Citizen Engagement for Pollinator Monitoring: 2015-2017 Bumble Bee Monitoring Summary

Pilot Knob Hill, Mendota Heights, MN

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The Endangered rusty-patched bumble bee (*Bombus affinis*), detected at Pilot Knob during this project. Photo by Sarah Foltz Jordan, Xerces Society.

Methods

- Bumble bee monitoring occurred once per month during the time of peak bumble bee abundance in Minnesota (July, August, and September) for three consecutive years (2015, 2016, 2017).
- Monitoring methods followed those used by the University of MN Bee Squad, in which volunteers are trained to collect bumble bees from flowers and bring them back to a central location for expert identification. Volunteers were encouraged to scout a variety of flowers, including natives and non-natives. Following identification, bees were marked with a dot on the top of thorax and then released (this approach ensures that the same bee is not captured/counted more than once). See Appendix 1 for detailed protocol.
- Surveys (including a short training session) took place for ~2.5 hours.
- For each bumble bee, the species, sex, and floral association was recorded.
- Flowering plants in the survey area (both native and non-native) that were *in bloom at the time of the survey* were also recorded.

Results

Abundance, Diversity, and Rare Species Detections:

Over the course of three years and nine surveys, 806 bumble bees were identified and released. Our first year of surveys revealed seven species of bumble bees; the following year, two additional species were observed, and the third year, one more species was added. In total, ten different species were observed at the site, including both rare and common species. The relative abundance of these species is shown in Figure 1.

Throughout the study, three rare species were detected in very low numbers at the site, most notably, *Bombus affinis* (the rusty patched bumble bee), which was recently listed as Federally Endangered under the Endangered Species Act by the Fish and Wildlife Service. Only one individual was encountered in our surveys, a female worker foraging on bee balm (*Monarda fistulosa*) in July of 2016. *Bombus fervidus* and *B. pensylvanicus* were also encountered in very low numbers (four and twelve individuals, respectively) during our surveys; both of these species are listed Vulnerable to extinction by the IUCN, and as Species of Greatest Conservation need in the state of MN, based on range declines and severe relative abundance declines in recent years (Hatfield et al. 2015; MNDNR 2015).

Bombus impatiens (the common eastern bumble bee) was the most abundant species at the site (Figure 1). This species is apparently secure (not at risk of extinction) and increasing in relative abundance across its range (Hatfield et al. 2015). Similarly, the next three most abundant species (*B. auricomus, B. bimaculatus,* and *B. griseocollis*) are fairly common across their ranges and not known to be at risk of extinction (Hatfield et al. 2015).

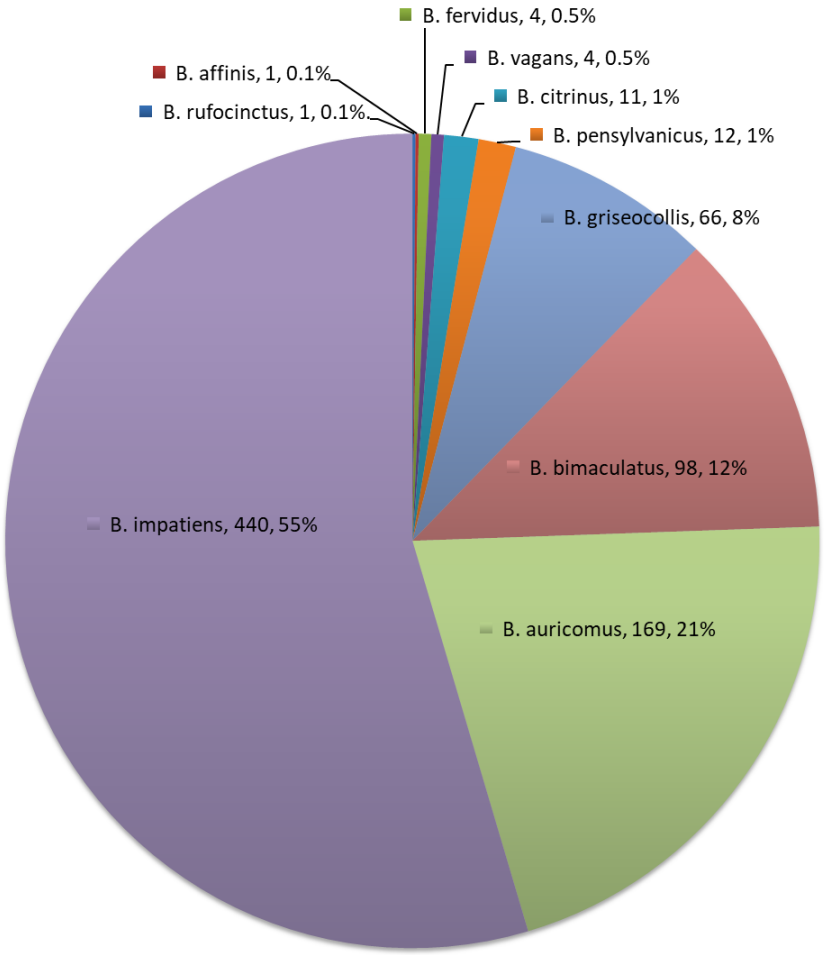

Figure 1. Relative abundance of ten bumble bee species over the 3-year survey period (2015- 2017). The species name in the graph is followed by (1) the number of individuals of that species observed (total abundance) and (2) the percentage of that species in the observed bumble bee population (relative abundance).

One cuckoo bee species, *Bombus citrinus*, was observed throughout the study. This is among the most common of the cuckoo bees in Minnesota, likely because it cleptoparasitizes *Bombus impatiens*, one of the most abundant bees in the region (and also at this site). Cuckoo bees, in general, are often a signal of ecosystem heath, since they can be highly specific in terms of the bee hosts that they will cleptoparasitize.

Floral Associations:

Floral association data revealed interesting seasonal floral visitation trends by bumble bees at the site.

In July, the vast majority (93%) of bumble bees were visiting bee balm (*Monarda fistulosa*), a well-known bumble bee plant (Figure 2).

In August, native field thistle (*Cirsium discolor*) was visited by bumble bees over twice as much as any other plant, despite numerous other high quality forage plants in bloom at that time. This plant is unfortunately rarely included in seed mixes due to general distaste for thistles, combined with low availability of seed (Eckberg et al. 2017). Our findings regarding the relative attractiveness of this plant to bumble bees are very useful in encouraging consumers and the native seed industry to prioritize planting and propagating this plant, along with other native thistles.

In September, New England aster (*Symphyotrichum novae-angliae*) was the most visited plant over all (3 years of September surveys combined (Figure 2)). However, the most visited September flower varied by year: in 2015, New England aster (*Symphyotrichum novae-angliae*) was the most visited; in 2016, Canada goldenrod (*Solidago canadensis*), and in 2017, showy goldenrod (*Solidago speciosa*). This variability was likely an artefact of slight differences in plant phenology during the time of our surveys. For example, our 2017 September survey occurred a bit later than the other years, and showy goldenrod was the only flower in peak bloom at the time (the other goldenrods and asters were slightly past peak bloom). This finding suggests that when designing seed mixes and plantings, it is often important to include multiple species within a given plant genus (and certainly within bloom time categories) in an effort to fill subtle niches in bloom time and food availability for bees.

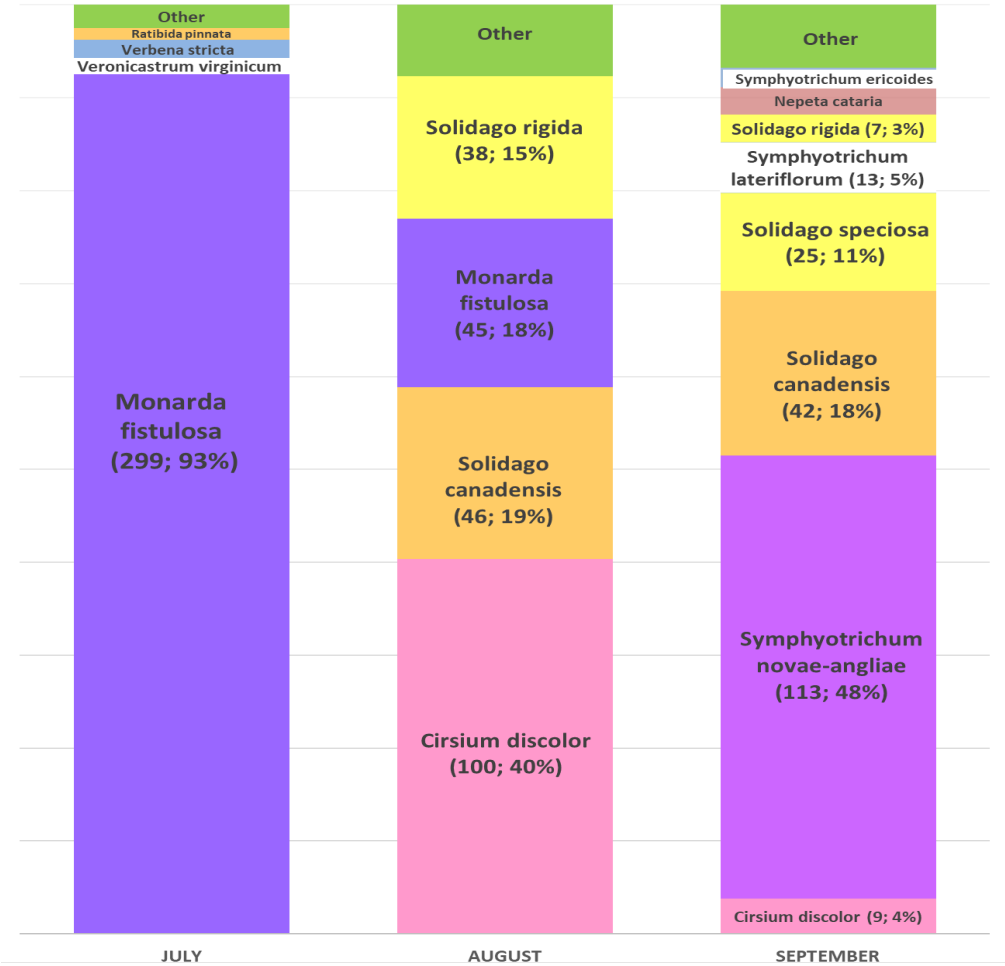

Figure 2. Floral associations of 806 bumble bee species observed over the 3-year survey period, divided by month (July, August, and September). The species names in the graph are followed by (1) the number of bumble bee floral associations observed on the plant, and (2) the percentage of total floral associations that occurred on that plant in that month. Approximate bloom color of the flower is reflected in the color choices used in the graph. Plants with less than 4 occurrences were combined into the "other" category.

With regard to rare species floral associations, the only individual we observed of *Bombus affinis* was detected on *Monarda fistulosa,* a plant well-known to be highly attractive to and supportive of bumble bees. *Bombus fervidus* was observed on *Cirsium discolor* (3 individuals) and *Monarda fistulosa* (1 individual). *Bombus penysylvanicus* was observed on *Monarda fistulosa* (11 individuals), and *Cirsium discolor* (1 individual). *Bombus rufocinctus*, very rare at Pilot Knob although fairly common in general, was detected only on *Veronicastrum virginicum*- a shallow-nectary plant that is well-suited for the shorter mouthparts of this bee.

Seasonal Variability:

Seasonal changes in the bumble bee community were observed as follows: In July, *Bombus auricomus* and *B. bimaculatus* were consistently the most abundant bumble bees observed at the site. In August, *Bombus impatiens* was typically the most abundant, although *B. auricomus* surpassed *B. impatiens* in numbers in August 2016. In September, *Bombus impatiens* was consistently the most abundant bee by far; many other bees had tapered off in activity at that time.

With regard to rare species detections, *Bombus affinis* was only detected once in our surveys, in July. Both *Bombus fervidus* and *B. penysylvanicus* were observed in low numbers in both in July and August.
On average, bumble bee species richness was highest in August, intermediate in July, and lowest in September. This suggests that if future studies are limited to conducting only one survey during the

growing season, August would likely yield the highest number of species at the site. No species were encountered in September surveys that had not already been detected in July or August.

The seasonality findings discussed above are more or less consistent with what is reported about the seasonality of these species in the literature (Williams et al. 2014).

References & Resources

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Appendix 1. University of MN Bumble Bee Survey Protocol

1. Before each survey, explains rules for catching bumble bees to volunteers to reduce chance of damage. Explain that they may find the endangered rusty patch bumble bee which is protected by federal law. We have a permit allowing us to do this activity. Without permit, it is recommended to not handle bumble bees. You could be liable to fines if you accidentally damage an endangered bumble bee without this permit. STEPS FOR PARTICIPANTS 1. Capture bees while on flowers. Place cup around bee. Hold cup upside down. Check to make sure bee is at top of cup before sealing lid. 2. Bring back to survey leader within 5 minutes of capture. Place bee on ice if it will be more than 5 minutes before you can ID mark and release.
2. Use data collection sheets for recording data. Feel free to adapt for your own use but please collect all the same data. If plant is unknown, take photo if possible, but sometimes volunteers aren't sure what flower they collection from, so you can also have a catch all UNKNOWN for plant id. With the exception of *Bombus affinis*, mark all bumble bees with an orange dot prior to release, to avoid recapturing and recording the same bee multiple times.
3. Photograph any B. affinis, B. terricola, or unusual or unexpected bumble bee species. Also photo any tentative IDs and note on data sheet. Note PhotoFileID (file name).
4. Snap a photo of your data sheet at the end of each survey date (just incase). I will only need these from you if data doesn't get entered here.
5. Enter survey information (date, time, location, etc) into "CollectionCodes" sheet.
6. Enter bumble bee data on "BumbleBeeData" sheet using appropriate CollectionCode
7. Ensure that a minimum of 3 surveys are completed over the growing season, and that a minimum of 200 bees are observed & recorded during this period (all survey dates, combined)