Floral visitation and pollen deposition of *Bombus* pollinated *Dodecatheon alpinum* and *Pedicularis groenlandica* in the Sierra Nevada

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Introduction: Flowering plants and their pollinators rely on each other for reproduction. Plants require transfer of pollen for reproduction, and pollinators collect pollen as their source of protein. Pollen may be placed on several bee body regions, after which bees may groom it onto corbicula to take it back to the colony, where it is used to feed young bees. It may be placed where they can easily groom it (ventral surface of abdomen), or where it is harder to access (dorsal surface of abdomen or head/thorax). Floral morphology can control pollen placement such that it reaches receptive stigma structures of conspecifics, while possibly also preventing heterospecific pollen transfer.

Pollen placement mechanisms may be a key driver of co-existance of plant species that share pollinators. Partitioning placement could even give rise to facilitation among guilds of flowers with similar displays and architectures. Here we begin to explore how pollen placement might mediate interactions between two otherwise similar co-flowering Sierra wildflower species.

General question: ***Does multi-trait similarity lead to facilitation?***
When plant species share floral signaling traits, they may benefit in a attracting more pollinators with their combined display (facilitation) (eg. Ghazoul 2006). However when pollinators move between species, plants risk the transfer of heterospecific pollen.

Specific aims of this pilot study:

Q1. Do bees use these species concurrently?

Q2. Does pollen placement differ between species?

Study system: ***Dodecatheon alpinum*** (alt. *Primula tetrandra,* Alpine shooting star) and ***Pedicularis groenlandica*** (Elephant's head) grow in subalpine wet meadows in the Sierra Nevada where they bloom concurrently (Harder & Barclay 1994; Macior 1977).

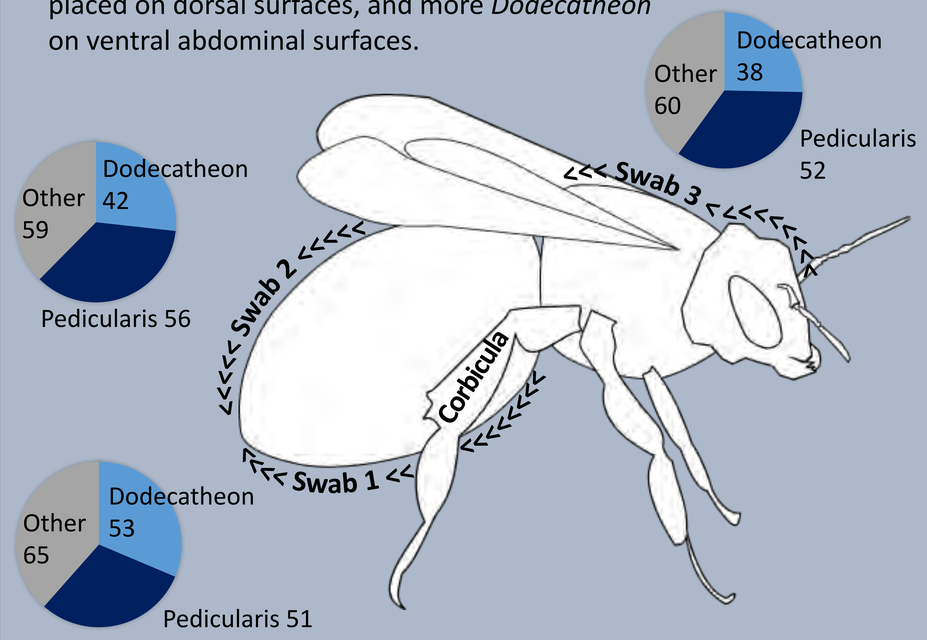
- These species have **Multi-trait floral similarity:**
- Color similarity
- Reward system (pollen only)
- Require buzz pollination
- Primarily pollinated by *Bombus*

Methods and Results:

Bees were observed in 8 sites in the Sierra Nevada (Sagehen Creek Field Station, CA and Tahoe Meadows, NV) with only *Dodecatheon* present, only *Pedicularis* present or with both species (mixed sites). Bees observed visiting the target plant species were collected and non-destructively sampled for pollen. Pollen was swabbed with a cube of Fuchsine jelly from bees' bodies from three locations (swab 1: ventral surface, swab 2: dorsal surface, swab 3: head/thorax), and one corbicular load was sampled.

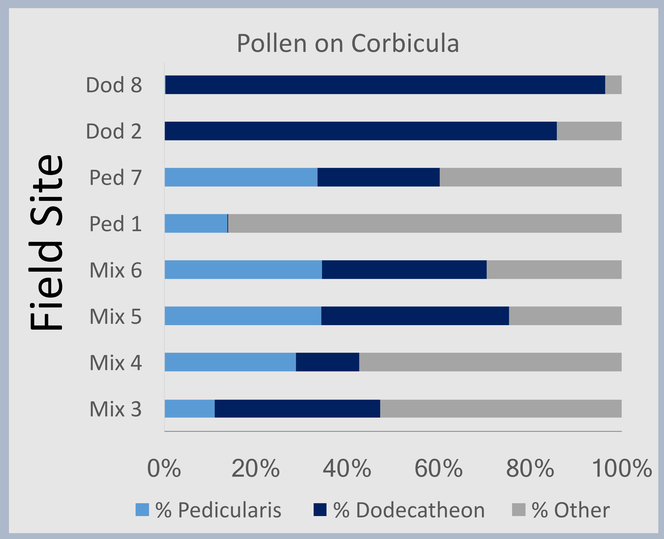
Pollen placement: Presence of each focal species or "other" pollen species in slides of swabs from each location on bees' bodies (n=79). "Other" pollen represents 25 species.

→ Placement may differ by species, with more *Pedicularis* placed on dorsal surfaces, and more *Dodecatheon* on ventral abdominal surfaces.



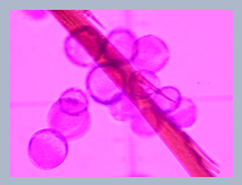
Corbicular loads: Pollen collected from the corbicula was dispersed in ethanol and percentages of each target species, or "other" species were quantified using a microscope.

→ Percentages differ by site type, and by individual site, with most bees carrying multiple species of pollen.



Future directions: ***Understanding bee behavior and plant reproductive consequences to floral similarity.***

Bee foraging observations at each site will be used to understand how bees move between these species when they co-occur. Detailed floral phenotyping (measuring color, scent, and reward quality) and floral preference assays will reveal how bees make foraging decisions in this system. Analyzing stigma samples collected at *Dodecatheon*-only, *Pedicularis*-only, and mixed sites are being analyzed, and will provide information about the reproductive consequences of multi-trait floral similarity.



Mixed pollen sample on a bee hair, 400x magnification.

Discussion: ***What does pollen placement, bee behavior, and plant fitness measurements tell us?***

These data show that these species are used concurrently by their *Bombus* pollinators. Pollen may be deposited differently on bees' bodies, and while species composition at field sites influences the species of pollen present in bees' corbicular loads, bees may be utilizing these species together.

By understanding both plant signaling and pollinator behavior, we may better understand how plant and pollinator species interact at community level, on ecological and evolutionary timescales. These series of field based experiments will yield a holistic picture of pollination in this system, both from the plant and the pollinator point of view.

Literature cited: Ghazoul J (2006). Floral diversity and the facilitation of pollination. Journal of Ecology 94: 295-304. Macior LW (1977). The pollination ecology of *Pedicularis* (Scrophulariaceae) in the Sierra Nevada of California. *Bulletin of the Torrey Botanical Club* 104: 148-154. Harder LD & Barclay RMR (1994). The functional significance of poricidal anthers and buzz pollination: controlled pollen removal from Dodecatheon. *Functional Ecology* 8: 509-517.