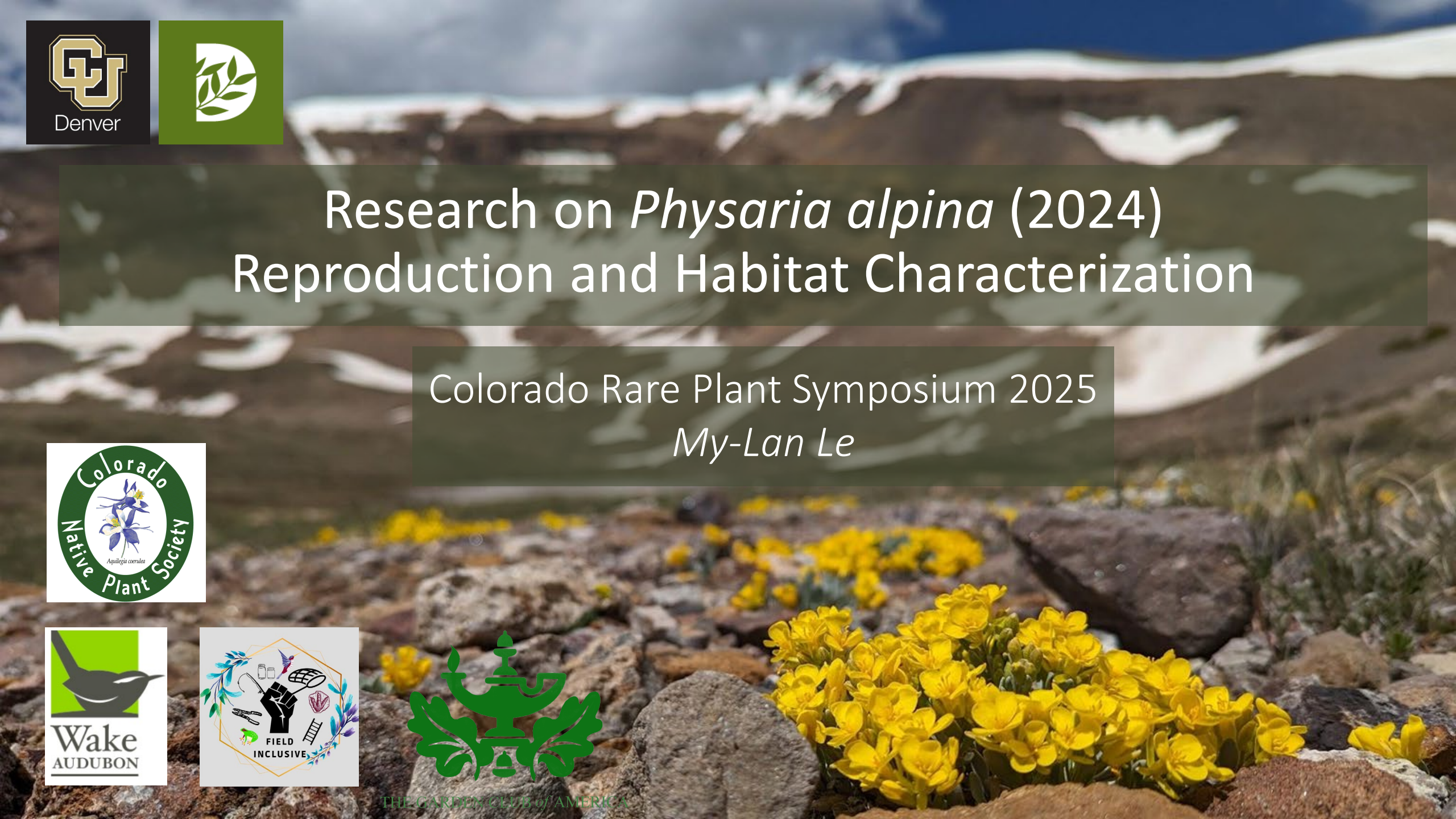
Research on *Physaria alpina* (2024) Reproduction and Habitat Characterization

Colorado Rare Plant Symposium 2025

My-Lan Le



Background

Endemic species can be affected by environmental variation;
and there is missing ecological information about most species which can make management decisions difficult.

Physaria alpina

Populations 1 & 2 (2022 - 2023)

Population 1
(Weston Pass)

Population 2
(Horseshoe Cirque)

Leading Questions and Study Aims

What affects whether a flowering plant fruits? →
Aim 1: Assess how select ecological variables relate to reproductive success in *P. alpina.*

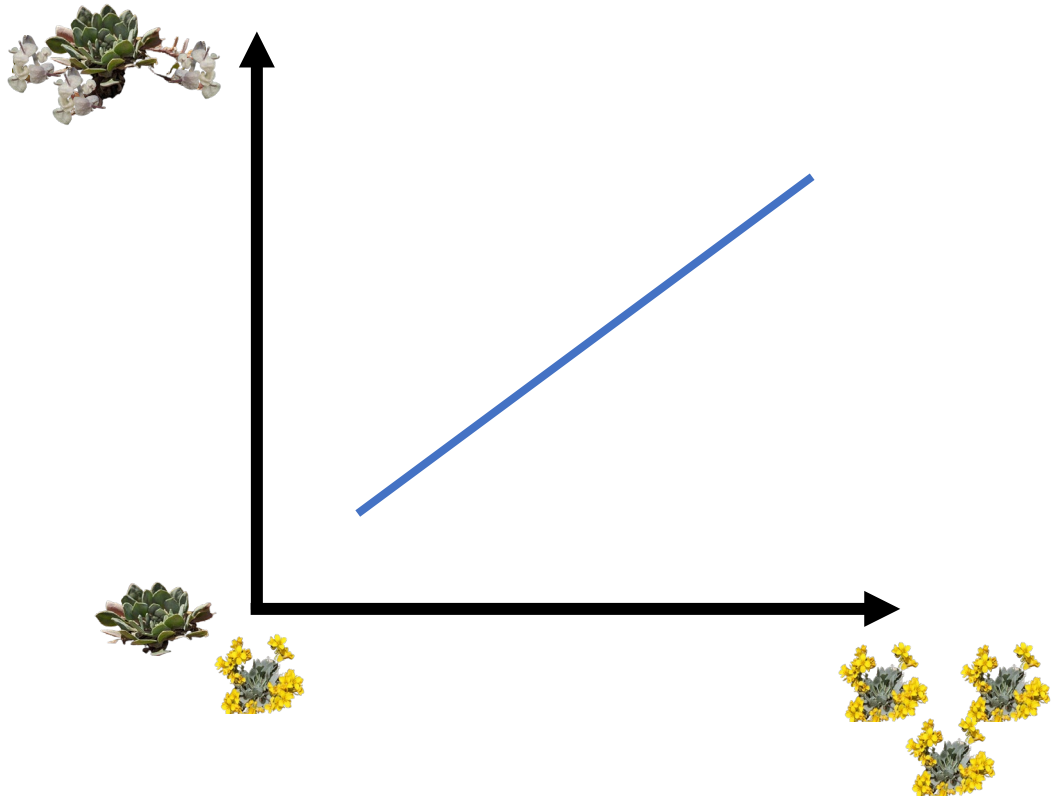
Does lower outcrossing opportunity affect populations' reproduction? →
Aim 2: Test whether pollen supplementation greatly changes seed production in *P. alpina* between sites.

What's similar or different between populations? →
Aim 3: Quantify and describe ecological variation among *P. alpina* populations to characterize its habitat (*truncated for time*).

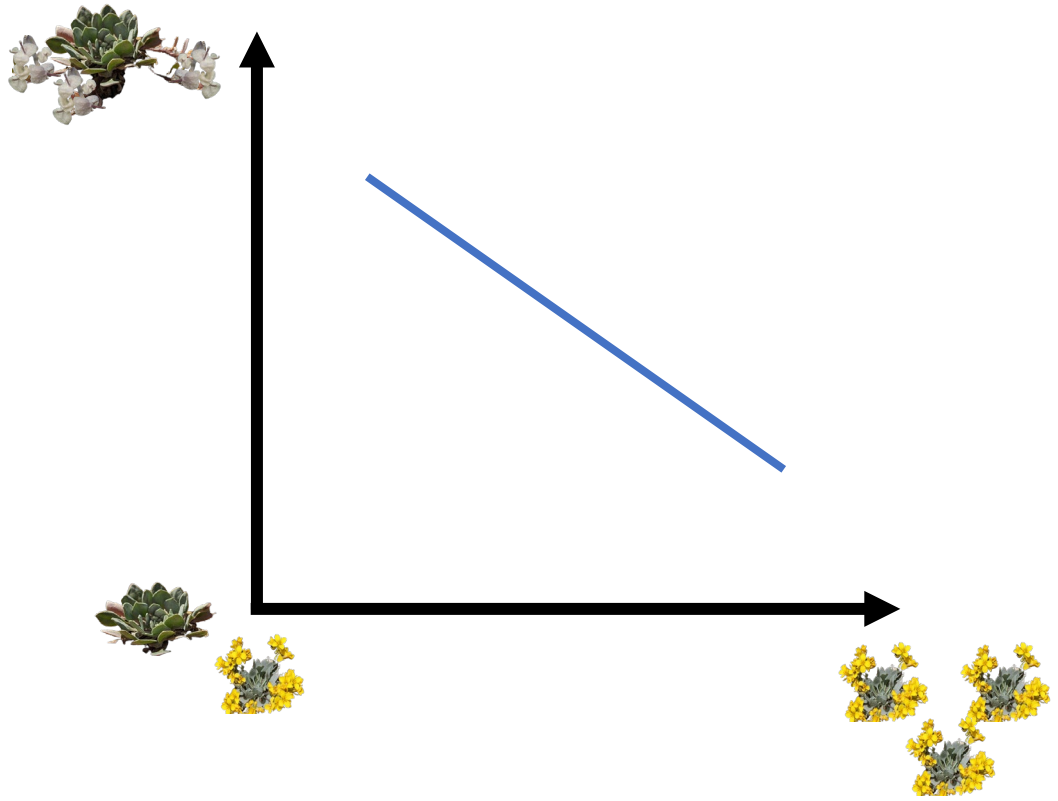
Hypotheses:
Aim 1

What affects the probability of a flowering plant going to fruit?

Intraspecific Facilitation



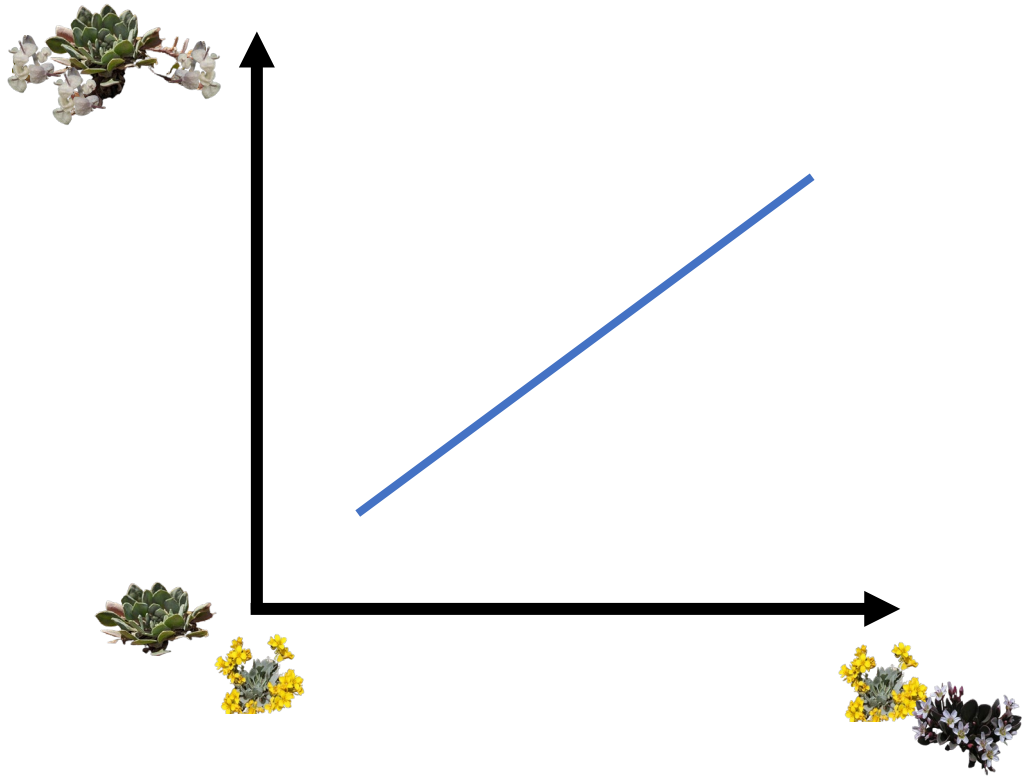
Intraspecific Competition



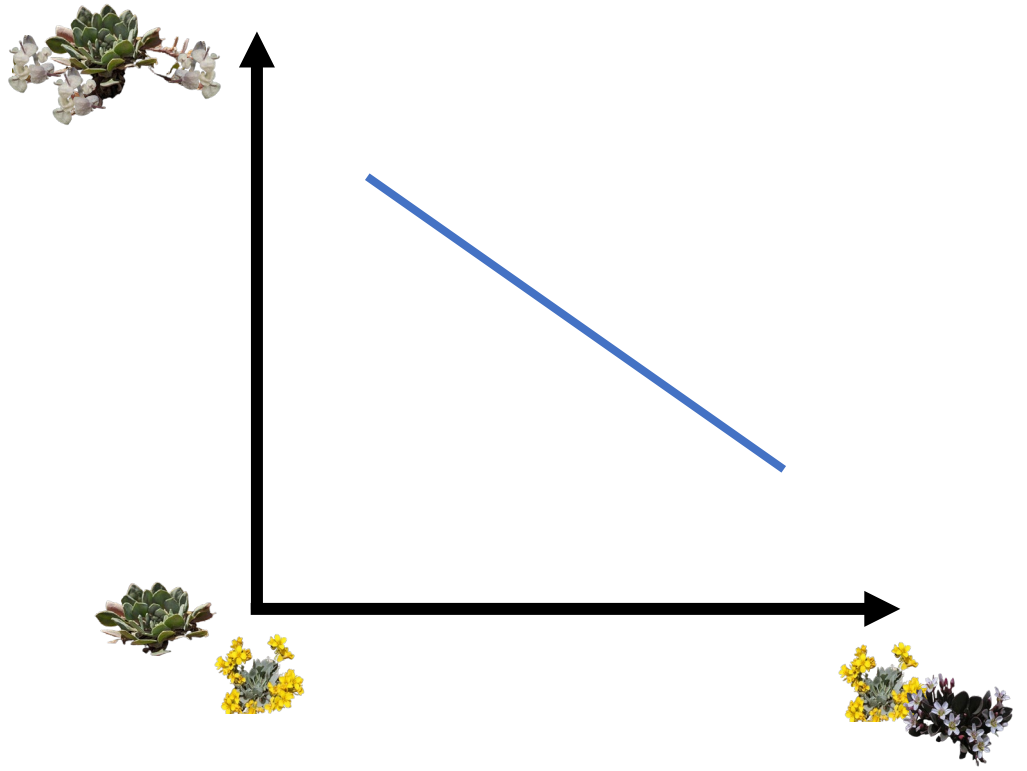
Hypotheses:
Aim 1

What affects the probability of a flowering plant going to fruit?

Interspecific Facilitation



Interspecific Competition



Methods

Data Collection (60 plots, 3 populations) – Visited Twice

1 m

1 m

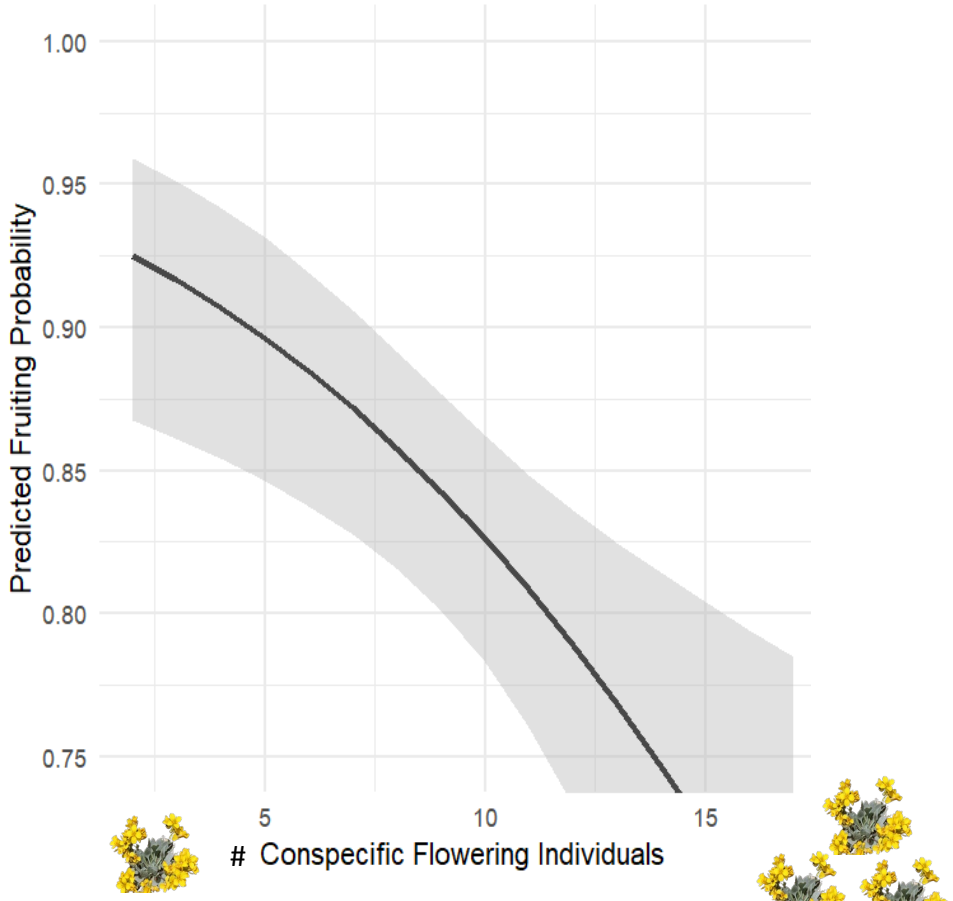
Intraspecific Effects: Number + estimated cover of *P. alpina* (vegetative, flowering, fruiting plants)

Interspecific Effects + Habitat Characterization:

Identified and estimated cover of each heterospecific forb/shrub taxon present (vegetative, flowering, fruiting)

You can ask me more later about other variables measured!

Top Model: Reproduction predicted by Conspecific Flowering Individuals + Conspecific Flowering Cover Estimate



ΔAICc = 0.00, weight = 0.43

β = – 0.120

95% CI: – 0.193 to – 0.049

Signal of intraspecific resource competition.

Results:
Aim 1

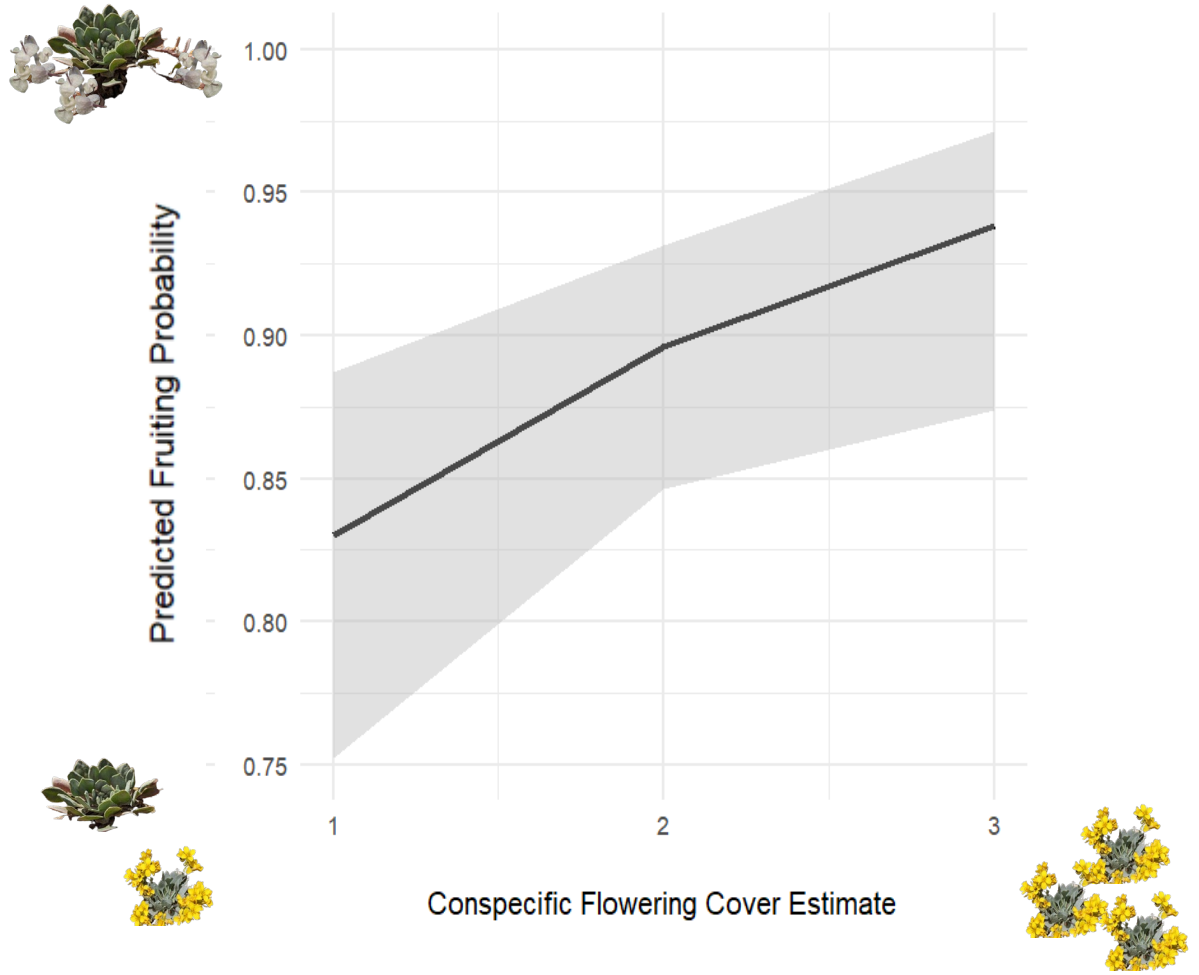
Top Model: Reproduction was predicted by Conspecific Flowering Individuals + Conspecific Flowering Cover Estimate

ΔAICc = 0.00 , weight = 0.43

β = 0.570

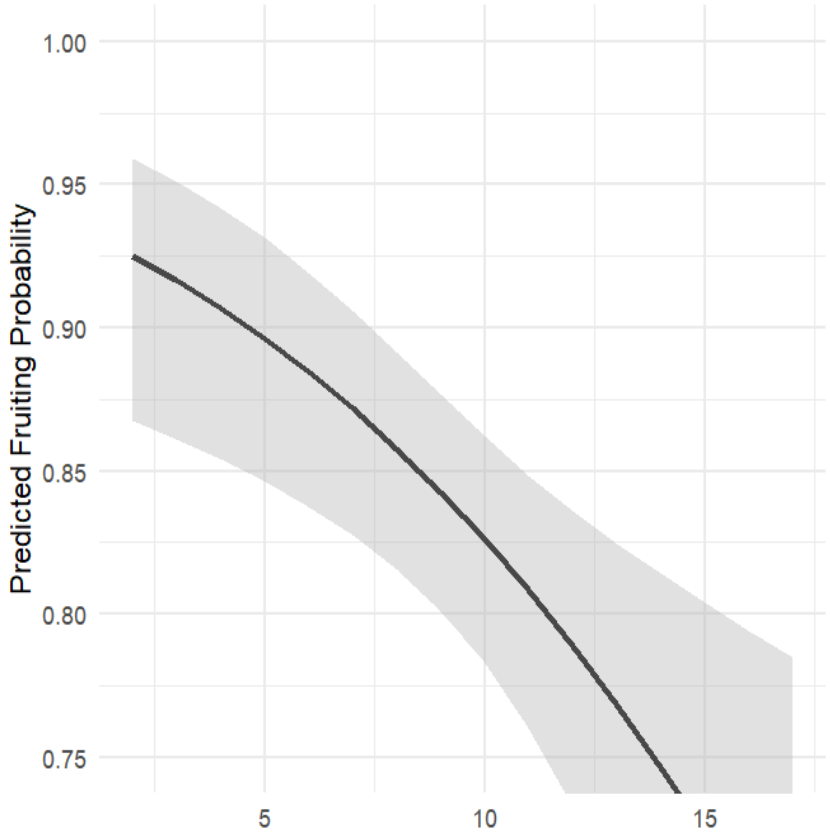
95% CI: 0.101 to 1.050

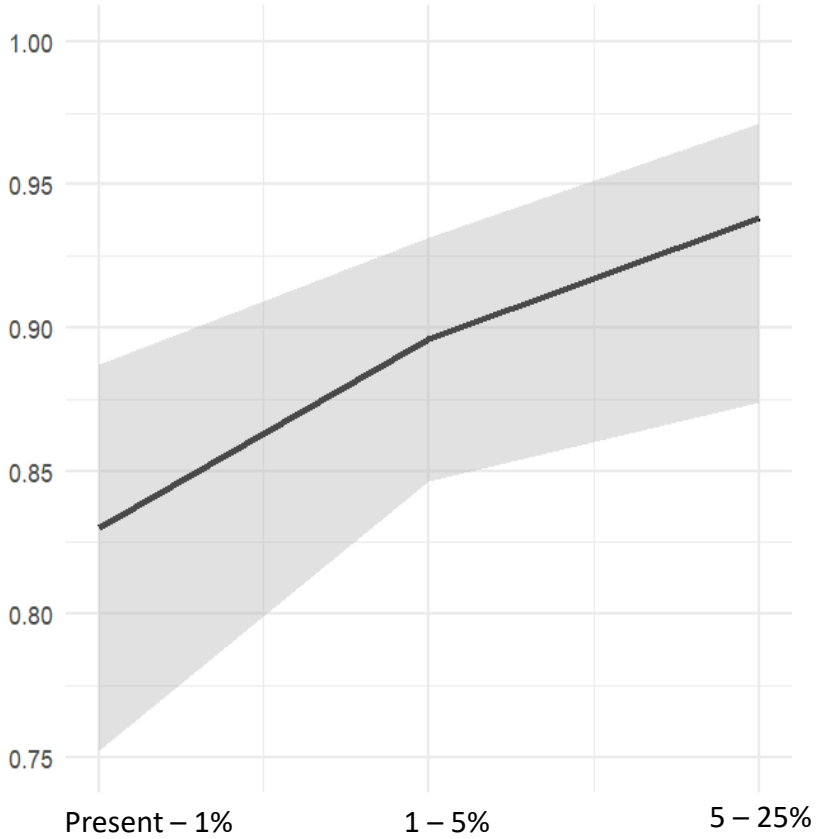
Contrasting signal of potential interspecific facilitation?



Results: Aim 1

Top Model: Reproduction was predicted by Conspecific Flowering Individuals + Conspecific Flowering Cover Estimate (ΔAICc = 0.00 , weight = 0.43)

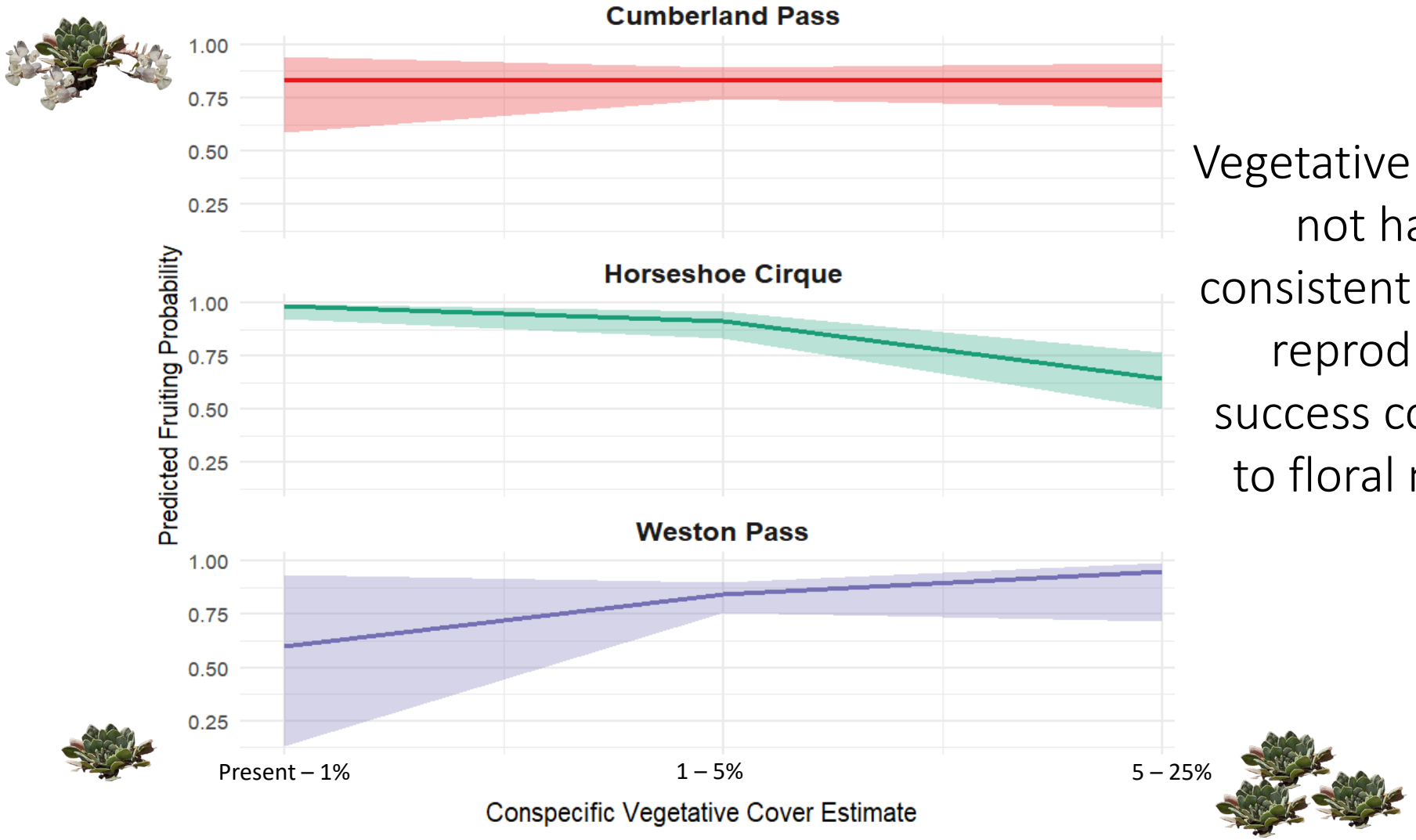




Results:
Aim 1

Second Best Model: Reproduction was predicted by conspecific vegetative cover + interaction with Site

(ΔAICc = 1.35, weight = 0.22)



Vegetative cover did not have a consistent effect on reproductive success compared to floral metrics.

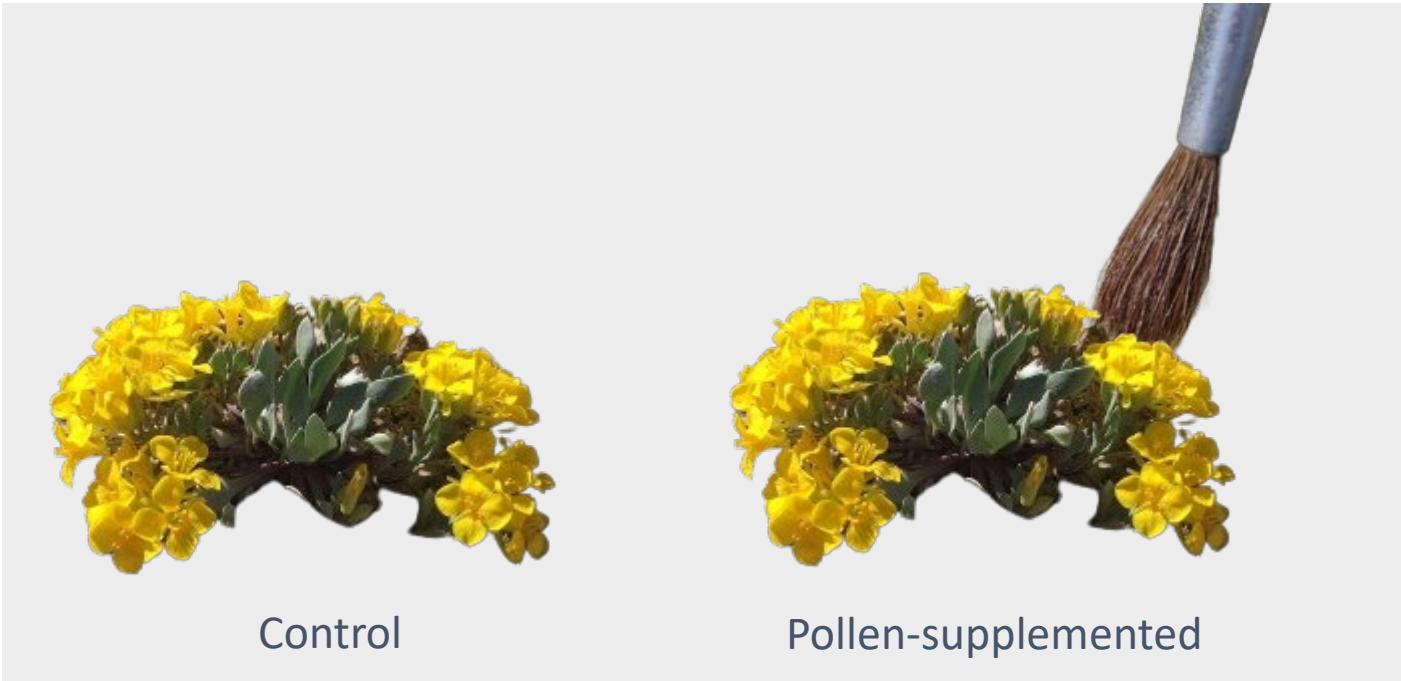
Results: Aim 1

None of the top models were predicted by heterospecific vascular plants' abundance or cover, survey timing and dates, bare ground or litter cover.

Hypotheses:
Aim 2

Pollen limitation (inadequate pollen receipt) is greater at specific sites (populations).

Compare differences between groups across sites

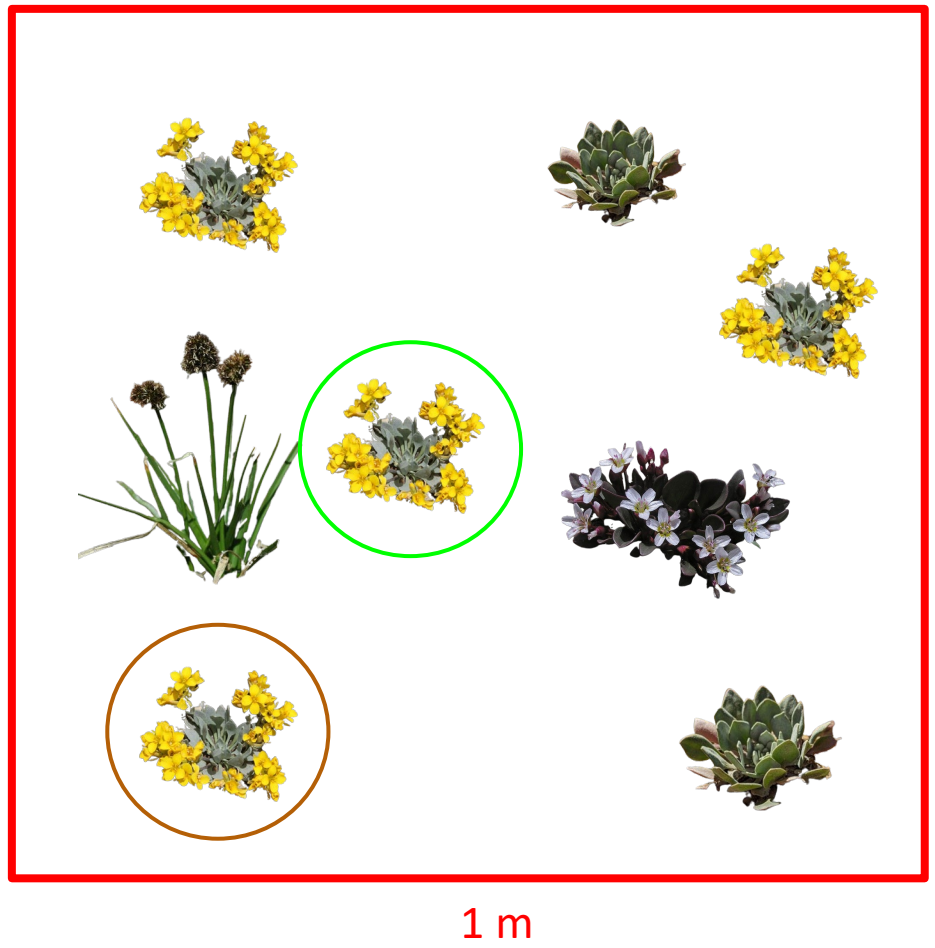


Hypotheses: Aim 2

If the difference in reproduction (seed set) between control and pollen-supplemented plants varies between sites, then pollen limitation may occur at specific populations of *P. alpina.*

Methods:
Aim 2

Data Collection: Focal Plants (Pollen Supplementation)

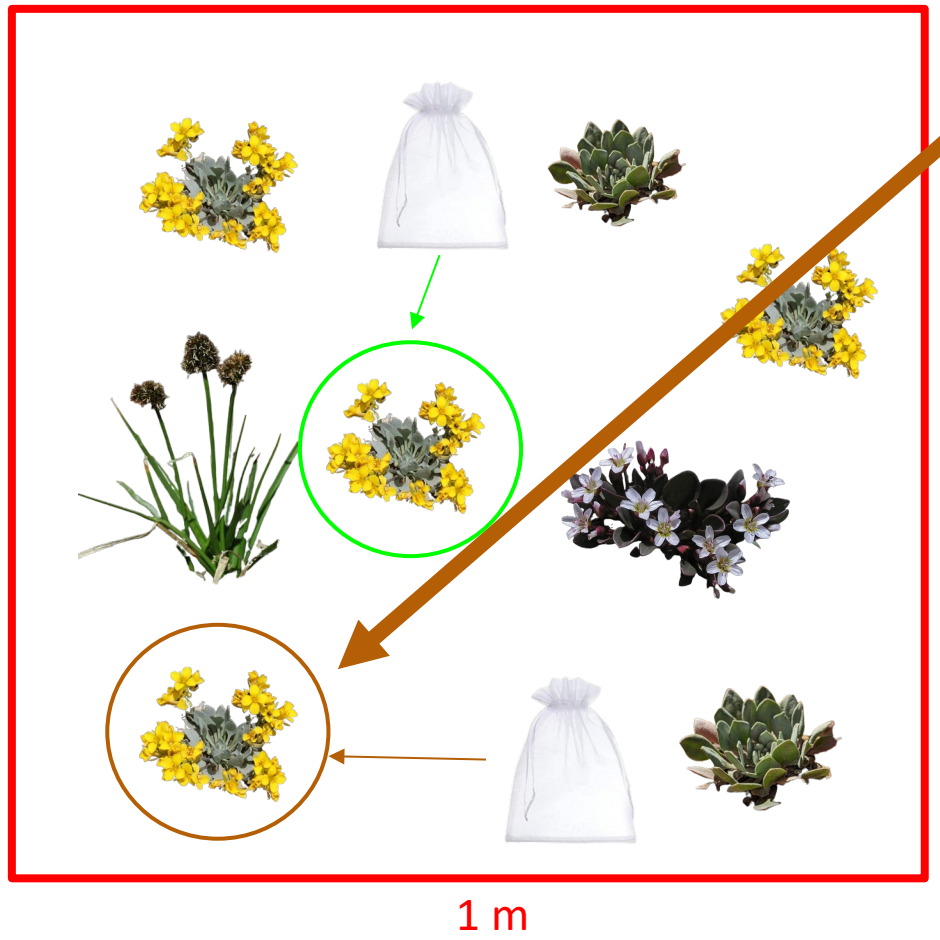


<u>Testing Pollen Limitation (First Survey):</u>

- Flowering plants numbered
- Two flowering *P. alpina* were randomly selected to be either treatment (pollen-supplemented) or control
    - 60 plants in each treatment

Methods:
Aim 2

Data Collection: Focal Plants (Pollen Supplementation)



<u>Testing Pollen Limitation (First Survey):</u>

- Anthers collected from <u>≥</u> 2 donors within 2-10 meters outside plot
- Anthers rubbed on stigmas of open flowers (<u>≥</u> 20% of open flowers)

Inflorescences bagged and yarn used to mark individuals

Methods:
Aim 2

Data Collection: Focal Plants (Pollen Supplementation)

<u>Testing Pollen Limitation (Second Survey):</u>

> 4 weeks after first survey

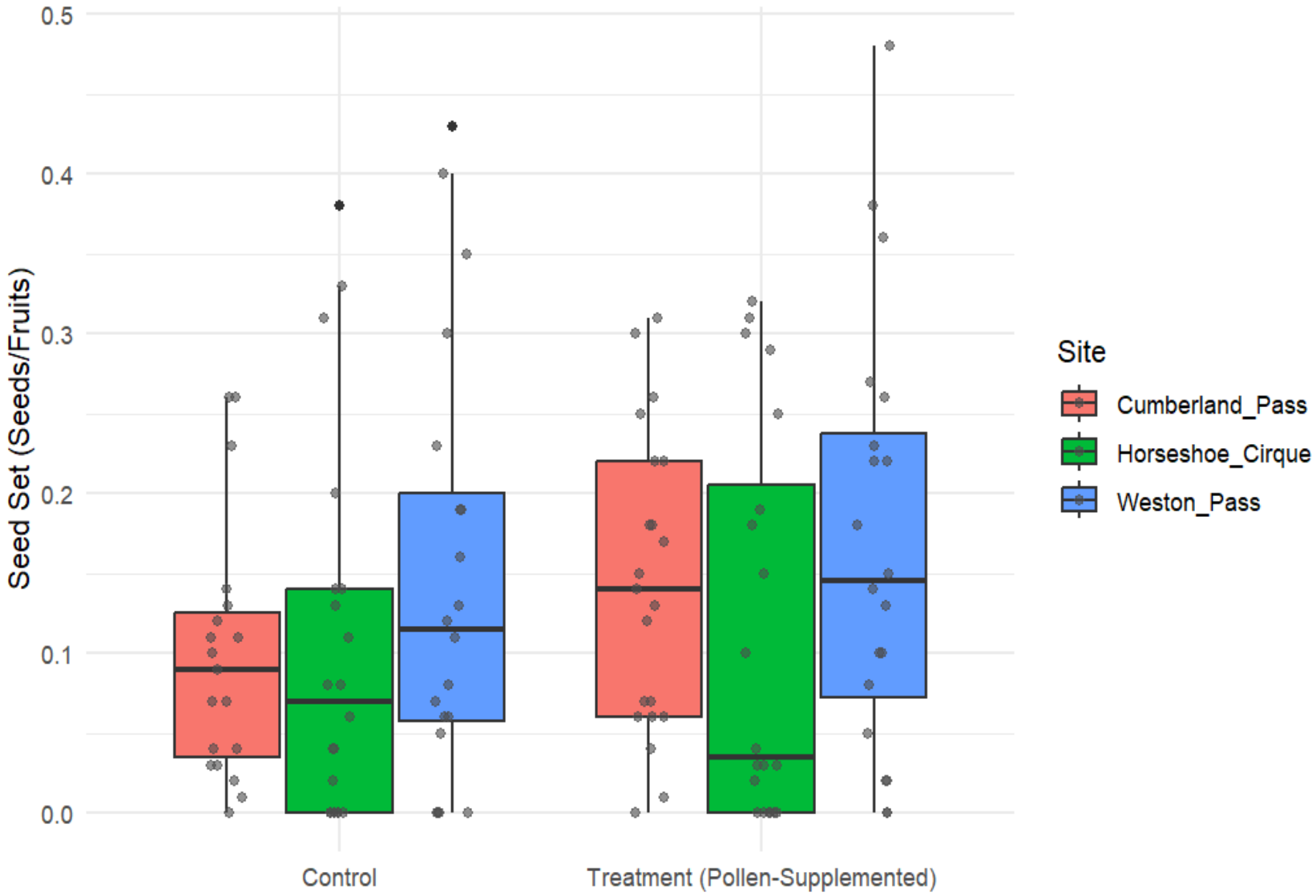
Data collected when bags were opened →

Seed set per plant = # Seeds / # Fruits

Viable seeds saved for seed banking at Denver Botanic Gardens

Results:
Aim 2

No evidence of pollen limitation.



Aim 3

Quantify and describe ecological variation among *P. alpina* sites (populations) to characterize habitat.

P. alpina abundance → Kruskal-Wallis tests comparing 110 plots found minimal variation in *P. alpina* abundance.

(Contact me later if you would like to discuss community structure and biodiversity indices) → Generally similar.



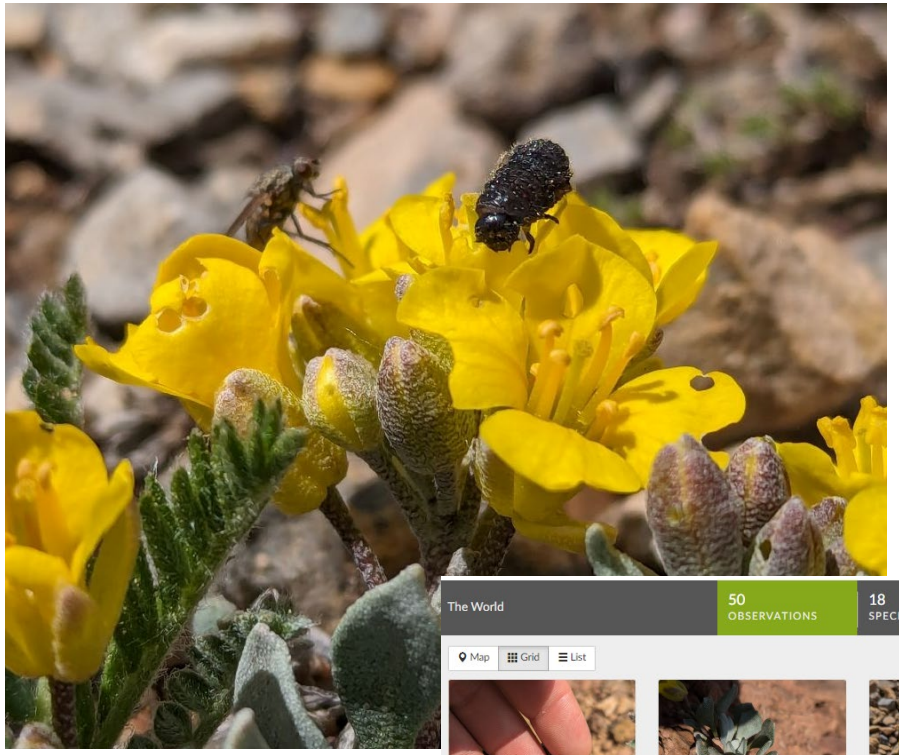

Methods: Aim 3
Part IV

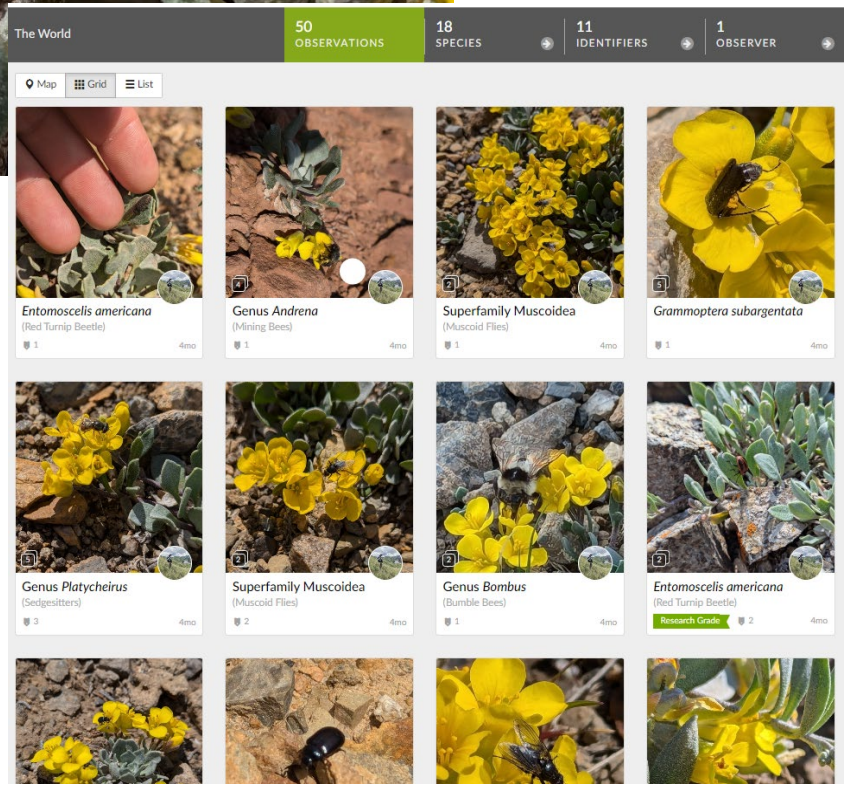
Ad-Hoc Natural History Observations

No previously documented animal interactions with *P. alpina*

→ Took photos of any animal interactions we encountered, which were uploaded to iNaturalist

→ Consulted top identifiers of particular taxonomic groups for herbivory





Results: Aim 3
Part IV

Floral Visitors

Visitation from several kinds of flies, bees and ants, beetles, moths, and one mite

Flies were the most commonly detected flower visitor, and ants were often seen in plots

Results: Aim 3
Part IV

Parasitism

At one of the 6 sites (Cumberland Pass – Sawatch Range), swollen leaf bases were observed on a few plants. Leaf opened →

Gall midge (family: Cecidomyiidae – ID by Dr. Matt Bertone, pending further ID)

Results: Aim 3
Part IV

Herbivory

Leaf beetle larvae

(family: Chrysomelidae)

Usually found eating

reproductive parts of *P. alpina*

Widespread and present at all

sites

Results: Aim 3
Part IV

Herbivory

Larvae observed eating other mustard taxa (*Smelowskia americana, Erysimum capitatum, Draba* spp.)

Results: Aim 3 Part IV

Most likely red turnip beetles (*Entomoscelis americana*) – native pest, occurs widely

Not formally documented as herbivores of/being hosted by *Physaria*

Initial ID by Rob Westerduijn, confirmed by Dr. Chris Reid

Takeaways

Aim 1: Reproduction was influenced by conspecific context in variable ways

- More flowering individuals reduced fruiting probability (intraspecific competition)
- More floral cover increased fruiting probability (potential intraspecific facilitation)
- Conspecific vegetative cover effects varied by site (e.g., negative at Horseshoe Cirque)

Aim 2: No strong evidence of pollen limitation

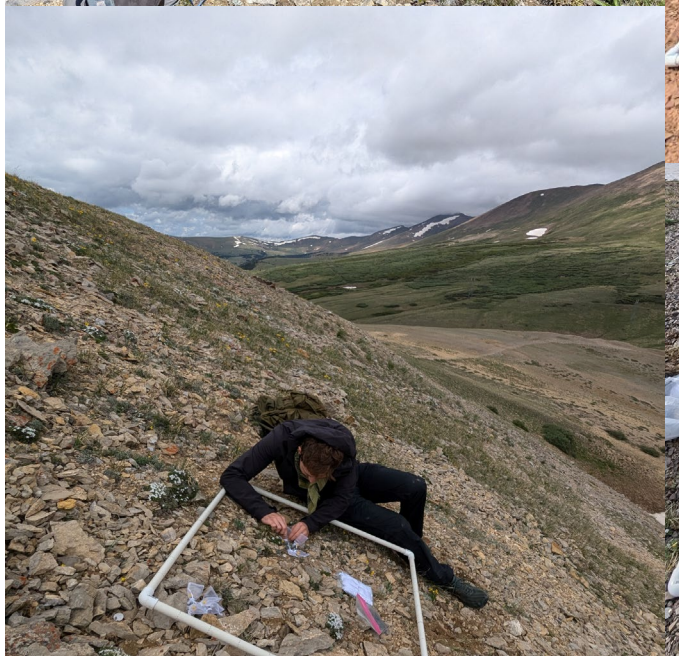
- Seed set did not increase significantly with pollen supplementation
- Seed set was consistent across sites and treatments

Aim 3: *P. alpina* abundances were similar across all plots. Floral visitors spanned several insect groups, and herbivory and parasitism were detected.

Management Recommendations

- Population monitoring and research efforts are relevant and effective approach
  - A study at an Elk Mountains population could make comparisons between the demographic studies more comprehensive

- Future surveyors could take note of within-site variation in the distribution of vegetative individuals and reproductive individuals within sites



Future Directions

Next Steps:

Incorporate abiotic data

- Analyze soil moisture and temperature data from data loggers
- Explore how microclimate affects reproduction, competition, and habitat composition

Confirm identity of herbivores, parasites

Future Considerations:

- Comparing results with demographic studies
- Sampling at more sites to verify trends/temporal variability with randomized plots

Q and A

Thank you for your time today!

Questions?

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