

DO INVASIVE PLANT SPECIES NEGATIVELY AFFECT DIET AND PREFERENCE OF A NATIVE CALIFORNIA BUMBLE BEE?



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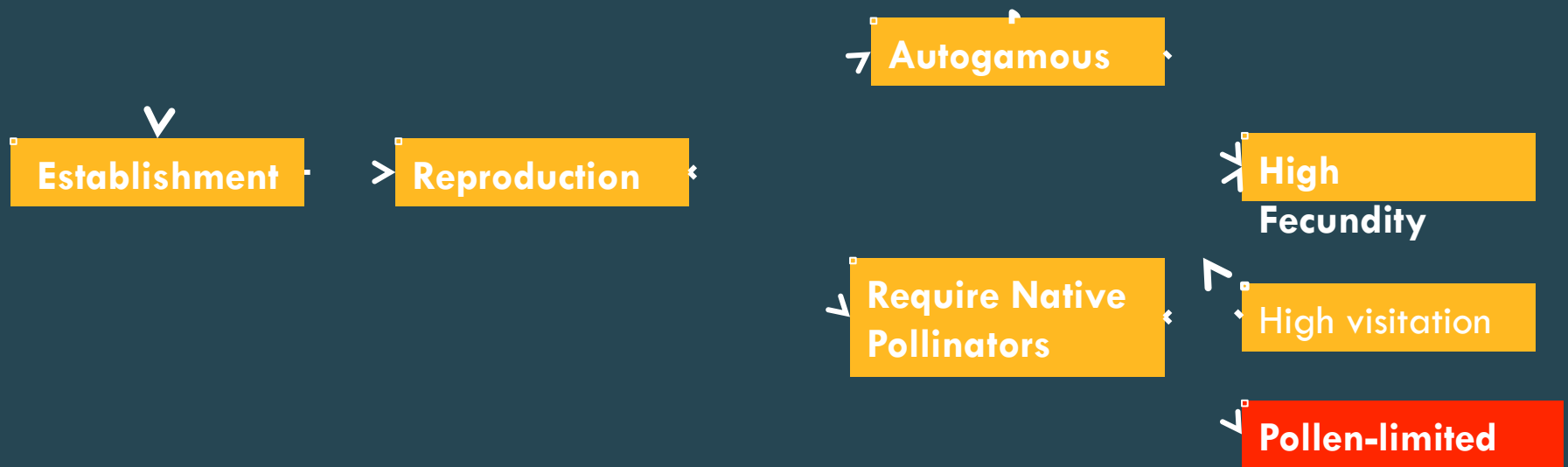
The importance of pollination for invasive plants

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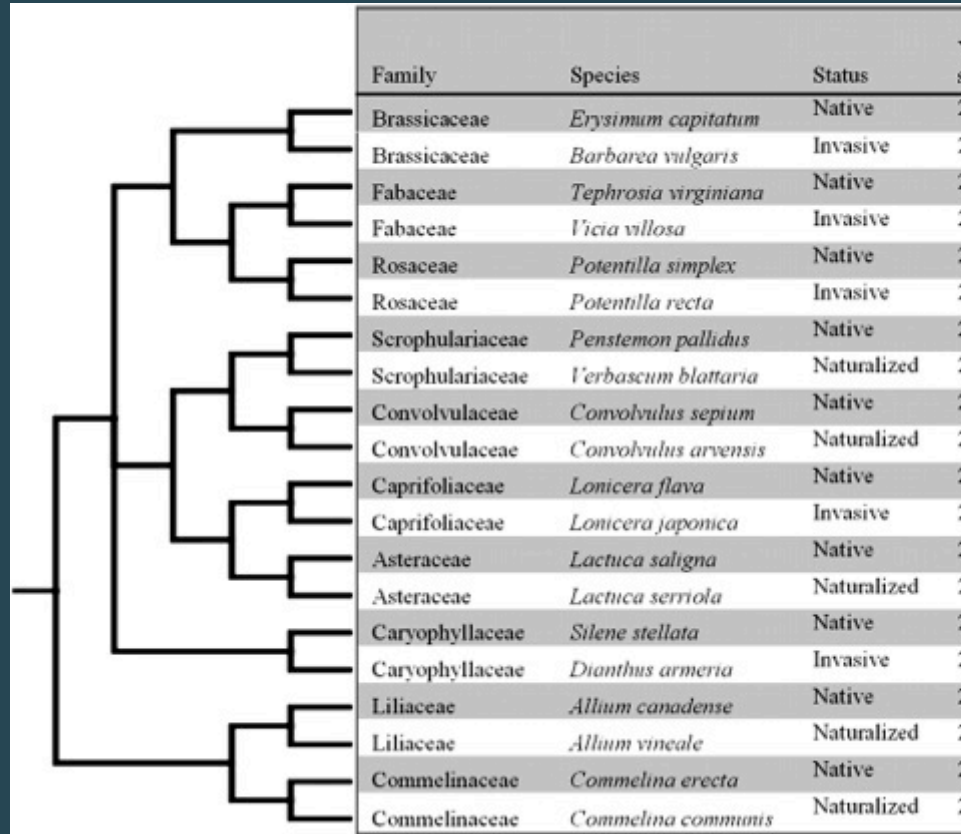
Establishment and Reproduction

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Close relatives

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Barbarea vulgaris



Potentilla recta



Lonicera japonica



Verbascum blattaria



Vicia villosa

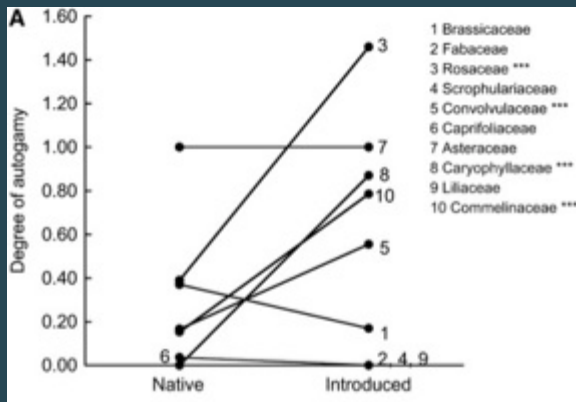


Convolvulus arvensis

Invasive Plants vs Native Plants

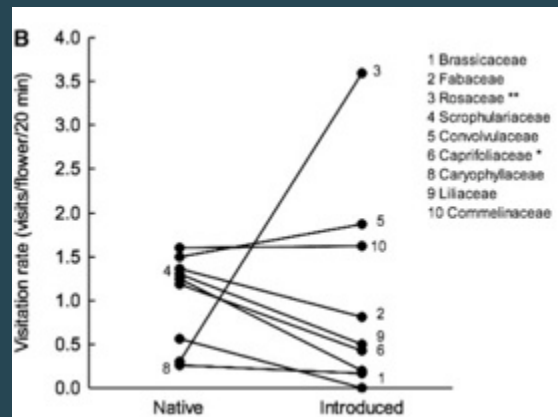
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Autogamy



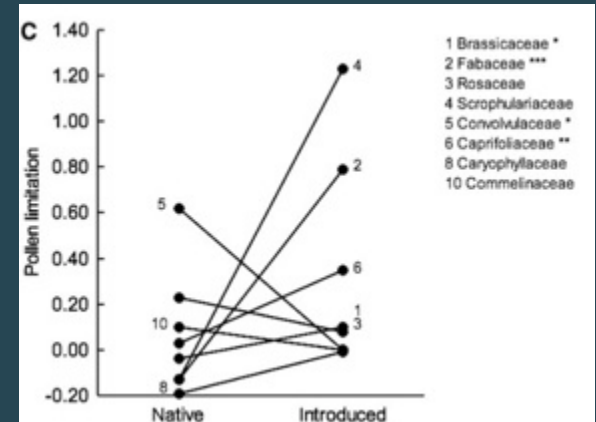
Most introduced species are more autogamous or equal to their native congeners

Visitation Rate



Eight of nine introduced species had equal or more pollinators than their native congeners

Pollen-limitation

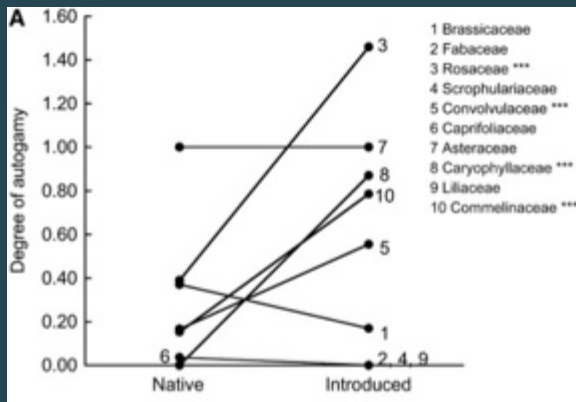


Only two invasive species were significantly pollen limited

Both Native Pollinators and Autogamy are critical to establishment and spread of invasive plants

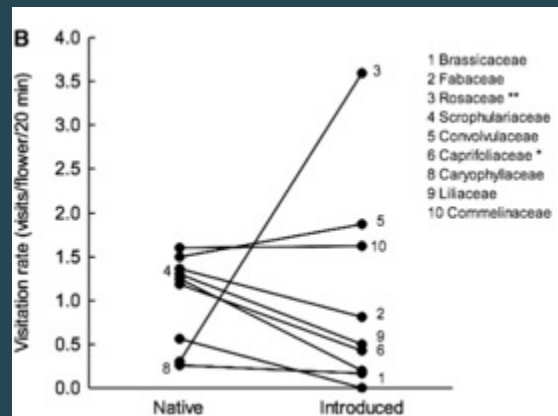
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Autogamy



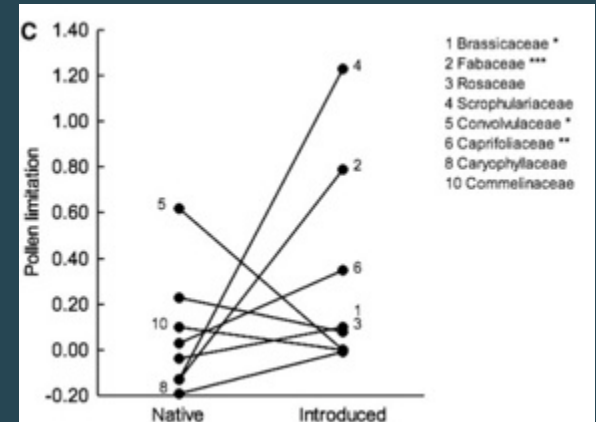
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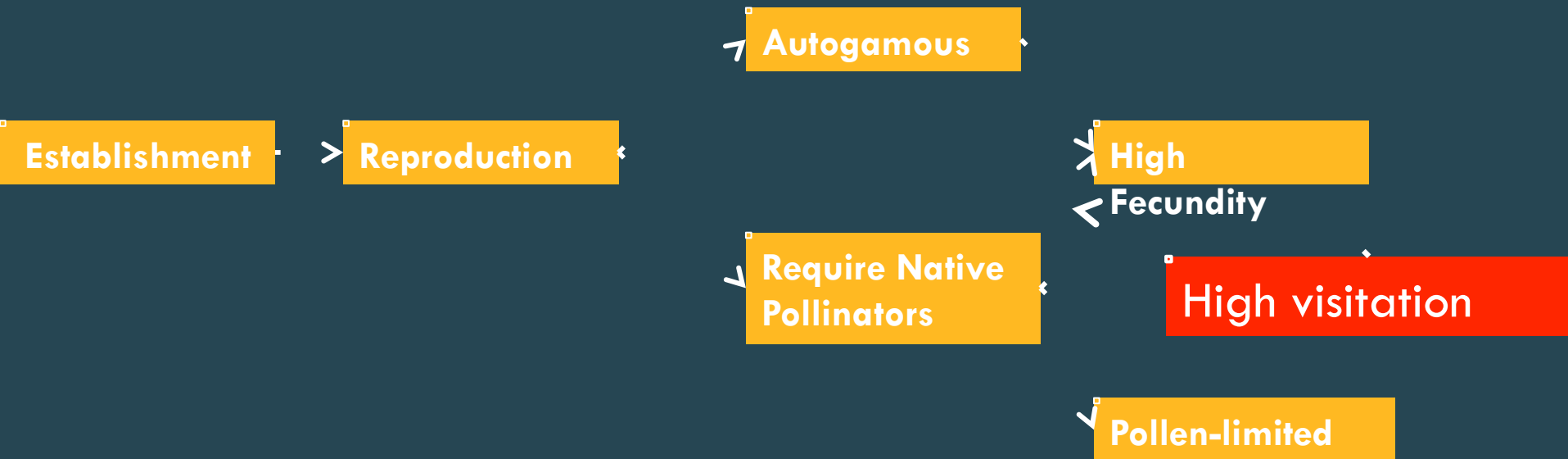
Pollen-limitation



Only two invasive species were significantly pollen limited

Why would native pollinators visit invasive plants?

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Why would native pollinators visit invasive plants?

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- Non-native plants could have both negative and positive impacts on native bees (Stout and Morales 2009)
- Little is known about the dietary preferences and needs of native bees
- Even less is known about how non-native plants impact diet



Diets of native bees

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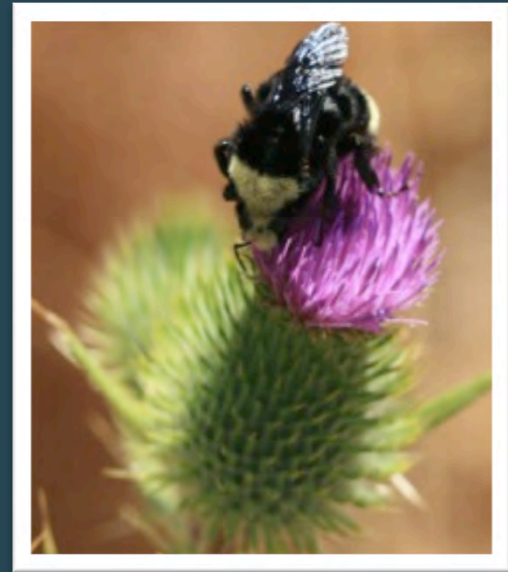


- Nectar- for flight
- Pollen-for larval development
- Most work uses visitation which confounds these

Bombus vosnesenskii

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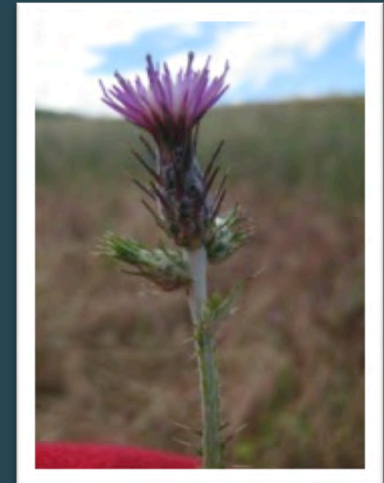
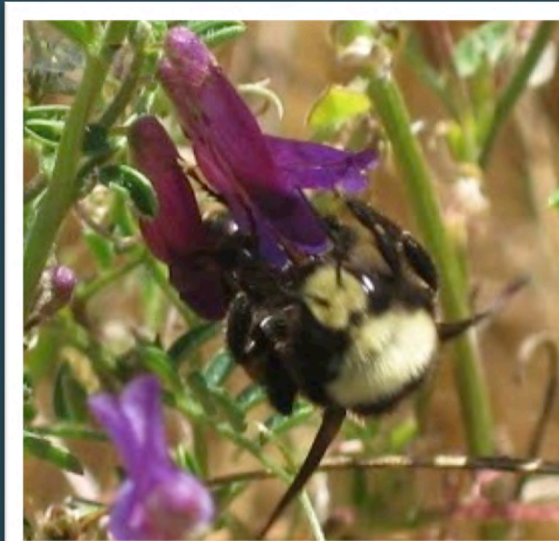
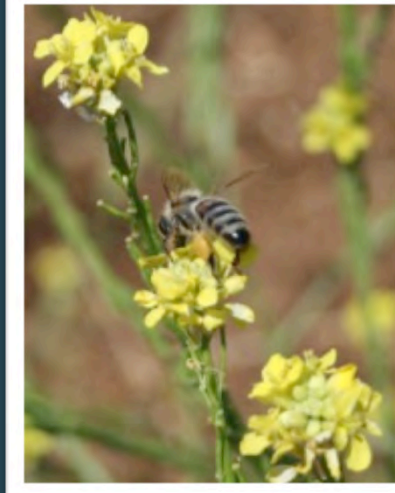
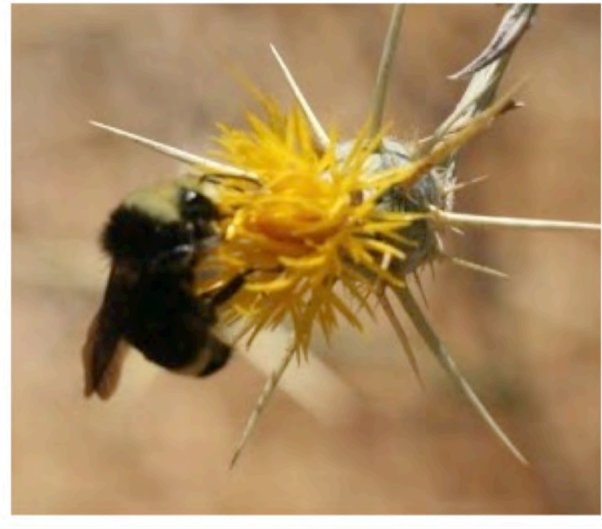
- Wide-distribution
- Polylectic
- Previously observed visiting non-native plants
- Excellent pollinator of crops and wildflowers



Highly Invaded Grasslands

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- Yellow Star Thistle
- Black Mustard
- Italian Thistle
- Winter Vetch
- Bristly Oxtongue



What species of plants do native bees visit in semi natural landscapes?

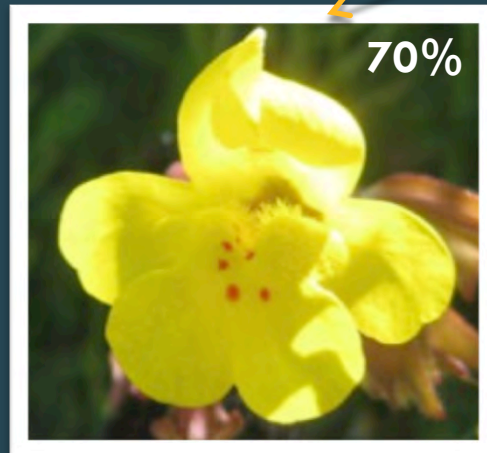
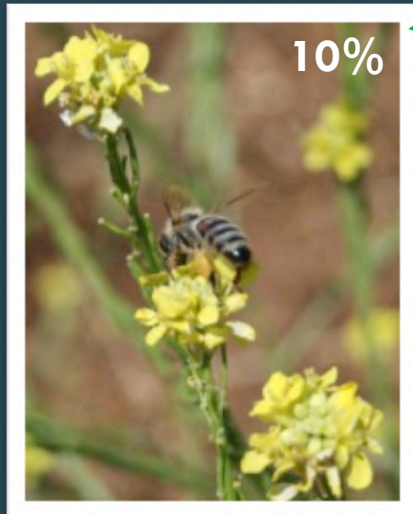
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- We recorded pollen and nectar collection of *Bombus vosnesneskii*.

Result: Of the 20 species of plants available *B. vosnesenskii* only collected from about 7 species. Additionally of the 225+ bees observed 96% of nectar foragers were on non-native plants while only 36% of pollen collectors were observed on non-native plants.

Pollen Preference

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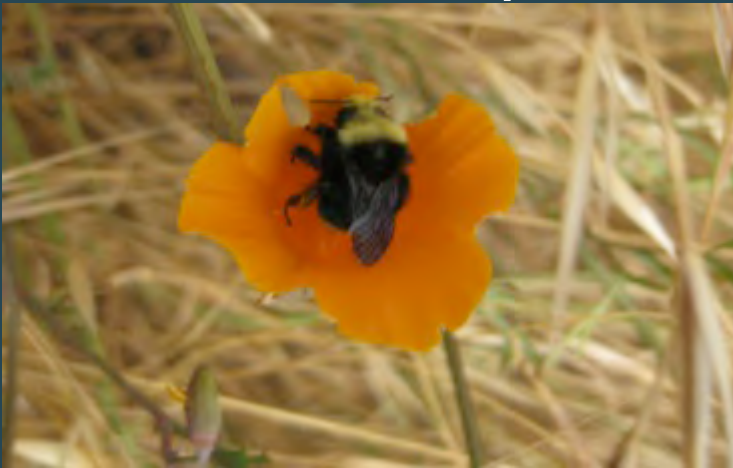
Over 200 bees were captured at 5 sites between May and July 2009

Pollen preference

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Using a new method to determine preference we found that some invasive pollens were preferred to native pollens but it was very site specific.

Vicia villosa and *Eschscholzia californica* were two of the most preferred.



Why would a native pollinator prefer an invasive plant?

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- Reward
- Nutrition-protein and amino acid content
 - ▣ Bees are known to be highly selective of pollen resources (Cane and Wcislo 1996)
 - ▣ Poor pollen resources can prevent or delay larval and adult development (Brodschnider 2010)
- Morphology
 - ▣ Bees are more efficient at visiting plants with corolla depths that match tongue length (Ranta and Lundberg 1980, Harder 1983)

Quantifying availability and quality

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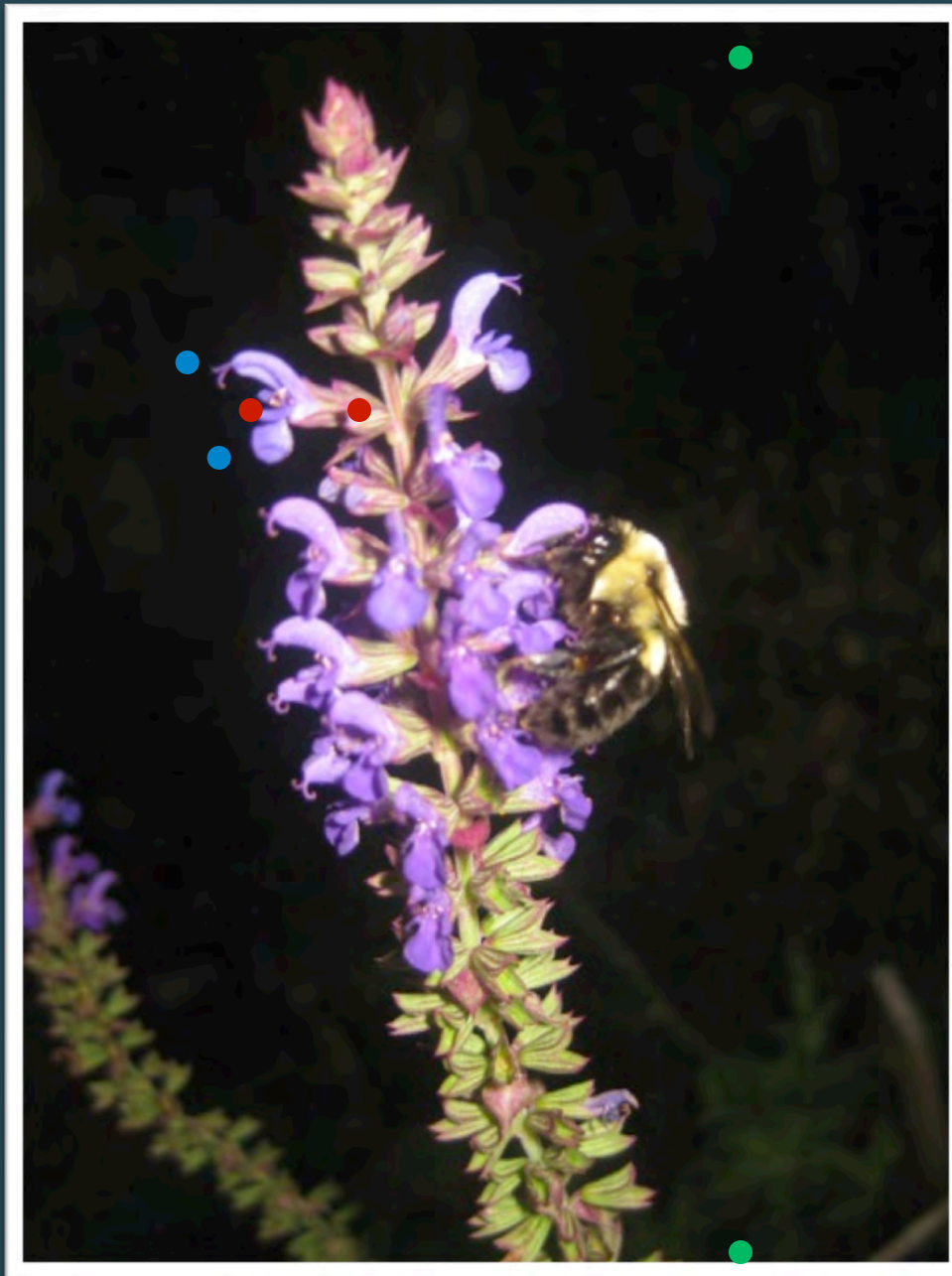
- Unopened flower heads brought into the lab and allowed to open over night.
- Protein was determined via micro-combustion analysis
- Amino Acid analysis was conducted at UC Davis



Greer using a 512Hz tuning fork to “buzz” pollinate



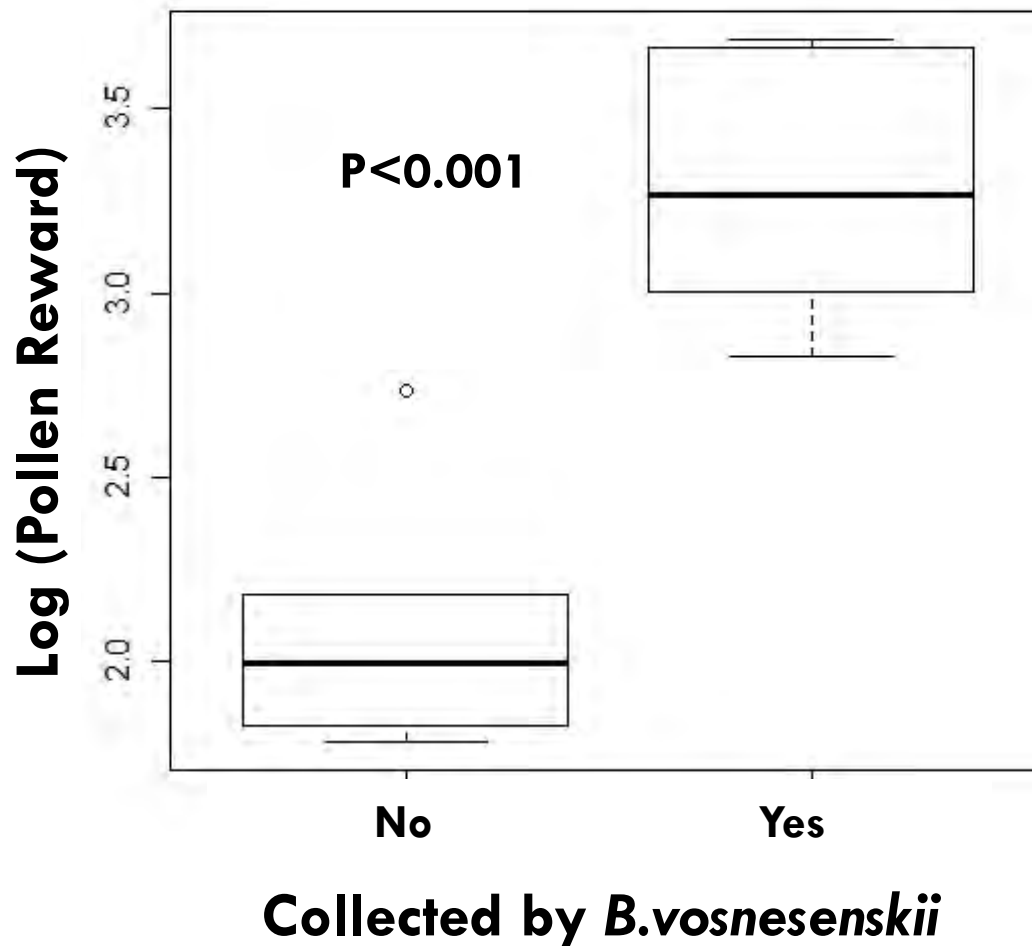
Corolla length
Corolla width
Plant height
Number of flowers
per inflorescence



Native Vs. Invasive plants

Collected vs Non-Collected

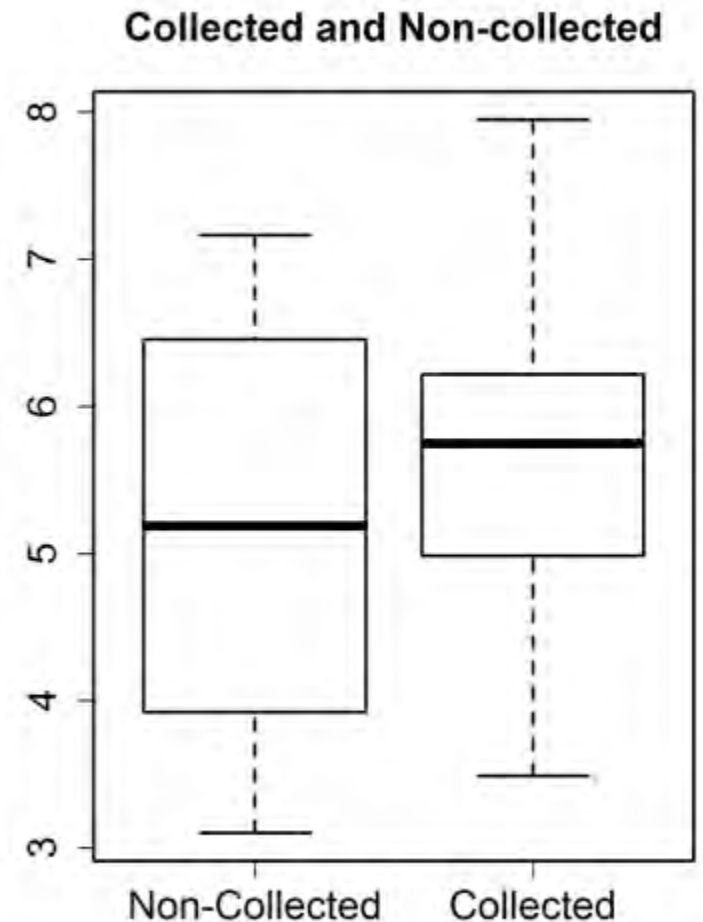
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Higher Protein

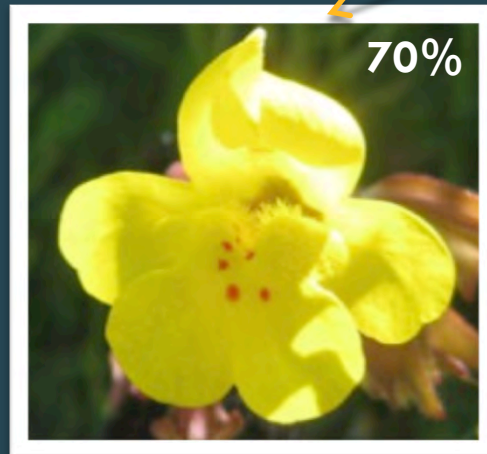
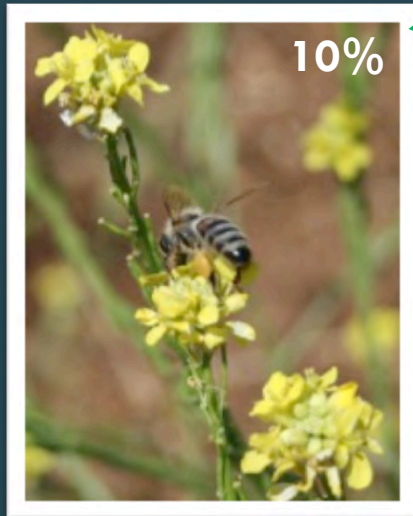
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- Non-collected species had less nitrogen (a proxy for protein) than those collected
- Neither amino acid nor morphology varied between collected and non-collected species



How does collection and availability affect nutritional intake?

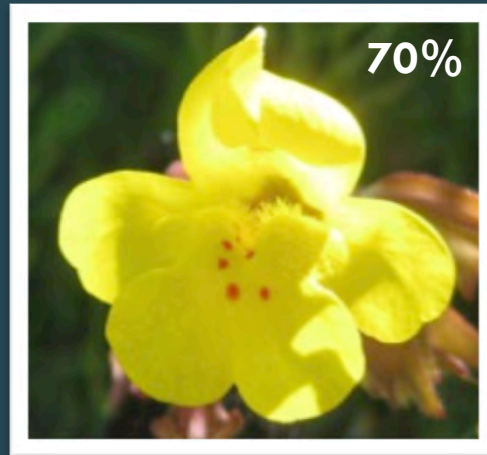
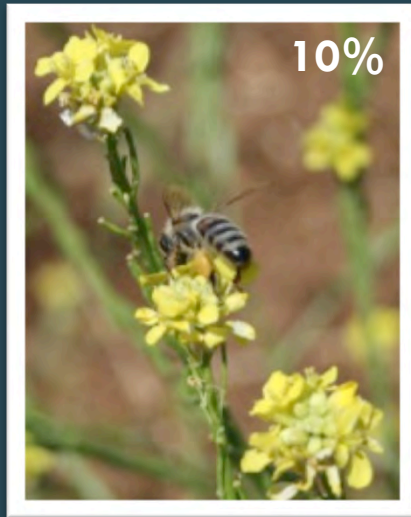
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Over 200 bees were captured at 5 sites between May and July 2009

Observed Nutritional Intake

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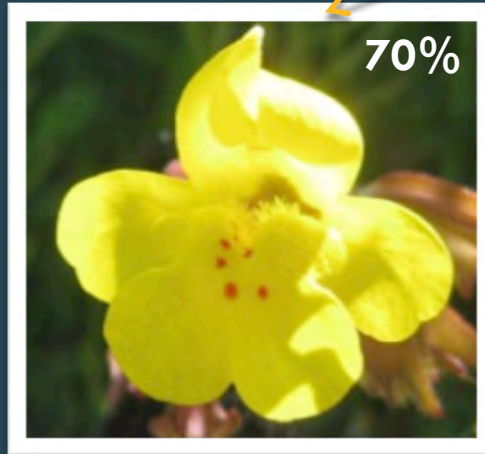
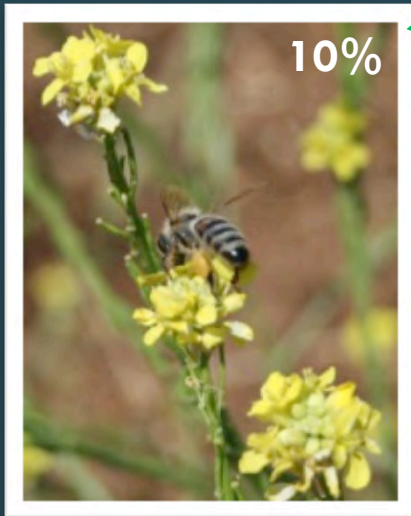
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Nutritional Content per plant species=

Nutritional Intake of the Species

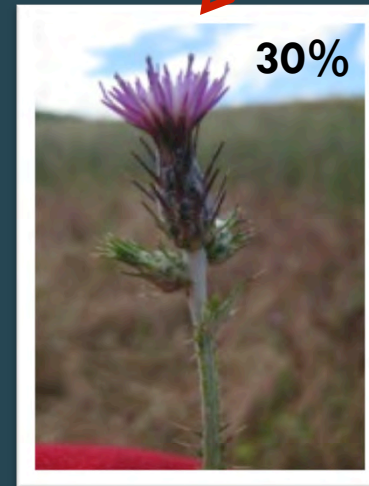
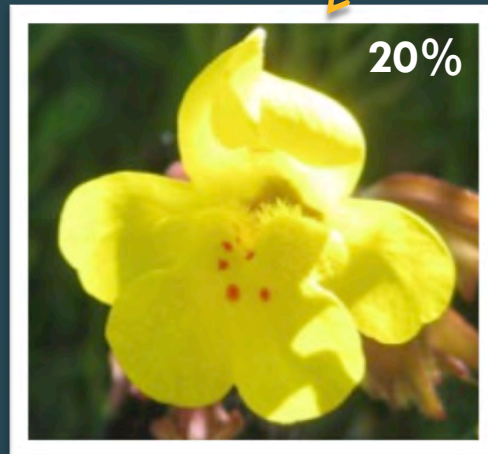
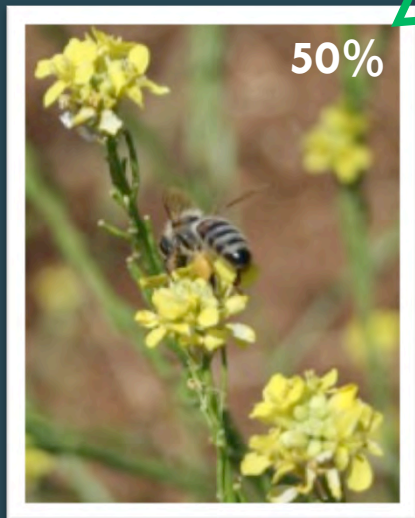
Expected Nutritional Intake

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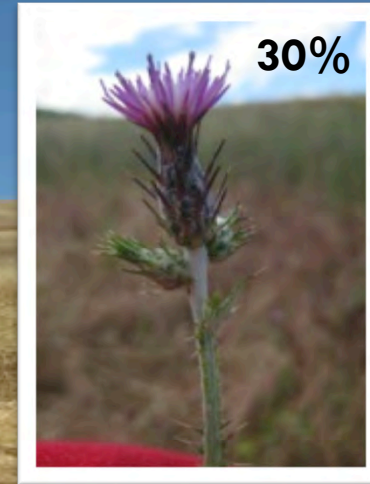
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Expected Nutritional Intake



Expected Nutritional Intake

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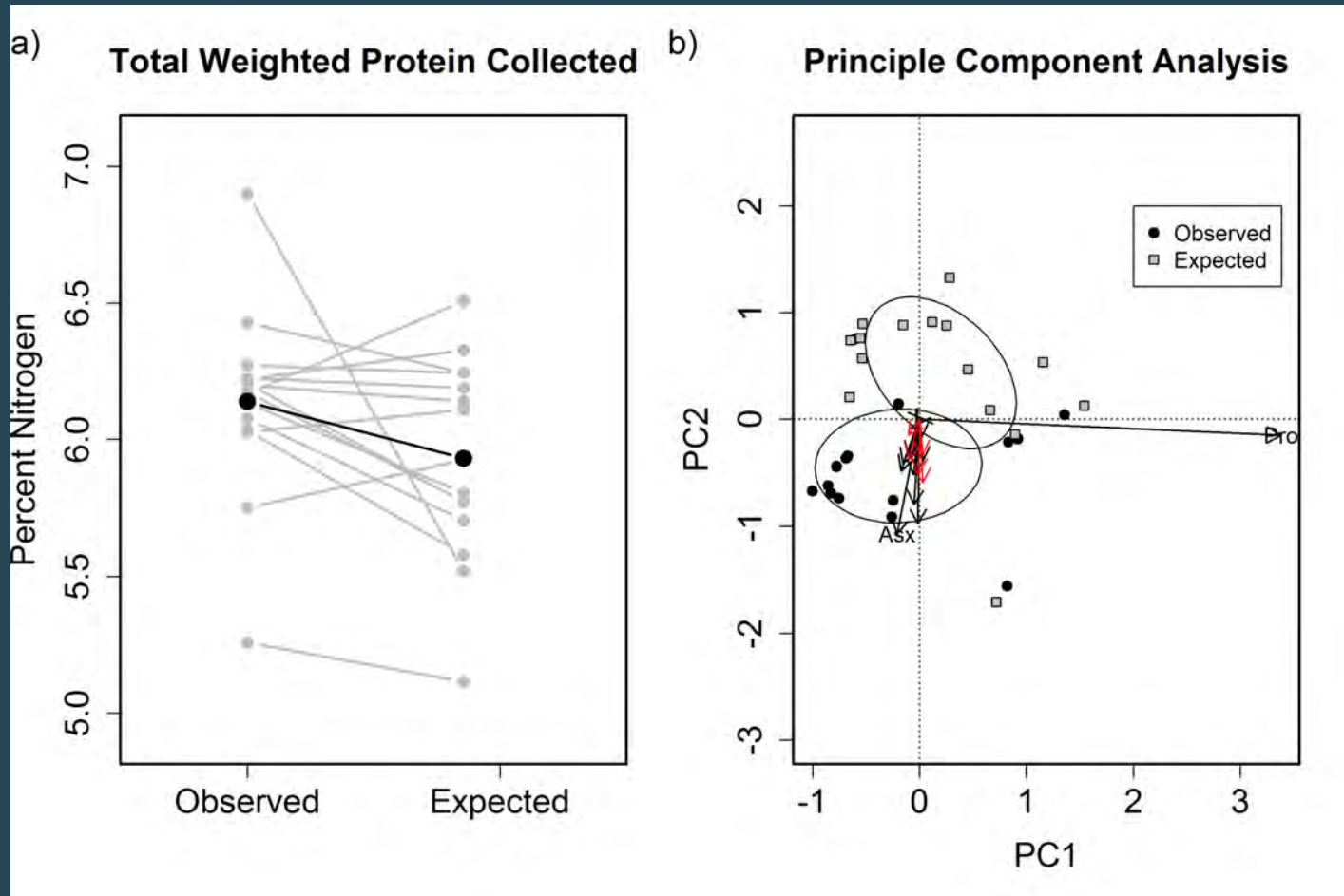
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Nutritional Content per plant species =

Expected Nutritional Intake of the Species

Maintaining consistent nutritional intake by adapting diet

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Conclusions

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- Invasive plants are often autogamous and also attract native pollinators which helps limit their pollen limitation and ensure their success
- Bees do show strong preferences for some invasive plants BUT this is in an effort to maintain a balanced diet.
- Not all native plants can fulfill the role of invasive plants in the diets of native bees.

Taking the Long View

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- Invasive plants can offer some of the needed resources for bees
- Large scale removal of invasive species can in the short term adversely affect bee diets but quick establishment of a wide diversity of native plants should be able to make up the difference.

Questions

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Collaborators:

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Silver Lab

UC Davis Genome Center

CA State Parks

East Bay Regional Parks

