Monitoring bumblebee populations in Boulder County

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Bumblebees are crucial pollinators of both crops and native wildflowers. Thus, it is alarming that significant bumblebee declines have been documented in many parts of the world (Williams et al. 2009, Williams and Osborne 2009). Declines appear to be related to a wide variety of factors including anthropogenic habitat change, nesting site availability, loss of overwintering habitat, pesticide use, and parasites (Kearns and Thomson 1994, Goulson et al. 2005, Evans et al. 2009). We have extensive records dating from the early 1900s that indicate what species occur locally in Boulder County. However, we do not have abundance data from the past. Our research team is documenting abundance of these species through systematic sampling to evaluate the status of bumblebees at several elevations along the Front Range (see 2012 Final Report for details). Our findings will provide insight into demographic changes in bumblebee populations that then can be applied to conservation management. Not only can this population information be used as baseline data for Boulder County, but it can be compared with information from other locales throughout the US.

Project Description

Field Work

Surveys of bumblebee diversity and abundance began during the summer of 2010 and have continued through the summer of 2013. Nine study sites have been established at three elevations in the Front Range of Colorado, to take advantage of the steep elevational gradient and diversity of plant communities in the Front Range.

In 2013, we conducted our first surveys on May 22 and our final surveys on August 19. Field work was performed with the assistance of five undergraduate student assistants. In addition to sampling the nine regular plots, we also surveyed Caribou Mine (3350 m) on July 31.

Results

Twenty-one species of bumblebees were collected in 2013 as compared to 20 species in 2012, 18 species in 2011, and 17 species in 2010. Early analyses (ANOVAs of log-transformed data) indicate that the number of bees is highest in the mid-elevation plots and lowest at the low-elevation plots

(Figures 1, 2). There is no significant decline in Boulder County bumblebees so far over the course of this study, and the variation each year is similar among the different plots (Figure 3).

One species of concern to conservation biologists is *Bombus occidentalis*, the western bumblebee. This species has shown declines in recent years in other parts of the United States. According to entomologists, it was once common in Boulder County. We did not collect a single specimen of *B. occidentalis* in our previous five-year study (Kearns and Oliveras 2009), nor did we find any individuals in 2010 or 2011. However, since 2012, we have found 20 *B. occidentalis* individuals including queens, workers and males. Nine bees were identified in 2012 and 11 were identified in 2013. These individuals were found in four separate sites, a finding which suggests that we are looking at distinct colonies (Figure 4).

Another species of concern is *B. pensylvanicus*. Like the western bumblebee, this species has also been in decline. In 2013, we saw 12 individual *B. pensylvanicus* compared to two in 2010 and one each in 2011 and 2012.

In 2012, we observed an unusual phenomenon. Males of *Bombus nevadensis* began to emerge in May. Male bumblebees are usually not produced until mid- to late summer (Figure 5).We hypothesized that early males could be the result of a) climate change or b) inbreeding. Increasing global temperatures and warm temperatures earlier in the season could accelerate development and result in the production of two generations per summer. Alternatively, inbred colonies can produce diploid males. Male bumblebees are normally haploid and females are diploid. However, if a diploid individual (normally a female) is homozygous for sex alleles, it develops as a male. Due to lack of genetic variation as a result of inbreeding, queens that normally produce diploid female workers early in the season could potentially produce diploid males. We are currently performing DNA analyses to determine whether these males are diploid. If they are diploid, this would support the inbreeding hypothesis. If they are haploid, this would support the global warming hypothesis.

All the bees collected from the nine sites from 2010 through 2013 have been identified, labeled and databased, and all specimens are being incorporated into the UCMC collection.

Summary

Bumblebees are crucial pollinators of both crops and wildflowers. Declines in bumblebees in those areas where they have been extensively monitored are a cause for concern and reflect a bigger trend of pollinator declines in North America. Since there are minimal data on bumblebee abundance on the Front Range, this project is important in assessing the local conservation status of these important pollinators. We plan to continue monitoring bumblebee populations through 2014.

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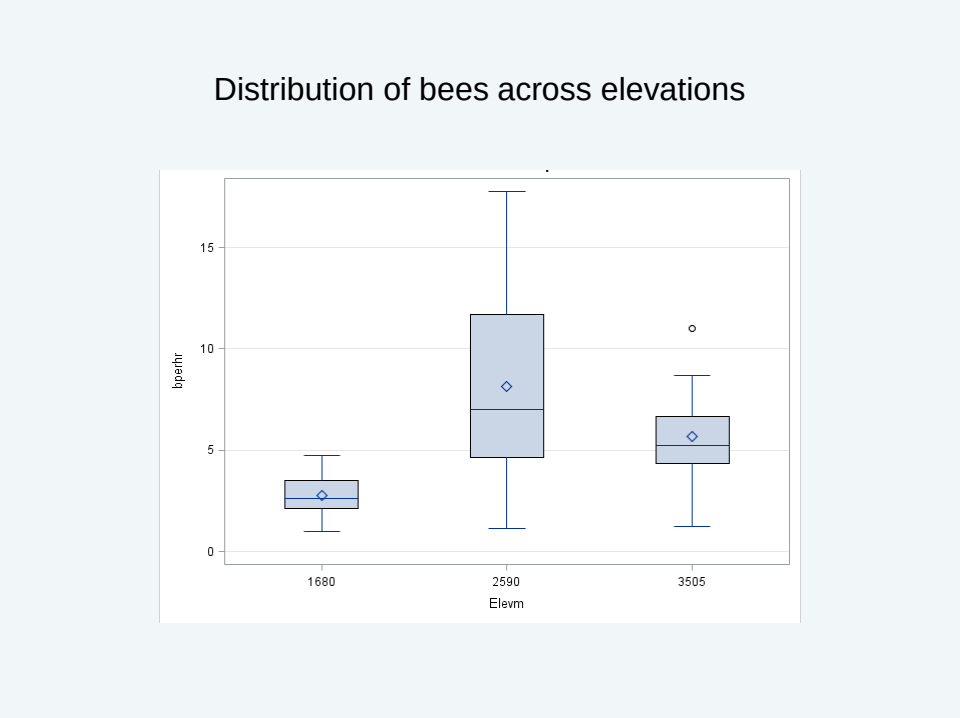

Figure 1. Distribution of bees across elevations. The total number of bees was significantly different with elevation (p=.0017, df = 2).
Year n.s.; interaction n.s.

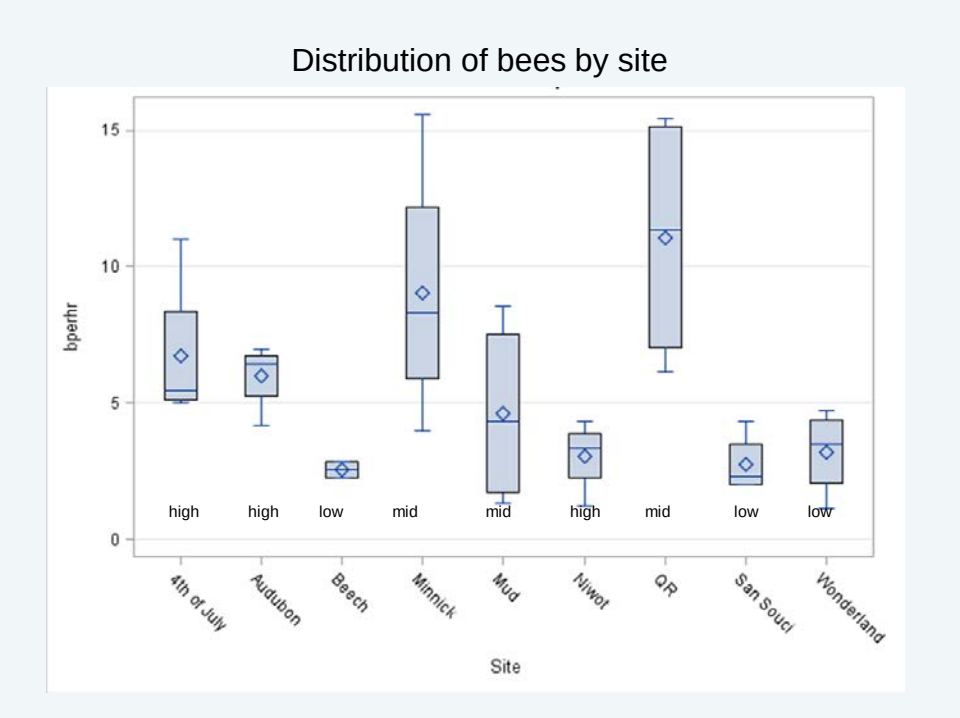

Figure 2. Distribution of bees by site. There are significant differences in the number of bees found by site (p = .0019, df = 8).
Year n.s.

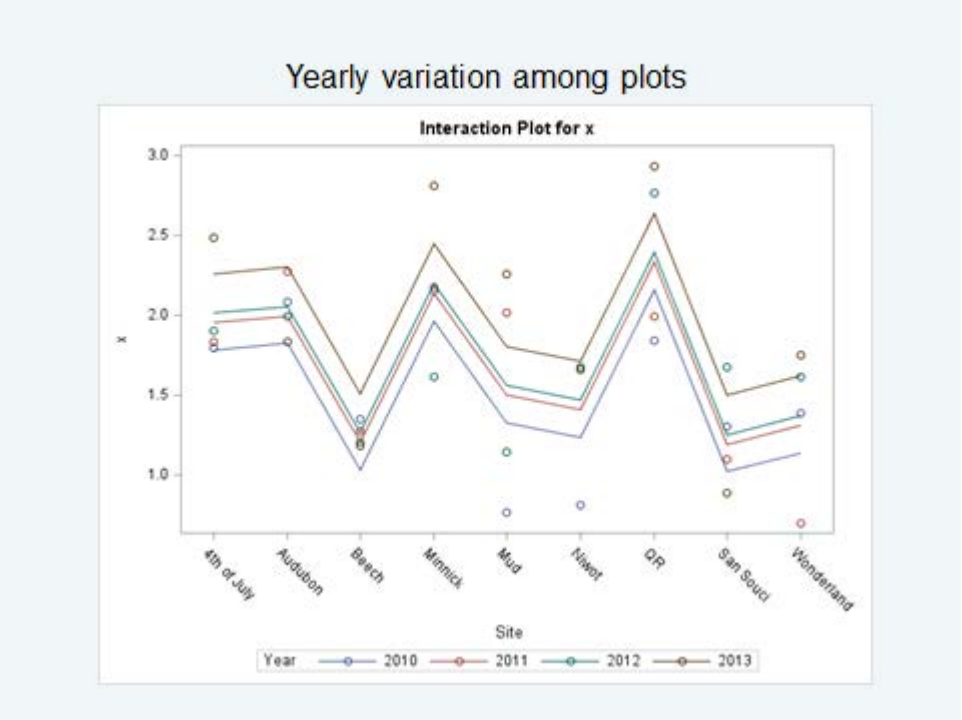

Figure 3. Variation among bees by site. Variation each year was similar among plots. This result was consistent across all species and by individual species.

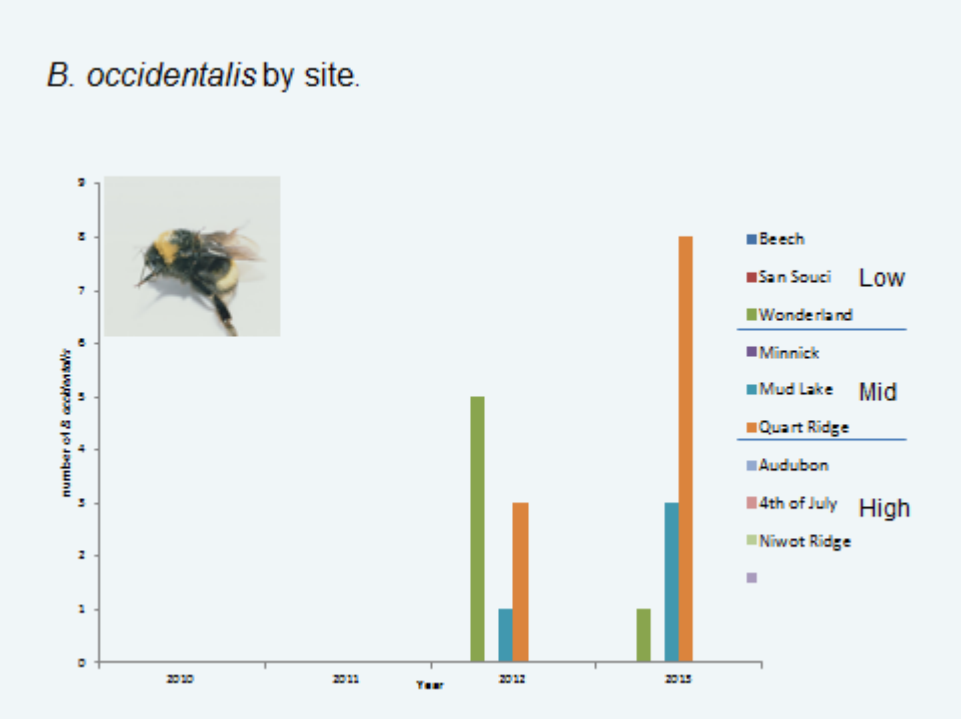

Figure 4. Location of *B. occidentalis* individuals in 2012 and 2013. No *B. occidentalis* individuals were found in 2010 or 2011.

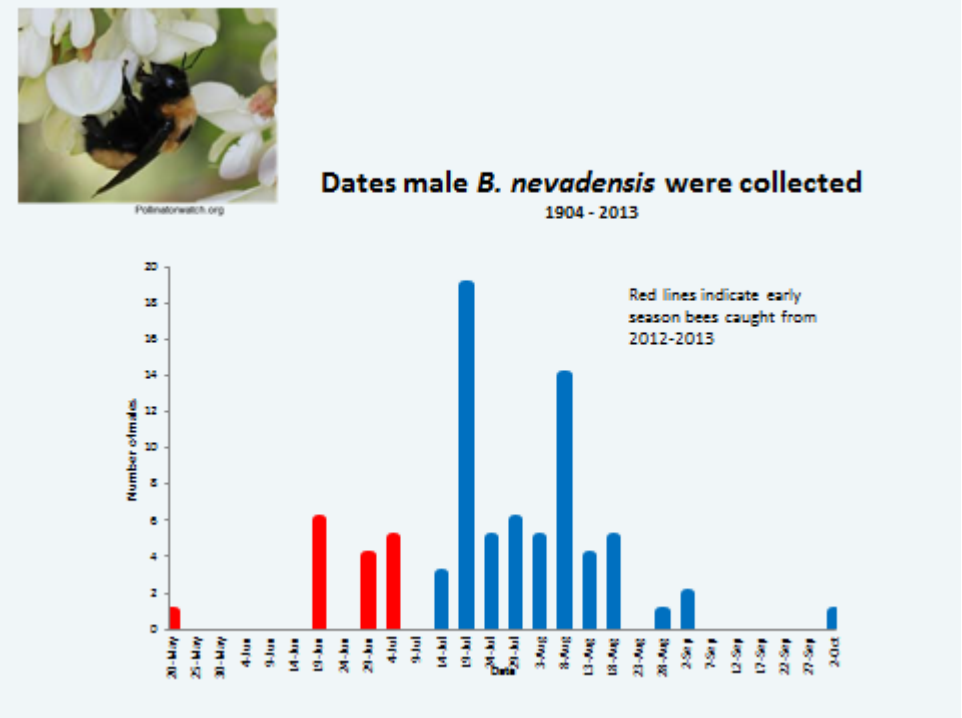

Figure 5. Dates when male *B. nevadensis* were collected. Red bars indicate bees caught from 2012-2013. These males emerged from one to two months earlier than normal.