

Planting for pollinators; Native
plant and weed preferences of *the*
yellow-faced bumble bee
(*Bombus vosnesenskii*)

Alexandra Harmon-Threatt

Claire Kremen

UC Berkeley

Dept of Environmental Science Policy and Management

Bees as ecosystem service providers

- The majority of plant species rely on animal pollinators for reproduction with bees providing the majority of this service
- Honeybees are the primary crop pollinators but native bees can be essential pollinators as well
- The decline of bees could threaten 75% of the world's crop species

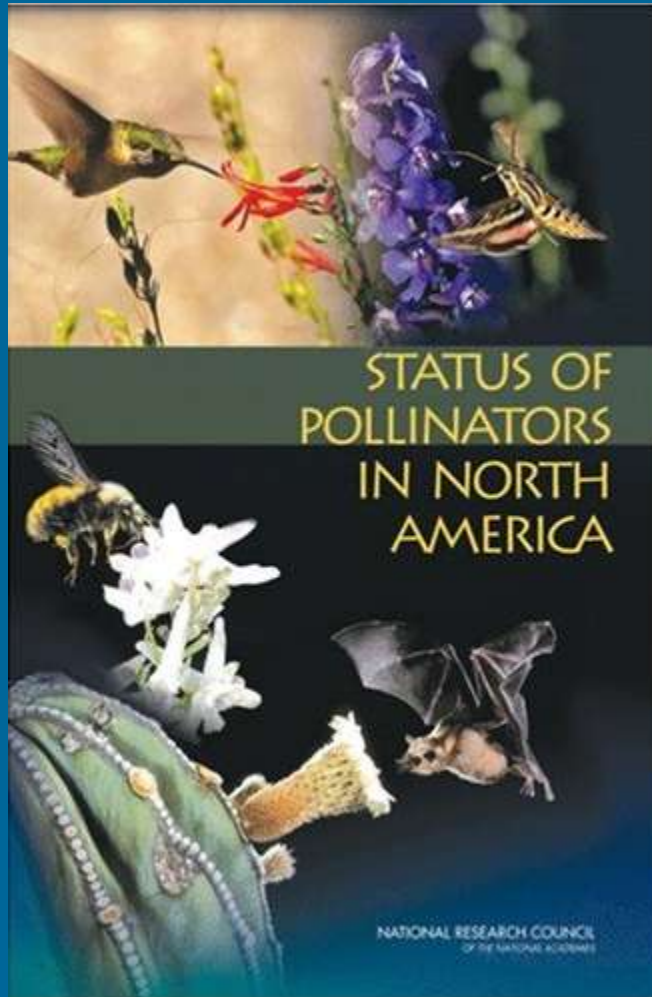


Native bees in agricultural landscapes

- Reduce dependency on honeybees
- Improve honeybee pollination efficiency (Greenleaf and Kremen 2006)
- Perform “buzz” pollination which honeybees cannot



Native Bees in Decline



- ❑ Habitat Degradation
- ❑ Loss of Native Flora
- ❑ Spread of Invasive (Non-native) Plant Species
- ❑ Climate Change
- ❑ Disease

Agricultural landscapes for native bees

- Soil tilling reduces nesting availability for ground nesting bees
- Low floral diversity can be detrimental to bee health
- Herbicide and Pesticide spraying can have adverse effects on bees
- Non-crop areas can support native bees but are often plowed under or sprayed to prevent weed growth

Agricultural landscapes for native bees



Agricultural land for native bee habitat

- Soil tilling reduces nesting availability for ground nesting bees
- Low floral diversity can be detrimental to bee health
- Pesticide spraying can have adverse effects on bees
- Non-crop areas can support native bees but are often plowed under or sprayed to prevent weed growth
- Hedgerows can improve habitat for native bees
HOWEVER most hedgerow plants were chosen for natural enemies not native bees

Resource Use of Native Bees

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

Importance for native plants and seeds

- Knowing the nutritional and floral requirements and preferences for native bees can help improve hedgerows and restoration efforts
 - Improve health of native bees in agricultural and restored land which could improve persistence and pollination
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Questions

- What species of plants do native bees visit in natural landscapes?
- What species of plants do native bees show strong preferences for?
- Are these plants native or non-native?
- Are there differences between the species they collect from and those they do not?
 - Nutritional Quality
 - Morphological Characteristics

Pollen

- Selectivity of pollen resources
- Demographic consequences
- Diet Diversity
- Novelty
 - Pollen Abundance



Bombus vosnesenskii

- Wide-distribution
- “Generalist” feeder
- Previously observed visiting non-native species
- Potential range expansion



B. vosnesenskii nectar foraging on *Vicia villosa*

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

- We performed one hour long Pollard walks to record 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 use of *Bombus vosnesenskii*

- 8 grassland sites were chosen in Contra Costa County, CA and monitored throughout the season for presence of *Bombus vosnesenskii*
- When bees were present in the site quadrat data was recorded to estimate floral abundance
- Flowers of all blooming species were collected to estimate pollen production



Pollen use of *Bombus vosnesenskii*

- Bees with pollen loads were captured and one pollen load was removed
- Pollen collected by bees was identified to species to determine pollen collection in a site



Preference of a Plant species

$$preference_i = \frac{\text{relative abundance of pollen}_i \text{ collected}}{\text{relative pollen}_i \text{ abundance}}$$

$$\text{relative abundance of pollen}_i \text{ collected} = \frac{\text{pollen collected}_i}{\sum_{i=1}^n \text{pollen collected}_i}$$

$$\text{relative pollen}_i \text{ abundance} = \frac{\text{floral abundance}_i \bullet \text{pollen production}_i}{\sum_{i=1}^n \text{floral abundance}_i \bullet \text{pollen production}_i}$$

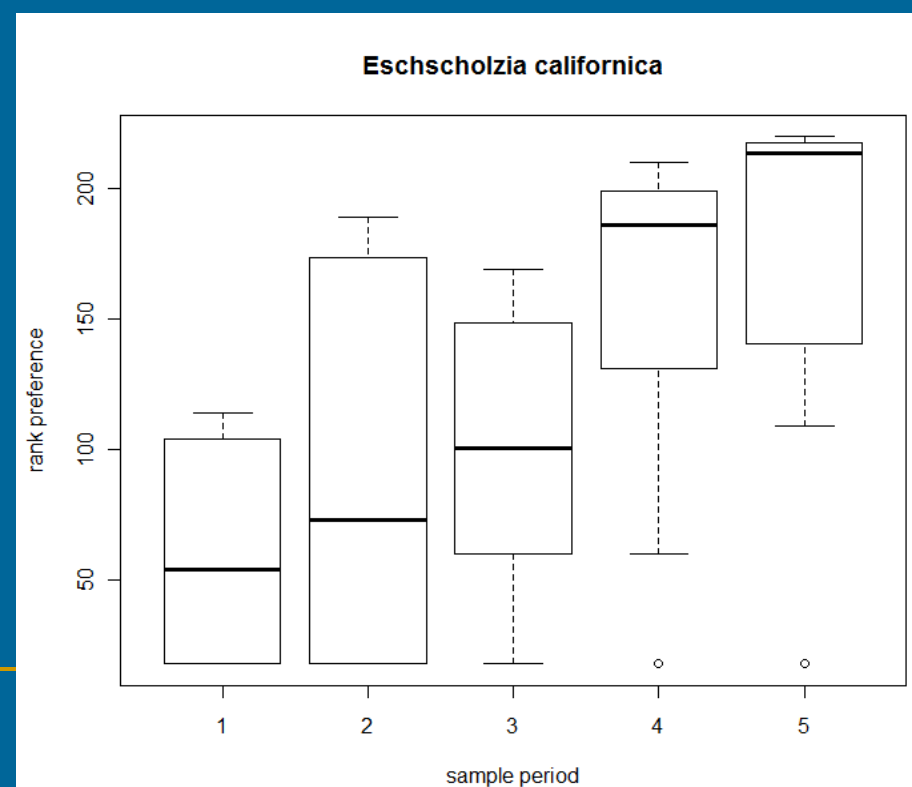
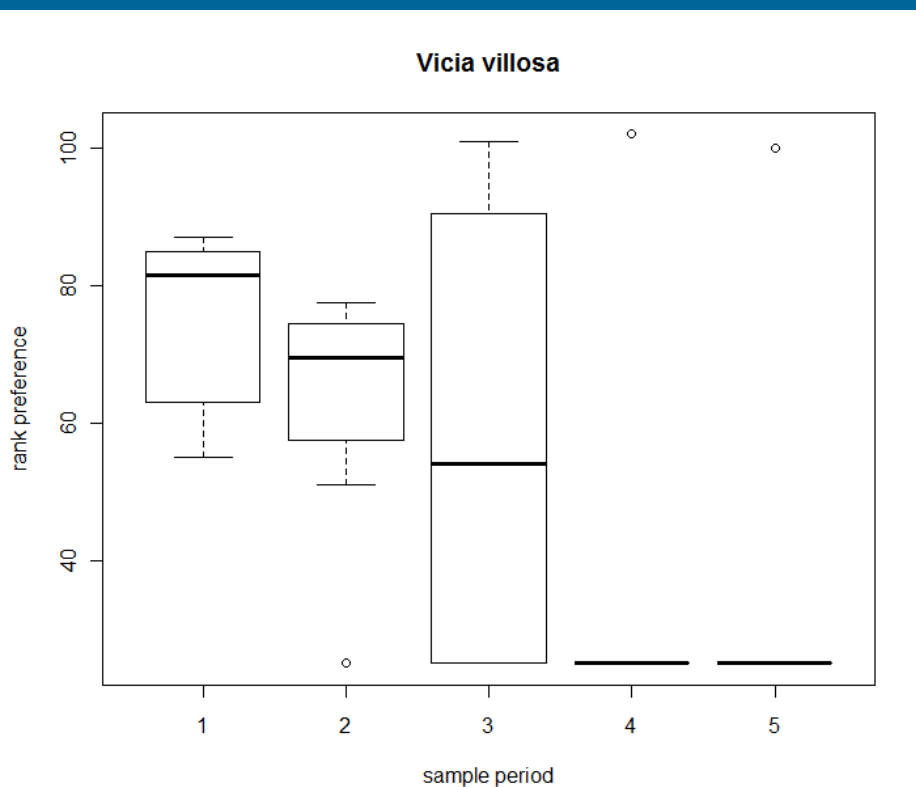
Preference ranking

Preferences were ranked to compare which species showed the highest rankings and compared using non-parametric comparisons

We compared the different species blooming during the same time periods as well as compared species blooming during multiple time periods to one another.

Preferences change temporally

- Early in the season *Vicia villosa* is preferred however as the season goes on preference for this species declines greatly and preference for *Eschscholzia californica* increases



Morphology and Nutrition



- These species differ significantly in their flower morphology.
- *V.villosa* is a bilateral, narrow, purple flower while *E.californica* is a radial, wide and orange flower

Are there differences in nutritional quality of species collected by *Bombus vosnesenskii*?

- Flowers collected in the field were hand “buzz-pollinated” to release pollen
- Samples were dried, cleaned and frozen
- Micro-combustion analysis was used to determine the percent carbon and nitrogen



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

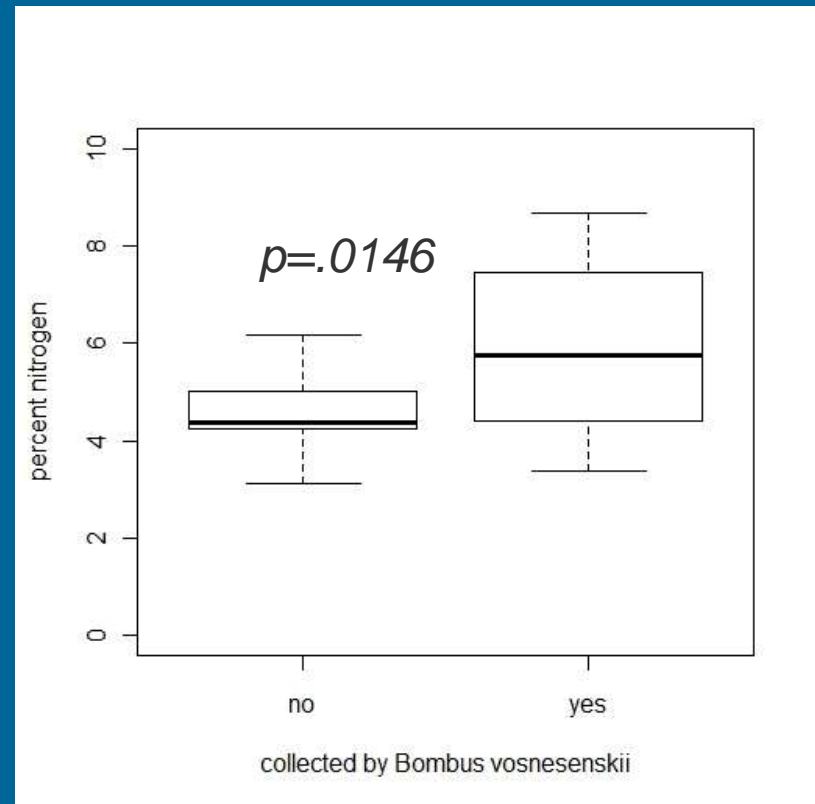
Morphology and Nutrition



- There was no significant difference in the mean nitrogen concentration of any of the plant species. When compared individually.

Nitrogen Rich!

- Pollens collected by *Bombus vosnesenskii* have higher nitrogen content than those in sites but not collected.



Discussion

- *Bombus vosnesenskii* collects from both native and non-native plants and does not show strong preference during a sample period
- *B. vosnesenskii* however does show increasing preference for certain native species late in the season when resources are more scarce
- However, the species they collect from have higher nitrogen content than other species in the sites
- Nitrogen rich pollen could be an additional characteristic of some invaders

Future Directions

- Hedgerow improvement
 - Amino acid make up of pollen grains
 - Comparisons of Morphological Characters of Plants
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Concluding thoughts

- Visitation does not mean a pollinator species requires or prefers these plant species
- Knowing pollen preferences will allow for more targeted efforts for pollinator conservation and restoration in natural and agricultural landscapes
- These targeted efforts could be critical to successful establishment and persistence of native bees in recovered habitat

Acknowledgements

Thanks for your
attention!

Kremen Lab

