Mapping and protecting rock habitat in the Cascades Mountains for the conservation of climate-sensitive species

WSU: Arjan Meddens, Lisa Shipley, Okikiola Alegbeleye, Ana Ferreira, Allison Stift, Meghan Camp, Amanda Stahl, Joe Celebrezze

USFS: Donald Brown, Tara Chestnut, Andrew Hudak, Adam Duarte, Ben Bright, Doug Glavich

WDFW: Keith Folkerts, Jeff Azerrad, Julia Michalak

NPS: Jason Ransom, Sallie Beavers

NASA Biological Diversity & Ecological Conservation Team Meeting, May 27-29, 2025

Motivation

- Broken rock habitats are key to survival of many species

- Data to inform habitat management has been limited in scale, scope, and level of detail

State and federal agencies need to characterize broken rock habitat quality:

(1) improve habitat and species monitoring and mapping

(2) plan future conservation areas

(3) inform day-to-day management activities

The Plan:

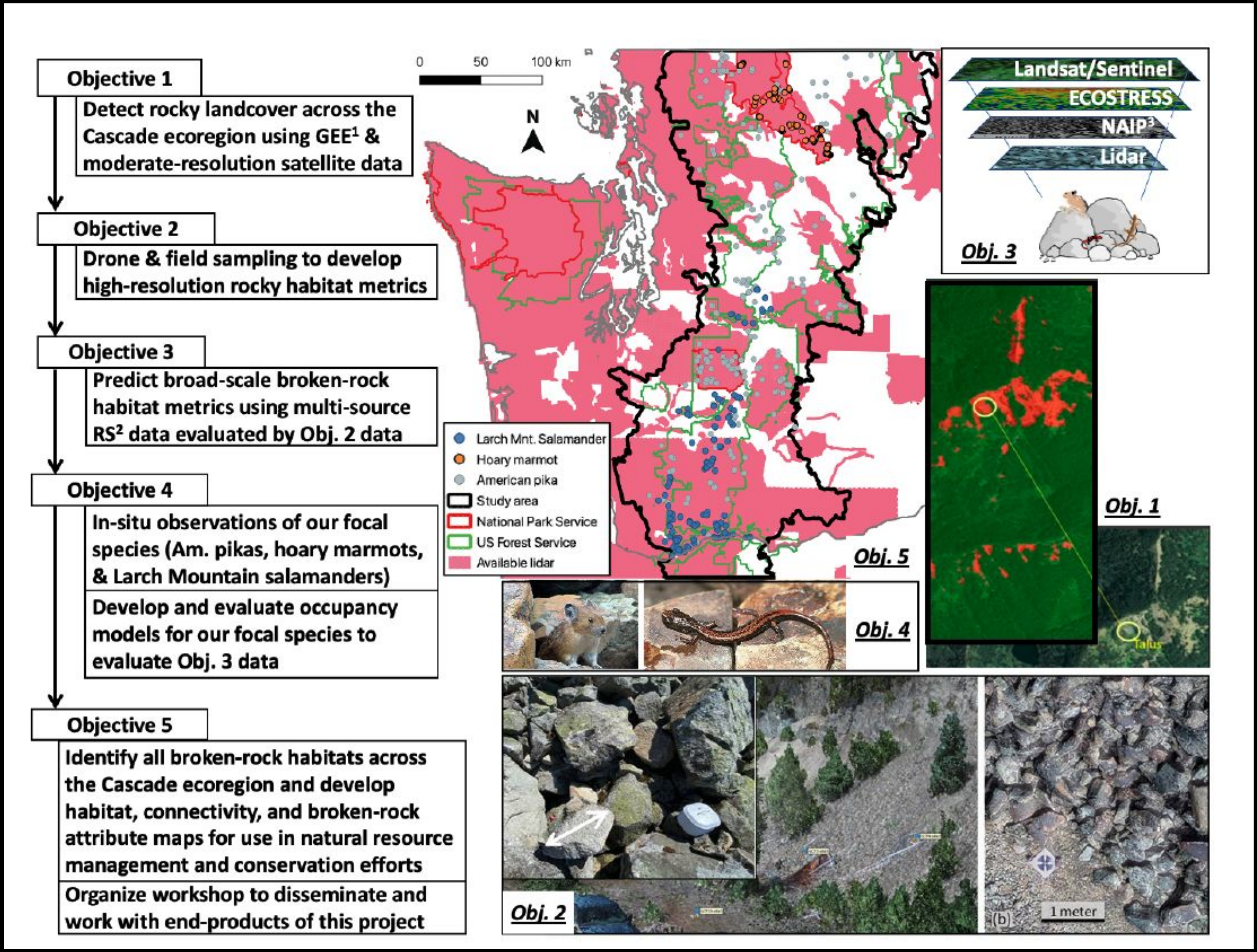
O1. Detect rocky cover

O2. Drone and field sampling at select sites

O3. Predict rocky habitat metrics

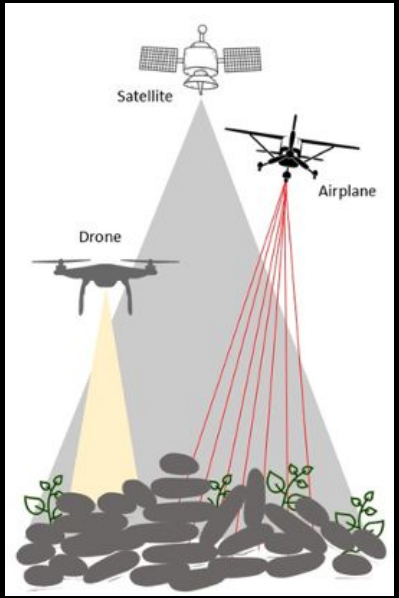
O4. Develop species occupancy models

O5. Develop maps/data for management



Many moving parts

A). Review on measuring rocky habitat



D). Handheld photogram-metry to syste-matically characterize rock habitat

B). Classifying rocky land cover

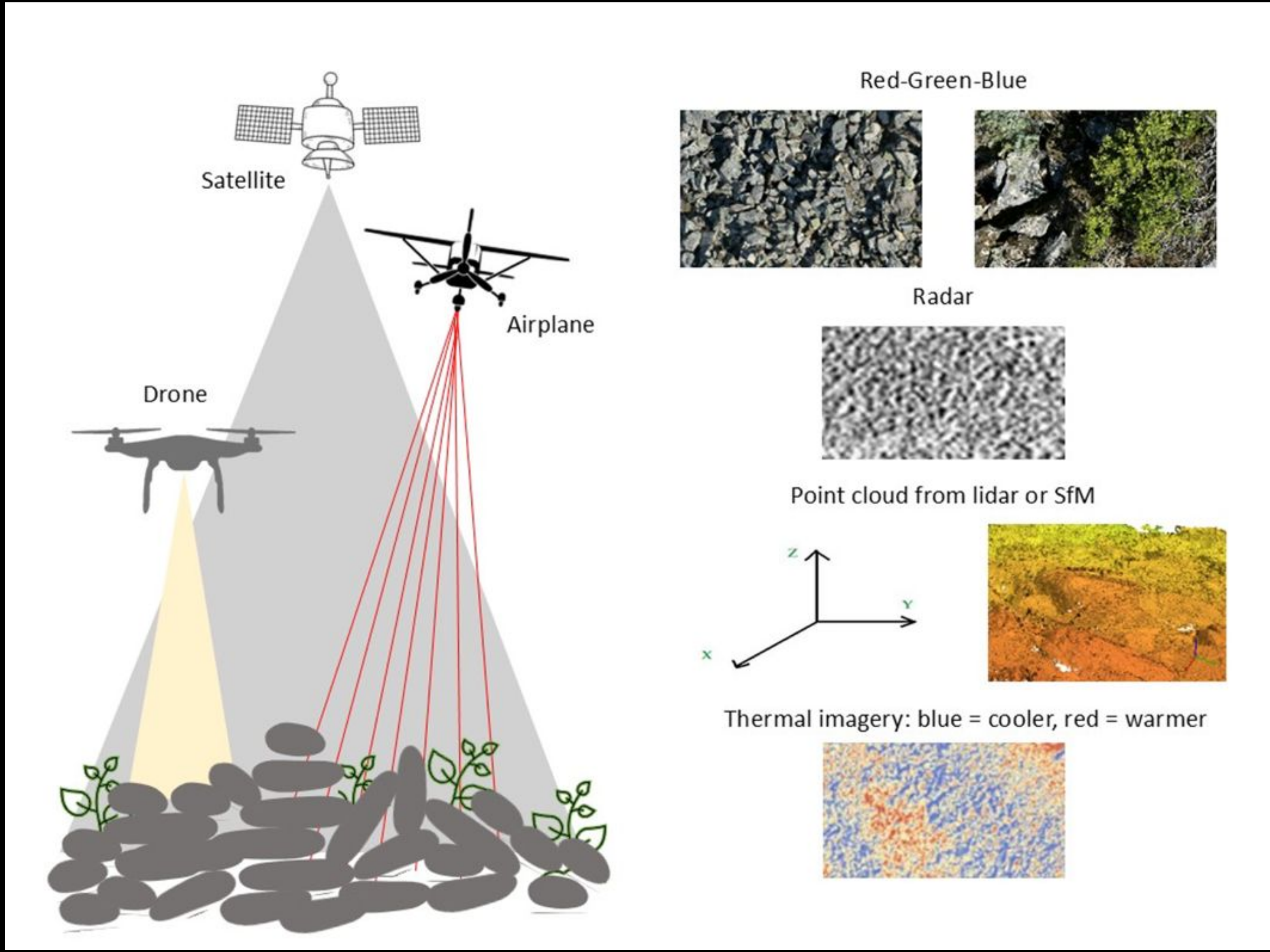
C). Informing conservation of the Larch Mountain Salamander

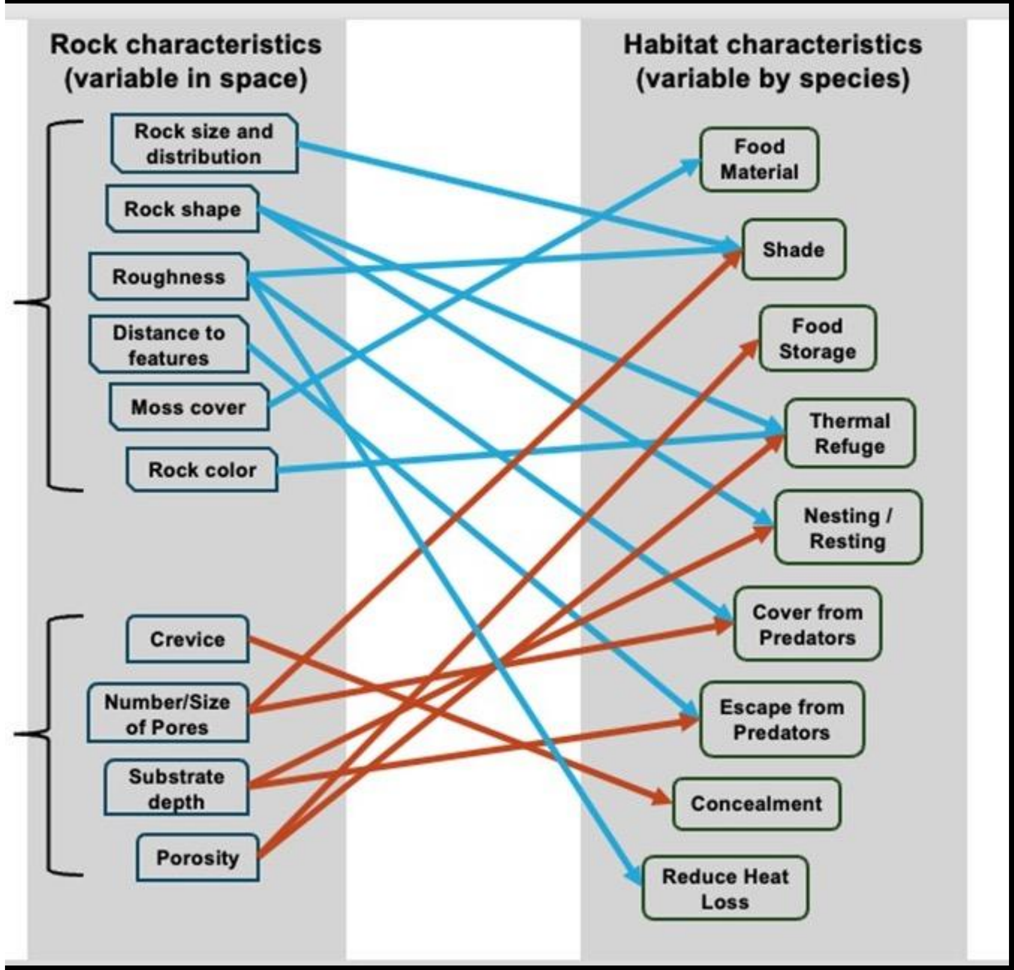
F). Citizen Science

E). Habitat suitability modeling

Progress: A). Review measuring rocky habitat

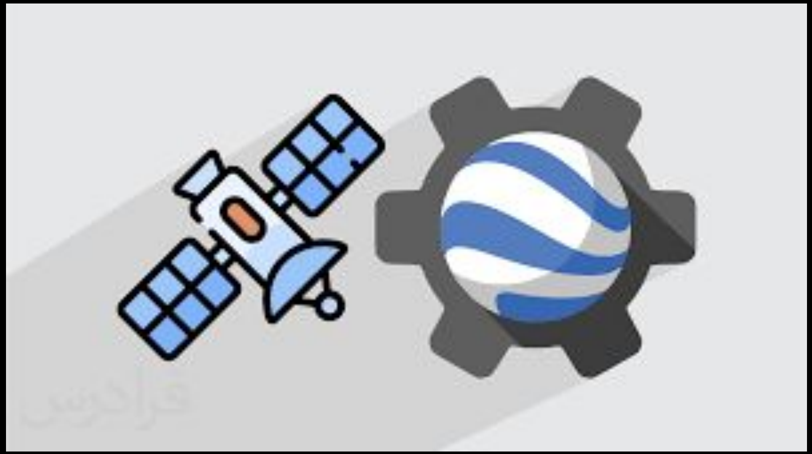
Alegbeleye et al (in review): Rocks as Refuge: A Review of the Functional Values and Methods for Measuring Broken-Rock Land Cover for Wildlife.

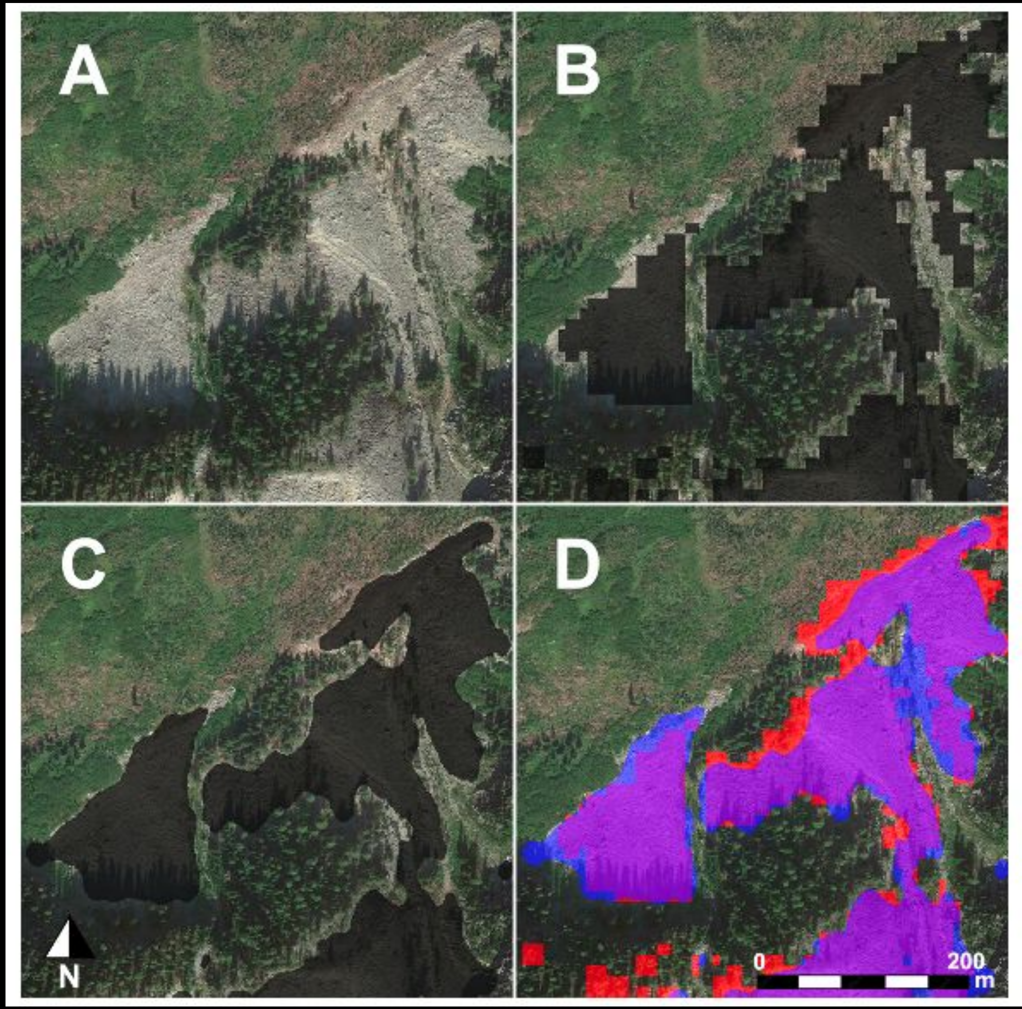




Progress: B). Classifying rocky land cover

Celebrezze et al. (2025): Classifying rocky land cover using random forest modeling: lessons learned and potential applications in Washington, USA *Remote Sensing* 17 (5), 915.

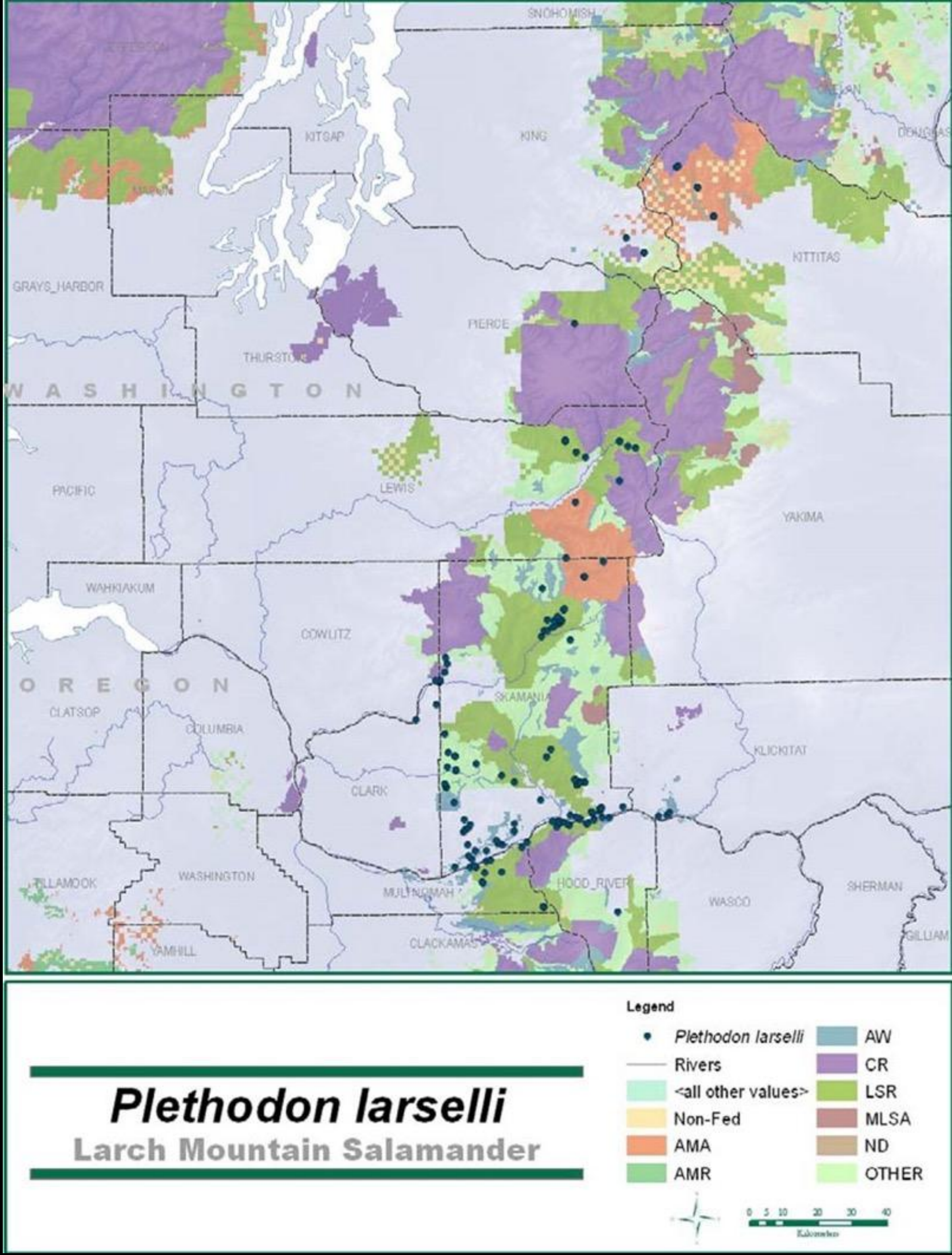




Detecting rocky landcover across the Cascades using multi-source remote sensing data

Progress: C). Larch Mountain salamander (*Plethodon larselli*)

- Lungless, fully terrestrial salamander
- Described in 1954, thought to be restricted to Columbia River Gorge until the mid-1980s
  - Cascades populations discovered near Cougar, WA and Packwood, WA
  - Currently ~150 known occurrence locations
- Occurrence is associated with rocky substrates



Crisafulli, C. M., D. R. Clayton, and D. H. Olson. 2008. Conservation assessment for the Larch Mountain salamander (*Plethodon larselli*). Version 1.0. Report to the USDA Forest Service Region 6 and USDI Bureau of Land Management Interagency Special Status and Sensitive Species Program.

Detectability and microhabitat associations for the Larch Mountain salamander (Lead: Dr. Brown, USFS)

1. Detectability

- Objective: Influence of survey timing (day/night), weather conditions
- Management Value Informs USFS protocol for clearance surveys prior to timber harvest

2. Microhabitat associations

- Objective: Identify important microhabitat variables
- Management Value Identifying potential habitat and clearance surveys in high quality habitat areas

3. Range-wide habitat suitability model

- Objective: Estimate spatially-explicit habitat quality throughout range
- Management Value Need for clearance surveys around proposed timber harvest areas

Progress: Detectability and microhabitat associations

Salamander surveys

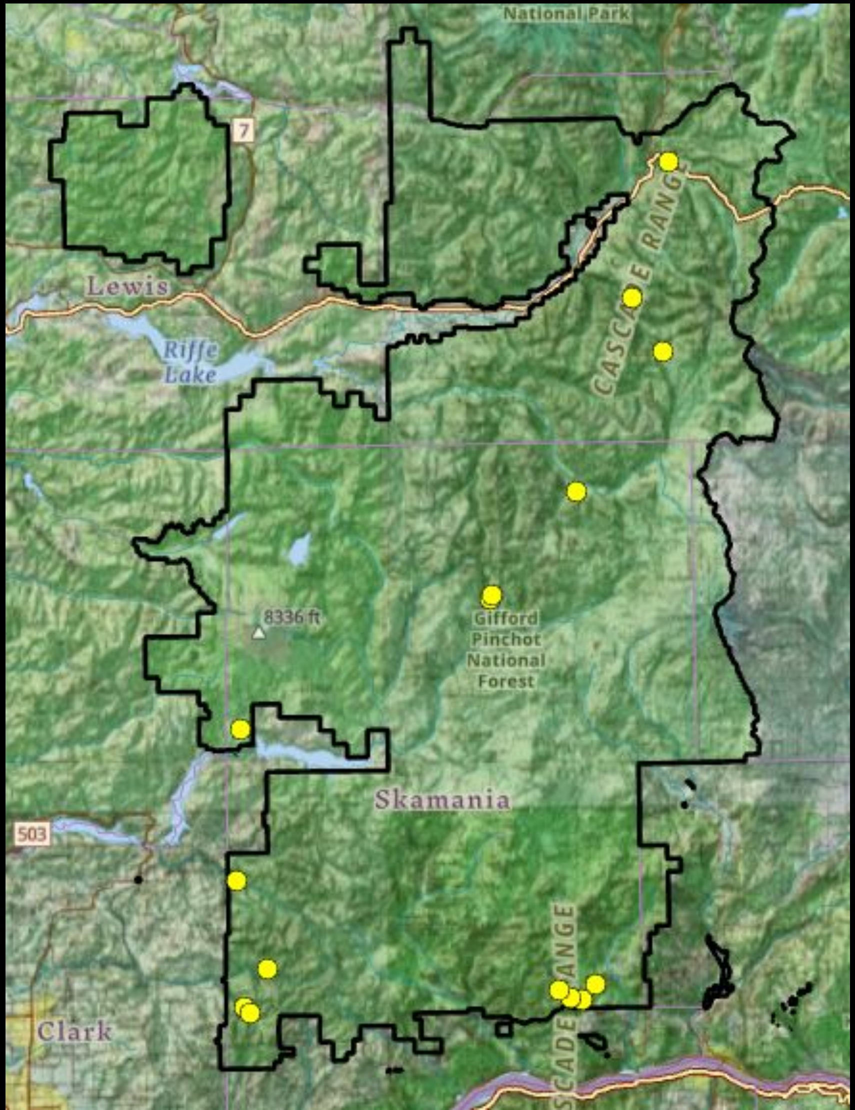
- 15 sites with historical occurrence

Habitat surveys

- Plot/subplot microhabitat characteristics surveys
- Plot photogrammetry to quantify surface rock characteristics

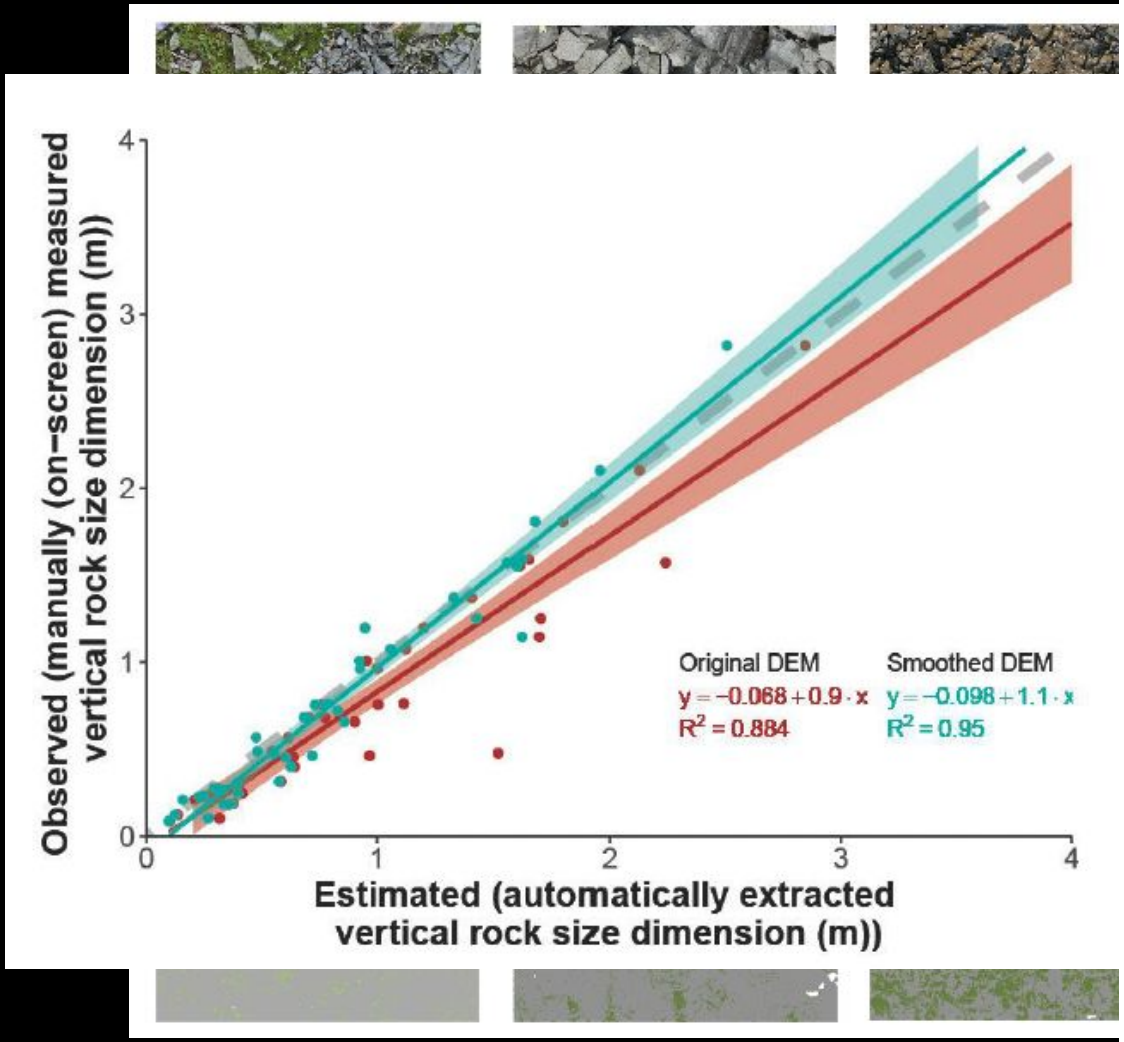
2024 survey results

- Larch Mountain salamanders detected at 5/10 sites; for occupied sites:
    - Observed plot occupancy: 15–60%



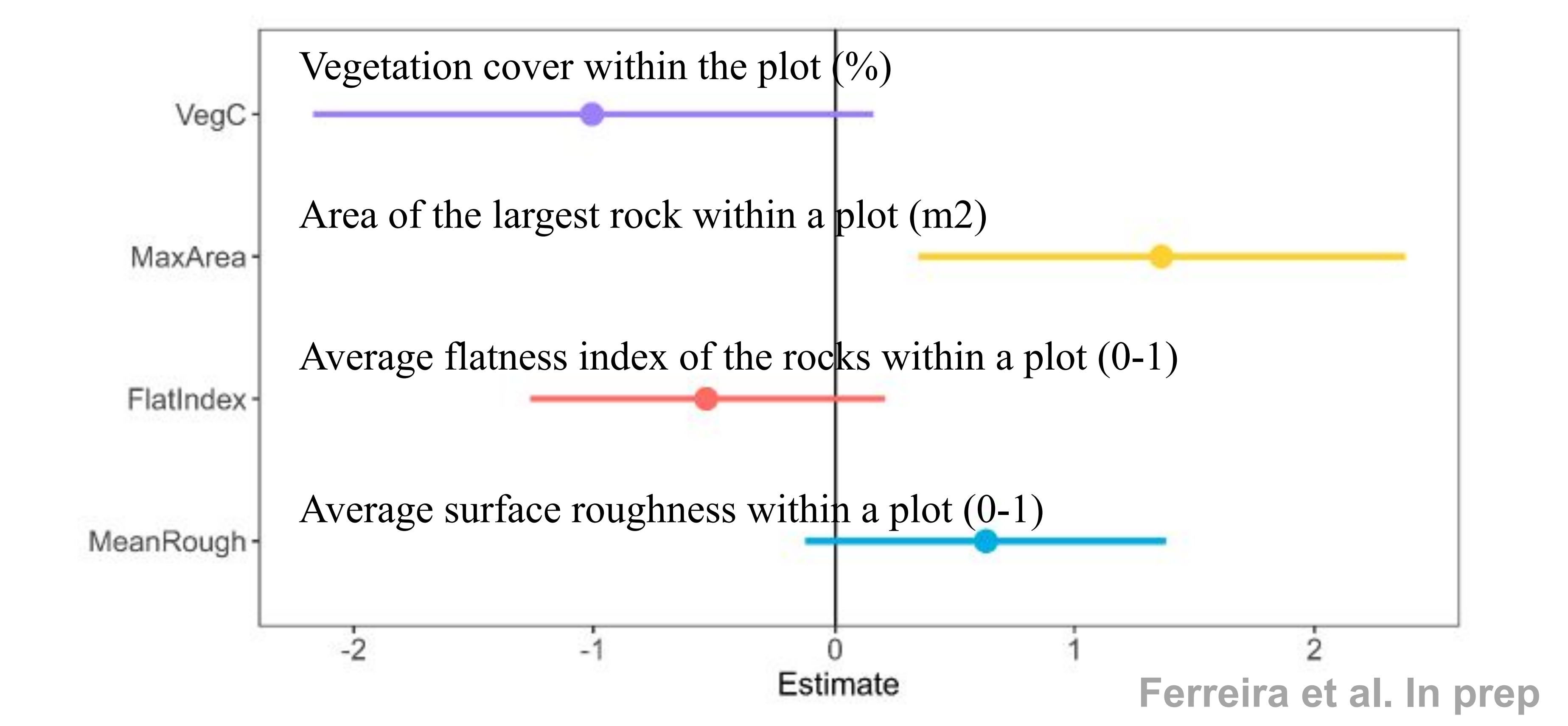
Progress: D). Handheld photogrammetry

Ferreira et al (in revision): Handheld photogrammetry advances capabilities to systematically characterize broken-rock habitat.



	Plot			
Measurement	ML1	ML2	RLO	TL1
Rock major axis (m)	0.34 ± 0.22	0.75 ± 0.58	0.42 ± 0.23	0.69 ± 0.60
Rock perimeter (m)	0.96 ± 0.58	2.22 ± 1.85	1.23 ± 0.69	2.00 ± 1.71
Rock area (m^2)	0.06 ± 0.09	0.39 ± 0.87	0.10 ± 0.11	0.34 ± 0.68
Rock volume (m^3)	0.02 ± 0.05	0.29 ± 0.88	0.03 ± 0.07	0.29 ± 0.92
Rock flatness index (0-1)	0.73 ± 0.16	0.66 ± 0.19	0.76 ± 0.16	0.72 ± 0.17
Rock elongation index (0-1)	0.73 ± 0.17	0.72 ± 0.17	0.74 ± 0.15	0.70 ± 0.16
Rock circularity (4π - ∞)	18.11 ± 3.46	20.70 ± 4.81	18.78 ± 3.76	19.56 ± 4.56
Bare rock cover (%)	81	92	65	54
Vegetation cover (%)	19	0	0	11
Moss cover (%)	0	8	35	35
North-facing rock surface (%)	21	24	35	29
East-facing rock surface (%)	14	19	27	17
South-facing rock surface (%)	27	31	17	18
West-facing rock surface (%)	38	26	21	36
Plot surface roughness (0-1)	0.37±0.13	0.42 ± 0.15	0.42 ± 0.12	0.47 ± 0.19

Progress E). Evaluating use, occupancy, and distribution of selected rock-dwelling (preview): Pika Haypiles



Standardized coefficient estimates and 95% confidence intervals for the generalized linear mixed effects model describing American pika (*Ochotona princeps*) haypile site selection

Progress F). Citizen Science

Evaluate the ability of community members to accurately measure pika and marmot abundance, occupancy, and rocky habitat characteristics in Mount Rainier National Park (this summer)

Next steps:

1. Scaling up □ Drone, lidar, & satellite data analysis on rocky habitat characteristics
    - Metrics: rock size, surface roughness, temperature, promontories

2. Species occupancy & distribution models with improved(!?!) rocky habitat data layers
    - Focal species: larch mountain salamander, American pika, and hoary marmot)

3. Information implementation into state and federal management and monitoring plans

<u>The Team (thank you!!)</u>

- <u>WSU:</u> Arjan Meddens, Lisa Shipley, Okikiola Alegbeleye, Ana Ferreira, Allison Stift, Meghan Camp, Amanda Stahl, Joe Celebrezze
- <u>USFS:</u> Donald Brown, Andrew Hudak, Adam Duarte, Ben Bright, Doug Glavich, Tara Chestnut
- <u>WDFW:</u> Keith Folkerts, Jeff Azerrod, Julia Michalak
- <u>NPS:</u> Jason Ransom, Sallie Beavers