Beetles, Bees, and Herbivory:
Fire Ecology in Southwestern Utah

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ABSTRACT

Fire can have a substantial effect on a dry pinion pine and juniper dominated forest. We studied the effect of fire on *Carpophilus pallipennis* populations in the blossoms of the prickly pear cactus. Our site was located in a portion of the forest that had been burned one year earlier in a wildfire and an adjacent unburned forest. We counted *C. pallipennis* in the blooms of *Opuntia basilaris* in both sites. We also noted herbivory, the presence of other beetle species, and bees. Our results suggest that there is a greater average of *C. pallipennis* in burned *O. basilaris* than in unburned. Our data also suggest that fire may have a negative effect on the prickly pear cactus by increasing abundance of a parasitic beetle. This beetle uses the flower for shelter and rearing larva, without benefiting the flower through pollination.

Key Words – Opuntia basilaris, Carpophilus pallipennis, prickly pear, *Apis mellifera*, fire ecology.

INTRODUCTION

Fire often changes these ecosystems' capacity for plant and animal life by limiting resources and alters species interactions. Our study was conducted within Dixie National Forest in southwestern Utah. There is a clear, unburned area within the same vicinity and the differences between the two are stark. We observed interaction between *Apis mellifera* (local honeybees) and the flowers of the prickly pear cactus (*Opuntia basilaris)*.

Prickly pear cacti have had a long history of adapting to fire rich environments. Fire itself has been a major contributing factor to its evolution and development (Benson et al., 1965). Although fire does not necessarily destroy established plants, it can decrease

individual plant size and diminish the presence of surrounding ground cover (Hoffman, 1996). Other relationships we investigated represented a parasitic interaction. These included plant-animal interaction where one organism used another without benefiting it in return. Our study focused on a unique relationship found between a small beetle (*Carpophilus pallipennis*) and *O. basilaris*. *C. pallipennis* are parasites by nature; they eat the fruit found within the flowers of plants and are difficult to control with pesticides (Dixon, 2005). The Rhodantha blossoms of the prickly pear were the focal point of our study.

The *C. pallipennis* rely on the Rhodantha blossoms solely for survival. As the blossom dies, the larvae continue to develop in these decaying flowers. It appears that the *C. pallipennis* experience their entire existence within the confines of the Rhodantha blossom, unless they outlast the blossom or are disturbed enough to fly away (Grant et. al, 1978).

The history of fire on our study site influenced the abundance and properties of the *O. basilaris* and, as a result, had a direct impact on the *C. pallipennis*. To determine the impact of fire on *C. pallipennis* as well as the Rhodantha blossoms, we examined samples in both a burned and unburned community. Corresponding with this focus, we also documented the presence of *A. mellifera* in order to better understand the correlation between beetle count and bee presence.

METHODS

Study site descriptions. – The Dixie National Forest in southwestern Utah commands two million acres. Throughout the area there are dramatic climate variations. Precipitation, for example, ranges from over 40 inches at higher elevations to 10 inches in the lower regions. Temperature also varies during changing seasons. Summer highs can surpass 100 degrees Fahrenheit while winter drops below negative 30 degrees (http://www.fs.fed.us/r4/dixie/dixie.html, accessed May 14th, 2007).

Dixie National Forest lies at an elevation of 1246m, with a latitude of 37° 17'90.13" N. and a longitude of 113° 18'34.58" W (Google Inc. San Jose, CA, http://earth.google.com/). This site was located in a juniper and mesquite rich area. Low vegetation was dominated by cheatgrass (*Bromus tectorum L.)*, an invasive species (http://plants.usda.gov, accessed May 16th, 2007).

Field Studies. – To assess the relationship between fire and beetle populations we studied in May of 2007 in two sites. These two sites differed in that one had been burned a year prior, while the other remained unburned. This type of burning occurs either of natural causes or to control an invasive species.

We used a random number generator to select individual prickly pear cacti. We counted the number of *C. pallipennis* found residing within the blossoms. This was crucial to our study in order to properly ascertain the larger beetle populations in both sites as well as determine how they were different. We also documented the presence of *A. mellifera* and

made note of flowers that were particularly pollen-heavy. This was important in order to determine whether increased beetle population had an impact on the amount of pollen.

RESULTS

Our results show that fire can have an effect on beetle population. We counted 136 individual *O. basilaris* blossoms. Blossoms observed in the burned area appeared to have larger populations, an average of 10.28 beetles per flower. The blossoms observed in the unburned area, had an average of 6.19 beetles per flower (Fig. 1). This information supports our original hypothesis that fire affects the population of beetles within *O. basilaris* blossoms.

We observed and documented the number of *C. pallipennis* per flower in both burned (Fig. 2) and unburned (Fig. 3) areas. These figures help illustrate the subtle change in *C. pallipennis* population density dependent on their location. We also analyzed the number of *A. mellifera* to the number of *C. pallipennis* in both the burned and unburned sites (Fig. 4). Finally, our group focused on was that of animal browsing taking place on the flowers of *O. basilaris* (Fig. 5).

DISCUSSION

Our original question asked whether or not there was a distinct difference in *C. pallipennis* population in a burned or unburned environment. We anticipated that there would be a significant variance dependent on which location the beetles were in. We found that there was an average of ten beetles per flower in the burned site, while there

was an average of six beetles in the unburned site. These data suggests difference in population averages.

Overall, in the burned area, there were more *O. basilaris* than in the unburned area. If we were to redo our study, it would be beneficial to take the same number of samples from both sites. A more accurate study would involve collecting data on a clear day. The majority of the data collected was on an overtly windy morning and this may have compromised some of the information.

Although a fire can be beneficial to an ecosystem, such as increasing re-generation rates in vegetation, it can have negative effects on certain species (Bailey et al, 2001). This became apparent while we found a higher average of *C. pallipennis* in the burned area's blossoms. This increase of beetles in burned areas can have a negative impact on the *O. basilaris*, and its ability to spread seeds (Grant et. al, 1979). The interaction between *C. pallipennis* and *O. basilaris* represents an important and interesting ecological relationship.

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Figure Legend – Fig. 1. – Average number of *C. pallipennis* found within *O. basilaris* flowers in both the burned and unburned environments. Fig. 2. – Number of *O. basilaris* flowers to the number of *C. pallipennis* in a burned environment. Fig. 3. – Number of *O. basilaris* flowers to the number of *C. pallipennis* in an unburned environment. Fig. 4. – Relationship of *A. mellifera* with *C. pallipennis* in both the burned and unburned environments. Fig. 5. – The presence of animal browsing taking place on *O. basilaris* flowers.

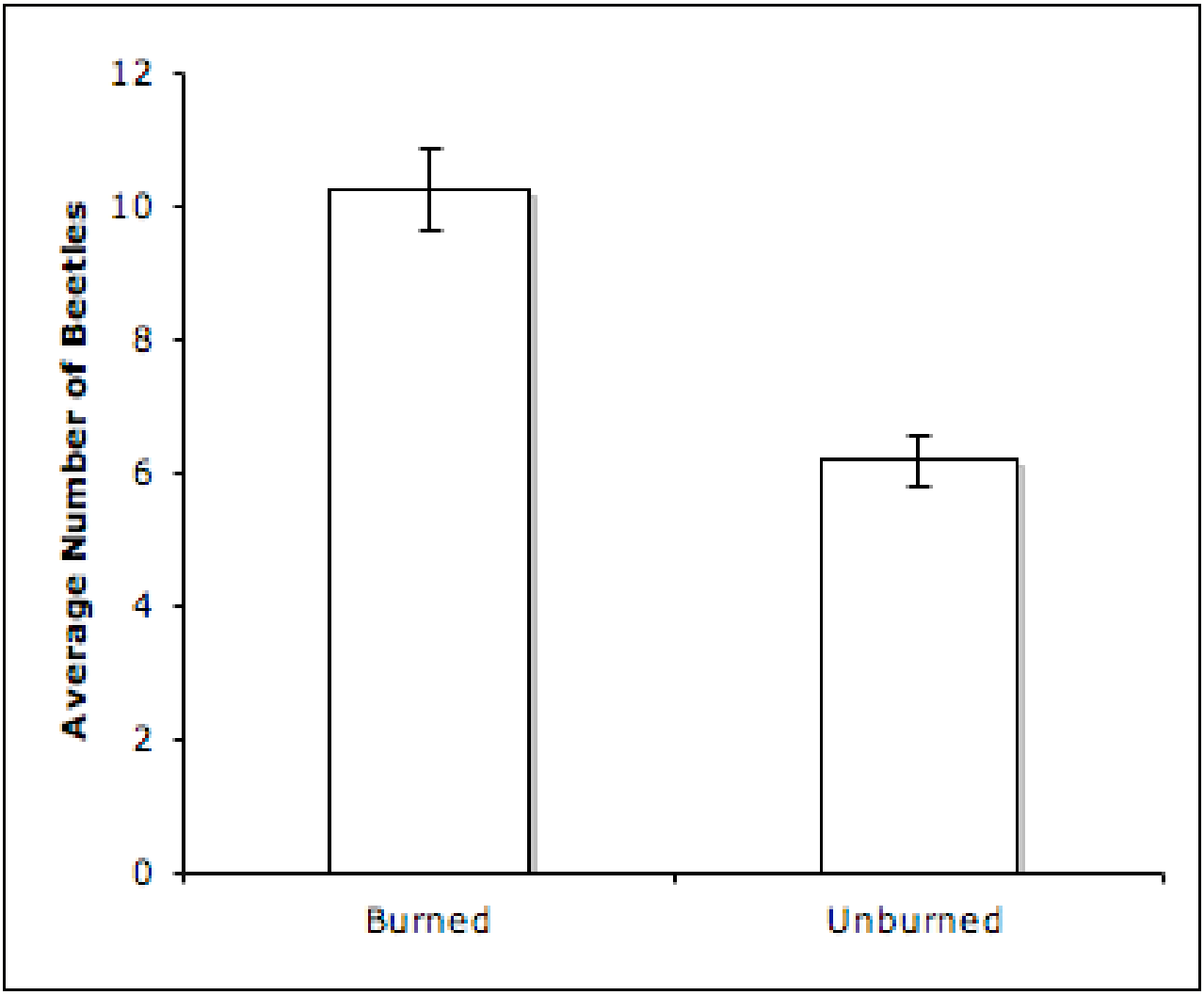

Figure 1

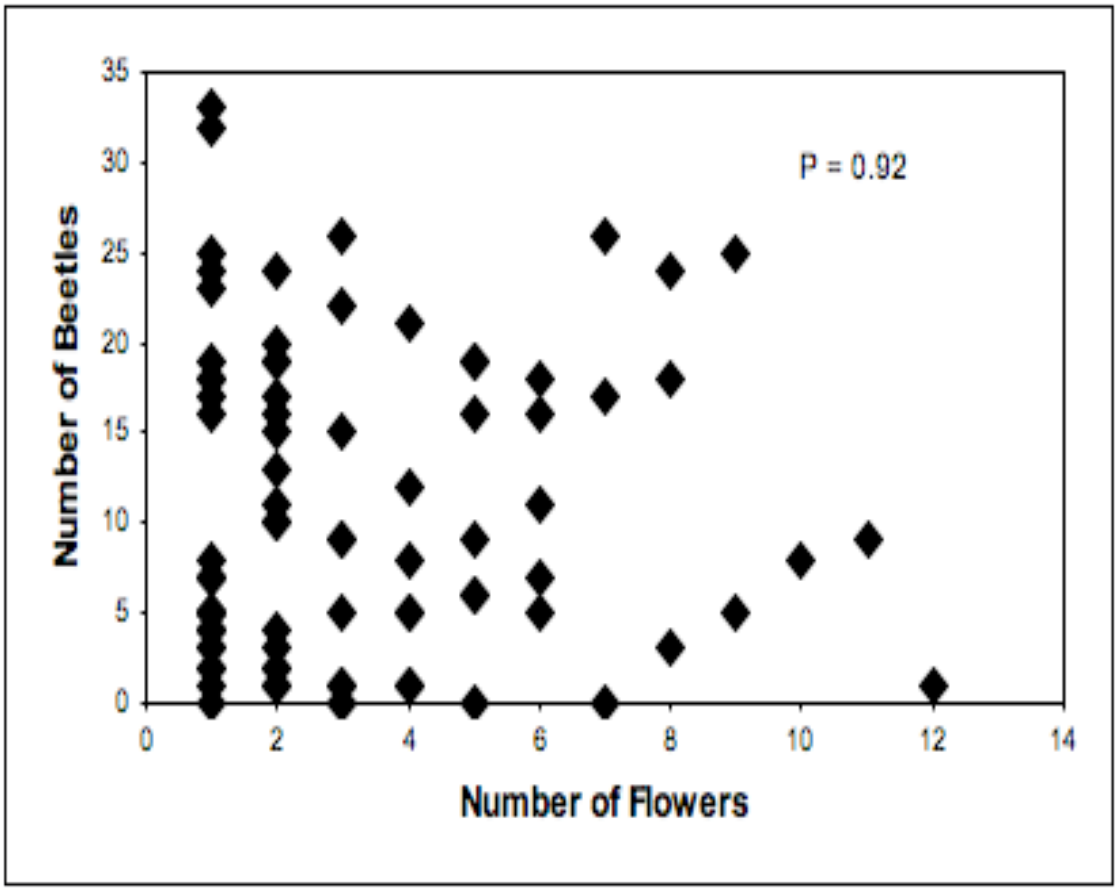
P = 0.92
Number of Beetles
Number of Flowers
0
5
10
15
20
25
30
35
0
2
4
6
8
10
12
14

Figure 2

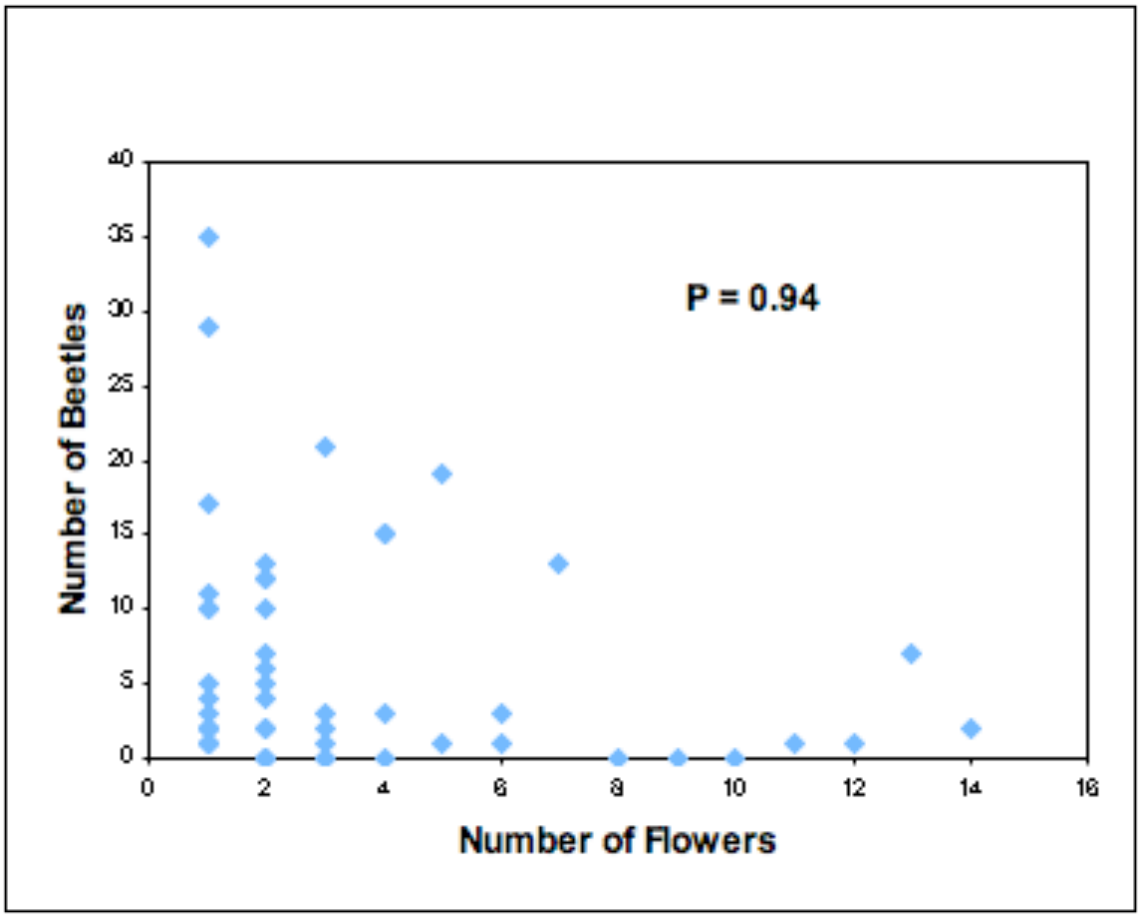
P = 0.94
Number of Beetles
Number of Flowers
0
5
10
15
20
25
30
35
40
0
2
4
6
8
10
12
14
16

Figure 3

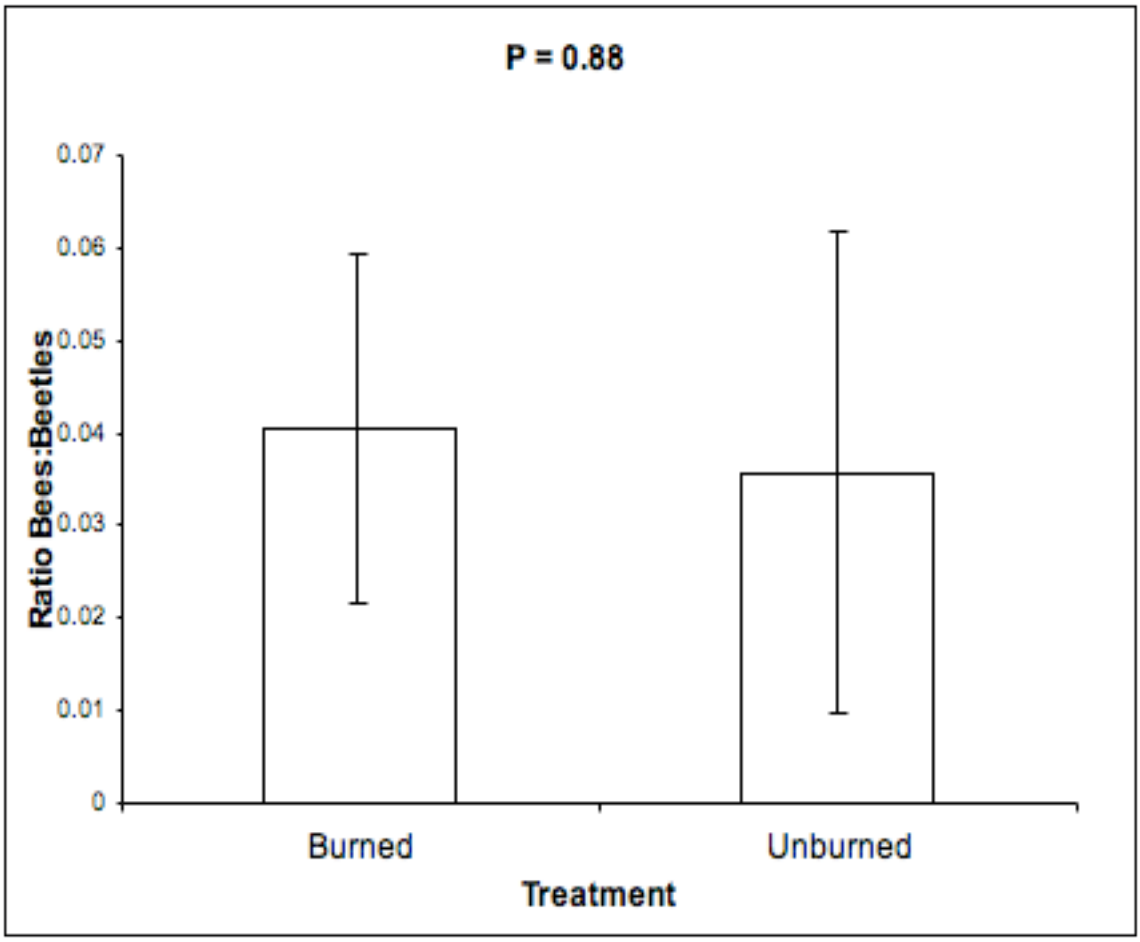
P = 0.88
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Ratio Bees:Beetles
Burned
Unburned
Treatment

Figure 4

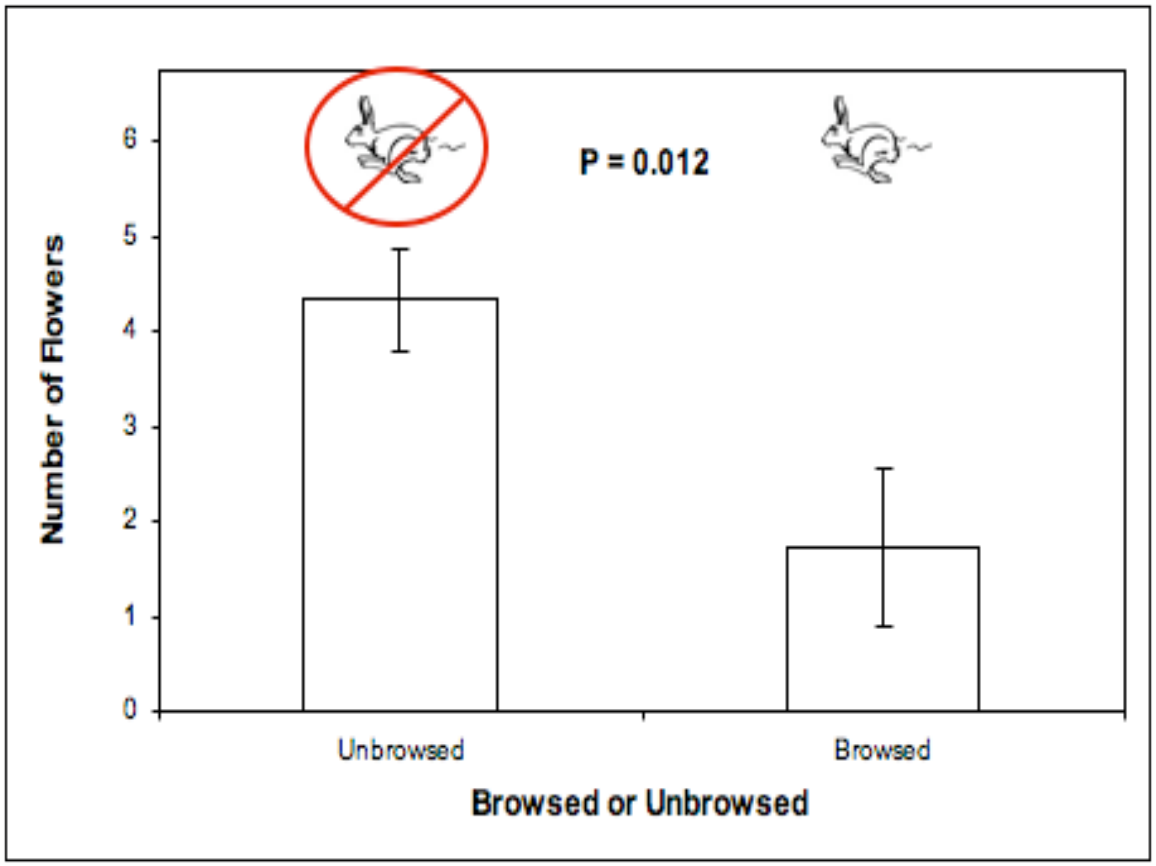
P = 0.012
Number of Flowers
0
1
2
3
4
5
6
Unbrowsed
Browsed
Browsed or Unbrowsed

Figure 5

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