

Conservation Status and Population Structure Comparisons of Abundant and Declining Bumblebee Species

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Bumblebee declines have been documented in many parts of the world (Williams et al. 2009, Williams and Osborne 2009). The importance of bumblebees as pollinators of native plants and crops has been well documented (Free 1993, Kearns and Thomson 2001, Goulson 2003, Velthuis et al. 2006) and their decline could have negative effects on pollination services (Kearns et al. 1998, Allen-Wardell et al. 1998, Potts et al. 2010). Declines appear to be related to a wide variety of factors including anthropogenic habitat change, nesting site availability, loss of overwintering habitat, and pesticide use (Kearns and Thomson 2001, Goulson et al. 2005, Evans et al. 2009).

In Boulder County, we have records of bumblebee specimens dating back to the late 1800s that provide information on which species occurred in the area. 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 2011 Final Report for details).

Project Description

Field Work

Surveys of bumblebee diversity and abundance began during the summer of 2010 and have continued through the summer of 2012. 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 2012, we conducted our first surveys on May 16th. Field work was performed with the assistance of four undergraduate student assistants. In addition to sampling the nine regular plots, we also surveyed the following locations:

Caribou Mine (3350 m)

Caribou Ranch (2600 m)

Results

Twenty species of bumblebees were collected in 2012 (Tables 1 and 2) as compared to 18 species in 2011, and 17 in 2010.

Two species of concern to conservation biologists are *Bombus occidentalis* and *B. pensylvanicus*. Both species have shown declines in recent years in other parts of the United States. According to entomologists, both species were once common in Boulder County. We did not collect a single specimen of *B. occidentalis* in 2010 or 2011, but in 2012 we collected specimens at two sites. These are the first *B. occidentalis* that we have seen in over ten years. As in 2011, we saw only one individual *B. pensylvanicus* in 2012.

The number of bumblebees caught per unit time in 2012 was compared among elevations using analysis of variance. There was no significant difference among elevations ($p=0.62$, $df=2$).

All the bees collected from the nine sites from 2010 through 2012 have been or are being identified, labeled and databased, and all specimens are being incorporated into the UCMC collection.

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. 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 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.

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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Table 1 - Field work 2012

SITE	Elevation	Number of visits	Number of species found at site
Sans Souci	Low	6	5
Beech	Low	6	4
Wonderland Lake	Low	6	10
Quartz Ridge Meadow	Mid	7	10
Minnick	Mid	7	9
Mud Lake	Mid	7	9
Mount Audobon	High	4	4
East Knoll, Niwot Ridge	High	6	7
Fourth of July Mine	High	3	8

Table 2 - *Bombus* species at each set of elevations

Species	Low Elevation Sites	Mid-Elevation Sites	High Elevation Sites
	1700 m	2600 m	3350 m
<i>appositus</i>	✓	✓	
<i>auricomus</i>			
<i>balteatus</i>			✓
<i>bifarius</i>		✓	✓
<i>californicus</i>		✓	
<i>centralis</i>		✓	
<i>fervidus</i>	✓	✓	
<i>flavifrons</i>	✓	✓	✓
<i>fraternus</i>	✓		
<i>frigidus</i>			✓
<i>griseocollis</i>	✓		
<i>huntii</i>	✓	✓	
<i>kirbyellii</i>			⊘
<i>melanopygus</i>			✓
<i>mixtus</i>			
<i>morrisoni</i>	✓	✓	
<i>nevadensis</i>	✓	✓	
<i>occidentalis</i>	✓	✓	
<i>pennsylvanicus</i>	✓		
<i>rufocinctus</i>	✓	✓	⊘
<i>sylvicola</i>			✓
subspecies <i>Psithyrus</i> <i>(cuckoo bumblebees)</i>			
<i>insularis</i>		✓	✓
<i>fernaldae</i>	✓	✓	✓
<i>suckleyi</i>	⊘	✓	✓

✓ - red check indicates new locations for 2012

⊘ - present in 2011 but absent in 2012

