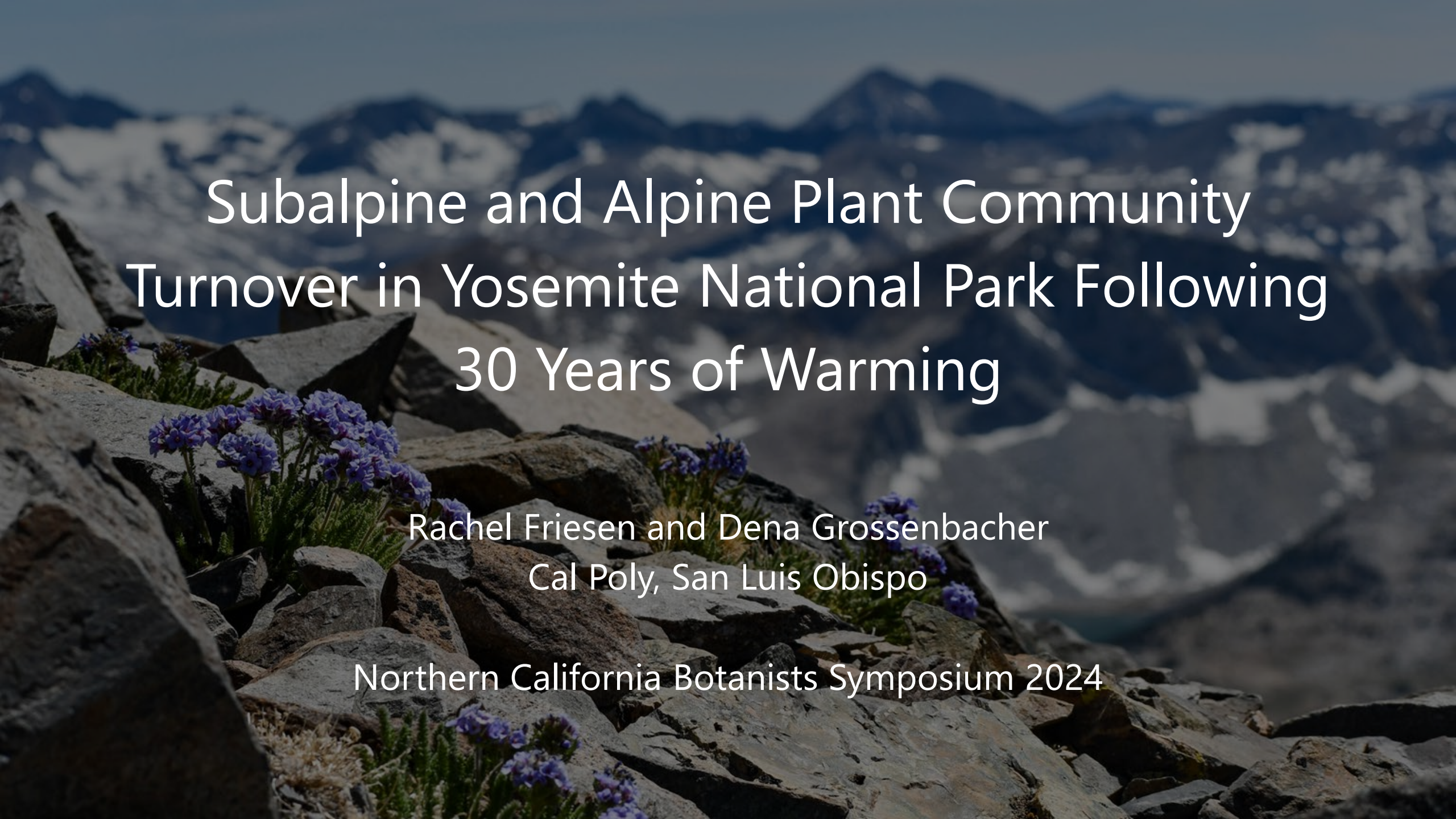


# Subalpine and Alpine Plant Community Turnover in Yosemite National Park Following 30 Years of Warming

Rachel Friesen and Dena Grossenbacher
Cal Poly, San Luis Obispo

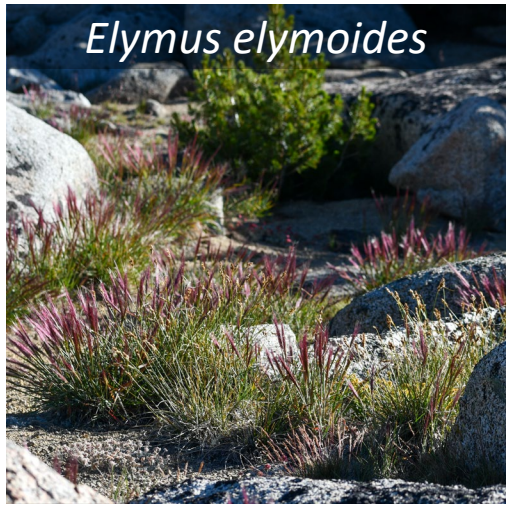
Northern California Botanists Symposium 2024

# Yosemite's Alpine Plant Diversity



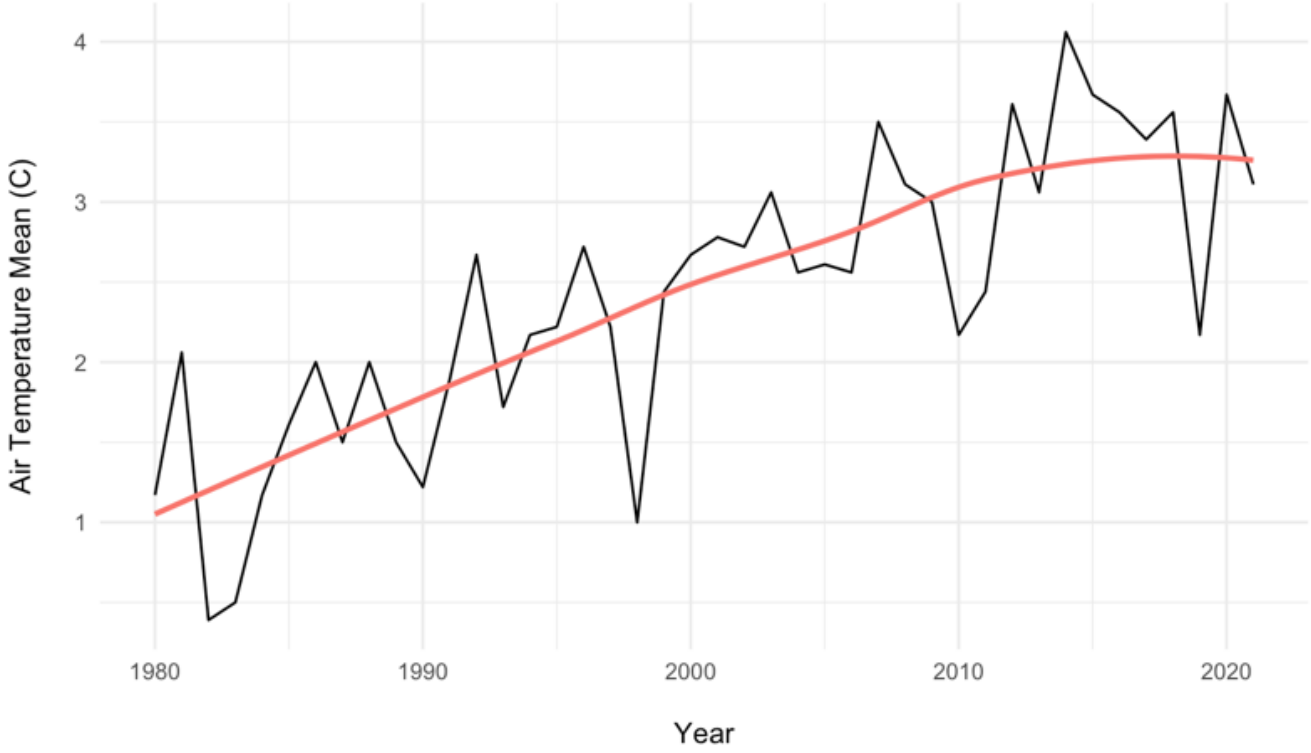







# Global Climate Change

Alpine regions around the world are experiencing a **faster rate** of temperature change relative to lowland areas
(Pepin et al. 2015)




Average Air Temperature at Dana Meadows, Yosemite NP
*Data source: PRISM*

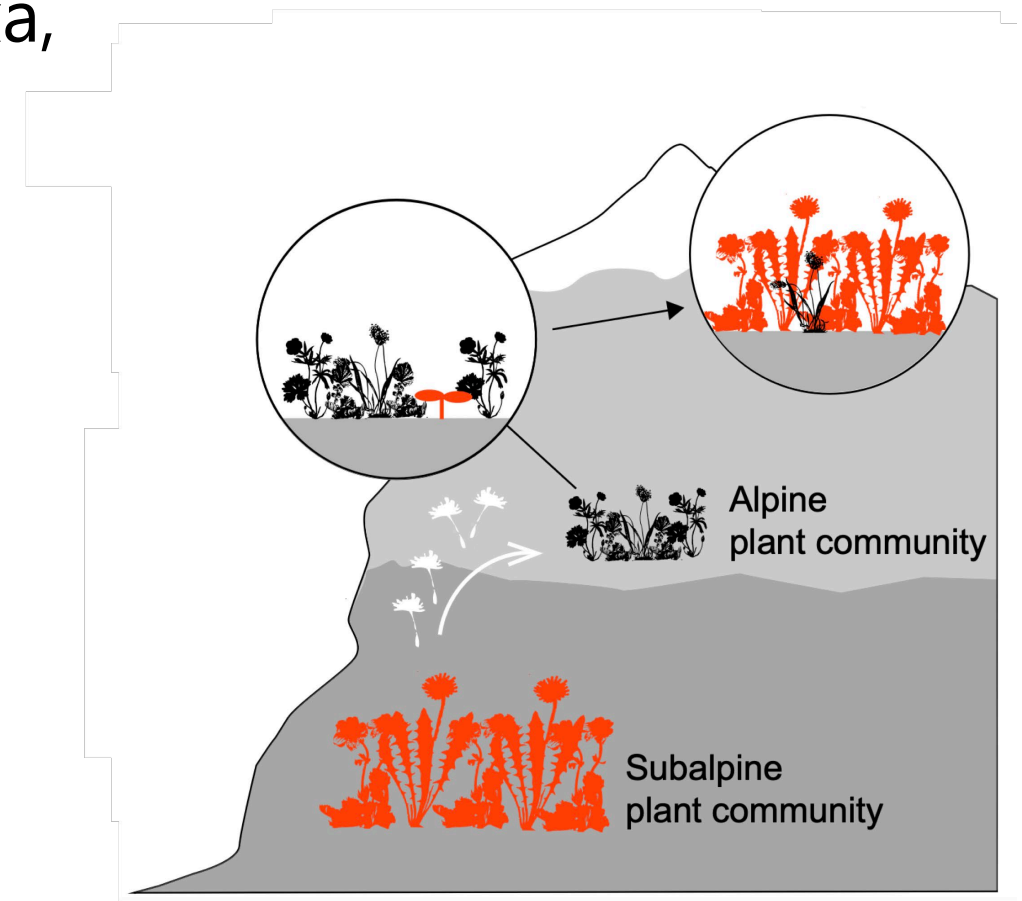
# Notice any changes?


August 14, 1991

August 8, 2022

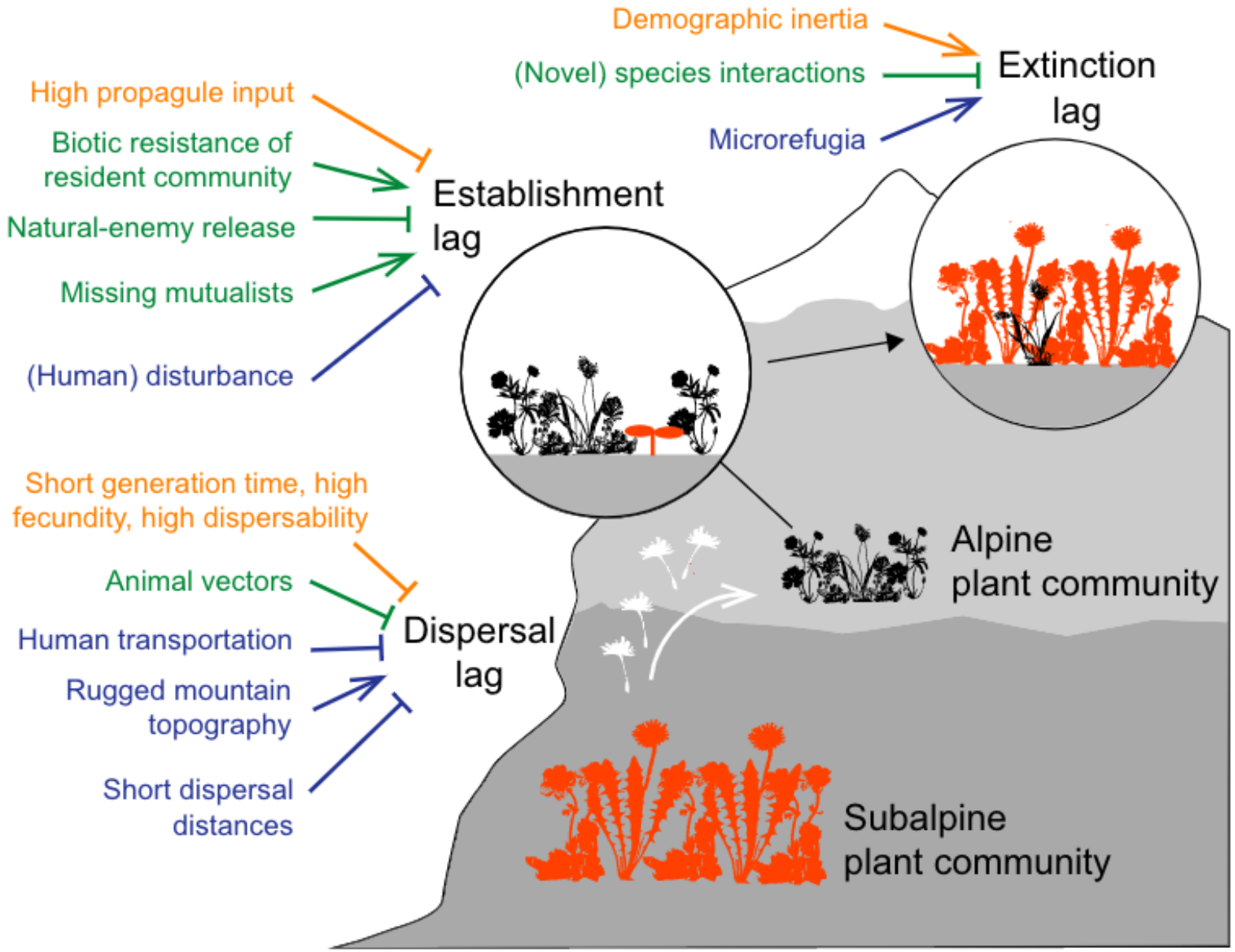
# General Predictions

- Colonization by warm adapted taxa, likely from lower elevations
- Decline of alpine specialist taxa
- Models predict that alpine habitat will **decline by 50-90%** across California by 2100 (Hayhoe et al. 2004)



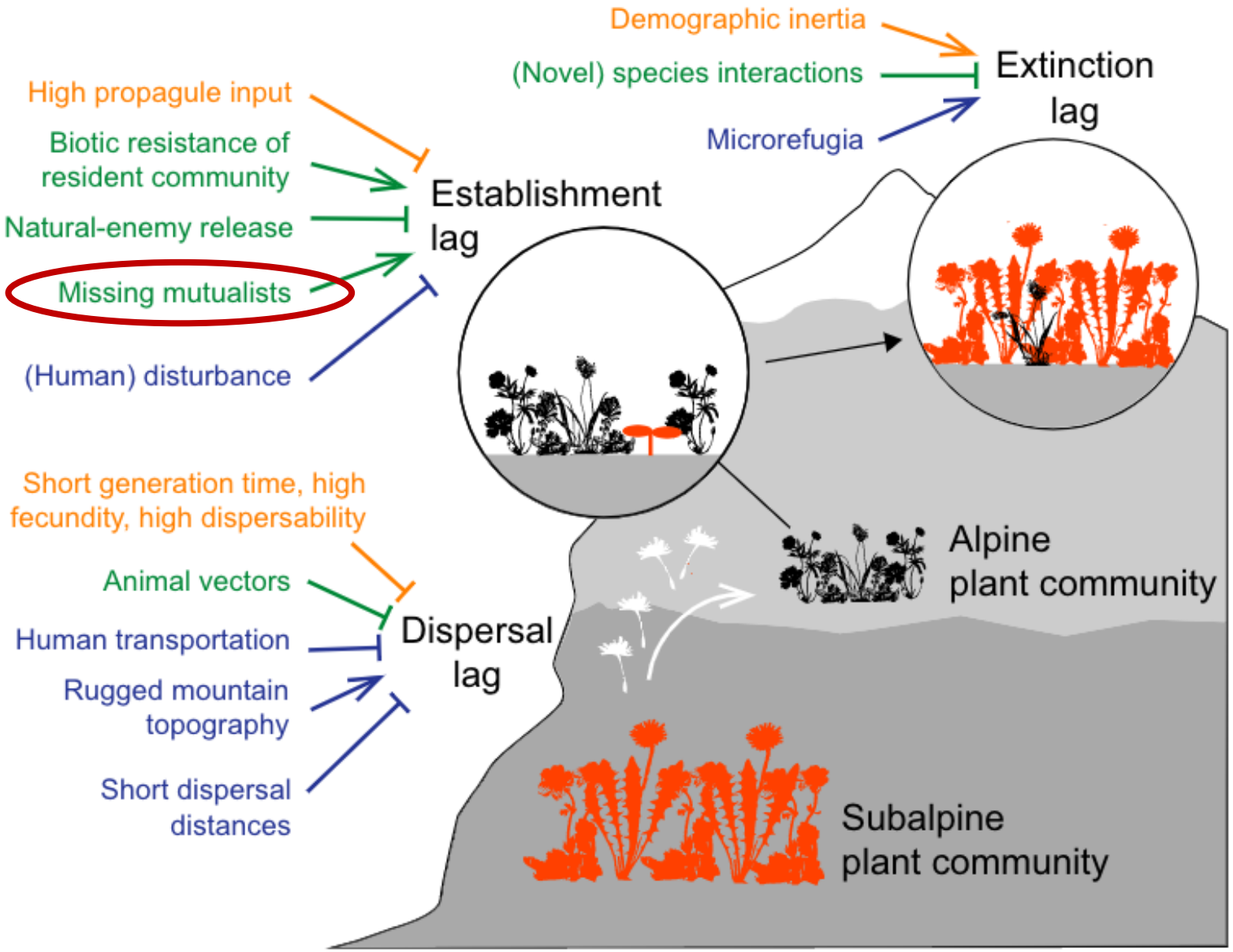

Alexander et al. 2017

# Dispersal, Establishment, & Extinction Lags



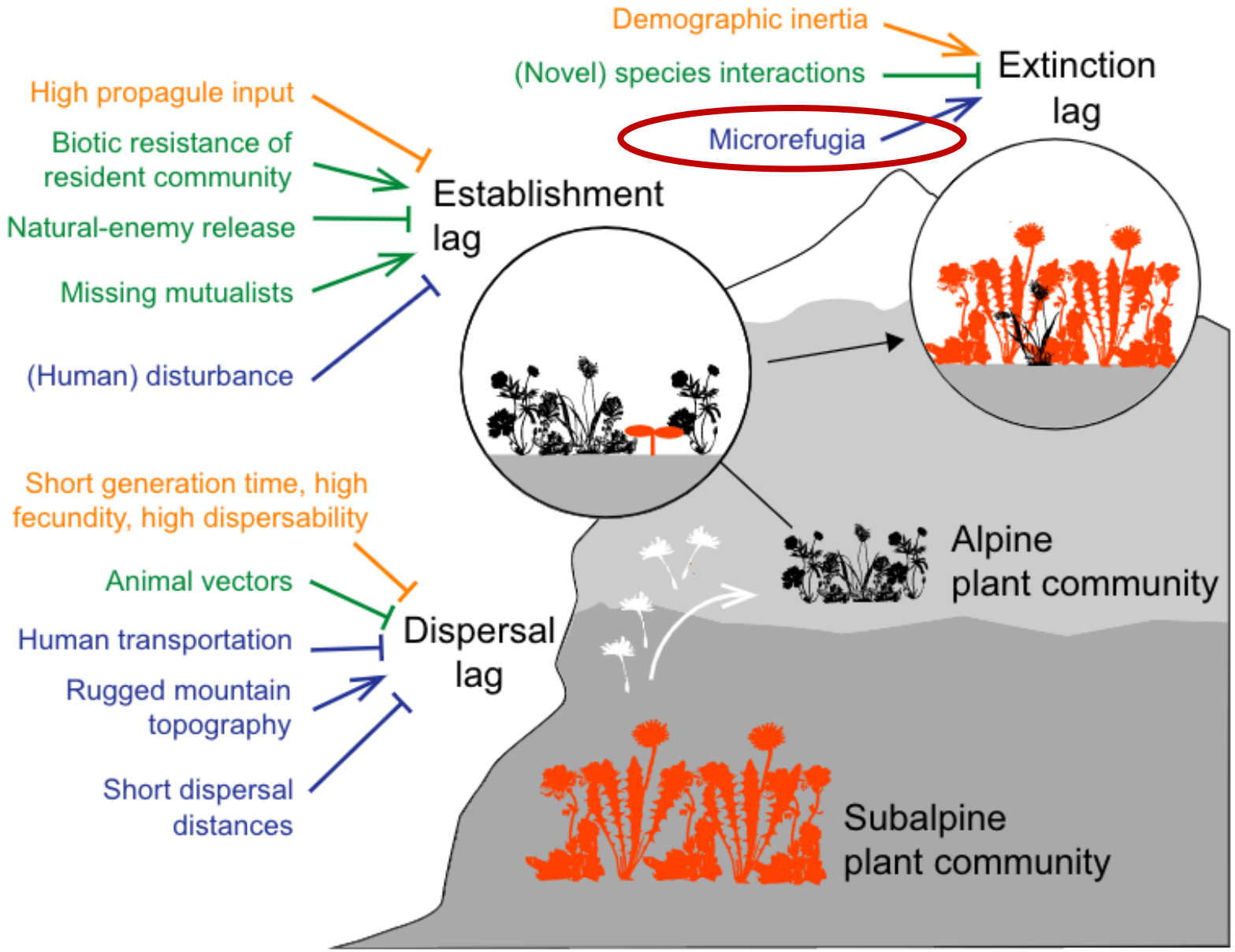

Alexander et al. 2017

# Dispersal, Establishment, & Extinction Lags




Alexander et al. 2017

# Dispersal, Establishment, & Extinction Lags



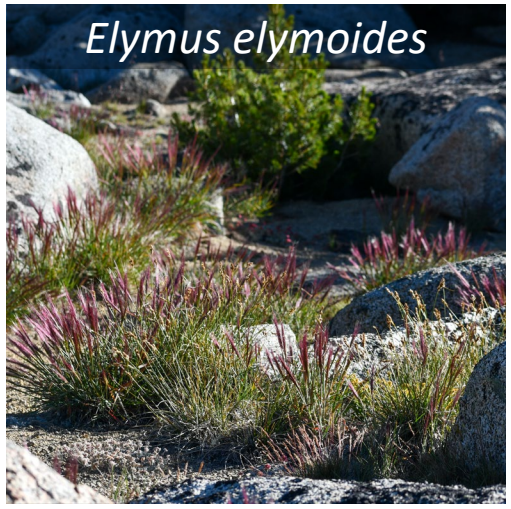

Alexander et al. 2017

# Shifts over the last 30 years?



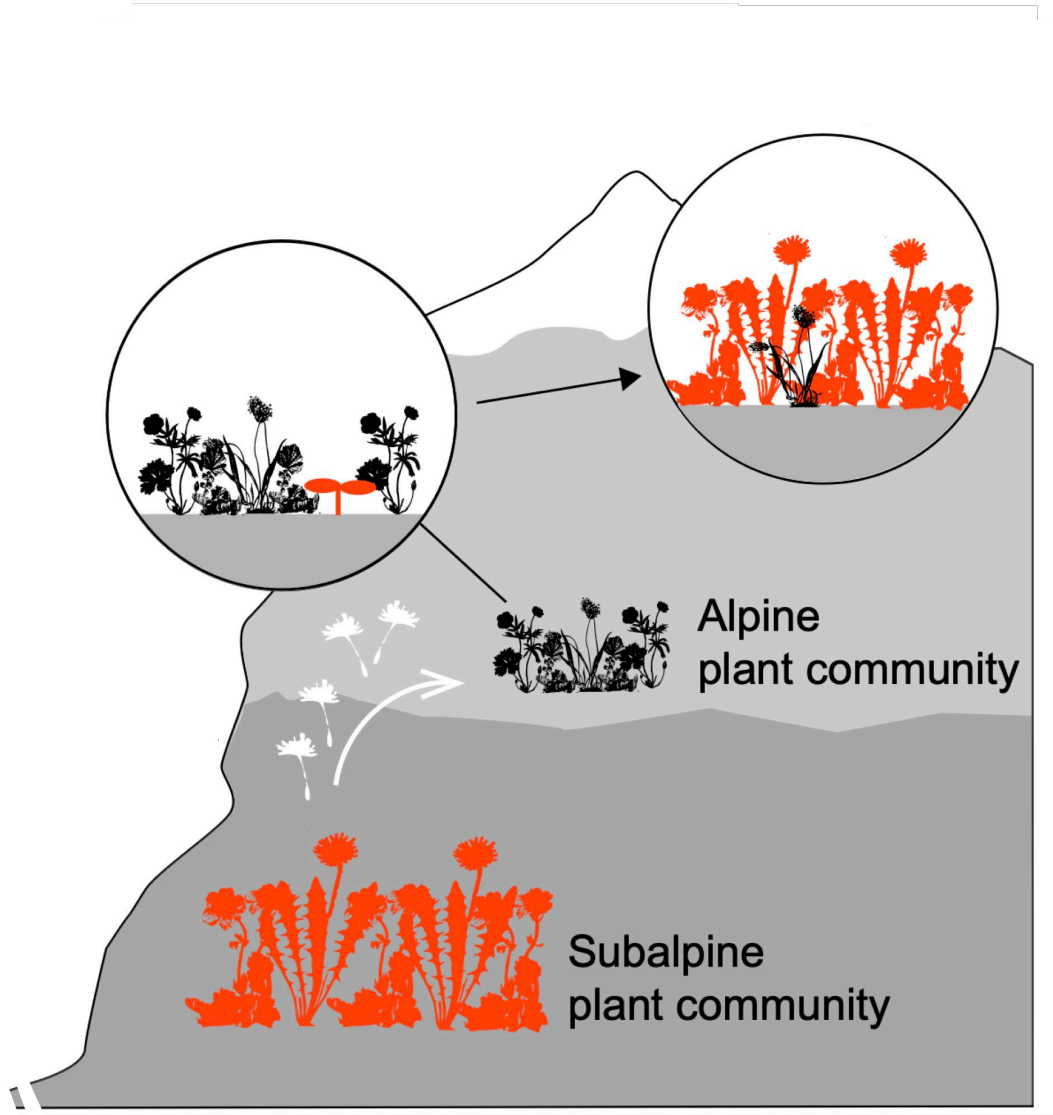







# Research Predictions

- Increase in total species richness
- Increase in vegetation cover
- Increase in warm affinity taxa and decrease in alpine specialists

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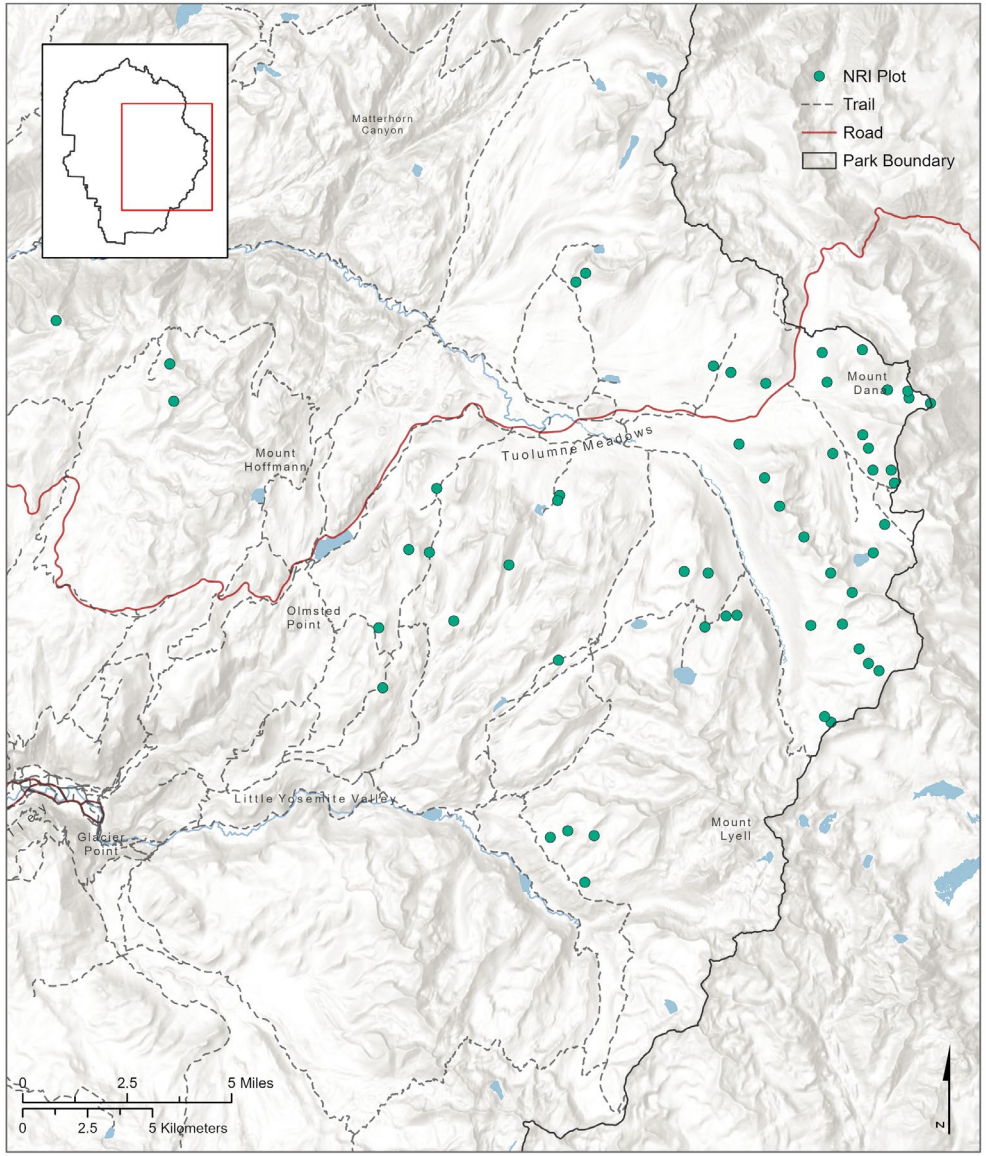
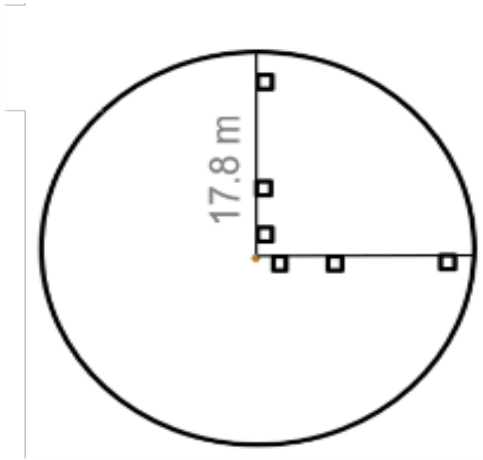
# Methods

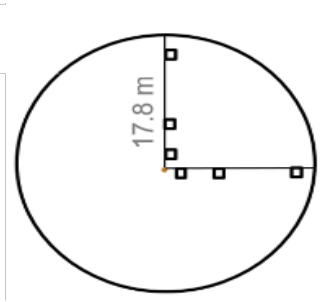
- Natural Resource Inventory Plots
  - Established 1990-1993
  - 55 plots (2800 – 3800 m)

# Relocate & Set Up Plots




# Quadrats: Herbaceous Species

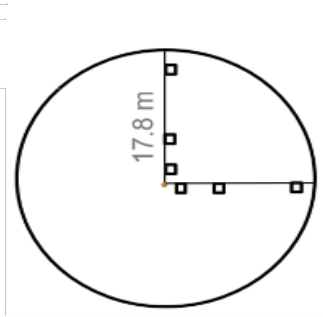



2 YOSE NRI Resurvey Plot # 313

Herbaceous Cover (01, 05, 15 m)

| QUAD | COL | SPECIES/MATERIAL/ UNK NICKNAME | % | QUAD | COL | SPECIES/MATERIAL/ UNK NICKNAME | % |
|---|---|---|---|---|---|---|---|
| N01 | | LICHEN (on rock) | 17 | E01 | | Packistera nevadensis | 3 |
| | ☒ | Astragalus kentrophyta | 1 | | | Eriogeron pygmaeus | 2 |
| | ☒ | Packistera nevadensis | 2 | | ✓ | Draba densifolia | 1 |
| | ☒ | Phlox pulvinata * | 3 | | | Phlox pulvinata | 1 |
| | ☒ | Eriogeron pygmaeus | 1 | | | Phlox condensata | 3 |
| | ☒ | Draba #1 | 1 | | ☒ | Festuca brachyphylla | 1 |
| | | Selaginella | 1 | | ☒ | Poa #1 | 1 |
| | | ROCK (default) | 71 | | | Astragalus kentrophyta | 1 |
| | | BARE | 2 | | | Eriogonum ovalifolium | 1 |
| | | MOSS | 1 | | | Elymus elymoides ~~fimbriata~~ | 1 |

# Transects: Vegetation Cover




3 YOSE NRI Resurvey Plot # 308

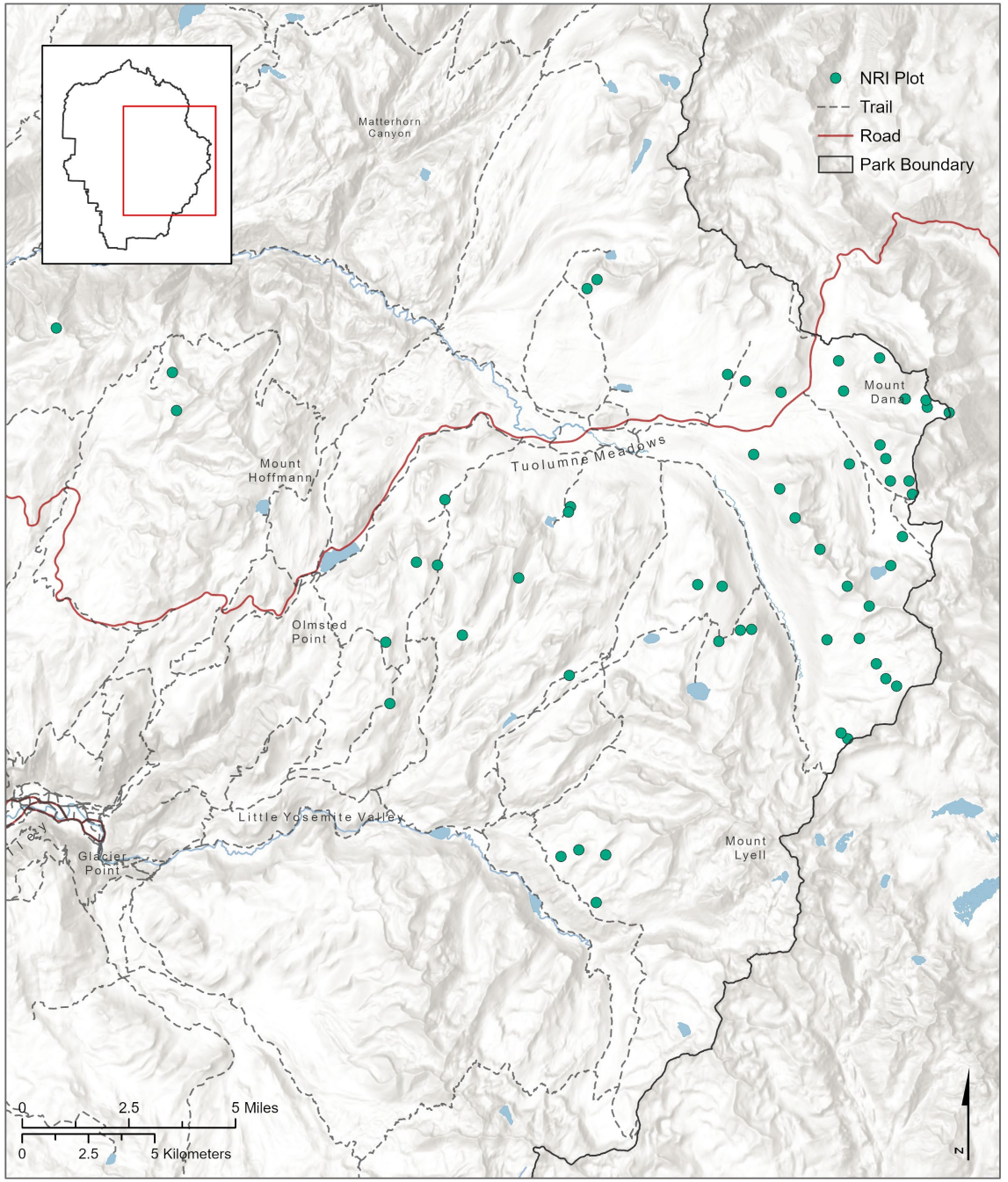
Shrub Transects (17.80 m)

| TR | SPECIES/MATERIAL, INTERCEPT LENGTH | TOTAL (cm) | TR | SPECIES/MATERIAL, INTERCEPT LENGTH | TOTAL (cm) |
|---|---|---|---|---|---|
| XE | Pinstemon #Sp. 2, 1, 3, 19, | 25 | XN | HERB: 30, 30, 2, 1, 2, 43, 6.5, 4, 13, | 195 |
| | BARE: 7, 2, 3, 14, 4, 3.5, 16, 3, 3, 3, 4, 2, 4, 3, 3, 3, 2, 4, 2, 9, 10, 24, 3, 2, 5, 6, 18, | 170 | | Phlox diffusa: 13, 11, | 24 |
| | HERB: 3, 4, 55, 3, 3, 5, 1, 4, 10, 20, 8, 6, 25, 12, 19, 20, 4, 3, 2, 8, 11, 6, 2, 6, 2, 2, 9, 4, 17, 3, 5, 3, 6, 4, | 295 | | Eremogone kingii: 10, 6, | 16 |
| | MOSS: 2, 2, | 4 | | BARE: 41, 3, 6, 2, 3, 3, 3, 15, | 76 |
| | LICHEN (on rock): 4, 7, | 11 | | Tsuega mertensiana 10.5-1m tall)? 60, | 60 |
| | WOOD: 11, | 11 | | LICHEN (on ROCK): 23, 3, 7, 16, 18, | 67 |
| | Phlox diffusa: 14, 8, 4, 1, 6, | 33 | | ROCK (default): 1780 - 438 | 1342 |
| | Eremogone kingii: 3, 5, 1, 6, 2, 3, 3, | 23 | | | |
| | ROCK (default): 1780 - 572 | 1208 | | | |

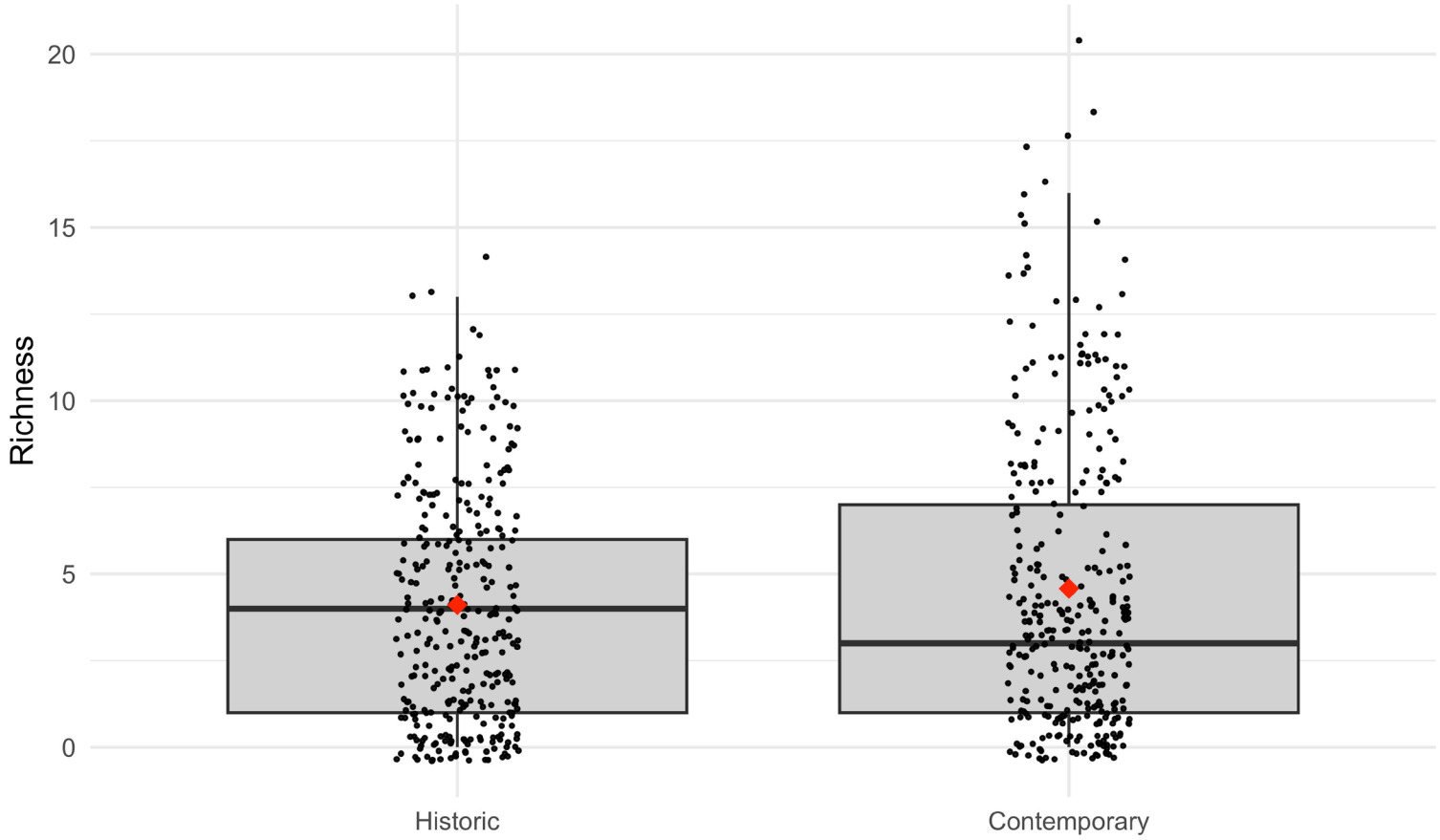
Options: Shrub Species/ Bare/Herb/Lichen/ Moss /Rock (≥ 10 cm)/Snow /Trail/Tree/Water/Wood (≥10 cm)

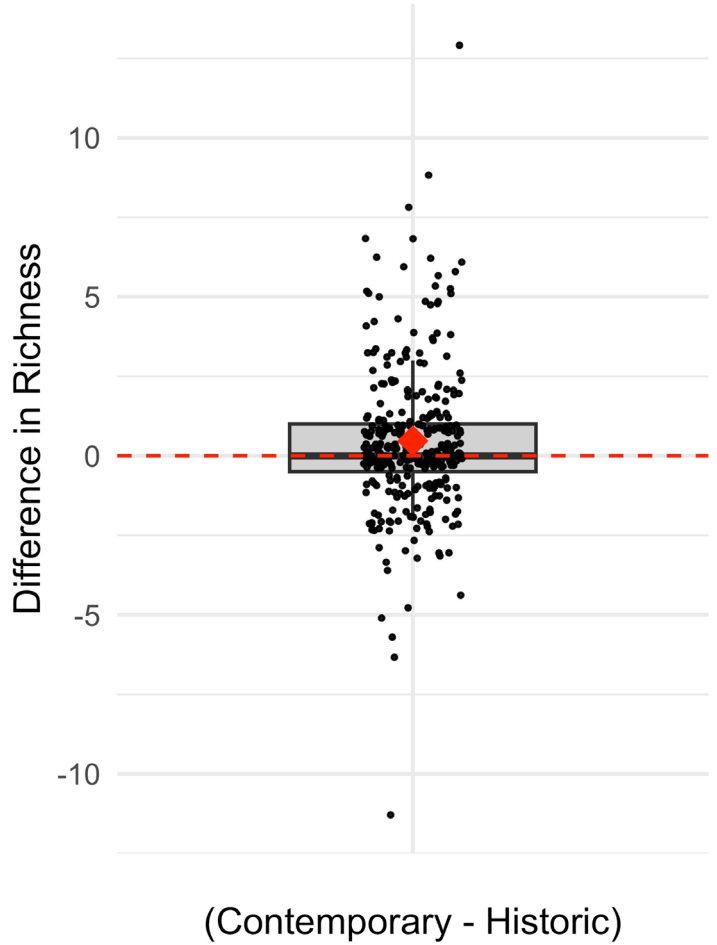
# Preliminary Results

- Resampled in 2022 and 2023
- 10 plots resurveyed twice



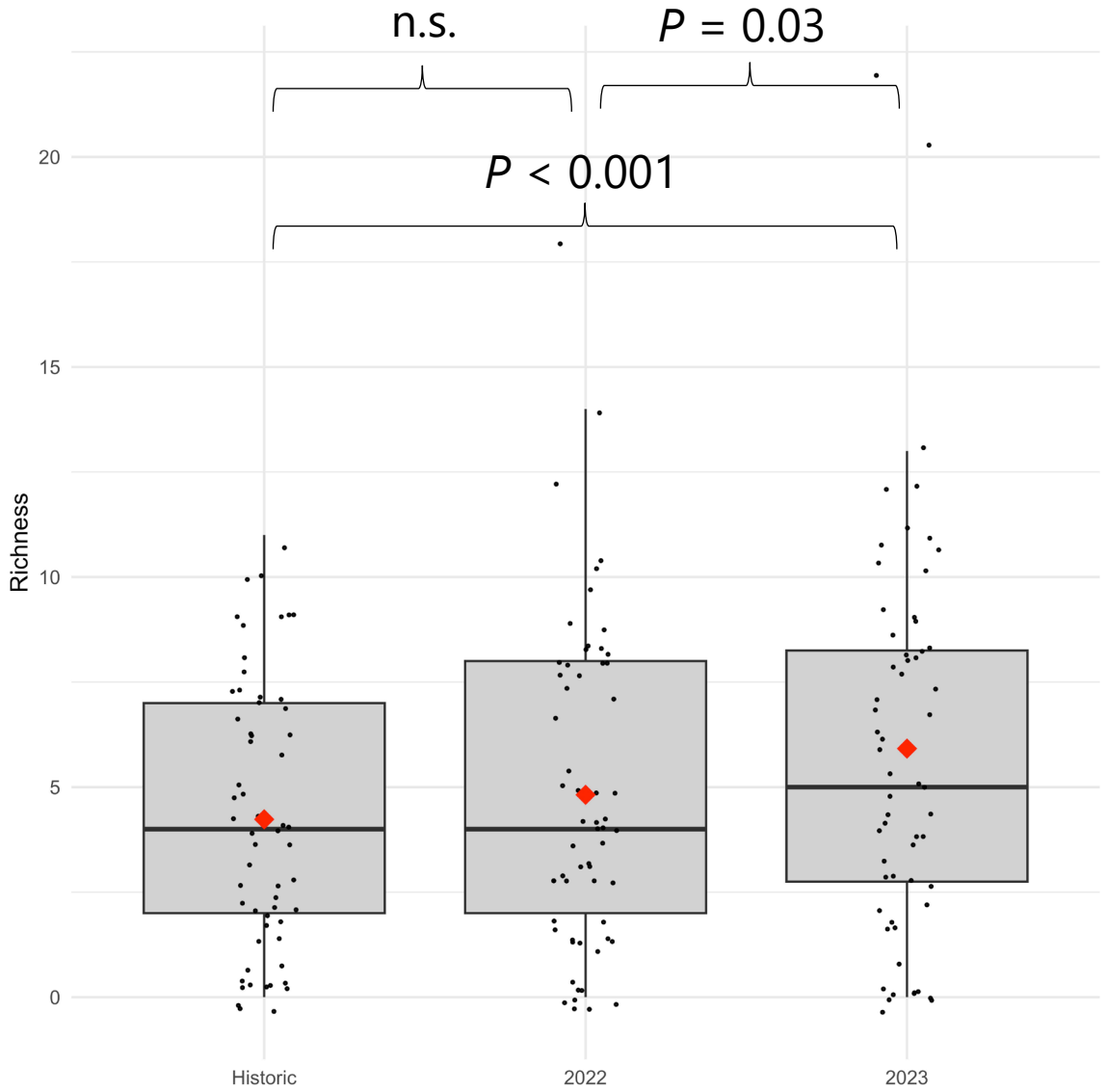
# Herb richness increased by 11% on average



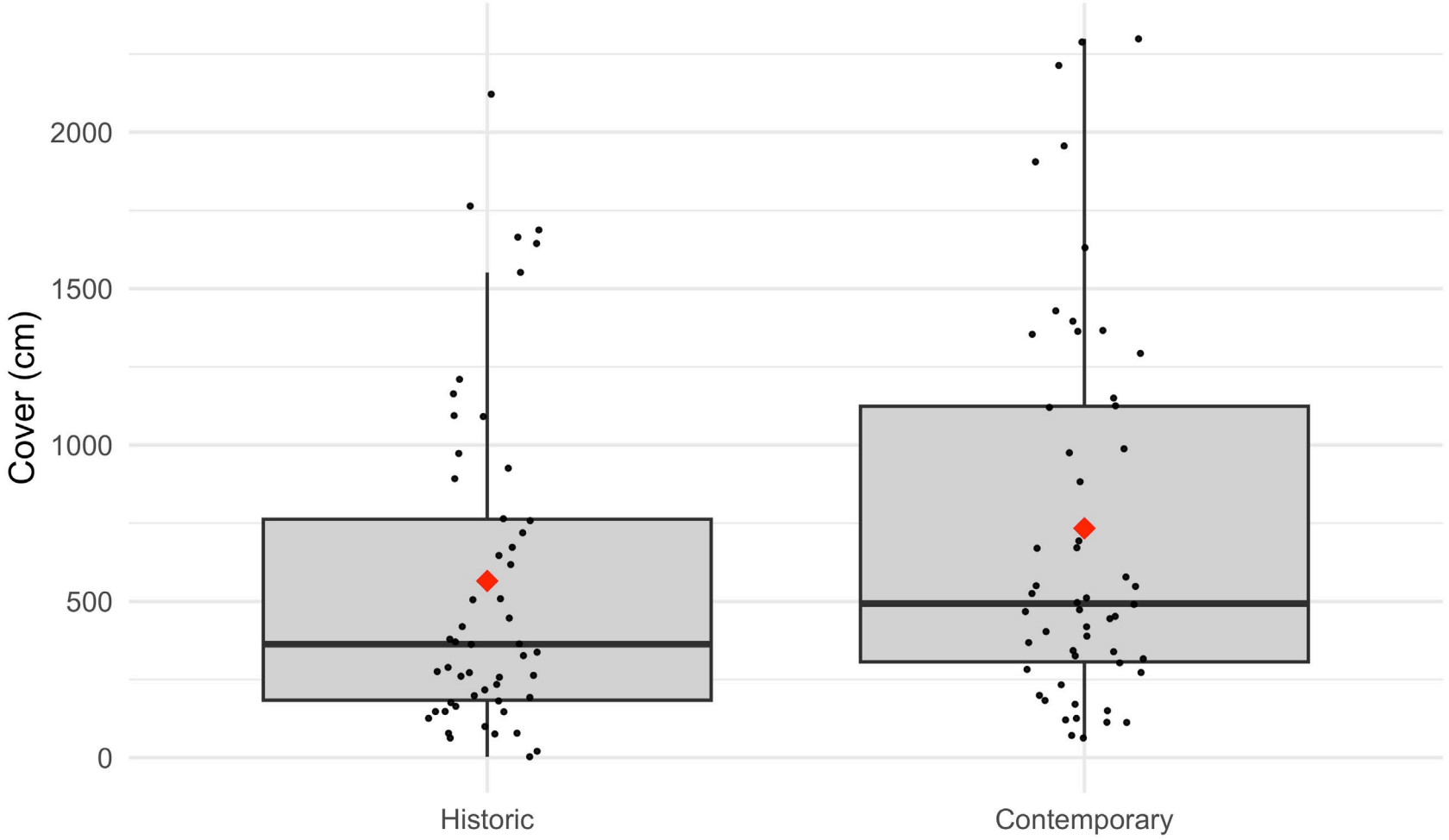

generalized linear mixed model, $P < 0.01$

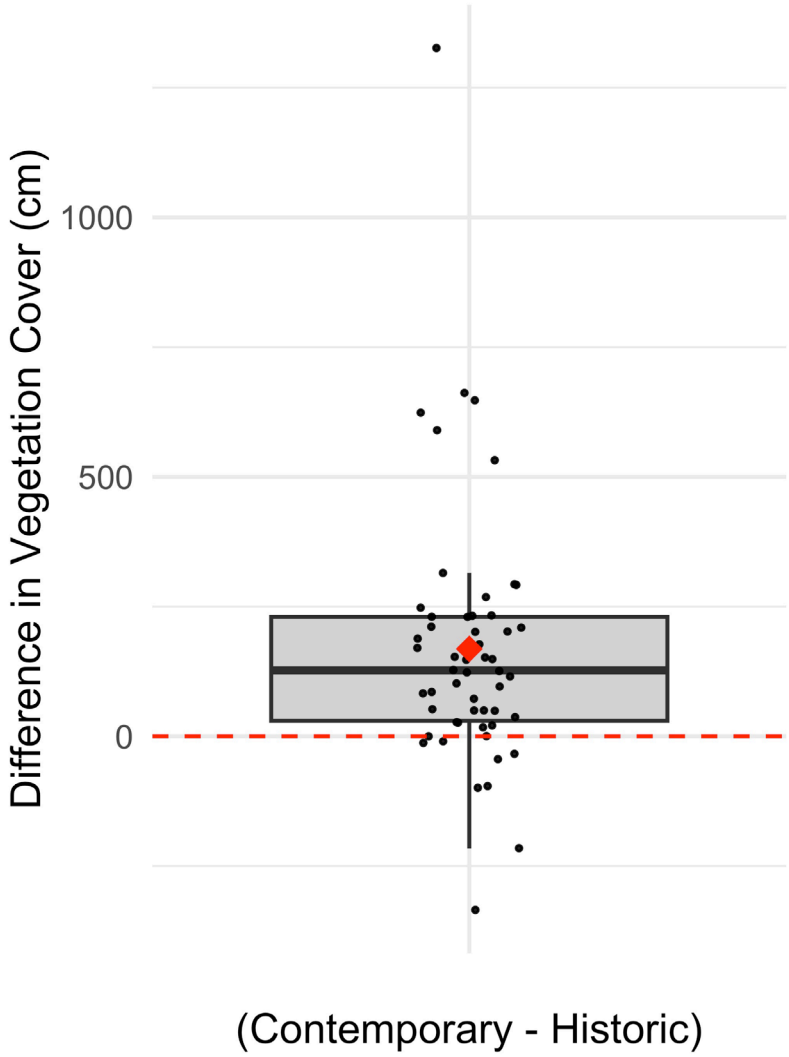
# Interannual variation in herb richness




generalized linear mixed model

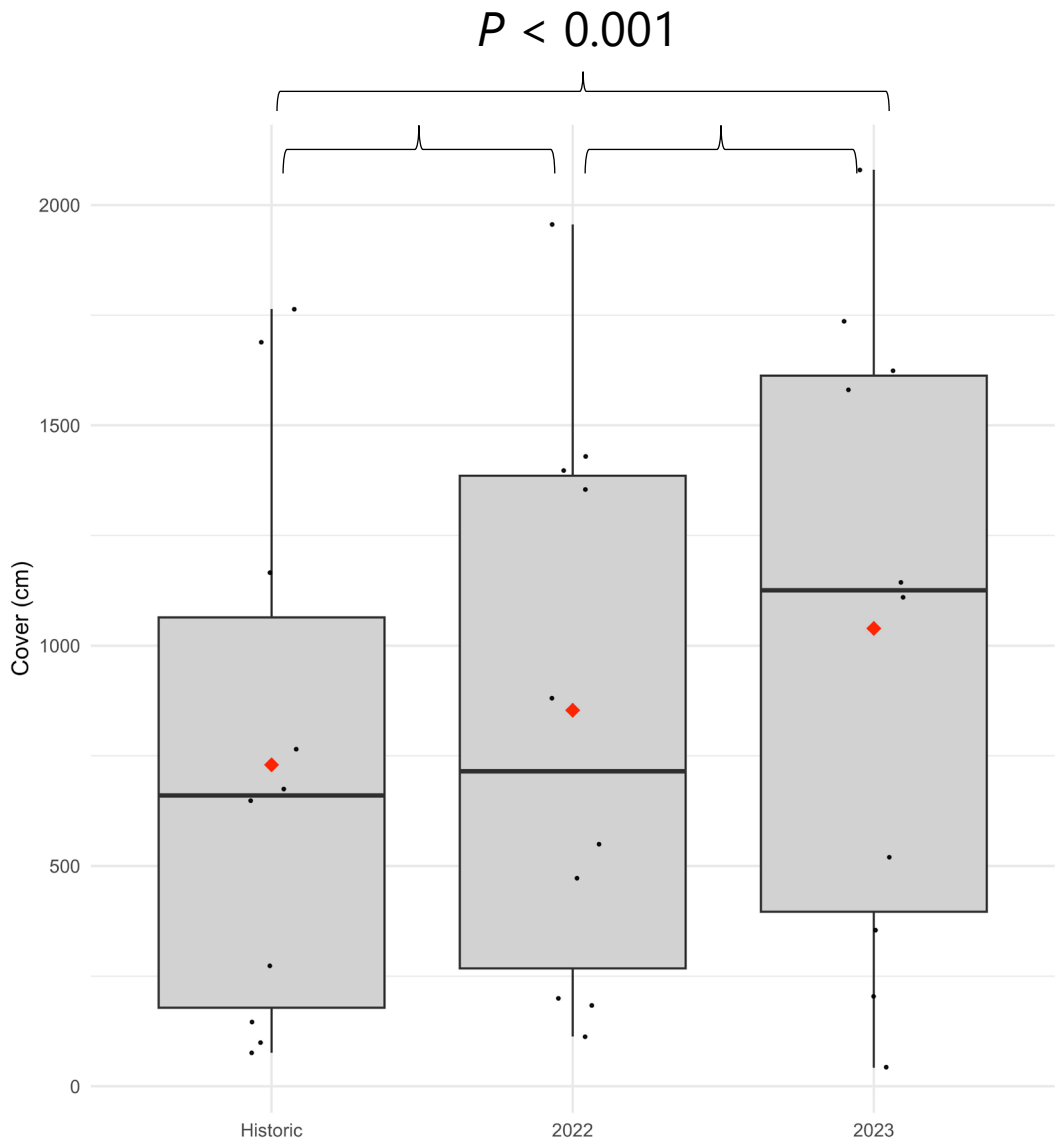
# Cover increased by 30% on average




generalized linear model, $P < 0.001$

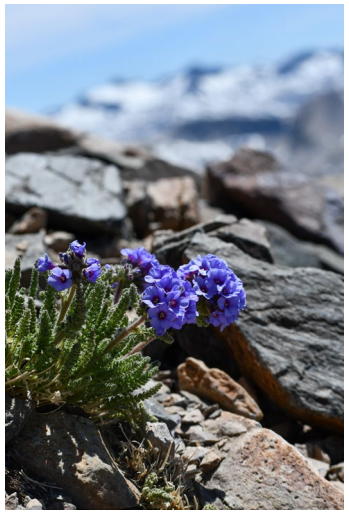
# Interannual variation in vegetation cover




generalized linear model

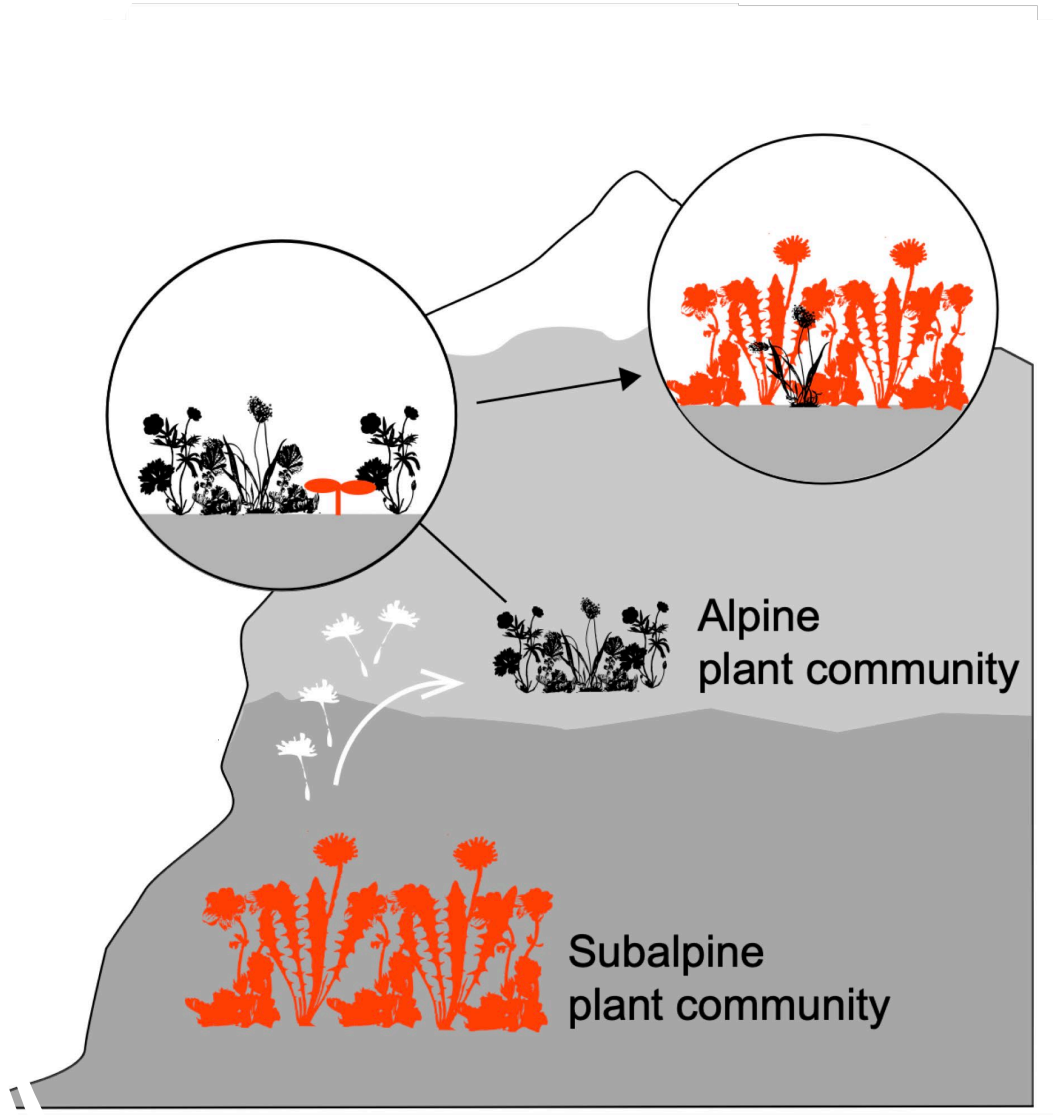
# Community Composition Shifts

- Analysis in progress
- Expected results:
  - Community shifts towards more warm affinity taxa
  - Decline in alpine specialist taxa



# Predictions

- Increase in total species richness ✗
- Increase in vegetation cover ✓
- Increase in warm affinity and decline in alpine specialist taxa ?



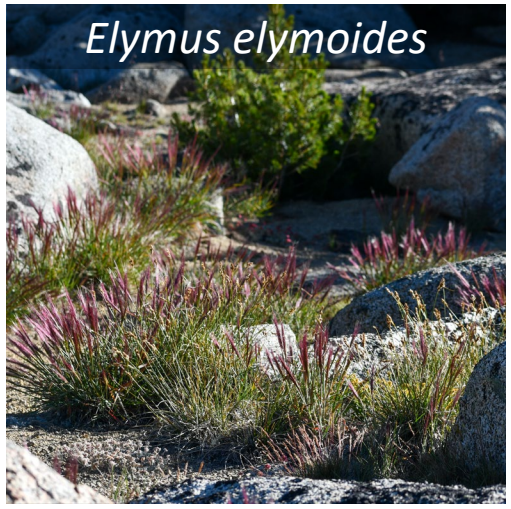

Alexander et al. 2017

# Future of Yosemite's Alpine Plant Diversity










# Land Acknowledgement

Southern Sierra Miwuk Nation

Bishop Paiute Tribe

Bridgeport Indian Colony

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North Fork Rancheria of Mono Indians of California

Picayune Rancheria of Chukchansi Indians

Tuolumne Band of Me-Wuk Indians

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Maddie Windsor (Cal Poly)

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Cal Poly Frost Fund

Cal Poly Baker and Koob Endowment

UC Valentine Eastern Sierra Reserves

California Native Plant Society

Bristlecone CNPS Chapter

San Luis Obispo CNPS Chapter

White Mountain Research Center

**Photo Credit:**

Brooke Wallasch and Ben Sherman


Thank You!