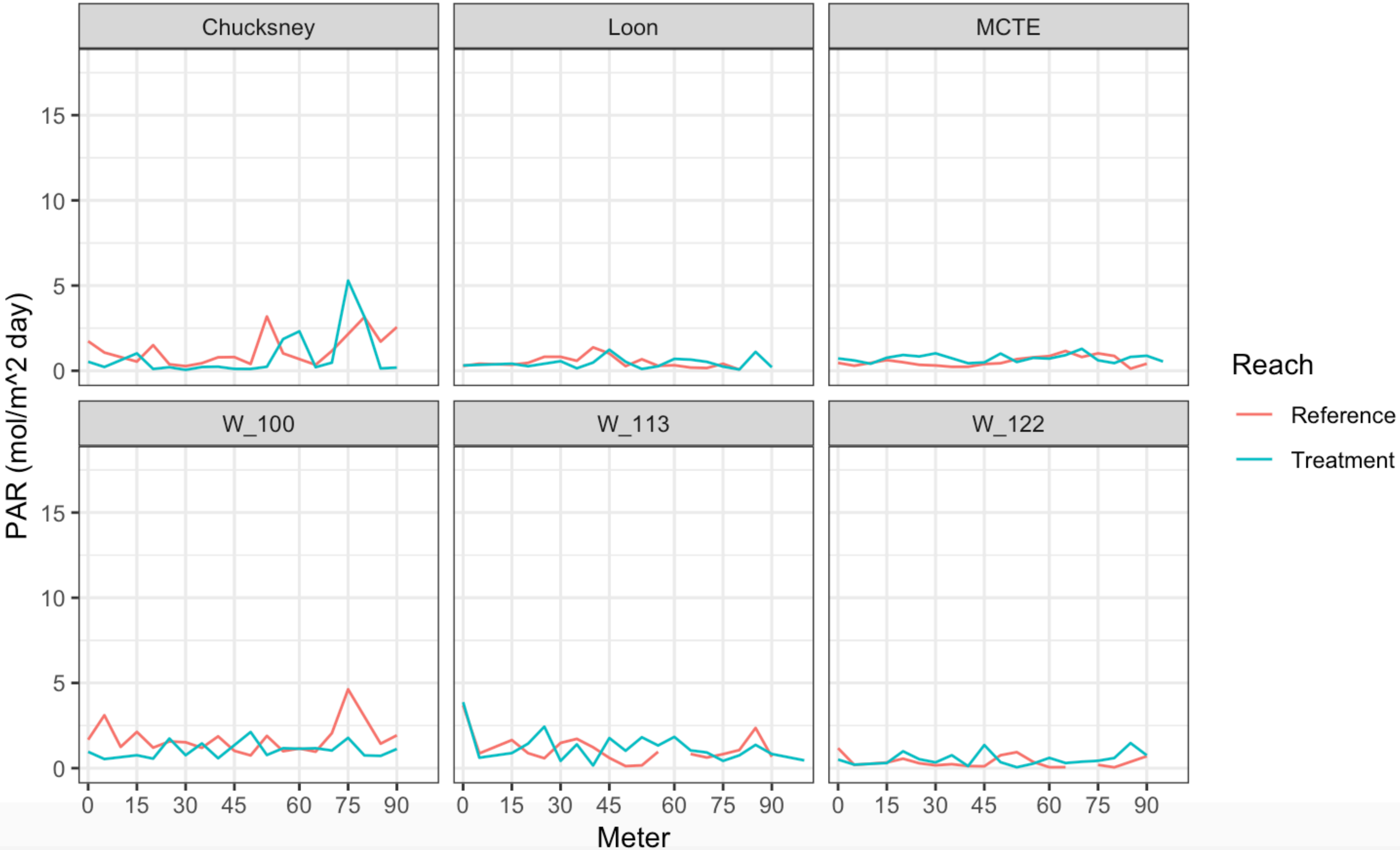
Light

Light flux to stream 2017 (PRE-treatment)



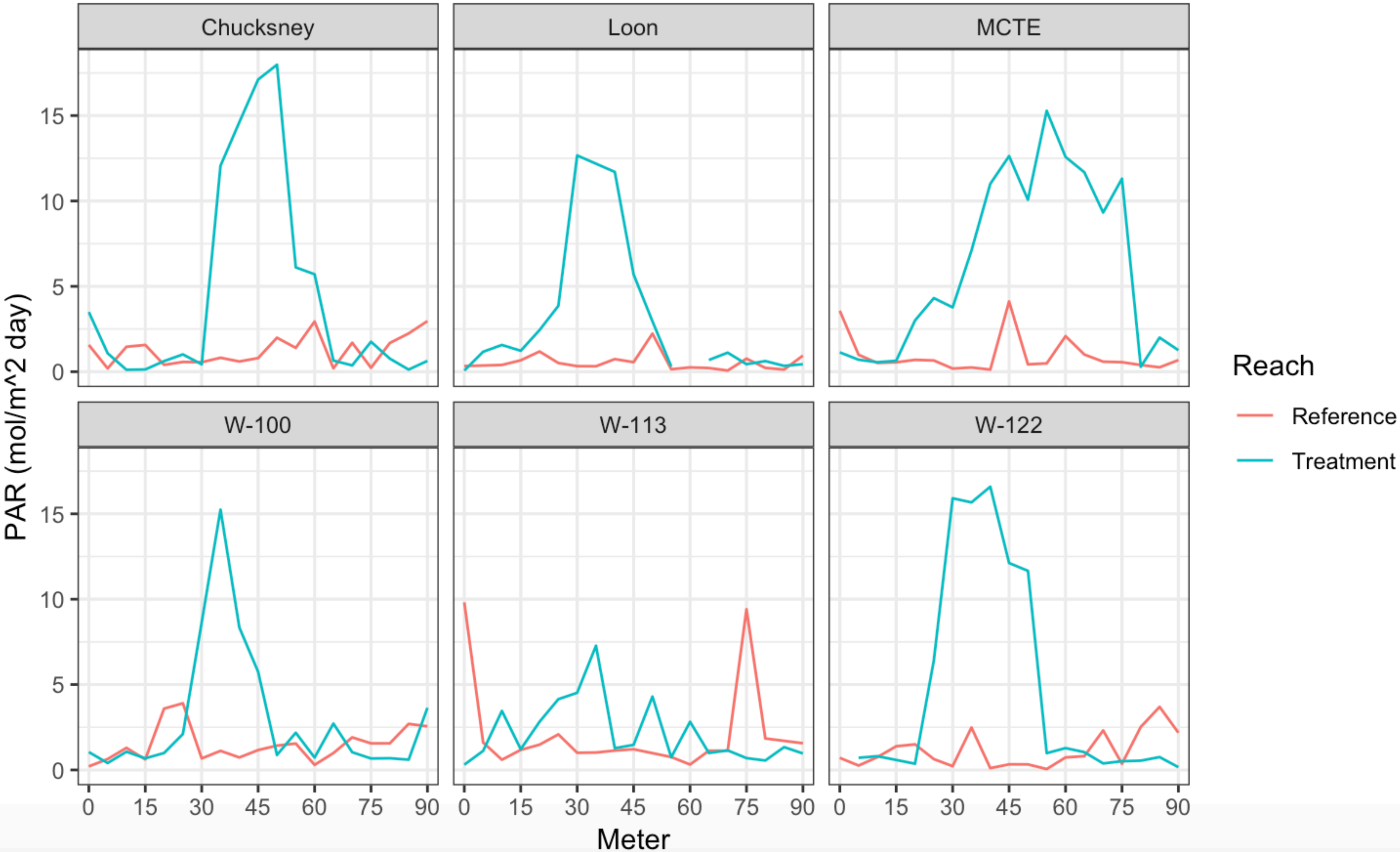
Light

Light flux to stream 2017 (PRE-treatment)



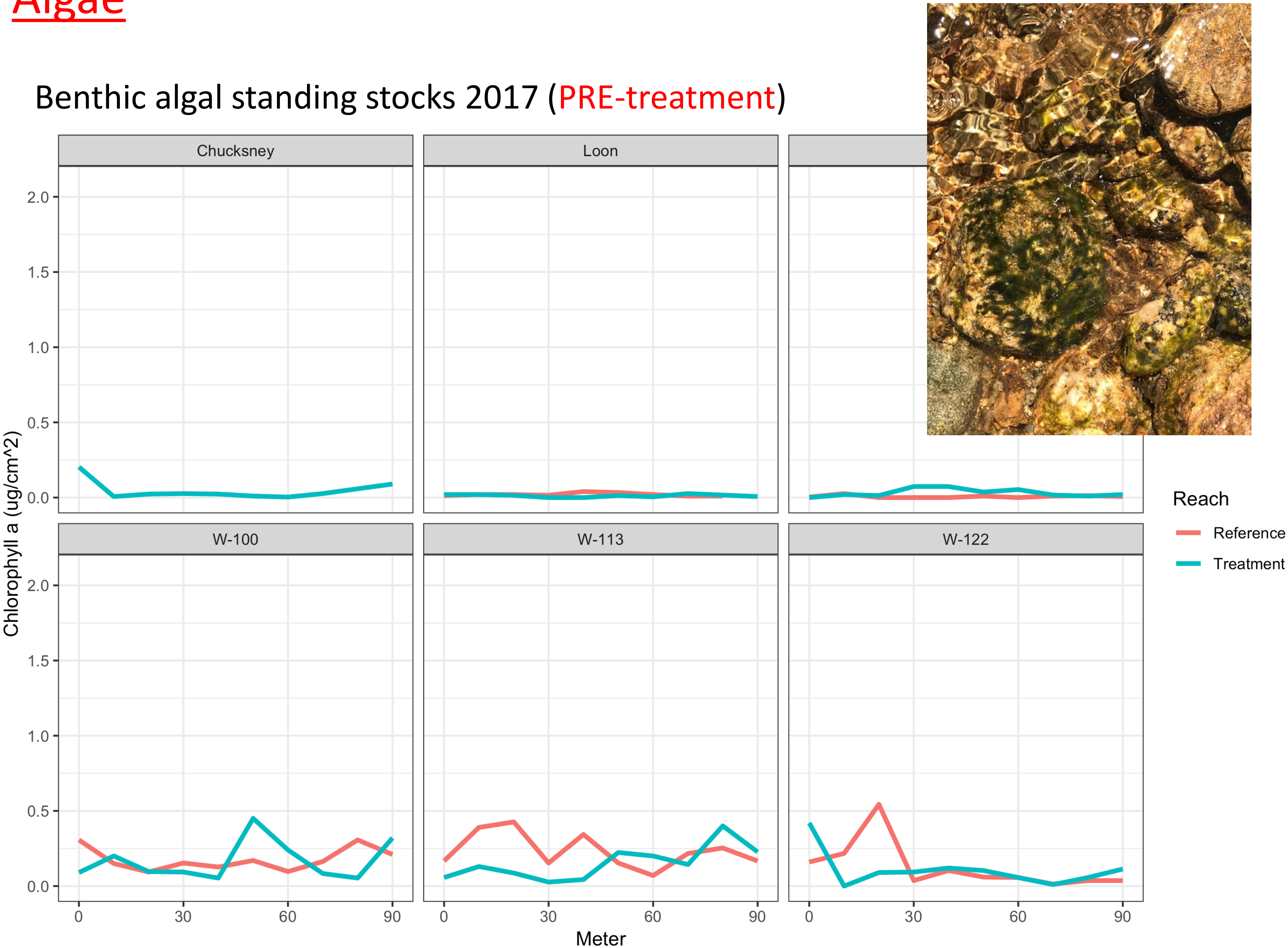
Light

Light flux to stream 2018 (**POST-treatment**)



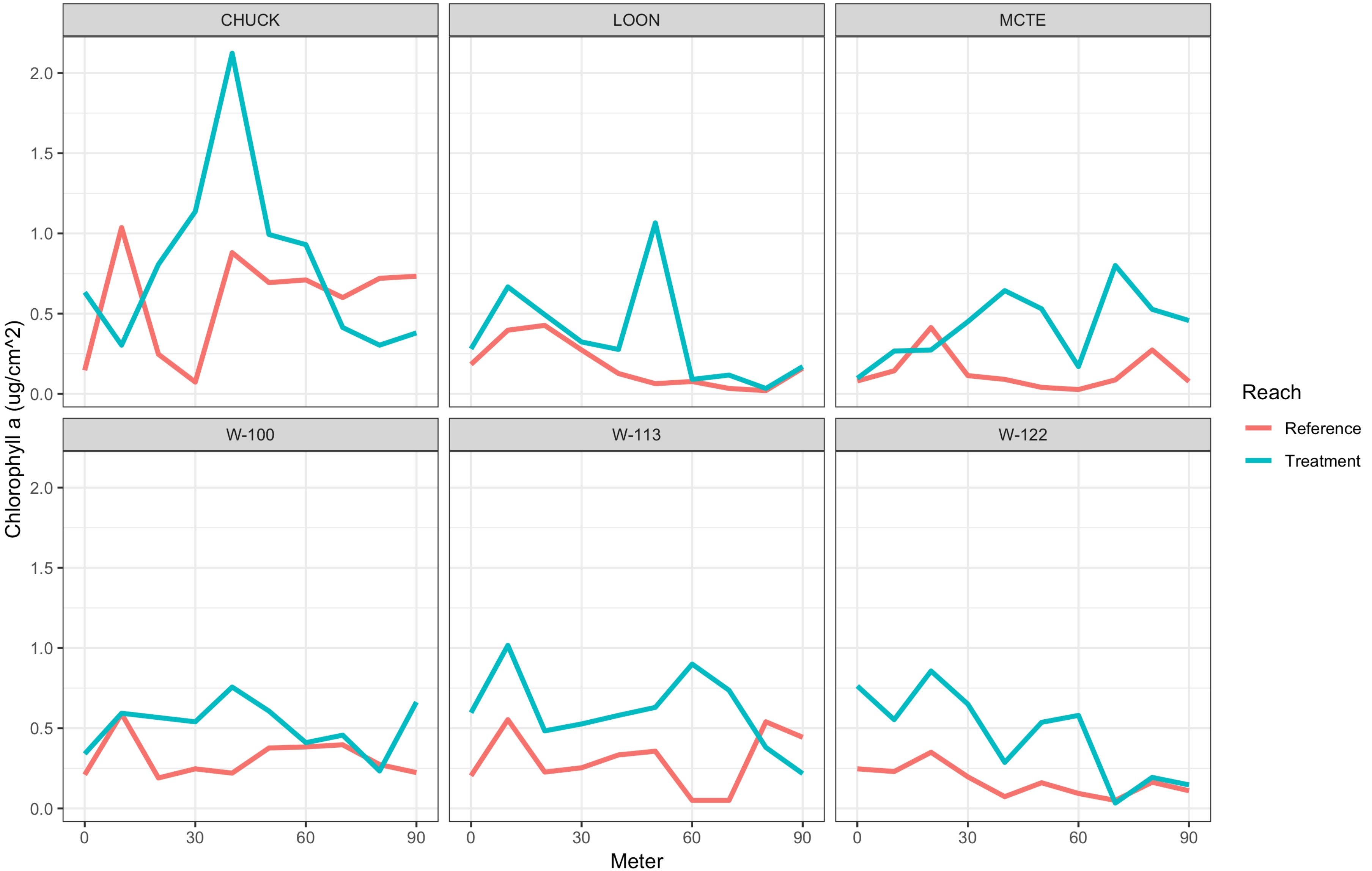
Algae

Benthic algal standing stocks 2017 (PRE-treatment)



Algae

Benthic algal standing stocks 2018 (**POST-treatment**)



Stream Temperature

Forest Ecology and Management 474 (2020) 118354

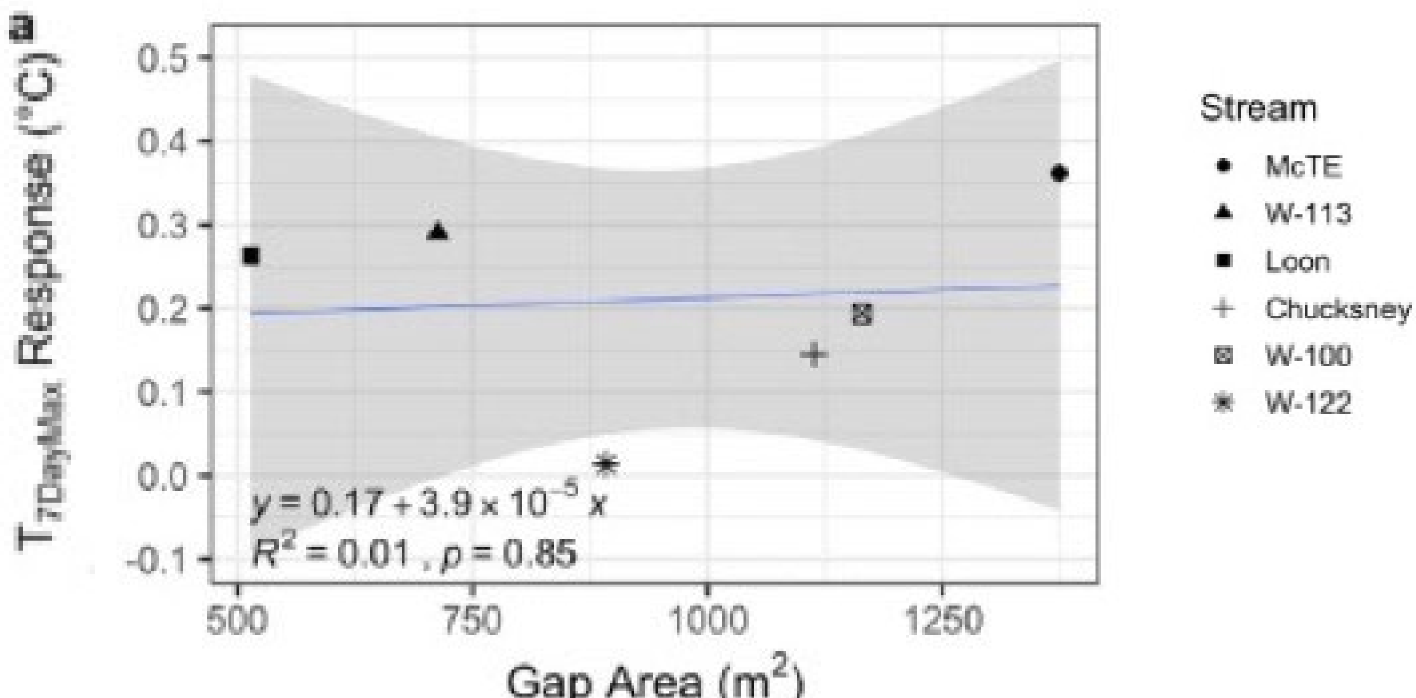
Contents lists available at ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

Stream temperature responses to experimental riparian canopy gaps along forested headwaters in western Oregon *

Allison Swartz[a,*], David Roon[b], Maryanne Reiter[c], Dana Warren[a,b]



*FWHMF funded project

Stream Temperature

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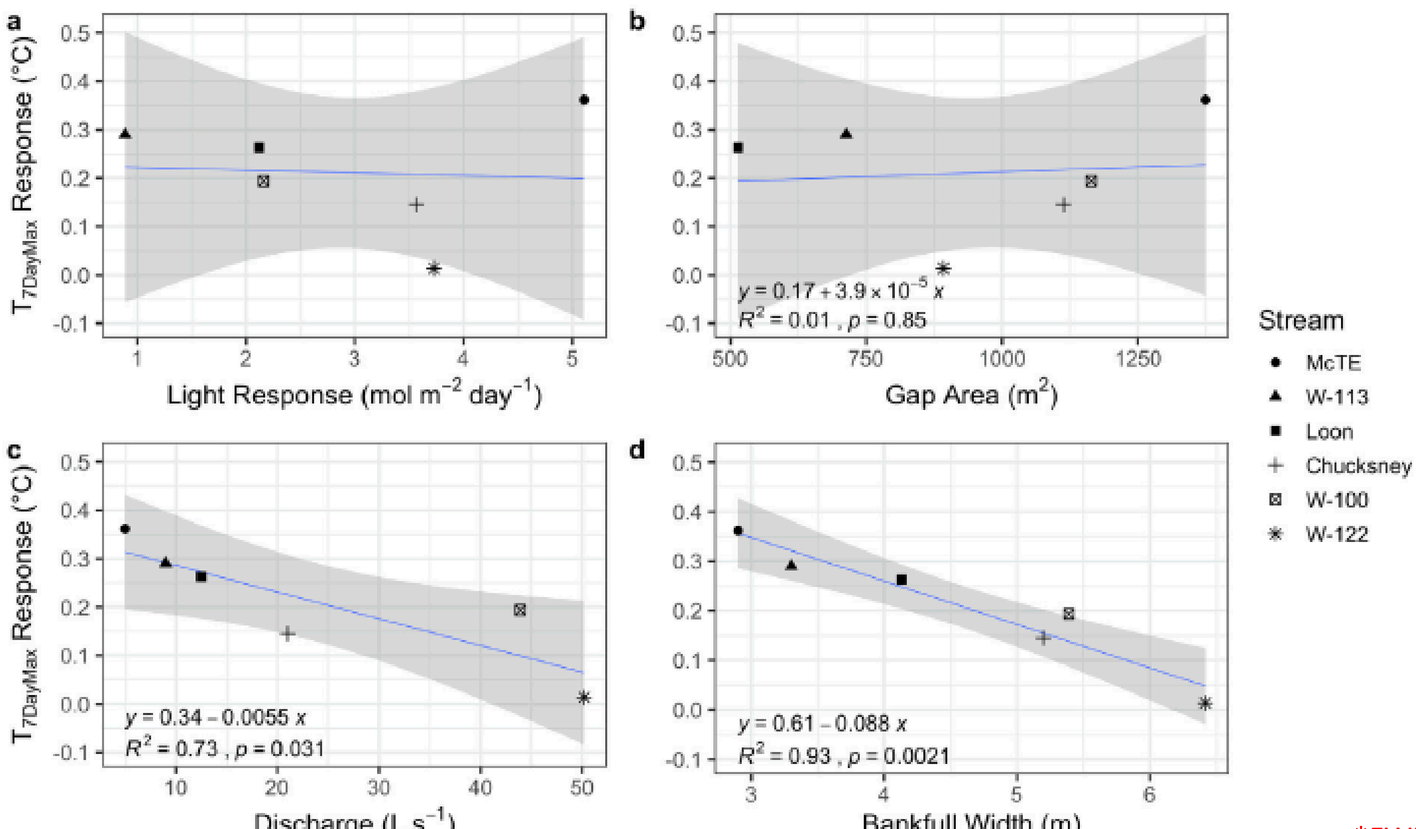
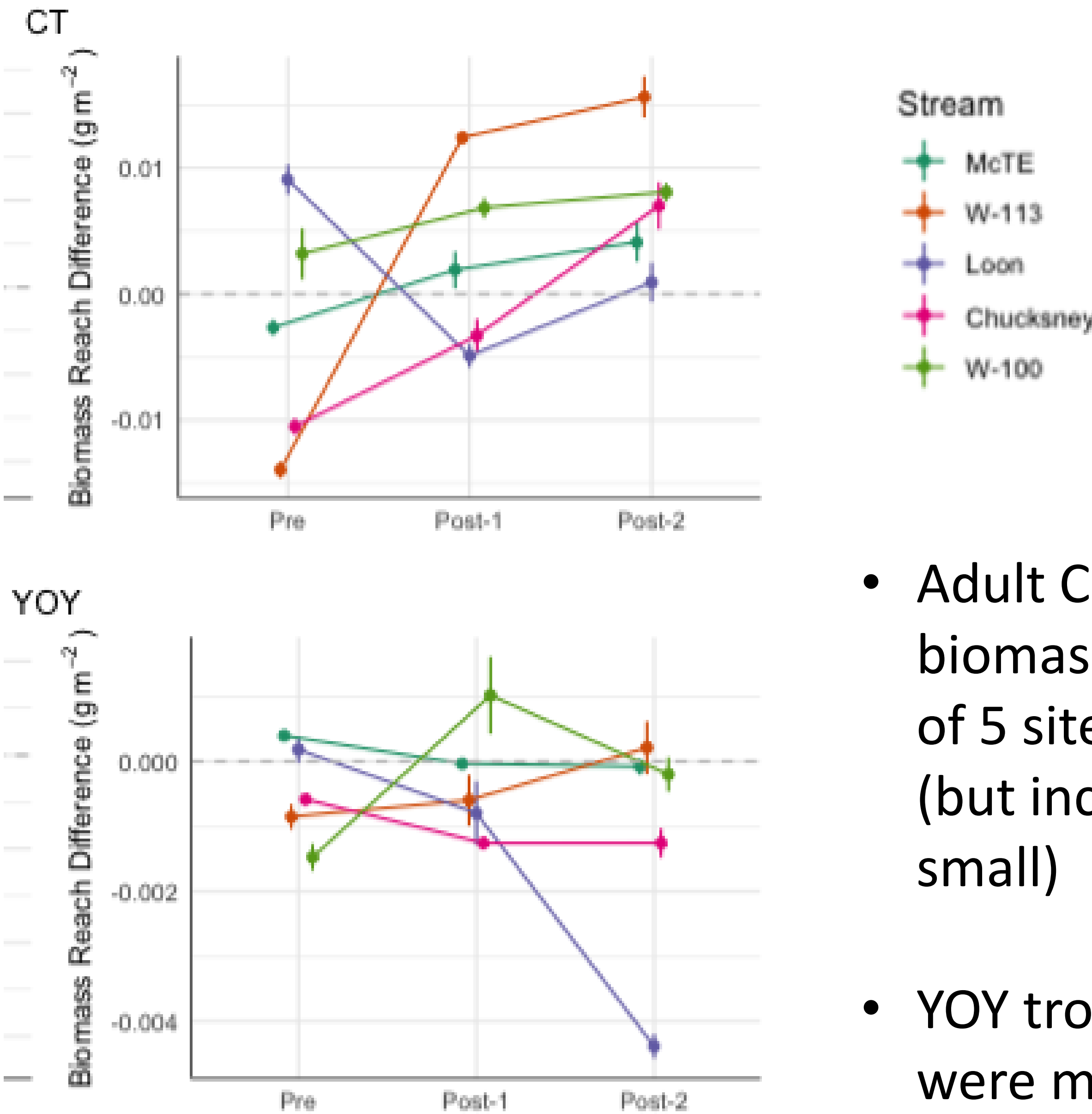


*FWHMF funded project

Fish



- Adult Cutthroat trout biomass increased in 4 of 5 sites following gaps (but increases were small)
- YOY trout responses were mixed

Take home messages (4)

1. Creating canopy gaps next to the stream led to increases in benthic primary production and slight increases in trout biomass in 4 of 5 sites.

2. Stream temperature was not substantially affected by the gaps and the changes that did occur were linked to stream size (with smaller streams more susceptible to change)

Experiment 3 – Riparian Alternatives

Assessing the response of aquatic biota to alternative riparian management practices

Moving from Theory to Practice

BACI study design

- 2 years Pre-treatment sampling
- 2 years Post-treatment sampling
- Staggered start/finish

1. Study Questions and Conceptual Framework

Project-specific questions

Our study goal is to determine how water quality and stream biota respond to three alternative riparian management options (buffer gaps, thinning, and variable retention) relative to standard fixed-width buffers and to a wholly unharvested unit. To meet this overarching goal, we had the following objectives:

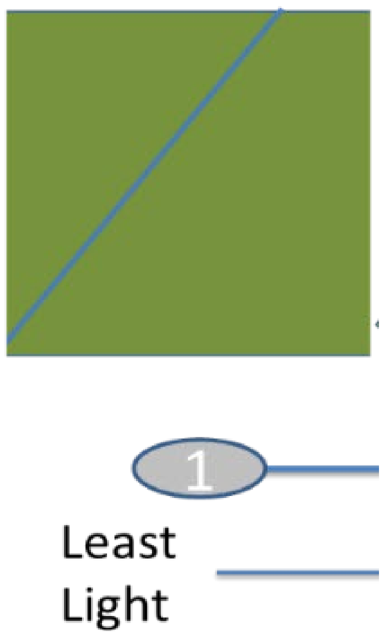
- *Quantify bottom-up factors, including algal standing stocks, primary production, and macroinvertebrate abundances, that may affect growth, abundance, and overall production of fish and salamanders in headwaters*

- *Quantify the short-term (<3 yr) responses of fish and salamander abundance, total biomass, and summer growth across riparian prescription alternatives.*

- *In each stream, determine how temperatures vary by treatment and whether significant temperature responses can be linked to other watershed or stream features such as stream size, water residence time, or substrate embeddedness.*

Quick review of the experimental design

Treatments target a gradient of shading and light availability

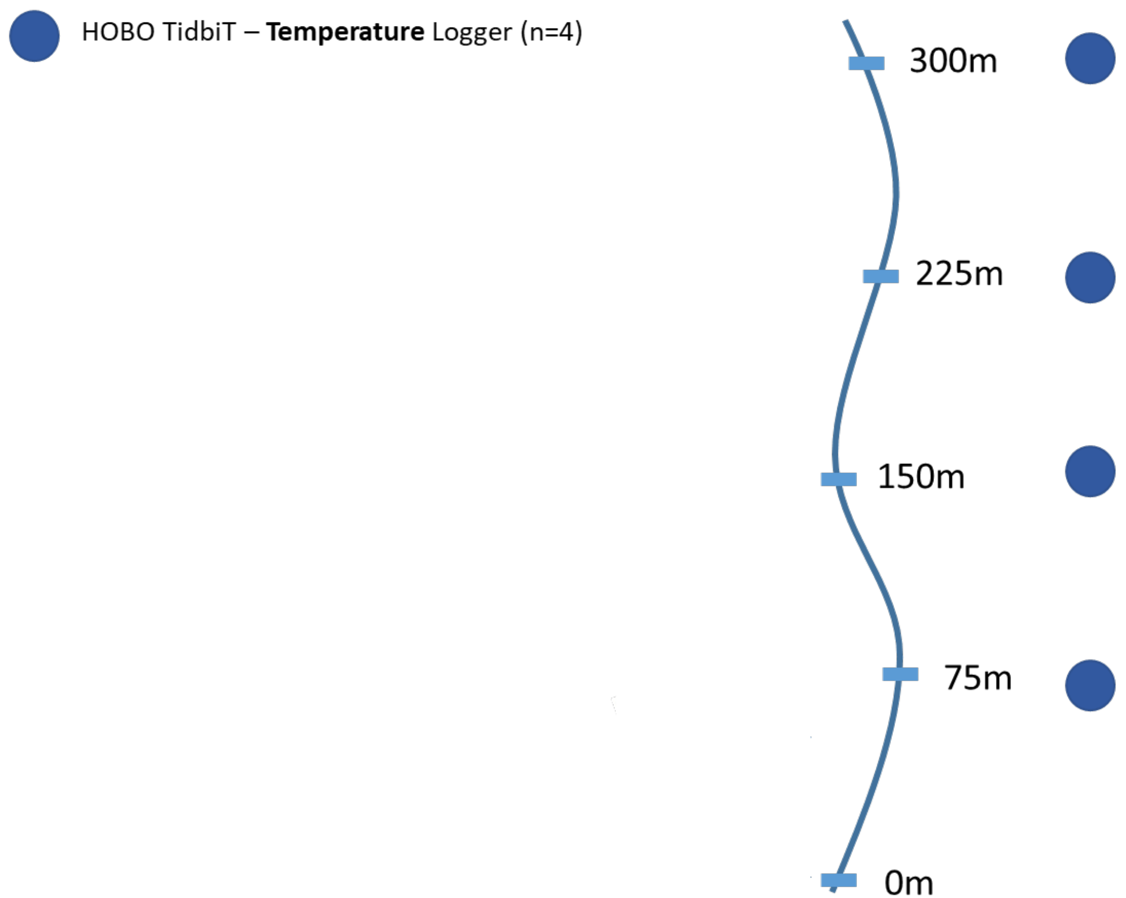


1. Uncut

“control” ?

“control” ?

Stream Sampling Layout



Major Accomplishments

- Established 6 blocks of study streams (30 streams total) in OR coast range with project partners
- Collected pre-treatment data for at least 1 year at all sites
- Collected 1 year post-treatment data at 1 block (5 streams)
- Trained 10 undergraduate field technicians over 3 years
- Published 1 paper
- Supported 1 undergraduate honors thesis (manuscript from thesis will be submitted soon)

Major Challenges

- COVID
- Fire
- Site Selection
  - Loss of sites from fire
  - Fish bearing streams (ODFW classifications not always accurate)

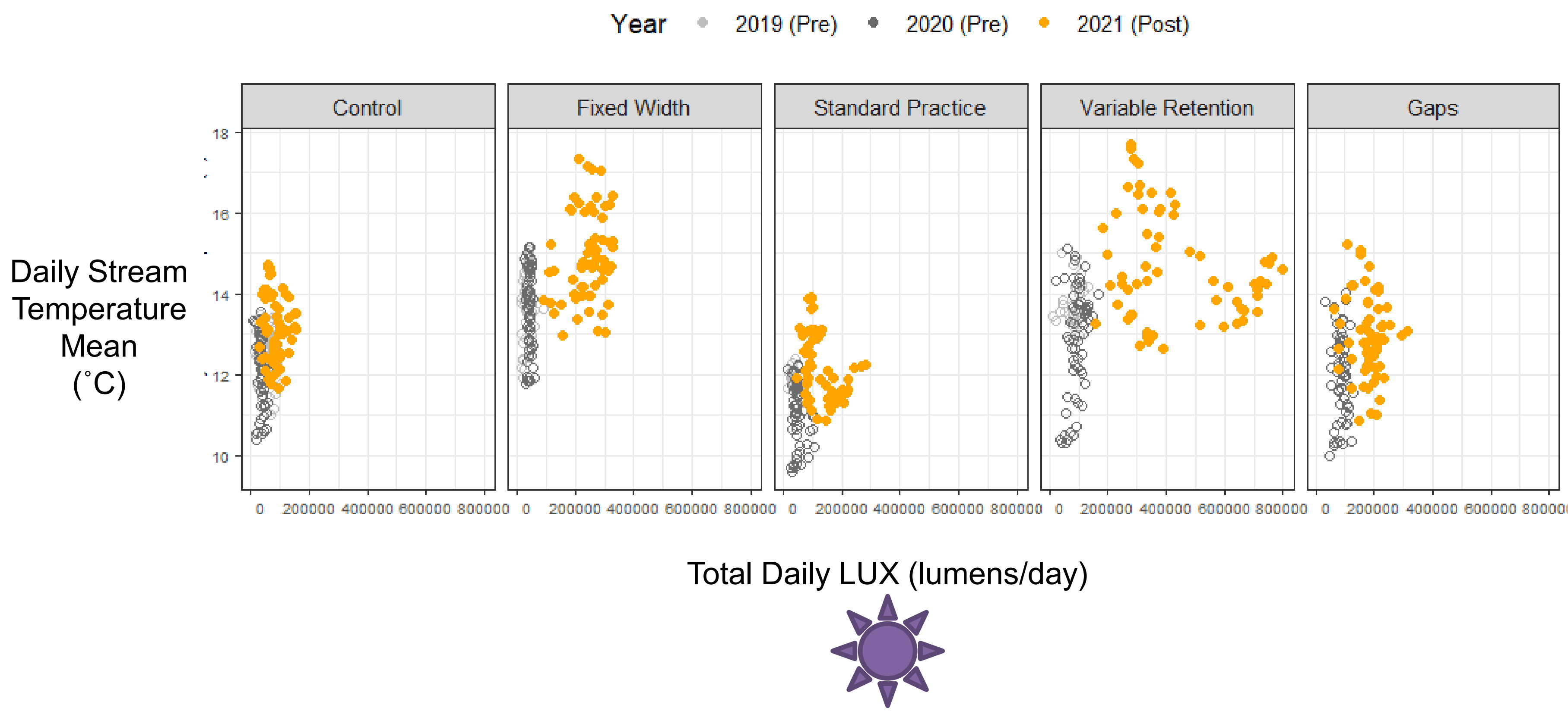
Products

6 presentations or posters

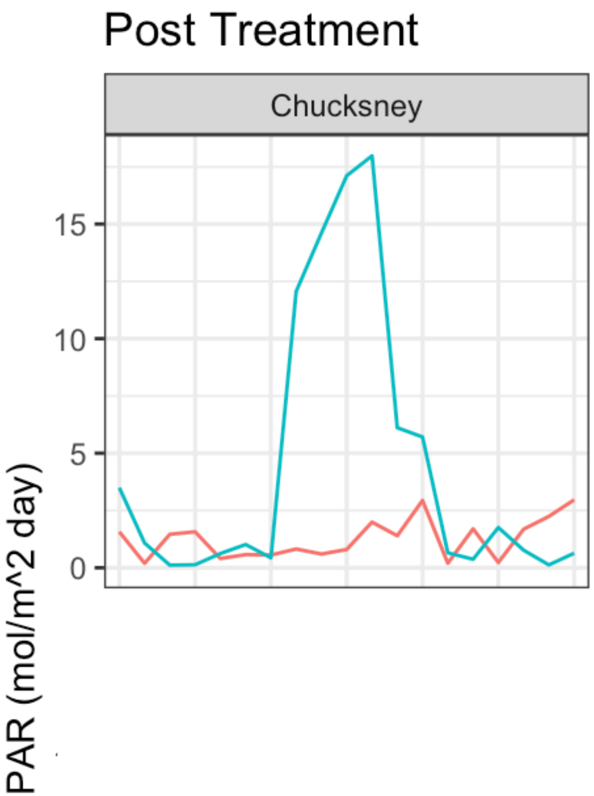
Sanders, A.M.^, A.A. Coble, A.G. Swartz^, M. River, P. James, and D.R. Warren. **2022**. Effects of fire and smoke on water temperature and dissolved oxygen in headwater streams. *Freshwater Science*

Neal, N.^ 2022. Abiotic and biotic predictors of coastal giant salamander (*Dicamptodon tenebrosus*) in headwaters of the Oregon Coast Range. Oregon State University Honors College Thesis

Thank you


Year
2019 (Pre)
2020 (Pre)
2021 (Post)
Control
Fixed Width
Standard Practice
Variable Retention
Gaps
Daily Stream Temperature Mean (˚C)
18
16
14
12
10
0
200000
400000
600000
800000
Total Daily LUX (lumens/day)

Light


Post Treatment
Chucksney
15
10
5
0
PAR (mol/m^2 day)
Reach
Reference
Treatment

Take home messages (4)

Light

1) Light levels go up when you cut trees (Phew!!)

Algae

1) Algal standing stocks increased
2) Spatial pattern largely consistent with light

Invertebrates

1) Can't really say at this point . . .

Fish

1) Increases in trout YOY in response to the gap
2) Larger size at age and aparant growth of YOY in gaps
3) Mixed results on adult trout responses
    - BUT less mass loss in gap sites over summer
4) Increases in sculpin (n=1)
5) Declines in salamanders in gaps
6) Limited change in overall vertebrate biomass at the reach scale

Temperature. . .

Responses of Fish to Forest Management: Evaluating How Different Riparian Reserve Configurations Affect Fish and Food Webs in Headwater Streams

Dana Warren - Oregon State University

Ashley Coble - NCASI

Ashley Sanders - Oregon State University

Landowner collaborators

CampbellGlobal FOREST & NATURAL RESOURCE INVESTMENTS

Rayonier

Weyerhaeuser

GreenWood Resources

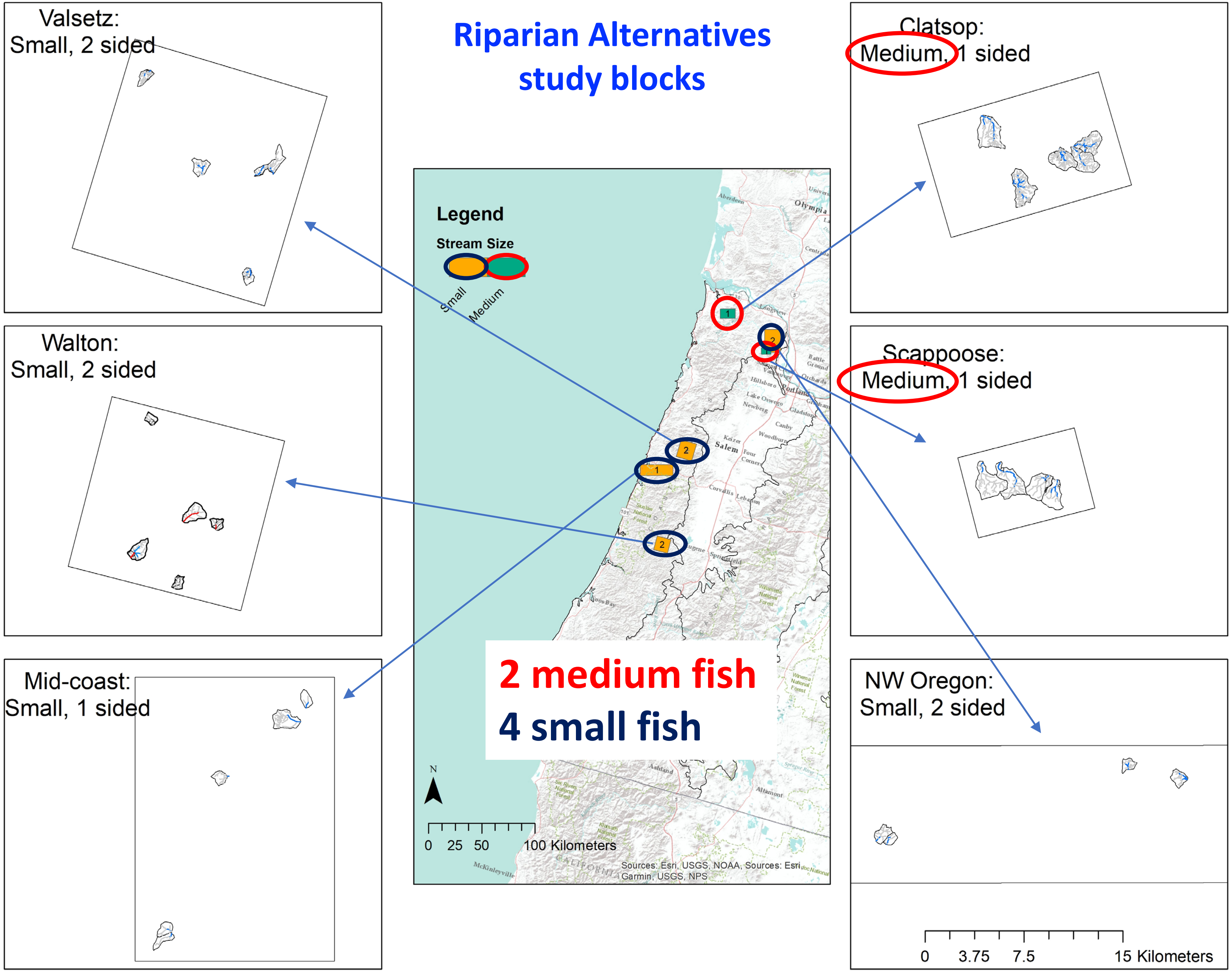
NCASI IMPACT. SCIENCE. SOLUTIONS.

Oregon State University College of Forestry

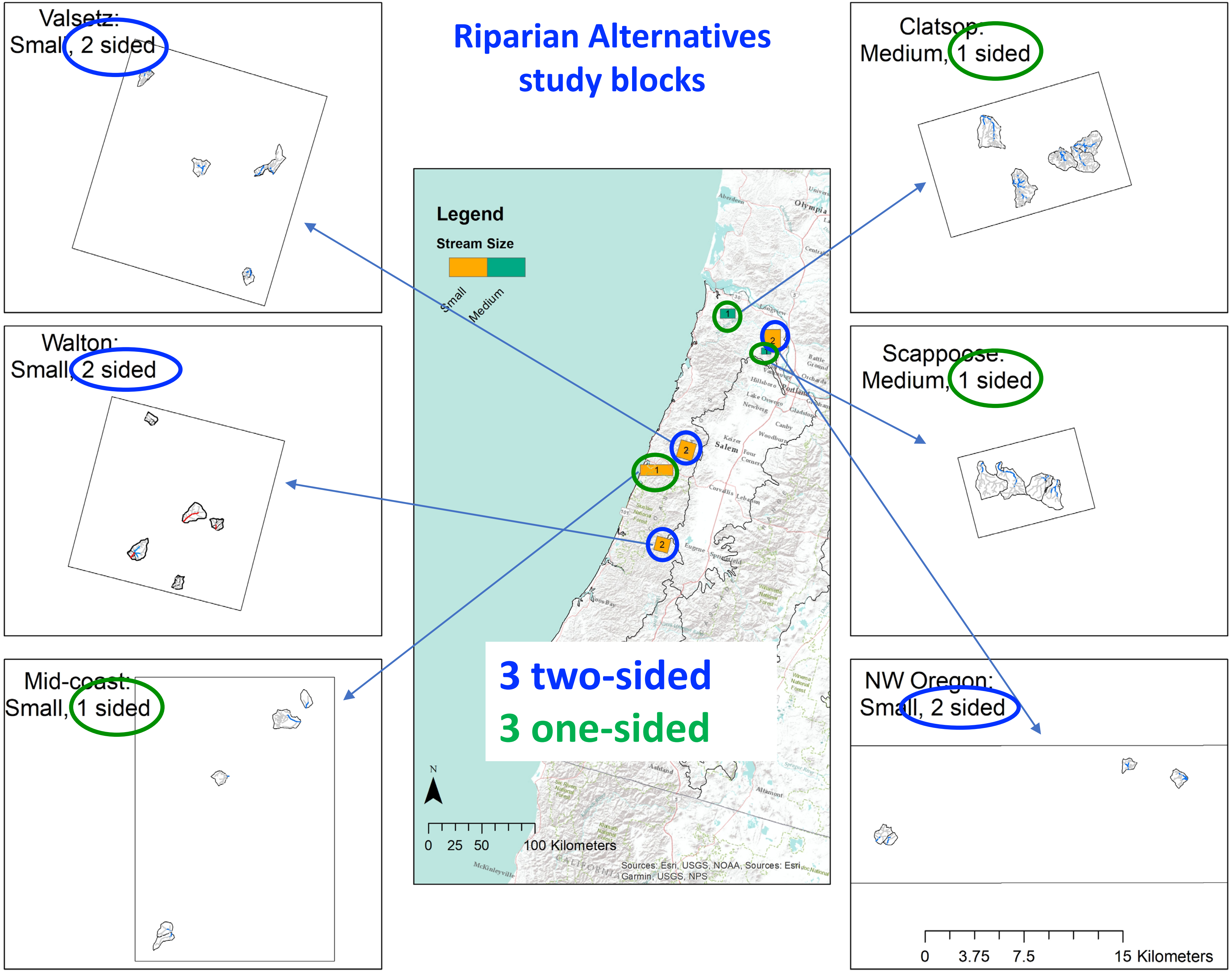
Manulife Investment Management

Roseburg A Forest Products Company

Giustina Land & Timber Co.



Riparian Alternatives
study blocks
Valsetz:
Small, 2 sided
Walton:
Small, 2 sided
Mid-coast:
Small, 1 sided
Clatsop:
Medium, 1 sided
Scappoose:
Medium, 1 sided
NW Oregon:
Small, 2 sided
Legend
Stream Size
Small
Medium
2 medium fish
4 small fish
N
0 25 50 100 Kilometers
0 3.75 7.5 15 Kilometers
Sources: Esri, USGS, NOAA, Sources: Esri, Garmin, USGS, NPS



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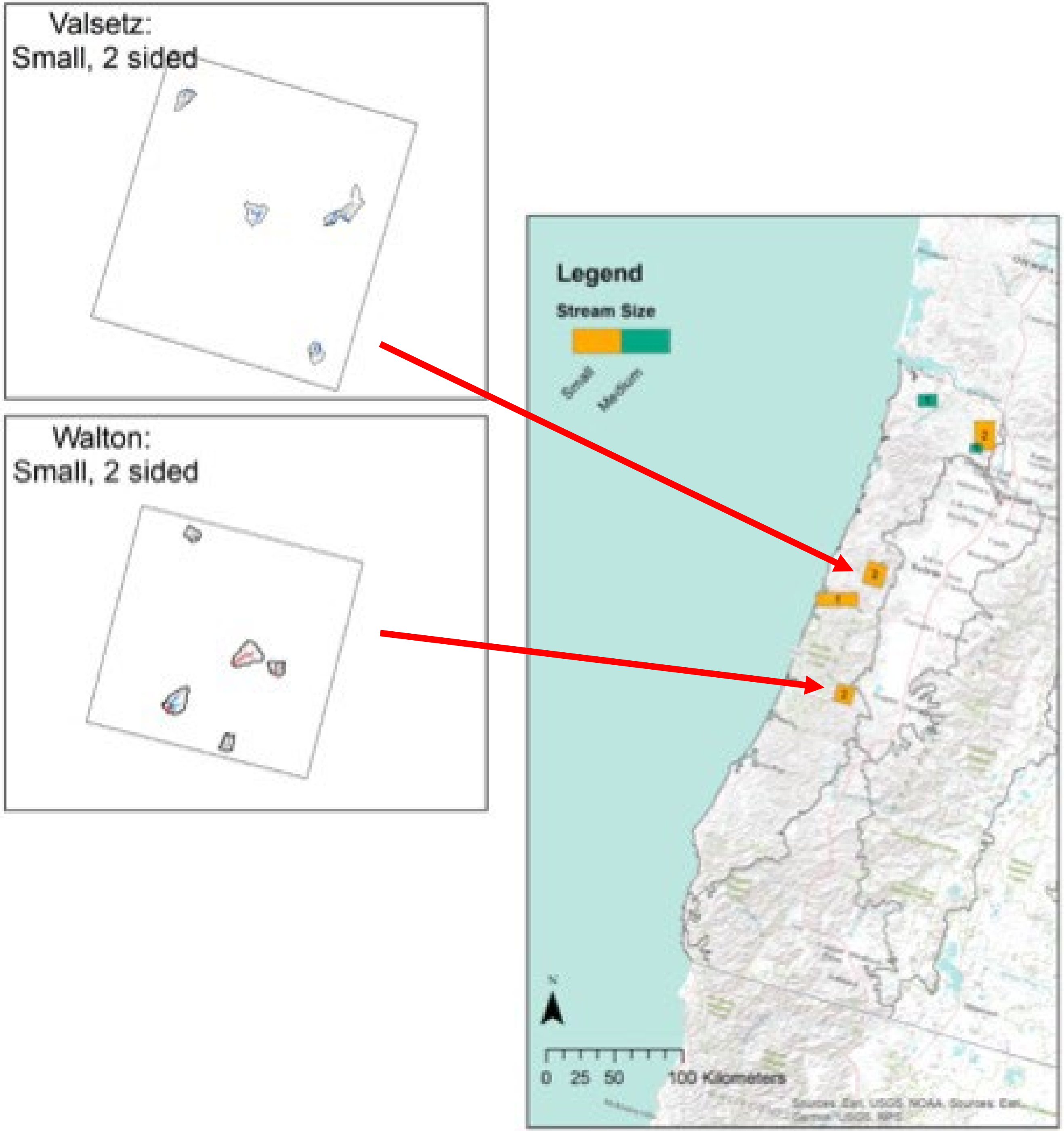
Medium, 1 sided
Scappoose:
Medium, 1 sided
NW Oregon:
Small, 2 sided
Legend
Stream Size
Small
Medium
1
2
Salem
N
0 25 50 100 Kilometers
Sources: Esri, USGS, NOAA, Sources: Esri, Garmin, USGS, NPS
3 two-sided
3 one-sided
0 3.75 7.5 15 Kilometers

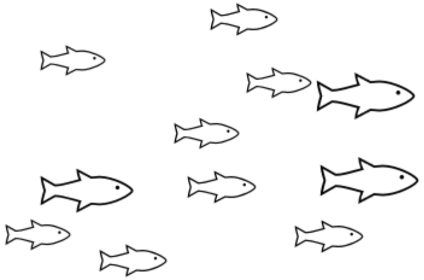


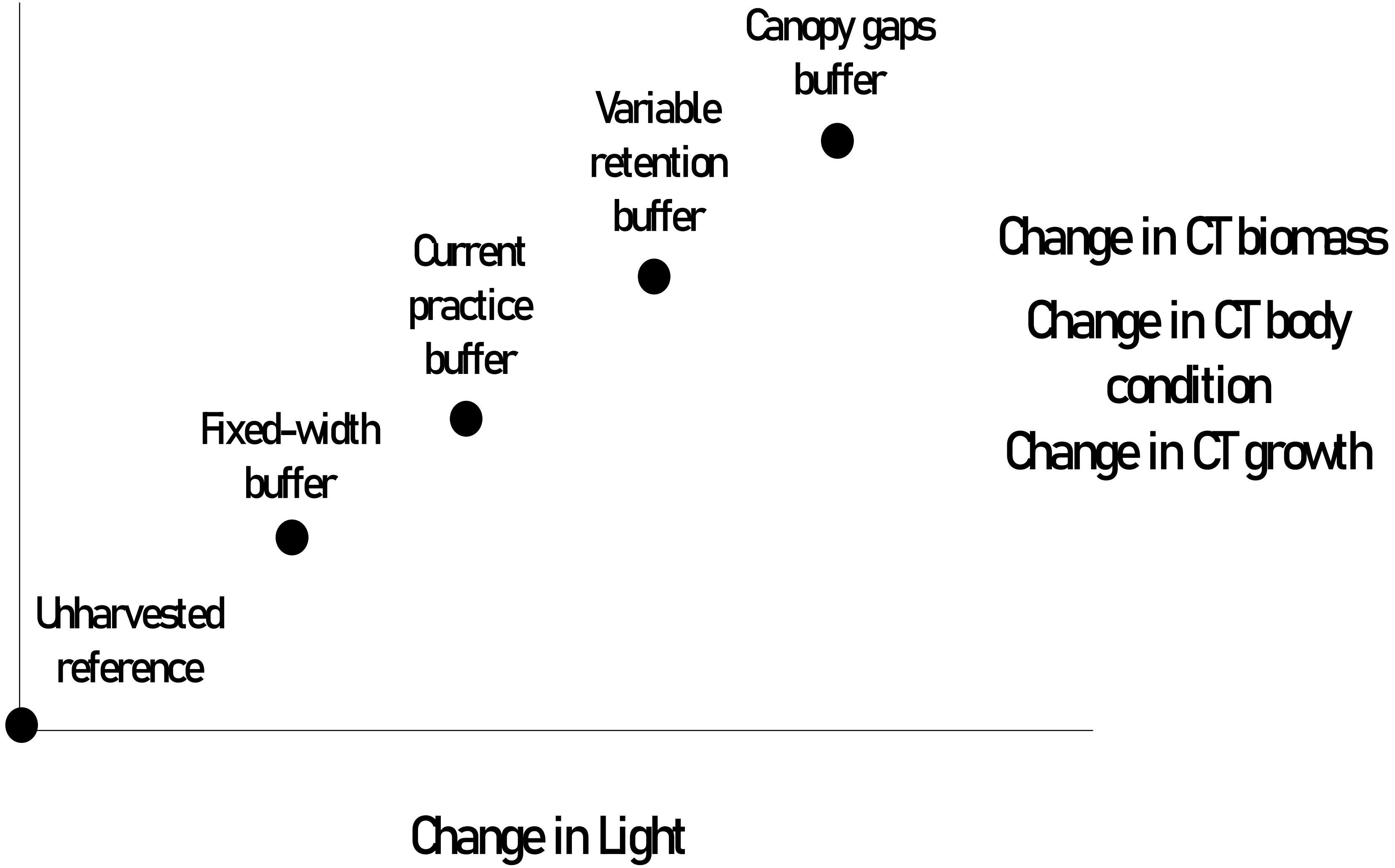
Valsetz:
Small, 2 sided
Walton:
Small, 2 sided
Legend
Stream Size
Small
Medium
0 25 50 100 Kilometers

Predictions

P2.3 Carrying capacity at streams with greater streamlight increases because of increased food availability

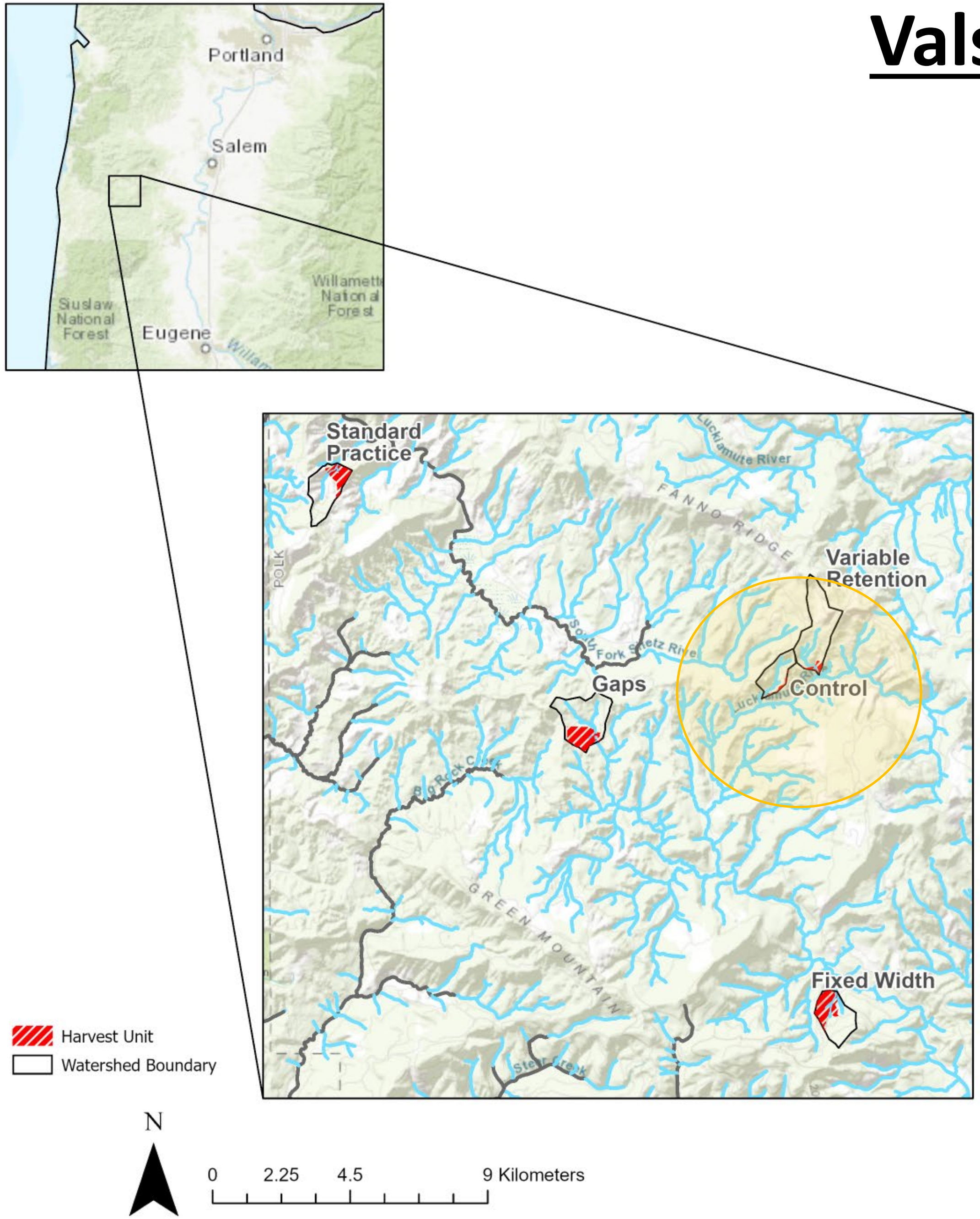
“A rising tide...”



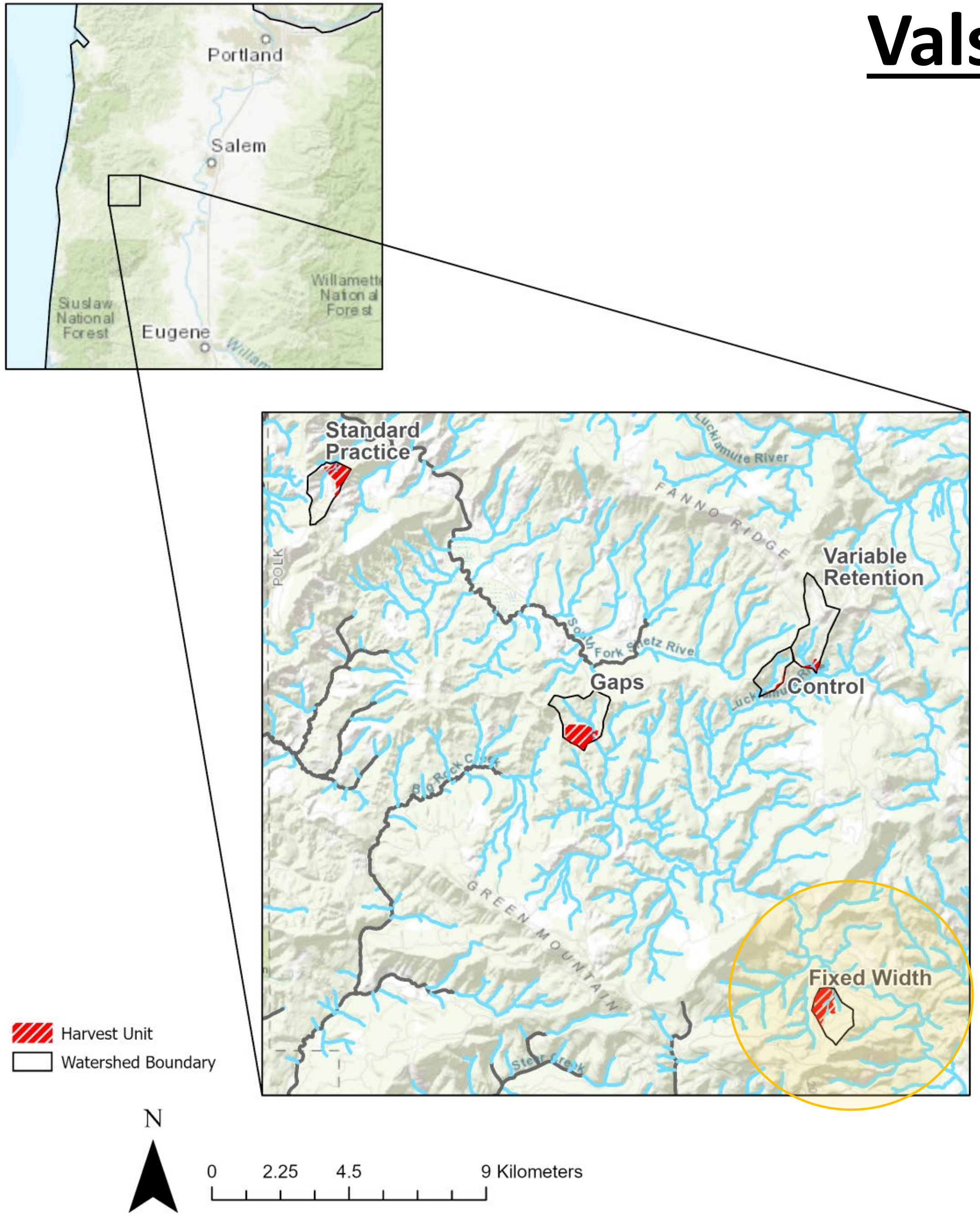


Valsetz

Control (unharvested)



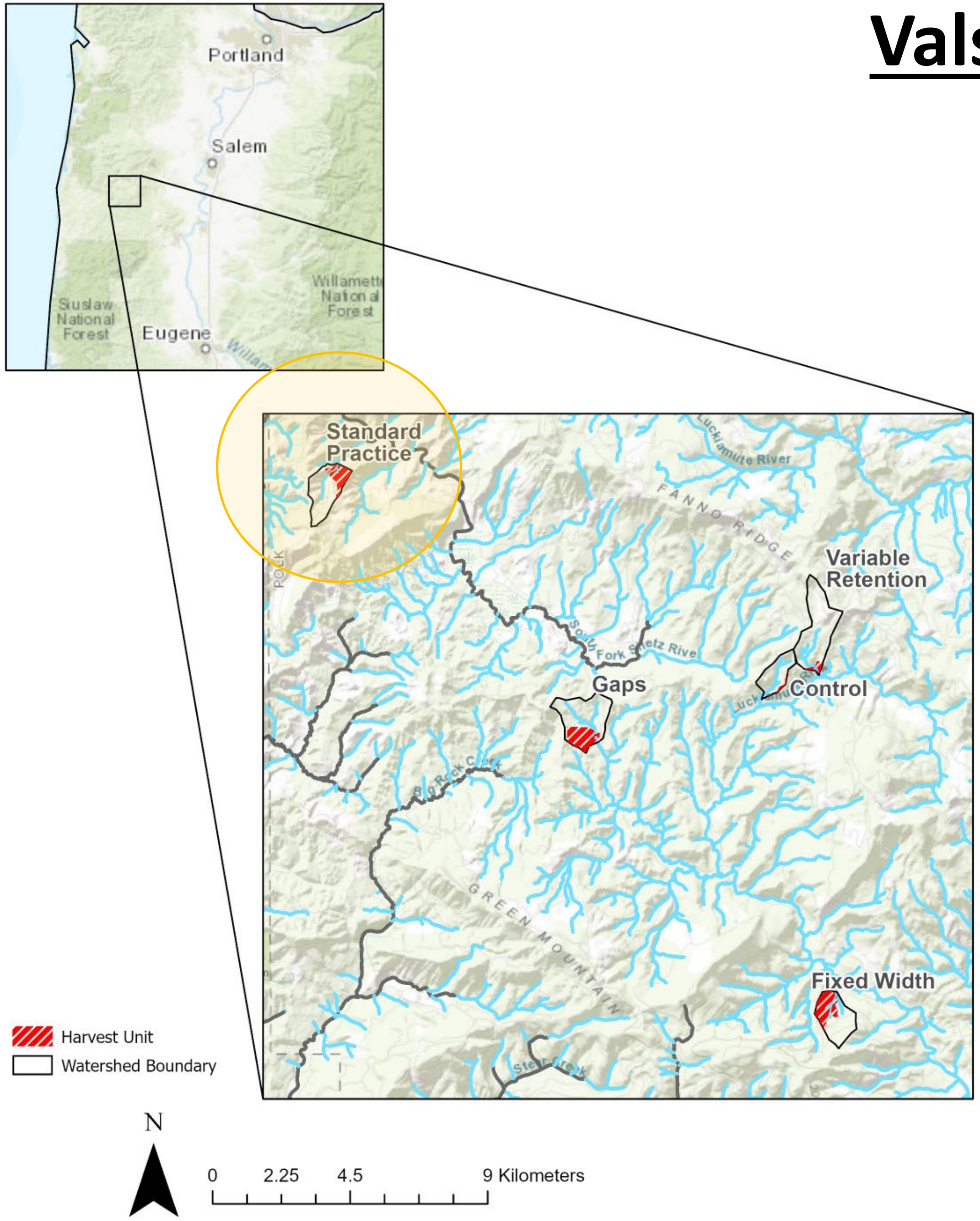
Valsetz



Fixed Width (50 ft)

Valsetz

Current Practice (>20 ft)



*affected by 2021 ice storm

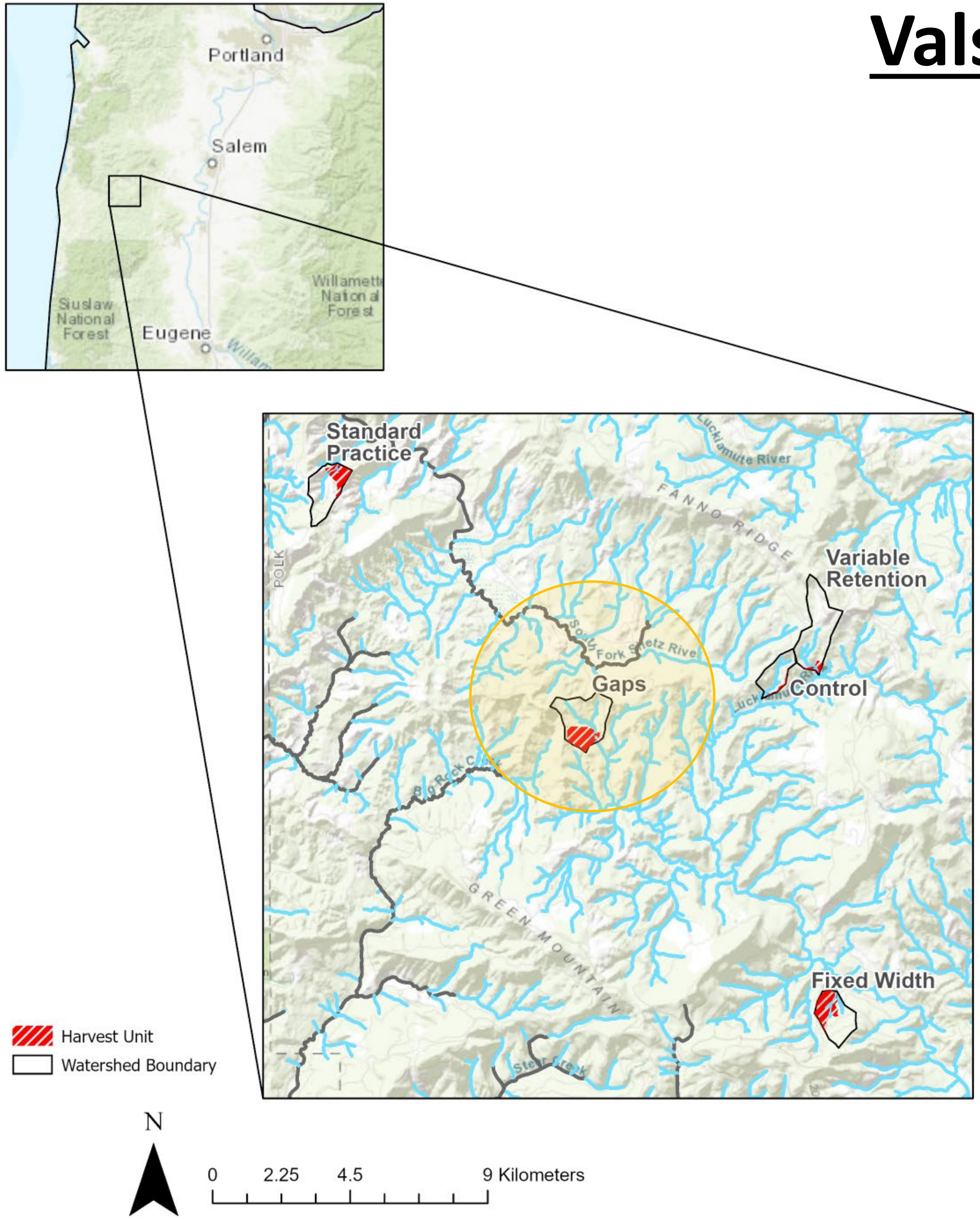
Harvest U

Watershe

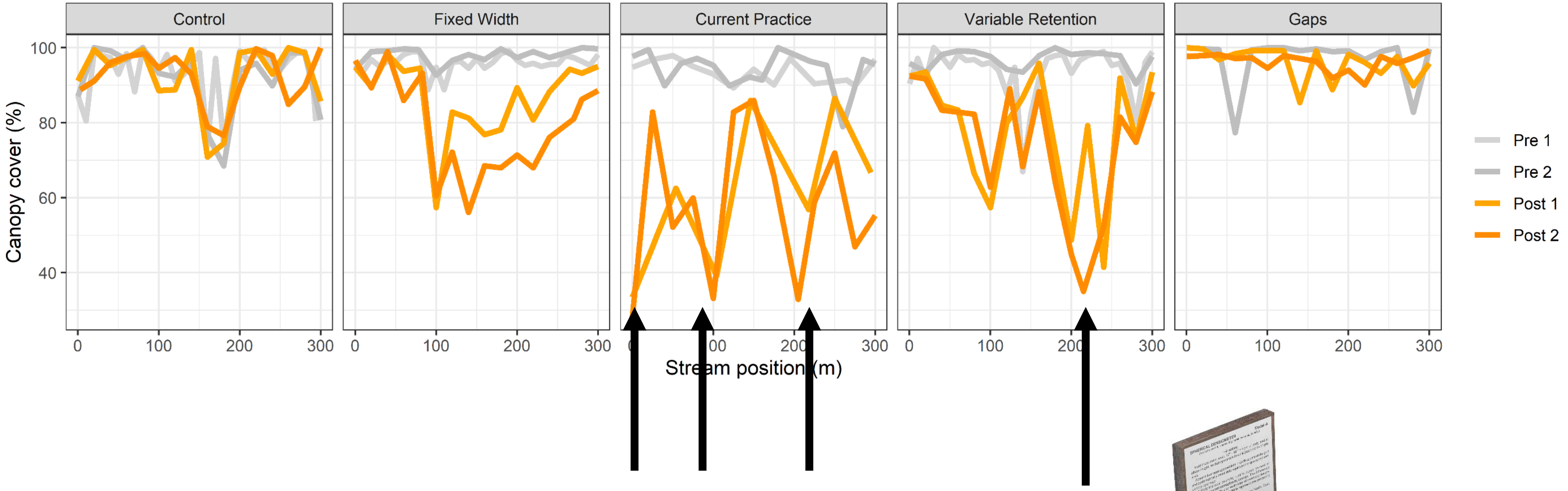
m

Valsetz

Gaps (40 m gaps in 50 ft buffer)



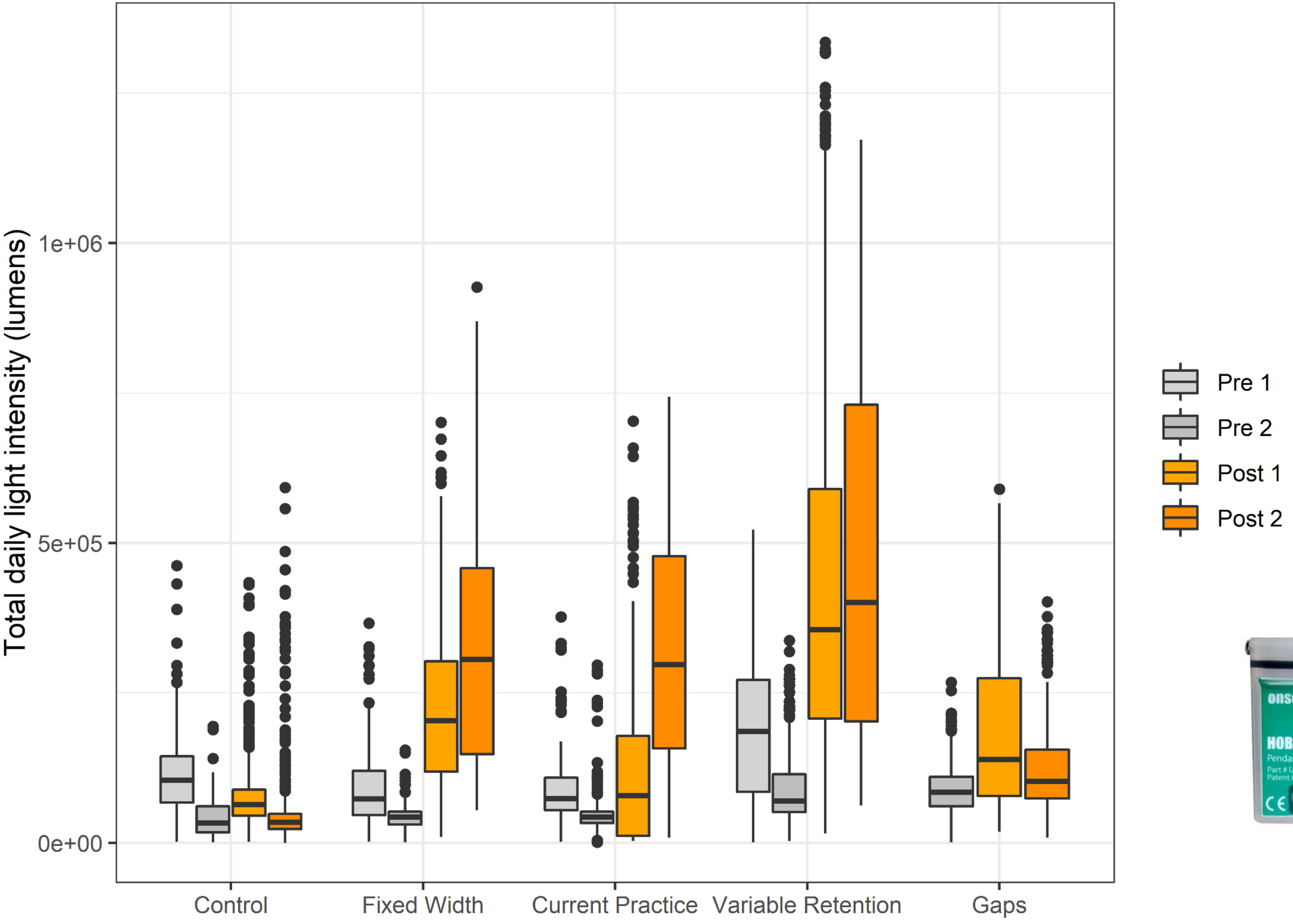
Light



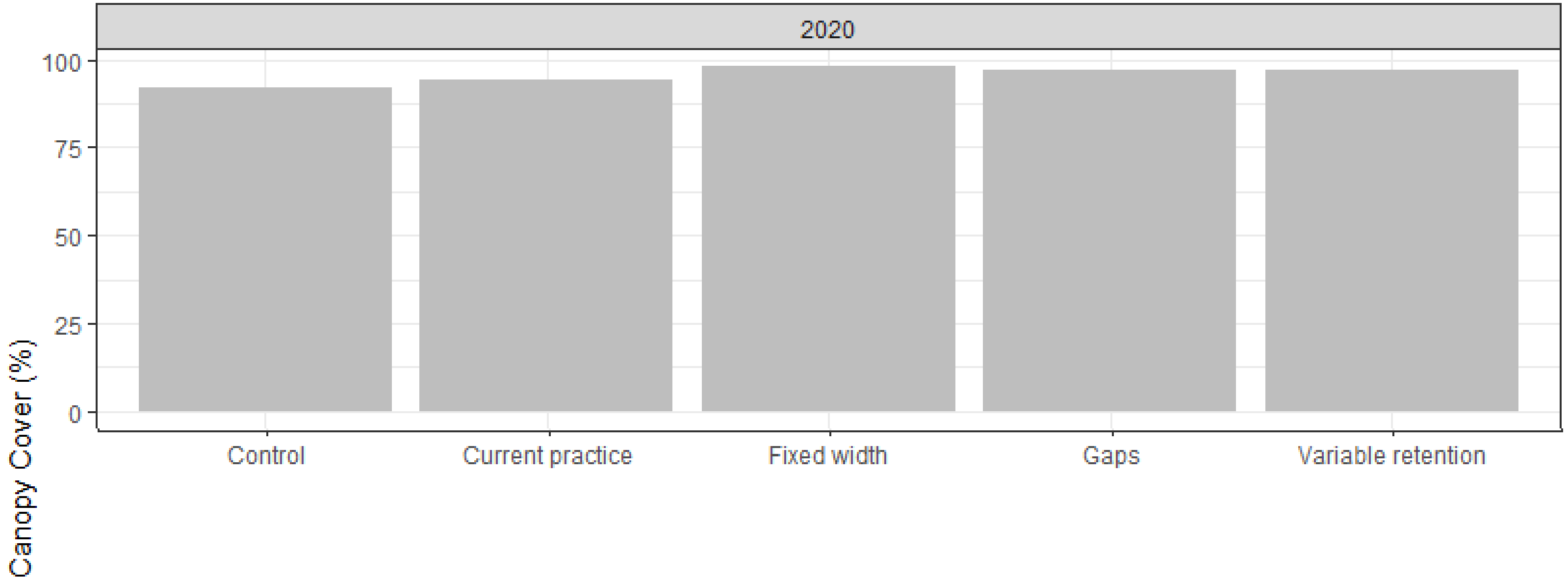
blowdown + few trees in buffer

blowdown

Light


Total daily light intensity (lumens)
1e+06
5e+05
0e+00
Control
Fixed Width
Current Practice
Variable Retention
Gaps
Pre 1
Pre 2
Post 1
Post 2


onset
HOBO
Pendant temp/light



Pre-treatment

Post-treatment

Blow down
event likely a
factor here. . .

Blow down
event likely a
factor here. . .

WB 140m

Before

After

CC 300m

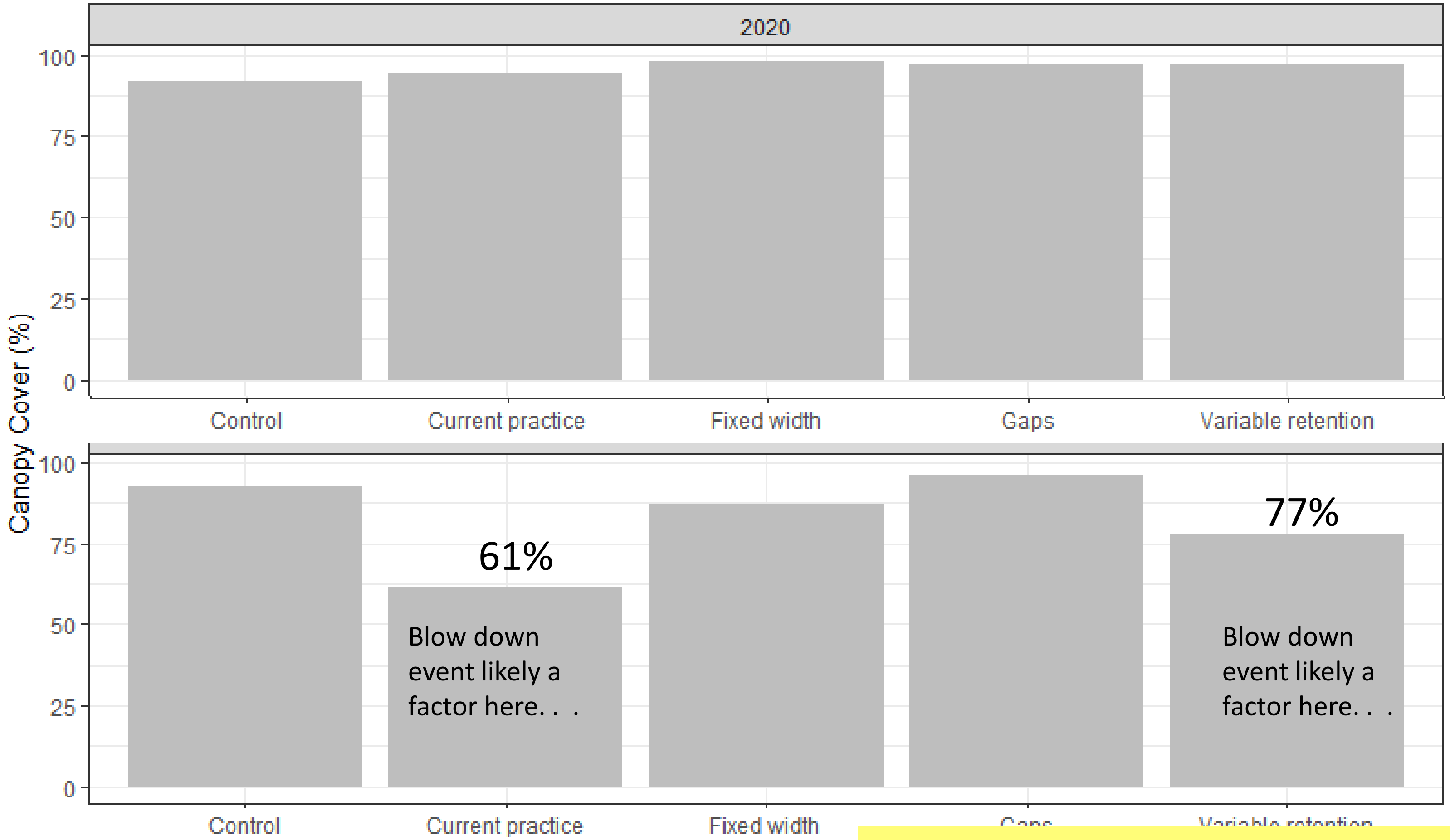
Before

After

HB 140m

Before

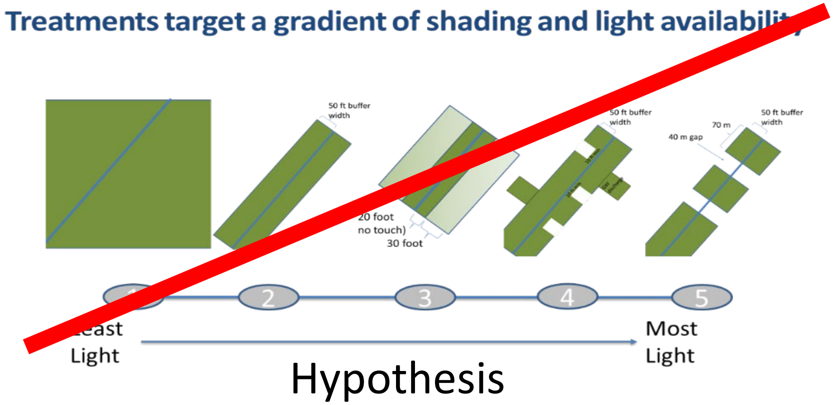
After

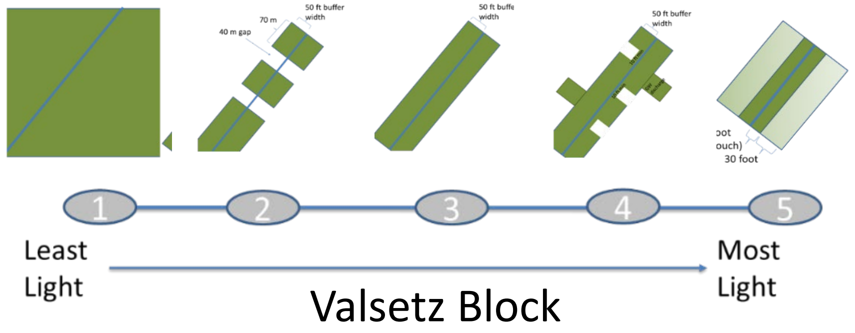


Pre-treatment

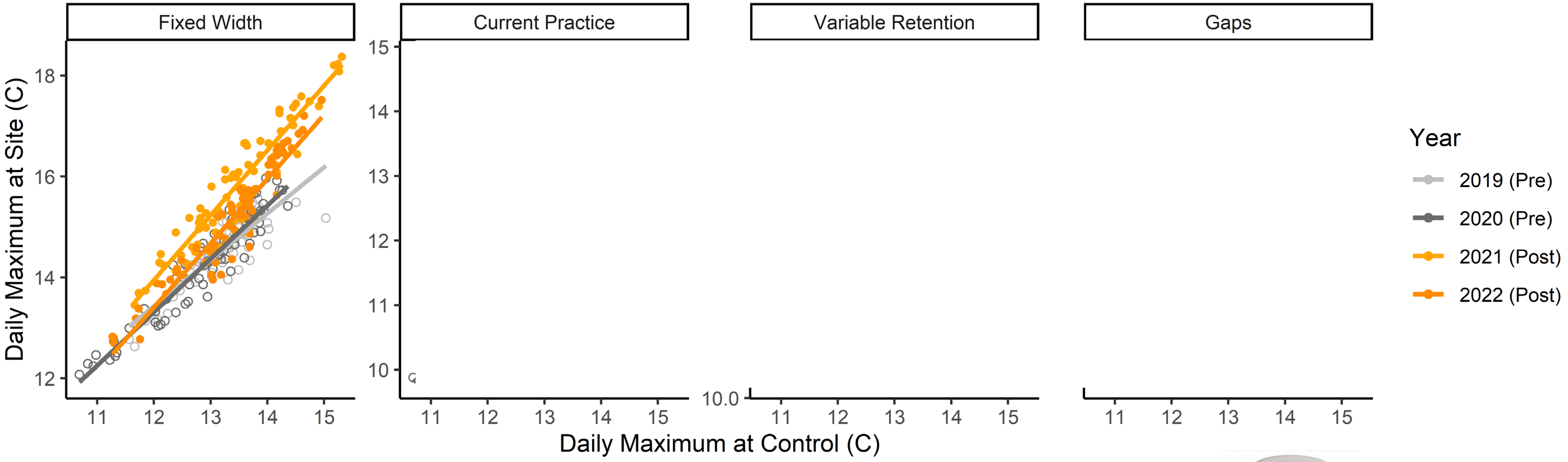
Post-treatment

Nonetheless, a clear gradient in cover response
(which will presumably transfer to light)

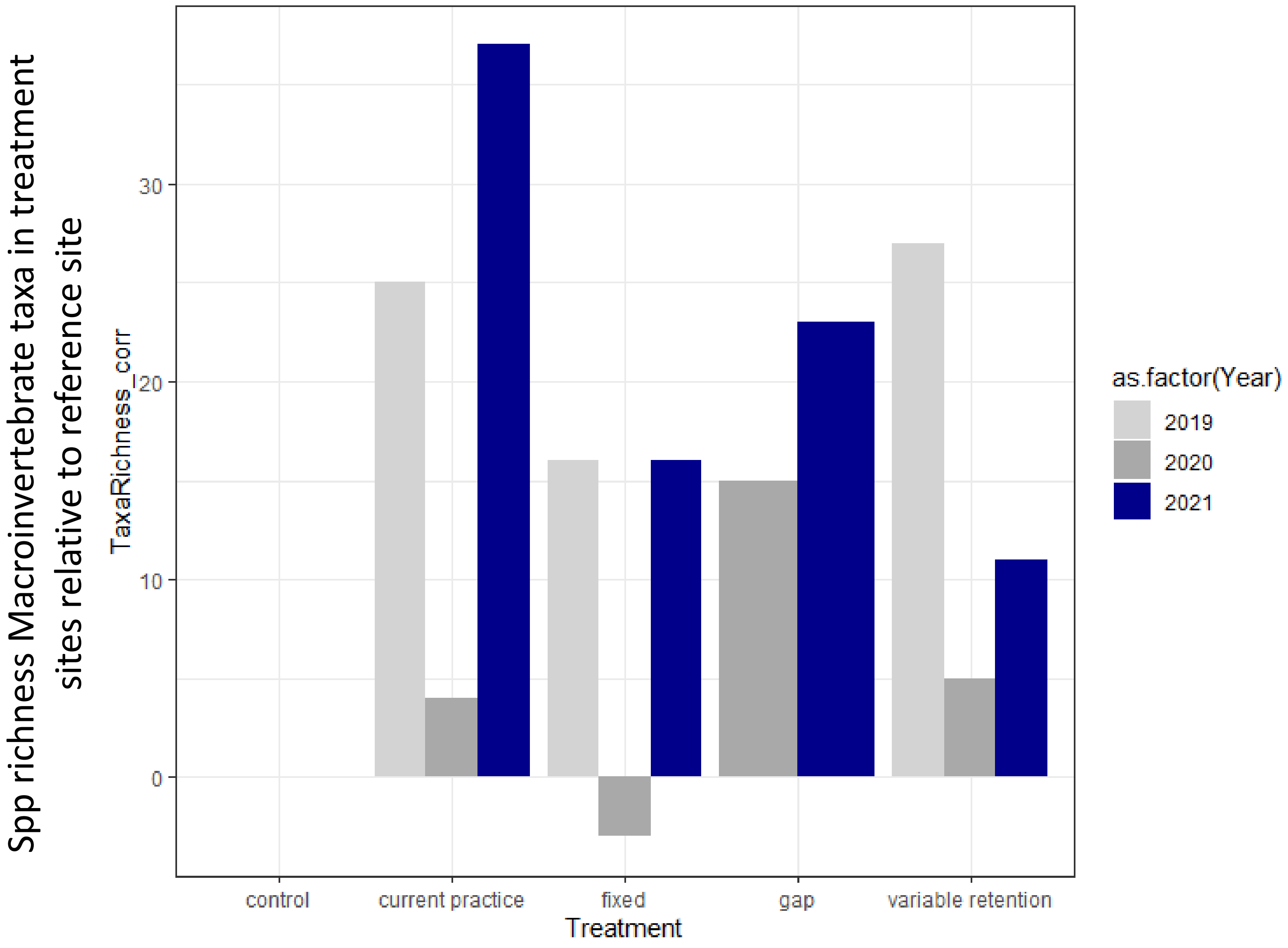




Temperature



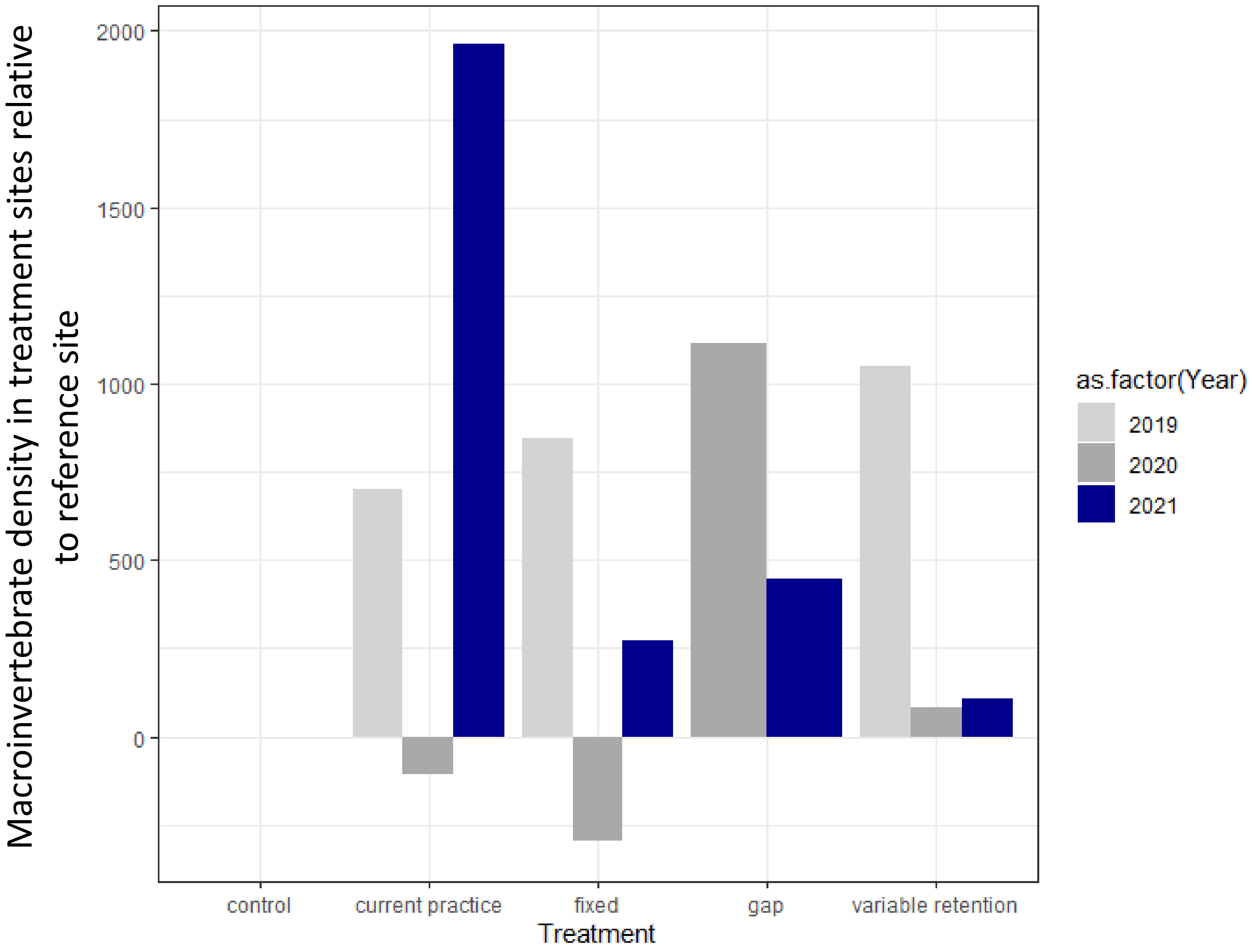
Macroinvertebrates



Richness responses were inconsistent

(due in large part to variability in pre-treatment years)

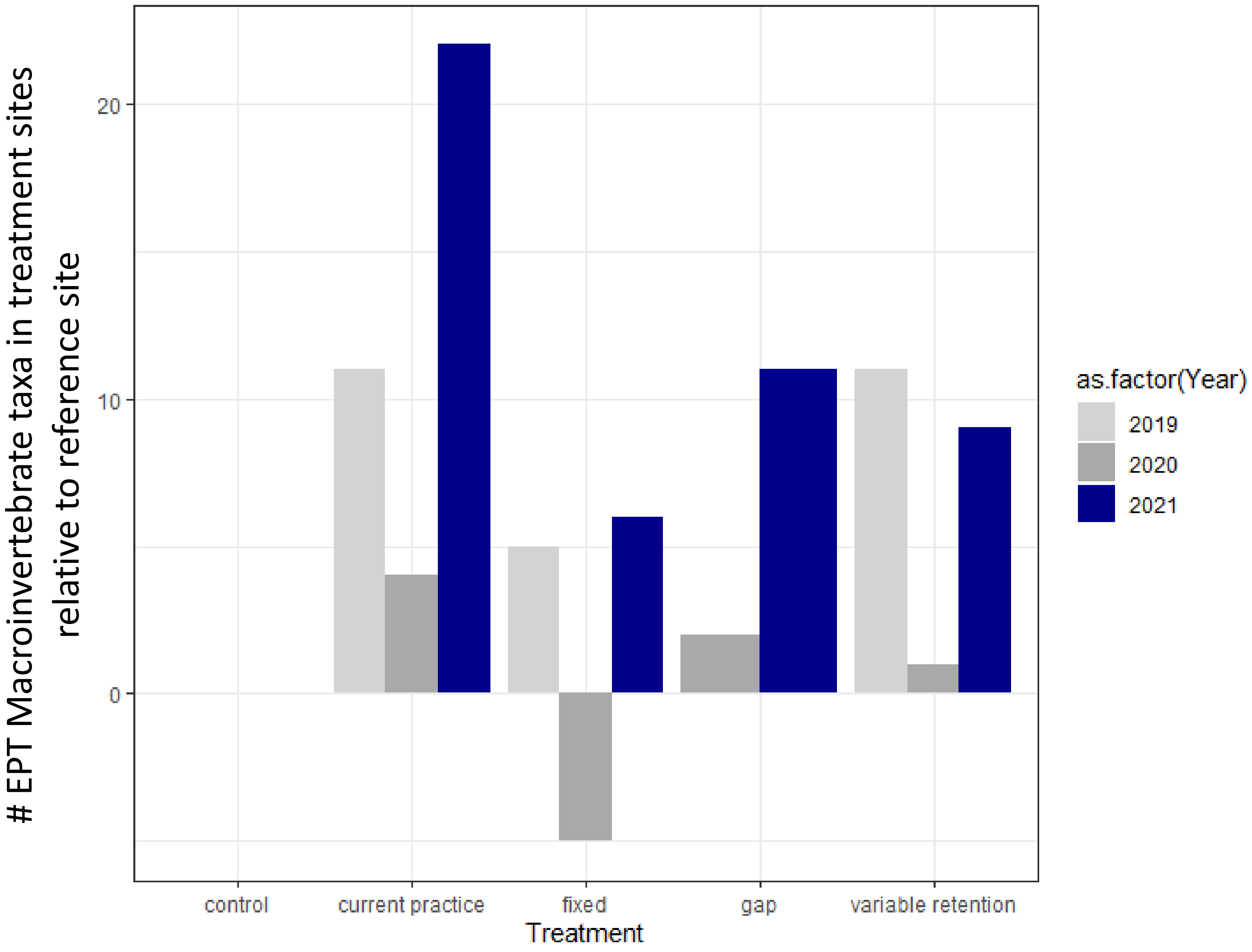
Macroinvertebrates



Overall relative density responses were variable

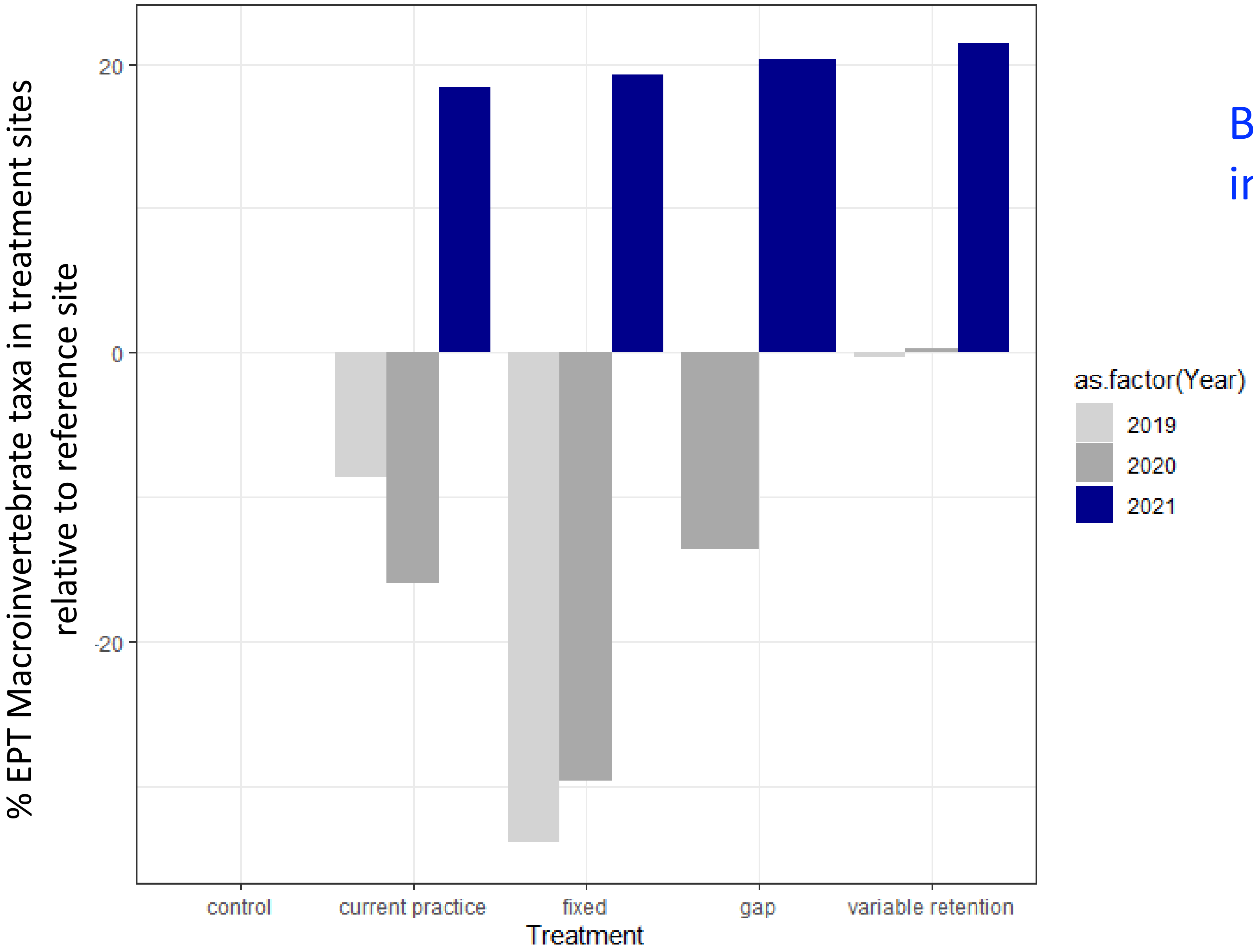
(due in part to variability in pre-treatment data)

Macroinvertebrates



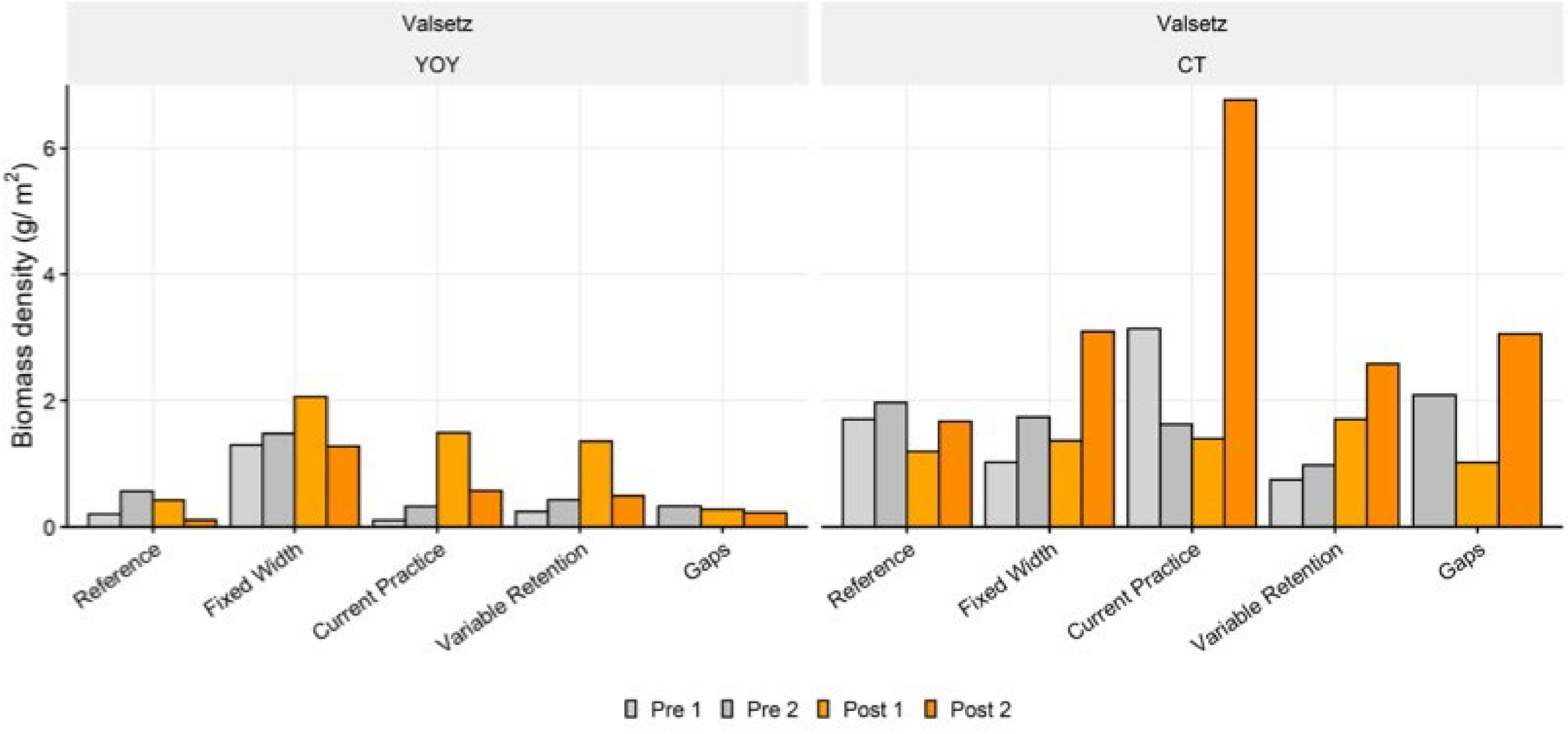
Total abundance of EPT taxa variable

Macroinvertebrates

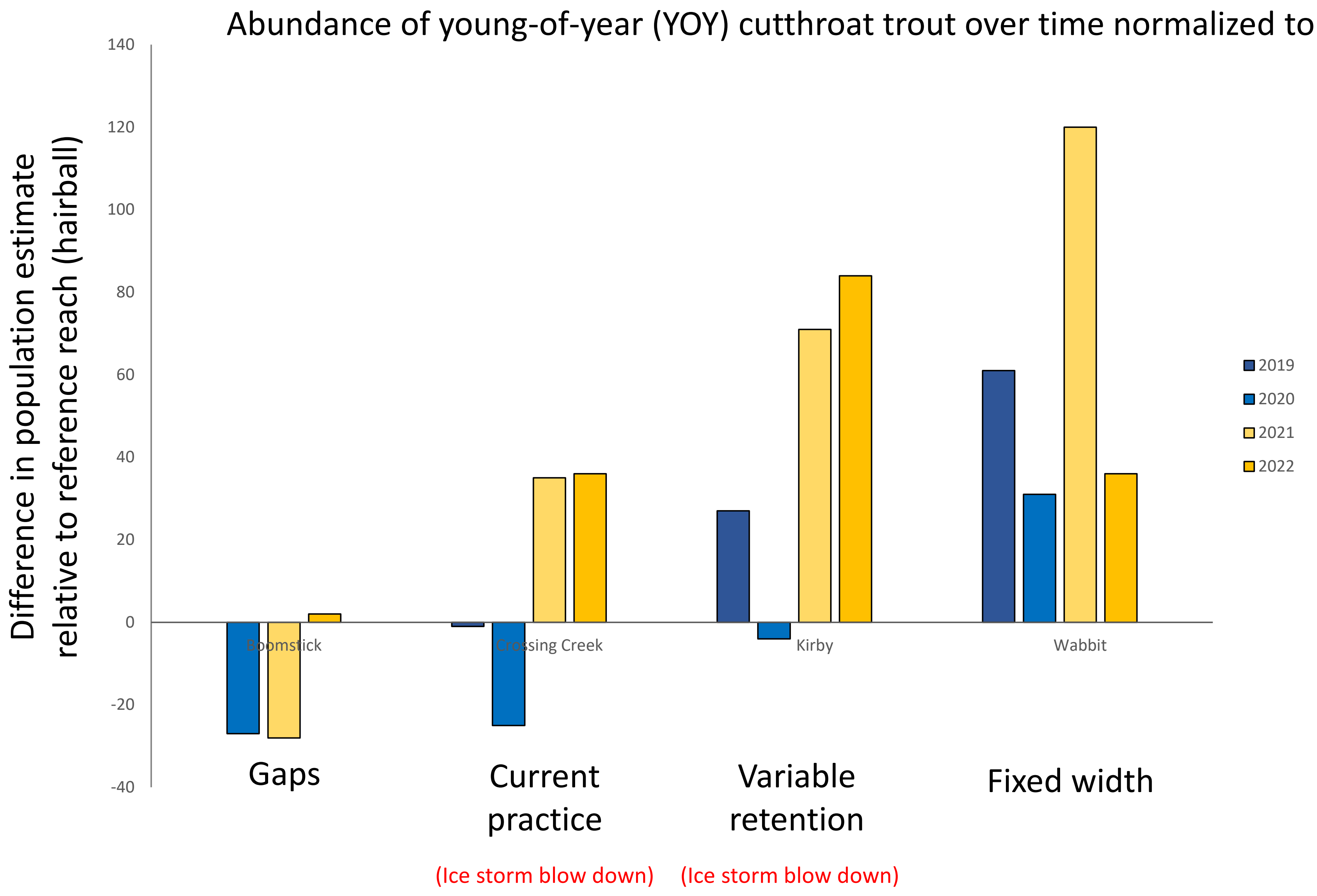


BUT, the % EPT taxa increase across all sites

Fish – Valsetz



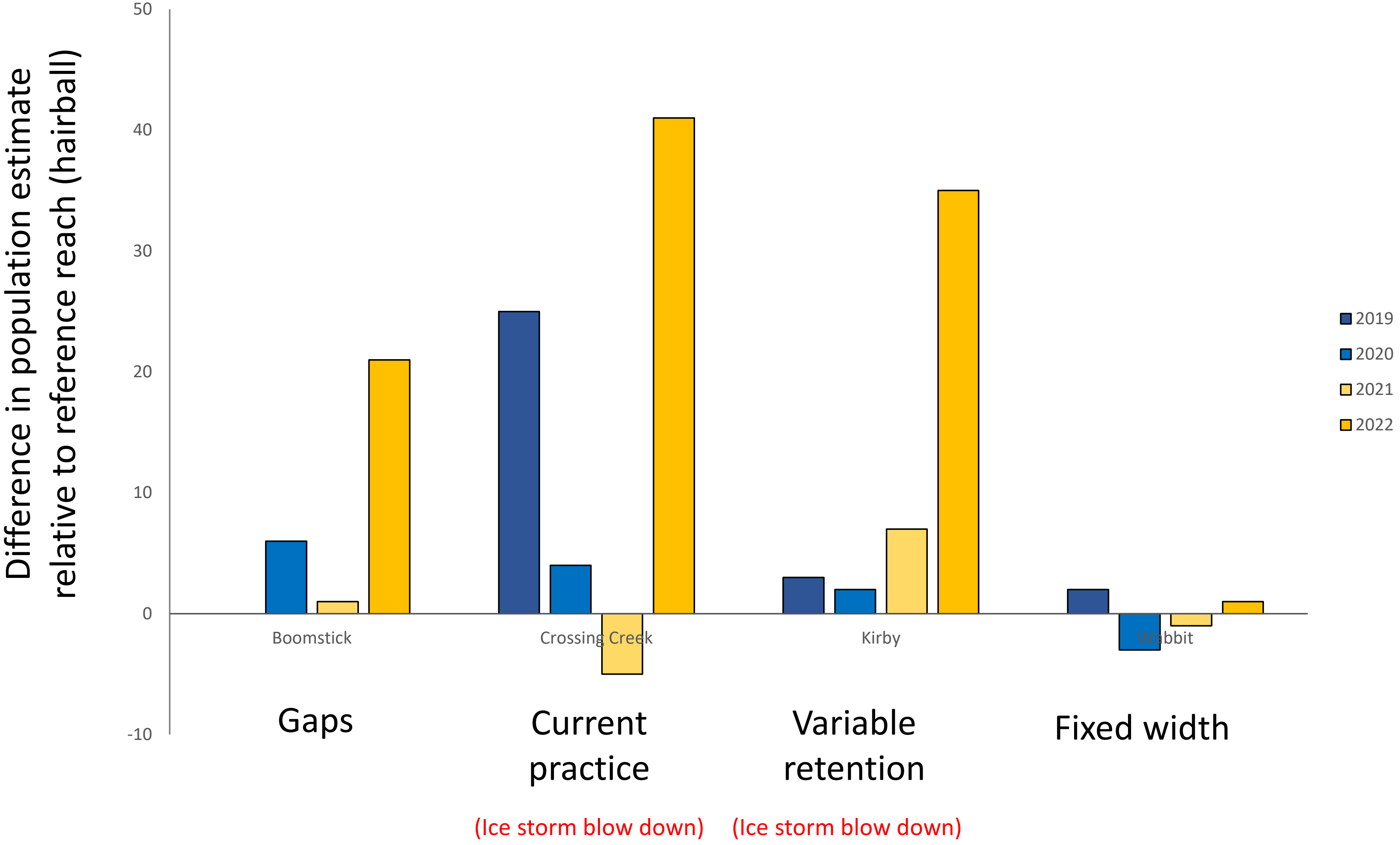
Fish – Valsetz



- Strong YOY response in sites with large changes in light
- Mixed or no consistent response in YOY in sites with moderate light

Fish – Valsetz

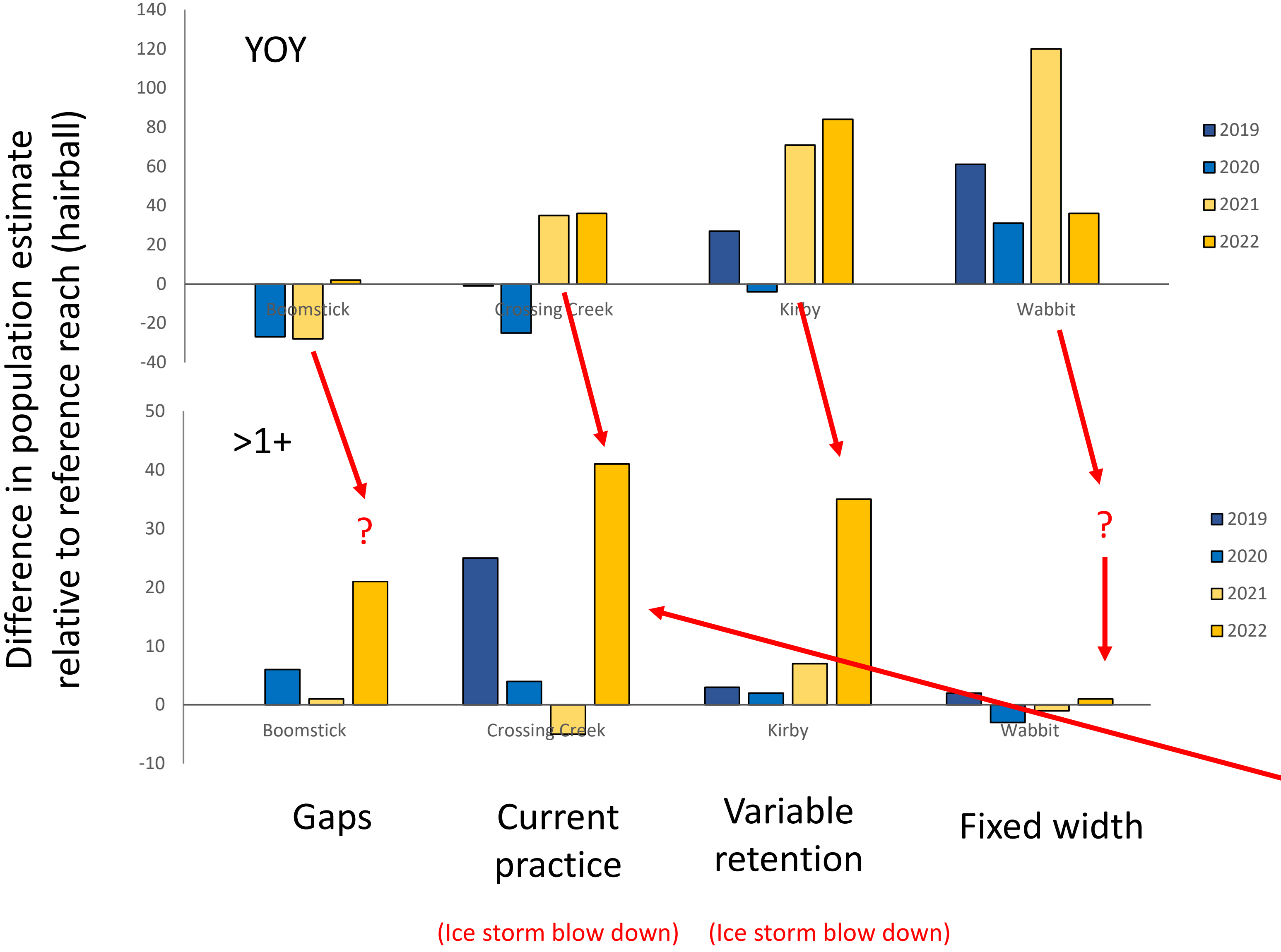
Abundance of age >1+ cutthroat trout over time normalized to reference site



- Limited response in adult fish in year 1
- Relative increase in adult fish for 3 of 4 sites in year 2

Fish – Valsetz

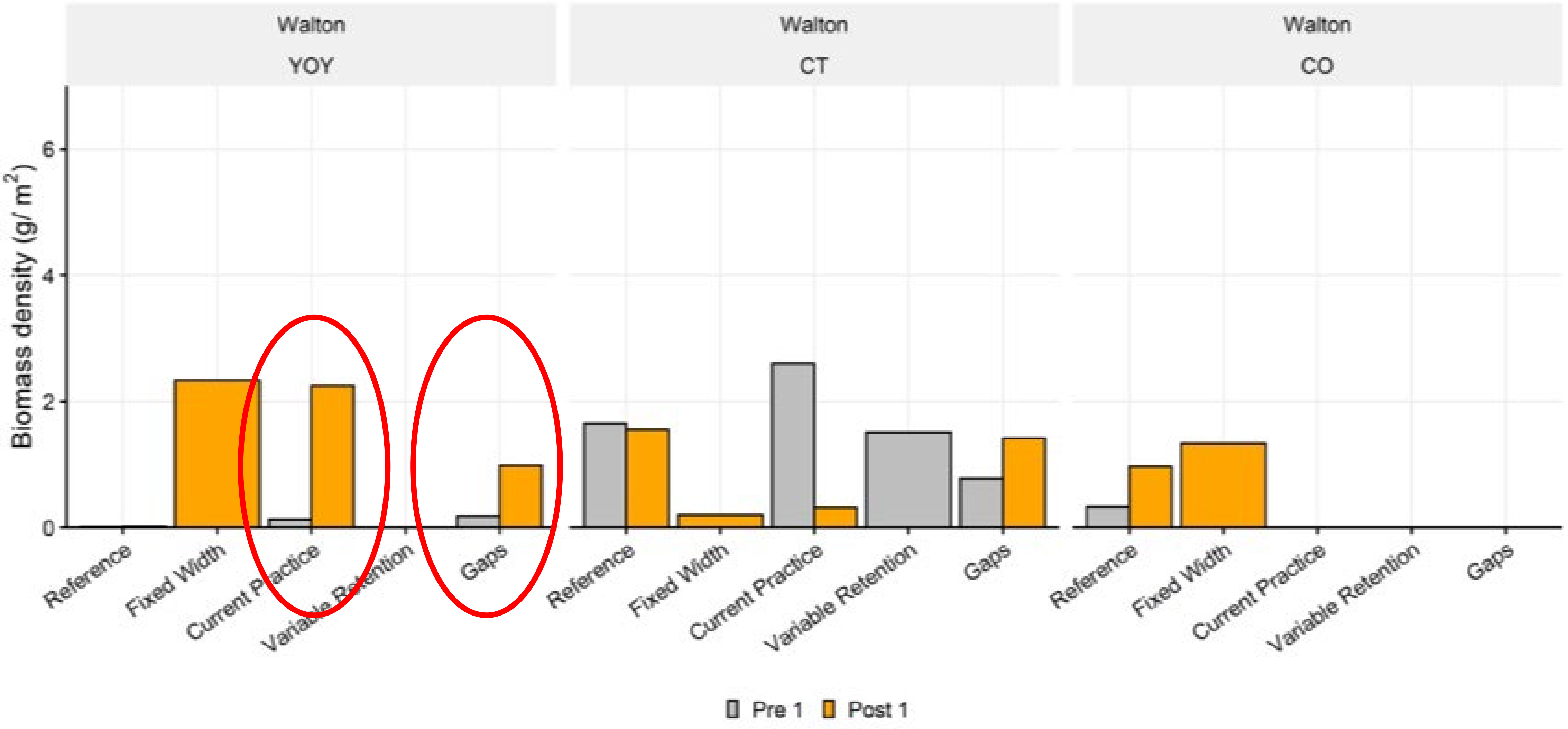
Abundance of age >1+ cutthroat trout over time normalized to reference site



- Clear cohort response in 2 sites
- Cohort carry-over unclear in 2 sites
- Need to explore other replicate blocks

Geomorphic change? (new pool formed; but not due to treatment)

Fish – Walton



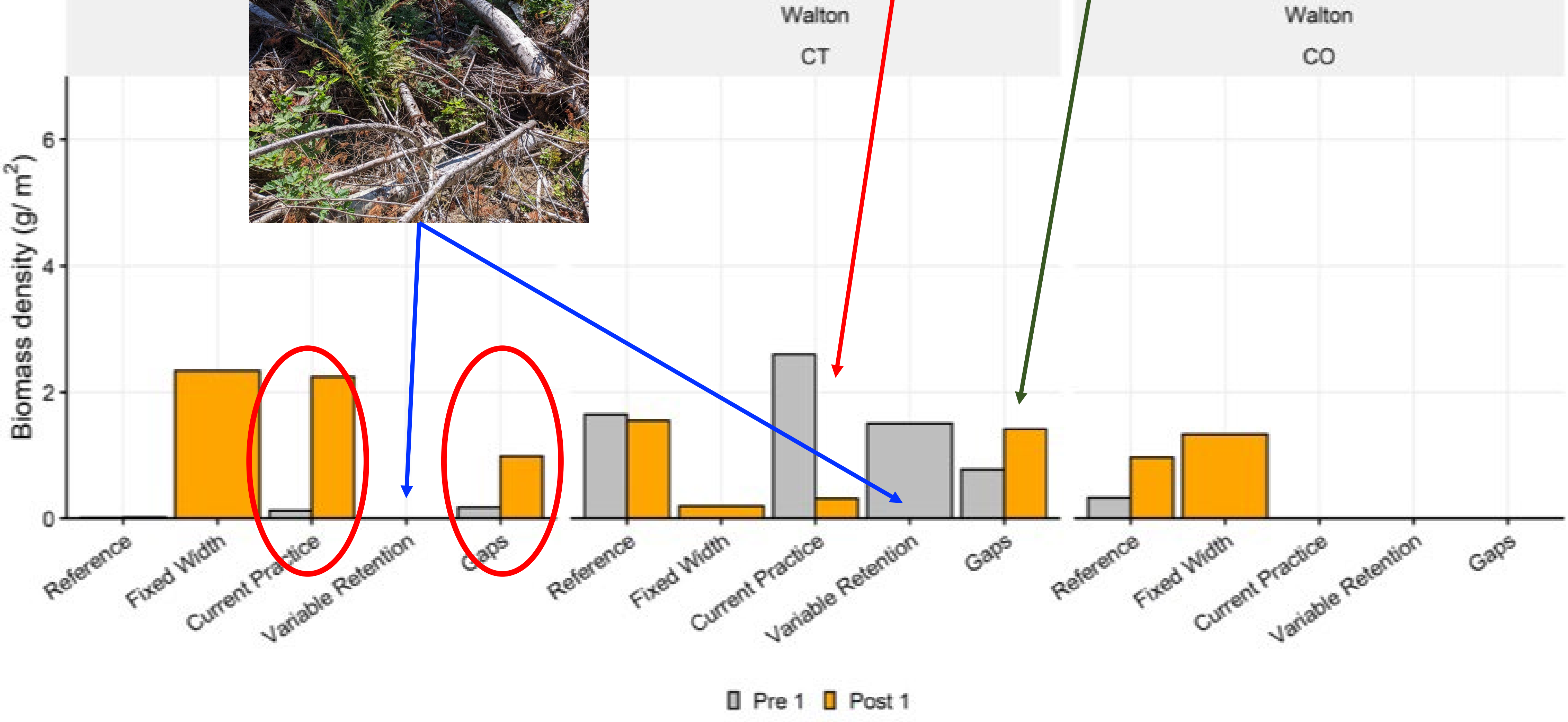
Walton
YOY
Walton
CT
Walton
CO
Biomass density (g/ m²)
6
4
2
0
Reference
Fixed Width
Current Practice
Variable Retention
Gaps
Reference
Fixed Width
Current Practice
Variable Retention
Gaps
Reference
Fixed Width
Current Practice
Variable Retention
Gaps
Pre 1
Post 1

Fish – Walton

No post-data due to slash

Decline in >1+ fish

Increase in >1+ fish



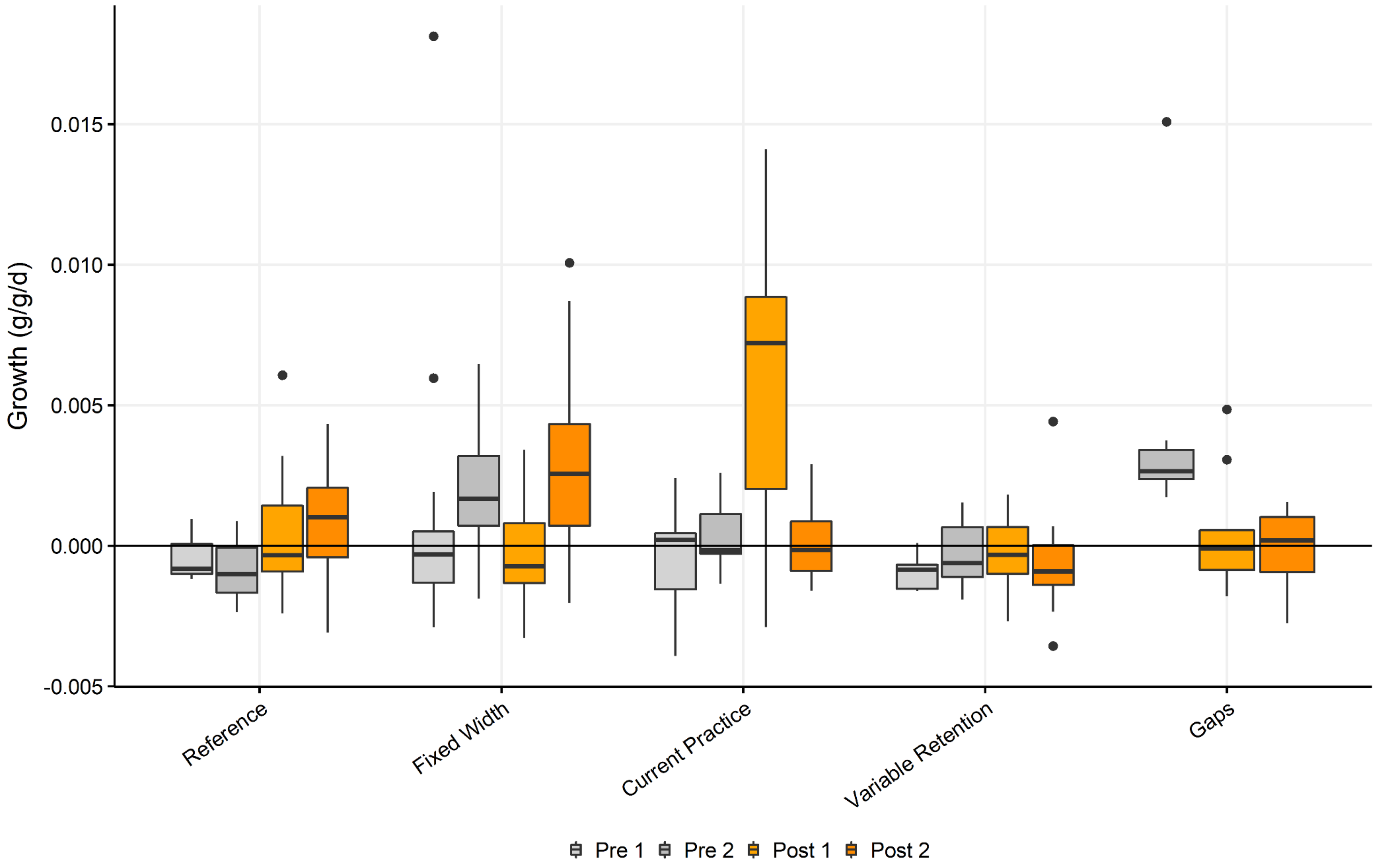
Questions?

Acknowledgements:
Landowners: Manulife Investment Management and Roseburg Forest Products

Field crews 2019-2022: Alex Boe, Molly Hamilton, Zowie DeLeon, Rylee Rawson, Annika Carlson, Nathan Maisonville, Rory Corrigan, Nate Neal, Maya Greydanus, Jacqui James, Tyler Parr, Nicole Miller, Brenna Cody, Alex Foote, and Ciana Carr

Funding:
OSU FWHMF grant and NCASI, Inc.

Fish - Valsetz



QUESTIONS?

Funding:

- NCASI
- Fish and Wildlife Habitat in Managed Forests Grant Program
- OSU Ag. Research Foundation

Collaborators:

Hancock Forest Management®
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GreenWood Resources

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Roseburg

Giustina Land & Timber Co.

Rayonier

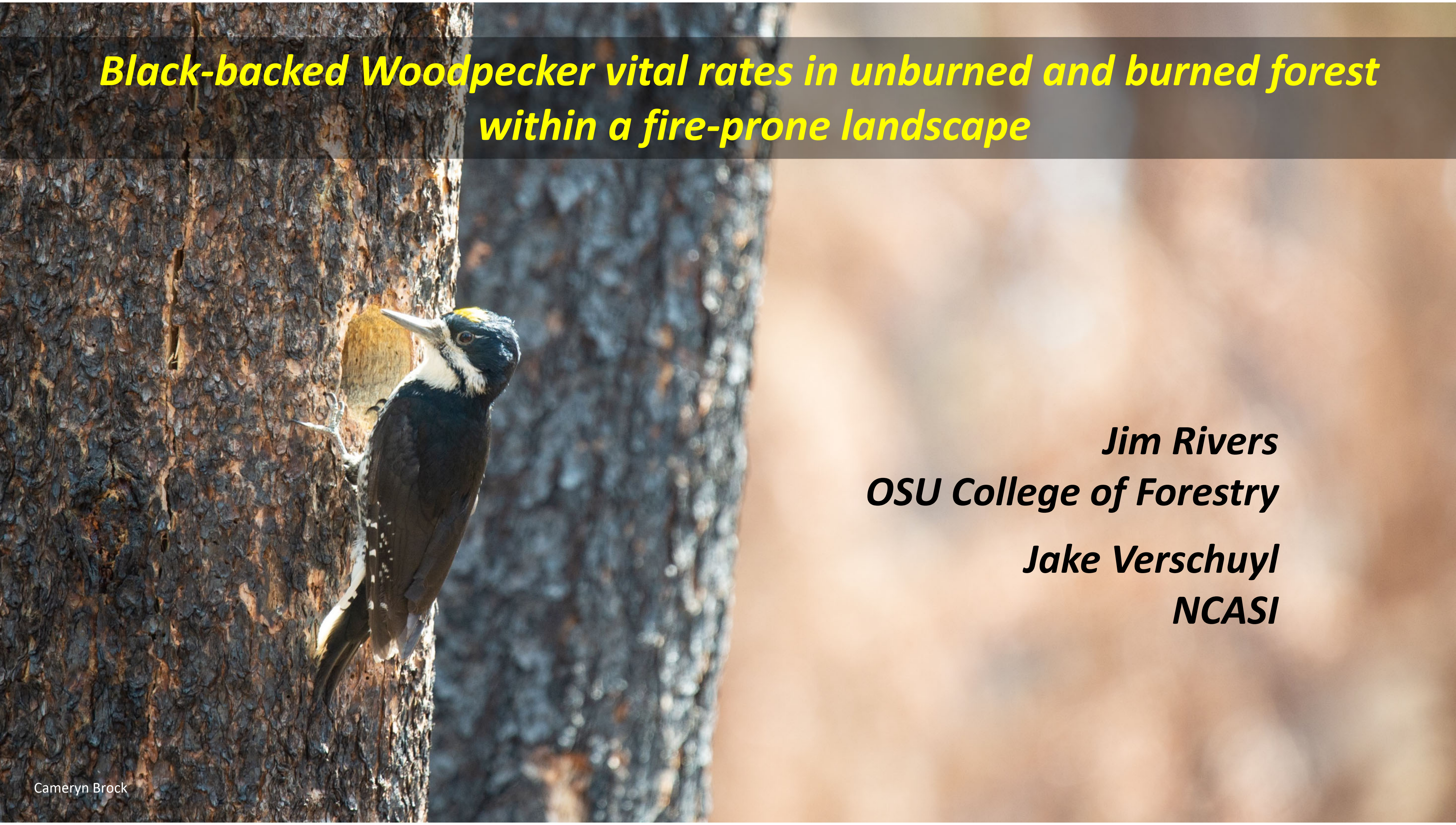
Other contributors:

- The many forest engineers, managers, and resource specialists at the collaborating companies

Fieldwork and data collection:

- **Ashley Sanders**
- Nathan Maisonville
- Rylee Rawson
- Annika Carlson
- Zowie DeLeon

Black-backed Woodpecker vital rates in unburned and burned forest within a fire-prone landscape



Jim Rivers
OSU College of Forestry

Jake Verschuyl
NCASI

We evaluated key vital rates within green and burned forest

Objective #1. Quantify nest survival in green vs. burned forest

- *Nest survival ↑ in burned forest*

Objective #2. Evaluate post-fledging survival in green vs. burned forest

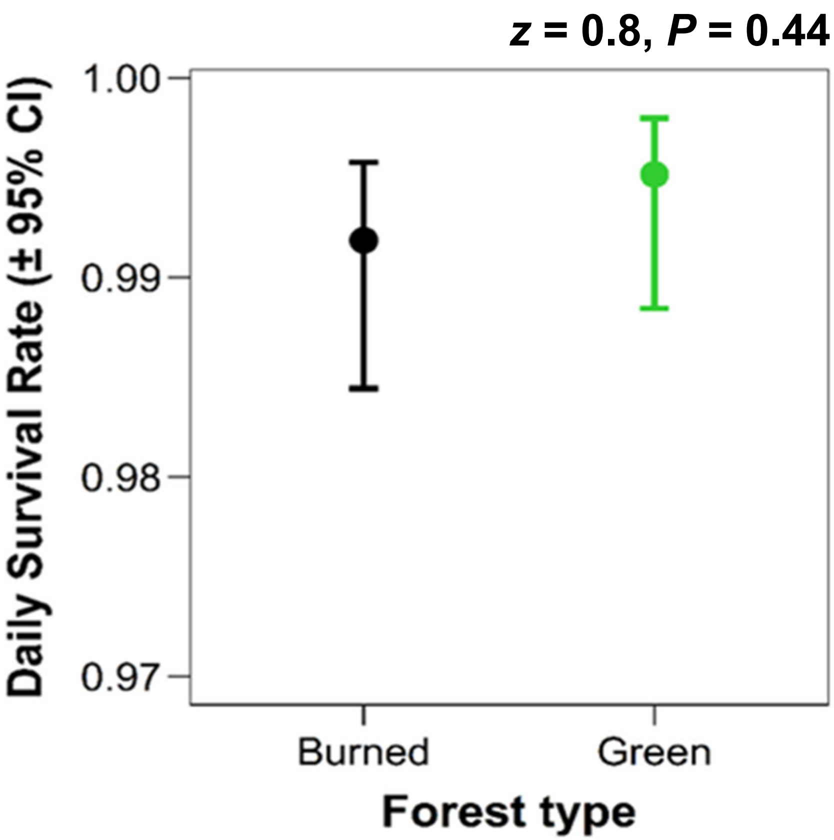
- *Post-fledging survival ↑ in burned forest*

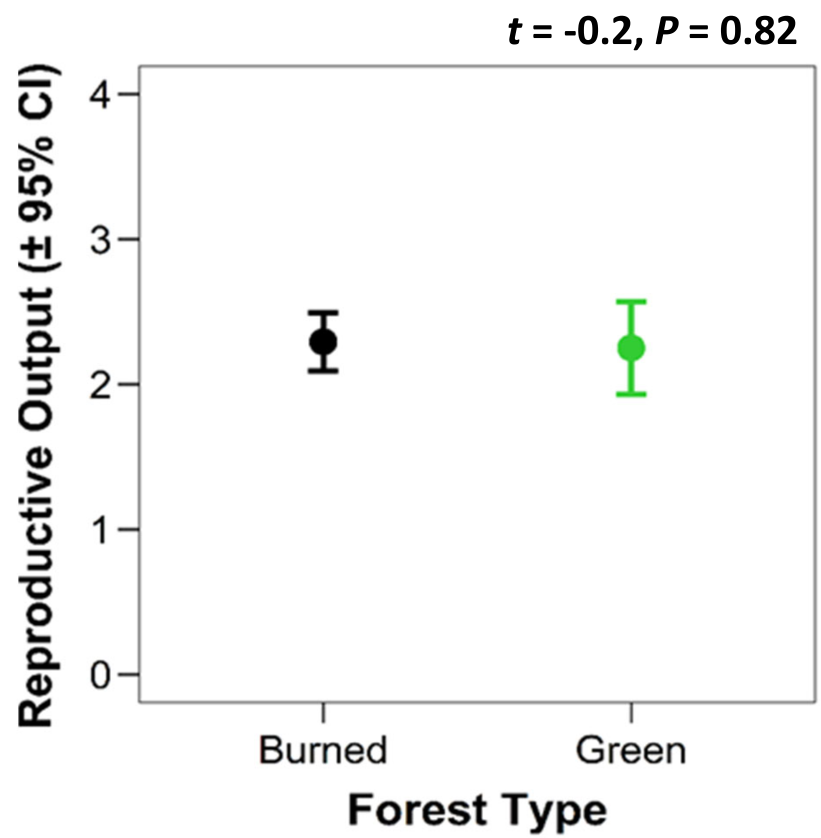
Lots of woodpecker nesting data were collected!

>1100 person-hours nest-searching across 3 years of field work

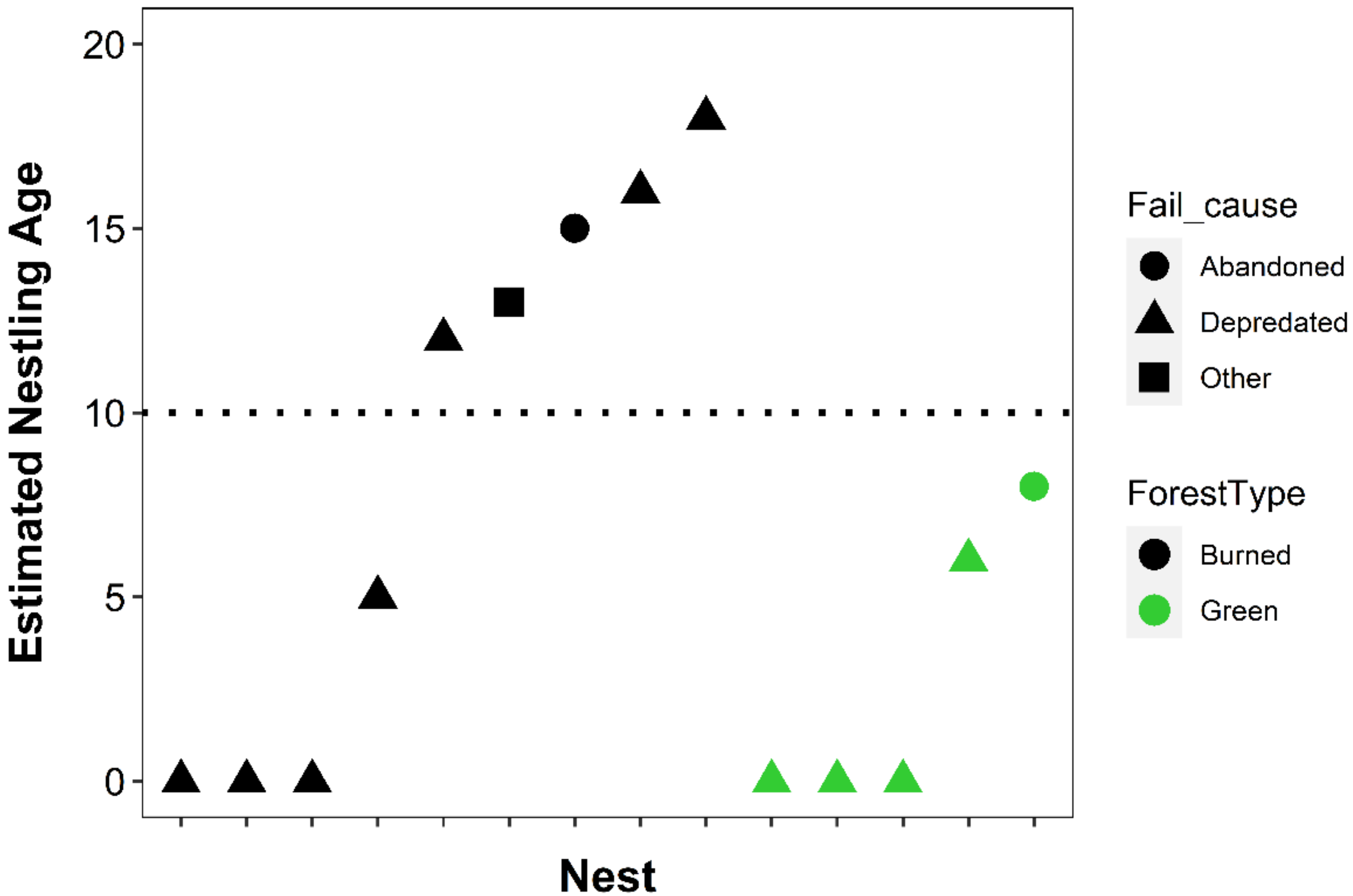
Species	2018	2019	2021
Black-backed Woodpecker	19	32	45
White-headed Woodpecker	6	2	1
Williamson's Sapsucker	7	2	0
Red-breasted Sapsucker	4	0	0
Red-naped Sapsucker	0	0	1
Hairy Woodpecker	21	15	4
Northern Flicker	13	4	1
American Three-toed Woodpecker	1	3	1
Total	**71**	**58**	**53**

No differences found in nest survival or reproductive output



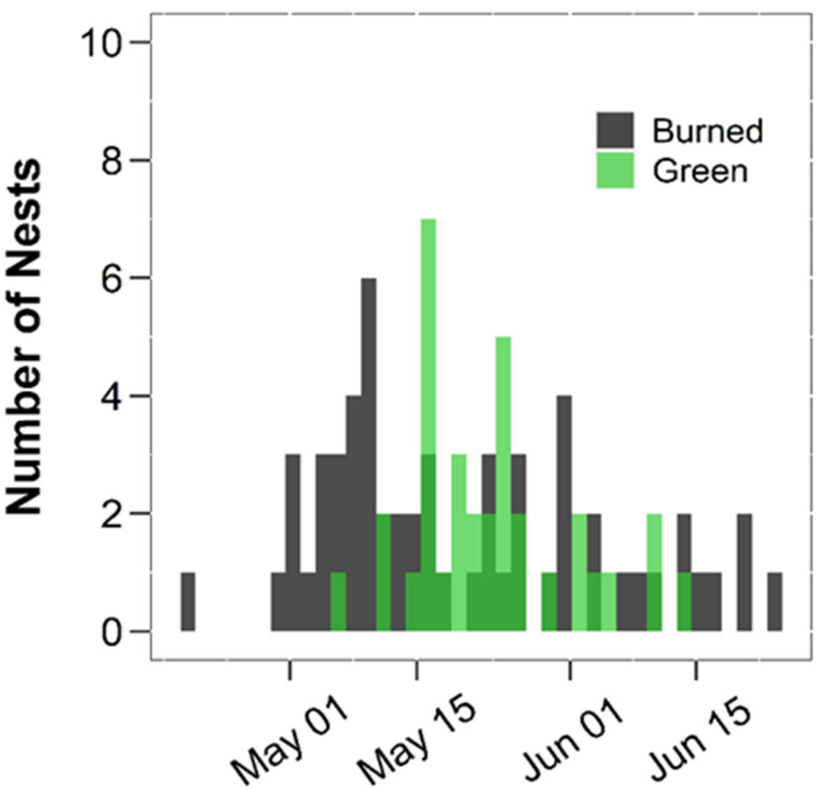


No clear patterns regarding nest age at time of failure

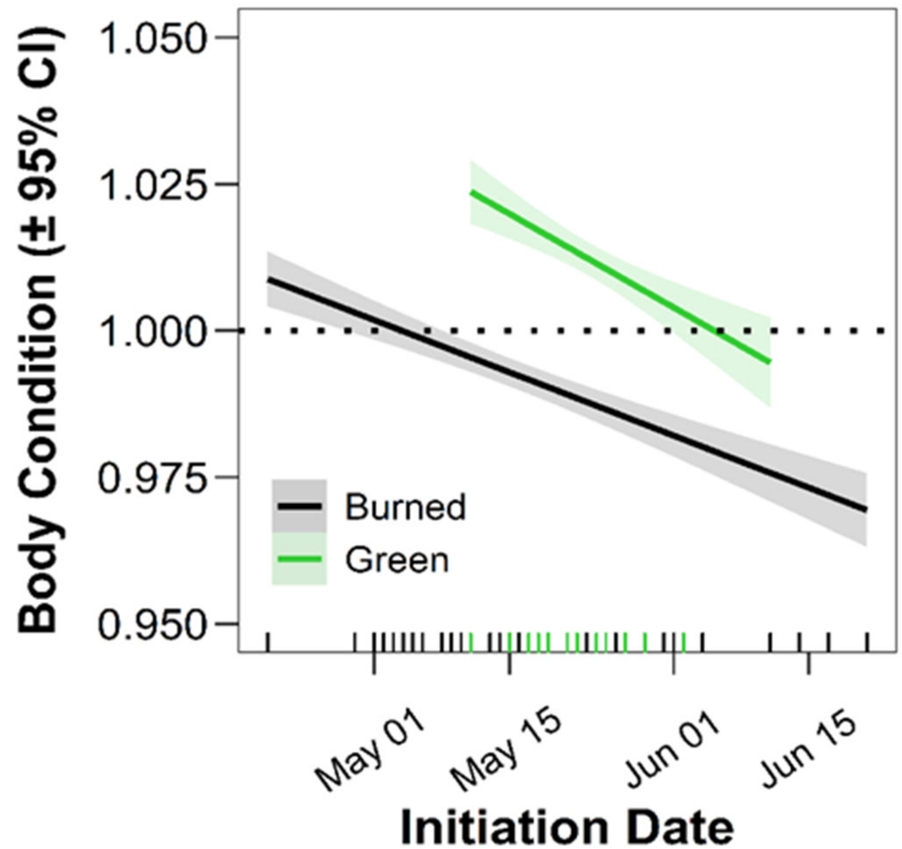


Differences found in nest initiation date, chick body condition

P = 0.04



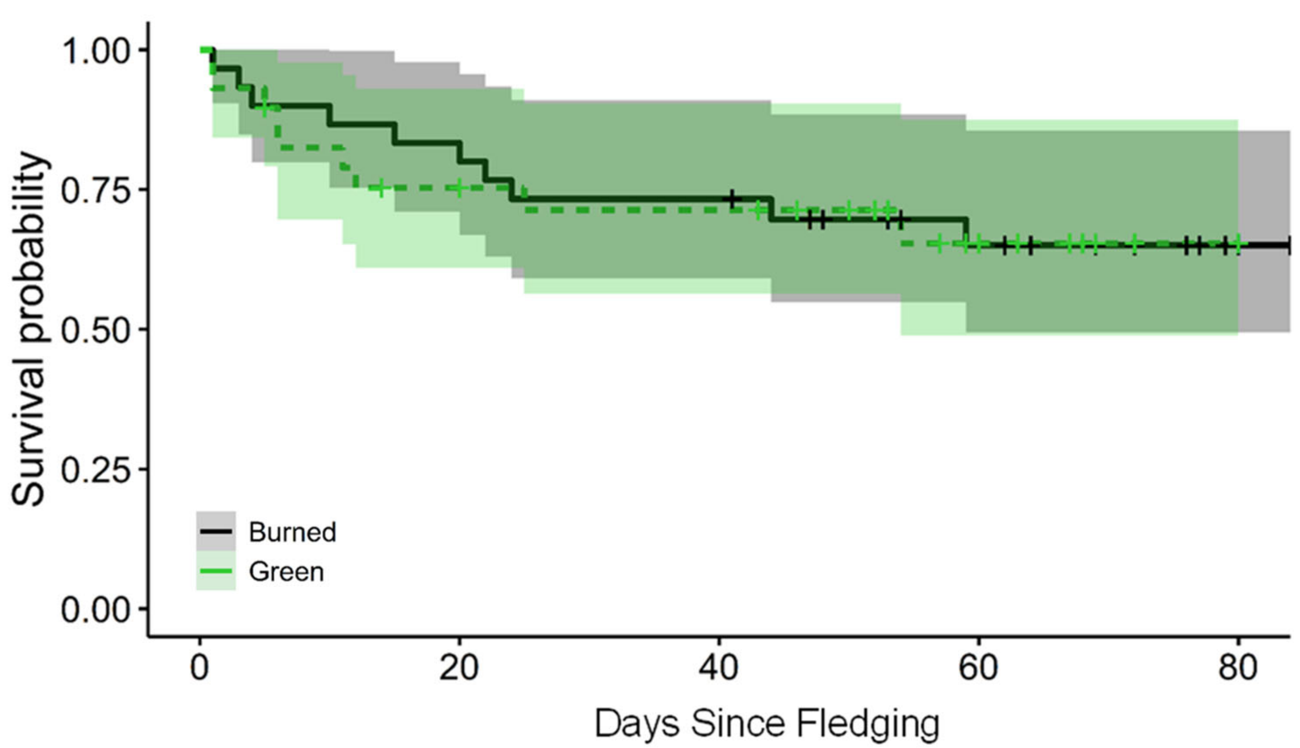
t = -1.9, *P* = 0.07



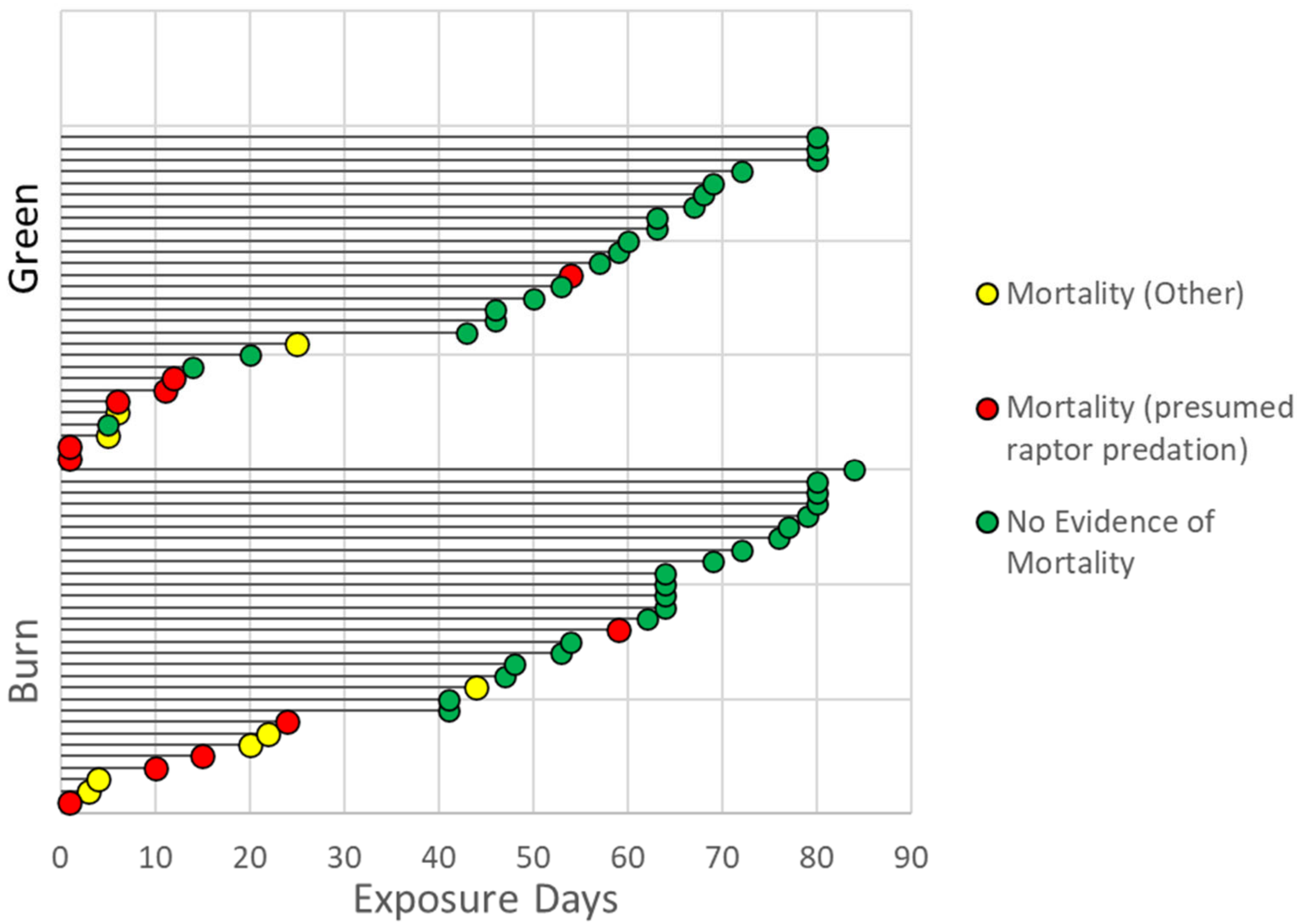
No differences in post-fledging survival

Hazard ratio = 1.04 (95% CI: 0.45, 2.41)

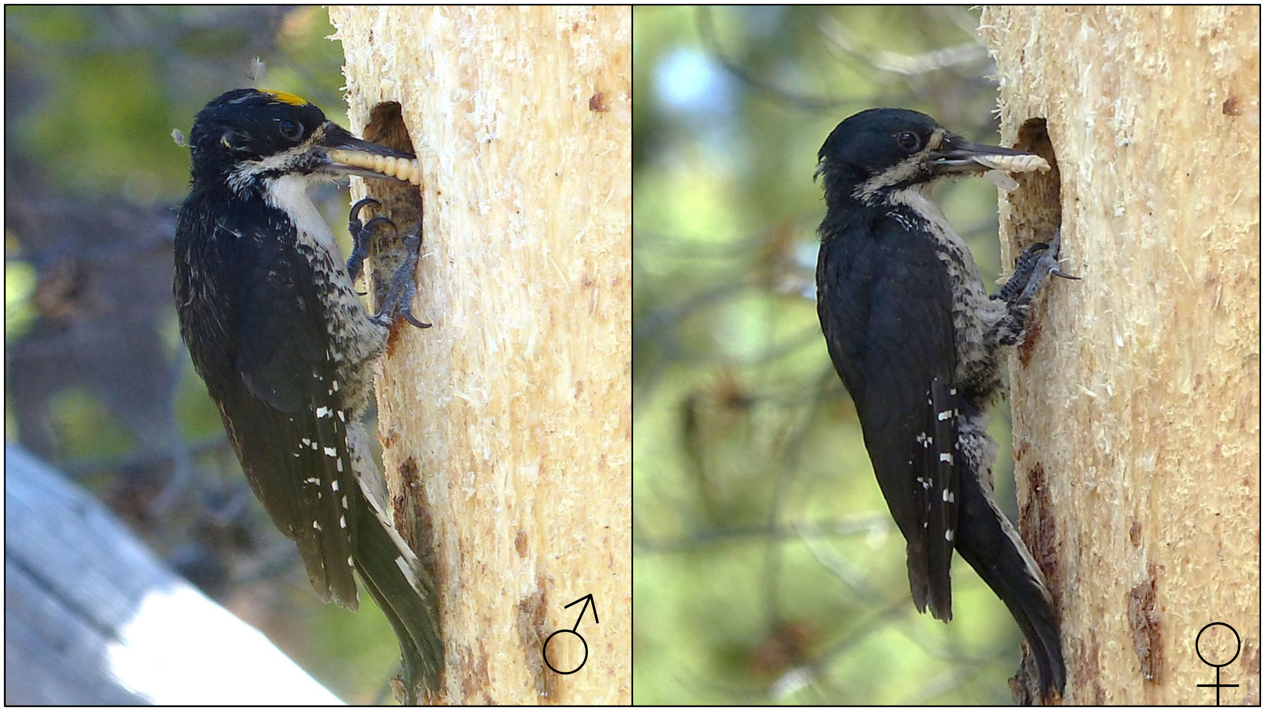
Forest type: χ^2 = 0.51, *P* = 0.47



Most fledgling mortality occurred in first 3-4 weeks



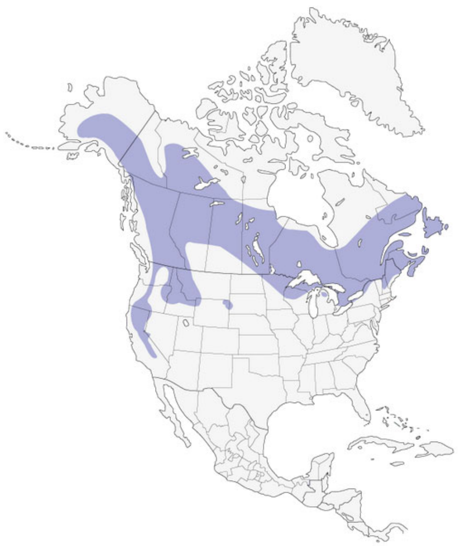
Project leveraging: assessing parental provisioning behavior across green and burned forest



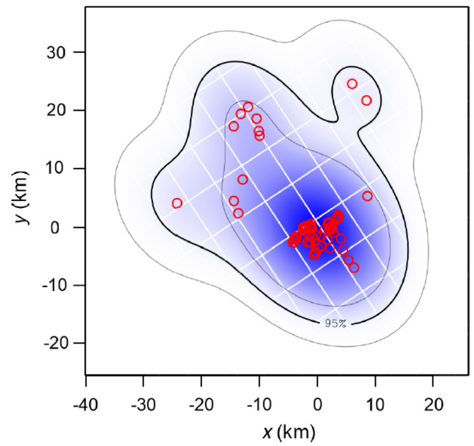
n=58 nests and
~155 hours of footage
across 3 years

Project leveraging: multi-order habitat selection

1st order selection (geographic range)



2nd order selection (home range)



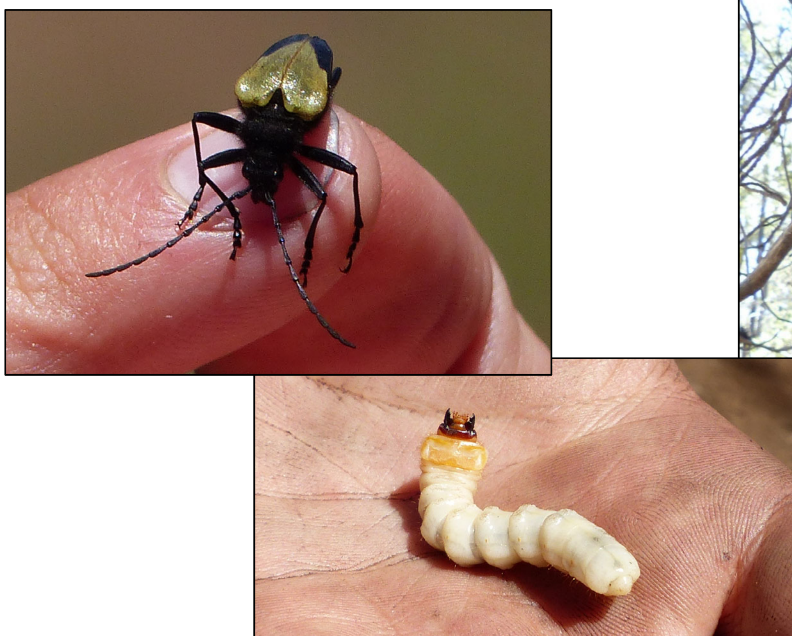
2nd order selection:
home range use vs. availability
(n=240 plots)

3rd order selection (habitat elements)

4th order selection
(use of habitat elements)

4th order selection:
nest-tree use vs. availability
(n=94)

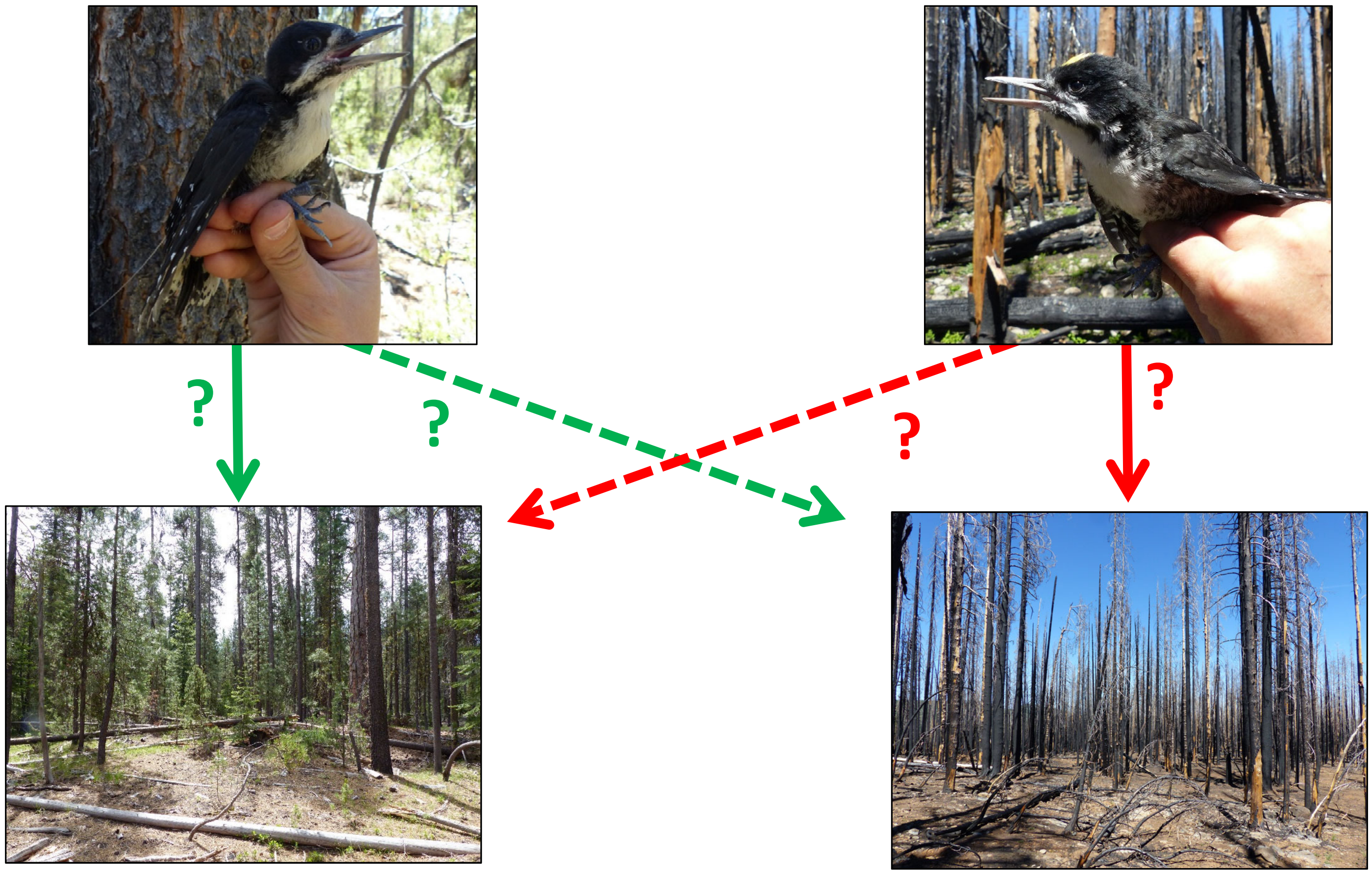
Project leveraging: food availability in green forests



>10,000 beetle specimens
collected in 2022

Project leveraging: natal dispersal and population connectivity

n=37 nestlings tagged with connectivity tags



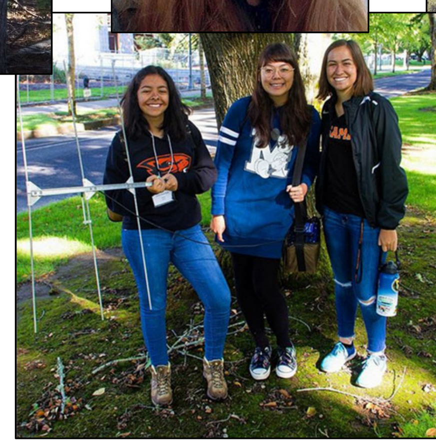
Mark Kerstens

Extensive student engagement on project

URSA Engage

Oregon State University
OSU STEM Leaders Program

Louis Stokes Alliance for Minority Participation



Many thanks…

Funding and in-kind support:

National Council for Air and Stream Improvement; Oregon Department of Forestry; Fish and Wildlife Habitat in Managed Forests Program, College of Forestry, Oregon State University; Chemult Ranger Station, Fremont-Winema National Forest; LightHawk Conservation Flying, Animal Behavior Society, the Association of Field Ornithologists, Klamath Basin Audubon Society, East Cascades Audubon Society

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Erin Eve

Development of native bee identification keys for the Pacific Northwest

Jim Rivers
OSU College of Forestry

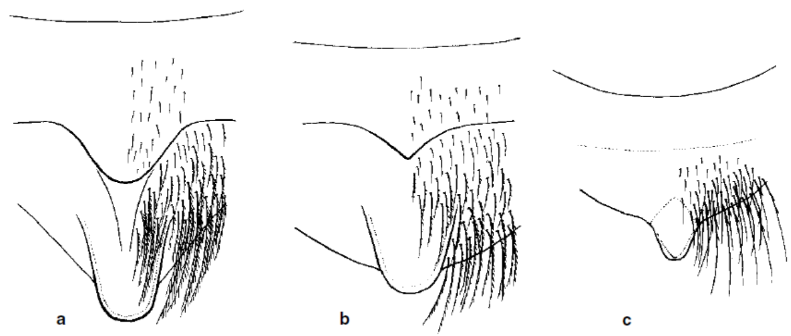
Lincoln R. Best
OSU College of Agriculture

Available bee identification keys are challenging to use, even for experts

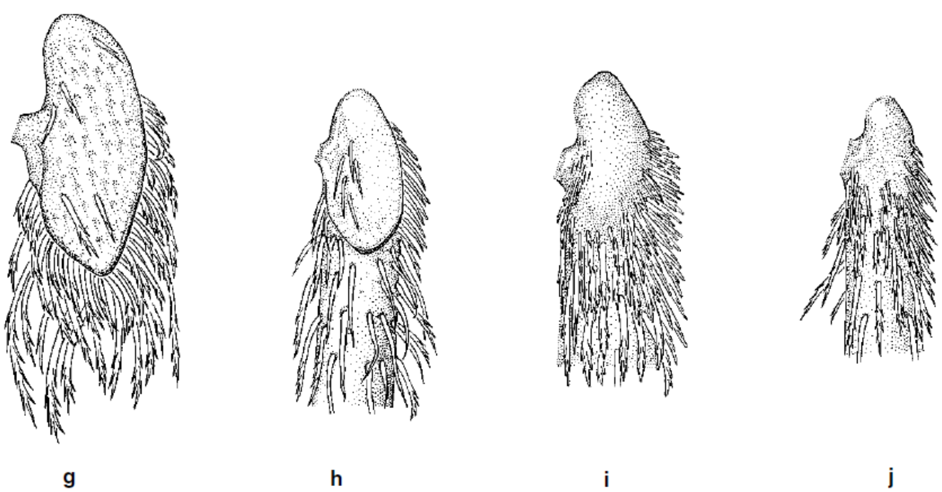
1. Scopa weak (Figs. 8-5a, 8-6) or absent; T5 with longitudinal median zone of fine punctation and short hairs weakly developed or absent; apical labral process without keel (as in Fig. 65-1i) or keel reduced to weak carina 2

—. Scopa present from hind trochanter to tibia (Fig. 8-5b), forming corbicula on underside of femur; T5 with well-developed longitudinal median zone of fine punctation and commonly short, dense hairs, this zone dividing prepygidial fimbria (Fig. 65-1j); apical labral process with strong longitudinal keel on anterior surface (Fig. 65-1a, b, e) 5

Idealized drawings often don't work well in the real world



Pygidial plates



Basitibial plates

Key used to teach bee identification in Oregon Bee School

CANPOLIN - Bee Course 2012

Key to Bee Genera in Canada

The sexes in bees can generally be differentiated by counting the number of metasomal terga – 6 in females, 7 in males, or the number of apparent segments of the antenna – 12 in females, 13 in males (excluding *Holcopasites*). The second antennal segment is sometimes largely retracted within the first, particularly in some wasp-like bees.

1. Three submarginal cells (Fig. 1)...2

   One or two submarginal cells (Fig. 2)...33

Our project will create two wild bee identification keys, in both online and print formats

Generic-level key for the PNW fauna

Species-level keys for: *Bombus* ♀ and *Bombus* ♂

Images courtesy of ODA

Joshua Dunlap ODA

1

Abdomen with long ovipositor (females) (**a**)…...**2**

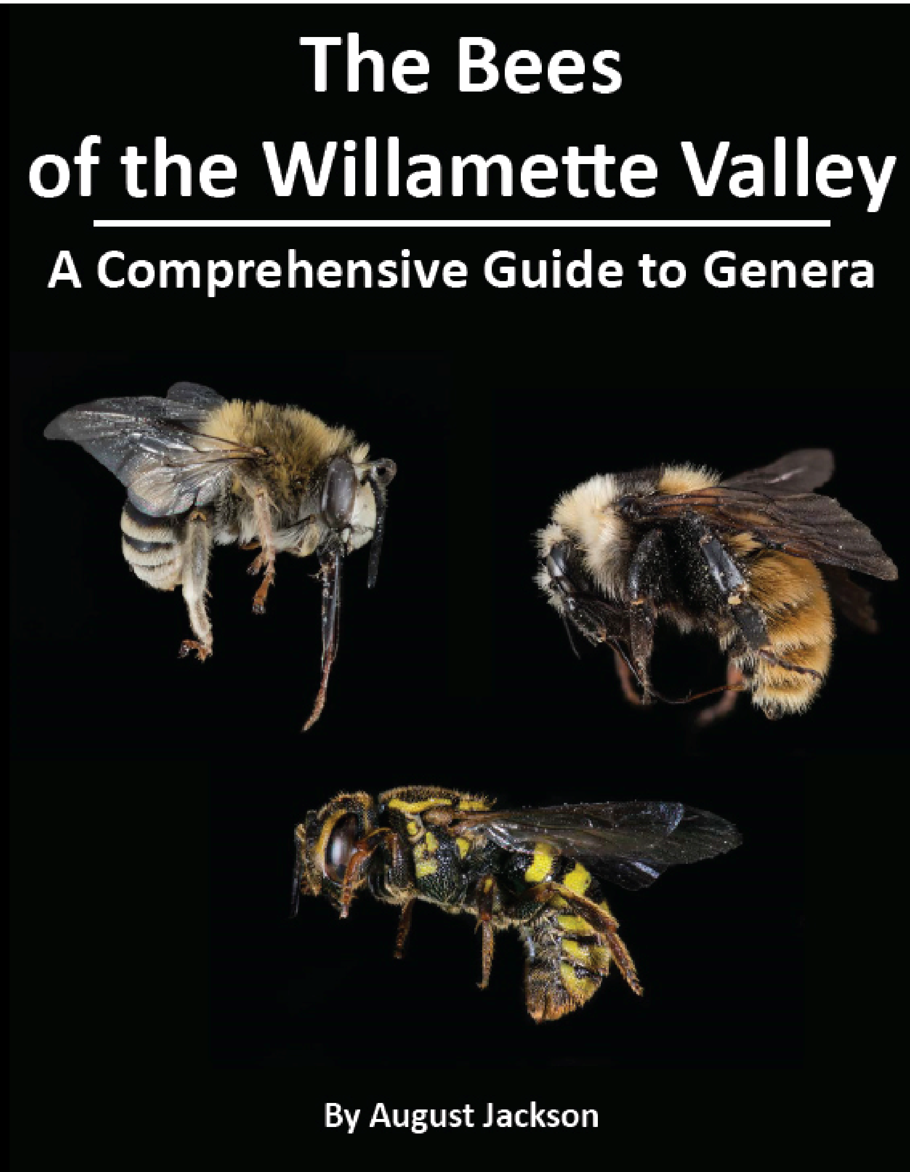
Abdomen without long ovipositor (males) (**b**)…..**Males***

*Males are rarely encountered or collected. Consequently, they will not be included in this key.

a.

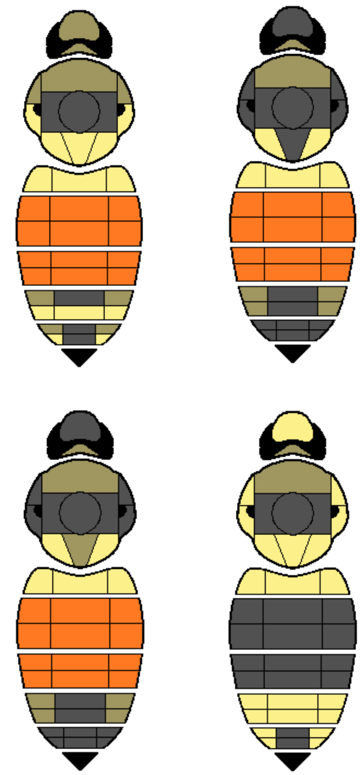
b.


August Jackson


The Bees
of the Willamette Valley
A Comprehensive Guide to Genera
By August Jackson

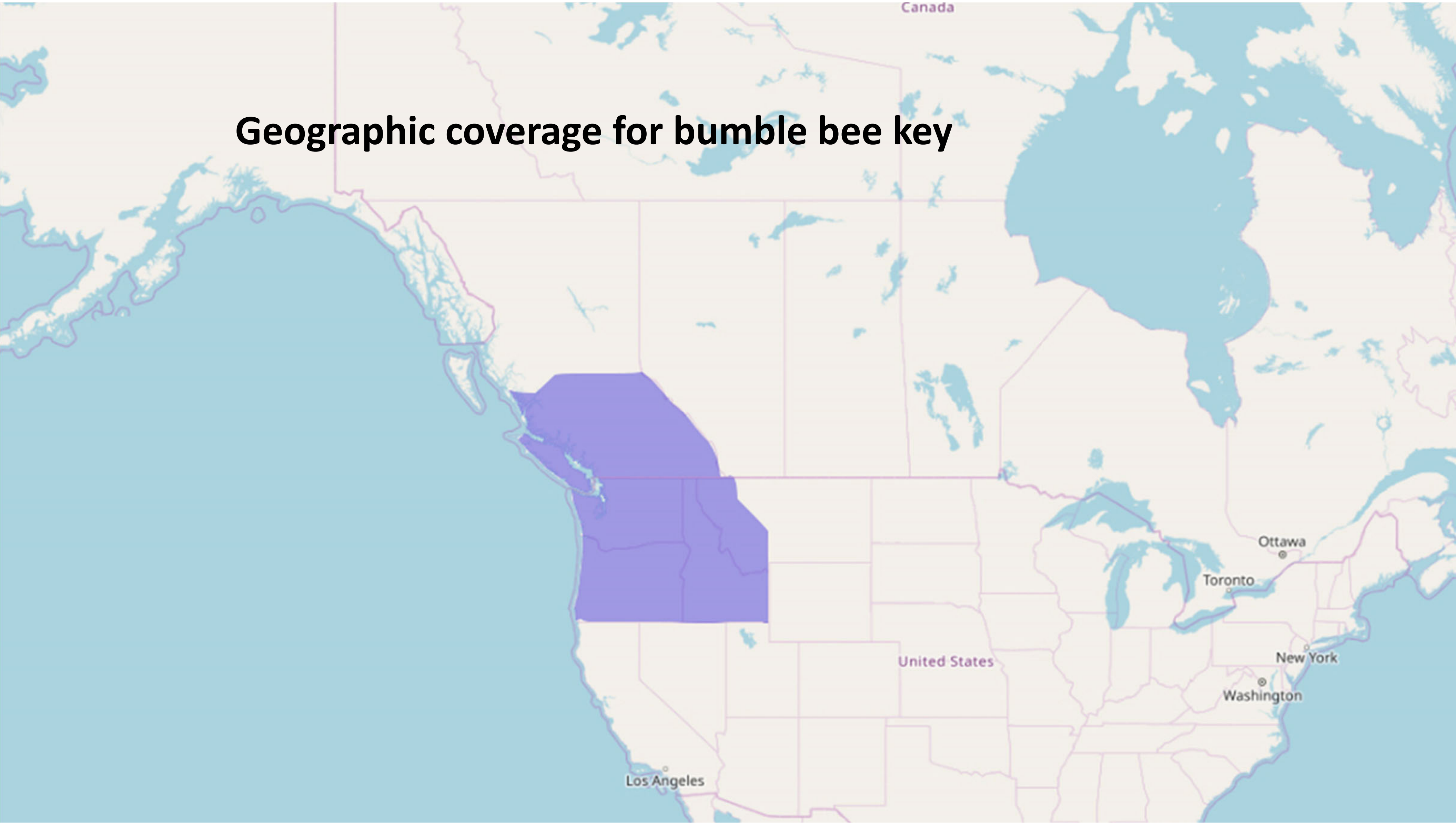
Bumble bee key encompasses 28 species and will leverage 473 existing ID templates from Paul Williams (NHM, London, UK)

Black-tailed Bumble Bee
(Bombus melanopygus)



Images courtesy of ODA and Paul Williams

Geographic coverage for bumble bee key



Modified from Williams et al 2014

Key to Female Bombus species of the PNW

1a Hindleg tibia with a pollen basket (corbicula), the outer surface flat without long hair in the center as well as short anterior and posterior fringes; S6 without lateral keels -> **2** (Pollen collecting species)

1b Hindleg tibia without a pollen basket, the outer surface convex with dense long hair in the center as well as short anterior and posterior fringes; S6 with lateral keels -> **26** (Cuckoo Bumble bee)

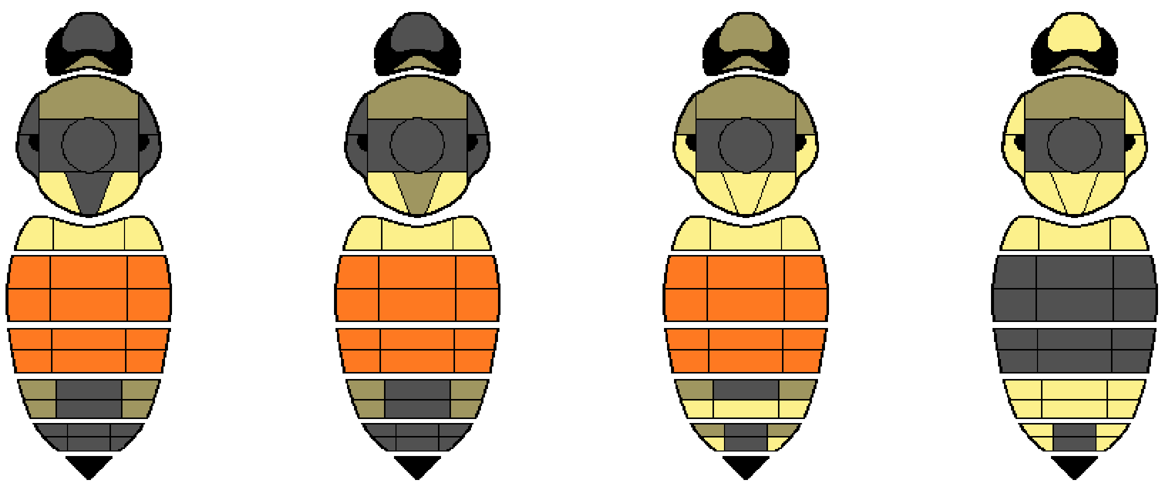
2a (1a) Midleg basitarsus distal posterior corner rounded -> **3** (Pyro; S.Str.; Cullu; Alpino)

2b Midleg basitarsus distal posterior corner with a sharp spine -> **24** (Bombias; Thoraco; Subterr)

3a (2a) Cheek about as long as broad, or longer than broad, the lateral ocellus always small and its center located posterior to the narrowest line between the eyes -> **4** (Pyro; Alpino)

3b Cheek shorter than broad, the lateral ocellus small *and* its center located posterior to the narrowest line between the eyes, *or if* the cheek is nearly equal in length and breadth *then* the lateral ocellus is

- 27 Couplets
- Differentiates 28 *Bombus* species



Modified from Williams et al 2014

Key to Male Bombus species of the PNW

1a Eye similar size and shape of female eye -> **3**

1b Eye enlarged and bulbous -> **2**

2a (1b) Eyes weakly convergent dorsally; penis valve head dorsoventrally flattened, curved in toward the body midline and sickle-shaped -> **22 (*Cullumanobombus*)**

2b Eyes strongly convergent dorsally, penis valve head laterally flattened, straight and about 5x as long as broad -> ***Bombus nevadensis***

3a (1a) Antenna short, antennal flagellum less than 2.5x the length of the scape; penis valve head greatly broadened dorsoventrally, flared outward and forming a broad funnel shape -> **21 (*Bombus*)**

3b Antenna long or very long, antennal flagellum more than 2.5x the length of the scape; penis valve head either straight, or outcurved from the body midline, or incurved toward the body midline as a sickle shape, or as a short, broad, deep spoon shape -> **4**

- 26 Couplets
- Differentiates 28 *Bombus* species

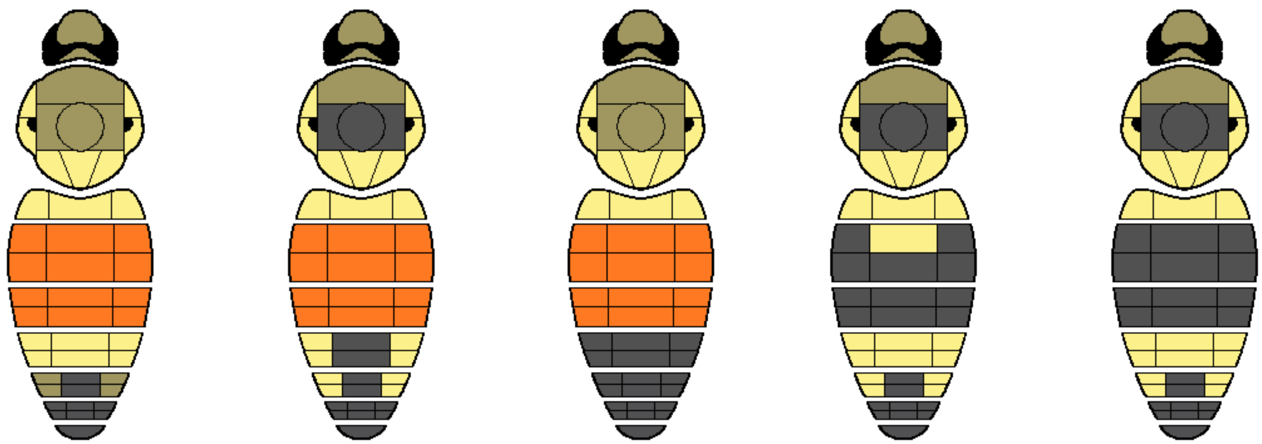


FIG 5

G 15

FIG 12

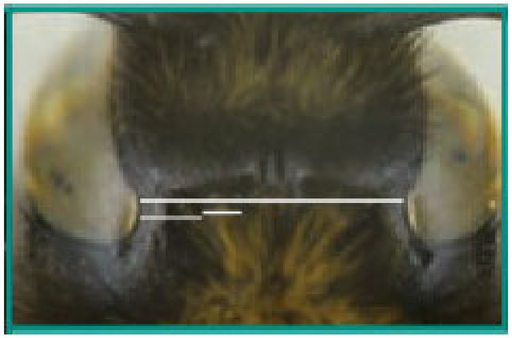
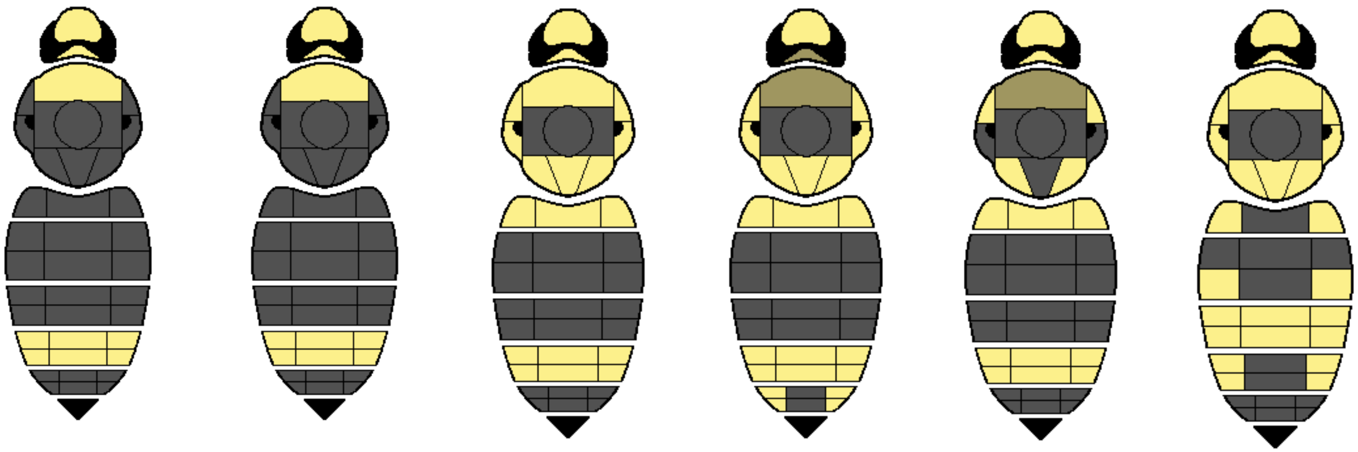
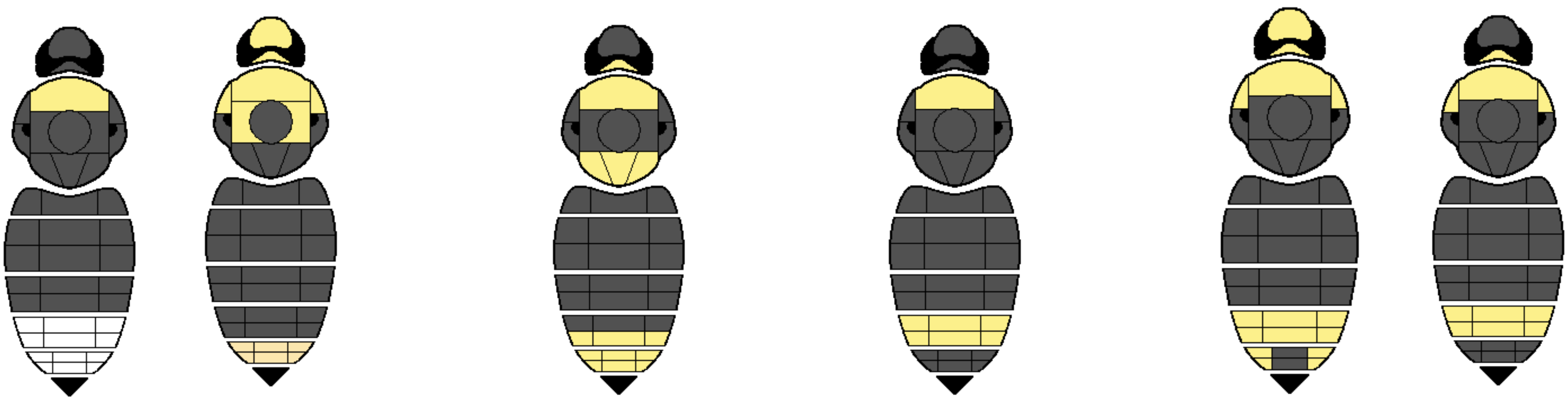


FIG 6

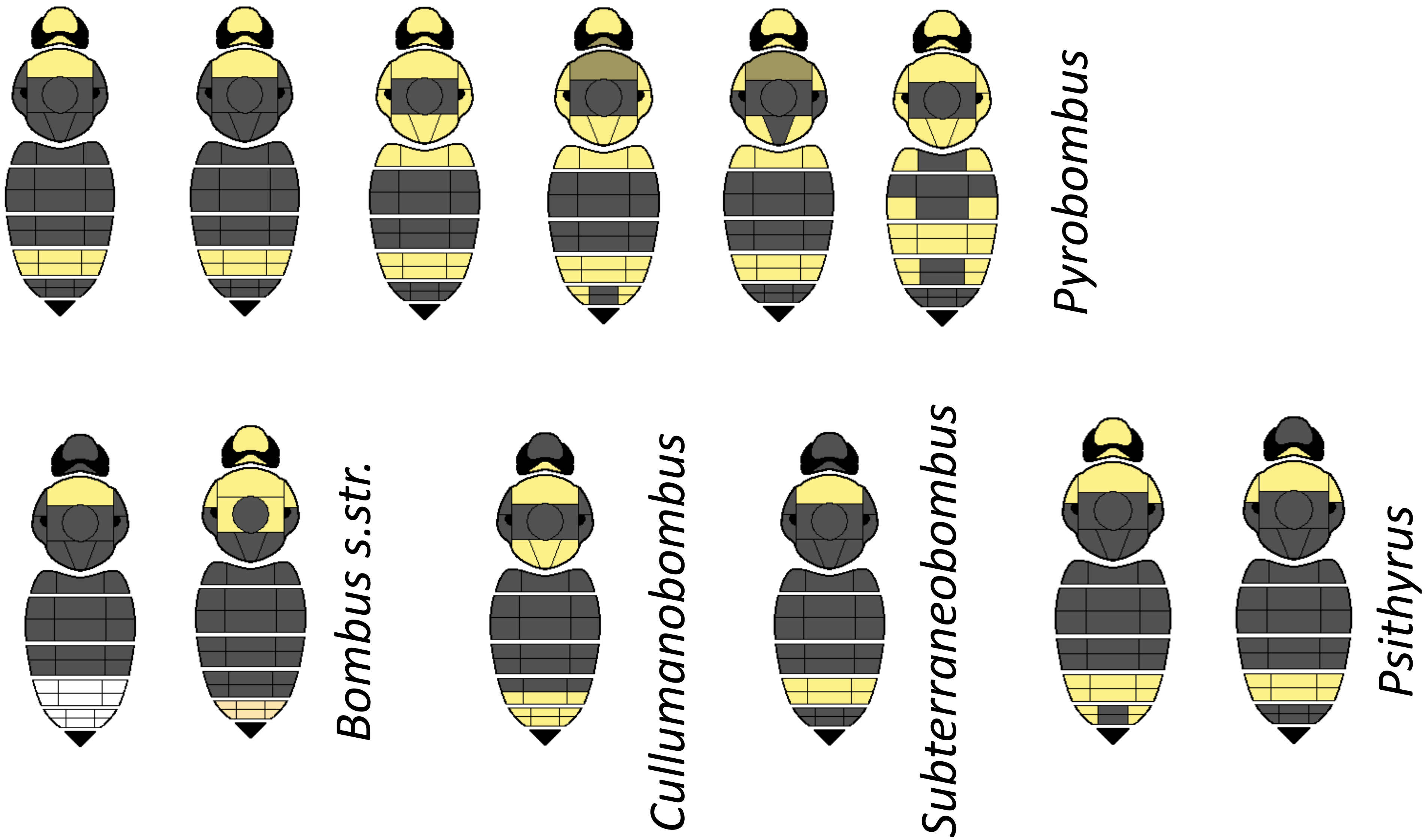
Joshua Dunlap
Oregon Department of Agriculture



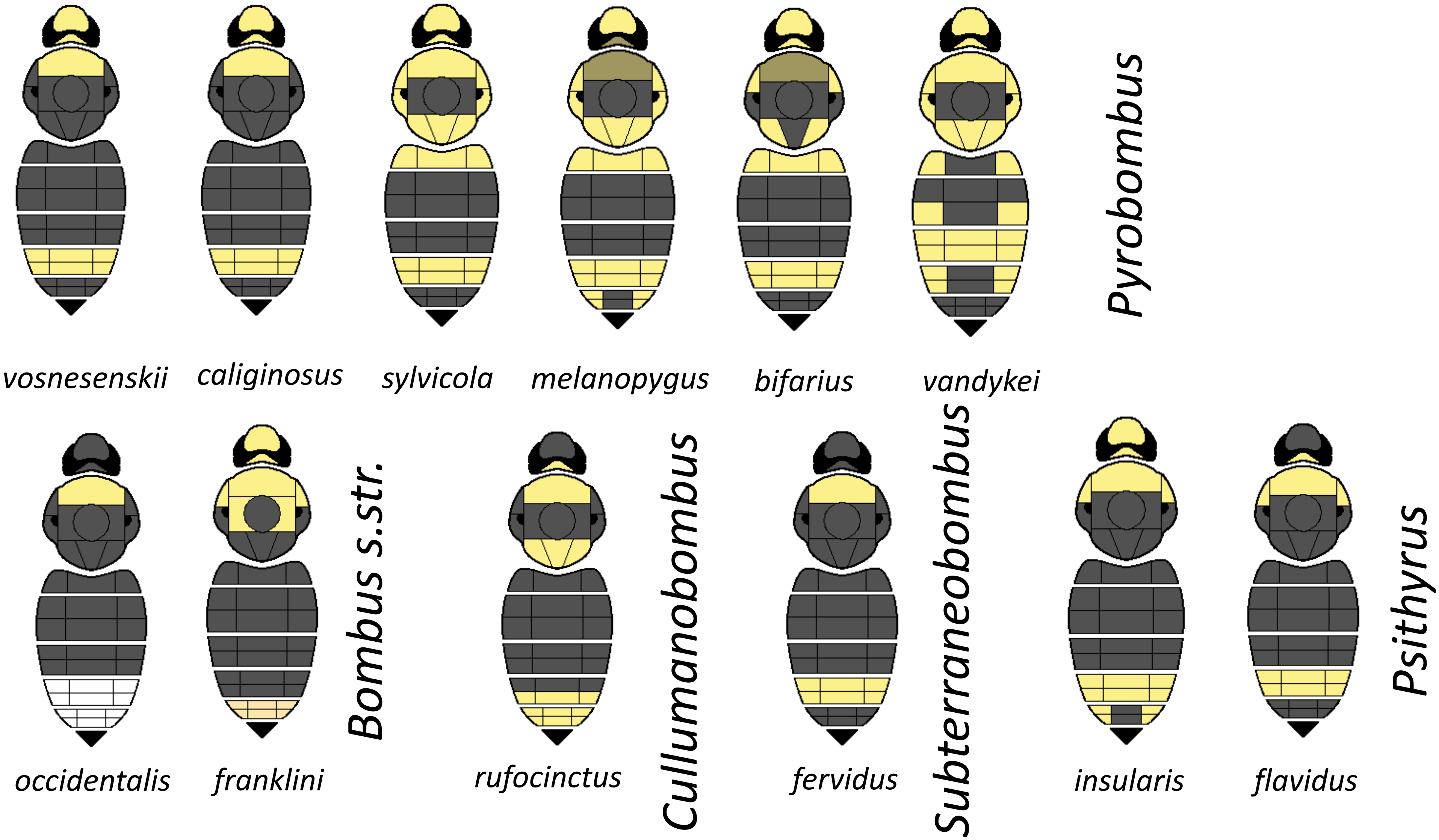
Mimicry Complexes 3 & 4



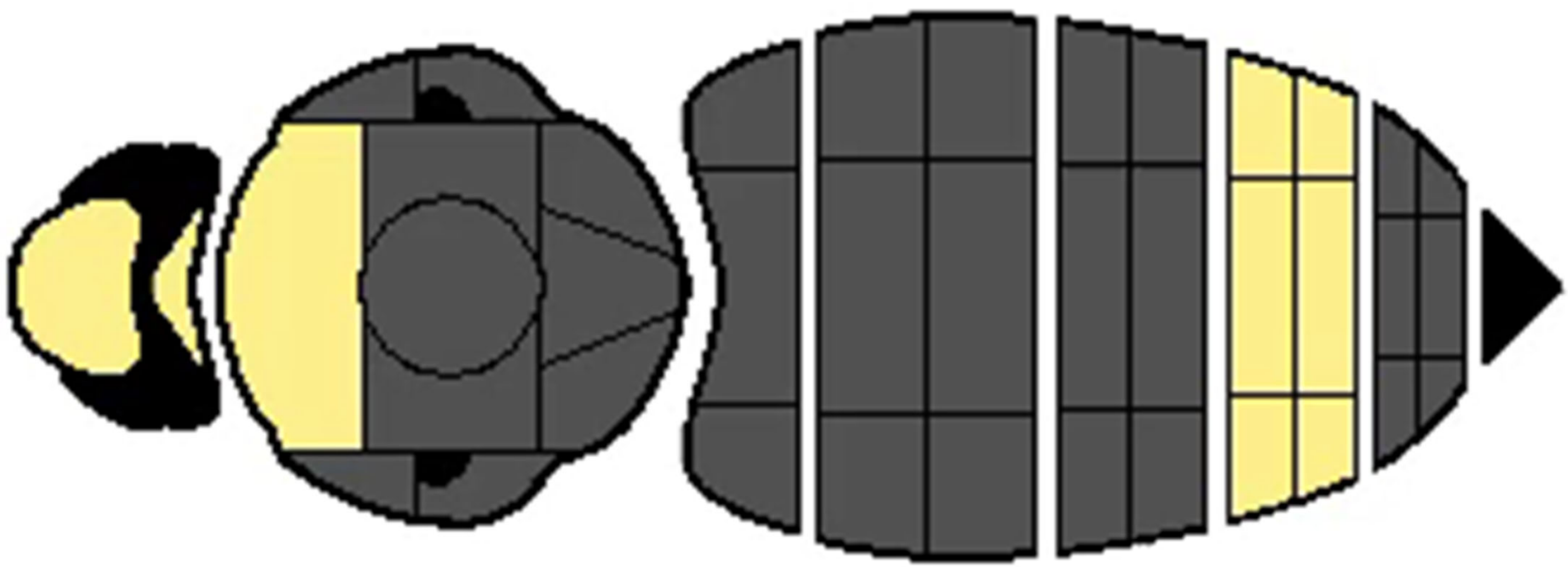
Page 40 in BBNA


Pyrobombus
Bombus s.str.
Cullumanobombus
Subterraneobombus
Psithyrus

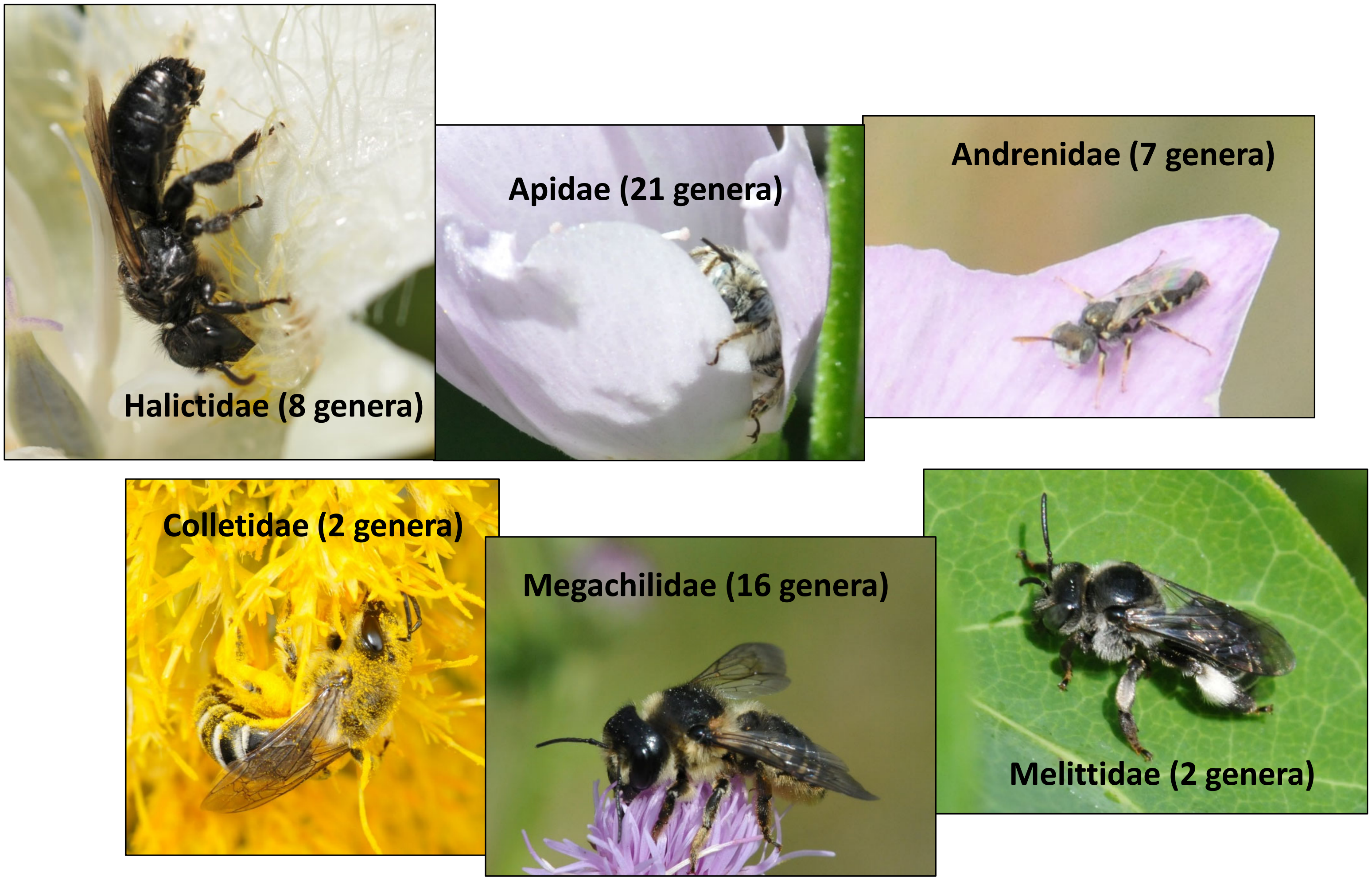

Paul Williams
Natural History Museum
London


vosnesenskii
caliginosus
sylvicola
melanopygus
bifarius
vandykei
Pyrobombus
occidentalis
franklini
Bombus s.str.
rufocinctus
Cullumanobombus
fervidus
Subterraneobombus
insularis
flavidus
Psithyrus


Paul Williams
Natural History Museum
London



Generic-level bee key encompasses 56 genera in 6 families



Geographic coverage for generic-level key

- 78 Couplets
- Differentiates 56 genera

Modified from MMD

Key to the bee genera of the PNW

1a With three submarginal cells -> **2**

1b With two submarginal cells; rarely only one -> **40**

2a (1a) Hind tibial spurs absent -> ***Apis mellifera***

2b Hind tibial spurs present -> **3**

3a (2b) Jugal lobe of hind wing absent -> ***Bombus***

3b Jugal lobe of hind wing present -> **4**

4a (3b) Posterior portion of second recurrent vein distinctly arcuate distad -> ***Colletes***

4b Posterior portion of second recurrent vein not arcuate distad -> **5**

5a (4b) Marginal cell pointed, apex on costal margin of wing or, if bent away from margin or truncated, apex less than about three vein widths from costal margin; stigma usually large, usually broader and much longer than prestigma, margin within marginal cell usually convex -> **6**

Where we're headed:

- 5th round draft to be delivered by August Jackson by Jan. 1, 2023

- Imaging the remaining characters for the keys: 1/3 of the generic images, and 1/3 of the *Bombus* images to complete by Spring 2023

- Graphic design and layout by the team, led by A.Jackson Summer 2023

- Delivery of print version on online version September 2023

Many thanks…

Funding and in-kind support:

Oregon Department of Agriculture, Oregon State Arthropod Collection, Oregon Bee Project, Oregon Forest Resources Institute, OSU Extension

Logistical support:

J. Dunlap, J. Labonte, C. Marshall, A. Melathopoulos, J.Vlach, A.Jackson

Images courtesy of ODA

Multi-scale Habitat Value of Slash Piles for Pacific Martens and Fishers

Jordan Ellison[1,2], Katie Moriarty[1], Angela Larsen-Gray[1], and John Bailey[2]

[1]National Council for Air and Stream Improvement, Inc.

[2]Oregon State University

Funding from **Fish and Wildlife Habitat in Managed Forests research program** and the **National Council for Air and Stream Improvement, Inc.**

Oregon State University College of Forestry

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Pacific fisher (*Pekania pennanti*)

- Southern Sierra population State (2019) and Federally (2020) Endangered
- **New petition for listing entire west coast population filed Sept. 13, 2022**

Caylen Kelsey

Mark Linnell

Pacific marten (*Martes caurina*)

- Coastal Distinct Population Segment Federally Threatened (2020)
- State Endangered in California (2019)


Connected, structurally complex forests
Erika Anderson

Woody debris

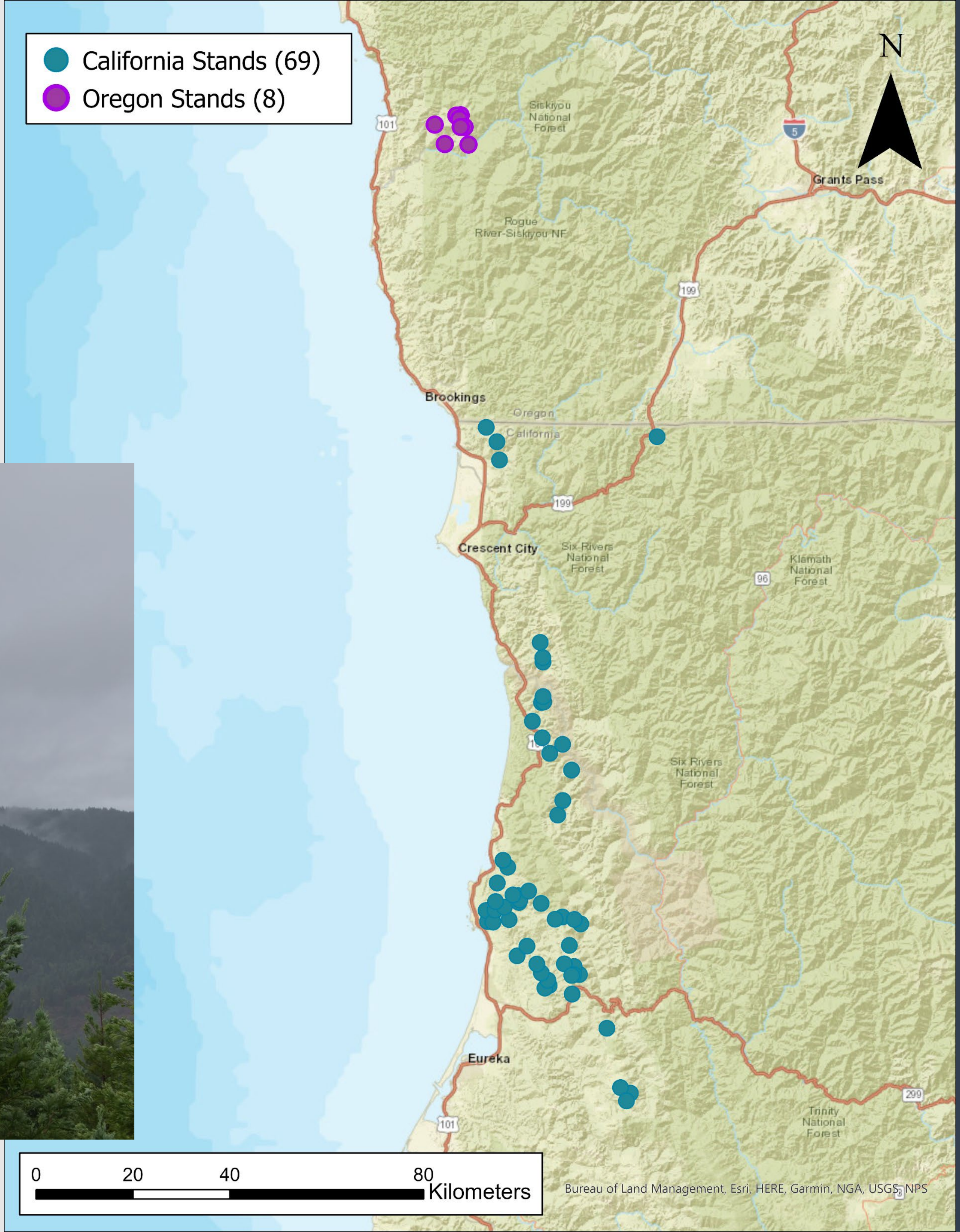
Caylen Kelsey

Slash Piles

Caylen Kelsey

Laurie Clark

Study Area


California Stands (69)
Oregon Stands (8)
N
Siskiyou National Forest
Grants Pass
Rogue River-Siskiyou NF
Brookings
Oregon
California
Crescent City
Six Rivers National Forest
Klamath National Forest
Six Rivers National Forest
Eureka
Trinity National Forest
0
20
40
80
Kilometers
Bureau of Land Management, Esri, HERE, Garmin, NGA, USGS, NPS

Objective 1: Pile Visitation

Document pile visitation by martens and fishers

Quantify associations between pile visitation and stand/pile characteristics

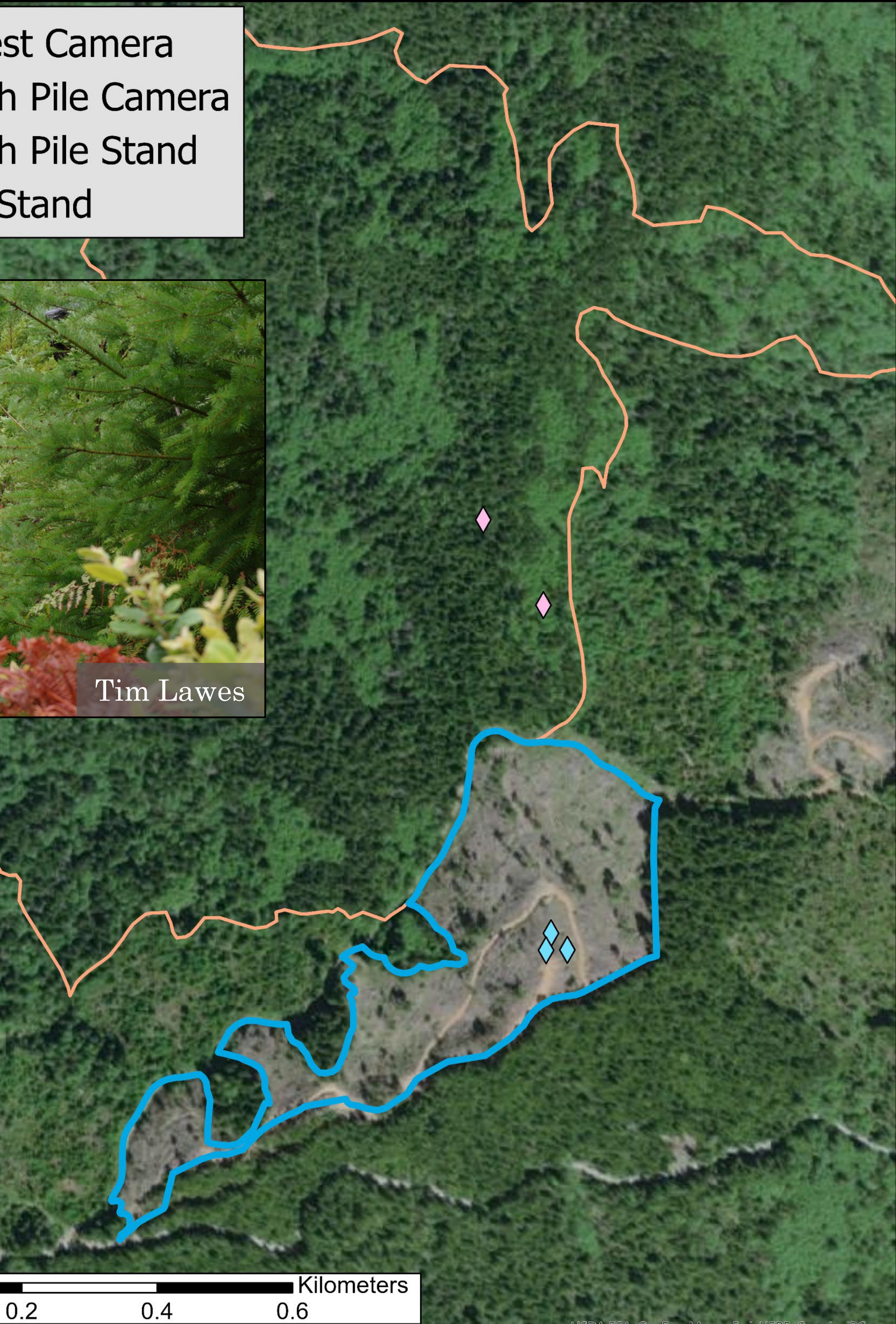
Objective 1: Pile Visits

Camera Surveys
(California only)

- 69 stand-pairs surveyed
- 354 cameras
- >1.6 million photos collected and tagged

Detection dog teams

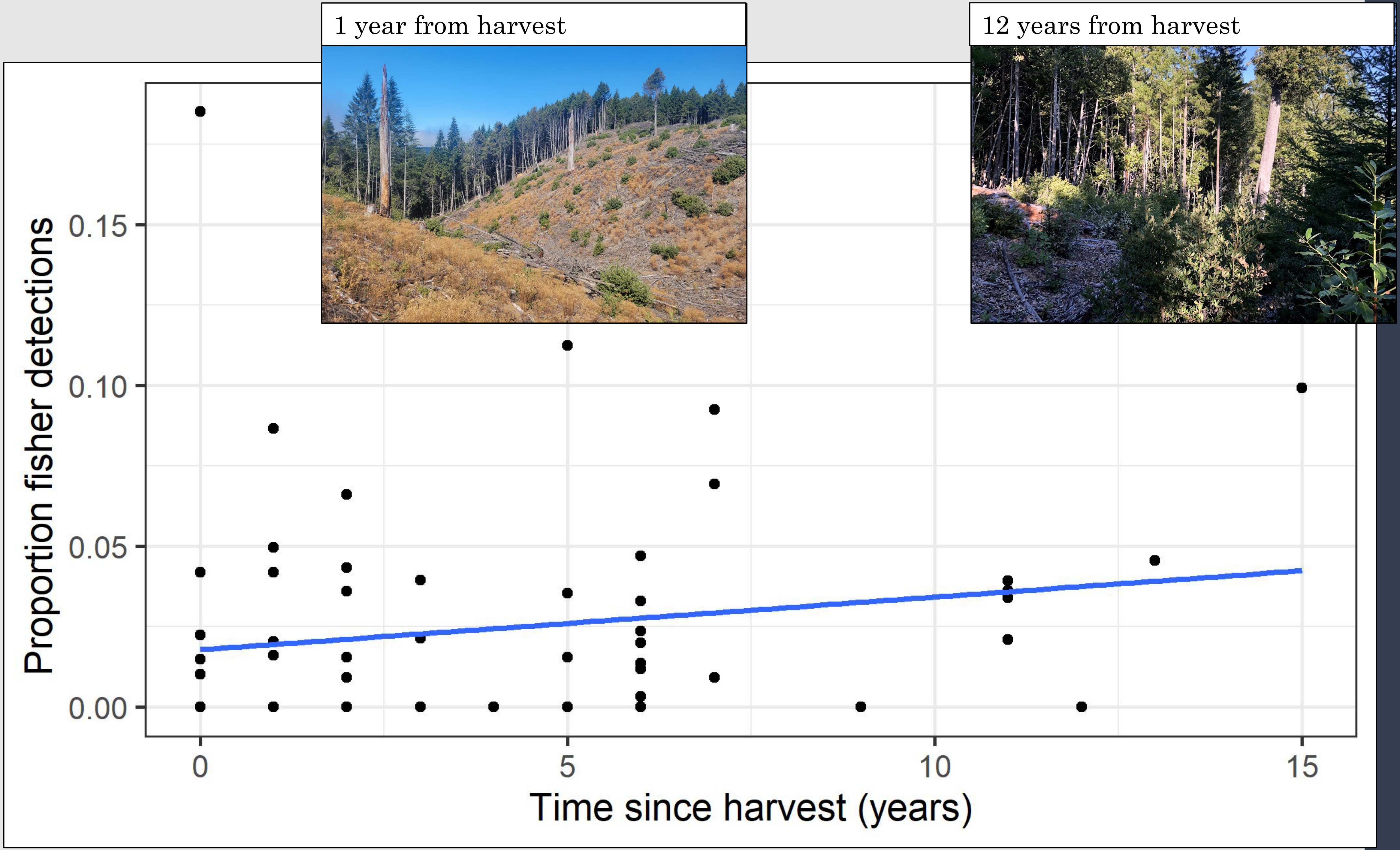
- Used in California (n = 45) and Oregon (n = 8)

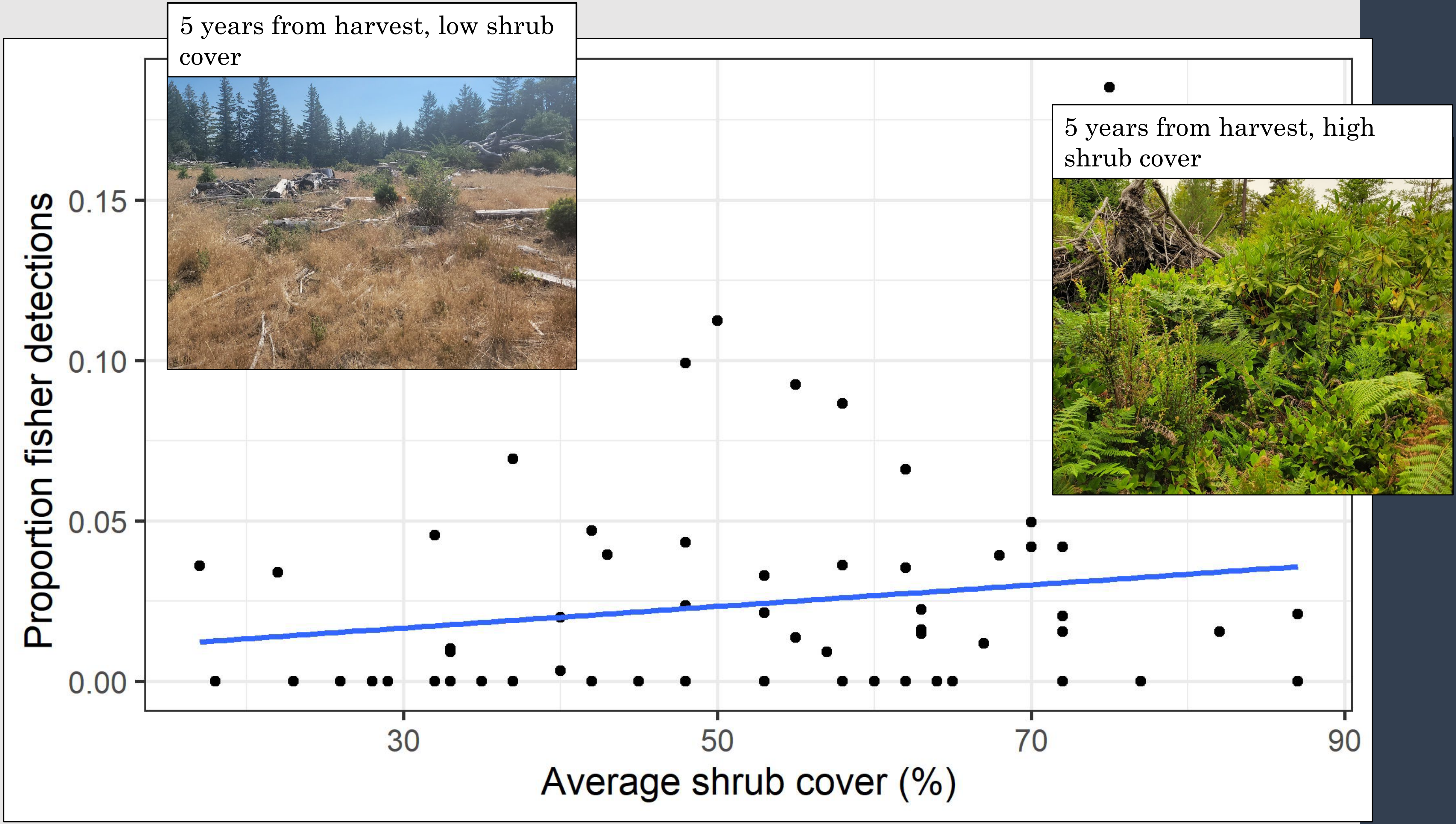


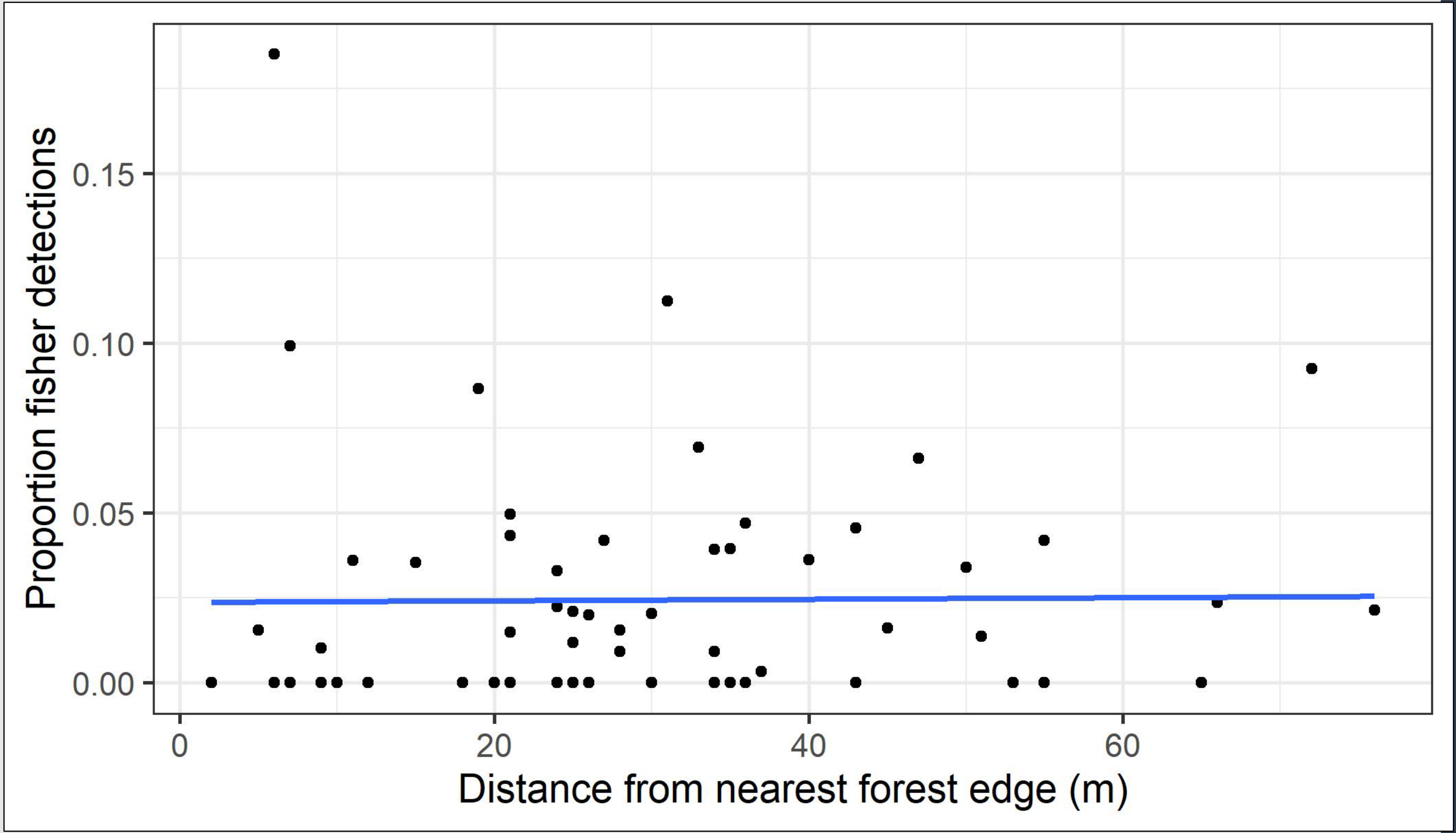

Bushnell
TP163N1 3
80°F 26°C
07-19-2021 16:14:19


95S1 2
55°F12°C
11-10-2021

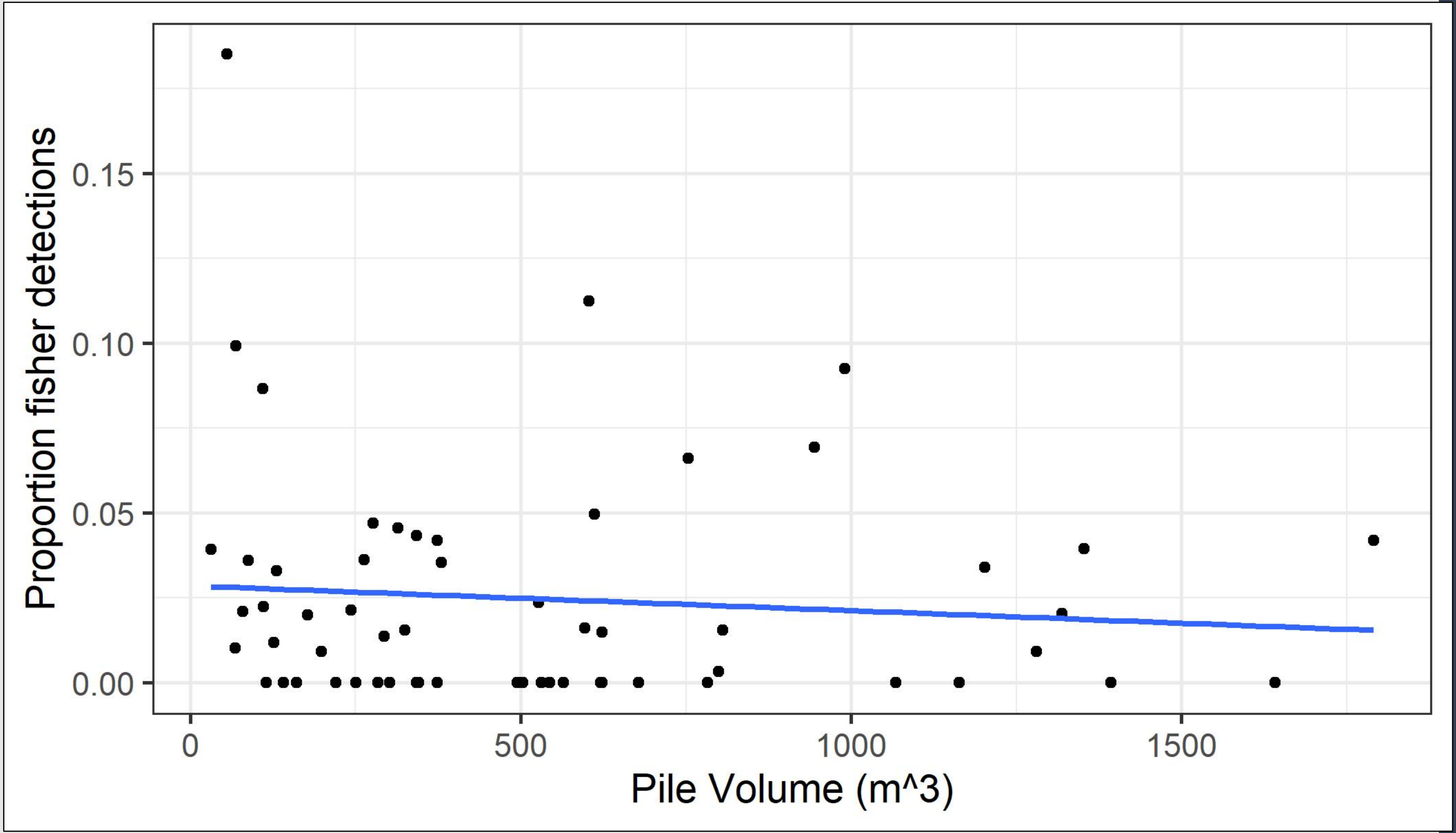

36°F
10/26/2020 08:24AM


1 year from harvest
12 years from harvest
Proportion fisher detections
0.00
0.05
0.10
0.15
0
5
10
15
Time since harvest (years)


5 years from harvest, low shrub cover
5 years from harvest, high shrub cover
Proportion fisher detections
0.00
0.05
0.10
0.15
30
50
70
90
Average shrub cover (%)



Proportion fisher detections
0.15
0.10
0.05
0.00
0
20
40
60
Distance from nearest forest edge (m)


Proportion fisher detections
0.00
0.05
0.10
0.15
0
500
1000
1500
Pile Volume (m^3)

Objective 2: Small mammal communities

Generate estimates of small mammal abundance, diversity, and energetic biomass at slash piles and in the surrounding landscape

Objective 2: Small mammal trapping

18 replicates

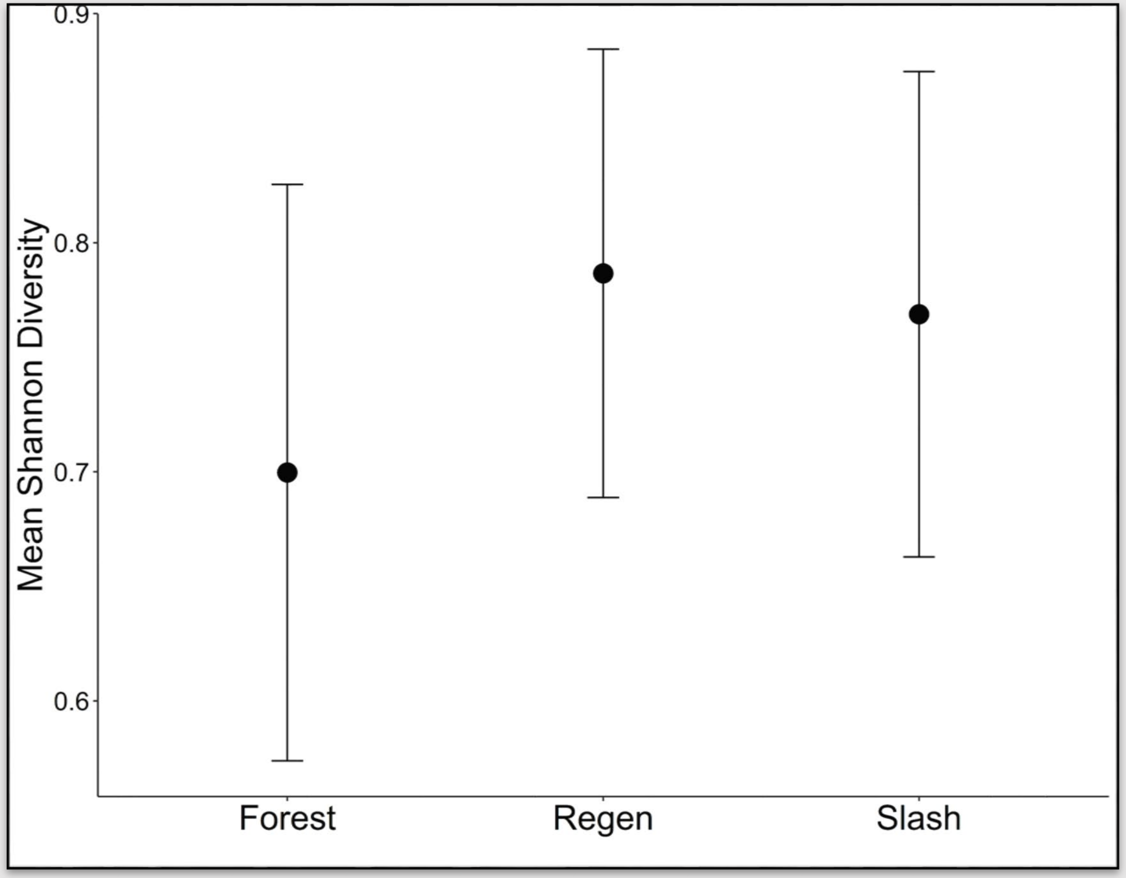
- 946 individuals from 16 species

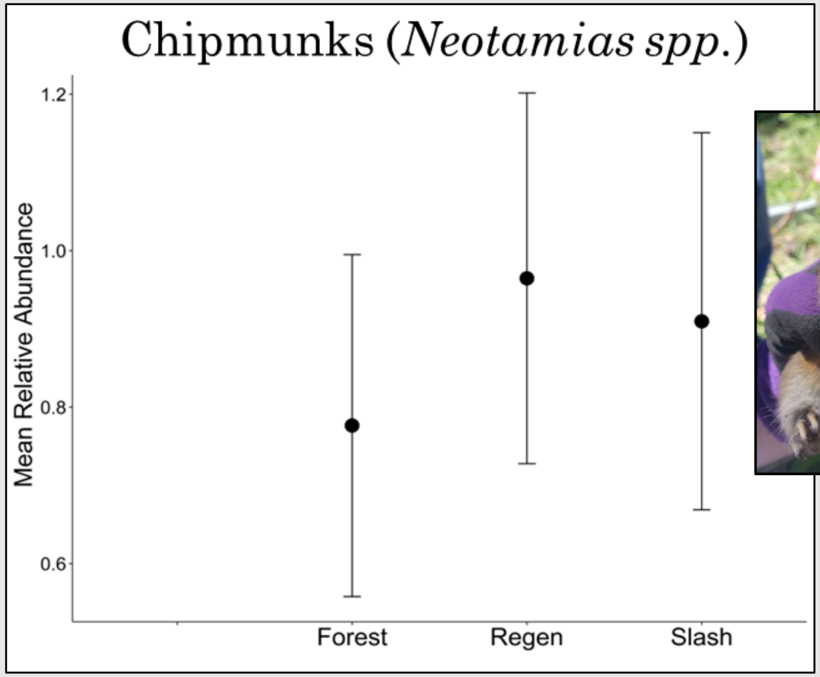
Adjacent forest

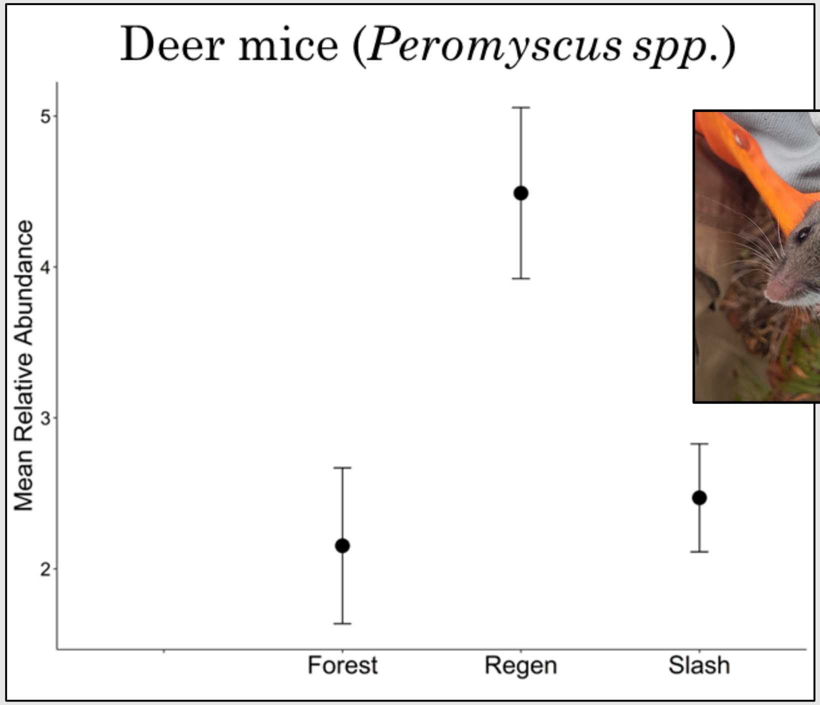
Slash pile


Regen – no piles

Preliminary data: Small Mammals







Objective 3: Fire Behavior

Model effects on surface fire behavior with occurrence of slash piles

Intensive Sampling

19 stands between California (n = 10) and Oregon (n = 9)

- Ages 0-7 years
- 3-6 vegetation and woody debris plots
- Up to 10 piles sampled per stand

Generate custom fuel models

Summary of accomplishments

78 stands surveyed between Oregon (n = 9) and California (n = 69)

>1.6 million remote camera images collected and photo-tagged

946 unique small mammal captures over 18 trapping replicates

Presented at:

- 68th Annual Meeting of the Western Section of the Wildlife Society, 2021
- Western Forestry Graduate Research Symposium, 2021
- Annual Meeting of the Oregon Chapter of the Wildlife Society, 2022
- Annual Meeting of the Wildlife Society, 2022

Next steps

Develop fire behavior models at slash piles

Model small mammal community metrics and energetic biomass at slash piles

Develop GLM describing associations between fisher detections at slash piles and stand and pile characteristics

Ellison MS Thesis, anticipated March 2023

Acknowledgements

Field crew: Shalom Fletcher, Dustin Marsh, James Mackenzie, Jordan McBain, Fiona McKibben, Jason Moriarty, Brandon Shea

Green Diamond field crew: Erika Anderson, Maddie Cameron, Drake Fehring, Theannah Hannon, Isley Jones, Jason Labrie, Jim Lucchesi, Ashley Morris, Kira Parker, John Roos

Additional support from Laurie Clark, Desiree Early, Keith Hamm, David Lamphear, Micaela Szykman Gunther, Alyssa Roddy, and Jake Verschuyl

Rogue Detection teams: Justin Broderick and Winnie, Will Chrisman and Hooper, Jenn Hartman and Filson

Photos from the field: Tim Lawes

Photo-taggers: Sandy Diaz, Alanna Garcia, Kelly Johnson, Sabrina Ott, Louis Salas, Anna Schwecke

Fish and Wildlife Habitat in Managed Forests Research Program

Questions?

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Oregon State University
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GREEN DIAMOND
Resource Company

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

ROGUE DETECTION TEAMS

Rayonier

Red tree voles in working forests

Jason Piasecki[1,2], John Bailey PhD[2], Katie Moriarty PhD[1,2]

[1] National Council for Air and Stream Improvement (NCASI)

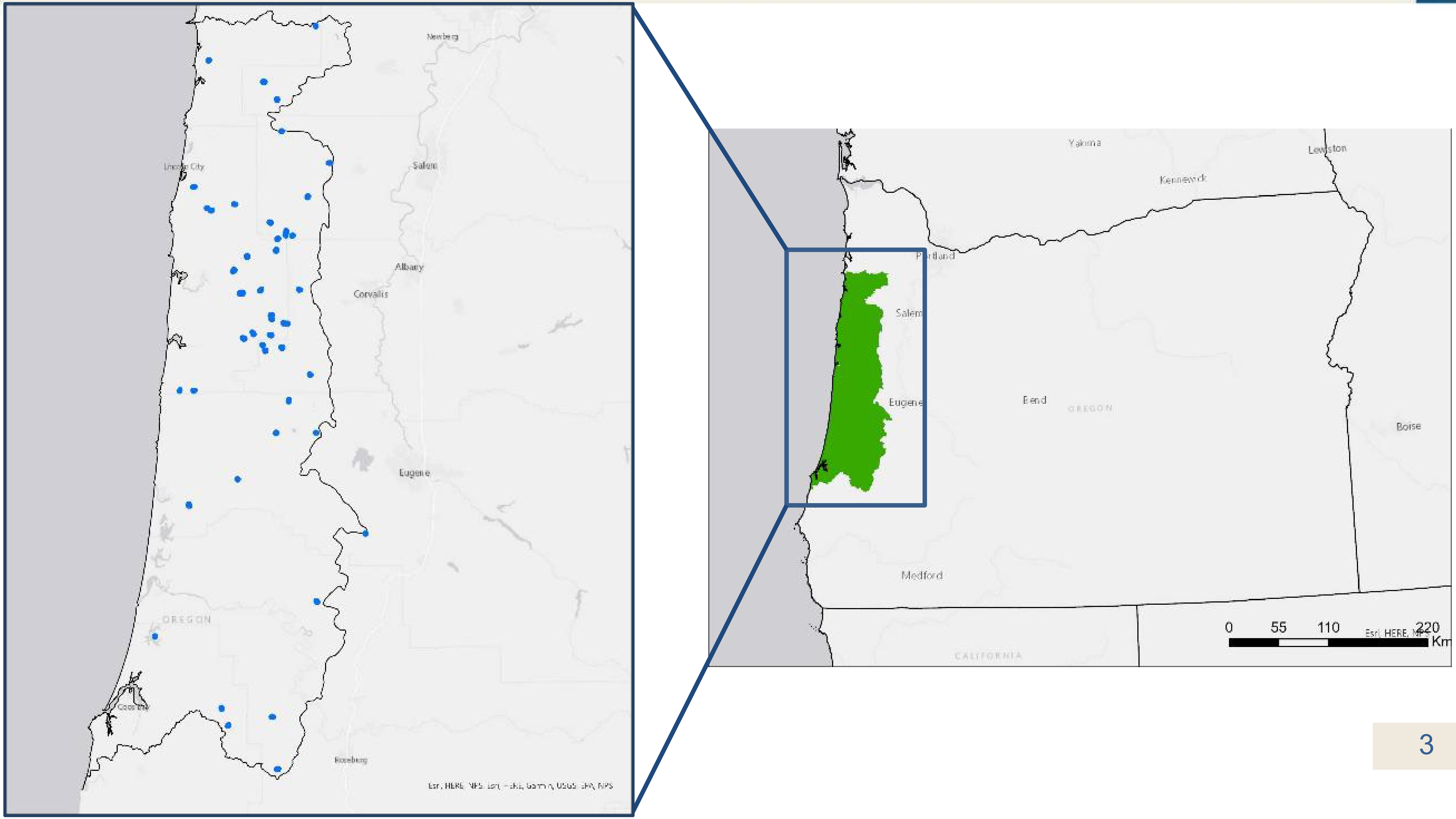
[2] Oregon State University, College of Forestry

Red tree vole (*Arborimus longicaudus*)

Study Goals

1. Quantify relative abundance of red tree vole nests
2. Estimate nest density
3. Quantify detection rates of red tree vole nests
4. Estimate nest status (e.g., occupied, recently occupied, old) and use by other arboreal mammals
5. Quantify red tree vole colonization and extirpation rates at the nest level
6. Estimate nest survival from 2019-2022

2021 Study Range



Surveying for red tree voles

Surveying for nests in young forests

- Fixed 1km^2 plots (1/ha)
- Ground based search
- All nests in live crown climbed
- Cameras installed to confirm tree vole occupancy

Surveying for nests in old forests

- Fixed 1km^2 plots (1/ha)
- 'vertical' plots
- Canopy based search
- All nests in live crown climbed
- Cameras installed to confirm tree vole occupancy

Tree vole signs

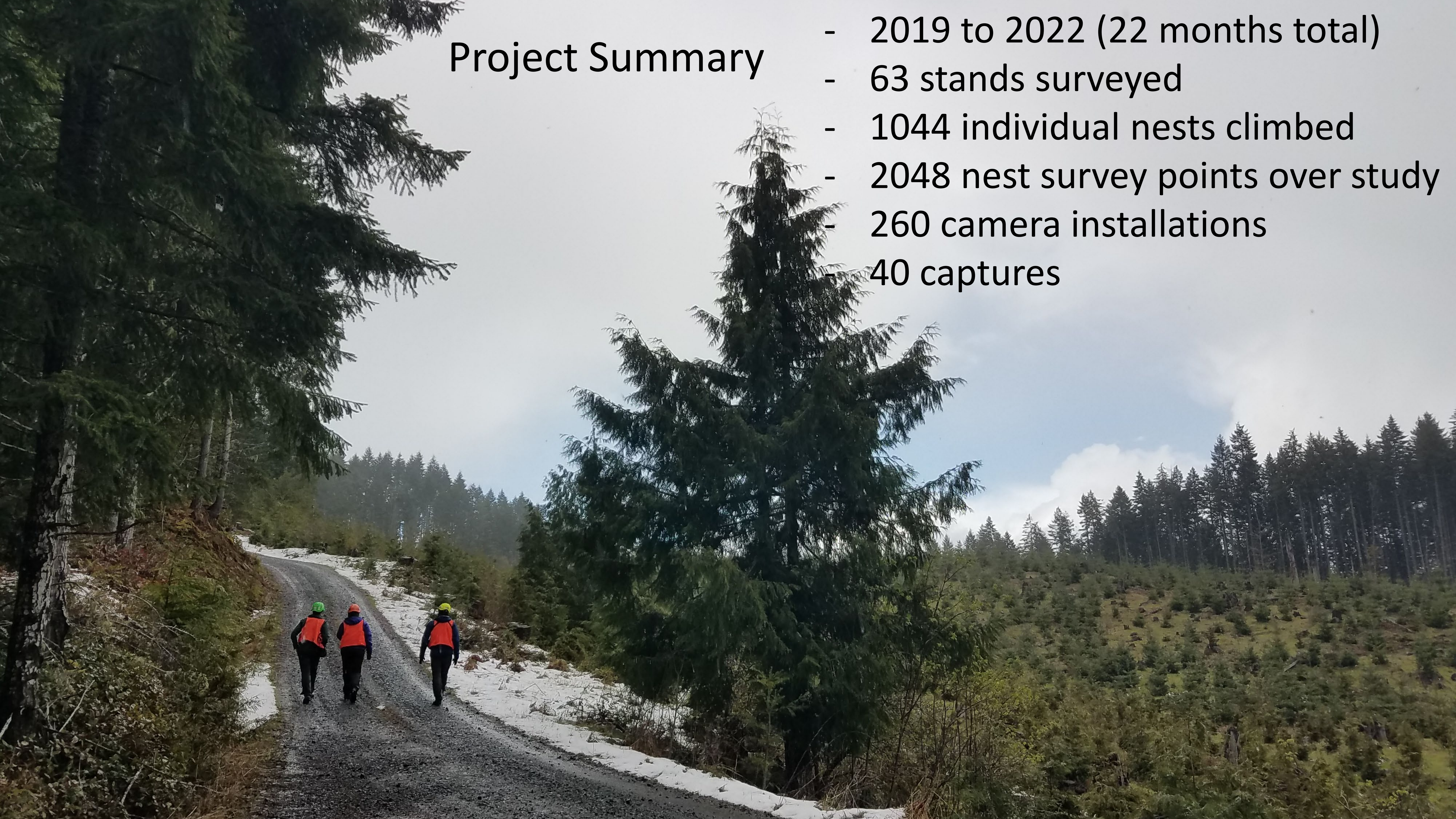
Douglas-fir resin ducts

45^{o} cut twig

Fresh Douglas-fir cuttings

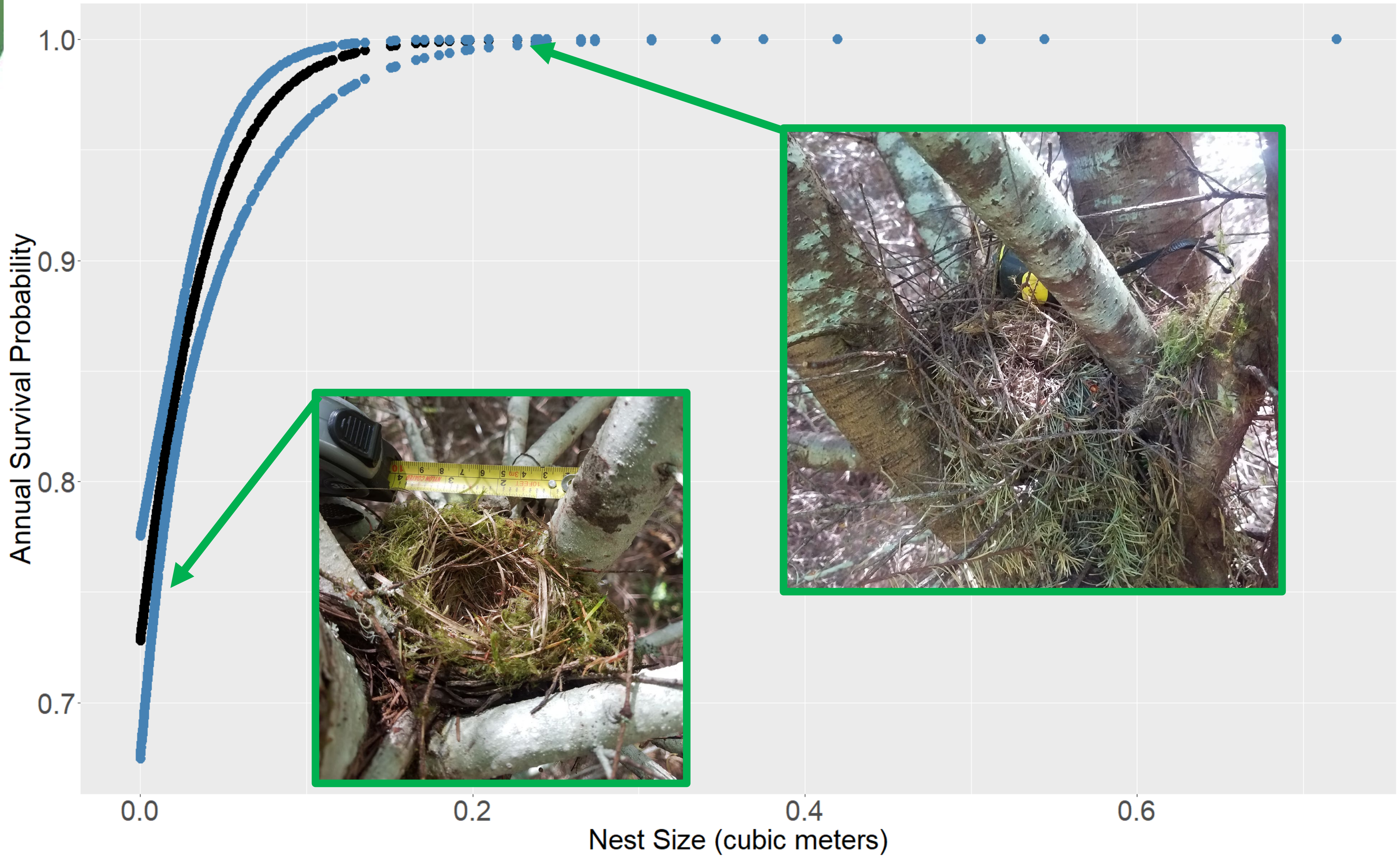
Project Summary

- 2019 to 2022 (22 months total)
- 63 stands surveyed
- 1044 individual nests climbed
- 2048 nest survey points over study
- 260 camera installations
- 40 captures



Arboreal nests

S(nest_size), AICc 61.79%

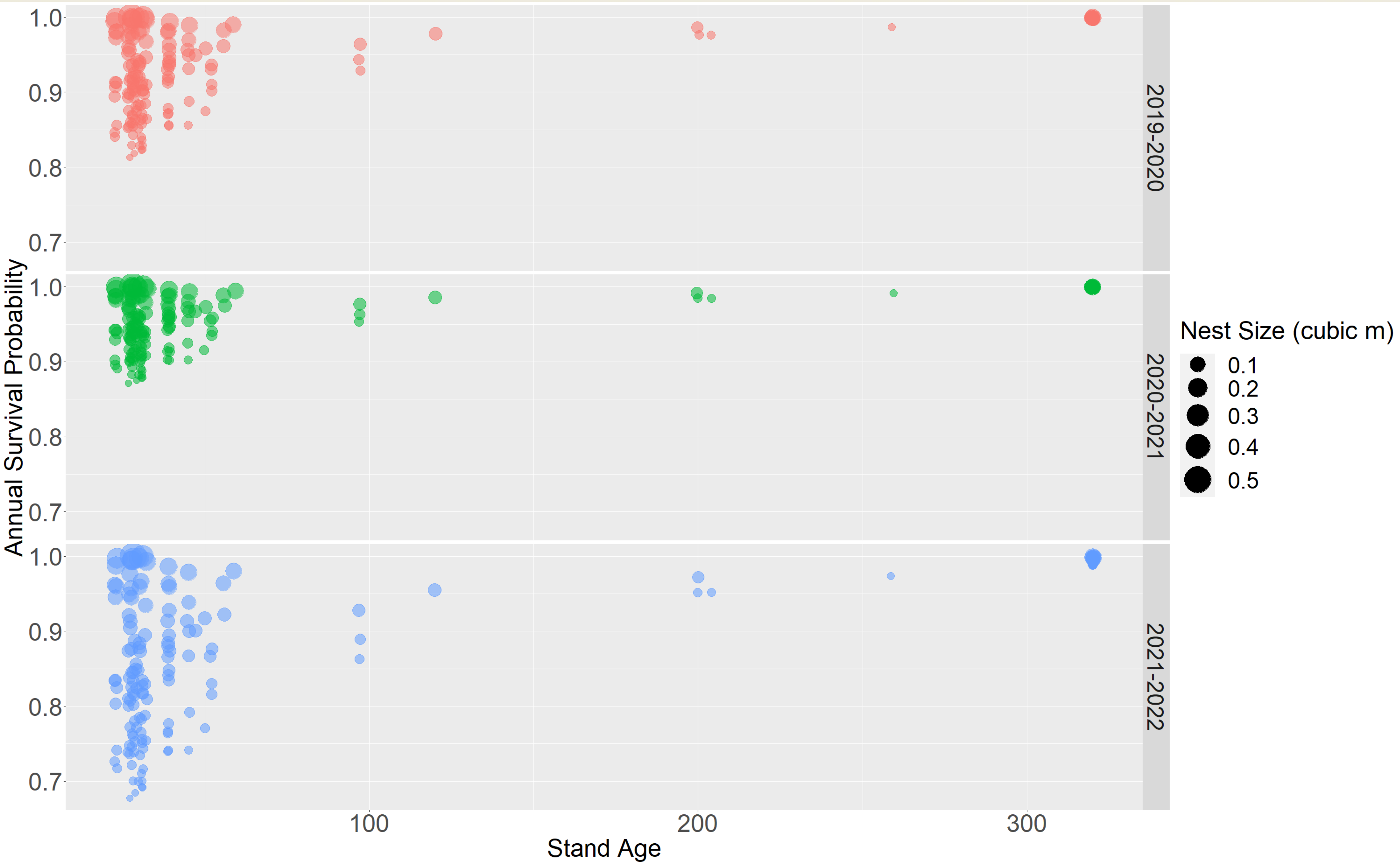


Tree vole nests

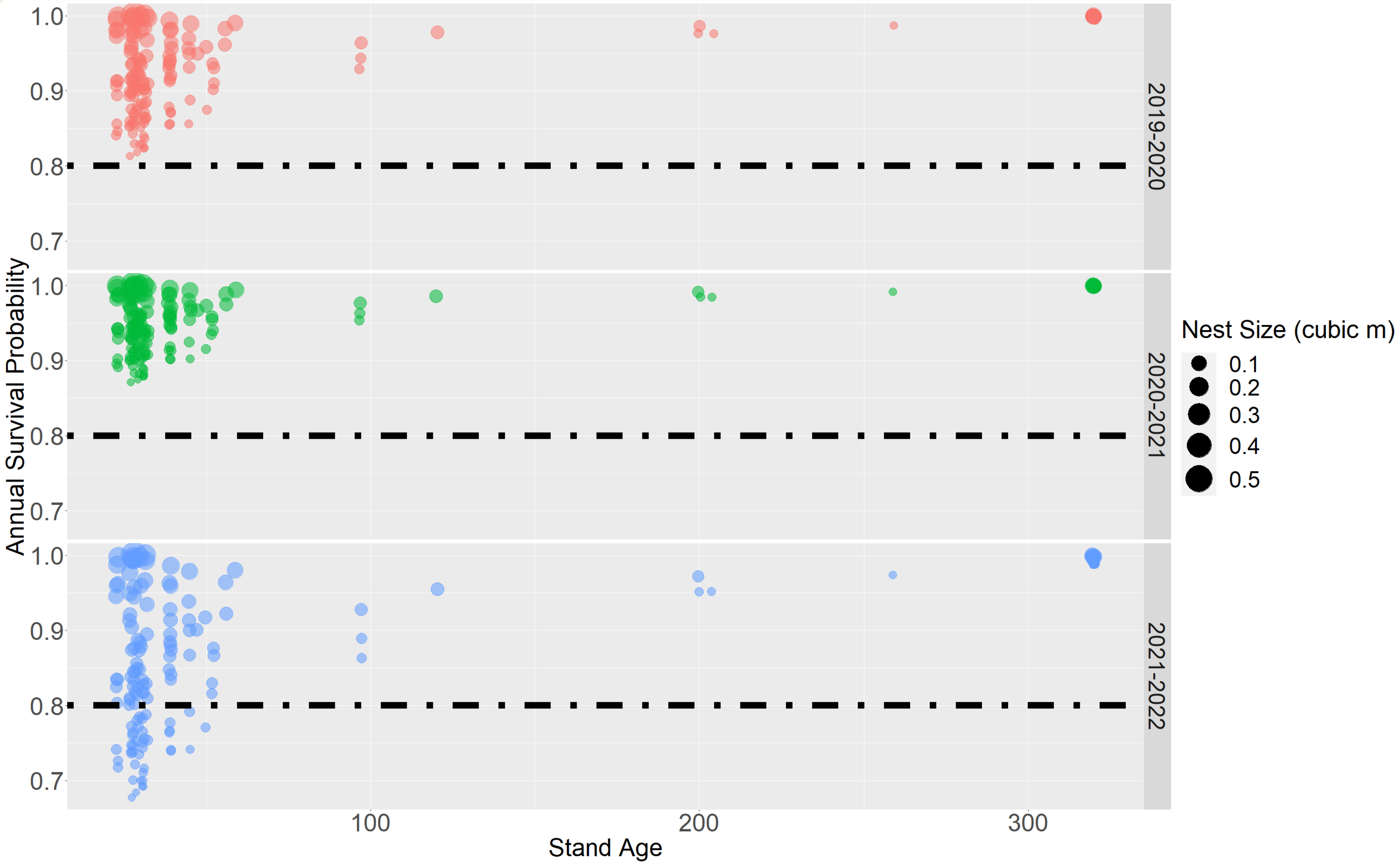
S(t + stand_age + nest_size), AICc weight 35.42%

S(stand_age + nest_size), AICc weight 20.24%

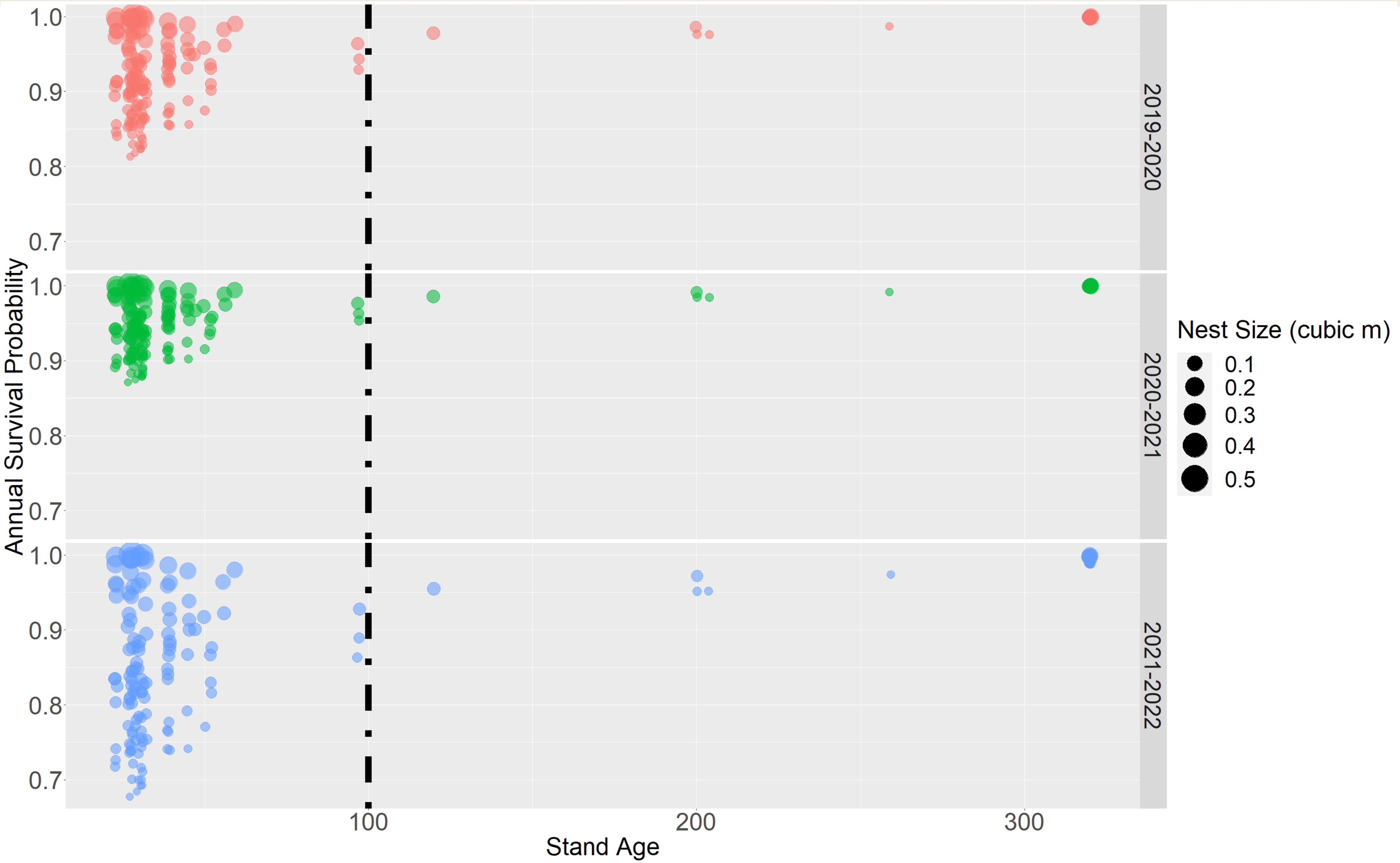
n=151



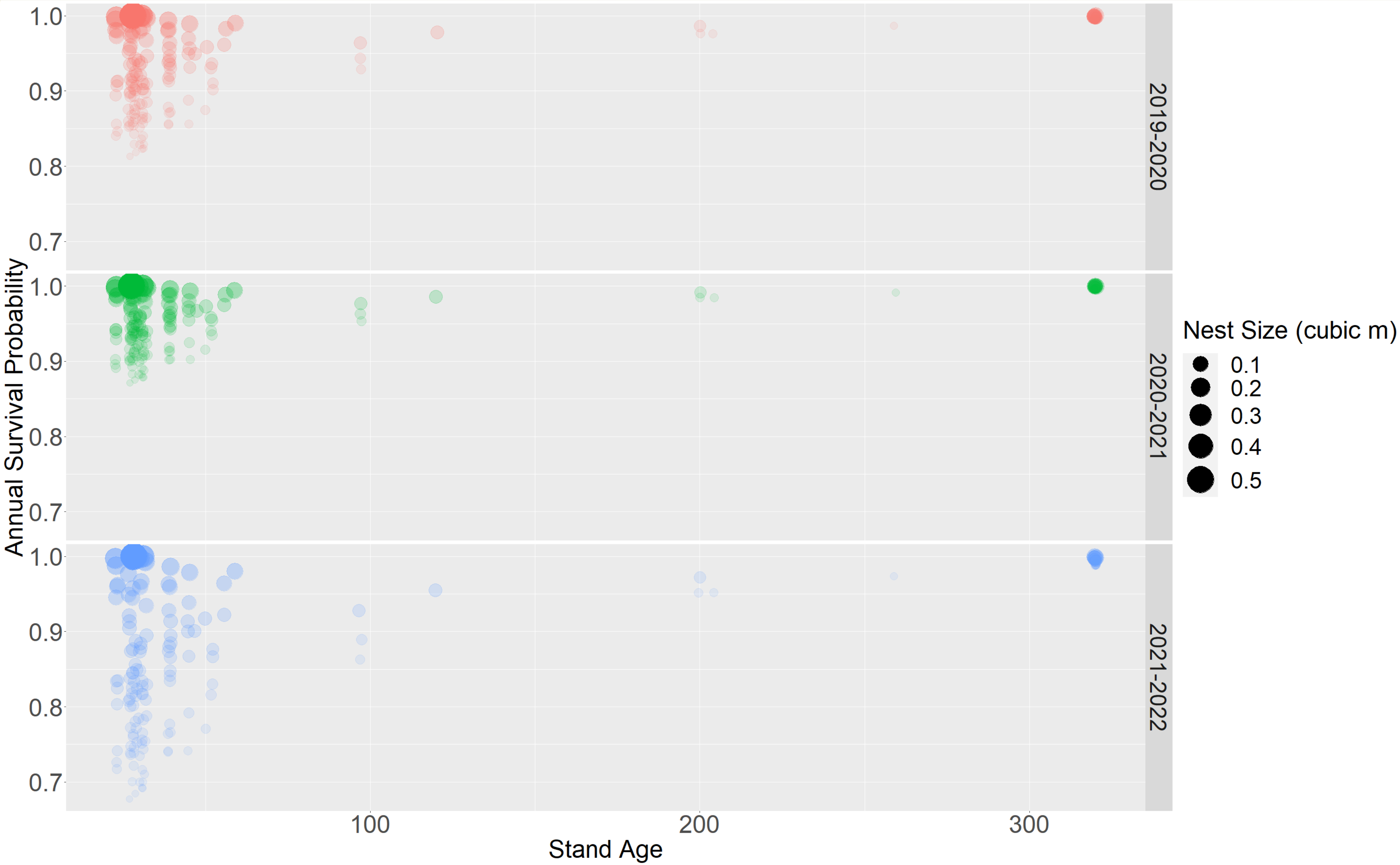
Tree vole nests S(t + stand_age + nest_size), AICc weight 35.42%



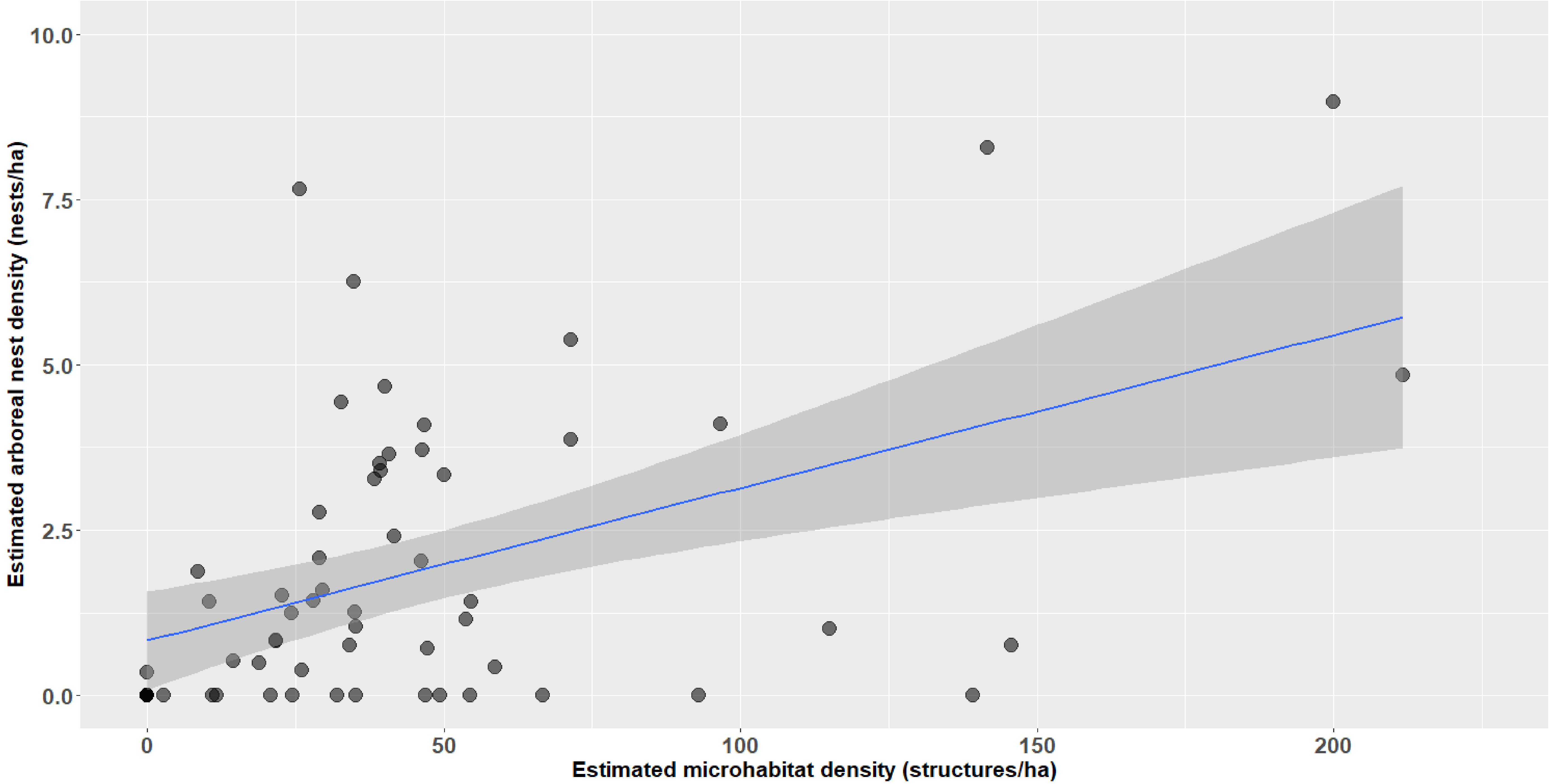
Tree vole nests S(t + stand_age + nest_size), AICc weight 35.42%



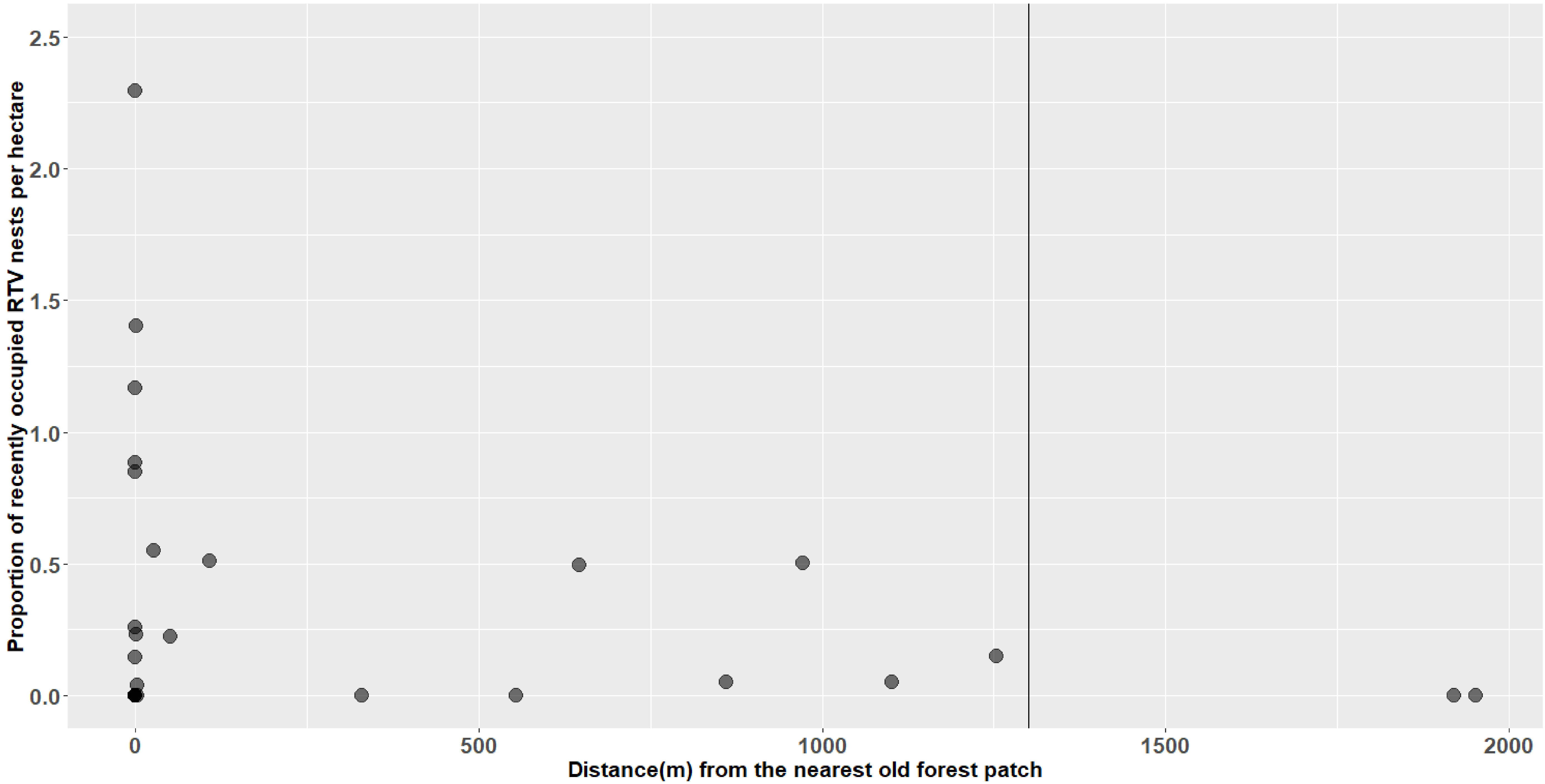
Tree vole nests S(t + stand_age + nest_size), AICc weight 35.42%



Estimated nest density and microhabitat structure



Proportional RTV nest density (young forests)



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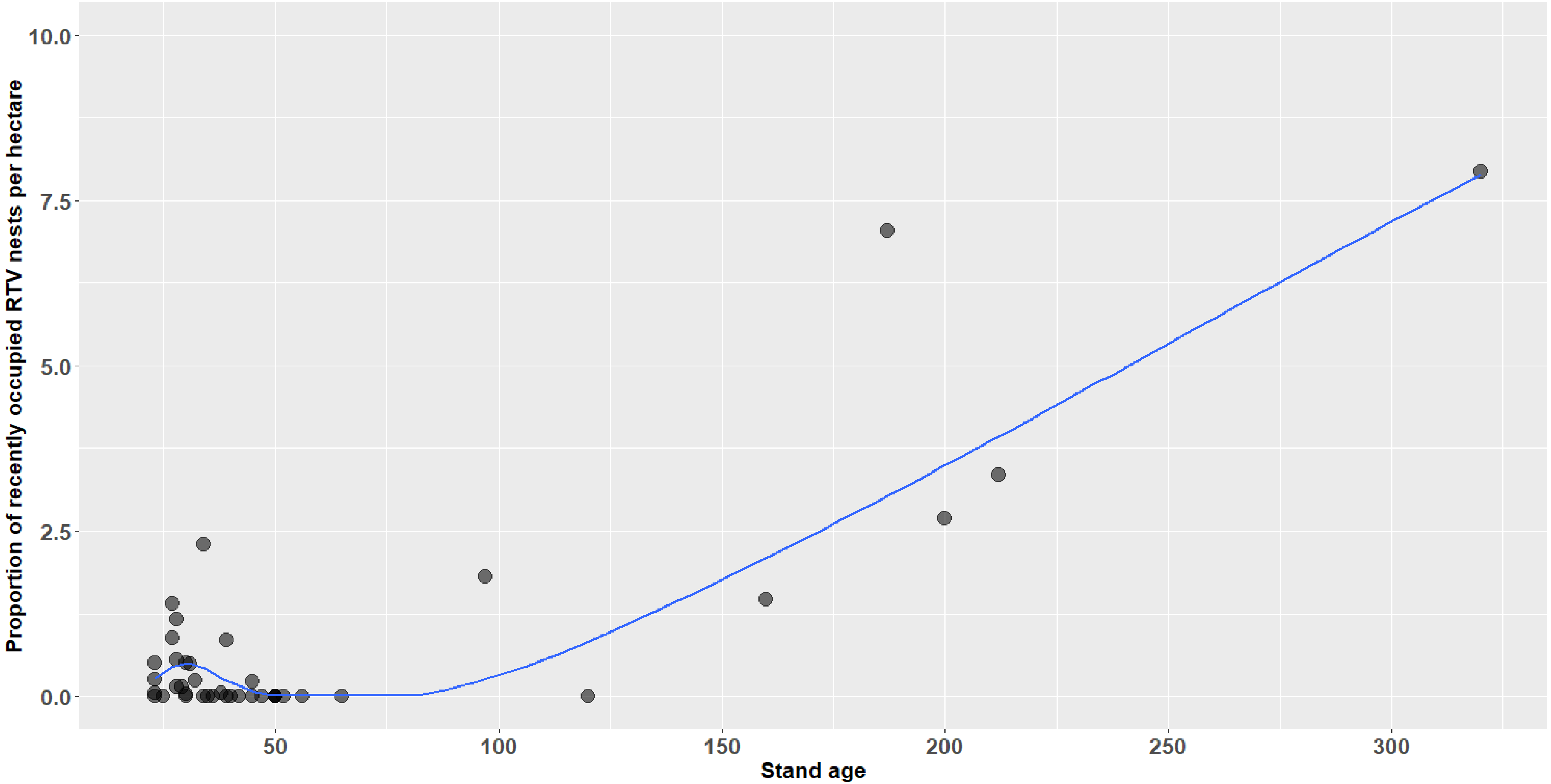
Proportional RTV nest density (forests within 1300m of OF)



Observations: nest colonization/extirpation

2020

2021

Colonization

2020

2021

Extirpation

Captures

Conclusions

Conclusions

- Successfully implementing two methods to assess tree vole occupancy
- Continue to observe low nest/tree vole occurrence surrounding the 50yr-60yr age classes
- Continue to observe both colonization and extirpation across all age classes where voles are found

Limitations

- Detectability in old forest

2022 Objectives – NAFO Wildlife Conservation Initiative

- Tag and evaluate camera data for conspecific interactions
- Identify predation events
- Evaluate microhabitat structure availability vs nesting habits

2022 Objectives – Oregon Wildlife Foundation

- Evaluate detectability in forests over 80yrs using climb-survey method
- Dedicated 2-person crew

Acknowledgements

Field crew – Cody Berthiaume, Mackenzie McCoy, Salix Scoresby, Kaitlin Webb, Jacob Baker, Ian Shriner, Mark Stevens, Jessie Ritter, Stephanie Loredo

Training and consulting – Eric Forsman, Jim Swingle, Mark Linnell

Photos – Tim Lawes, Ian Shriner, Jake Baker

Wildlife Conservation Initiative NAFO

Lone Rock Resources

Weyerhaeuser

Manulife Investment Management

Oregon Wildlife Foundation

Starker Forests, Inc.

Oregon Department of Forestry

U.S. Department of the Interior Bureau of Land Management

Forest Service U.S. Department of Agriculture

Cafferata Consulting

Questions?

Jason Piasecki
Graduate Research Assistant – OSU College of Forestry

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Quantifying the effects of wildfire on water quantity, water quality, and fish: The Hinkle Creek Watershed Study revisited

Kevin D. Bladon, Dana R. Warren, and David Roon

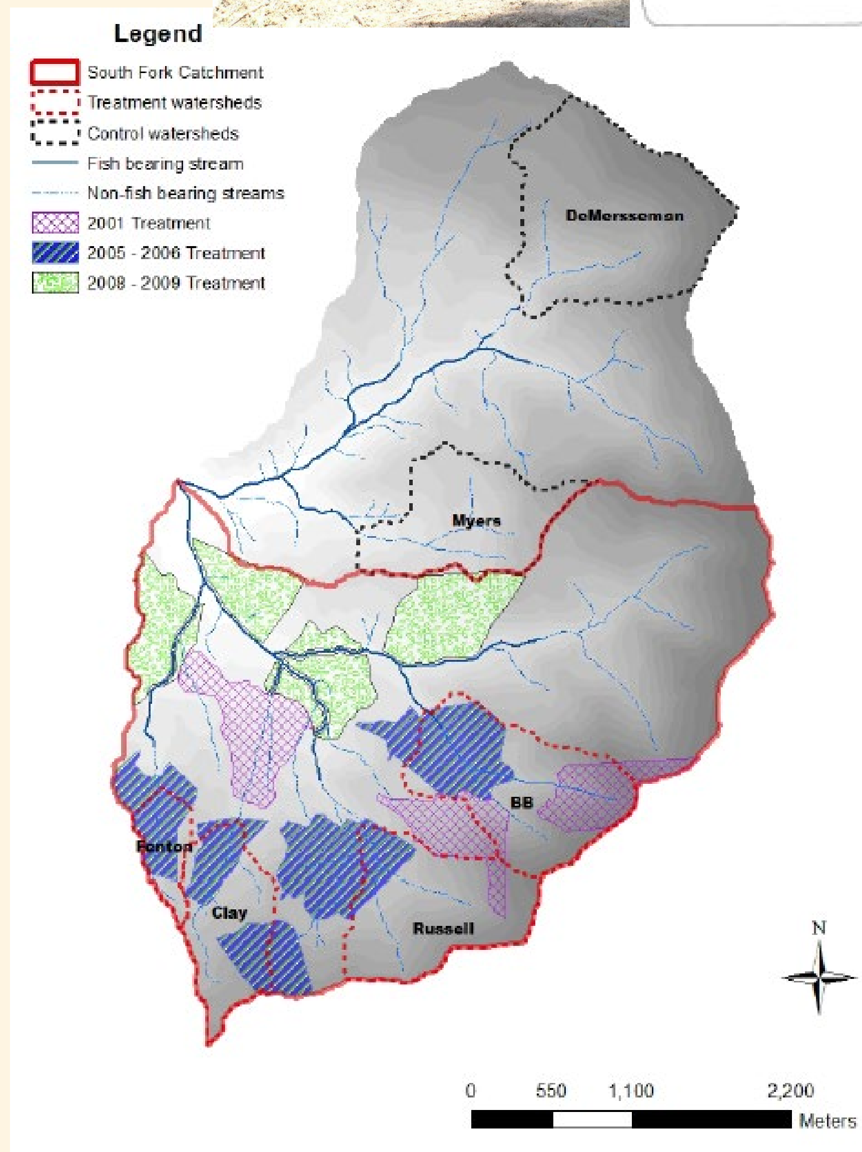
FWHMF Project Update
November 18, 2022

Oregon State University

FOREST ECOHYDROLOGY AND WATERSHED SCIENCE LAB

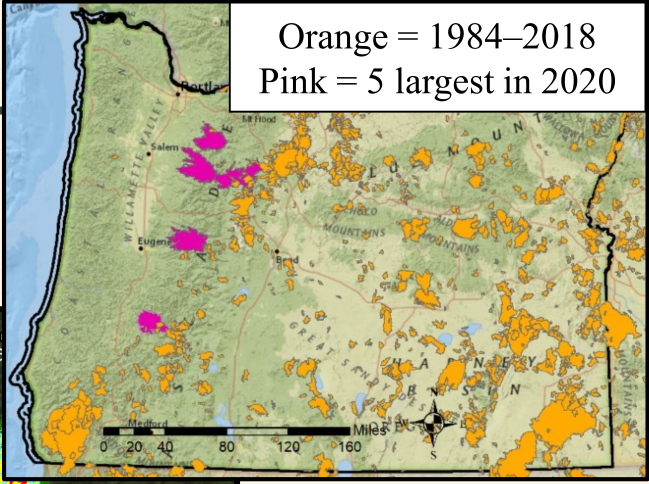
Hinkle Creek (2001–2011)

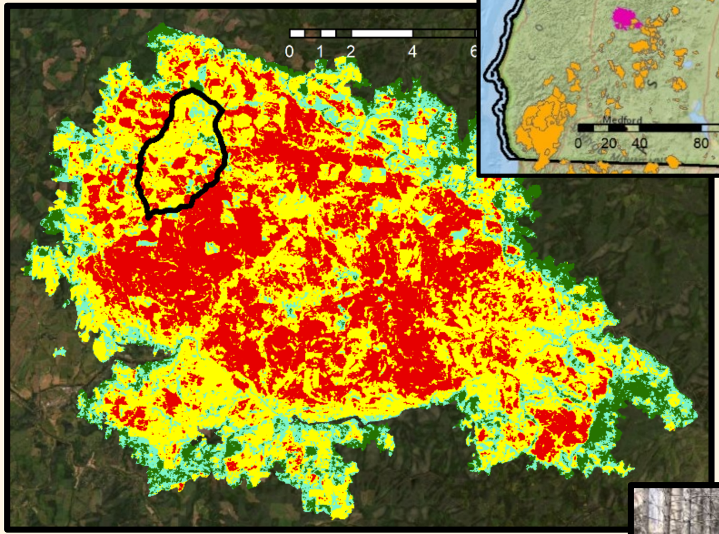
- S. Fork Hinkle: 2,117 ac (857 ha)
- Nested watersheds: Fenton, Clay, Russell, and Beebe
- Harvested 2005/06 & 2008/09: 704 ac (283 ha)
- Parameters measured:
    - streamflow
    - suspended sediment
    - stream temperature
    - chemical water quality
    - invertebrates
    - fish

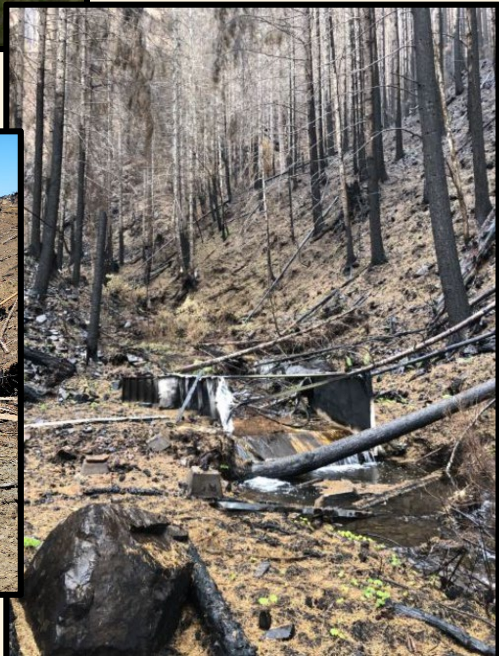


2020 Archie Creek Fire

- Umpqua River Basin
- 131,542 acres (531 km^2)
- Burn severity
  - High: 32.9 %
  - Moderate: 44.0 %
  - Low: 14.2 %
  - Unburned: 8.9 %
- Burned area included sub-watersheds from the original Hinkle Creek Watershed Study

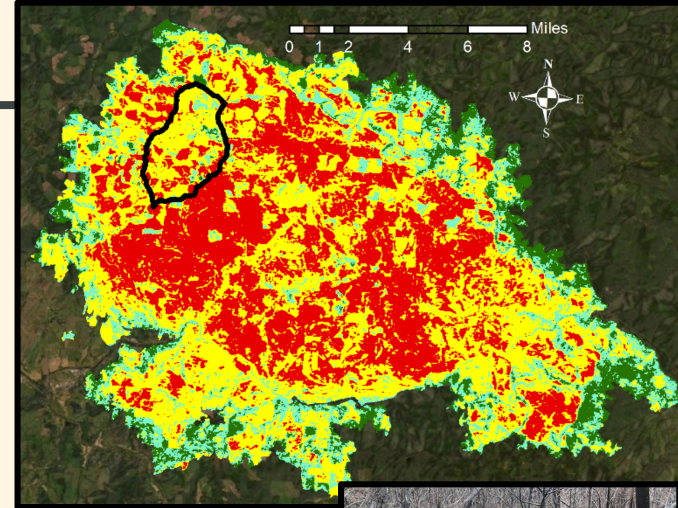


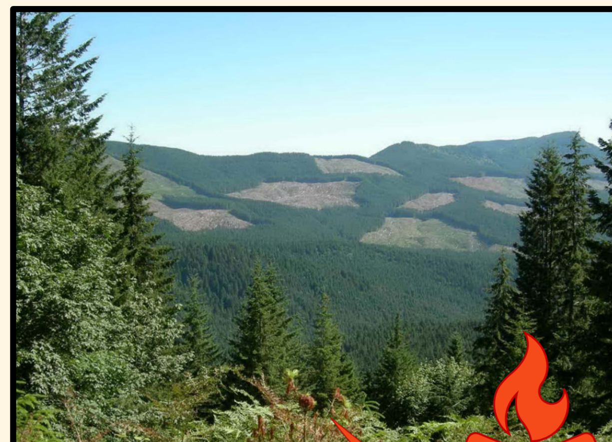




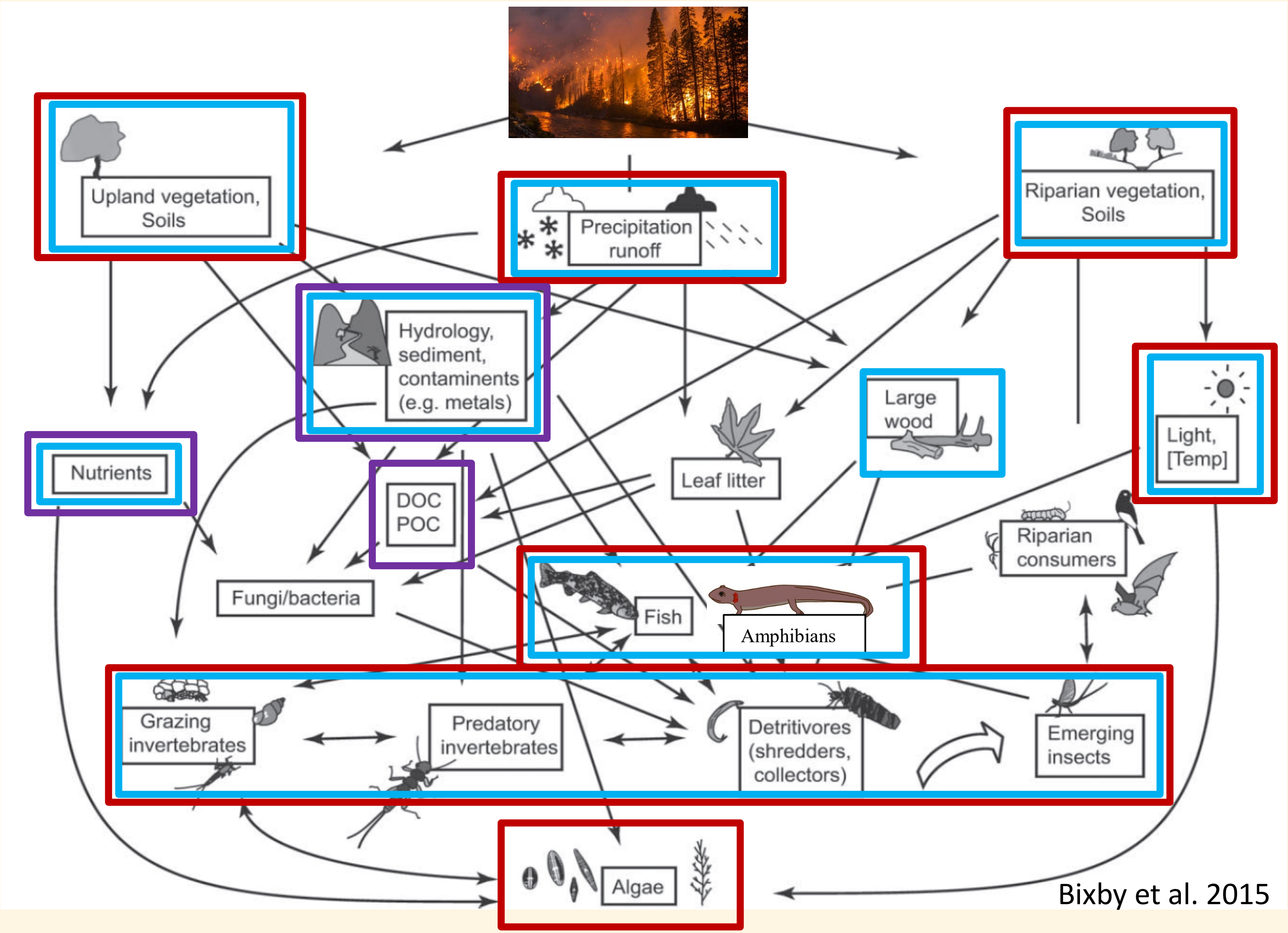
Objectives

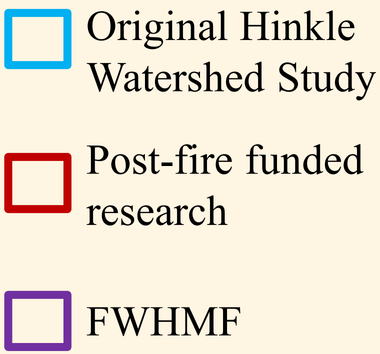
- Quantify wildfire effects on streamflow
- Quantify wildfire effects on water quality (N, P, C)
- Relate water quantity and quality responses to changes in primary productivity, fish abundance, and fish biomass
- Compare effects from wildfire to effects from forest harvesting by leveraging data from the original Hinkle Ck study





Wildfire impacts on a range of ecosystem components





Timeline

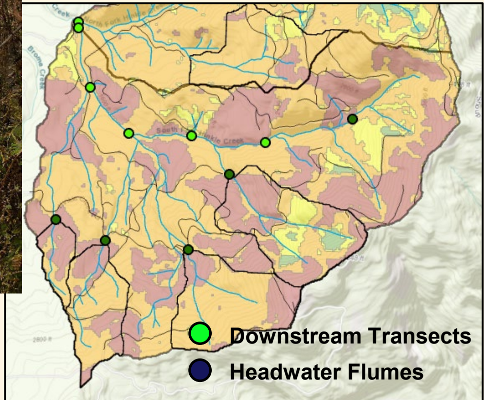
Activity	Year 1 (2022)				Year 2 (2023)				Year 3 (2024)	
	Su	Fa	Wi	Sp	Su	Fa	Wi	Sp	Su	Fa
Deploy ISCOs for water samples	■									
Reinstall flumes to quantify streamflow	■									
Water quality and quantity monitoring	■	■	■	■	■	■	■	■		
Lab processing of water quality samples	■	■	■	■	■	■	■	■		
Fish, amphibian, primary productivity sampling (previously funded)	■				■					
Erosion, TSS, DOC, stream temperature, soil, and vegetation sampling (previously funded)	■	■	■	■	■	■	■	■		
Data analysis		■	■			■	■			
Dissemination of results at professional meetings (e.g., SFA, AGU) and FWHMF annual meeting		■	■			■	■			■
Manuscript writing and submission							■	■	■	■

Stage and discharge

- Stage: Pressure transducers and staff gauges installed at 11 sites through stream network
- Barometric pressure: 2 centrally located barometers installed across study region
- Discharge: Spring 2022 re-installed Montana flumes in S. Fork headwater streams to facilitate comparison with original HCWS



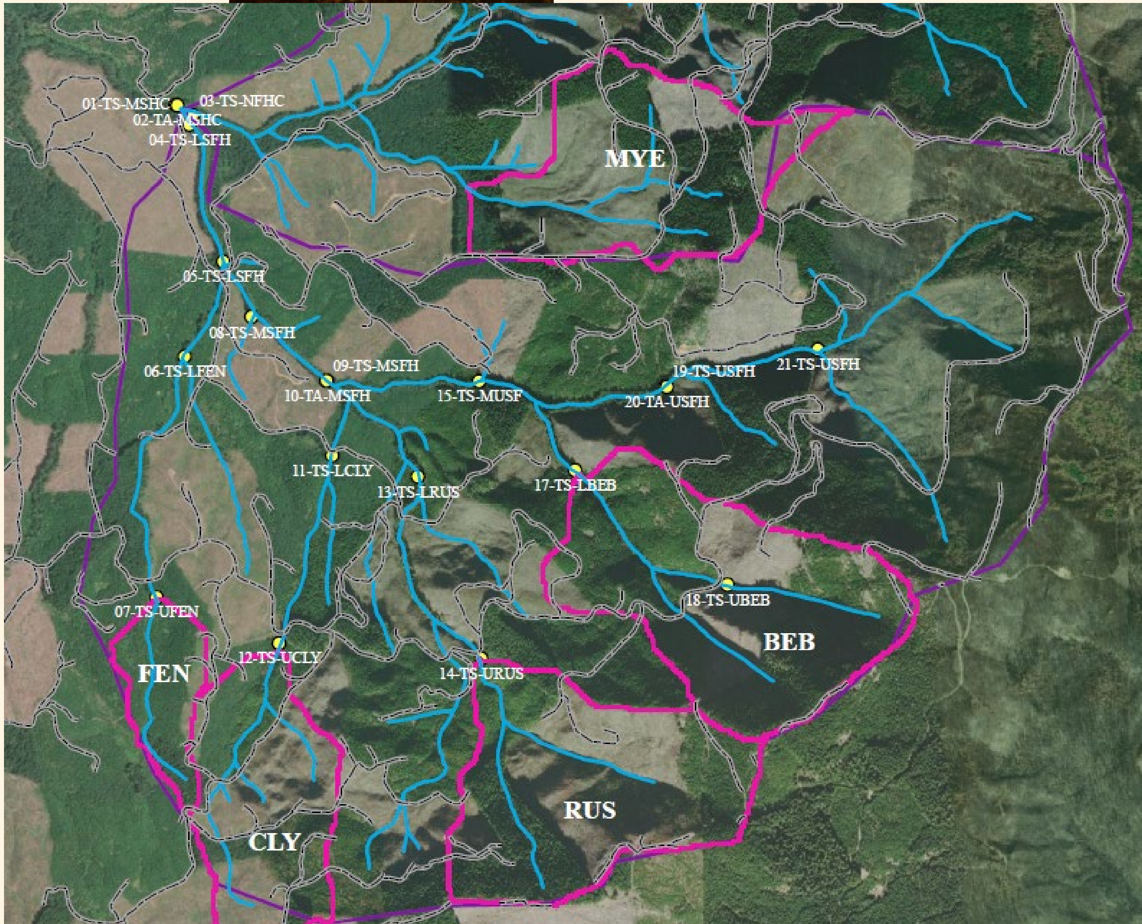


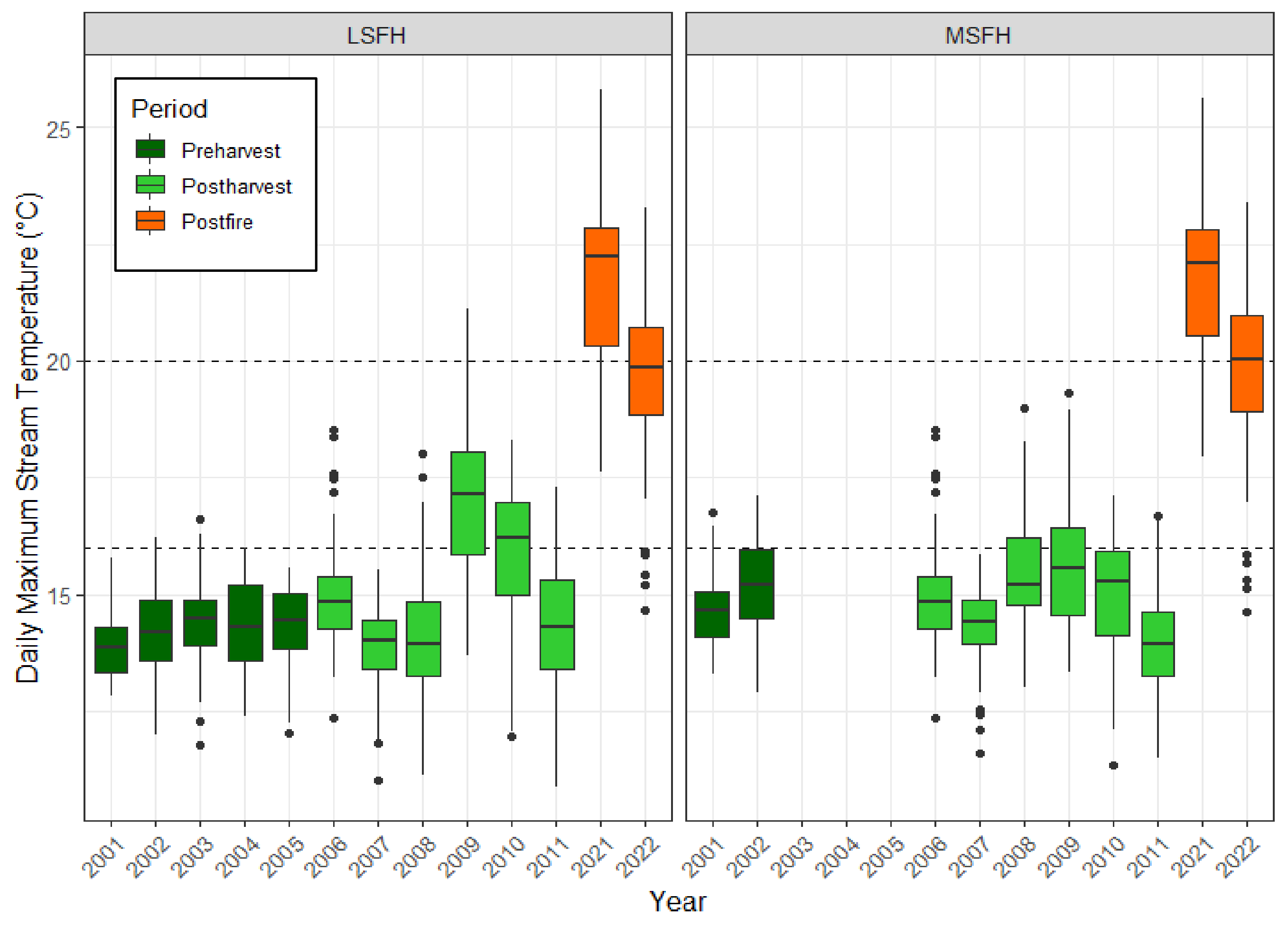
Stream and air temperature

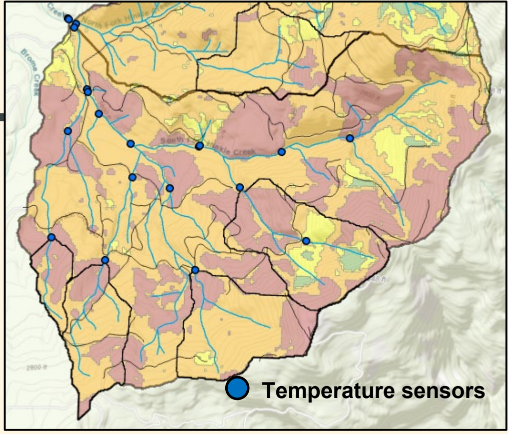
- Installed across the stream network:
    - 17 stream temperature sensors
    - 3 air temperature sensors

- Sensors measure every 60 seconds and store data every 15 minutes



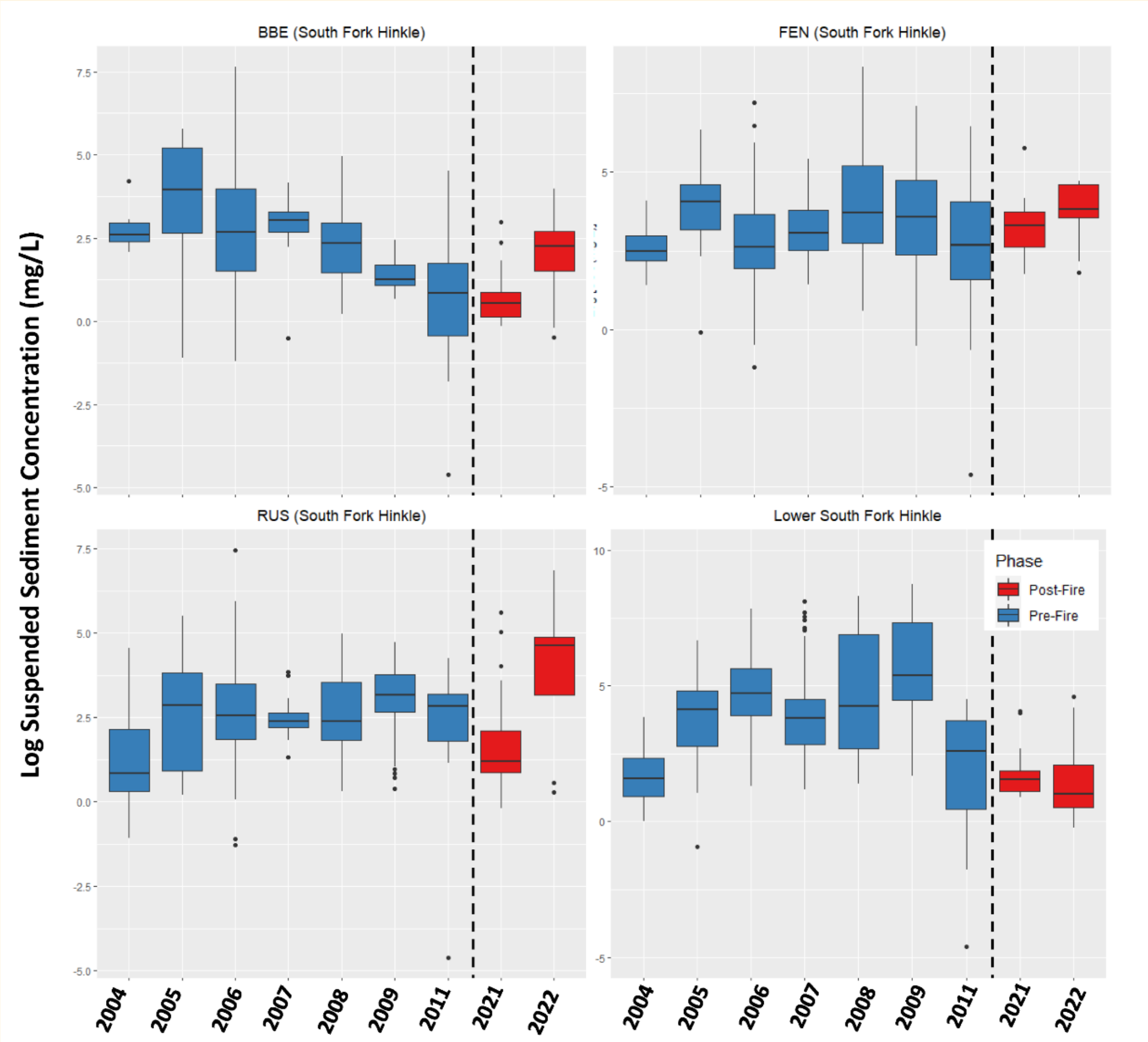
Stream temperature





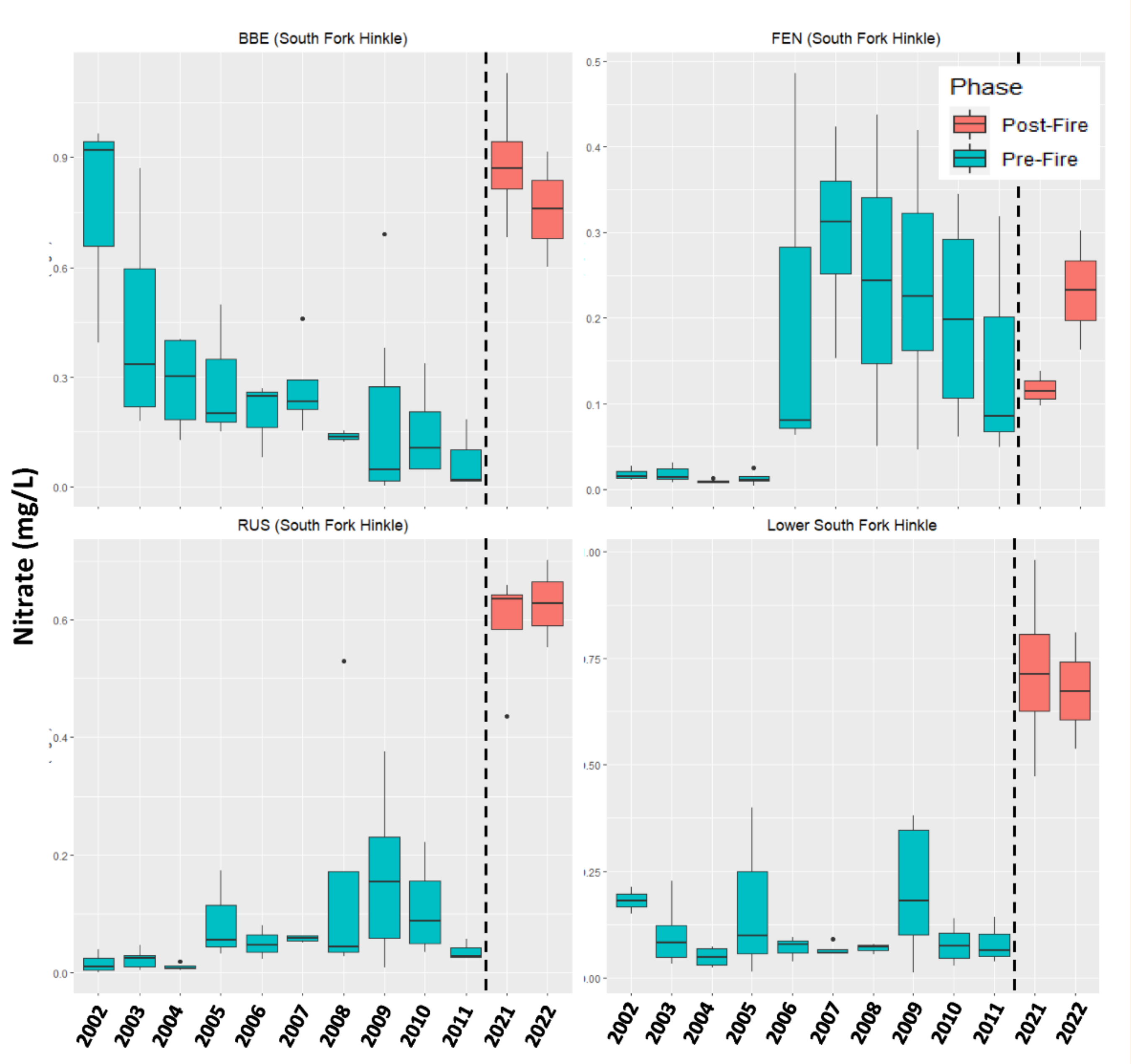
- Post-harvest: $T_{7daymax}$ 0.2–0.5 °C increase post-harvest
- Post-fire: $T_{7daymax}$ median values ~2.5–6.0 °C warmer than the highest median value in the pre- or post-harvest periods

Suspended sediment

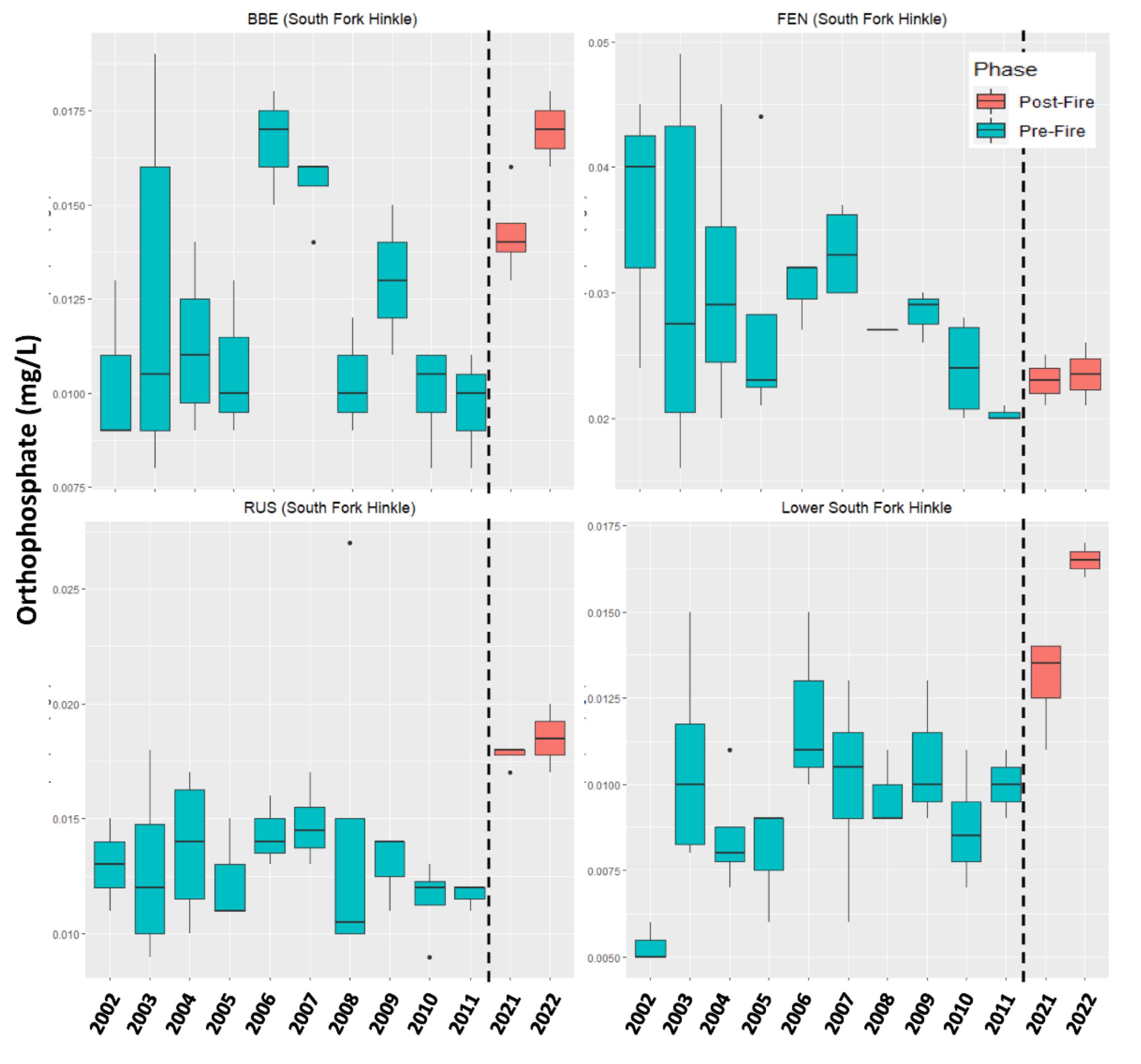


- **NOTE**: Different sampling regimes b/n original study and current study that still need to be resolved

Stream nutrients - nitrate



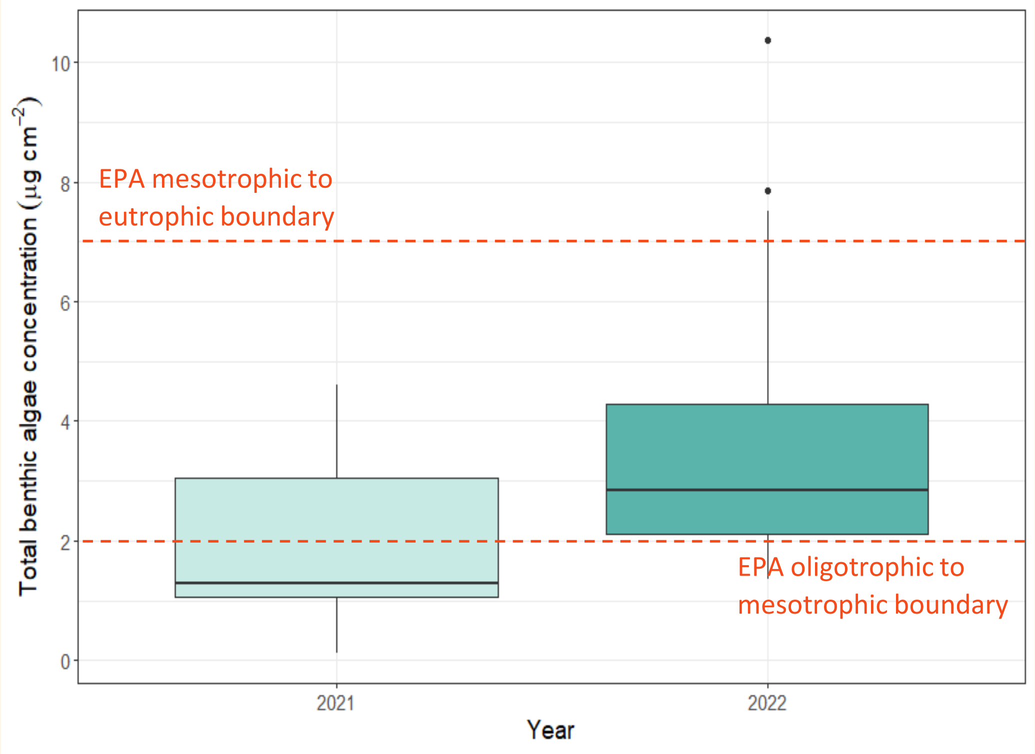
Stream nutrients - phosphorus



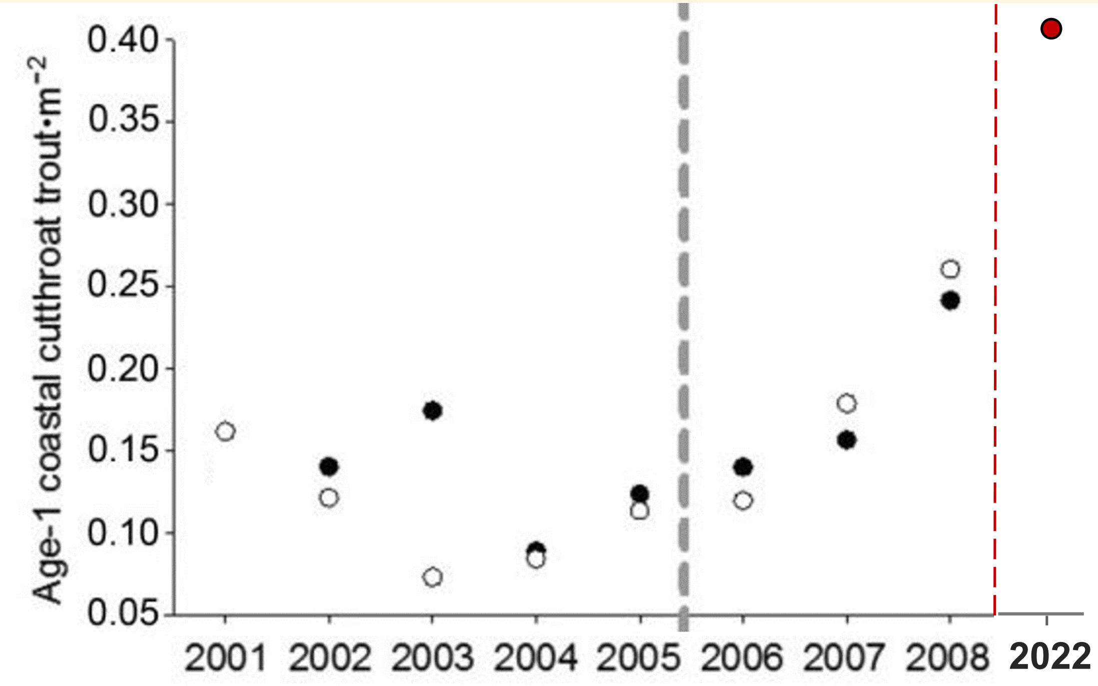
Primary productivity

- ~250 instantaneous measurements across the stream network monthly during the summer low flow period

- tiles deployed to periodically scrape and quantify algal biomass and chl-*a*

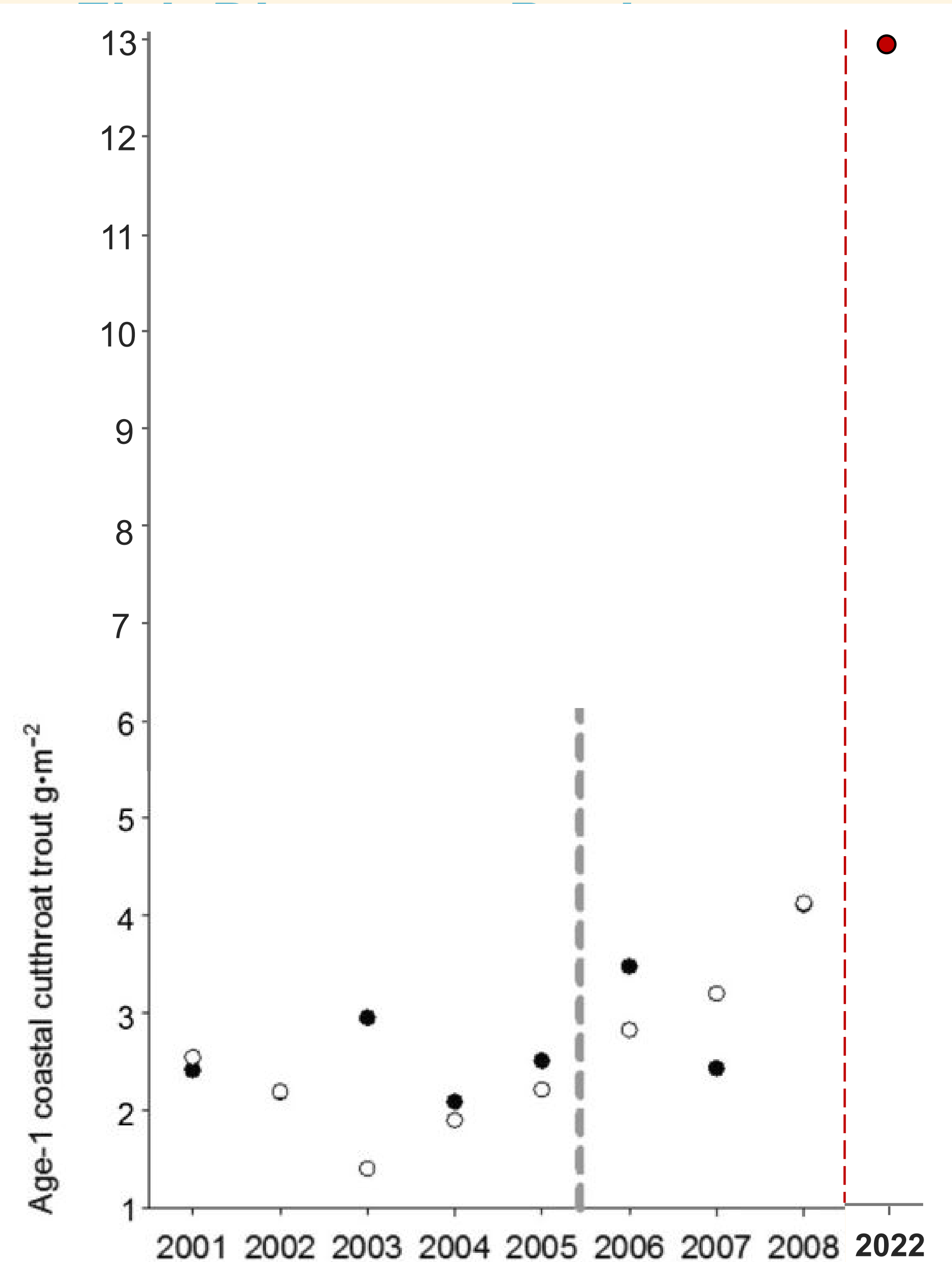


Fish Density - Pools



- Coastal cutthroat trout mean density over course of the study (tributaries & catchment): 0.04–0.36 fish m^{-2}
- Post-harvest net increase in tributaries: +0.11 fish m^{-2} (p = 0.091); suggestive evidence of a difference at catchment level
- Post-fire mean density at catchment level: 0.41 fish m^{-2}

Bateman et al., CJFAS, 2016



- Coastal cutthroat trout mean biomass over course of the study (tributaries & catchment): 0.69–5.19 g m^{-2}
- Post-harvest net increase in tributaries: +1.54 g m^{-2} (p = 0.047); suggestive evidence of a difference
- Post-fire mean biomass: 12.9 g m^{-2}

Bateman et al., CJFAS, 2016

Communications and engagement

Presentations

- Bladon, K.D., Cole, R.P., Donahue, D., Graham, E., Grieger, S., *McCredie, K., Myers-Pigg, A., Roebuck, J.A., *Roon, D.A., Scheibe, T., *Wampler, K.A., and Warren, D. 2022. Wildfire effects on catchment hydrology and biogeochemical processes. American Geophysical Union Fall Meeting. Dec. 12–16, 2022, Chicago, IL. (Invited)
- *McCredie, K., Bladon, K.D., and DeLuca, T.H. 2022. Disentangling pre- and post-fire forest management effects on water quality and soil health in the Hinkle Creek Watershed, Western Oregon. American Geophysical Union Fall Meeting. Dec. 12–16, 2022, Chicago, IL.
- Bladon, K.D., Warren, D.R., Roon, D.A., Swartz, A., *McCredie, K., and Ivie, J. 2022. Wildfire and post-fire management effects on water quantity, water quality, and aquatic ecology: The Hinkle Creek Watershed Study revisited. Nov. 3, 2022. Umpqua Hydro Breakfast, Roseburg, OR. (Invited)
- Roon, D.A., Bladon, K.D., Warren, D.R., Swartz, A., *McCredie, K., and Ivie, J. 2022. Wildfire and post-fire management effects on water quantity, water quality, and aquatic ecology: The Hinkle Creek Watershed Study revisited. Sep. 28, 2022. National Council for Air and Stream Improvement Fall Meeting, Vancouver, WA. (Invited)
- Warren, D.R., Roon, D.A., Swartz, A., Bladon, K.D. 2022. Cold-water fish persist in a stream system with elevated summer temperatures after a severe wildfire. Sustainable Forestry Initiative, Oregon State Implementation Committee Meeting. Sep. 21, 2022. Virtual.

Field tour

- Hinkle Creek Watershed Study Revisited: Wildfire effects on water quantity, water quality, and aquatic ecology. September 15, 2022, Hinkle Creek Watershed, OR. OFIC and NCASI members. (17 attendees)

Media

- Media: Timber Fires and High-Water Temperatures Didn't Impact an Oregon Trout Stream Population. Sport Fishing. Oct. 17, 2022. https://www.sportfishingmag.com/news/timber-fires-high-water-temperatures-didnt-impact-oregon-trout-stream-population/.
- Media: Warmer stream temperatures in burned-over Oregon watershed didn't result in fewer trout. PhysOrg. Oct. 4, 2022. https://phys.org/news/2022-10-warmer-stream-temperatures-burned-over-oregon.html.

Publications

- Warren, DR., Roon, D., Swartz, A., and Bladon, K.D. 2022. Cold-water fish persist in a stream system with elevated summer temperatures after a severe wildfire. Ecosphere. 13(9): e4233. doi: 10.1002/ecs2.4233.

Student engagement or professional development

- Three MS students (Ivie, McCredie, Pimont)
- Six undergraduate field assistants
- Two post-doctoral scholars and one FRA

Acknowledgements

PI's on the original Hinkle Ck project:

- Arne Skaugset
- Bob Gresswell
- Judy Li
- Kermit Cromack
- Lisa Ganio
- Mick Adams

NASA

Oregon Forest & Industries Council
Sustainability. Science. Innovation. Growth.

Oregon State University

Forest Ecohydrology and Watershed Science Lab

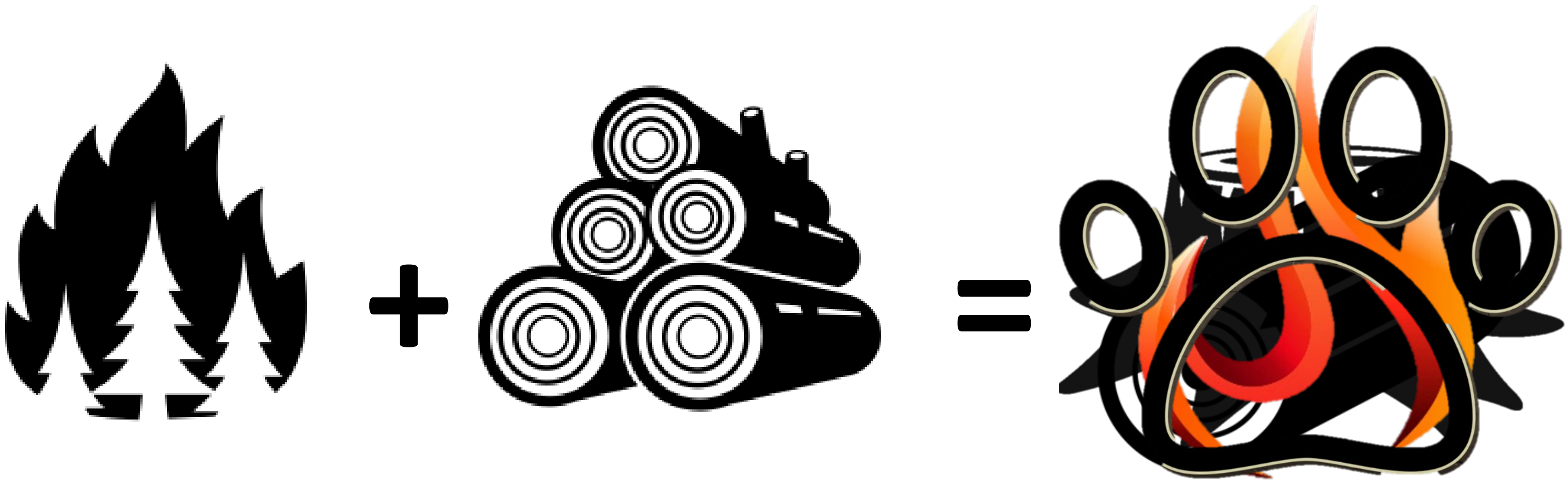
Forest Service U S Department of Agriculture

NCASI
Impact. Science. Solutions.

Roseburg
A Forest Products Company

Post-Wildfire Resurvey of Terrestrial Salamanders on Managed Forests

Tiffany Garcia, Jessica Homyack, Claudine Reynolds, Meg Krawchuk, and AJ Kroll



Direct and Cumulative Impacts

- Downed wood management
- Salvage logging
- Fire Intensity
- Species of Conservation Concern

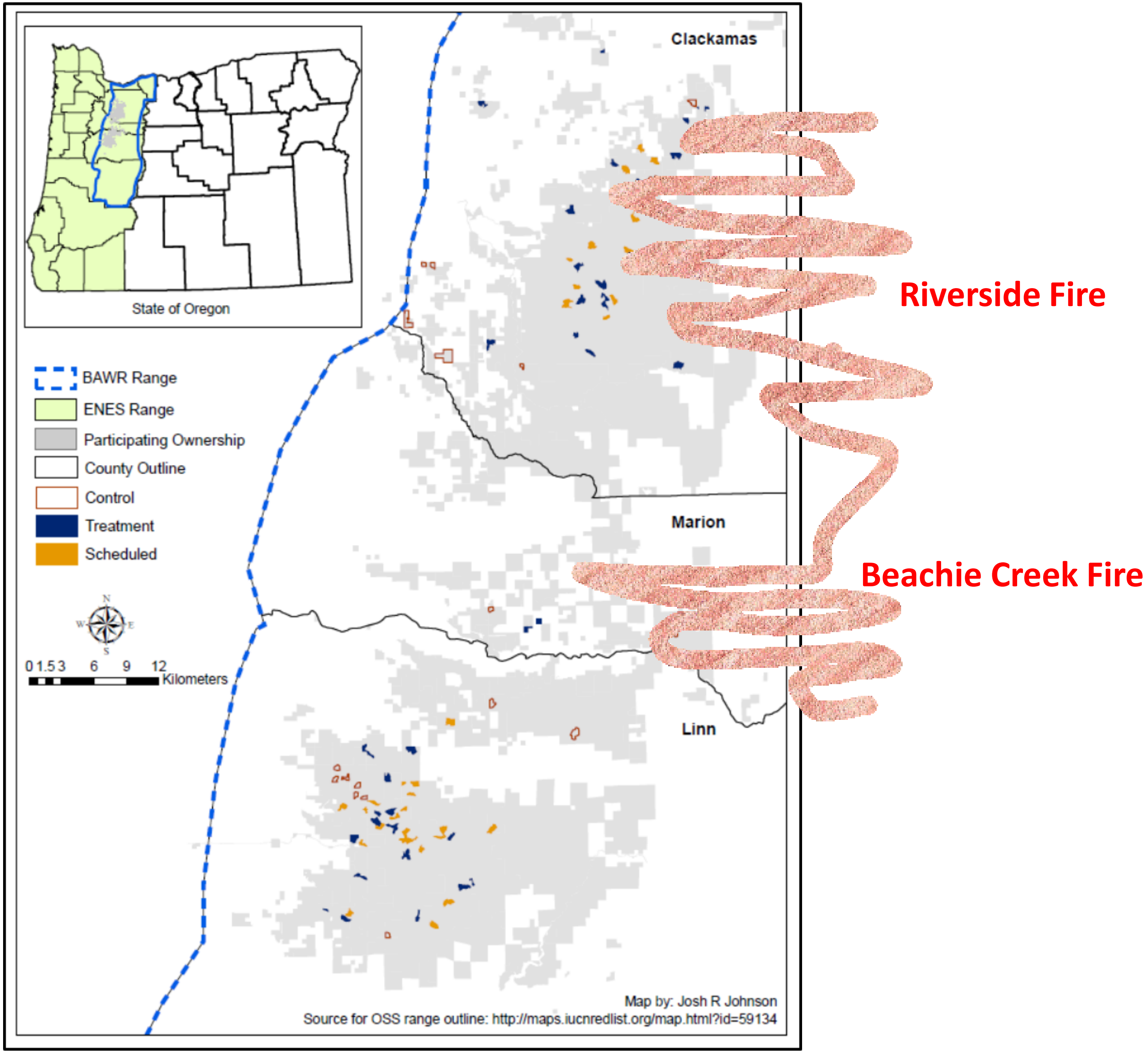
Ensatina eschscholtzii oregonensis- Ensatina

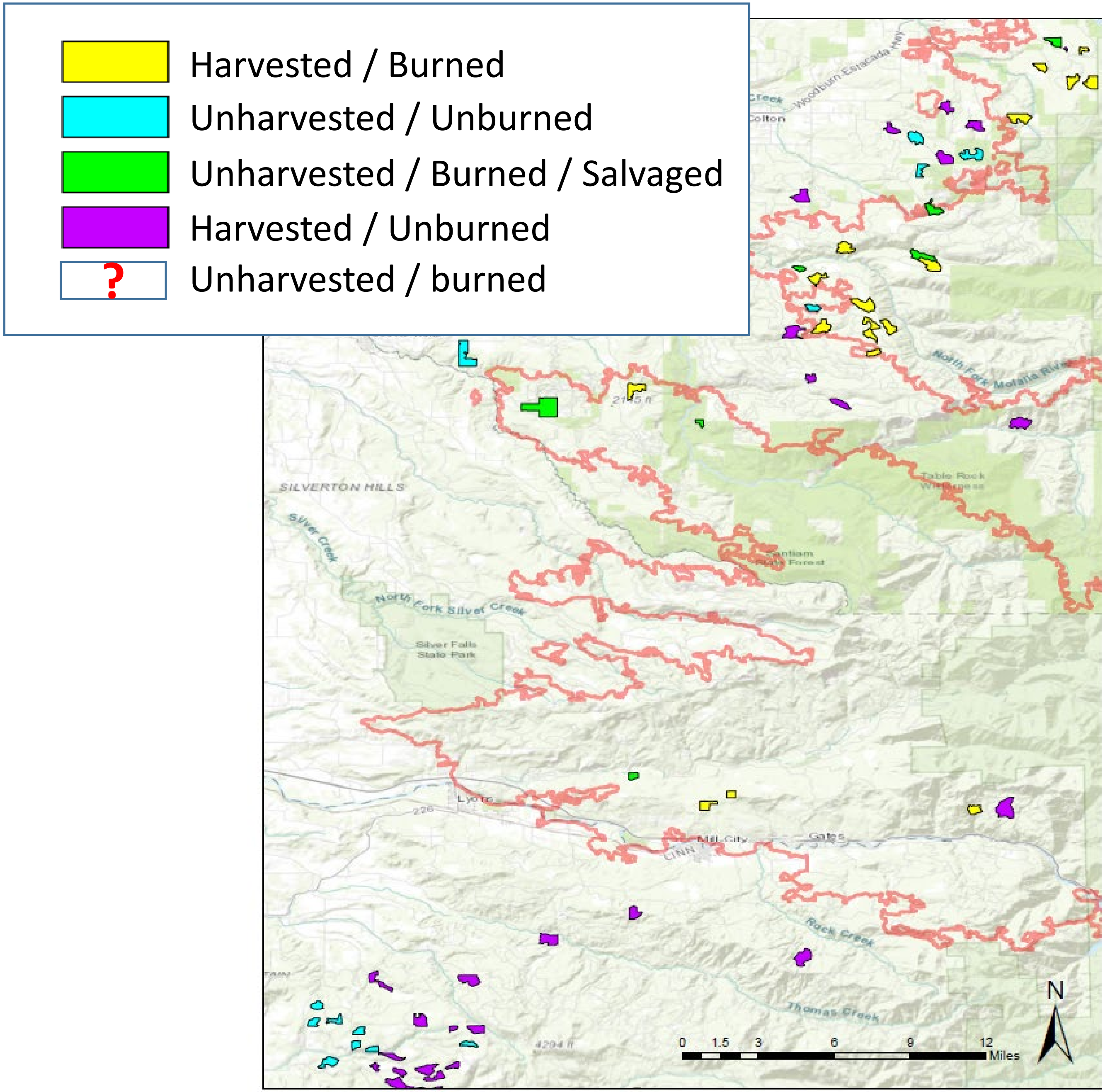
- Common Species in PNW forests
- Widely distributed in W. Oregon
- Large home and dispersal range
- Associated with downed wood
- Reduced occupancy and abundance probabilities after harvest

Batrachoseps wright- Oregon Slender Salamander

- Cryptic Species endemic to Oregon
- Narrow distribution
- Tiny home and dispersal range
- Oregon Priority Species
- Associated with downed wood
- No detected impact of harvest on occupancy probability

2013-2019 Terrestrial Salamander Survey




Harvested / Burned
Unharvested / Unburned
Unharvested / Burned / Salvaged
Harvested / Unburned
? Unharvested / burned
Colton
North Fork Molalla River
SILVERTON HILLS
Silver Creek
North Fork Silver Creek
Silver Falls State Park
Lyons
Mill City
Gates
Rock Creek
Thomas Creek
0 1.5 3 6 9 12
Miles
N

Treatment	# Resurvey Stands
Harvested / Burned	15
Unharvested / Unburned	15
Unharvested / Burned / Salvaged	7 + 8 new plots
Harvested / Unburned	15

Pre-Fire Harvest

Post-Fire Harvest

Project Objective: Quantify impacts of wildfire and harvest on salamander occupancy and abundance on managed timberlands.

1. **Impacts of pre- and post-fire harvest**
2. **Contextualize fire severity and downed wood condition**

Temporal and Spatial Lens:

- Use information gained from the salamander survey (2013-2019)
- Add new sites to increase statistical power for a treatment comparison using only 2022-2023 data

Methods:

- Survey spring 2023 and 2024- all 60 (or 75) sites
- 12 weeks field seasons with 3 person crew

Summary of Accomplishments

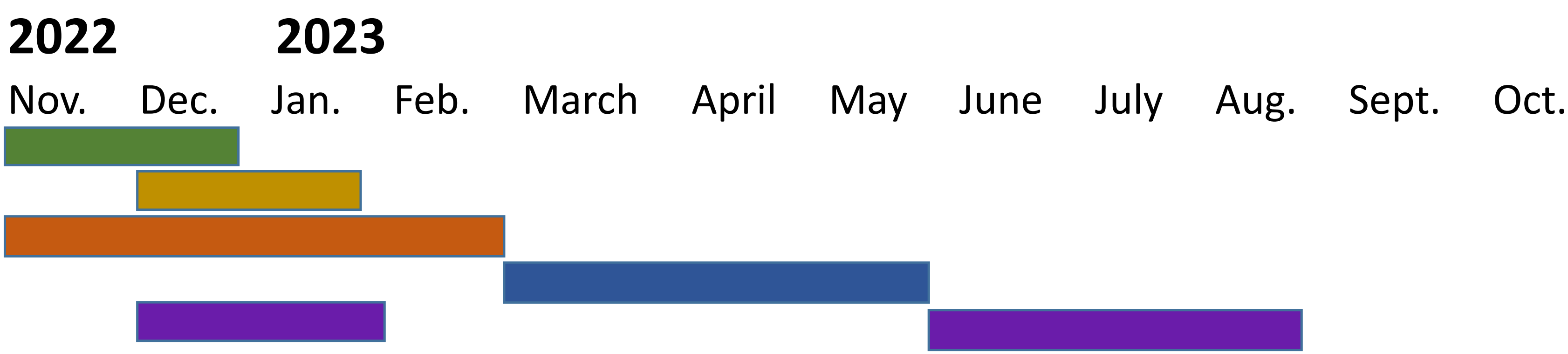
Site Selection

Field Housing and Hiring

Permissions and Permits

Survey Season

Database Construction



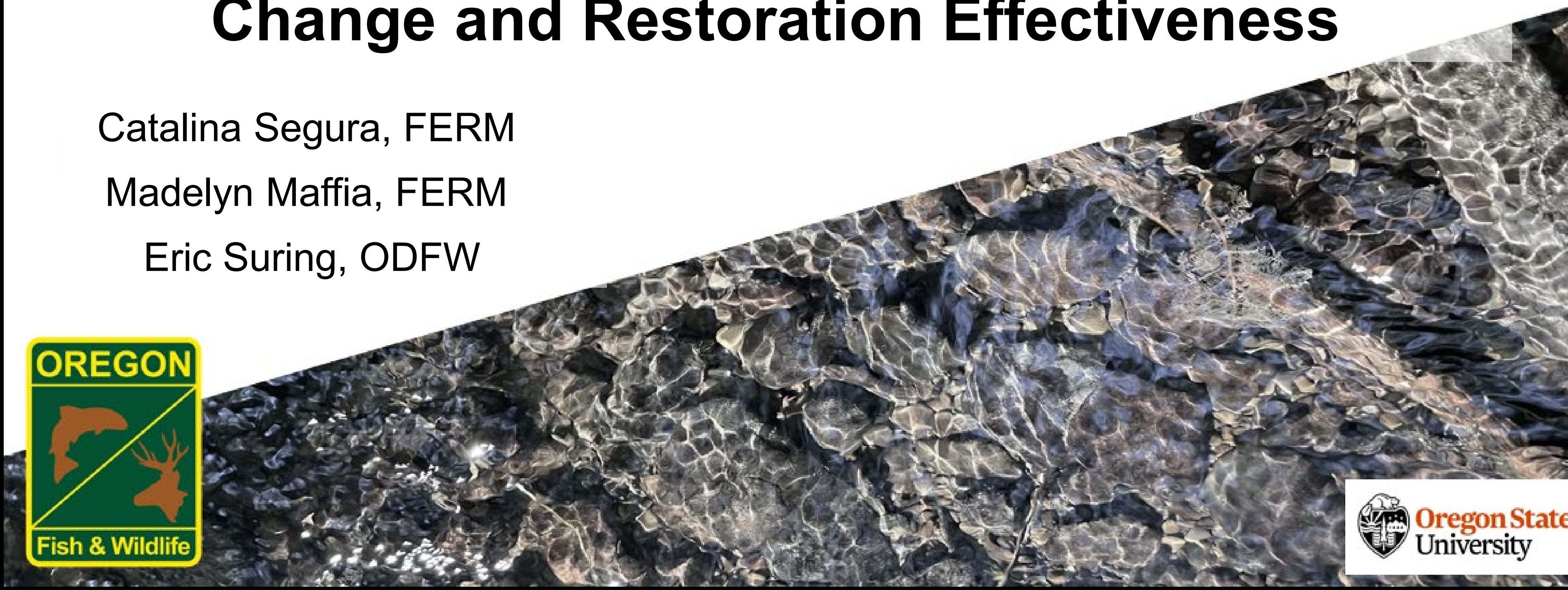
Acknowledgments

Where is it the most effective to restore streams? Salmon Habitat Restoration using Large Wood: Linking Stream Geomorphic Change and Restoration Effectiveness

Catalina Segura, FERM

Madelyn Maffia, FERM

Eric Suring, ODFW



Oregon Fish & Wildlife

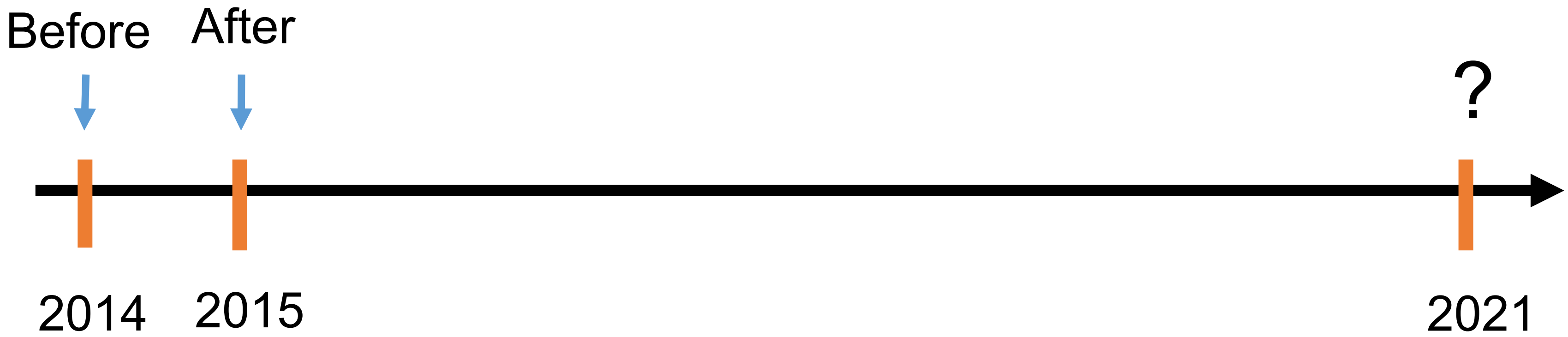
Oregon State University

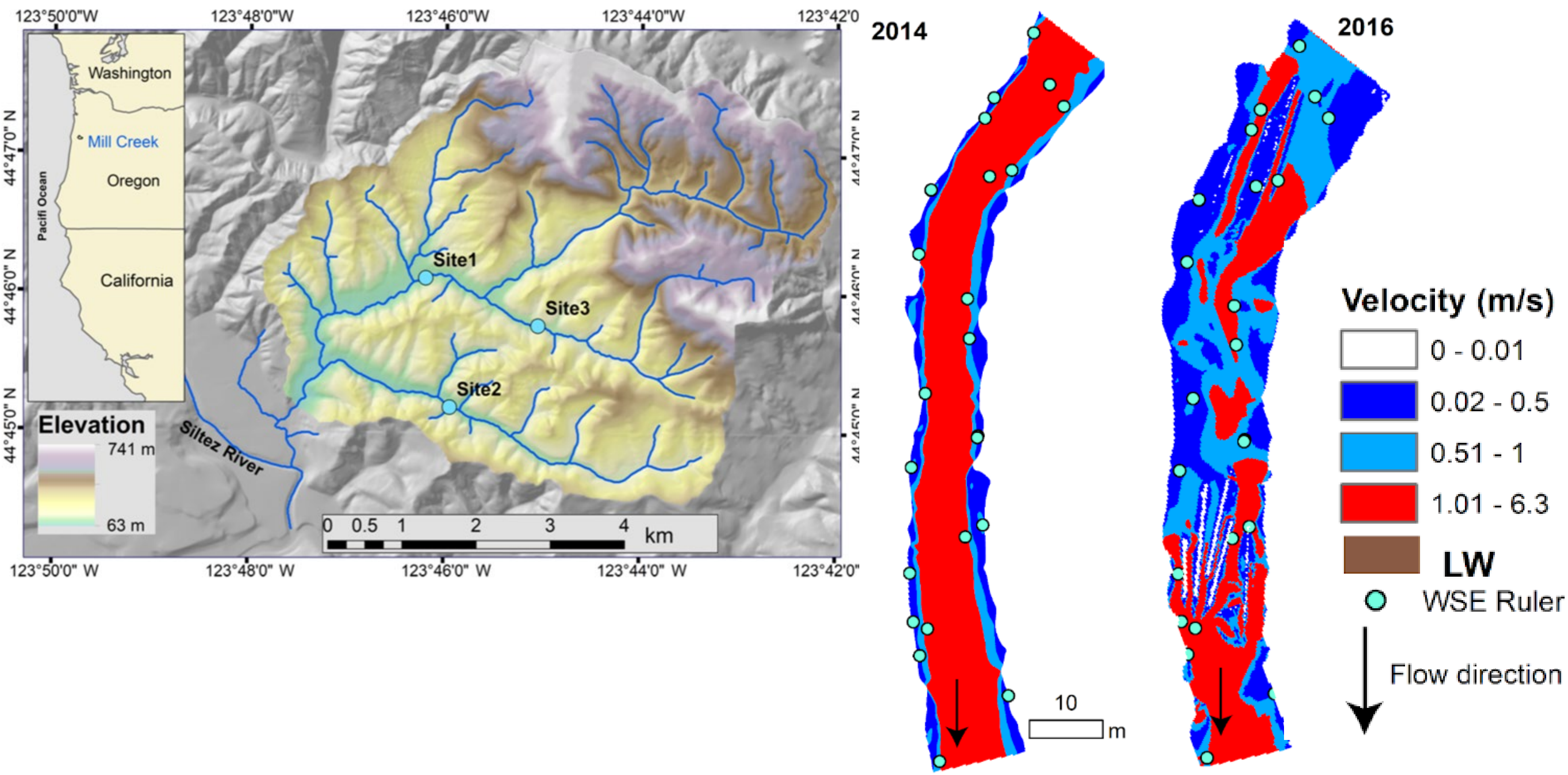
Introduction

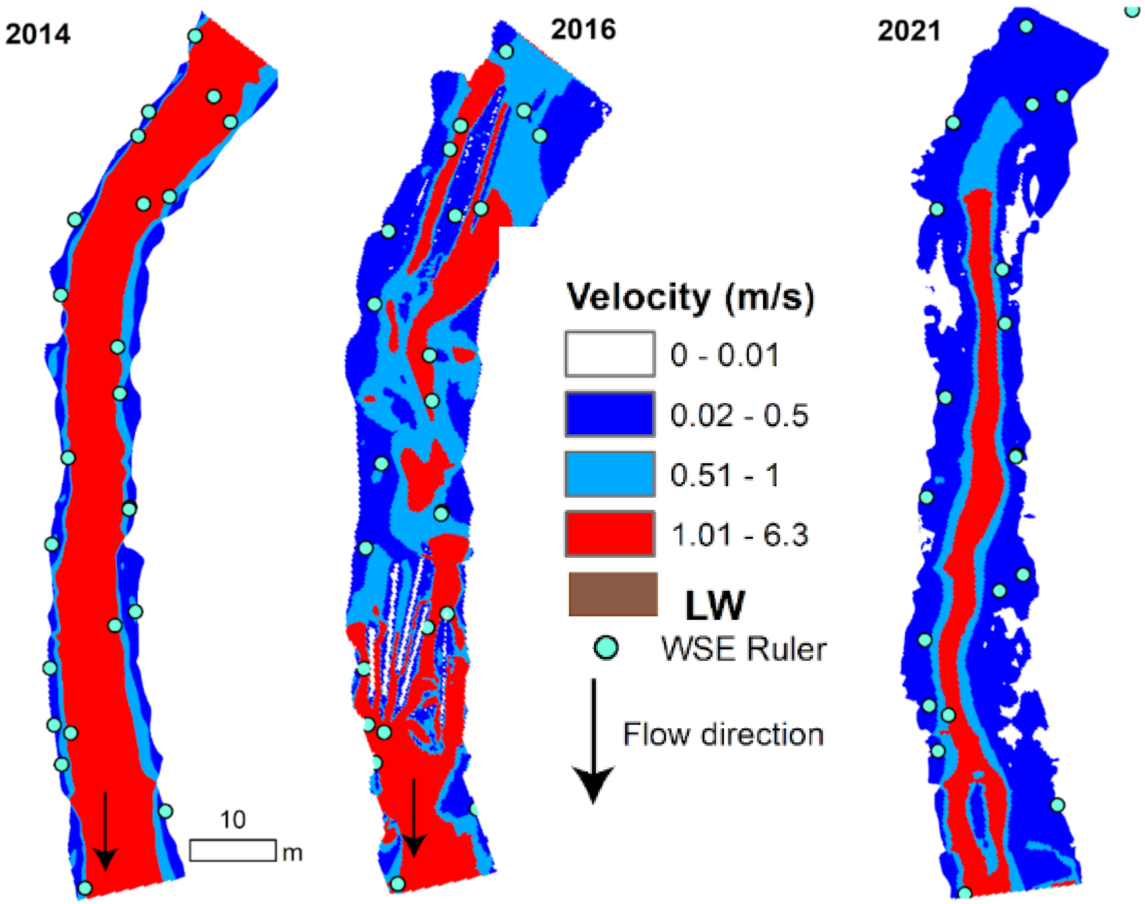
- We know that LW pieces promote fish habitat.
- In many systems the limiting factor to fish populations is availability of winter habitat.
- Natural wood recruitment leads to forced-pool-riffle morphologies.
- Historic riparian clear-cutting led to deciduous dominated forests and simplified channels.
- While wood additions are common, success is rarely quantified.

Objectives

1. Assess the resilience of the fish habitat changes observed one-year post LW restoration to changes observed 6-yrs post restoration.
2. Investigate the geomorphological changes triggered by LW restoration in three reaches based on the comparison of annual topographic surveys conducted 1-yr pre- to 5-yrs post-restoration.
3. Assess the stability of LW structures at the basin scale by comparing a wood survey conducted in 2016 to a new 2022 survey.
4. Investigate the relationship between local and basin scale habitat/geomorphic metrics and fish populations response after the restoration in the context of long-term fish population data.


Before
After
?
2014
2015
2021

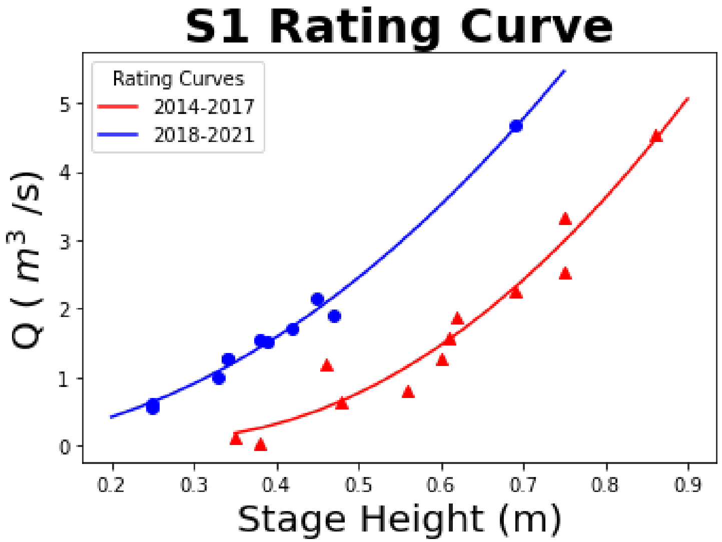

123°50'0"W
123°48'0"W
123°46'0"W
123°44'0"W
44°47'0" N
44°46'0" N
44°45'0" N
Washington
Mill Creek
Oregon
California
Pacifi Ocean
Site1
Site2
Site3
Siltez River
Elevation
741 m
63 m
0 0.5 1 2 3 4 km
2014
2016
Velocity (m/s)
0 - 0.01
0.02 - 0.5
0.51 - 1
1.01 - 6.3
LW
WSE Ruler
Flow direction
10 m

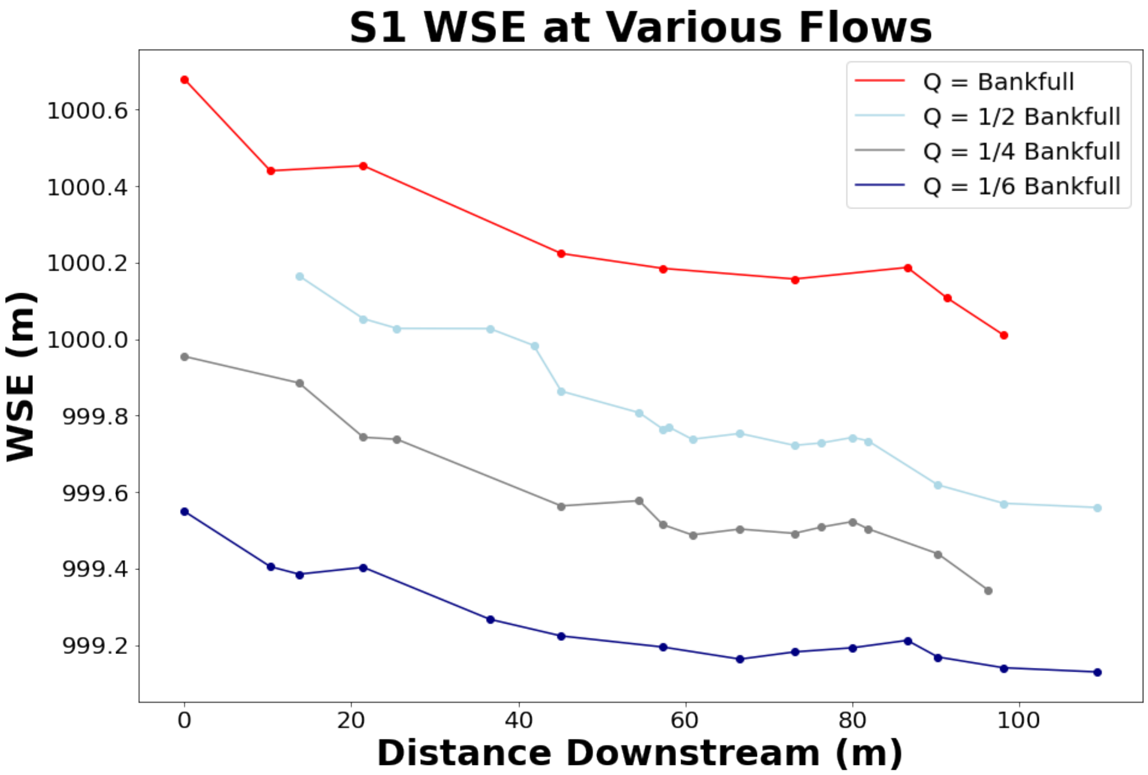


This indicate that habitat has continued to increase as the channel adjusts to the wood introductions.

Blue or light blue increased from 29.2% to 65.2%

Blue or light blue increase by 80% since 2014


S1 Rating Curve
Rating Curves
2014-2017
2018-2021
Q (m^3 /s)
Stage Height (m)


S1 WSE at Various Flows
Q = Bankfull
Q = 1/2 Bankfull
Q = 1/4 Bankfull
Q = 1/6 Bankfull
WSE (m)
Distance Downstream (m)

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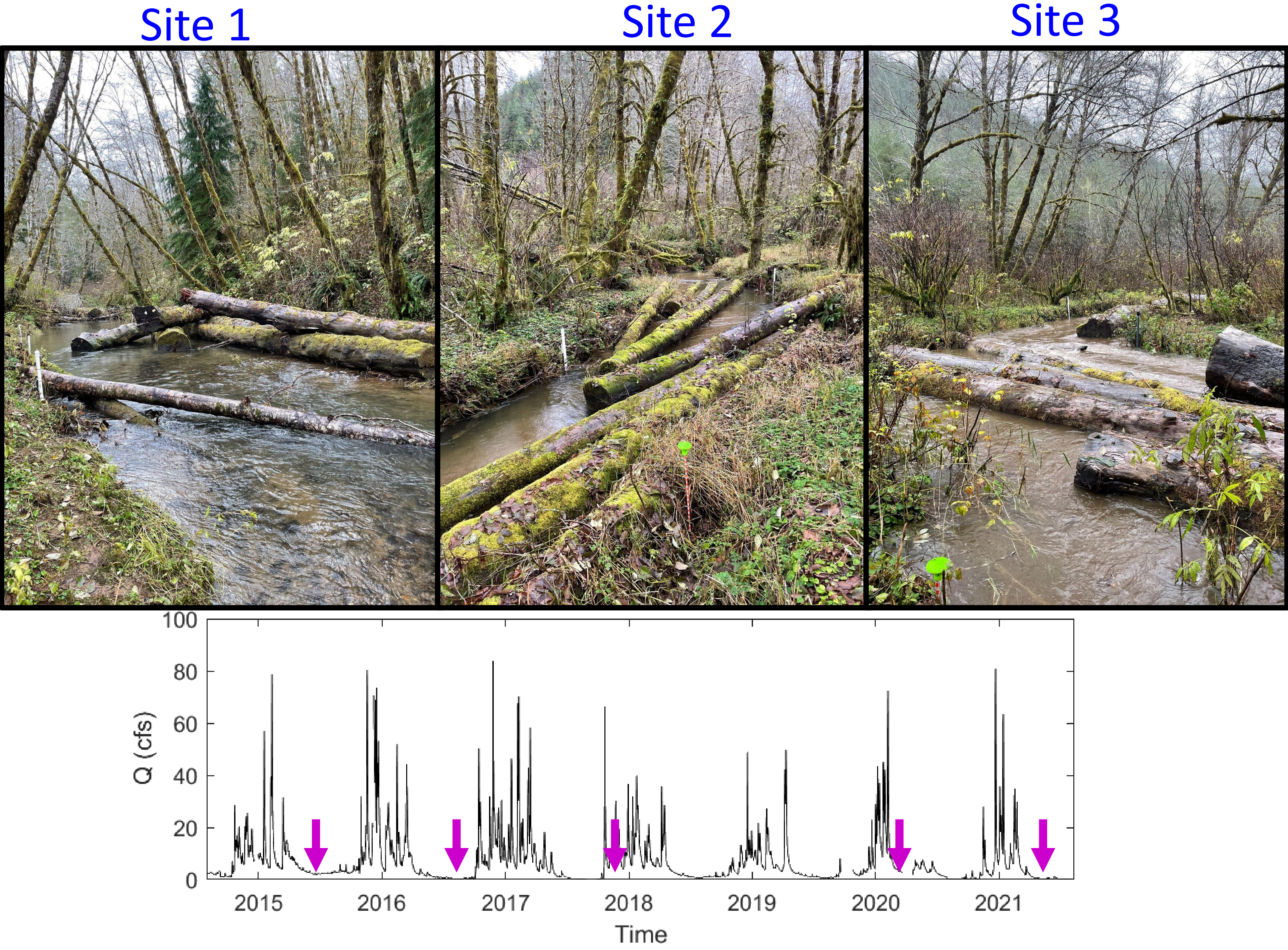
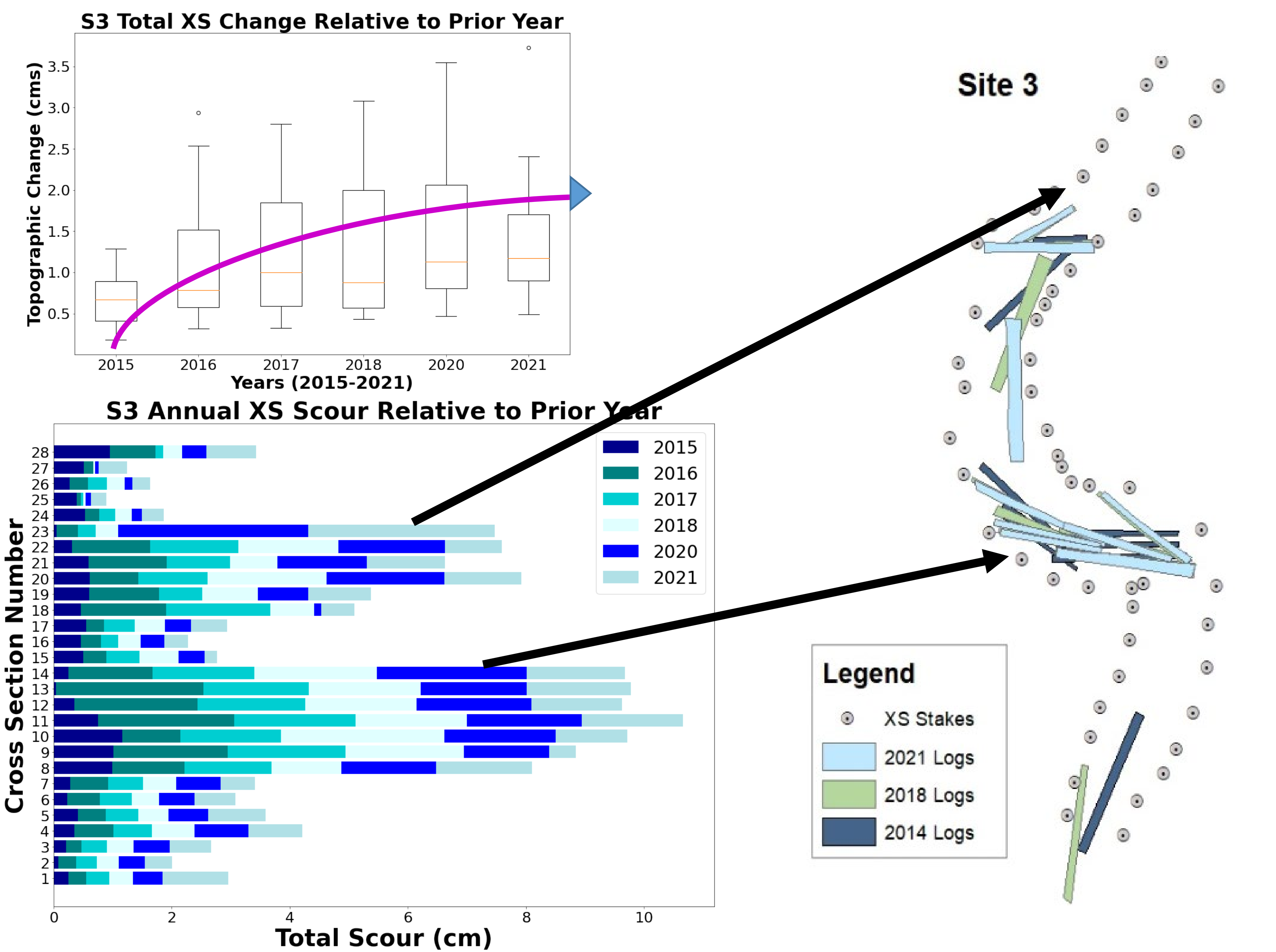
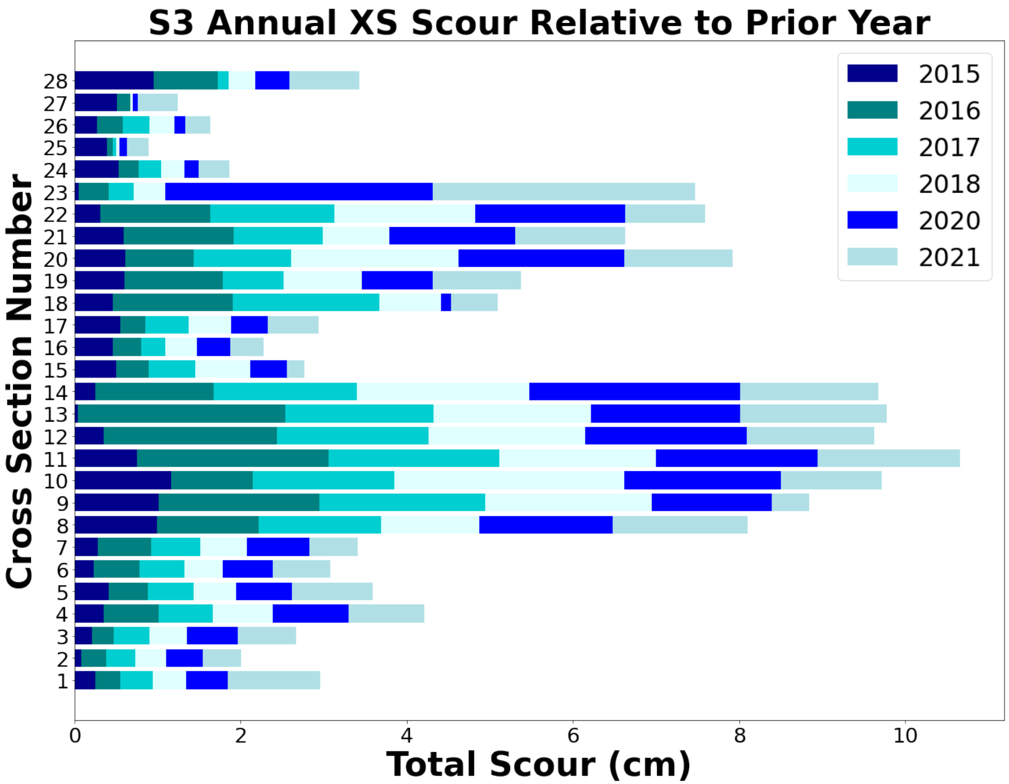

Site 1
Site 2
Site 3
100
80
60
40
20
0
Q (cfs)
2015
2016
2017
2018
2019
2020
2021
Time

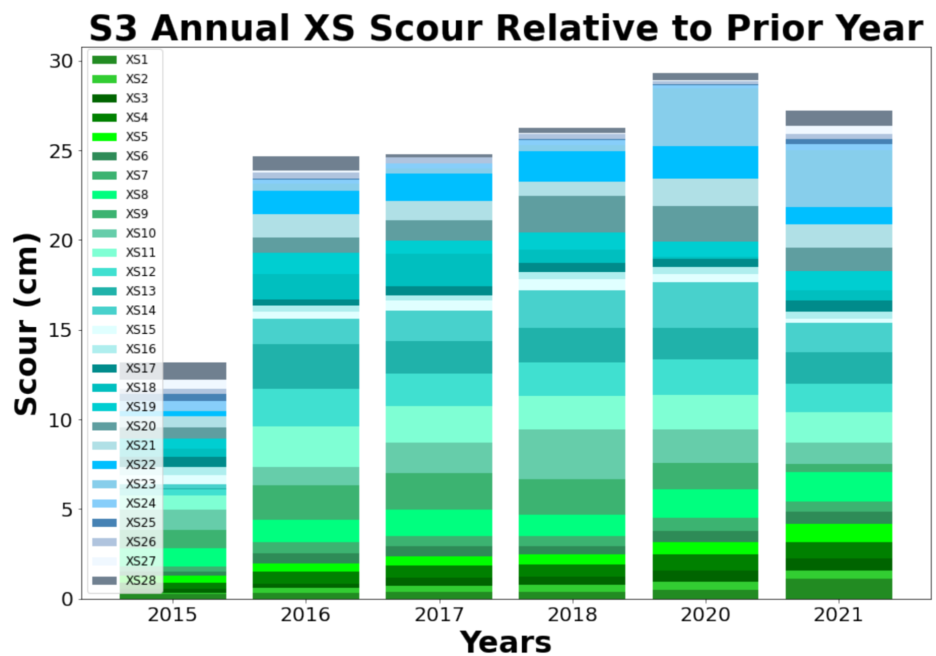


S3 Total XS Change Relative to Prior Year
Topographic Change (cms)
Years (2015-2021)
2015
2016
2017
2018
2020
2021
S3 Annual XS Scour Relative to Prior Year
Cross Section Number
Total Scour (cm)
Site 3
Legend
XS Stakes
2021 Logs
2018 Logs
2014 Logs



Most of the scouring has occurred around the LW (XS 7–14 and XS 18–23)

From the temporal perspective it is evident that most changes occurred 2020–2021



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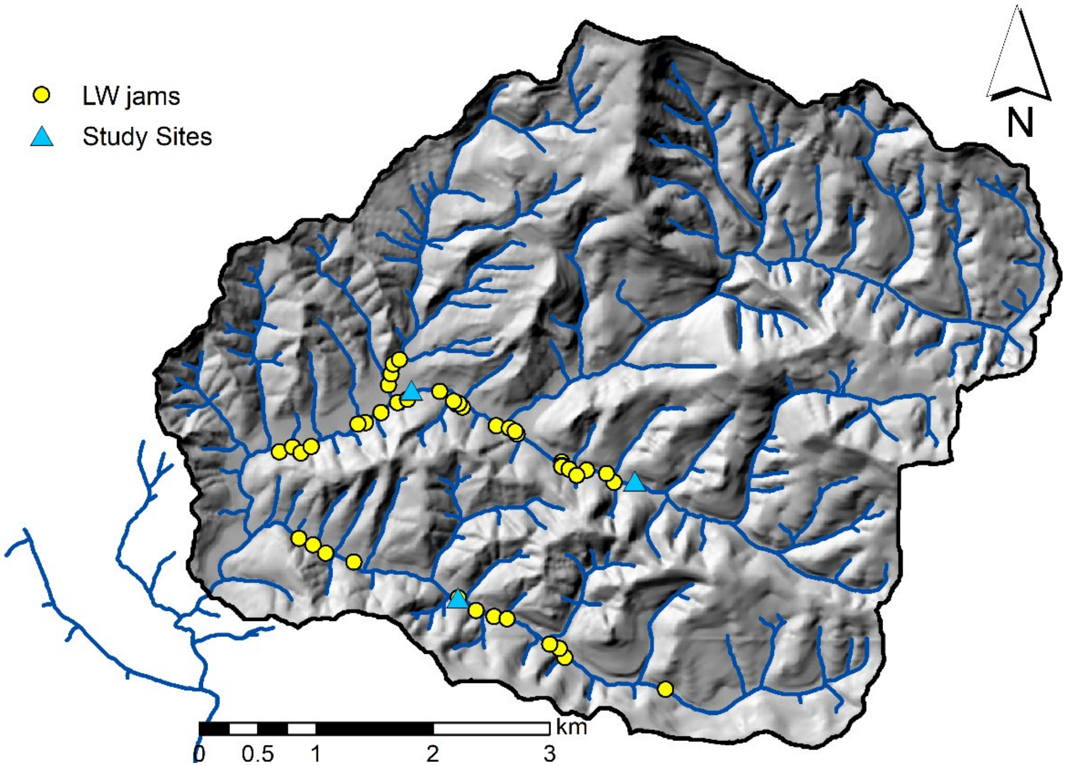

Last summer we measured every piece of LW larger than 10 cm in diameter and 1 meter in length

= 1600 pieces

For every log measured

- Diameter
- Length
- LW extent (Partial Spanning /Full Spanning)
- Orientation (Orthogonal/ Parallel /Oblique)

Every 100 meters we measured

- Channel confinement
- Floodplain connectivity






Objectives

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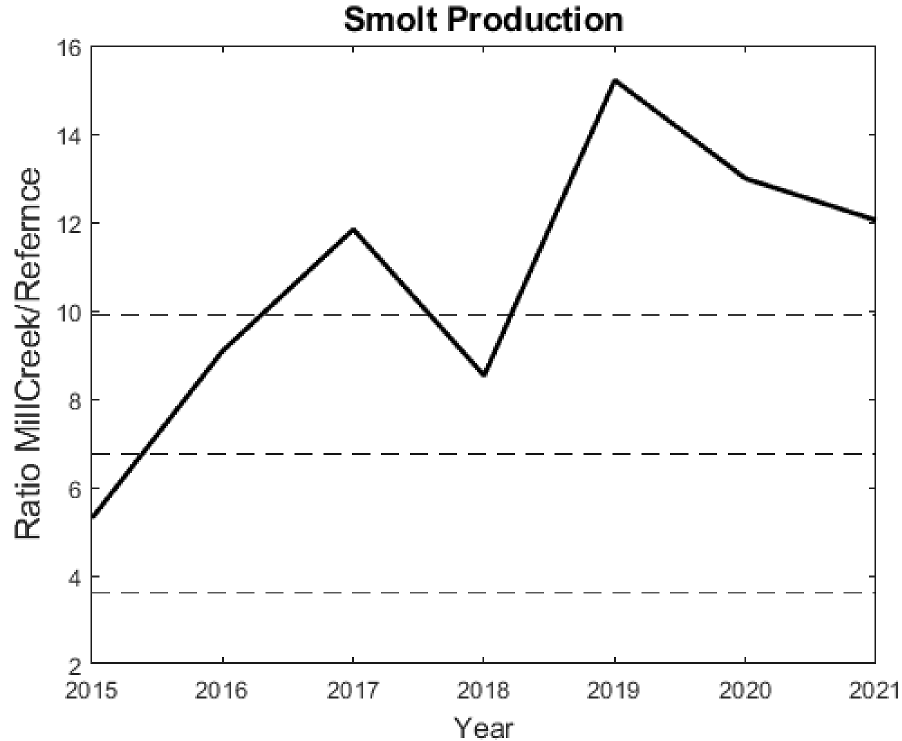
Preliminary results at the basin scale indicate increases in Mill Creek fish populations after the restoration in 2016.

We also have fish absence and presence data per tributary from electrofishing surveys.



Posters and presentations

- Presented to 2022 ODFW Salmonid Life Cycle Monitoring Symposium, June 8, 2022, presented by Madelyn Maffia
- A poster contribution to the American Geophysical Union Fall Meeting, December 12–16, 2022 will be presented by Madelyn Maffia
- A poster contribution to the Pacific Northwest Water Research Symposium, April 13-14, 2023, will be presented by Madelyn Maffia

Students involve in the project

- Madelyn Maffia, Master Student in Water Resources Science.
- Melissa Mauk, Sydney Anderson, and Will Potter, Undergraduate field assistants
- Michal Tutka, Graduate student in the department of Biological and Ecological Engineering advised by Dr. Desiree Tullos, is additionally partnering with us to investigate LW impact on flow depth and velocities of varying log jam orientations in the same sites where we have been working.
- Madelyn secured additional funding from the CoF SUGAR Program to an undergraduate technician,Christopher Neihoff, to assist with the basin-wide survey during the summer of 2022.

To do:

- Hydraulic modeling at bankfull flow for the three sites..
- Continue the analysis of 7 years of geomorphic information pre- (2014) and post (2015–2021) restoration at three reaches.
- Based on the field data collected last summer we will develop metrics of geomorphic response to orientation and volume of log jams to extrapolate data to the basin scale.
- Investigate the relationship between geomorphic metrics derived and fish populations at the tributary and basin scales.

Acknowledgements

- FWHMF
- Weyerhaeuser
- CoF

Weyerhaeuser

OREGON

Fish & Wildlife