



# Characterizing Floral Traits and Pollinator Preference in a *Penstemon digitalis* Population

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## INTRODUCTION

Domesticated honey bee and wild bumblebee populations have steeply declined in the U.S. over the last half decade. In the last 5 years alone, bee populations have seen a 30% reduction in the number of extant hives.

The loss of bees affects plants that rely on pollinators for reproduction, which includes 90% of all plants. 1/3 of those plants are utilized by humans for crops and produce, including broccoli, onions, and many varieties of berries and nuts.

These bee losses are attributed to various factors, such as viruses within colonies and habitat loss/destruction from human activity. Habitat destruction often forms many smaller, fragmented patches of natural land available for plants and pollinators. It has been found that pollinators visit plants in small patches less frequently than those in larger patches.

Reduced pollinator services leads to increased competition among plants within small patches to attract the attention of the few available pollinators. Studies have shown that when pollinators display a preference for certain plant traits, 75% prefer plants that are taller, have larger flowers, and/or have more open flowers at a given time.

Previous studies on *P. digitalis* found that greater flower size and number increased fitness in some populations, with height having no significant effect. (Parachnowitsch et al., 2010 and 2012) However, direct pollinator visitation has not been studied in relation to height and floral display.

## QUESTIONS AND APPROACHES

By characterizing attractive physical traits of *Penstemon digitalis* individuals (n = 73) found at the Calder Center and observing their pollinator activity, it can be shown whether or not pollinator selection is taking place, favoring larger, showier plants.

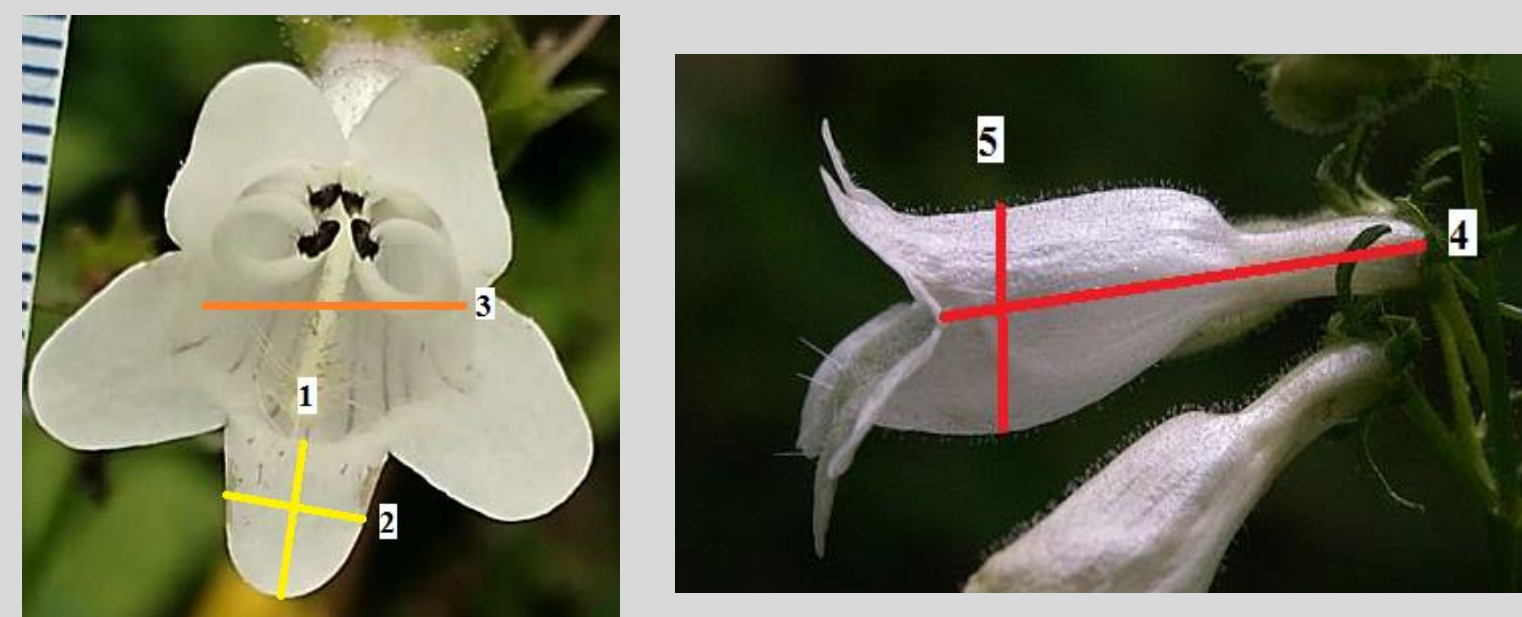
1) Is there **phenotypic variation** in this population?

2) Does **plant height** affect pollinator activity in *P. digitalis*?

3) Does a greater floral display, either in the **number or size of flowers**, increase pollinator visitation to a plant?

### • Measurements

- Height of each plant
- Flower Size (4 flowers per plant)
  - Center petal length and width (1 & 2)
  - Tube opening (3)
  - Tube length and width (4 & 5)



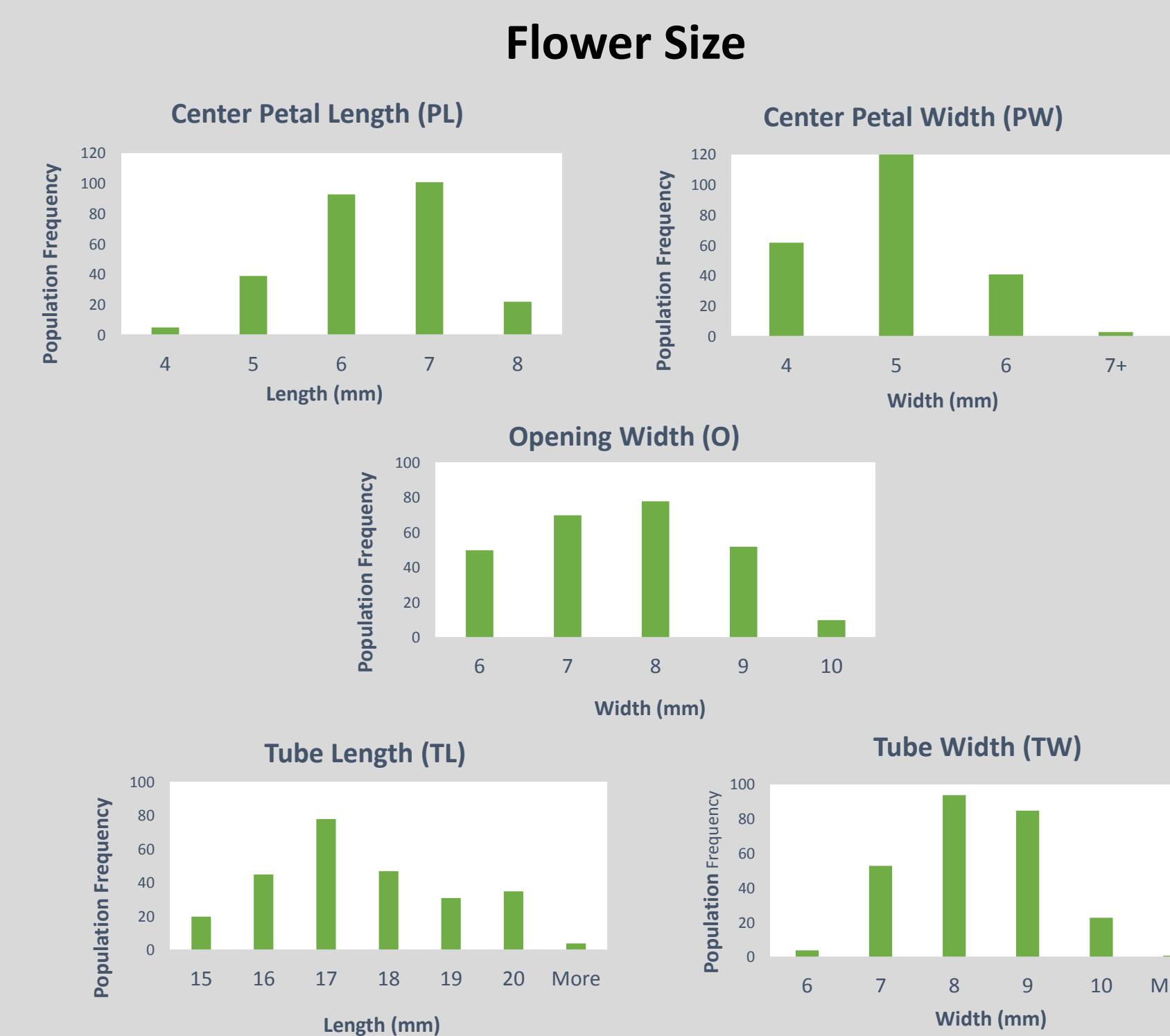
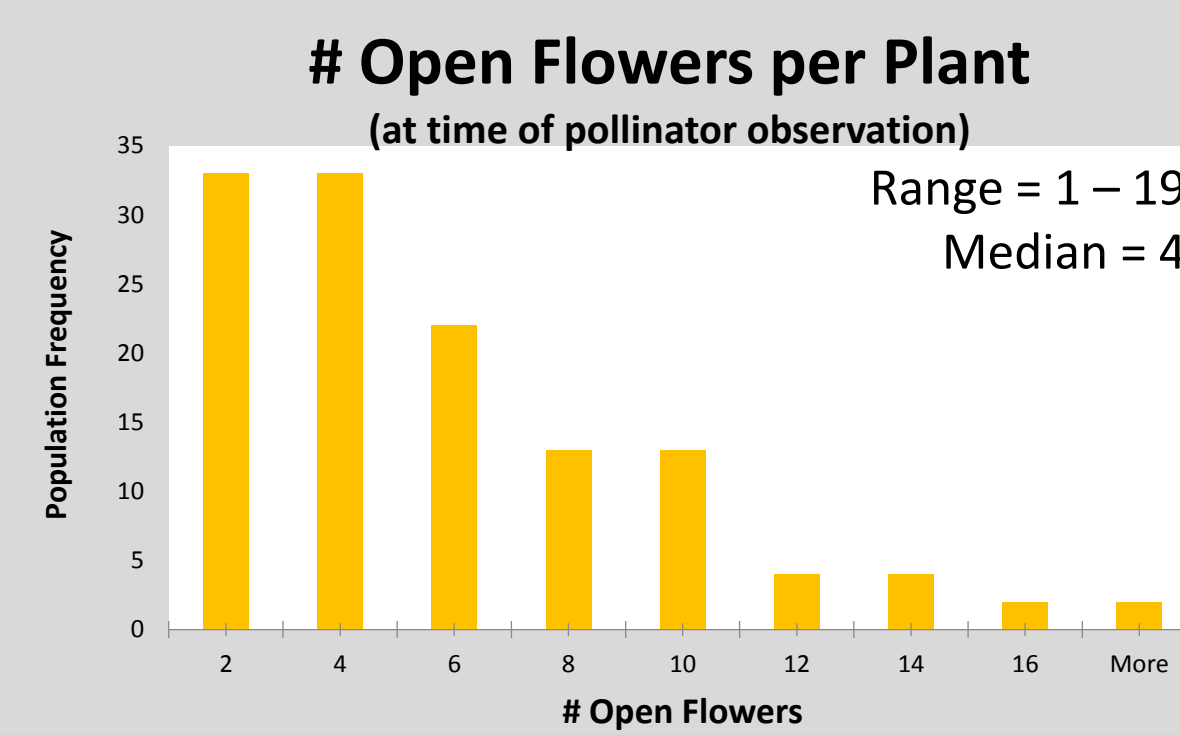
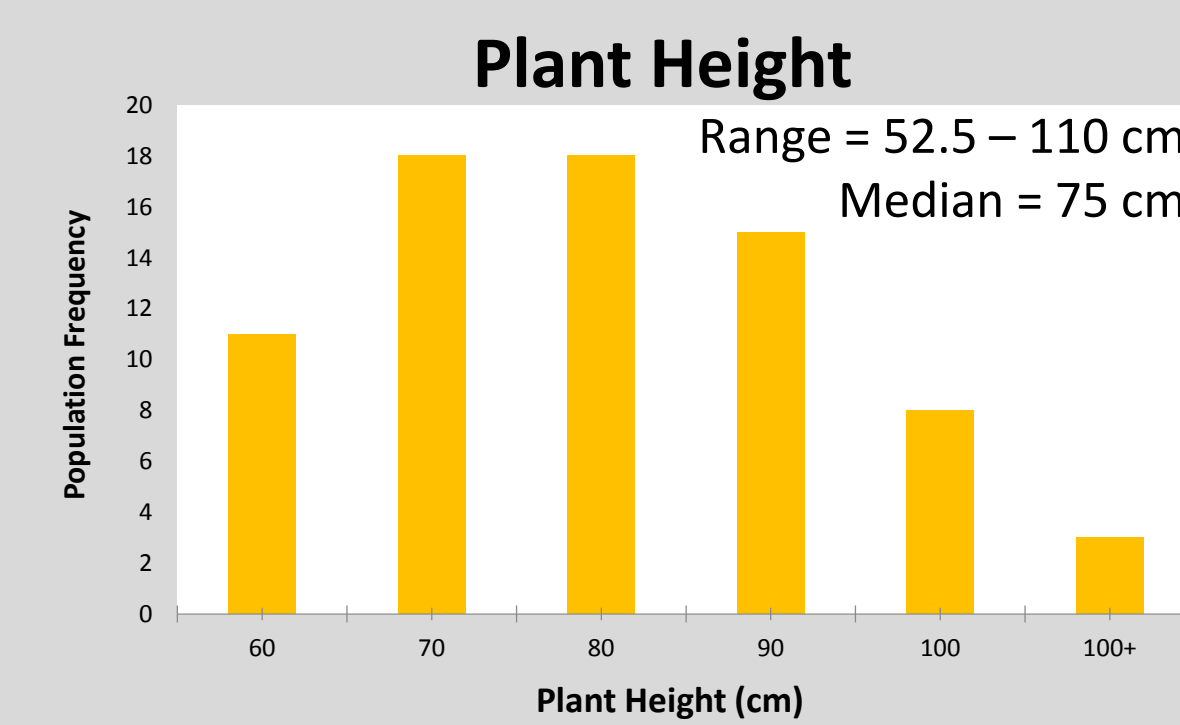
### • Pollinator Observations

- Recorded number of open flowers per plant
- Recorded number of bees and flies that foraged in a 20-minute period

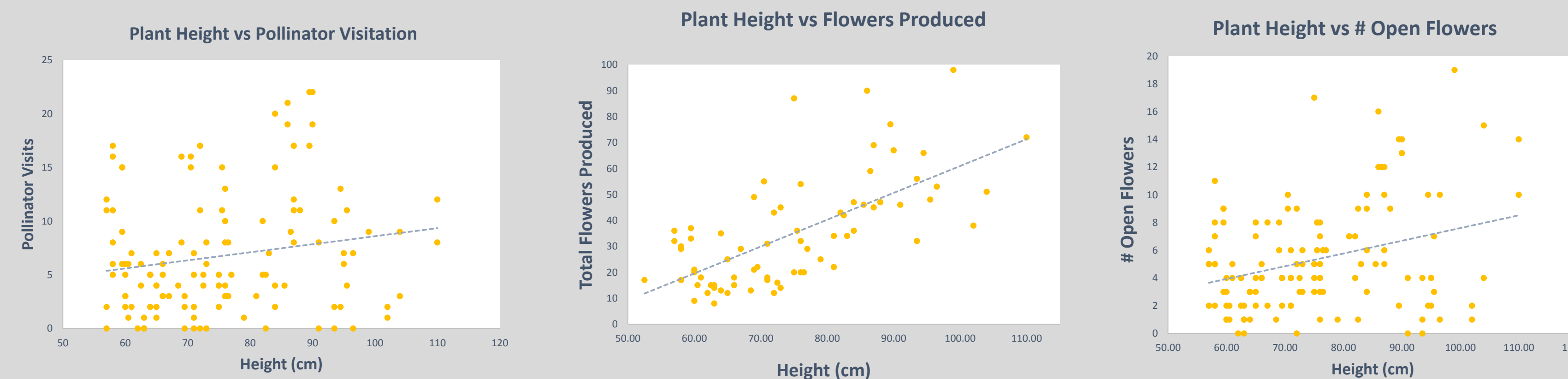


## RESULTS

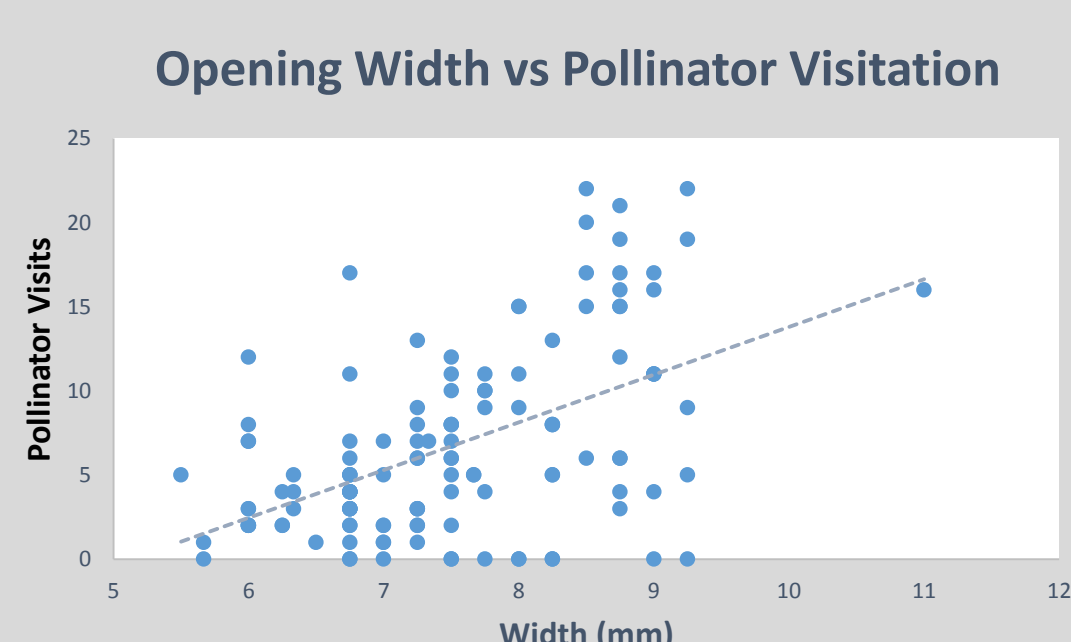
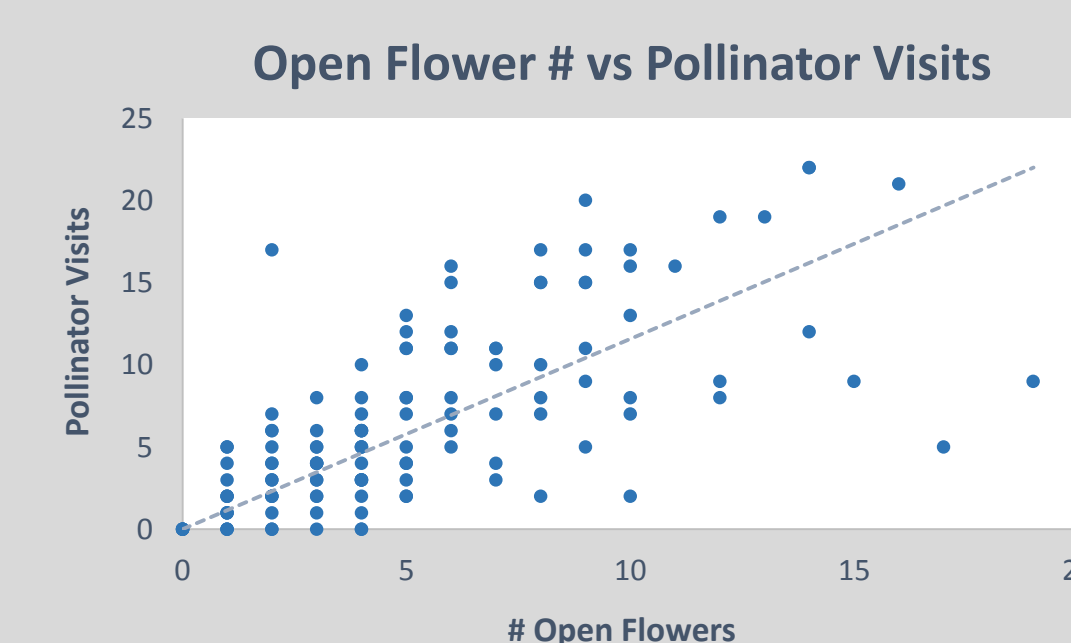
- Phenotypic traits varied substantially within population.
- Flower size was more similar within a plant than among plants ( $P < 0.0001$ ).



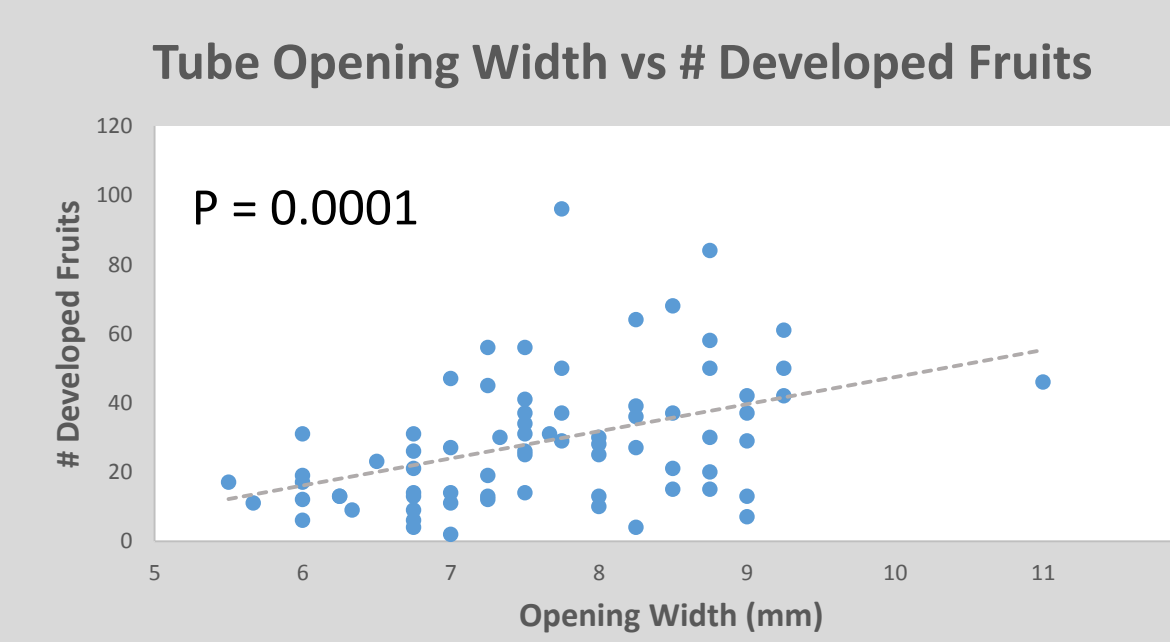
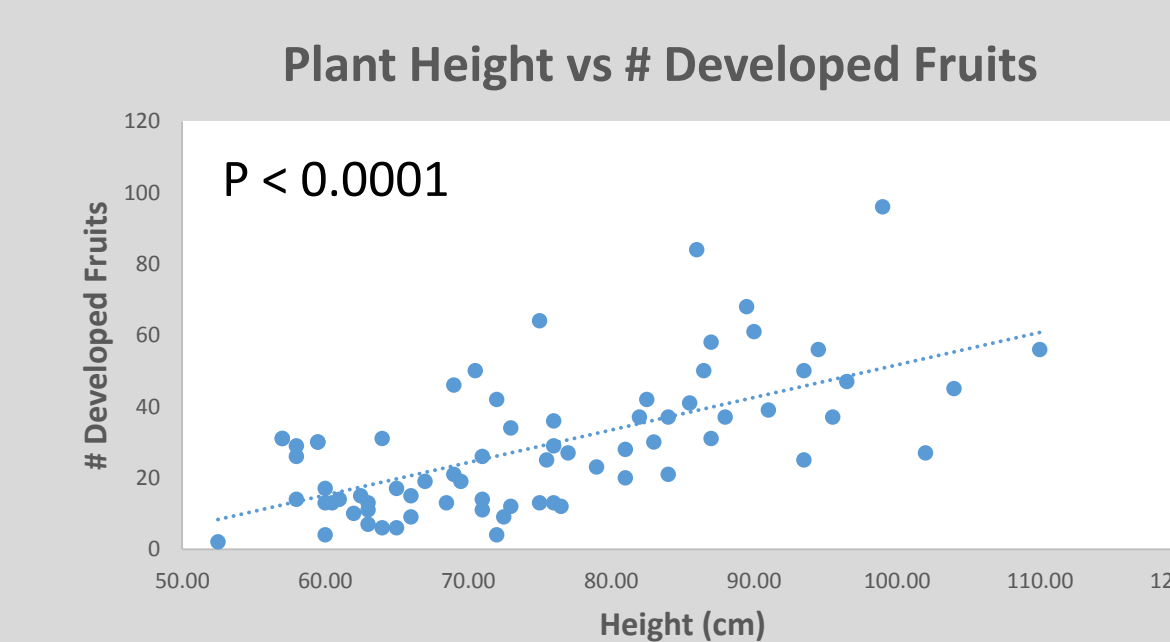
- Plant height was associated with increased pollinator visitation ( $P = 0.042$ ).
- Taller plants produced more flowers overall ( $P < 0.0001$ ) and had more open flowers at a given time ( $P = 0.0003$ ). However, height was unrelated to flower size.



- Open flower number exhibited a strong association with increased pollinator visitation ( $P < 0.0001$ )
- All flower traits *except tube length* were associated with increased pollinator visitation at larger sizes, especially tube opening width ( $P < 0.0001$ )



Height, flower number and flower size were associated with increased fruit development, which is hereby used as a proxy for seed weight to indicate fitness



## CONCLUSIONS

It was found that in this population of *P. digitalis*...

-Plant height was associated with increased pollinator visitation (*Directly and indirectly via # open flowers*)

-Individuals with more open flowers experienced more pollinator visitation

-Plants with larger flowers were visited more frequently by pollinators, especially those with wider tube openings and larger center petals.

Bigger petal = More room for bee to land?  
Wider opening = Easier bee access to nectar?

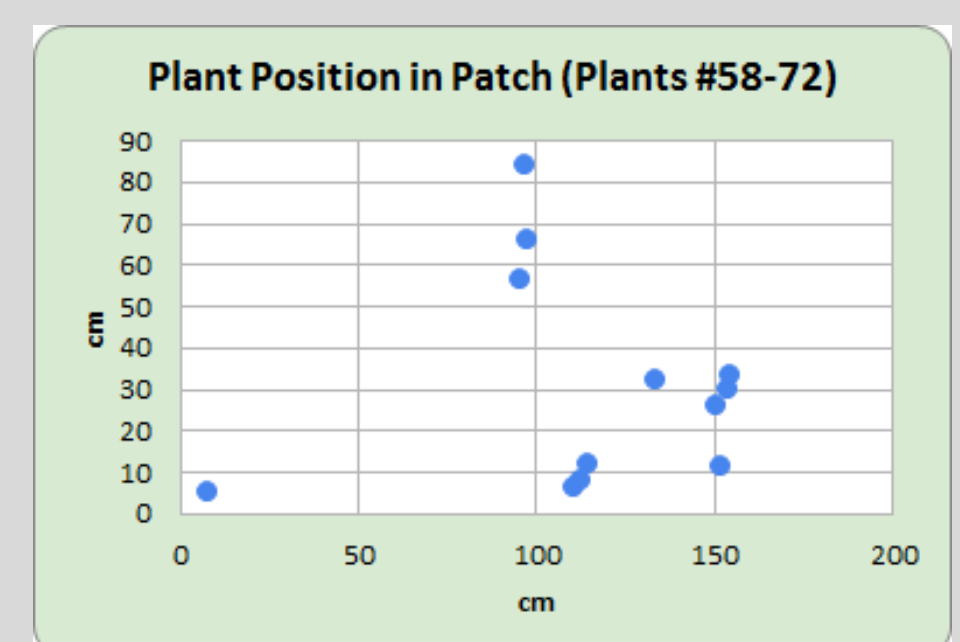
-Plants that had more flowers and larger flowers had greater fitness

-Frequency of pollinator visitation was strong associated with increased fitness ( $P \lll 0.0001$ )

-Results suggest that these pollinators are selecting for larger, showier plants, following the trend of pollinator selection found in other plant species.

## FUTURE DIRECTIONS

Some unexplained variation in pollinator visitation may be due to locational differences within a patch. To investigate this further, spatial analysis will be carried out to see if less showy individuals experienced more visitation when within close proximity to taller plants and/or those with greater floral display.



## ACKNOWLEDGEMENTS

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