# POLLINATORS OF SLENDER WHITE PRAIRIECLOVER

by

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# ABSTRACT

Slender white prairieclover (*Dalea candida*) is a perennial angiosperm, grown at Bridger plant materials center (BMPC) for reclamation purposes. Interest in the pollinators and pests of this plant developed at BPMC following the death of a 5year old stand. The objectives of these experiments were to (1) determine the diversity and identify the potential pollinators on *D. candida* and other cultivated and non-cultivated angiosperm species using sweep samples and pan traps; (2) determination of pollen load size and composition of individual insects collected on angiosperm plant species; (3) use of different size exclusion cages to determine the general sizes of insects most important for pollination of *D. candida* at BPMC; and (4) determine the composition of the community of cavity-nesting Hymenoptera species at BPMC by using trap nests. The overall diversity of BPMC was much higher than expected in a monoculture agriculture area, with a total of 102 Hymenoptera taxa collected. Hill's #2 index was used to determine the diversity of different angiosperm plants and revealed that *D. candida* had the highest diversity. Analysis of pollen loads via the proportion of "pure" vs. mixed loads (PBP) and mean proportion of conspecific pollen (PCP) revealed conflicting results between the two measures, but there does appear to be some floral constancy occurring, especially in *D. candida*. Kruskal-Wallis tests of differences in exclusion cage treatments revealed that there are differences in pollination efficacy and the size subset allowed to reach the flowers. Emergences from trap nests revealed differences in the trap nesting community at BPMC and actual pollinator collections in the field.

# INTRODUCTION

Pollination is the process by which male plant gametes (pollen) fertilize female plant gametes (ovules) (Proctor et al., 1996). These reproductive structures are used in propagation of the plant. In addition to self-fertilization, two means by which plants are pollinated include wind (anemophily), in which copious amounts of pollen are produced and released into the air and animal-mediated pollination, where plants rely on animals to transfer pollen from flower to flower. Animal-mediated pollination has profound importance to ecosystems. It is estimated that approximately 75% of the 240,000 angiosperm plant species are pollinated by animals (Committee on the Status of Pollinators in North America, 2007). In addition, 15-30% of food produced by humans depends, to some extent, on animals to enhance rates of pollination (Greenleaf et al., 2006; Committee on the Status of Pollinators in North America, 2007). An estimated 25,000-30,000 bee species exist worldwide and all are dependent on flower resources for survival (Buchmann, 2006; Wcislo and Cane, 1996). Including all other possible flower-visiting animals such as flies, butterflies, moths, beetles, mammals and birds, there are an estimated 300,000 flower-visiting animal species (Nabahn, 1996). Although there are specialized relationships in which, one flower species has one pollinator species responsible for pollination; most flower visitors do not depend on any single flower species, but there are morphological and behavioral traits that limit the types of flowers a pollinator will visit.

## Attraction of Flower Visitors

The first part of the sequence of pollen transfer involves the flower attracting a flower visitor, often using particular color cues that can be detected only by certain animals. For example, bird-pollinated flowers are often red, a color not readily distinguished by insects. Color patterns, called ‘nectar guides’, can also indicate the location of nectar or pollen on the flower. Nectar guides are common in flowers that possess UV reflectance patterns that are only visible to certain insect pollinators (Gullan and Cranston, 2000).

Flowers may also attract visitors using odors that, like colors, may be detectable only by certain animals and serve as a pre-mating isolating mechanism for plant species. In general, flowers tend to produce three different categories of fragrances, ‘flowery fragrances’ (of the type that are often considered pleasant by humans), mimics of insect pheromones, and carrion-like smells. Each of the three categories attracts a different subset of flower visitors, for example, the carrion-like volatiles tend to attract flies. Additionally, fragrance can also serve as nectar guides that direct the visitor to the nectar. These fragrance guides are known as ‘scent-marks’ (Proctor et al., 1996).

Pollen transfer can also be achieved in a specialized manner, in which a combination of flower attributes is employed. Flowers of some orchids, for example, mimic females of flower-visiting insect species and also produce pheromones that attract males of particular species. Some of these orchid flowers may also have visual and tactile traits that aid in deception. When males attempt to copulate with the flower, this “pseudocopulation” transfers pollen either to or from the male (Gullan and Cranston, 2000).

Flowers often offer rewards for visitation. Rewards may consist of nectar, pollen, and in some cases oil, which vary in attractiveness to flower visitors. The type of flower visitor that can exploit those rewards depends of several characteristics, both of the flower and the flower visitor. Flower characteristics such as the structure of the inflorescence, the depth of the nectaries, the location of pollen, and whether the flower opens nocturnally or diurnally affect what flower visitors are capable of visiting that flower (Proctor et al., 1996). Recent studies have shown that certain bee species are sensitive and respond differently to the rewards offered by flowers. Pollen-foraging bumble bees were capable of distinguishing between new and old flower pollen sources and actually modified their behavior in response to anticipated versus actual pollen returns; they spent less time foraging on flowers that did not give a sufficient pollen reward (Buchman and Cane, 1989; Shelly et al., 2002). With differences in pollen rewards, nectar rewards have also been shown to contain different sugars in different compositions which attract different flower visitors (Proctor et al., 1996).

## Flower Visitors as Pollinators: General Considerations

Not all flower visiting insects have the same potential to affect pollination; differences in behavior and morphology affect how well they pick up pollen from anthers and transfer it to stigmas of flowers. To be effective, pollen must be picked up in sufficient quantities and transferred to the appropriate location on another plant of the same species, and it must be transferred while still viable. Whether pollination is successful depends on flower size and structure, flower phenology (e.g., the timing of pollen presentation), flower location, insect size and structure, and insect behavior.

Insect morphology and behavior, and their effect on pollinator efficiency are some of the more important characteristics to focus on.

## Flower Visitors as Pollinators: Morphological Aspects

Whether and how an insect visitor comes in contact with the sexual structures on a flower depend on both its size and structure. The physical size of the flower visitor, whether small or large, affects how much pollen can be transferred on the body, though many flower visitors have special structures on the body for collecting pollen. Structures such as the corbicula or "pollen-basket" on the hind tibia of honey bees or the scopa on the ventral abdominal surface on megachilids, pack pollen tightly so there is little chance of pollen transfer (Gullan and Cranston, 2000); the collected pollen may also be carried in a manner that keeps it from making contact with the stigma. So, although many flower visitors have structures for transferring pollen, certain morphological traits influence indirect pollen transfer. Body hairs are an important means of trapping and transferring pollen, so that wasps, which are relatively non-hairy may be much less effective in pollen transfer than are bees, which have numerous hairs that are often highly branched.

The mouthparts of Hymenoptera consist of a sucking tube of varying length that is formed out of the galea of the maxillae, and used for nectar collection. The length of the tongue affects the flower visitor's ability to reach nectar in nectaries of different depths while coming in contact with the flower's sexual structures (Triplehorn and Johnson, 2005). Some flower visitors can bypass the sexual structures completely by using their mandibles to cut into the flower below the nectaries and collect nectar by this method.  This is commonly seen in honey bees in alfalfa that are trying to avoid the alfalfa's trigger mechanism, which is explained later (Cane, 2002).

## Flower Visitors as Pollinators:  Behavioral Aspects

Once the flower has attracted an insect, any one of a sequence of events, from its arrival, to its subsequent visits to other flowers, can strongly influence its effectiveness as a pollinator.  Among flower visitors that do not feed on pollen while on the flower (or that feed it to their offspring), pollen is collected accidentally on their bodies as they move about on the flower, usually in search of nectar.  Other insects, bees in particular, but also certain species of flies and beetles, actively collect pollen (Proctor et al., 1996).  Some flowers, such as alfalfa (*Medicago sativa* L.) have a trigger mechanism, so when the flower visitor lands on the flower, the trigger causes the anthers of the flower to swing forward and upward and hit the visitor on the underside of the face, and thus cause pollen to be deposited on the insect (Cane, 2002).  Both flower visitor behavior and characteristics of the flower or trip mechanism help insure pollen deposition.

Bumble bees sometimes collect pollen by a method known as "buzz" pollination, in which they will vibrate their bodies to shake the pollen loose from a flower; this is most often done when the pollen being collected is dry pollen (Proctor et al., 1996).  While the flower visitors are often the more active partner in collecting pollen, some flowers have developed certain characteristics that ensure particular behaviors in visitors that guarantee pollen collection, such as flower mimics.  Mimics use flower structures and pheromones to attract male flower visitors and sometimes deposit pollen packets (pollinia).  This method of pollen transfer also increases the chance of flower constancy since the pheromones attract a smaller subset of flower visitors and helps keep them relatively reliable in what flowers they are visiting.

## Flower Visitors as Pollinators:
### Behavior of Insect After Leaving the Flower

Much of the pollen collected by bees may be unlikely to affect pollination as the bee moves from flower to flower. Many bees, for example, sequester pollen on particular body parts, where it may be unavailable for transfer to other flowers. Honey bees pack pollen onto their corbicula by continually brushing their legs over their body. Other bees, such as megachilids, pack the pollen onto a scopa on the abdominal venter, whereas colletids (as well as masarine wasps) collect pollen in their crops. Most bees randomly collect pollen on the hairs covering their body as they forage for nectar. Despite the varying methods of pollen collection, bees are among the most efficient plant pollinators.

The most effective pollinators have a tendency to repeatedly visit flowers of the same species, an attribute described as flower constancy (Proctor et al., 1996). Honey bees are an example of a flower visitor with high flower constancy. The likelihood of high flower constancy is also affected by the spatial distribution of the flower species. Flowers of the same species that are distributed near each other have a higher chance of receiving pollen from neighboring flowers than do flowers that are situated at a greater distance (Proctor et al., 1996).

Pollen transfer is also affected by how long pollen stays viable after being picked up by a flower visitor. The longer pollen stays viable the better chance it has of being transported to the correct flower species (Proctor et al., 1996). Flower spatial distribution and pollen viability affect how much pollen is deposited on the female structures of the flower upon subsequent visits from a flower visitor. The amount of pollen deposited decreases at a predictable rate upon sequential future visits to other flowers (Proctor et al., 1996). But, for pollen transfer to occur there must first be pollen on a specific area of the flower visitors' body surface. Tightly-packed pollen has a lower probability of being transferred than loosely packed or pollen trapped in the body hairs of a flower visitor. But flower and flower-visitor morphology, along with flower visitor behavior are not the only things that affect the probability of successful pollen transfer.

## Pollinator Communities: Plant-Pollinator Interactions

The mutualism between angiosperms and pollinators began an estimated 130-140 million years ago and it is this symbiotic relationship that is in part due to the overwhelming success of these plants (Grimaldi and Engel, 2005). Plants receive the benefit of outcrossing, or fertilization from pollen that is genetically distinct from its' own, while pollinators receive nutrients in the form of pollen, nectar, and oils from the plants (Committee on the Status of Pollinators in North America, 2007). Although there is cheating, such as nectar robbing, the interaction between plants and pollinators is reciprocal, each affecting the other. Because plants are sessile and pollinators are not, the plant community composition should greatly influence the pollinator community. A study in a Mediterranean landscape found that the bee community structure was dependent on nectar resource diversity, the ratio of pollen to nectar energy, floral diversity, floral abundance, and time-elapsed since the last fire (Potts et al., 2003). Another study found that, at the landscape level, there is a positive relationship between the richness and abundance of floral resources and pollinator diversity (Hegland and

Boeke, 2006). But again, the relationship between plants and pollinators is reciprocal and this may influence the plant community. A two-year study found that the plant community was affected by the pollinator community, with 50% more species being found when the pollinator assemblage was more diverse, with diversity referring to different mouthpart lengths (Fontaine et al., 2006). Memmot et al. (2004) examined the tolerance of pollinated plants to pollinator species extinction and found that plant species diversity declined most rapidly when specialized pollinators were removed. A tolerance to species extinction was found when the generalized pollinators were removed and this is probably due to that generalization. The interactions between plants and pollinators is very complex and more study needs to be done to better understand these interactions.

## Factors Affecting Native Pollinators:
## Introduction of the European Honey Bee

A topic of much controversy in studies of pollinator communities is the impact of the introduced European honey bee, *Apis mellifera* L., on native pollinators. Honey bees were imported to North America in the 1600s, arriving with the English colonists (Committee on the Status of Pollinators in North America, 2007). Due to their transportability, effectiveness at crop pollination, ease of maintenance, and honey production, they have now become the primary means of commercialized crop pollination in many countries. Calculations done by Heinrich (1972), found that in the U.S. a single, strong honey bee colony can collect in one year enough pollen and nectar to support 38,400 bumble bee reproductives or roughly 102 colonies. Based on these numbers, it would seem inevitable that honey bees have an impact on native pollinators such as bumble bees (assuming that pollen and nectar are limiting resources in bee communities). Several studies claim that honey bees impact native pollinators by competition for food and nesting resources. Other negative impacts honey bees are charged with range from inferior pollination of native plants, increased hybridization, physical damage to plants, and intensification of problems with invasive weeds. Butz Huryn (1997) reviewed the literature on the interactions between honey bees and native pollinators and argued that papers alleging honey bees as having a negative influence give inadequate support to imply causation. Two recent studies found no evidence of competition between the honey bee and native pollinators; one of those studies was conducted over a 10-year period (Roubik and Wolda, 2001; Steffan-Dewenter and Tscharntke, 2000). In contrast, honey bees were shown to reduce seed set of *Clusia arrudae* by removal of up to 99% of the pollen, without affecting the floral resources, in this case nectar, taken by native pollinators (Mendes and Franceschinelli, 2004). Another study in California found that honey bees lowered reproductive success of *Bombus occidentalis* by creating pollen and nectar scarcity (Thomson, 2004). Many scientists focus on the negative impact that honey bees may be having on the native fauna, but some have found that native pollinators in conjunction with honey bees actually enhance pollination (Evans and Spivak, 2006; Greenleaf and Kremen, 2006).

## Factors Affecting Native Pollinators: <u>Disruption of European Honey Bee Colonies</u>

In recent years, it has become more important to understand the relationship between honey bees and native pollinators. Since the late 1940s, the numbers of managed honey bee hives has declined from 6 million to roughly 2.5 million in the U.S. (Committee on the Status of Pollinators in North America, 2007). The decline has accelerated with the recent emergence of Colony Collapse Disorder (CCD). CCD, for unknown reasons, causes the abandonment of the hive by workers and eventually leads to the death of the colony. It is estimated that 23% of U.S. apiaries have been affected, with losses reaching 90% in some locations (Stokstad, 2007). Steady decline in the number of managed colonies particularly due to CCD has renewed interest in the importance of native pollinators. Recent studies have focused on whether native pollinators could replace commercialized honey bees as primary pollinators for some crops. In crops with less agricultural management (i.e. use of herbicides and insecticides), such as tomatoes and watermelons, the native pollinators were sufficient for pollination (Greenleaf and Kremen, 2006(a); Winfree et al., 2007). Kreman et al. (2002) examined native pollinators in different farm settings and found the native pollinators were capable of full pollination of watermelons in an organic farm near natural habitat, but that non-organic farms, regardless of proximity of natural habitat, and organic farms isolated from natural habitat did not receive sufficient pollination. Before the introduction of insecticides, around the 1940s, adequate pollination by native bees occurred, and in the cases of blueberries and cranberries, native fauna were reported to be better pollinators than the imported honey bee (Wilson, 1926; Batra, 1995).

Honey bees are also affected by parasitic mites and viruses. There are thought to be more than 100 mites associated with honey bees (Sammantaro et al., 2000). The two most common detrimental mites that infect honey bees are *Acarapis woodi* and *Varroa jacobsoni*. *Acarapis woodi*, also known as tracheal mites, was first discovered in the U.S. in 1984. Tracheal mites feed on the hemolymph of bees by piercing the tracheal walls. In large numbers, tracheal mites can cause diminished brood area in a hive, smaller bee populations, looser winter clusters (which have decreased efficiency of thermoregulation), increased honey consumption, lower honey yields, and eventually the death of the colony (Sammantaro et al., 2000). *Varroa destructor* (= *Varroa jacobsoni*), is commonly known at the varroa mite. Also reaching the U.S. in the 1980s, it is considered the major natural enemy of honey bees, causing significant damage to hives. Varroa mites also feed on hemolymph, but live in between the abdominal sclerites of young bees and have a complicated life cycle that also involves feeding on brood. Symptoms of varroa infestation include weak colonies with few brood, increased brood disease, disfigured or stunted adults, and pale or dark red spots found on pupae (Sammantaro et al., 2000). Of the two aforementioned mites, the varroa is considered the more severe pest.

Along with the mites that infest honey bees, there are many pathogens, some of which have been associated with varroa and tracheal mites. Three common viruses that are found to be associated with varroa infestation are Acute Paralysis Virus (APV), which kills both the adults and brood of varroa infested colonies (Sammantaro et al., 2000). A strain of this virus, known as Israel Acute Paralysis Virus has recently been associated with CCD, though colonies that experience CCD tend to have numerous pathogens found in the colony (Stokstad, 2007). Kashmir Bee Virus (KBV) is a widespread and virulent disease that is often found in Varroa-infested colonies and, Deformed Wing Virus (DWV), which causes the formation of stunted or deformed wings in workers that are infected as brood. The only virus that has been associated with tracheal mites is Chronic Paralysis Virus (CPV) and is characterized by trembling bees that are unable to fly and have distended abdomens or shiny black bees found near the entrance to the hive

(Sammantaro et al., 2000). Finally, there are many bacterial and fungal pathogens than can infect a hive such as American foulbrood (*Paenibacillus larvae larvae* White), European foulbrood (*Melissococcus pluton* (White)), and chalkbrood (*Ascosphaera apis* (Maassen ex Claussen)), all of which kill brood in the hive (Sammantaro et al., 2000). While most of these mites and pathogens only affect honey bees, there is increasing concern that they will be passed on to native pollinators.

## Factors Affecting Native Pollinators: the Abiotic Environment

Abiotic factors have profound influence on native pollinators. Weather can play a substantial role in the ecology of pollinators. All flower-visiting insects are temperature-constrained, and rely on good weather to allow them to forage. Bad weather (i.e., cold or rain) prevents many flower visitors from visiting flower species and stops pollen transfer (Xerces Society, 2003). Some flower-visiting insects such as bumble bees are capable of foraging on suboptimal days, raising their own body temperature by vibrating their flight muscles. Cloudy weather decreases the activity of many pollinators. Many insects use polarized light (only visible in blue skies) as a means of navigation and need clear patches of sky to do this (Gullan and Cranston, 2000). Along with weather conditions, the climate of a region is also important. Some Hymenoptera are more suited to temperate regions and others to tropical. Memmott et al. (2007) modeled the effects of global warming on plant-pollinator interactions and found that an increase in temperature resulted in large extinctions of plants and pollinators. Other abiotic factors affecting native pollinators are the availability of nesting sites or materials. Many solitary bees, such as megachilids, nest in available wood cavities or in soil substrate. Other pollinators are much more specific in their needs, such as the genus *Nomia* which require moist alkali soil in which to nest (Michner, 2007). Interactions between pollinators and their natural environment play an important role in what pollinators are found in the environment.

## Factors Affecting Native Pollinators: Human-Induced Environmental Changes

Human disturbances and how native pollinators respond to these changes are pivotal in conservation efforts aimed at native pollinators. Two major human disturbances of importance are loss of habitat and fragmentation of the habitat that creates islands of suitable habitat well separated from one another. With 87% of the Earth's land surface not protected from human manipulation (Groom, 2006), loss of habitat for pollinators is an obvious problem. Taki and Kevan (2007) found that as habitat loss increased, insects became more generalized in niche habits and suggested that insect communities are more sensitive than plant communities to habitat loss (Taki and Kevan, 2007). While many pollinators are not obligate on any one flower it is important to remember that many of the specialized interactions that do occur between plants and pollinators have ecological and monetary implications for humans. For example, a single fig species is usually only pollinated by one pollinator species (Weiblen and Bush, 2002).

Habitat fragmentation plays a major role in pollinator population dynamics because many pollinators have constraints on foraging and dispersal distances (Beekman and Ratnieks, 2000; Gathmann and Tscharntke, 2002; Greenleaf et al., 2007). Thus, in fragmented habitats, a decline in pollination services, due to the inability of pollinators to move between habitat remnants, can lead to a depression in fruit set (Cunningham, 2000). In areas with intensive agriculture, the crops may not receive sufficient pollination from native pollinators (Kreman et al., 2002). Agriculturally intense areas are lacking in natural pollinators, it's estimated that 83% of crop yields suffer from pollen limitation and this is primarily due to the habitat being unsuitable for native pollinators (Richards, 2001). Recent studies have focused on integrating agriculturally intensive areas with patches of natural habitat that allow native pollinators to survive. Higher abundances of bumble bees and wild bees were found in canola fields that had 15% or more pasture land within 800-m of the canola field (Morandin et al., 2007). More abundant and diverse communities of native bees were found on farms that had patches of natural habitat. These natural habitats serve as a place for bees to nest and may act as a natural buffer against variation in bee populations in agriculturally intensive areas (Kim et al., 2006). Mass- flowering crops may also be a way to increase bumble bee and wild bee populations. In England, it was found that densities of bumble bees were not associated with semi-natural habitats within agricultural areas, which is standard procedure for pollinator conservation under the European Union's Common Agricultural Policy. Bumble bee densities were instead associated with mass-flowering crops, which supply a higher reward (Westphal et al., 2003). Devoting small portions of land to staying natural, in agriculturally intense areas may be an effective means of conserving natural pollinators systems, which is becoming increasingly important as the decline in commercialized honey bees continues.

Other concerns for native pollinators include the use of pesticides in agricultural settings. The use of pesticides in a field that requires pollination services would ideally be confined to the field, and only at times when pollinators will not contact the chemicals either directly or through exposure to persistent residues. Often pesticide sprays drift into areas that serve as refuges and nesting habitat for native pollinators (Richards, 2001). Pesticides also kill or disrupt the ability of flower-visiting insects to pollinate (Johansen, 1977). Pesticides also have a huge effect in forested ecosystems when large amounts are dropped for the control of spruce budworm (Kevan, 1975). A risk assessment of the lethality of certain pesticides to bumble bees found that the toxicity was highly dependent on body size; the larger the bumble bee the more pesticide it could tolerate (Thomson and Hunt, 1999). Another concern is the use of genetically modified crops in which insecticidal toxins have been introduced into the plant. To date, transgenic pollen and nectar have been found to have no detrimental effects on native pollinators as well as honey bees (Arpaia, 1996). Still these are things to keep in mind when considering the future of native pollinators.

## Conservation of Native Pollinators

Conservation of native pollinators, including honey bees, has received wide attention since the recent publicity about CCD. Although it is well documented that certain pollinator species are in decline, others state that the cases of pollinators resistant to decline makes the pollinator crisis more hype than reality (Ghazoul, 2005). However, declines in honey bees are well documented and, while information on native pollinators is far from complete, the warnings in these studies are not anecdotal. To conserve pollinators, there are many things that need to be done: increase research funding to elucidate the ecology of native pollinators, understand the plant-pollinator interactions that occur in different landscapes, evaluate long-term changes in pollinator communities over time, study the effects of pesticides on native pollinators, develop a list of endangered pollinators, and educate the public about the significance of this crisis (Society for Conservation Biology, 1997). The study, documentation, and conservation, of native pollinators are extremely important, especially if honey bees continue to decline.

## Objectives

Interest in the characterization of native pollinator communities has increased since the discovery of CCD, but there exists an alarming gap in the knowledge of native insect pollinators between natural and agricultural habitats (Committee on the Status of Pollinators in North America, 2007). Native pollinators are not well characterized either taxonomically or ecologically; due primarily to a lack of monitoring systems as well as taxonomists specialized in their identification (Committee on the Status of Pollinators in North America, 2007). In the United States, there very few data on long-term population trends, but despite this shortage of information, there is evidence for declines in native pollinators. Due to the diversity and variation among species, it is hard to determine any single factor as a cause of decline. Focus has been placed on anthropogenic activities such as agriculture and urbanization, as well as climate change, and the effects of introduced species and disease transference between native and non-native species (Committee on the Status of Pollinators in North America, 2007). Although these are important topics of study, baseline characterization of native pollinator populations must first be completed to understand how communities are changing.

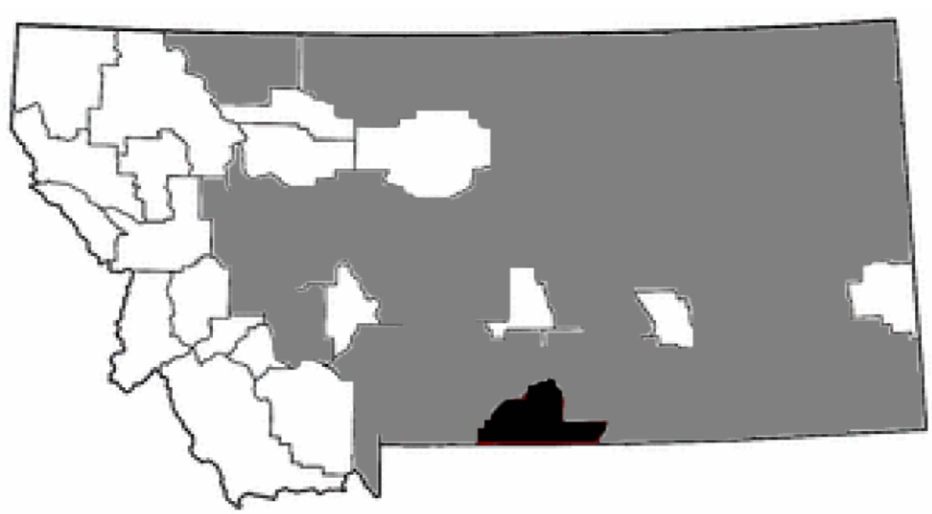
My study site, Bridger Plant Material Center (BPMC), grows plants for seeds suitable for use in land reclamation. Interest in the pollinators of a specific plant species grown at BPMC followed the death of a 5-year old stand of slender white prairieclover (*Dalea candida* Willd.). The overall objective of my research was to obtain baseline information on the pollinators of *D. candida* at the BPMC. The focus of my research was on pollination of *D. candida*. My specific objectives were to: (1) determine the diversity and identify the potential pollinators on *D. candida* and other cultivated and non-cultivated angiosperm species present at BPMC; (2) determine pollen load size and composition of insects collected on angiosperm plant species; (3) determine the general sizes of insects most important for pollination of *D. candida* at BPMC; and (4) determine the composition of the community of cavity-nesting Hymenoptera species at BPMC

# MATERIALS AND METHODS

## Study Site Description

The study site was located at the Bridger Plant Material Center (BPMC), southeast of Bridger, Carbon County, Montana (Fig.1). BPMC was established in 1959 as a means for evaluating, selecting, and developing plant materials for land reclamation sites in Montana and Wyoming. Seed of selected plant materials is released and distributed for a variety of reclamation projects. The area encompasses 140 acres of land devoted to seed production (NRCS, 11/14/2006).

Figure 1. Map of Montana counties. The black represents Carbon County, while the gray areas represent where D. candida can be found in the state.



## Slender White Prairieclover

Slender white prairieclover (*Dalea candida* Willd.) was originally collected in 1947 in Stark County, North Dakota and sent to BPMC in 1960 for evaluation as forage for livestock and wildlife, a nitrogen source for associated grasses, or a plant to be used in seed mixes for range renovation, reclamation of drastically-disturbed lands, and wildlife habitat restoration or enhancement (Majerus and Holzworth, 2003). The plant is a perennial legume categorized as a subshrub forb/herb. *Dalea candida* reaches heights of 43-61 cm and has a woody base, with a single, poorly-branched taproot. Multiple, slender stems arise from the woody base and support white flowers that form terminal spikes that are compact and cylindrical. *Dalea candida* flowers during July and August, and seeds are typically produced in August and September. Each flower produces one seed pod, which contains one, rarely two, small kidney-shaped seeds. At the end of the season, the plants die back to their base. *Dalea candida* is typically found in well-drained, sandy or gravelly, and silty soils that receive 25-45 cm of precipitation annually in northern U.S. prairies and plains (Majerus and Holzworth, 2003).

At BPMC *D. candida* is grown in Haverson silty clay loam (Hm), with a typical area having about 95% Haverson soil and 5% Heldt silty clay loam and Glenberg loam. *Dalea candida* is planted as a row crop and irrigated by flooding. Chemical management of the plant includes use of Pursuit/Select/Buctryl. BPMC differs in the plants grown for seed purposes yearly, so a layout of entire facility for 2006 and 2007 is included (Fig. 2 and 3).

Figure 2. Layout of all plants grown at USDA, NRCS-Plant Materials Center, Bridger, MT during 2006.

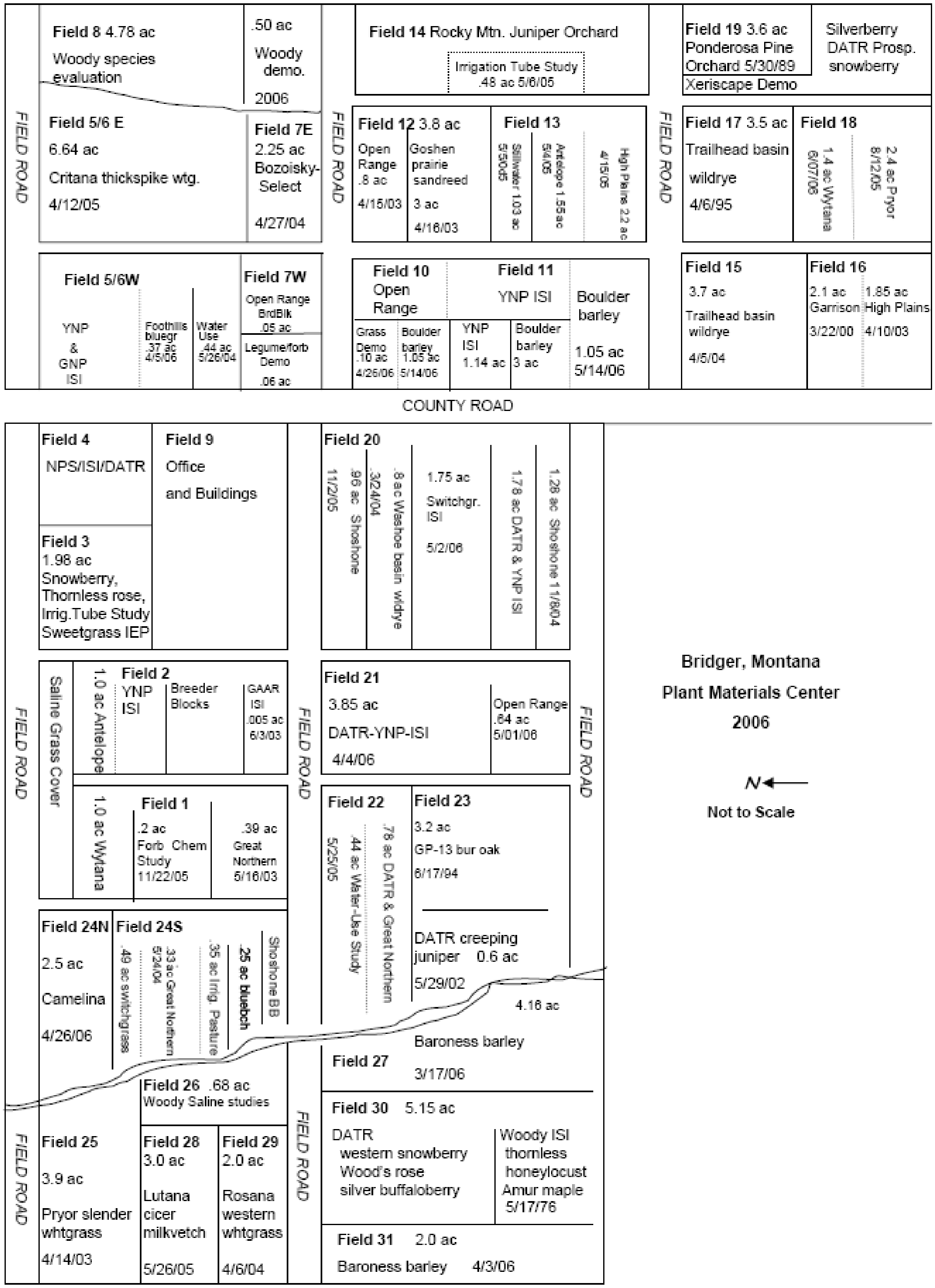
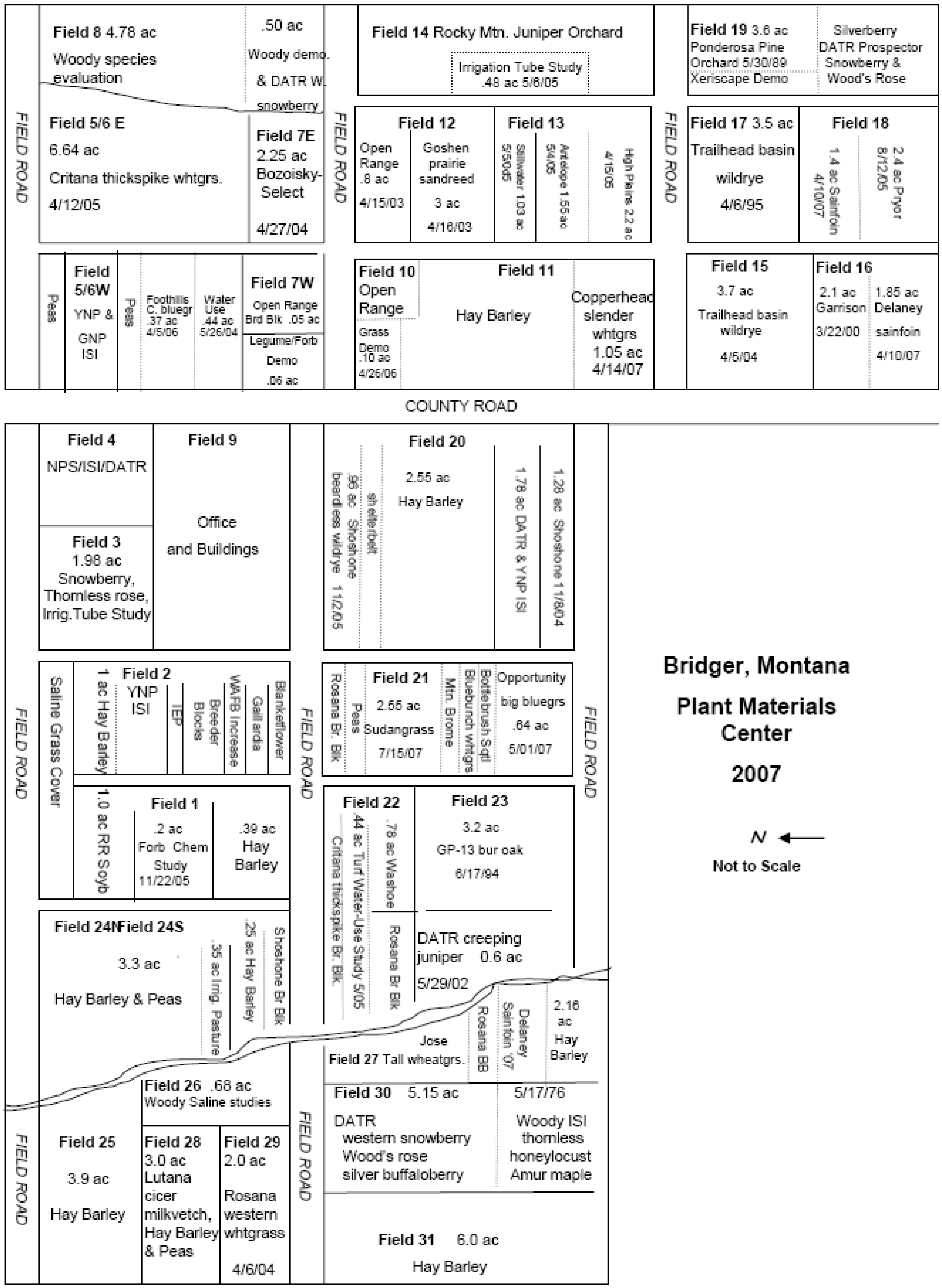


Figure 3. Layout of all plants grown at USDA, NRCS-Plant Materials Center, Bridger, MT during 2007.



## Flower Diversity and Abundance

In the first year of study, 2006, there were two plots of *D. candida* (referred to hereafter as the "upper" and "lower" fields). The upper *D. candida* field measured 1.55 acres and was located east of the lower plot, which measured 1 acre. Along with these two plots, samples (described below) were also taken from most flowering plants being grown at the BPMC (Table 1).

Table 1. Layout of all plants grown at USDA, NRCS-Plant Materials Center, Bridger, MT during 2007.

| Plant species | Common name | Status |
|---|---|---|
| *Achillea millefolium* L. | yarrow | cultivated |
| *Astragalus cicer* L. | cicer milkvetch | cultivated |
| *Camelina* sp. Crantz | falseflax | cultivated |
| *Cirsium arvense* L. | Canada thistle | non-cultivated |
| *Convolvulus arvensis* L. | bindweed | non-cultivated |
| *Dalea candida* Michx. ex. Willd | slender white prairieclover | cultivated |
| *Lotus corniculatus* L. | birdsfoot trefoil | non-cultivated |
| *Medicago sativa* L. | alfalfa | non-cultivated |
| *Melilotus alba* Medik | white sweetclover | non-cultivated |
| *Melilotus officinalis* (L.) Pall | yellow sweetclover | non-cultivated |
| *Ratibida columnifera* [Nutt.] Woot. & Standl. | prairie coneflower | cultivated |
| *Sonchus* sp. L. | sow thistle | non-cultivated |
| *Symphoricarpos* sp. Dill ex. Juss | snowberry | cultivated |
| *Symphyotrichum chilensis* (Nees) G.L. Nesom | aster | cultivated |

In the second year of study, 2007, the lower field of *D. candida* was replanted with a different crop, so only the upper plot of *D. candida* was available for study. As in 2006, along with *D. candida*, samples were taken from other flowering plants being cultivated at BPMC (Table 2).

Table 2. Flowering species additionally collected at USDA, NRCS-Plant Materials Center, Bridger, MT during the 2007 field season.

| Plant species | Common name | Status |
|---|---|---|
| *Dalea candida* | slender white prairieclover | cultivated |
| *Onobrychis viciifolia* Scop. | sainfoin | cultivated |
| *Ratibida columnifera* | prairie coneflower | cultivated |
| *Symphyotrichum chilensis* | aster | cultivated |

Flower abundance was measured for *D. candida* during the 2006 and 2007 season as soon as flowers began appearing in the fields. Flower abundance was measured at 10-points along a 50-m transect within fields, counting all flower heads in one row between a 0.5-m interval every 5-m. A stem was counted as a flowering head if at least one flower on the head was in bloom. Mean flower abundance was measured only for the upper field of *D. candida* (both years), because the lower field was extremely weedy, lowering flower abundance significantly in 2006.

Data Analysis

Mean flower abundance was measured as the total number of flowers counted over the 50-m transect, divided by the number of points measured. Standard error was also calculated for the mean flower abundances. All analysis of flower abundance was done in conjunction with sweep sample data.

## Sampling the Flower-Visiting Insect Assemblages

### Sweep Samples: Abundance and Diversity

To characterize the insect assemblage found in *D. candida* and other flowering plants at BPMC, I used both sweep nets and pan traps. For sweep samples, at least two

50-sweep samples were completed on each plant (or field) that was flowering on each visit (8 days in 2006, 10 days in 2007). Sweeps were completed by walking between plant rows. A 40-cm diameter sweep net was swept across the top of one row of plants to a depth of no more than 5-cm. Fifty sweeps were completed while walking forward. The net contents were then immediately placed in a plastic bag, and labeled with date, time of day, location, and plant species, and then placed in a cooler for transportation back to the lab. In the lab, the bags were frozen before later sorting. All Hymenoptera (excluding honey bees, *Apis mellifera* L.) were removed from bags and pinned/pointed and labeled.

Pan Traps: Abundance and Diversity

For pan traps, I used plastic, yellow bowls, 15-cm in diameter and 4-cm deep in both the upper and lower field of *D. candida* in 2006 and the upper field in 2007. On warm, clear days, 10 bowls containing approximately 200 ml of water and soap to a depth of 2-cm were placed in a straight row between plants, approximately 1-m apart. Two rows were placed in each field, with the two rows being 10 plant rows apart. A total of 20 bowls were placed in each field and left for two hours. All bowls were placed between 9:00 a.m. and 12:00 noon. After two hours, the bowls were drained with a strainer and all contents were placed in 70% ethanol. The contents of all bowls from any one day in one field were combined into a single sample. Samples were then transported to the lab in a cooler and then frozen. All Hymenoptera (excluding honey bees) were removed, dried, pinned/pointed and labeled.

Data Analysis

Abundance and Diversity. Analysis of most data focuses specifically on bee families or genera because these tend to be the major pollinators of insect-pollinated flowers. Abundance is defined here as the total number of individuals for a given collection method per plot. For all sweep samples, the total number of Hymenoptera were counted and standardized to the number of Hymenoptera per 50 sweeps for each plant species examined because some samples involved 25, 50, or 100 sweeps. The total number of Hymenoptera for all pan traps for the 2006 and 2007 field season was recorded.

To characterize species diversity measures, I used Hills #2 Index, the inverse of Simpson's Index as well as species richness. Simpson's Index is a measure of the probability of any two individuals being drawn at random from an infinite population belonging to the same species (Magurran, 2004). The index ranges from 0 to 1, with lower values indicated higher species diversity; a sample comprised of individuals of just one species would have a Simpson's Index of 1. Hill's Index, which ranges upward from zero, has greater intuitive value than Simpson's Index because higher values indicate higher diversity (Reynolds and Ludwig, 1988). These indices were only calculated for insect samples from the following plants: *D. candida, R. columnifera, C. arvensis* and *S. chilensis*. Species richness was defined as the number of Hymenoptera taxa for a given habitat (usually a single plant species).

Statistical analysis using Spearman rank correlation (statistical level of significance at P = 0.05) was performed on sweep sample from *D. candida* in conjunction with flower abundance data to determine whether a correlation between the two variables existed. This method was also used to see if a relationship existed between pan trap data and Julian data. Spearman rank correlation is a non-parametric rank correlation procedure which allows statistical analysis between two variables which do not meet normality assumptions in regression analysis; the strength of association between two variables is measured (Neter et al., 1996).

## Sampling and Identification of Pollen

In the summer of 2006, I collected individual insects on flowers to characterize the identity and size of pollen loads. Overall, 506 insects were individually collected by sweep netting and placed singly into 1.5-ml centrifuge tubes to prevent pollen contamination between individuals. The tubes were then frozen. To create a pollen reference library, individual flowers from BPMC were collected and placed in separate bags to prevent contamination. All angiosperm flowers found at BPMC, whether weed or crop, were collected for the pollen reference library that was used to identify pollen removed from insect specimens (see Table 3). Flowers were also frozen until the pollen could be processed. Pollen removed from insects was identified by comparison to the pollen library and counted to assess what flowers were visited and flower constancy.

Table 3. Flowering species collected in 2006 for pollen reference library from USDA, NRCS-Plant Materials Center, Bridger, MT.

| Plant Species | Common Name |
|---|---|
| *Achilleae millefolium* L. | yarrow |
| *Astragalus cicer* L. | cicer milkvetch |
| *Camelina* sp. Crantz. | falseflax |
| *Cirsium arvense* L. | Canada thistle |
| *Convolvulus arvensis* L. | bindweed |
| *Dalea candida* Michx. ex. Willd | slender white prairieclover |
| *Lotus corniculatus* L. | birdsfoot trefoil |
| *Medicago sativa* L. | alfalfa |
| *Melilotus alba/ officinalis* (L.) Pall/Medik | white/yellow sweetclover |
| *Ratibida columnifera* [Nutt.] Woot. & Standl. | prairie coneflower |
| *Sonchus* sp. L. | sow thistle |
| *Symphoricarpos* sp. Dill ex. Juss | snowberry |
| *Symphyotrichum chilensis* (Nees) G.L. Nesom | aster |

To make the pollen reference collection, I followed the procedures devised by Fultz (2005). To extract pollen from the flowers, anthers were removed from the flower and placed in a 1.5-ml microfuge tube with 70% ethanol. The anthers were then crushed and stirred using a glass rod. The contents of the microfuge tube were then agitated using a vortex machine. Flower tissue was strained from the pollen-ethanol mixture using a small Buchner funnel with a silkscreen strainer. The pollen-ethanol mixture was then stored in a refrigerator until staining. To stain the mixture, the pollen-ethanol mixture was centrifuged at 5000 rpms for 5 minutes. The supernatant was then removed and the remaining pellet was suspended in 95-µl distilled water with 5-µl 1% aqueous Safranin solution. The mixture was then allowed to stain for at least 24 hours before it was centrifuged again at 5000 rpms for 5 minutes. The supernatant was removed and the remaining pellet suspended in 20-µl distilled water, but more water was used if a large amount of pollen was extracted. Next, 10-µl of the pollen suspension was allowed to dry on a clean glass slide. A drop of Euparal mounting medium was placed over the suspension and covered with a cover slip. The slide was then left to dry overnight on a warming plate set on low heat. The finished reference slide was labeled with the flower that the pollen was extracted from and characteristics of the pollen were noted for future comparison to insect pollen loads.

To extract pollen from individual insects, microfuge tubes containing the insects were removed from the freezer, filled with 70% ethanol and allowed to defrost overnight. Each tube was then agitated with a vortex machine for 30 seconds to loosen pollen. Each insect was removed and individually placed in a 36-well ceramic plate. Under a stereomicroscope, the insect was cleaned of pollen using 70% ethanol and a paint brush; multiple cleanings were required if the insect possessed a lot of pollen on the body. Once clean, the pollen and ethanol in each well was placed back in the microfuge tube using a pipetter. The individual insects were allowed to dry before being pinned or pointed, and labeled with a unique identification number.

Staining the pollen from the insects followed the same methods as staining the flower pollen. Once the pollen was stained, a hemacytometer was used for estimation of the number of pollen grains in the suspension as well as identification of the pollen. To use the hemacytometer, 10 µl of the pollen suspension were pipetted under the cover slip of the hemacytometer and using a light microscope at 10X, every pollen grain in the four large corner squares was counted. An equation was used to estimate the number of pollen grains collected from the individual specimen (Pollen grains / µl = (number of pollen grains counted/counted area (0.4 µl)) × volume of pollen grain suspension). Higher magnification was needed to identify many of the pollen types. Identification of pollen loads on insects was done by using the pollen library and a pollen and spores manual (Kapp, 2000). Variation in size, shape, exine structure as well as the number of apertures and pores was used to differentiate pollen species.

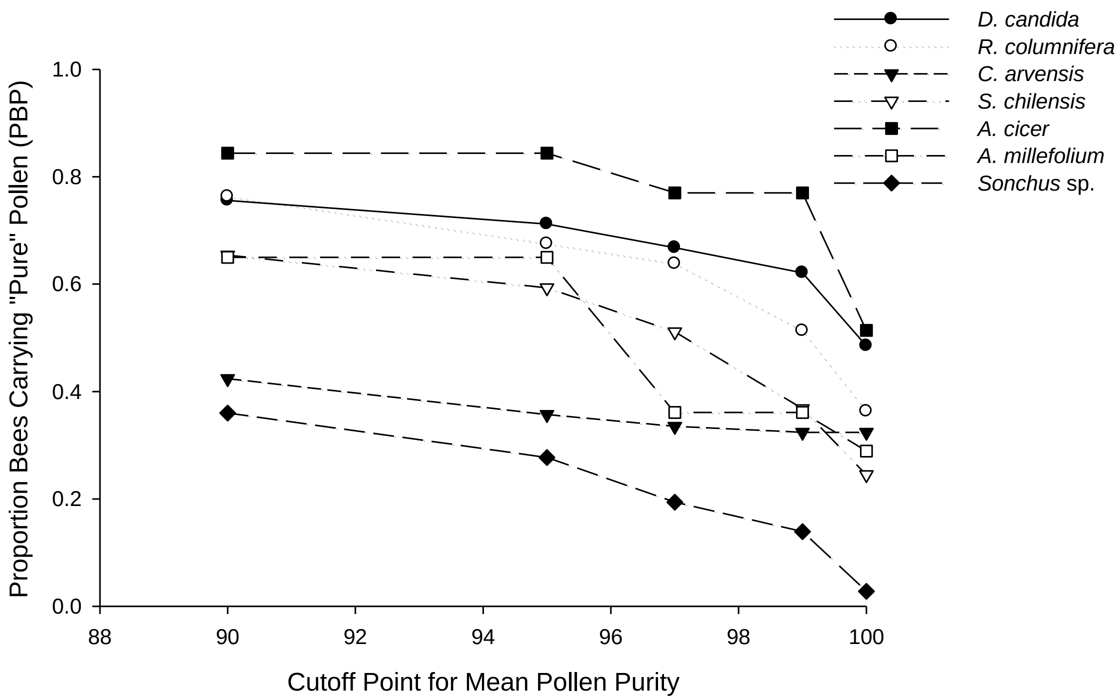
## Data Analysis

Pollen Load Size. Pollen quantity was analyzed at either the insect genus or family levels. Kruskal-Wallis analyses (statistical significance level at $P = 0.05$) were done to test for differences in pollen load size among taxa collected on the same plant species. Kruskal-Wallis is a non-parametric method for testing equality of medians among groups and is similar to a one-way ANOVA (Reynolds and Ludwig, 1988).

Pollen Load Composition. Pollen load composition was analyzed using three methods. The first method involved calculating the mean proportion of conspecific pollen (PCP) on all the bees collected on the same flower species. Conspecific pollen is defined as pollen collected from an individual insect that is the same as the plant species the individual was collected from. The proportion of conspecific pollen is used as a loose measure of flower constancy.

The second method was to calculate the proportion of bees carrying “pure” versus mixed pollen loads (PBP) which is also taken as an indication of flower constancy. However, even bees that consistently visit the same flower species during each foraging trip are unlikely to carry pollen from just one plant species. They may carry some grains from previous pollen loads (Free, 1963), or may pick up other pollen types during encounters with conspecifics. PCP values less than 100% may be found on bees that show high flower constancy and may therefore be efficient pollinators from the plant’s perspective. Thus, 100% may be too conservative a value as a cutoff point to define pollen load purity. After calculating the PCP for each bee, I judged each pollen count value as being "pure" relative to five different percentage levels: 90%, 95%, 97%, 99%, and 100%; thus, if ≥90% of the pollen came from the flower species on which the bee was collected, it was considered "pure" relative to that cutoff value. Once this was done for each percentage and for each bee, the PBP was calculated by dividing the number of "pure" pollen loads by the total pollen loads (i.e., number of bees) on a given flower species. I did this for all flower species and for all five percentage levels. Then, for each of seven plant species, I compared the arbitrary cut-off percentage to the PBP. For each flower species, PBP differed relatively little between the 90% and 95% categories, but it usually declined dramatically after that (except for *C. arvensis*) (Fig. 4). For subsequent analysis and discussion, I will use the 97% cutoff point to define pure loads, the approximate midpoint between 95% and 100%, as the cutoff to define pure loads in this study.

Figure 4. Proportion of bees carrying “pure” pollen loads (PBP) for several plant species at different “pure” percentages.




The first two methods, calculation of PCP and PBP, are the traditional means of analyzing pollen loads, but a recent paper proposes that these methods are not capable of determining “flower-constancy” and thus are not good measures of the probability of pollination (Ne’eman et al., 1999). The paper proposes a pollination probability index (PPI), which is a combination of the first two methods. The PPI is calculated by PBP*PCP and is proposed as an estimation of the probability of pollination and efficiency of pollination (Ne’eman et al., 1999).

Hill’s #2 index was used to measure the diversity of the pollen species found on individual insects collected on flowers of each of 11 plant species; I also calculated mean pollen species richness and Hill’s index overall for each bee genus independent of the plant species on which they were collected.

## Exclusion Cage Experiments

I used exclusion cages to determine the general size-class of insect flower visitors most important for pollinating SWPC. To accomplish this, I constructed small exclusion cages of three different mesh sizes: 1-mm, 3-mm, and 5-mm. The 1-mm mesh size was used to prevent all bee visitors, including the smallest halictid bees. The 3-mm mesh size was used to exclude large-bodied anthophorids and apids (bumble bees and honey bees), while allowing the small- to medium-sized bees such as halictids and megachilids to pass through to flowers. The 5-mm mesh was used to exclude only large-bodied anthophorids and *Bombus*. All three treatments were compared to a no-mesh control that allowed for open pollination (Barthell et al., 2001).

I constructed exclusion cages using a 26.5 cm in diameter circle of fabric. The 1-mm and 3-mm mesh fabric were green with green thread, while the 5-mm mesh was available only in white. Green thread was woven around the outside of the circle so that a drawstring pouch was made. Thirty of the 1-mm and 3-mm mesh sizes were placed in the field on 13 June 2007 and were supported with wooden dowels and zip ties. All flowers that were placed inside the bags had no open flowers visible, so that pollination could not have occurred prior to exclusion. The 1-mm and 3-mm mesh bags were disturbed twice, once on 26 June 2007 when the plants were sprayed with herbicide by personnel at the BPMC; two 1-mm bags had to be replaced. The second disturbance occurred on 11 July 2007 when half the field was mowed over for weed control purposes; five 1-mm and seven 3-mm cages had to be replaced. However, in no case were the flower heads inside the cages exposed to open pollination. On 11 July 2007, 30 of the 5-mm white mesh exclusion cages were placed out in the field, the delay in putting it out was because the 5-mm mesh was much heavier than the 1-mm and 3-mm and the plants needed to be larger to sustain the weight. These were also supported with wooden dowels and zip ties and only included flowers that had no flowers visible.

On 3 September 2007 (when all flowers were senesced) each mesh bag, along with all the flowers enclosed were cut from the plants and placed in individual plastic storage bags. At this time, 25 randomly selected individual flower heads that had no treatment (openly pollinated) were also collected. All bags were placed in a refrigerator at approximately 8$^{\circ}$ C and 85% relative humidity until they could be processed. Eighteen samples for the 1-mm were recovered, 10 for the 3-mm, 28 for the 5-mm, and 25 for the no-mesh treatment. Processing of samples included separating out the mature seeds and removing the seed case. For each sample, I recorded the number of flower heads collected, the length of the flower head, the number of seeds produced on the head, and the combined weight of those seeds. Seeds were weighed using an analytical balance.

Data Analysis

A Kruskal-Wallis test (statistical significance level at $P = 0.05$) was used to test for among-treatment differences in the number of seed/flower head and the weight of seeds/flower head. The number of seeds/flower head was used as a direct measure of the amount of pollination that occurred. Total seed weight/flower head was analyzed because a plant of the same genus, *Dalea purpurea* Lucanus, is partially self-incompatible and when it self-fertilizes it produces smaller seeds (Cane, 2006). So, while self-pollination may occur it is at a sub-optimal level, because of this both measures were included to see if differences occurred in the results.

I also examined the relationship between the number of seeds/flower head in different treatments and the sizes of insects at the site capable of getting through each mesh size. Measures of the widest part of individual insects of potential pollinator taxa were compared with mesh diameters. Based on this, all pollinators collected for the 2007 season on *D. candida*, separated into each mesh size group.

## Sampling Cavity-Nesting Bee and Wasp Community

Trap nests were used to document the assemblage of solitary, cavity-nesting bees and wasps at BPMC, and to examine the potential for enhancing native bee populations at BPMC. In 2006, eight sets of trap nests were placed near the upper and lower fields of *D. candida*. The trap nests consisted of wood into which were drilled 15-cm long holes of varying diameters: 4, 5, 6, 8, 9, 10, and 12-mm. Paper or cardboard tubes with inside diameters of 3, 4, 5, 6, 7, 8, and 9-mm were inserted into the holes to provide potential nest sites for cavity-nesting species (Krombein, 1967). Each set of trap nests consisted of multiple boards containing, in combination, 6-11 tubes of each diameter.

Trap nests were placed out at BPMC on 23 June 2006, and on each subsequent visit to the site, traps were checked and capped nests were removed. Capped nests were defined as those in which the tube was plugged at the end (i.e. by mud or plant materials placed there by the resident females). New paper tubes were then placed in the nest holes that had been removed. The collected tubes were placed in a ventilated plastic bag and transported to the lab in a cooler. In the lab, tubes were individually labeled by site and date of collection and placed in individually capped glass culture tubes with ventilated lids (20-cm in length with a tube opening of 22-mm); a piece of fined-meshed fabric was placed between the lid and glass tube to allow ventilation, while preventing parasitic insects from entering or leaving the tube. All nests remained at room temperature in the lab, until 25 October 2006, when all tubes were placed in a refrigerated storage room (at ~8°C and 85% relative humidity). On 25 April 2007, tubes were returned to room temperature and were checked daily. All emerged insects were removed from the tube, freeze killed, pinned or pointed, and labeled with the date of emergence and an individual nest number.

### Data Analysis

Analysis of trap nest emergence involved contrasting the differences in emergence numbers in families, genus, and species. Differences in emerged Hymenoptera and those collected using sweep samples were also noted. Chi-squared tests were used to analyze sex-ratio data (statistical significance level at $P = 0.05$).

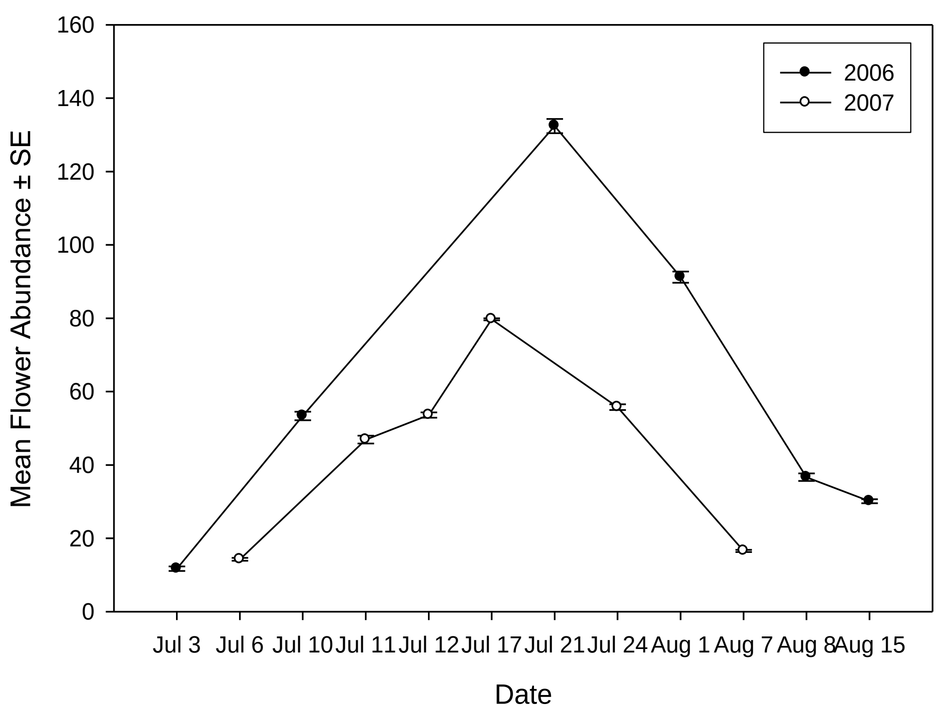
# RESULTS

## Flower Diversity and Abundance

### *D. candida*

Mean flower abundance for *D. candida* peaked about mid-July during the 2006 and 2007 field seasons (Fig.5). Differences is the mean flower abundance between the 2006 and 2007 field seasons can probably be attributed to abiotic factors such as weather, management strategies, soil chemistry, and the phenology of the plant.

Figure 5. Mean flower abundance per 50-m of planted row ± SE for D. candida field over the 2006 and 2007 field season, at USDA, NRCS-Plant Materials Center, Bridger, MT.



Other Available Flower Resources

The species of cultivated flowering angiosperms likely to be visited by insects differed between 2006 and 2007 (Table 4). In addition, as noted earlier, two fields of SWPC were present in 2006, but only one in 2007. In both years, there was also a large number of flowering weedy species that were attractive to insects (Table 5).

Table 4. Cultivated flowering angiosperms collected during the 2006 and 2007 field season at USDA, NRCS-Plant Materials Center, Bridger, MT.

| Plant species | Common name | Collected 2006 | Collected 2007 |
|---|---|---|---|
| *Achillea millefolium* | yarrow | yes | no |
| *Dalea candida* | slender white prairieclover | yes | yes |
| *Onobrychis viciifolia* | sainfoin | no | yes |
| *Symphoricarpos* sp. | snowberry | yes | no |
| *Symphyotrichum chilensis* | aster | yes | yes |
| *Ratibida columnifera* | prairie coneflower | yes | yes |
| *Astragalus cicer* | cicer milkvetch | yes | no |
| *Camelina* sp. | falseflax | yes | no |

Table 5. Flowering weedy species that were collected during the 2006 field season only at USDA, NRCS-Plant Materials Center, Bridger, MT.

| Plant species | Common name |
|---|---|
| *Asclepias* sp. | milkweed |
| *Cirsium arvense* | Canada thistle |
| *Convolvulus arvensis* | bindweed |
| *Lotus corniculatus* | birdsfoot trefoil |
| *Medicago sativa* | alfalfa |
| *Melilotus alba* | white sweetclover |
| *Melilotus officinalis* | yellow sweetclover |
| *Sonchus* sp. | sow thistle |

## Sampling the Flower-Visiting Insect Assemblages

### Sweep Samples: Abundance and Diversity

A total of 1,836 individual native aculeate wasp and bee individuals and 1,697 honey bees were collected in sweep samples during the 2006-2007 field seasons, comprising a total of 102 Hyemnoptera taxa for all of BPMC (species and genera; Appendix A); the total number of bee species is likely larger, but there is a difficulty identifying the genus *Lasioglossum*. Of the total taxa collected, 67 are bees, with 58 of those being pollen foragers and nine being brood parasites (Appendix B). The number of Hymenoptera taxa collected varied, not only on each plant (Appendix B), but also between years (when it was possible to collect both years). *Ach. millefolium* had the highest mean number of Hymenoptera collected per 50 sweeps at 17.4 ± 0.64, *Camelina* sp. had the lowest number of Hymenoptera per 50 sweeps at 2.25 ± 1.54. The rest of the plant species examined had Hymenoptera specimens in the mid-range (Table 6). During 2007 *R. columnifera* had the highest mean number of Hymenoptera per 50 sweeps at 9.22 ± 0.53 and *O. viciifolia* had the lowest, at 8.16 ± 0.72.

Table 6. Mean number of Hymenoptera collected per 50 sweeps ± SE during the 2006 and 2007 season for flowering species collected at USDA, NRCS-Plant Materials Center, Bridger, MT.

| Plant Species | Mean number of Hymenoptera/50 sweeps | |
|---|---|---|
| | 2006 | 2007 |
| *Ast. cicer* | 7.50 ± 0.35 | - |
| *Ach. millefolium* | 17.40 ± 0.64 | - |
| *Camelina* sp. | 2.25 ± 1.54 | - |
| *Con. arvensis* | 7.16 ± 0.41 | - |
| *D. candida* | 9.13 ± 0.70 | 8.85 ± 0.42 |
| *M. sativa* | 5.00 ± 0.42 | - |
| *O. viciifolia* | - | 8.16 ± 0.72 |
| *R. columnifera* | 8.88 ± 0.86 | 9.22 ± 0.53 |
| *S. chilensis* | 5.10 ± 0.57 | 8.77 ± 0.84 |
| *Sonchus* sp. | 7.88 ± 1.07 | - |
| *Symphoricarpos* sp. | 12.83 ± 0.43 | - |

Species Richness on Different Plant Species. *Dalea candida* had the highest species richness with 36 Hymenoptera taxa in 2006 and 20 in 2007 (Table 7). *Ratibida columnifera* had higher species richness that *S. chilensis*, but there was very little difference between the two years for each plant (Table 7). Plant species that were collected for a single field season also exhibit differences in the number of Hymenoptera taxa collected on them, with *Ach. millefolium* having the largest number of taxa collected and *M. alba and Camelina* sp. the lowest (Table 7).

Table 7. Species richness and species richness per 50-sweep sample for all angiosperm plant species collected 2006 and 2007 at USDA, NRCS-Plant Materials Center, Bridger, MT.

| | 2006 | | 2007 | |
|---|---|---|---|---|
| Plant Species | Species richness | Species richness per 50-sweep sample | Species richness | Species richness per 50-sweep sample |
| *Ast. cicer* | 9 | 2.25 | - | - |
| *Ach. millefolium* | 24 | 2.40 | - | - |
| *Camelina* sp. | 3 | 0.75 | - | - |
| *Con. arvensis* | 12 | 2.16 | - | - |
| *D. candida* | 36 | 2.68 | 20 | 2.85 |
| *M. alba* | 3 | 2.00 | - | - |
| *M. sativa* | 6 | 1.66 | - | - |
| *O. viifolia* | - | - | 11 | 1.83 |
| *R. columnifera* | 21 | 0.79 | 23 | 1.11 |
| *S. chilensis* | 9 | 0.80 | 11 | 1.11 |
| *Sonchus* sp. | 9 | 1.13 | - | - |
| *Symphoricarpos* sp. | 16 | 3.16 | - | - |

Hill's Index. For plants that were the most intensively collected, Hill's index revealed that *D. candida* had the highest diversity of Hymenoptera (Table 8) in both years. *Ratibida columnifera* had the next highest diversity, followed by *Con. arvensis* and *S. chilensis*, although *Con. arvensis* was not sampled again in 2007. Hill's index for *D. candida* was higher in 2006 than 2007, but for *R. columnifera* and *S. chilensis* it was higher in 2007. These comparisons are not as straight forward as they appear and the different numbers of sweep samples collected on each plant must be taken into account.

Table 8. Hill's Index of pollinator diversity for plant species with the most intensive collection at USDA, NRCS-Plant Materials Center, Bridger, MT.

| | 2006 | | 2007 | | 2006-2007 |
|---|---|---|---|---|---|
| Plant Species | Hill's Index | Number of 50-sweep samples | Hill's Index | Number of 50-sweep samples | Hill's Index |
| *D. candida* | 7.453 | 47 | 6.84 | 20 | 7.42 |
| *Con. arvensis* | 3.687 | 6 | n/a | - | 3.687 |
| *S. chilensis* | 3.214 | 10 | 4.082 | 9 | 3.694 |
| *R. columnifera* | 4.046 | 24 | 6.567 | 18 | 5.158 |

<u>Hymenoptera Abundance in Relation to Flower Abundance.</u> For *D. candida*, the only plant for which flower abundance was quantified, there was no significant relationship between flower abundance and the number of Hymenoptera per 50 sweeps (Spearman rank correlation, r = 0.46, P = 0.26, N = 7) (Fig 6). Similar results were obtained for the 2007 field season (P = 0.13, r = 0.80, N = 5) (Fig. 6). Combining the 2006 and 2007 data also did not reveal a significant relationship between the two variables (P = 0.139, r = 0.453, N = 12). Comparison between mean flower abundance and the number of Hymenoptera taxa collected yielded different results. Statistical significance between the two variables was found for the 2006 (r = 0.86, P = 0.006, N = 7) and the 2007 (r = 1.00, P = 0.017, N = 5) field season at the 0.05 level (Fig. 7). Combining the 2006 and 2007 data also revealed a significant relationship between the two variables (P = 0.003, r = 0.812 N = 12) (Fig. 7).

Figure 6. Mean flower abundance vs. number of Hymenoptera per 50 sweeps on D. candida for the 2006 and 2007 field season at USDA, NRCS-Plant Materials Center, Bridger, MT (P = 0.139, r = 0.453, N = 12).

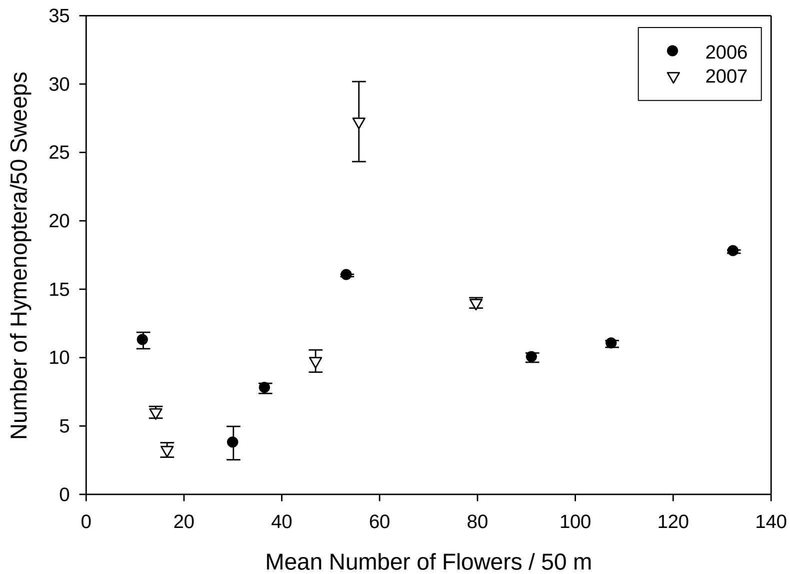
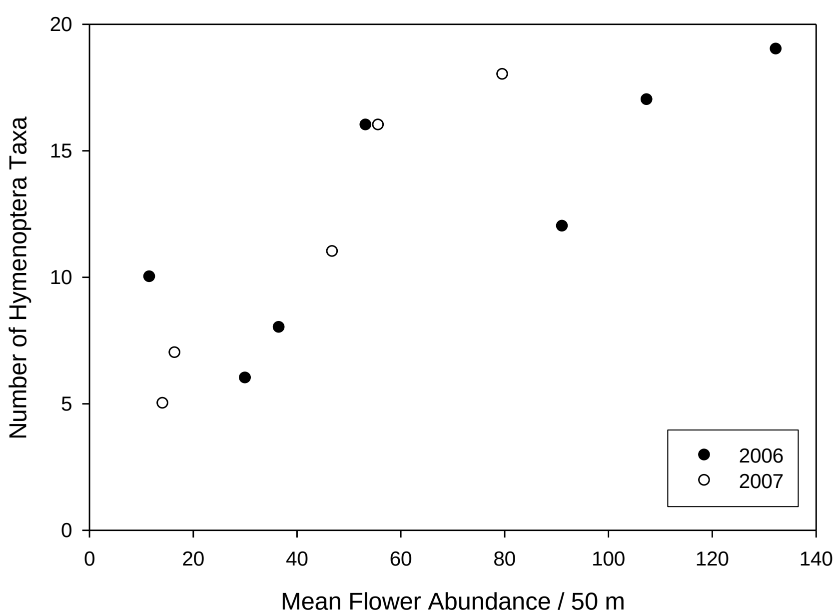



Figure 7. Mean flower abundance vs. number of Hymenoptera taxa on D. candida for the 2006 and 2007 field season at USDA, NRCS-Plant Materials Center, Bridger, MT (P = 0.003, r = 0.812 N = 12).



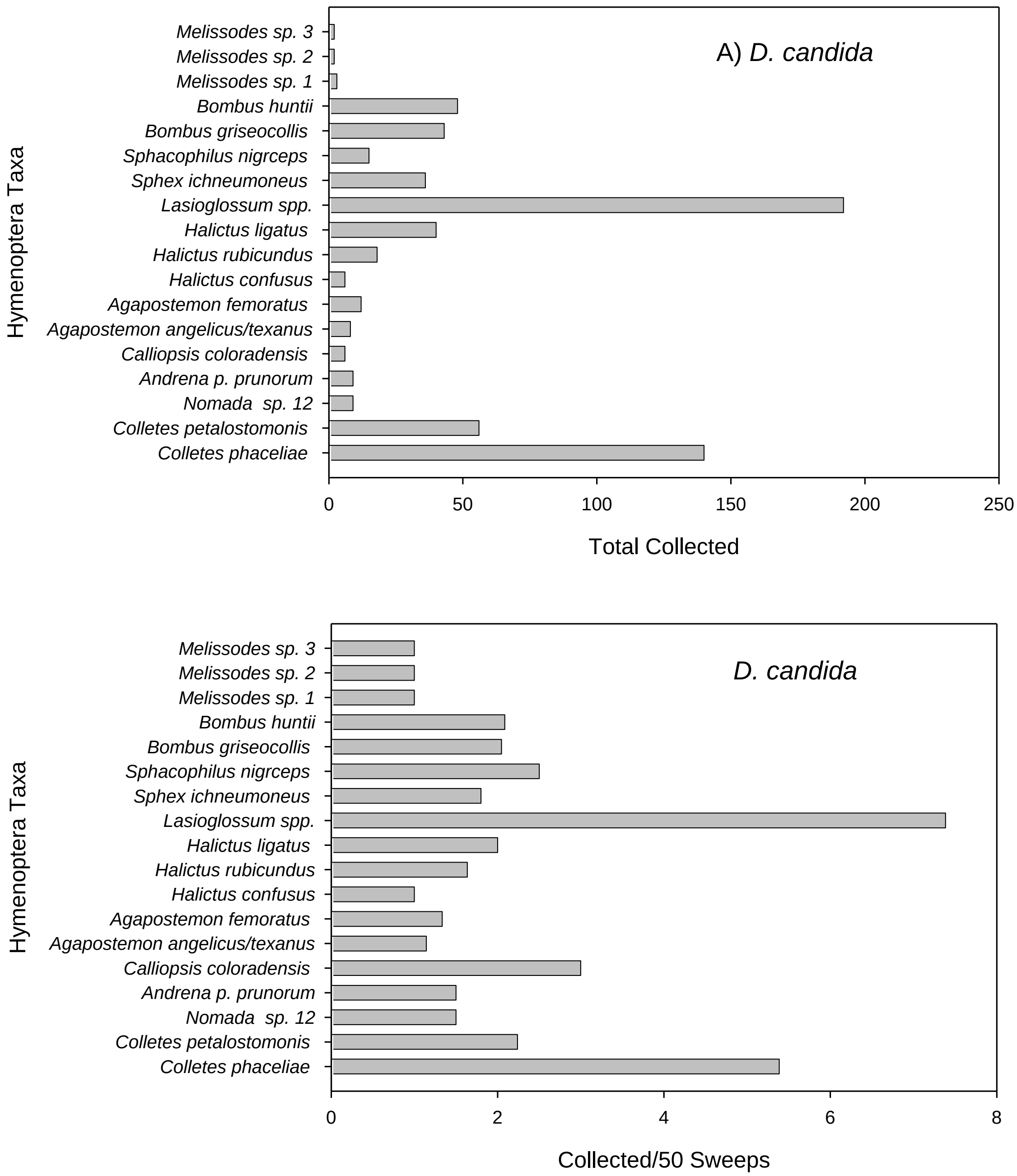
Hymenoptera Community Composition. Comparison of flowering plant species revealed some differences in hymenopteran community composition. For certain Hymenoptera species, the majority of the specimens were collected on a single plant species, but only a few Hymenoptera species were collected exclusively on one plant species.

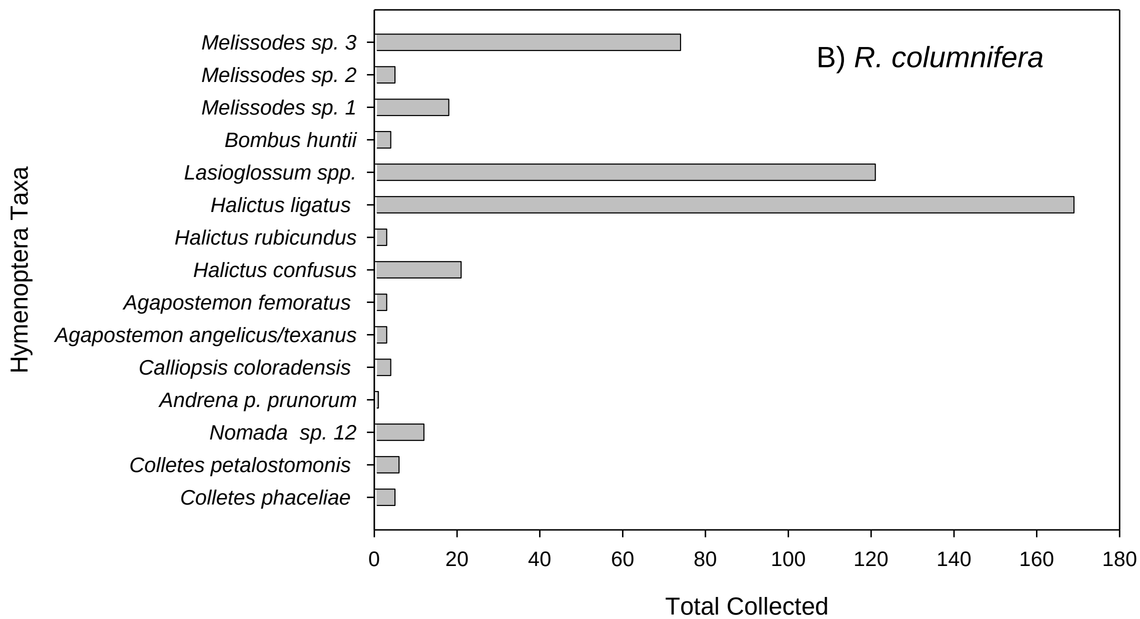
Among the cultivated plants, several non-*Apis* bee taxa were collected frequently (Fig. 8), and several were uncommon (Table 9). “Frequent collection” is defined here as having a total number of more than 15, regardless of the plant in which it was collected. Of the more frequently collected Hymenoptera, only the sawfly, *Sphacophilus nigrcep,* was found only on *D. candida.* Among the Hymenoptera collected infrequently there were five species found only on *D. candida*, *Megachile brevis*, *Hoplitis* sp. 1, *Andrena* sp. 1, *Bombus* sp. 1, and *Bombus rufocinctus* (Table 9) in 2006.

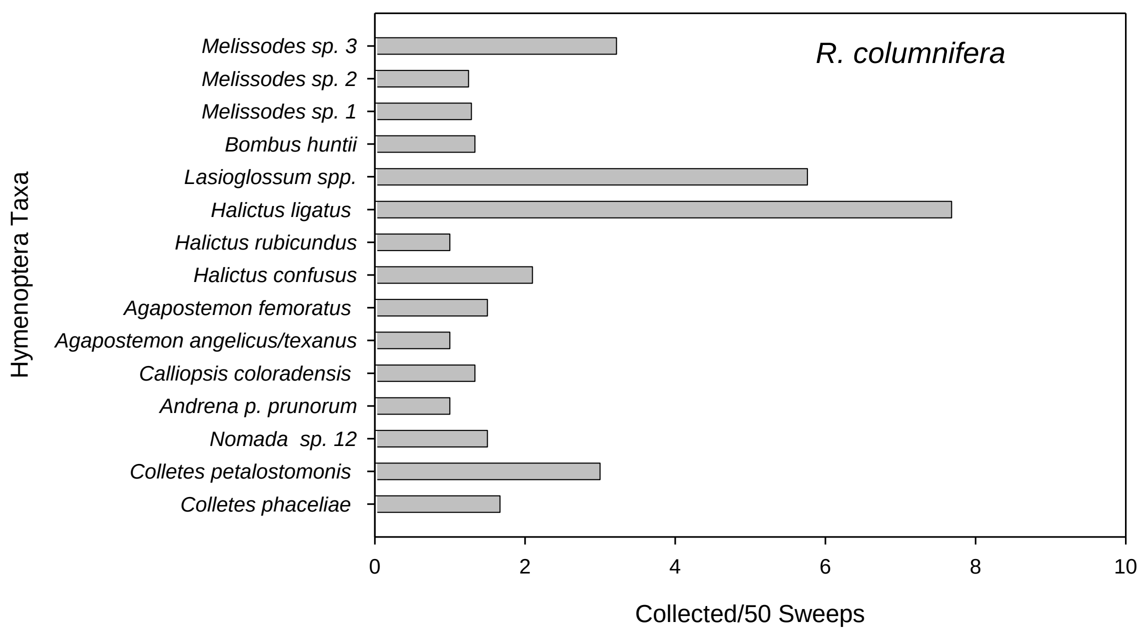
For the other cultivated flowering plants *Megachile parallela*, *Andrena andreniformis* and *Triepeolis* sp. 2 were found only on *R. columnifera*, *Hylaeus* sp. and *Nomada* sp. 10 were found only on *Ach. millefolium, Megachile inimical,* only on *S. chilensis,* and *Nomada* sp. 11 was found only on *O. viciifolia.* Only two species, the sawfly *Schizocerella pilicornis* and *Osmia* sp., were found on the uncultivated plants and not on cultivated ones (Table 10).

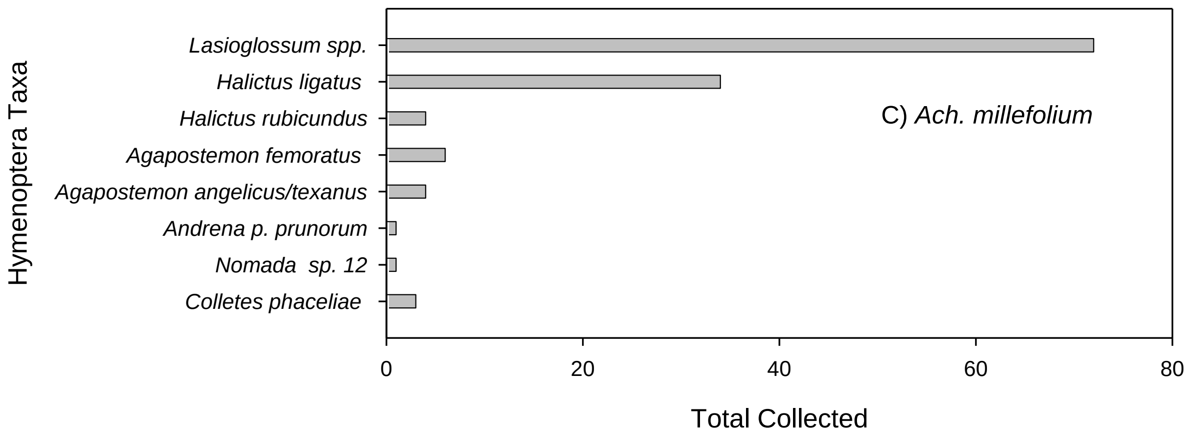
*Lasioglossum* spp. was the most common non-*Apis* taxon found on *D. candida, Ach. millefolium*, and *Symphoricarpos* spp., and the second most common on *R. columnifera* (Fig. 8). *Halictus ligatus* was the most commonly collected taxon on *R. columnifera* and *S. chilensis*, and the second most frequent on *Ach. millefolium*. Species of *Melissodes* were relatively common on *R. columnifera* and *S. chilensis*. Perhaps the most divergent assemblage of bees was found on *O. viciifolia,* where *Bombus* and *Lasiglossum* were common. Comparisons of the total number of each taxa collected on each plant with the number of each taxa collected per 50 sweeps reveals slight differences in the community composition of each plant, but is overall similar to the total number of each taxa collected on each plants.

Figure 8. Community composition of the Hymenoptera taxa collected frequently on the cultivated plants and the number collected per 50 sweeps for A) *D. candida*, B*) R. columnifera*, C) *Ach. millefolium*, D) *S. chilensis* and E) *O. viciifolia* in the 2006-2007 field s.

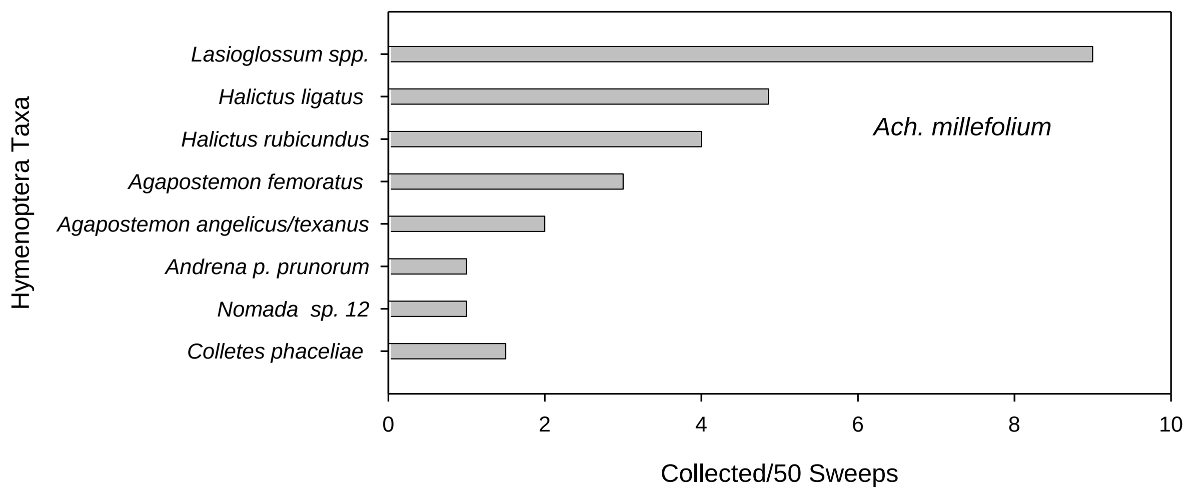



B) R. columnifera
Hymenoptera Taxa
Melissodes sp. 3
Melissodes sp. 2
Melissodes sp. 1
Bombus huntii
Lasioglossum spp.
Halictus ligatus
Halictus rubicundus
Halictus confusus
Agapostemon femoratus
Agapostemon angelicus/texanus
Calliopsis coloradensis
Andrena p. prunorum
Nomada sp. 12
Colletes petalostomonis
Colletes phaceliae
0
20
40
60
80
100
120
140
160
180
Total Collected

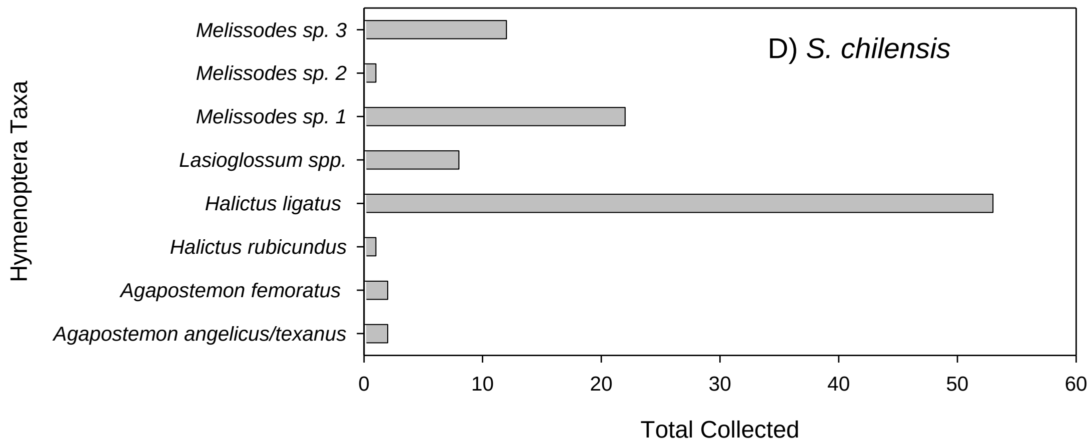

R. columnifera
Hymenoptera Taxa
Melissodes sp. 3
Melissodes sp. 2
Melissodes sp. 1
Bombus huntii
Lasioglossum spp.
Halictus ligatus
Halictus rubicundus
Halictus confusus
Agapostemon femoratus
Agapostemon angelicus/texanus
Calliopsis coloradensis
Andrena p. prunorum
Nomada sp. 12
Colletes petalostomonis
Colletes phaceliae
0
2
4
6
8
10
Collected/50 Sweeps

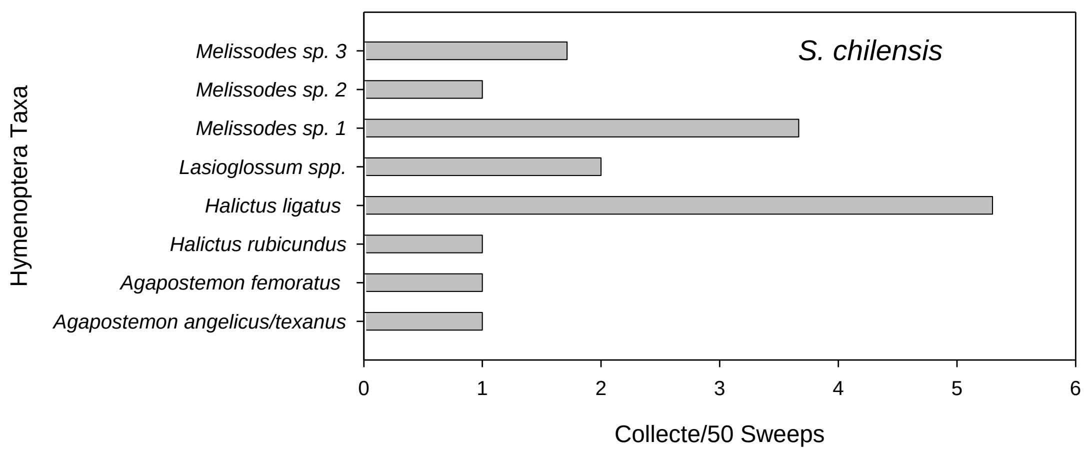


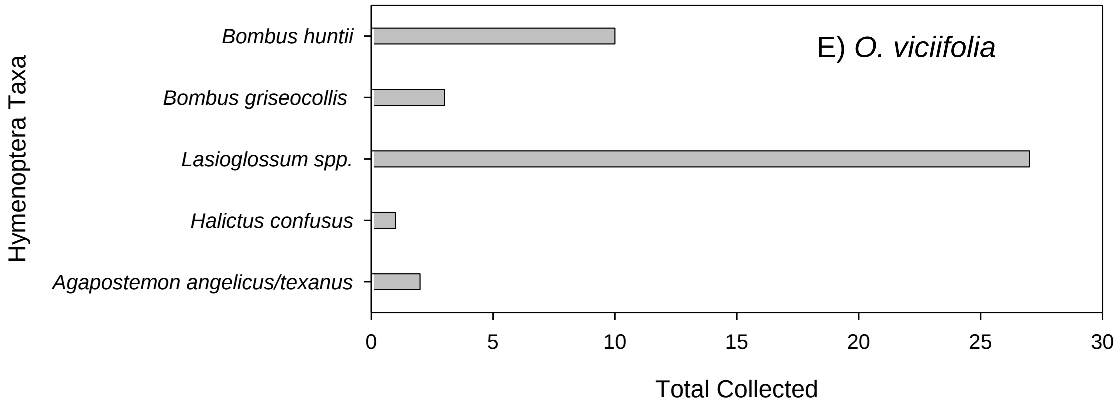
C) Ach. millefolium
Hymenoptera Taxa
Lasioglossum spp.
Halictus ligatus
Halictus rubicundus
Agapostemon femoratus
Agapostemon angelicus/texanus
Andrena p. prunorum
Nomada sp. 12
Colletes phaceliae
0
20
40
60
80
Total Collected

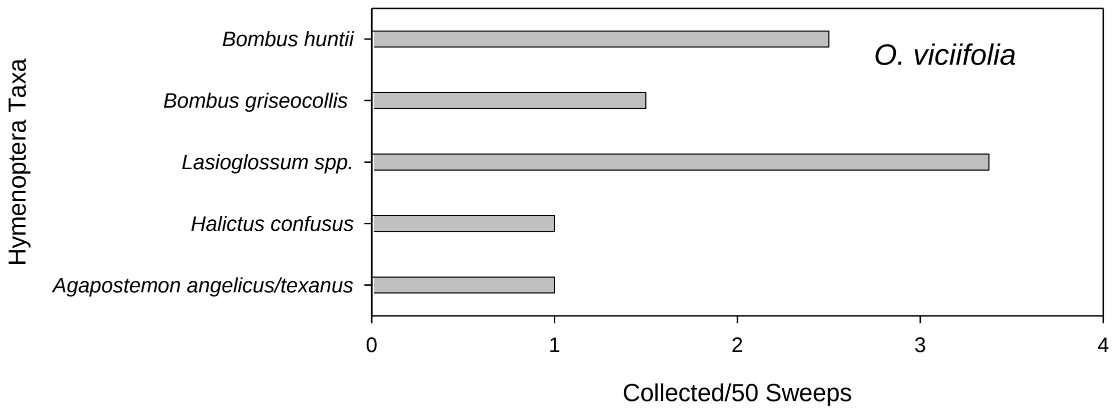
Ach. millefolium
Hymenoptera Taxa
Lasioglossum spp.
Halictus ligatus
Halictus rubicundus
Agapostemon femoratus
Agapostemon angelicus/texanus
Andrena p. prunorum
Nomada sp. 12
Colletes phaceliae
0
2
4
6
8
10
Collected/50 Sweeps


D) S. chilensis
Melissodes sp. 3
Melissodes sp. 2
Melissodes sp. 1
Lasioglossum spp.
Halictus ligatus
Halictus rubicundus
Agapostemon femoratus
Agapostemon angelicus/texanus
Hymenoptera Taxa
0
10
20
30
40
50
60
Total Collected


S. chilensis
Melissodes sp. 3
Melissodes sp. 2
Melissodes sp. 1
Lasioglossum spp.
Halictus ligatus
Halictus rubicundus
Agapostemon femoratus
Agapostemon angelicus/texanus
Hymenoptera Taxa
0
1
2
3
4
5
6
Collecte/50 Sweeps



E) O. viciifolia
Hymenoptera Taxa
Bombus huntii
Bombus griseocollis
Lasioglossum spp.
Halictus confusus
Agapostemon angelicus/texanus
0
5
10
15
20
25
30
Total Collected

O. viciifolia
Hymenoptera Taxa
Bombus huntii
Bombus griseocollis
Lasioglossum spp.
Halictus confusus
Agapostemon angelicus/texanus
0
1
2
3
4
Collected/50 Sweeps

Table 9. Total number of individuals of each species infrequently collected on cultivated plants during the 2006 and 2007 field seasons at USDA, NRCS-Plant Materials Center, Bridger, MT. **Indicates that species was collected only on that plant.

| | *D. candida* | | *R. columnifera* | | *Ach. millefolium* | | *Symphoricarpos* sp. | | *S. chilensis* | | *O. viciifolia* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hymenoptera species | 2007 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 |
| *Agapostemon angelicus* | 4 | - | - | - | - | - | - | - | - | - | - | - |
| *Agapostemon texanus* | 3 | - | - | - | - | - | - | - | - | - | - | - |
| *Andrena andreniformis* | - | - | - | 2** | - | - | - | - | - | - | - | - |
| *Andrena* sp. 2 | - | - | - | - | 2 | - | 1 | - | - | - | - | - |
| *Andrena* sp. 3 | 1** | - | - | - | - | - | - | - | - | - | - | - |
| *Bombus centralis* | 1 | - | - | - | - | - | 4 | - | - | - | - | - |
| *Bombus rufocinctus* | 1** | - | - | - | - | - | - | - | - | - | - | - |
| *Bombus* sp. 1 | 1** | - | - | - | - | - | - | - | - | - | - | - |
| *Coelioxys masae* | 1 | - | - | 1 | - | - | - | - | - | - | - | - |
| *Colletes fulgida* | 1 | - | - | 1 | 2 | - | - | - | - | - | - | - |
| *Colletes* sp. | 1 | - | - | - | - | - | 1 | - | - | - | - | - |
| *Heriades carinata* | 3 | - | - | - | 6 | - | 2 | - | - | 1 | - | - |
| *Hoplitis* sp. 1 | 1** | - | - | - | - | - | - | - | - | - | - | - |
| *Hylaeus bisinuatus* | - | - | - | 1 | 2 | - | 1 | - | - | - | - | - |
| *Hylaeus* sp. 3 | 1 | - | - | - | 2 | - | - | - | - | - | - | - |
| *Hylaeus* sp. 4 | - | - | - | - | 1 | - | 1 | - | - | - | - | - |
| *Hylaeus* sp.1 | - | - | - | - | 1** | - | - | - | - | - | - | - |

Table 9 Continued: Total number of each species collected infrequently on cultivated plants during the 2006 and 2007 field seasons at USDA, NRCS-Plant Materials Center, Bridger, MT. **Indicates that species was collected only on that plant.

| | *D. candida* | | *R. columnifera* | | *Ach. millefolium* | | *Symphoricarpos* sp. | | *S. chilensis* | | *O. viciifolia* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hymenoptera species | 2007 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 |
| *Megachile brevis* | 1** | - | - | - | - | - | - | - | - | - | - | - |
| *Megachile inimica* | - | - | - | - | - | - | - | - | - | 1** | - | - |
| *Megachile lippiae* | 2 | 1 | 4 | - | - | - | - | - | - | - | - | - |
| *Megachile parallela* | - | - | 1** | 1** | - | - | - | - | - | - | - | - |
| *Megachile rotundata* | 2 | - | 2 | - | - | - | - | - | - | 2 | - | 1 |
| *Nomada* sp. 10 | - | - | - | - | 1** | - | - | - | - | - | - | - |
| *Nomada* sp. 11 | - | - | - | - | - | - | - | - | - | - | - | 1** |
| *Perdita* sp. 1 | - | - | - | 1 | - | - | - | - | - | 1 | - | - |
| *Sphecodes* sp. 1 | - | - | - | 1 | 1 | - | - | - | - | - | - | - |
| *Sphecodes* sp. 2 | - | 1 | - | - | 1 | - | - | - | - | - | - | 2 |
| *Triepeolus* sp. 1 | - | 1 | 3 | 1 | - | - | - | - | - | - | - | - |
| *Triepeolus* sp. 2 | - | - | 1** | - | - | - | - | - | - | - | - | - |

Table 9 Continued: Total number of individuals of each species collected in sweep samples on cultivated plants in 2006 at USDA, NRCS-Plant Materials Center, Bridger, MT (no 2007 collection). **Indicates that species was collected only on that plant.

| Hymenoptera species | *Ast. cicer* | *Camelina* sp. |
|---|---|---|
| *Bombus centralis* | 1 | - |
| *Bombus fervidus* | 1 | - |
| *Bombus griseocollis* | 7 | - |
| *Bombus huntii* | 10 | - |
| *Colletes phaceliae* | - | 1 |
| *Halictus rubicundus* | 1 | - |
| *Hylaeus bisinuatus* | - | 1 |
| *Lasioglossum* spp. | 6 | 7 |
| *Osmia* sp. | 2** | - |
| *Schizocerella pilicornis* | 1** | - |

Table 10. Total number of individuals of each species collected in sweep samples on non-cultivated plants in 2006 at USDA, NRCS-Plant Materials Center, Bridger, MT (no 2007 collection).

| Hymenoptera species | *M. alba* | *Sonchus* sp. | *Con. arvensis* | *M. sativa* | *Cir. arvense* |
|---|---|---|---|---|---|
| *Agapostemon angelicus* | - | - | 1 | - | - |
| *Agapostemon angelicus/texanus* | - | 3 | - | - | - |
| *Agapostemon femoratus* | - | - | 1 | 3 | - |
| *Agapostemon texanus* | - | - | - | 1 | - |
| *Bombus centralis* | 1 | - | - | - | - |
| *Bombus fervidus* | - | 1 | - | - | - |
| *Bombus griseocollis* | - | - | - | - | - |
| *Bombus huntii* | - | 5 | - | - | 1 |
| *Bombus occidentalis* | - | 1 | - | - | - |
| *Colletes phaceliae* | - | - | - | - | 1 |
| *Halictus ligatus* | - | 20 | 3 | 4 | - |
| *Halictus rubicundus* | 1 | - | 3 | - | - |
| *Hylaeus bisinuatus* | - | - | - | - | - |
| *Lasioglossum* spp. | 1 | 27 | 21 | 6 | - |
| *Melissodes* sp. 1 | - | 1 | - | - | - |
| *Melissodes* sp. 3 | - | 4 | - | - | - |
| *Osmia* sp. | - | - | - | - | - |
| *Schizocerella pilicornis* | - | - | - | - | - |
| *Triepeolus* sp. 1 | - | - | - | 1 | - |

Honey bees were by far the most commonly collected bee species in sweep samples on *D. candida*, comprising 67% of the total Hymenoptera collected during the 2006 and 2007 season combined. Collection of honey bees on other plant species was not nearly as numerous as the collection on *D. candida* (Table 11). Mean number of honey bees collected was highest on *D. candida* in 2006 and *O. viciifolia* in 2007. More honey bees were collected on more plants as well as in higher numbers in 2006 then 2007, possibly because there were more flowering species present in 2006 (Table 11).

Table 11. Total numbers of honey bees collected and mean number of honey bees ± SE collected on different plants for the 2006 and 2007 field seasons at USDA, NRCS-Plant Materials Center, Bridger, MT.

| Plant Species | 2006 | | 2007 | |
|---|---|---|---|---|
| | Total Collected | Mean ± SE | Total Collected | Mean ± SE |
| *D. candida* | 1301 | 28.30 ± 2.88 | 183 | 11.44 ± 3.63 |
| *Ach. millefolium* | 1 | - | - | - |
| *Astragalus* sp. | 3 | - | - | - |
| *Camelina* sp. | 12 | 6.00 ± 0.00 | - | - |
| *Cir. arvense* | 6 | 2.00 ± 0.58 | - | - |
| *M. alba* | 12 | - | - | - |
| *O. viciifolia* | - | - | 113 | 14.13 ± 3.58 |
| *R. columnifera* | 12 | 2.40 ± 0.51 | - | - |
| *Sonchus* sp. | 25 | 12.50 ± 6.50 | - | - |
| *Symphoricarpos* sp. | 25 | 3.57 ± 0.69 | - | - |
| *S. chilensis* | 4 | 2.00 ± 1.00 | - | - |

<u>Pan Trap Collections: Diversity and Abundance</u>

A total of 337 individual native wasps and bees, from 48 taxa were collected in pan trap samples during the 2006 (N = 7, with 4 traps/sample) and 2007 (N = 4, with 4 traps/sample) (Fig. 9). A mean 8.92 ± 0.9 specimens/pan trap and 3.62 ± 0.25 taxa/pan trap was collected for the 2006 field season. During 2007, a mean of 5.75 ± 0.92

specimens/pan trap and 2.44 ± 0.21 taxa/pan trap was collected. Many of the taxa were only collected in one year (Table 12); this is not surprising given the small numbers of some taxa collected. The most common taxa collected were *Agapostemon* spp., *Halictus* spp., and *Lasioglossum* spp. among the bees and *Tachytes sayi* among the wasps.

Figure 9. Total number of Hymenoptera taxa and number of Hymenoptera collected by pan traps for the 2006 and 2007 field season at USDA, NRCS-Plant Materials Center, Bridger, MT.

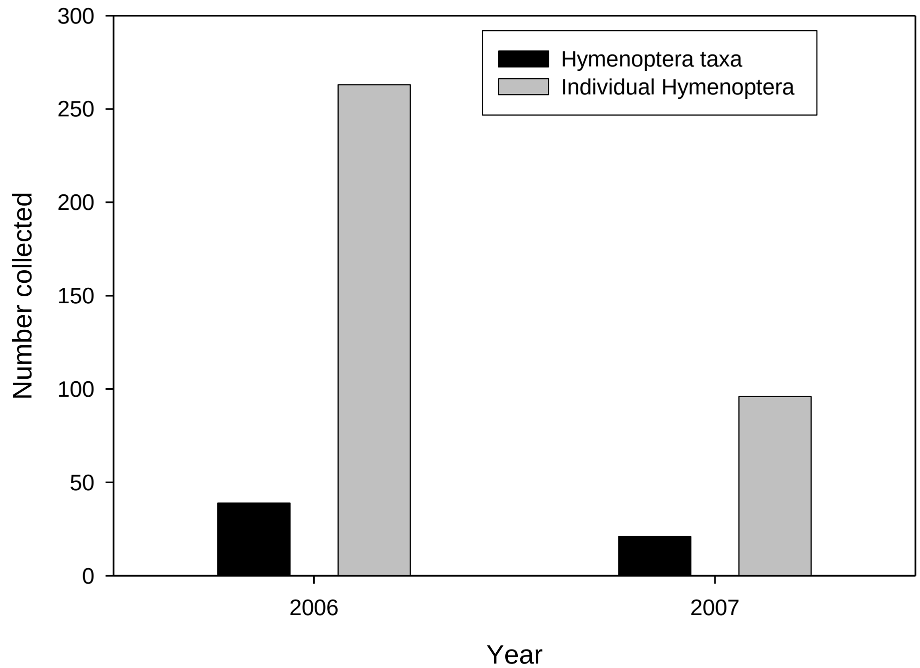


Table 12. Hymenoptera taxa collected in pan traps at BPMC for the 2006 and 2007 at USDA, NRCS-Plant Materials Center, Bridger, MT, with the total number of specimens collected for each taxa each year.

| Family | *Genus* | *Species* | 2006 | 2007 |
|---|---|---|---|---|
| **Wasp taxa** | | | | |
| Ichneumonidae | | | 6 | - |
| Braconidae | | | 1 | - |
| Bethylidae | | | 1 | - |
| Sphecidae | *Prionyx* | *canadensis* | 4 | 4 |
| Sphecidae | *Sphex* | *ichneumoneus* | 2 | - |
| Tiphiidae | | | 2 | - |
| Crabronidae | *Ectemnius* | | - | 1 |
| Crabronidae | *Glenostictia* | | 1 | - |
| Crabronidae | *Lindenius* | | 1 | - |
| Crabronidae | *Oxybelus* | | 8 | - |
| Crabronidae | *Stictiella* | | 1 | - |
| Crabronidae | *Tachytes* | *sayi* | 25 | 12 |
| Crabronidae | *Tachytes* | sp. 2 | 1 | - |
| Crabronidae | *Tachytes* | sp. 3 | 1 | - |
| Crabronidae | *Tachysphex* | | - | 3 |
| Pompilidae | | | 9 | 3 |
| Vespidae | | | - | 3 |
| **Bee taxa** | | | | |
| Andrenidae | *Andrena* | *pronorum. pronorum* | 2 | - |
| Andrenidae | *Calliopsis* | *andreniformis* | 4 | 1 |
| Andrenidae | *Calliopsis* | *coloradensis* | 6 | 1 |
| Andrenidae | *Perdita* | sp. 1 | 1 | 1 |
| Apidae | *Bombus* | *fervidus* | 1 | - |
| Apidae | *Bombus* | *rufocinctus* | 1 | - |
| Apidae | *Melissodes* | sp. 2 | - | 1 |
| Apidae | *Melissodes* | sp. 3 | 1 | 1 |
| Apidae | *Nomada* | sp. 11 | - | 1 |
| Apidae | *Nomada* | sp. 12 | 1 | - |
| Colletidae | *Colletes* | *phaceliae* | 2 | - |
| Colletidae | *Hylaeus* | *bisinuatus* | 1 | - |
| Colletidae | *Hylaeus* | *episcopalis* | 1 | - |

Table 12 Continued. Hymenoptera taxa collected in pan traps at BPMC for the 2006 and 2007 at USDA, NRCS-Plant Materials Center, Bridger, MT, with the total number of specimens collected for each taxa each year.

| Family | *Genus* | *Species* | 2006 | 2007 |
|---|---|---|---|---|
| **Bee taxa** | | | | |
| Colletidae | *Hylaeus* | sp. 2 | - | 1 |
| Halicitidae | *Agapostemon* | *angelicus/texanus* | 17 | 12 |
| Halicitidae | *Agapostemon* | *femoratus* | 5 | - |
| Halicitidae | *Agapostemon* | *texanus* | 1 | - |
| Halicitidae | *Agapostemon* | *virescens* | 1 | 3 |
| Halicitidae | *Halictus* | *ligatus* | 27 | 22 |
| Halicitidae | *Halictus* | *confusus* | 11 | 7 |
| Halicitidae | *Halictus* | *rubicundus* | 5 | 5 |
| Halicitidae | *Lasioglossum* | spp. | 90 | 14 |
| Halicitidae | *Sphecodes* | spp. | 3 | - |
| Megachilidae | *Osmia* | sp. | 4 | - |
| Megachilidae | *Hoplitis* | sp. 2 | 1 | - |
| Megachilidae | *Megachile* | *brevis* | 10 | - |
| Megachilidae | *Megachile* | *lippiae* | 2 | 1 |
| Megachilidae | *Megachile* | *rotundata* | 1 | 2 |
| Megachilidae | *Megachile* | *latimanus/perihirta* | 1 | - |
| Megachilidae | *Dianthidium* | *sayi* | 4 | - |
| Megachilidae | *Anthidium* | sp. 1 | - | 1 |

<u>Comparison of Pan Trap Biodiversity to Sweep Samples.</u> Comparing the taxa collected in the pan traps with all taxa collected using sweep samples, reveals several differences. Six taxa were collected using pan traps that were not collected in sweep nets (Table 13), whereas 25 taxa collected in sweep nets were not collected using pan traps (Table 13). Comparing the pan trap taxa collected with just the taxa collected exclusively on *D. candida*, reveals that there were still 15 taxa collected in sweep nets not collected using pan traps (Table 13).

Table 13. Unique Hymenoptera taxa collected from all of USDA, NRCS-Plant Materials Center, Bridger, MT and all unique Hymenoptera collected on D. candida not collected using pan traps. In comparison with the unique taxa collected using pan traps that were not collected using pan traps that were not collected using sweep nets.

| Hymenoptera collected using sweep samples not collected using pan traps (all plant species) | Hymenoptera collected on *D. candida* in sweep samples but not in pan traps | Hymenoptera collected in pan traps but not in sweep samples |
|---|---|---|
| *Schizocerella pilicornis* (Holmgren) | *Sphacophilus nigrceps* | *Anthidium* sp. 1 |
| *Sphacophilus nigrceps* | *Andrena* sp. 3 | *Dianthidium sayi* |
| *Andrena* sp. 2 | *Bombus centralis* | *Hoplitis* sp. 2 |
| *Andrena* sp. 3 | *Bombus griseocollis* | *Hylaeus episcopalis* |
| *Bombus centralis* | *Bombus huntii* | *Hylaeus* sp. 2 |
| *Bombus griseocollis* | *Bombus* sp. 1 | *Megachile latimanus/perihirta* |
| *Bombus huntii* | *Coelioxys masae* | |
| *Bombus occidentalis* | *Colletes fulgida* | |
| *Bombus* sp. 1 | *Colletes petalostemonis* | |
| *Coelioxys masae* | *Colletes* sp. 1 | |
| *Colletes fulgida* | *Heriades carinata* | |
| *Colletes petalostemonis* | *Hoplitis* sp. 1 | |
| *Colletes* sp. 1 | *Hylaeus* sp. 3 | |
| *Heriades carinata* | *Melissodes* sp. 1 | |
| *Hoplitis* sp. 1 | *Triepeolus* sp. 1 | |
| *Hylaeus* sp. 3 | | |
| *Hylaeus* sp. 4 | | |
| *Hylaeus* sp. | | |
| *Megachile inimical* | | |
| *Megachile parallela* | | |
| *Melissodes* sp. 1 | | |
| *Nomada* sp. 10 | | |
| *Triepeolus* sp. 1 | | |
| *Triepeolus* sp. 2 | | |

## Identification of Pollen Loads

### Quantity and Diversity

Eleven pollen types (as species or genera) were identified from the 506 individual Hymenoptera collected at BPMC, all during 2006. The quantity and diversity of the pollen collected from the bodies of the individual insects varied within insect genera, and was clearly, but not completely, related to plant species on which the insects were collected.

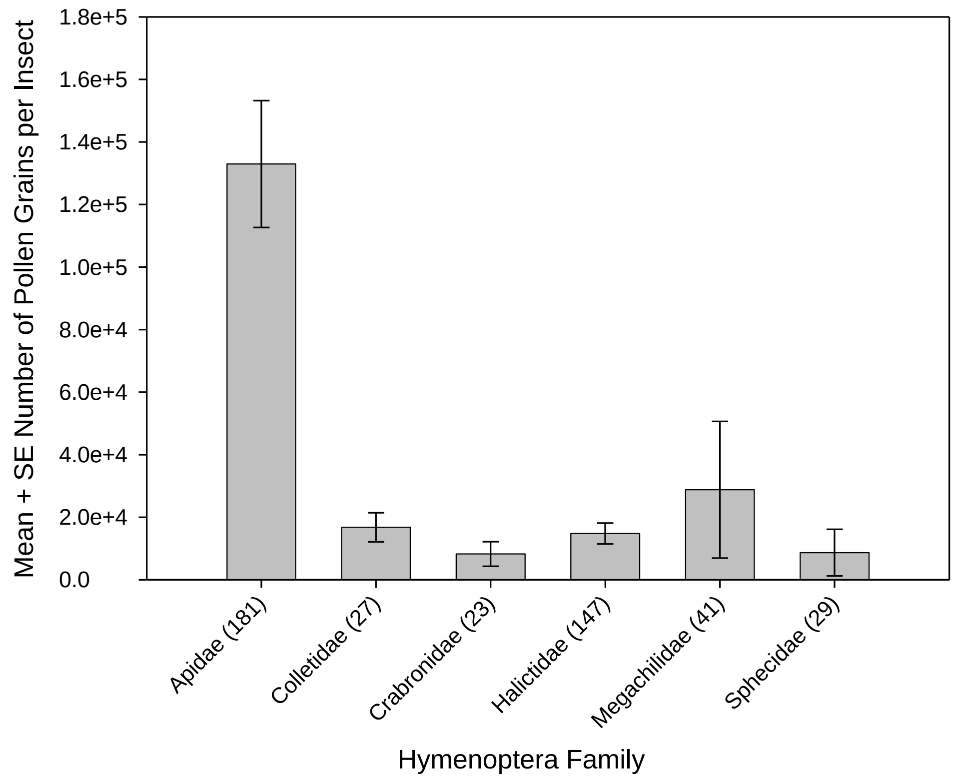
Pollen Quantity. The mean and maximum number of pollen grains found on the bodies of the individuals collected was variable among insect genera (Table 14). Overall, the estimated number of pollen grains per individual ranged from 25 for one *Halictus confusus* to 1,741,278 for one *Bombus griseocollis*. For certain bee genera there are large pollen grain quantities and for others there are smaller pollen grain quantities. This may be a function of bee body size, pollen grain size, or that all bees were captured while foraging (regardless of duration of foraging time).

Table 14. Maximum and minimum values of pollen grain quantities for select bee genera collected at USDA, NRCS-Plant Materials Center, Bridger, MT, with sample sizes greater than one.

| Family | Genus | N | Mean Pollen Grains ± SE | Minimum Values | Maximum Value |
|---|---|---|---|---|---|
| Apidae | *Bombus* | 104 | 236,316 ± 35,481 | 30 | 1,741,278 |
| Megachilidae | *Megachile* | 21 | 186,627 ± 71,749 | 293 | 1,448,325 |
| Apidae | *Melissodes* | 46 | 143,855 ± 32,713 | 110 | 983,250 |
| Apidae | *Apis* | 77 | 79,680 ± 15,405 | 55 | 773,500 |
| Andrenidae | *Andrena* | 2 | 85,607 ± 11,767 | 120 | 252,000 |
| Megachilidae | *Osmia* | 2 | 54,375 ± 24,660 | 19,500 | 89,250 |
| Halictidae | *Agapostemon* | 31 | 27,311 ± 8,257 | 28 | 202,033 |
| Halictidae | *Halictus* | 93 | 26,616 ± 5,641 | 25 | 353,250 |
| Colletidae | *Colletes* | 27 | 16,768 ± 4,656 | 83 | 67,500 |
| Megachilidae | *Coelioxys* | 4 | 8,503 ± 5,934 | 355 | 29,000 |
| Megachilidae | *Dianthidium* | 11 | 7,721 ± 4,644 | 71 | 54,954 |
| Halictidae | *Lasioglossum* | 23 | 3,874 ± 1,456 | 70 | 33,005 |

A Kruskal-Wallis ANOVA on ranks revealed that ($P = 0.001$) the number of pollen grains on individuals varied among genera. Analysis of quantity of pollen grains from six hymenopteran families revealed significant differences ($P = 0.001$) (Fig. 10).

Figure 10. Mean pollen grains ± SE found on six predominant hymenopteran families collected from NRCS-Plant Materials Center, Bridger, MT during 2006 & 2007.




Pollen Load Analysis

Proportion of Bees Carrying Pure- Versus Mixed-Pollen Loads (PBP). The proportion of bees carrying pure- versus mixed-pollen loads (PBP) varied with the plant species on which they were collected (Table 15). Insects collected on *D. candida* had a PBP of 0.73 meaning 73% of the bees collected on *D. candida* carried pure pollen loads, defined as a minimum value of 97% of one pollen type. That value was exceeded by the 84% for insects on *Ast. cicer*, another cultivated species. In general, PBP was higher for insect collected on cultivated plants rather than weed species.

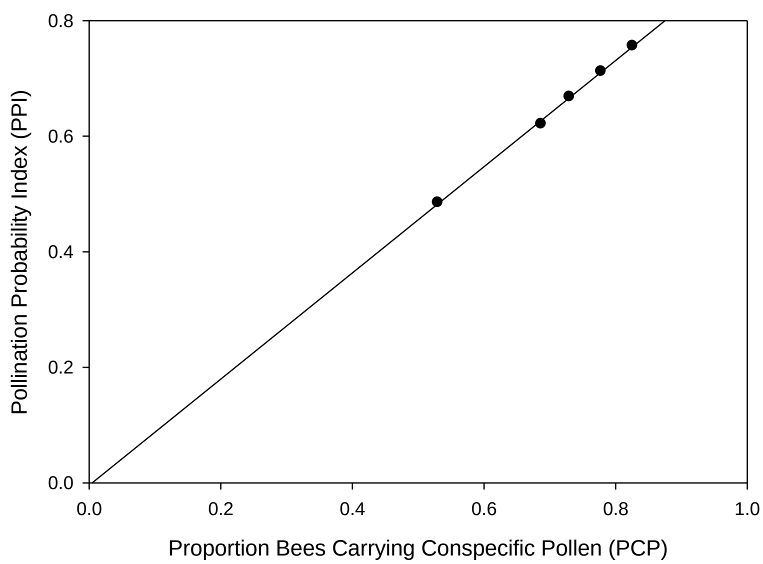
<u>Proportion of Bees Carrying Conspecific Pollen (PCP).</u> The mean proportion of *D. candida* pollen collected on the specimens (PCP) was 0.915, meaning an average 91.5% of the pollen collected from the specimen came from *D. candida* (Table 15). Looking specifically at the PCP, there were high values (≥0.70) for *D. candida*, *R. columnifera, S. chilensis, Ach. millfolium, Ast. cicer, Symphoricarpos* sp., and *Con. arvensis* (Table 15). There are large discrepancies between PBP and PCP, with PCP having seven plant species with high pollen purity (≥0.70) versus PBP with only three; this is why it is important to examine both measures. Looking at both measures, it can be estimated that *D. candida, Ast. cicer,* and *R. columnifera*'*s* hymenopteran visitors have a high floral constancy.

Table 15. The proportion of bees carrying pure vs. mixed pollen loads in relation to what flower it was collected on (PBP) and the mean proportion of conspecific pollen on a bee in relation to what flower it was collected on (PCP) at USDA, NRCS-Plant Materials Center, Bridger, MT.

| Plant Species | N | PBP | PCP |
|---|---|---|---|
| **Cultivated species** | | | |
| *Ach. millefolium* | 12 | 0.42 | 0.87 |
| *Ast. cicer* | 25 | 0.84 | 0.82 |
| *D. candida* | 230 | 0.73 | 0.92 |
| *R. columnifera* | 73 | 0.70 | 0.91 |
| *S. chilensis* | 45 | 0.56 | 0.92 |
| *Symphoricarpos* sp. | 3 | 0.40 | 0.95 |
| **Weed species** | | | |
| *Cir. arvense* | 14 | 0.00 | 0.12 |
| *Con. arvensis* | 66 | 0.46 | 0.74 |
| *L. corniculatus* | 10 | 0.10 | 0.48 |
| *M. alba/officinalis* | 3 | 0.33 | 0.33 |
| *Sonchus* sp. | 25 | 0.28 | 0.69 |

<u>Pollination Probability Index (PPI).</u> The PPI (as PBP x PCP) has been proposed as an index for estimating the probability of how efficient a pollinator will be (Ne'eman et al., 1999). Using my data, I found that there was almost a one to one ratio between the PPI and PBP for *D. candida* (Fig. 11). Because of this, PPI does not seem to have an advantage over PBP, so is not discussed further here

Figure 11. Probability of pollination index (PPI) vs. proportion of consepecific pollen collected from specimens on that flower (PCP) showing close to a one to one ratio for D. candida found at USDA, NRCS-Plant Materials Center, Bridger, MT.




<u>Pollen Diversity.</u> Mean Hill's index of each of the 11 plant species collected, reveal low diversity, with *Ast. cicer* having the lowest diversity and *L. corniculatus* having the highest pollen species diversity (Fig. 12). Despite the high number of collections on *D. candida, R. columnifera, S. chilensis and C. arvensis,* the diversity and species richness is relatively low compared to other plant species collected. Pollen species richness is also relatively low, with the mean number of pollen species per sample ranging from 1-3 out of the 11 possible plant species.

I also compared pollen records for select bee genera collected from different plants (Table 16). *Agapostemon* collected on *D. candida* displayed the highest values for both diversity and richness (Figure 11 and Table 16). Six of the *Agapostemon* collected with *D. candida* pollen also carried *Con. convolvulus* pollen while five also carried *Cirs. arvense* pollen. Among the remaining species there was little variation in diversity. *Lasioglossum* spp. in this data set had among the lowest pollen species richness (Table 16), perhaps because these small bees have a lower flight range, so are unlikely to have visited many plant species when collected in a *D. candida* monoculture. *Apis* and *Bombus* species had the highest collection rate, their diversity and species richness did not vary greatly between the two genera, possibly because of the similar pollen collection methods.

Figure 12. Overall mean Hill's Index ± SE and mean pollen species richness ± SE for nine plant species at USDA, NRCS-Plant Materials Center, Bridger, MT, on which I collected and analyzed one or more individuals; sample sizes appear in parentheses after the plant species name.

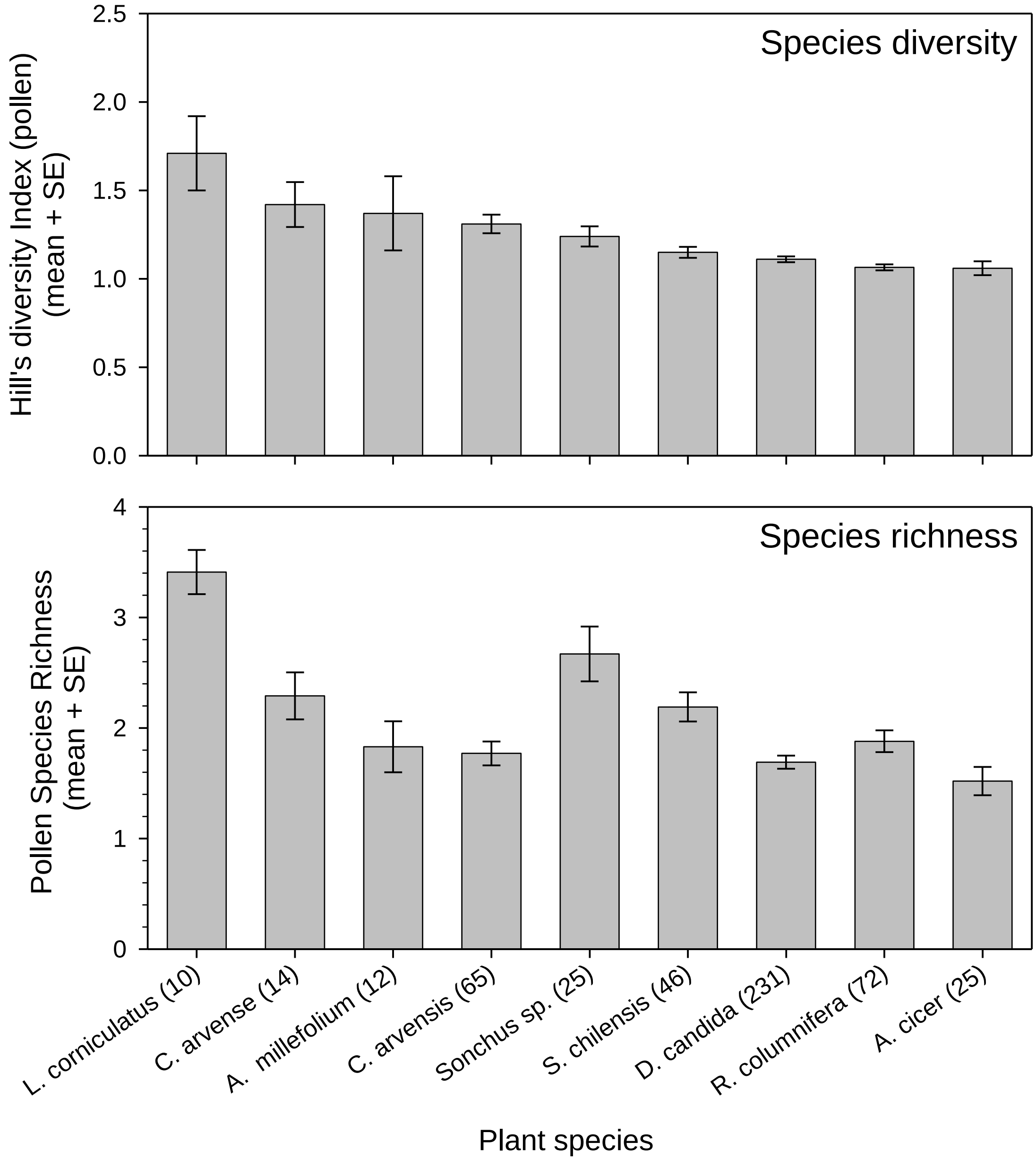
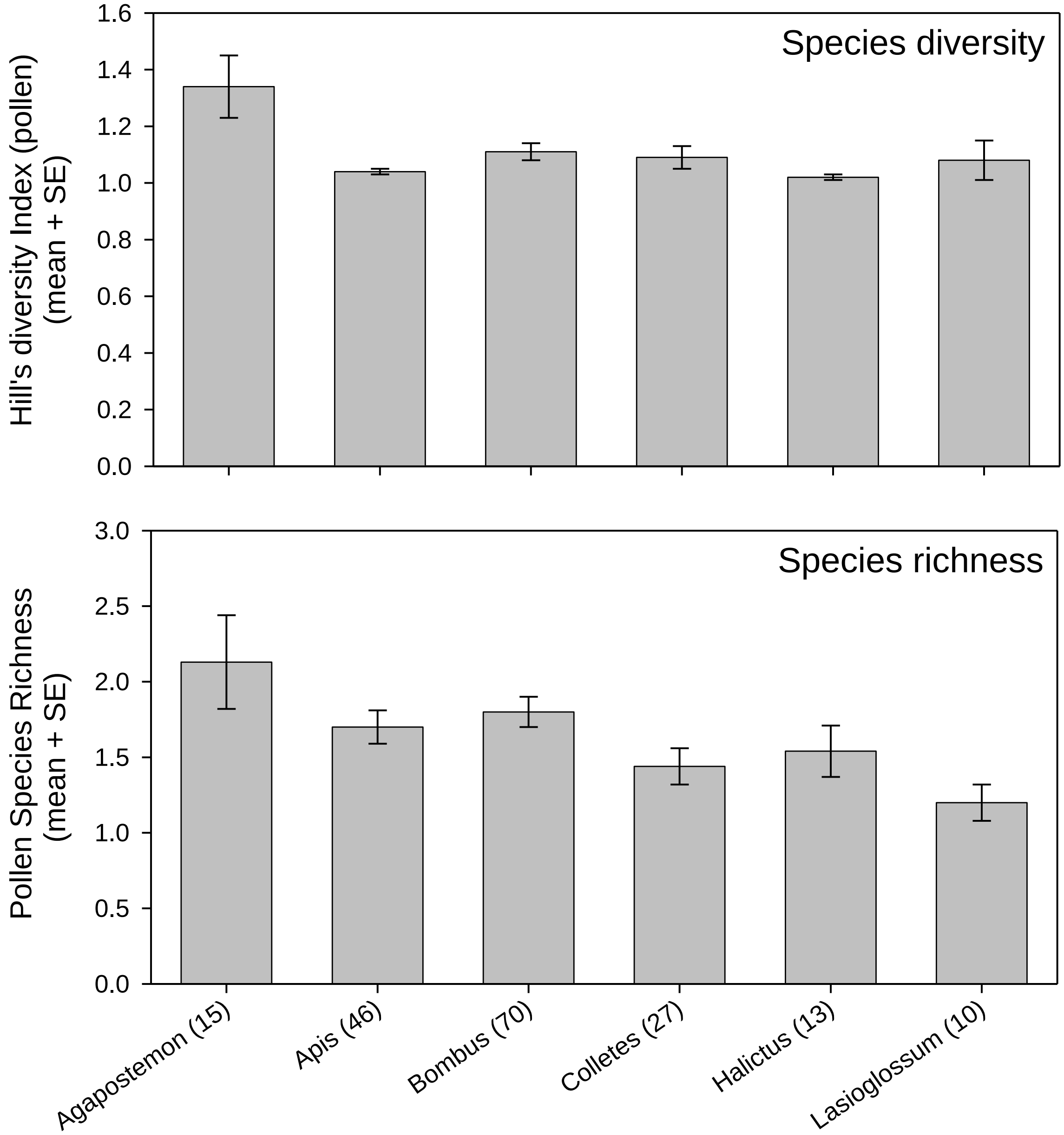


Table 16. Hills Index ± SE and mean pollen species richness ± SE for select bee genera on different plant species found at USDA, NRCS-Plant Materials Center, Bridger, MT.

| Hymenoptera Genus | Plant Species | n | Mean Hills Index ± SE | Mean Pollen Species Richness ± SE |
|---|---|---|---|---|
| *Agapostemon* | *Cir. arvense* | 6 | 1.72 ± 0.21 | 2.67 ± 0.19 |
| | *Con. arvensis* | 6 | 1.55 ± 0.16 | 1.70 ± 0.26 |
| | *D. candida* | 15 | 1.34 ± 0.11 | 2.13 ± 0.31 |
| *Apis* | *D. candida* | 46 | 1.04 ± 0.01 | 1.70 ± 0.11 |
| | *Sonchus sp.* | 19 | 1.19 ± 0.05 | 2.84 ± 0.29 |
| *Bombus* | *Ast. cicer* | 22 | 1.04 ± 0.04 | 1.48 ± 0.14 |
| | *D. candida* | 70 | 1.11 ± 0.03 | 1.80 ± 0.12 |
| *Colletes* | *D. candida* | 27 | 1.09 ± 0.04 | 1.44 ± 0.12 |
| *Halictus* | *Con. arvensis* | 42 | 1.24 ± 0.06 | 1.62 ± 0.13 |
| | *D. candida* | 13 | 1.02 ± 0.01 | 1.54 ± 0.17 |
| | *R. columnifera* | 15 | 1.02 ± 0.01 | 1.67 ± 0.20 |
| | *S. chilensis* | 15 | 1.10 ± 0.05 | 1.87 ± 0.25 |
| *Lasioglossum* | *Con. arvensis* | 7 | 1.12 ± 0.12 | 1.29 ± 0.17 |
| | *D. candida* | 10 | 1.08 ± 0.07 | 1.20 ± 0.12 |
| *Megachile* | *L. corniculatus* | 7 | 1.84 ± 0.27 | 3.14 ± 0.24 |
| | *R. columnifera* | 10 | 1.10 ± 0.05 | 2.00 ± 0.20 |
| *Melissodes* | *R. columnifera* | 19 | 1.04 ± 0.02 | 1.89 ± 0.21 |
| | *S. chilensis* | 26 | 1.18 ± 0.04 | 2.27 ± 0.15 |

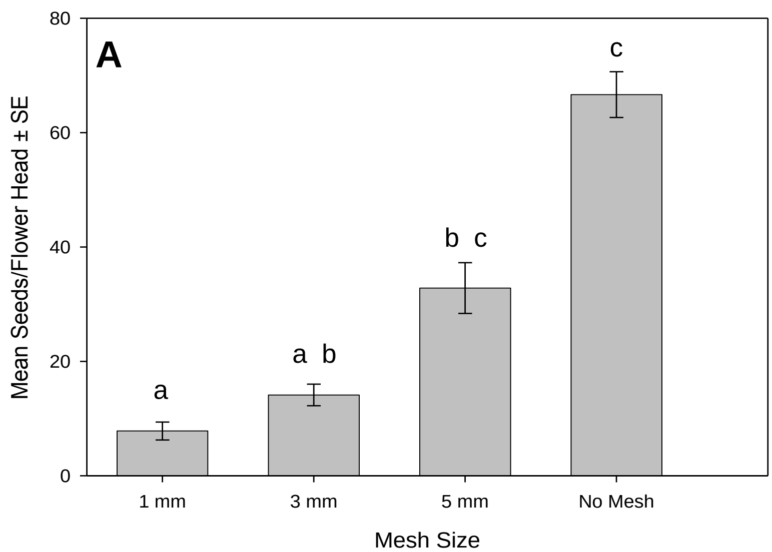
Figure 13. Comparison of pollen species diversity and species richness of bees collected on D. candida at USDA, NRCS-Plant Materials Center, Bridger, MT.

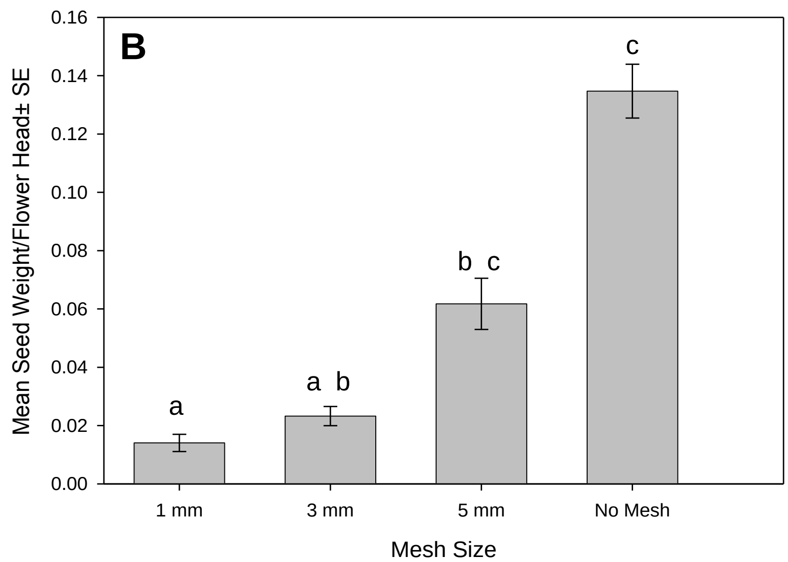


Exclusion Cage Experiments

The control (no=mesh) treatment had both a higher number of seeds per flower head (Figure 14a) and a total seed weight per flower head (Figure 14b) than either the 1-mm or 3-mm mesh size treatments. There were no significant differences between the 5-mm mesh treatment and the no-mesh treatment or between 5-mm and 3-mm mesh sizes.

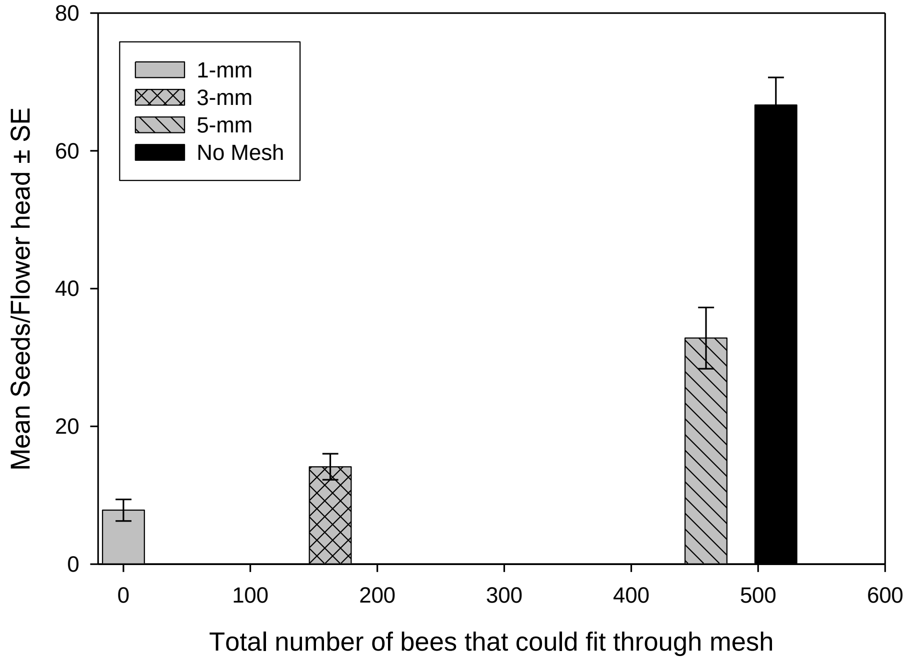
Figure 14. (A) Mean numbers of seeds per flower head in relation to mesh size. (B) mean weight of seeds per flower head in relation to mesh size. For D.candida at USDA, NRCS-Plant Materials Center, Bridger, MT. Different letters designate significant differences at $P < 0.05$ (Kruskal-Wallis Test).






Comparison of the number of seeds/flower head at each mesh size in relation to the number of pollinators capable of reaching the flower head at each mesh size, support the notion that as the number of pollinators increase, the number of seeds/flower head also increase (Fig. 15).

Figure 15. Number of seeds/flower head in relation to the number of pollinators each mesh size could allow in measured at largest width of the insect body for all bees collected at USDA, NRCS-Plant Materials Center, Bridger, MT. Each point represents a mesh size (1-mm, 3-mm, 5-mm and No-Mesh).




## Sampling the Cavity-Nesting Bee and Wasp Community

A total of 1,793 individual insects of the orders Hymenoptera (N = 1,757), Coleoptera (N = 24), and Diptera (N = 12) emerged from 484 capped trap nest tubes collected at BPMC during the 2006 field season (Appendix C). Emergence of insects from trap nests began in mid-April (after the nests had been removed from cold storage on 25 April 2007) and continued through early July; peak emergence occurred in early June.

The vast majority of emerged insects belonged to the family Megachilidae. Within the Megachilidae, *Megachile rotundata*, was the most abundant (N = 1,414).

Other megachilids included *Heriades carinata*, *Ashmeadiella cactorum, Ashmeadiella gillettei, and Ashmeadiella bucconis* (Fig. 16).

No bees or wasps occurred in numbers comparable to Megachilidae (Table 17). The only others bees were *Hyleaus stevensi* (N = 17), *Ashmeadiella bucconis* (N = 3), *Ashmeadiella cactorum* (N = 15), *Ashmeadiella gilletei* (N = 21), and *Heriades carinata* (N = 65). Only 98 Crabronidae, the next most abundant taxon, emerged from nests; approximately half of the crabronid wasps belonged to the genus *Trypoxylon* (N = 48), followed by *Solierella* sp. (N = 24), *Psenulus pallipes patenosus* (N = 15), and *Passaloecus melanocrus* (N = 11) (Fig. 17). Another 81 wasps, all *Isodontia mexicana* (Sphecidae) also emerged. Very few Vespidae (subfamily Eumeninae) emerged (N = 11).

All other insects that emerged from nests were brood parasites or scavengers of the bees and apoid wasps (Dermestidae = 24, Tachinidae = 12, Chrysididae = 8, and Sapygidae = 24).

Figure 16. Total number of Megachilidae emerged organized by species for USDA, NRCS-Plant Materials Center, Bridger, MT.

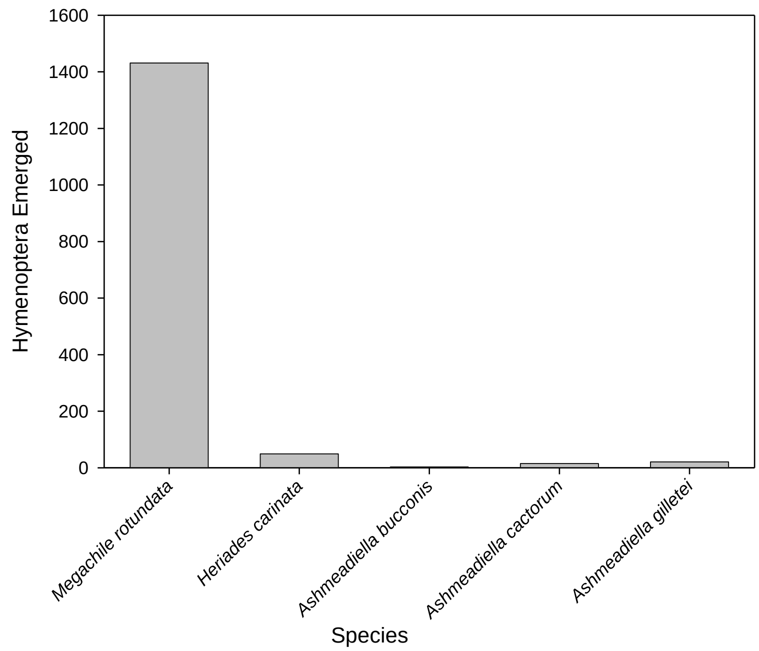



Figure 17. Total number of Crabronidae emerged organized by genus for USDA, NRCS-Plant Materials Center, Bridger, MT.

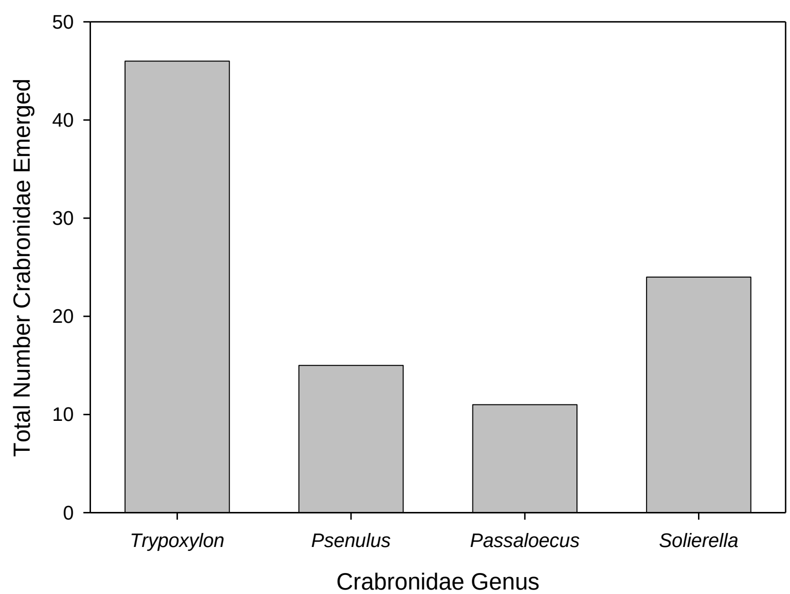


Table 17. Numbers of individuals of each family emerged from trap nests located at USDA, NRCS-Plant Materials Center, Bridger, MT.

| | Trap nest site | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Insect taxa | B1 | B2 | B3 | B4 | B5 | B6 | B7 | B8 |
| **Coleoptera** | | | | | | | | |
| Dermestidae | 7 | 1 | 3 | 4 | 2 | 4 | - | 3 |
| **Diptera** | | | | | | | | |
| Tachinidae | 2 | - | - | 1 | 7 | 2 | - | - |
| **Hymenoptera** | | | | | | | | |
| Chrysididae | 1 | - | - | - | 1 | 4 | 1 | 1 |
| Sapygidae | 8 | 5 | - | 11 | - | - | - | - |
| Vespidae | - | - | - | - | 11 | - | - | - |
| Sphecidae | 8 | 8 | 7 | 43 | 2 | - | - | 13 |
| Crabronidae | 4 | 17 | - | 25 | 2 | 15 | 18 | 17 |
| Colletidae | 14 | - | - | - | - | - | 2 | 1 |
| Megachilidae | 187 | 77 | 286 | 196 | 173 | 228 | 126 | 254 |

Comparison of Trap Nest Emergences with
Hymenoptera Collected in Sweep Nets and Pan Traps

The only Hymenoptera that emerged from trap nests that were also collected in sweep nets and pan traps included *Megachile rotundata* and *Heriades carinata*. The large numbers of *Megachile rotundata* collected are probably attributable to the fact that there was, at one time in the recent past, a alfalfa seed production farm in the vicinity that used managed populations of this non-native species to enhance pollination.

Trap Nest Tube Sizes

Trap nest emergences occurred from all trap nest tube sizes (3-mm, 4-mm, 5-mm, 6- mm, 7-mm, 8-mm, and 9-mm diameters). Among the megachilids, *M. rotundata* emerged from all trap nest tube sizes, while *Ashmeadiella* and *Heriades* emerged only from 3-mm tubes. *Isodontia mexicana* emerged from tube sizes 4-mm, 6-mm, 7-mm, and

9-mm, with the majority of those emerging from 9-mm, as is typical for this species in Montana (Neill and Neill, 2003). All crabronids emerged from 3-mm sized tubes. The few vespids that were collected emerged from 6 mm diameter tubes. There was no trap nest tube size that was not utilized by Hymenoptera, but the vast majority of emerged individuals came from 3-mm, 4-mm, 5-mm and 6-mm tube sizes (Table 18).

Table 18. Trap nest size used by most common cavity-nesting Hymenoptera at USDA, NRCS-Plant Materials Center, Bridger, MT.

| Nest | *Isodontia mexicana* | *Passaloecus melanocrus* | *Solierella* spp. | *Hylaeus stevensi* | *Ashmediella* spp. | *Heriades carinata* | *Megachile rotundata* | *Sapyga pumila* | *Trypoxylon* spp. |
|---|---|---|---|---|---|---|---|---|---|
| 3-mm | - | 11 | 24 | 17 | 39 | 65 | 428 | 24 | 48 |
| 4-mm | 4 | - | - | - | - | - | 494 | - | - |
| 5-mm | - | - | - | - | - | - | 164 | - | - |
| 6-mm | 2 | - | - | - | - | - | 181 | - | - |
| 7-mm | 1 | - | - | - | - | - | 86 | - | - |
| 8-mm | - | - | - | - | - | - | 35 | - | - |
| 9-mm | 74 | - | - | - | - | - | 26 | - | - |

<u>Sex Ratios</u>

All six species for which at least 20 individuals emerged from nests had biased sex ratios (Table 19). All but *M. rotundata* had female-biased sex ratios. Because of the large number of individuals emerged, it was also possible to look at the sex ratio for *M. rotundata* in relation to tube size (Table 20). Significant male-biased sex ratios were observed only in the 3-mm diameter nests, whereas female-biased ratios occurred only in 8-mm nests. Overall, 3-6 mm nests produced significantly greater numbers of males (i.e., 20% more males), whereas 7-9 mm nests produced an excess of females (i.e., 72% more females).

Table 19. Male to female sex ratios for Hymenoptera taxa collected by trap nests located at USDA, NRCS-Plant Materials Center, Bridger, MT. Chi-square values (tested only for species where N > 20) are from Chi-square goodness-of-fit test (with observed ratio tested against null hypothesis of a 1:1 sex ratio; the chi-square value is corrected for continuity and the degrees of freedom for each test = 1).

| Family | Species | Male | Female | ♂/♀ Ratio | Chi-square | Prob. |
|---|---|---|---|---|---|---|
| Sphecidae | *Isodontia mexicana* | 32 | 49 | 0.65 | 7.72 | 0.008 |
| Crabronidae | *Passaloecus melanocrus* | 4 | 7 | 0.57 | - | - |
| | *Psenulus pallipes* | 9 | 6 | 1.50 | - | - |
| | *Solierella* spp. | 3 | 21 | 0.14 | 12.04 | < 0.001 |
| | *Trypoxlyon* spp. | 1 | 47 | 0.02 | 42.18 | < 0.001 |
| Colletidae | *Hylaeus stevensi* | 8 | 9 | 0.89 | - | - |
| Megachilidae | *Ashmeadiella bucconis* | 1 | 2 | 0.50 | - | - |
| | *Ashmeadiella cactorum* | 9 | 6 | 1.50 | - | - |
| | *Ashmeadiella gilletei* | 4 | 17 | 0.24 | 6.86 | 0.009 |
| | *Heriades carinata* | 24 | 41 | 0.59 | 3.94 | 0.047 |
| | *Megachile rotundata* | 726 | 669 | 1.08 | 4.20 | 0.040 |

Table 20. Male to female sex ratio for M. rotundata in relation to nest diameter Chi-square values are from Chi-square goodness-of-fit test (with observed ratio tested against null hypothesis of a 1:1 sex ratio; the chi-square value is corrected for continuity and the degrees of freedom for each test = 1). USDA, NRCS-Plant Materials Center, Bridger, MT.

| Nest Diameter | # Females | # Males | Total Offspring | Sex Ratio | Chi-square | Prob. |
|---|---|---|---|---|---|---|
| 3-mm | 170 | 256 | 435 | 0.39 | 23.84 | < 0.001 |
| 4-mm | 234 | 232 | 466 | 0.50 | 0 | 1.00 |
| 5-mm | 89 | 81 | 170 | 0.52 | 0.5 | 0.48 |
| 6-mm | 86 | 99 | 185 | 0.47 | 3.18 | 0.07 |
| 7-mm | 47 | 32 | 79 | 0.60 | 1.96 | 0.16 |
| 8-mm | 26 | 9 | 35 | 0.73 | 7.32 | 0.007 |
| 9-mm | 17 | 8 | 25 | 0.68 | 1.88 | 0.17 |
| 3-6 mm | 579 | 668 | 1256 | 0.46 | 10.62 | 0.001 |
| 7-9 mm | 90 | 49 | 139 | 0.65 | 9.82 | 0.002 |

# DISCUSSION

## Sampling the Flower-visiting Insect Assemblages

A total of 102 Hymenoptera taxa, comprising 2,679 specimens were collected from USDA, NRCS-Plant Materials Center, Bridger, MT (hereafter referred to as BPMC) using sweep nets, pan traps, individual collections, and trap nests. In 2006, sweep net samples revealed *Symphoricarpos* sp. and *D. candida* had the highest species richness per 50 sweeps, whereas *Camelina* sp., *R. columnifera,* and *S. chilensis* had the lowest. During 2007, when only four plant species were sampled, *D. candida* had the highest species richness, whereas *R. columnifera* and *S. chilensis* had the lowest. Overall, 34 bee and wasp species were recorded on *D. candida*, whereas three were collected on *Camelina* sp., 12 on *S. chilensis*, and 25 on *R. columnifera*.

In both 2006 and 2007, *D. candida* also had the highest diversity of flower visitors; the lowest values for diversity were for *S. chilensis* in 2006 and the *Con. arvensis* in 2007. Collections on *S. chilensis* were dominated by just three species, *Halictus ligatus* and two species of *Melissodes*. Those on *Con. arvensis* consisted primarily of *Lasioglossum* spp. and an unidentified species of Tiphiidae.

Some of the differences in total species richness and diversity of flower visitors were undoubtedly due to differences in sampling intensity. Although this study did not address the mechanisms driving patterns of flower visitor distribution, differences in species richness and diversity among plant species could potentially be due to such factors as 1) the quality and density of flower pollen and nectar resources, 2) flower morphology and its effect on the accessibility of nectar and pollen, 3) local competition among plant species for pollinators, and 4) proximity of nesting sites to different fields. *Dalea candida* was cultivated at BPMC in very high densities and each plant contained dozens of inflorescences and hundreds of individual flowers at the peak of bloom. The flowers themselves are shallow, and provide easy access to nectar even for small, short-tongued species of flower visitors.

Several factors may limit the density and diversity of native pollinators at BPMC. First, because BPMC keeps several commercial honey bee hives for pollination of flowering crops, the honey bees might outcompete native pollinators and keep their numbers low. Honey bees tend to occur in high densities and, because of their communication system, they can rapidly exploit flower resources as they become available. In contrast to this, females of solitary bees and bumble bees forage individually without sharing information on the location of resources. Several studies have implicated honey bees (along with intensive agricultural practices) as causes for declines in bumble bee densities (Goulson et al. 2002, Goulson and Sparrow 2008, Thompson 2004).

A second reason may be that the disturbance of the habitat in an agricultural setting reduces the quality of nesting habitat of native, ground nesting pollinators. Even enhancement of nesting habitat for the cavity-nesters through the use of trap nests in 2006 seemed to have no effect on the density of bees visiting the plant species that I sampled. Females of the *Ashmeadiella* spp., *Heriades carinata*, and *Megachile rotundata* were rare in collections from flowers despite the fact that trap nests were being used by these species adjacent to our flower-sampling sites.

Pesticide use can also account for reductions in bee communities and their value as pollinators (Committee on the Status of Pollinators in North American, 2007). Kremen et al. (2002) documented lower levels of pollination due to native bees in habitats with higher levels of “agricultural intensification” due to reductions in nesting habitat and greater use of pesticides. They found that on “organic farms near natural habitat…that native bee communities could provide full pollination services even for a crop with heavy pollination requirements.” However, information on the effect of agricultural practices on native bees is relatively scarce compared to equivalent data for honey bees (Committee on the Status of Pollinators in North American, 2007).

I observed a significant relationship between flower abundance and the number of Hymenoptera taxa collected. This makes sense because different Hymenoptera taxa will emerge at different times throughout the summer due to developmental differences inherent in each taxa as well as environmental factors. As the field season progresses more taxa will emerge and be available to forage on *D. candida*.

The composition of the Hymenoptera community collected on different flowering species varied. The community composition was only examined for flowering plants with the most intensive collections (six total), since these would be more accurate. Eighteen taxa commonly occurred on *Dalea candida*, with *Lasioglossum* spp., *Colletes phaceliae* and *Colletes petalostomonis* being the most abundant. For *R. columnifera* there were 15 commonly occurring taxa, with *Melissodes* sp. 3, *Lasioglossum* spp., and

*Halictus ligatus* being most common. *Achillae millefolium* had eight frequently collected taxa, with *Lasioglossum* spp., *Halictus ligatus*, and *Agapostemon femoratus* being the most numerous. On *S. chilensis*, eight taxa were collected commonly, with *Halictus ligatus*, *Melissodes* sp. 1, and *Melissodes* sp. 3 being the most abundant. For the last plant, *O. viciifolia*, there were five taxa commonly collected with *Lasioglossum* spp., *Bombus huntii*, and *Bombus griseocolis* the most numerous collections. In all these collections, *Lasioglossum* spp. was one of the more abundant taxa collected on all plants.

Differences in taxa collected among the plant species occurred despite the fact that many of the cultivated flowering plants are found within foraging distance of each other, and some plots were even adjacent to each other. Thus, distances between nesting sites and foraging sites are not a sufficient explanation for differences in flower-visiting insect assemblages on different plant species. Regular collection of honey bees occurred only on *D. candida*, even though fields of other plant species were closer to the apiary. Cultivated plots of *A. millefolium*, *Symphoricarpos* sp., and *S. chilensis* were situated between the lower *D. candida* field and the apiary, and a large field of *R. columnifera* intervened between the apiary and the upper *D. candida* plot. Thus, *D. candida* may be preferred as pollen and nectar sources over alternative cultivated species at BPMC. As a consequence, those other species may be important resources for native pollinators where competition with honey bees may be lower.

In many agricultural settings, the use of non-native honey bees is often the standard in pollinating crops. With the alarming declines in honey bee populations that have been occurring since the 1940's (Committee on the Status of Pollinators in North

America, 2007) and the onslaught of Colony Collapse Disorder (Stokstad, 2007), scientists have started looking at native pollinators. There is an alarming lack of information on native pollinators in most areas (Committee on the Status of Pollinators in North America, 2007). The importance of understanding the diversity, abundance, and requirements of native pollinators is now being realized.

The high diversity and species richness of BPMC was unexpected because the area in which BPMC is located, primarily cropped cropped with anemophilus monoculture crop plants. While, BPMC itself has a diversity of crops, few are flowering plants that require pollination services. Due to the fragmentation of the habitat from farming and the monoculture of crop plants, it was hypothesized that the diversity of Hymenoptera taxa would be low (Kearns et al., 1998). Documentation of the flowering plants found at BPMC revealed, in addition to a few cultivated flowering plants, a relatively large number of non-cultivated flowering plants. Some studies have shown that mass-flowering crops like those found at BPMC (Westphal et al., 2003) and monoculture areas with adjacent natural habitats or weedy areas have higher diversity of pollinators than fragmented monoculture farm land (Kim et al., 2006). It has been hypothesized that these small natural habitats or weedy areas serve as an alternative food source when mass-flowering crops or other sources of food are not available (Kim et al., 2006). The mass-flowering crops along with the large number of non-cultivated flowering plants found at BPMC could be the reason the diversity was much higher than anticipated.

In bumble bees, higher diversity of species is associated with mass-flowering plants because they are a larger concentrated reward than semi-natural habitats and do not require long foraging trips (Westphal et al., 2006). For slender white prairieclover, diversity of taxa was also relatively high. Comparisons between taxa I collected and those collected in previous samplings reveal large differences (USDA-NRCS, 2000). Only 18 taxa were collected in 1965 compared with a total of 46 between the 2006-2007 field seasons. There are some similarities between the collections, with 10 of the previous collected taxa coinciding with my collections (USDA-NRCS, 2000). Differences between these two collections could be attributed to establishment period, collection methods and intensity of collections.

## Comparison of Sampling Methods

In samples from *D. candida*, sweep nets and pan traps collected a different assemblage of bee species. During the two summers, 32 bee taxa were collected in sweep samples, but only 14 in pan traps. Fourteen taxa were collected using sweep nets that were not found in pan traps, but one species (*Agapostemon virescens*) was collected only in pan traps. Among the more abundant taxa, the two methods each detected the presence of *Lasioglossum* spp., *Halictus ligatus*, *Halictus rubicundus*, and *Agapostemon angelicus/texanus*. However, *Colletes phaceliae*, while abundant in sweep samples was rare in pan traps. And, although *Bombus huntii* and *Bombus griseocollis* were the third and fourth most common species (other than honey bees) in sweep samples, they never appeared in pan traps. In fact, *Bombus* spp. comprised 16.9% of sweep net samples, but only 0.4% of pan trap samples. The only two species for which pan traps were a superior method of collection were *Halictus confusus* and *Megachile brevis*. Overall, a combination of both methods is needed to assess the biodiversity of bees at BPMC, a conclusion also reached by Roulston et al. (2007) in their study of bees collected on an experimental farm in Virginia.

## Assessment of Pollen Loads

Quantities of pollen varied widely on insect bodies, with the family Apidae having the highest mean number of pollen grains and Crabronidae the lowest. Within bee families, *Bombus* and *Megachile* had the highest mean pollen grains and *Dianthidium* and *Lasiglossum* spp. had the lowest. Variation in the amount of pollen collected on the specimens, even those of the same species and body size, is expected because all specimens were collected in the field rather than at the end of a foraging trip. Thus, there was no way to determine how long each individual had been in the field. Nevertheless, the methods used provide a way to estimates the pollen load diversity and the pollen load sizes near the upper limits for commonly-collected species.

Most of the insects collected for pollen analysis seem to have been foraging within the confines of the BPMC. Although most crops in the surrounding area were not insect pollinated plants (e.g. wheat), an alfalfa field was located within foraging distance of BPMC (0.6 km to the north of the upper *D. candida* plot). Despite the close proximity of the alfalfa and the low number of flowering plants at BPMC, there was no alfalfa pollen found on the specimens collected. This suggests that the cultivated and uncultivated plants found at BPMC were sufficient to keep pollinators within the area. Analysis of the pollen loads revealed that at a 95% purity level the PBP, or proportion of "pure" vs. mixed loads, is relatively low, with only *D. candida* and *Ast. cicer* having PBP's ≥70%. The second analysis measure of pollen loads examined the mean proportion of pollen from the flower on which the insect was collected (PCP). *Dalea candida, R. columnifera, S. chilensis, Ach. millefolium, Ast. cicer, Symphoricarpos* sp., and *Con. arvensis* all had values ≥70%, and often much higher. Because of some inconsistency between the two measures, using both measures is important so as not to over or underestimate floral constancy. Based on these two measures, *D. candida, Ast. cicer*, and *R. columnifera* had insects with high floral constancy and low pollen diversity (i.e., insects collected on those plants tended to have pure pollen loads consisting of pollen from the plants on which they were collected). Insects collected on *Melilotus* spp., *Sonchus* sp., and *Cir. arvense*, however, tended to have mixed pollen loads of high diversity. That diversity likely reflects the fact that insects collected on those sparsely distributed plants had been moving frequently among plant species.

Pollen plays a critical role in brood rearing of all bees. In the case of social bees like *Apis mellifera*, adults use pollen to feed brood as well as young adults (Baum, 2004). In solitary bees such as *Megachile rotundata*, pollen and nectar are used to provision cells in which larvae will develop (Krombein, 1967). It is the pollen-foraging habit that has made bees such valuable pollinators in natural and agricultural environments. However, their effectiveness as pollinators depends, at least partly, on their tendency to revisit the same species of plant during foraging trips (flower constancy). Adult foraging behavior of most bees can be described either as oligolectic, which is defined as a pollen specialist collecting pollen belonging to the same family, subfamily or tribe and polylectic, as a pollen generalist (Robertson, 1925); monolectic bees, those that take pollen from a single species are extremely rare. While honey bees tend to be polylectic, each bee on single foraging trip away from the colony tends to have high flower constancy (Free, 1963).

Flower constancy is an important factor to measure when attempting to understand the pollination ecology of a target angiosperm. Some studies focus on visitation rates to determine pollinator efficacy and then examine seed set of the plant, but these studies usually do not actually analyze the pollen carried by these pollinators and are thus are not always good indicators of pollinator effectiveness or flower constancy (Javorek et al., 2002; Thomas and Goodell, 2001). Bumble bees are considered to have an intermediate level of constancy with PBP values ranging form 31% to 51%, although the percentage of foreign pollen found in pollen loads is low (Thomas, 1981).

Analyses of the pollen loads collected at BPMC revealed low diversity of pollen species and PBP values but high PCP values. Traditionally papers analyze either PBP values or PCP values (Ne'eman et al., 1999), but the discrepancy between the values obtained from my specimens shows that both values should be used. The combination of these measures supports the notion that some insects collected at BPMC exhibit floral constancy on some plants. Muller (1996) used PCP values to define whether anthidiine bees were oligolectic or polylectic; based on his criteria, only taxa collected on

*Symphoricarpos* sp. at BPMC would be considered oligolectic (PCP value ≥ 95%). The vast majority of taxa collected on specific plants would be considered polylectic with a strong preference for one plant family (PCP values from 70-95%), with a few being exclusively polylectic (PCP ≤ 70%).

Other factors could affect foraging and could explain some of the differences between genera collected on the same flower, one being the foraging ability of the bees collected. If BMPC is the only large pollen source located within the area, then bees may be restricted to what is available. Foraging distances of solitary bees have been correlated with body size, where the smaller an insect is the shorter the foraging distances from nests (Gathmann and Tscharntke 2002; Greenleaf et al., 2007). Honey bees are capable of foraging at distances up to of 9.5 km and thus may not be restricted to BPMC (Beekman and Ratnieks, 2000). Along with foraging distance, size, hairiness, longevity, learning ability, cold tolerance, season, and flowering handling all affect the ability of pollinators to find, collect, and transfer pollen among plants (Batra, 1995). Kreman et al. (2004) showed that if native pollinators are to become replacement pollinators to compensate for honey bee declines, watermelon farms would need to have ≥ 40% natural habitat in the surrounding area. This indicates that the surrounding habitat is also important in influencing the pollinator community and thus the flower constancy of those pollinators.

Exclusion Cage Experiments

Exclusion experiments at BPMC revealed that the 1-mm and 3-mm mesh sizes, the 3-mm and 5-mm mesh sizes and the 5-mm and No mesh were not significantly different from each other, but that the 1-mm and 5-mm and the 3-mm and No mesh were different from each other. Comparison of the number of seeds/flower head at each mesh size in relation to the number of pollinators capable of reaching the flower head at each mesh size, support the notion that as the number of pollinators within a size class increase, the number of seeds/flower head also increase.

To discern the effectiveness of pollinators, exclusion experiments are often employed. Many experiments will exclude all pollinators to discover the effectiveness of the entire community rather than just a certain size class. Comparisons of the effectiveness of pollen foragers, generalist herbivores, self-pollination, and manual hand pollinations have been done to understand the dynamics of a plant's fecundity (Herrera, 2000). Some researchers use exclusion-cage experiments to understand how pollination augments fruit set in plants that are capable of self-pollination, often discovering that fruit set or fruit size is often larger in the presence of native pollinators (Karoly, 1992; Greenleaf and Kremen. 2006a). Other experiments focus on the efficacy of a single pollinator visit, using exclusion bags to keep flowers virginal until the time of the experiment and to rebag them once a single visit has occurred (Dieringer, 1992). The results of experiments like this are often quantified using seed set of the flower. Barthell et al. (2001) found through exclusion experiments that honey bees had a large impact on seed set in yellow starthistle. There were large differences between their no-mesh control and the medium mesh designed to exclude honey bees (other large bodied bees were absent). These results are comparable to mine in that there were significant differences between my no-mesh control and the 3-mm mesh which excluded honey bees. Though these results are comparable, my 3-mm mesh also excluded bumble bees and large bodied anthrophorids, which were all numerous at my field site, so this cannot be considered a measure of the impacts of honey bees alone. Though honey bees were the most numerous pollinator collected on *D. candida*, it could be said that they do have a large impact on seed set in this plant.

## <u>Enhancement of Nesting Habitat with Trap Nests</u>

From 484 capped trap nest tubes, a total of 1,793 individual insects of the orders Hymenoptera (N = 1,757), Coleoptera (N = 24), and Diptera (N = 12) emerged. Of the emerged insects, more than 80% were *Megachile rotundata*, which emerged from 52% of the capped nests. Another 5% of the nests produced megachilids of three species of *Ashmediella* and one of *Heriades*. Bees of the genus *Hylaeus* (Colletidae) also emerged from three nests.

Another 5.6% of emerged insects were from the solitary apoid wasps of the genera (in declining order of abundance) *Isodontia* (26 nests), *Trypoxylon* (13 nests), *Solierella* (8 nests), *Psenulus* (1 nest), and *Passaloecus* (3 nests). Very few Vespidae (subfamily Eumeninae) emerged (N = 11, from 2 nests). Some brood parasites and scavengers of bees and apoid wasps also emerged from the trap nests (Dermestidae = 24, Tachinidae = 12, Chrysididae = 8, and Sapygidae = 24).

Comparisons between the emerged insects and collections made with sweep nets, pan traps, and individual collections revealed very little overlap. *Megachile rotundata* and *Heriades carinata* were the only taxa found in trap nests that were collected using other methods, but they were extremely rare in sweep nets and pan trap samples.

The vast majority emerged from 3, 4, 5 and 6-mm tube sizes, but individuals came out of all tube sizes. Sex ratio data were also obtained on a number of taxa with sample sizes greater than 20 and all but *Megachile rotundata* had female-biased ratios. Because of the large number of individual emerged, it was also possible to examine the sex ratio for *M. rotundata* in relation to tube size. Significant male-biased sex ratios were observed only in the 3-mm diameter nests, whereas female-biased ratios occurred only in 8 mm nests. Overall, 3-6 mm nests produced significantly greater numbers of males (i.e., 20% more males), whereas 7-9 mm nests produced an excess of females (i.e., 72% more females). A correlation between nest size and sex ratio is a common feature of trap nesting bees and wasps (Krombein, 1967).

Trap-nesting can play an important role in understanding the abundance and species richness of cavity nesting bees and wasps (and their natural enemies) in an area in relation to factors such as habitat loss and fragmentation (Steffan-Dewenter, 2002; Taki et al., 2008); trap nests can also serve as indicators of ecological change or habitat quality (Tscharntke et al., 1998). There seems to be a different effect on trap nesting communities in local habitat versus the structural landscape of an area. Taki et al. (2008) found that forest loss had no impact on communities of trap nesting bees and wasps, but were more affected by local habitat complexity as indicated by flower species richness or plant species richness (Tscharntke et al., 1998). Others have found that is a positive correlation between the proportion of semi-natural habitat and surrounding habitat diversity with species richness of trap-nesting bees, wasps, and their natural enemies and that on a small scale these effects are strongest on bees and wasps (Steffan-Dewenter, 2002). On a larger landscape scale it was found that habitat loss negatively impacts trap-nesting bees and wasps (Steffan-Dewenter, 2002), which conflicts with Taki et al.'s findings in forests. Still others have found that intensive farming practices in coffee benefit wasps, while extensive practices benefit bees (Klein et al., 200). There is a large amount of fluctuation in trap nesting communities from year to year (Krombein, 1967; Jenkins and Matthews, 2004), which could reflect relative colonizing ability of species, available cavity sizes, and habitat suitability. Trap nest placement and microclimates also may have an effect on the community of trap nesting Hymenoptera (Jenkins and Matthews, 2004). Disturbed habitats, such as abandoned fields and early successional stages of clear cut, found in the southeast U.S. also play a role in trap-nesting communities. Jenkins and Matthews (2004) had 11 Hymenoptera species emerge from trap nests located in such areas and Steffan-Dewenter (2002) had 15 emerge from semi-natural habitats, compared to European studies having 46 species emerge (Jenkins and Matthews, 2004). BPMC could be considered a semi-natural or disturbed habitat, considering the majority of the area is non-flowering crop land, with BPMC having flowering crops. As with Jenkins and Matthews (2004), only 12 bee and wasp taxa emerged from trap nests at BPMC. These low numbers, seem to indicate a low diversity and that the local as well as landscape habitats have an impact on the trap-nesting community.

Sex bias has been observed in many non-social insects; female-biased sex ratios seem to be common in Hymenoptera (Oku and Nishida, 1999). These biased sex ratios can be the result of several hypotheses: 1) local mate competition, 2) resource quality, 3) partial bivoltinism, and 4) presence of constrained females. Local mate competition operates under the assumption that in areas where males compete with each other for mates, a mother will bias her progeny toward females to lessen the competition between her male offspring (Hamilton, 1967). The resource quality assumes that investment in one sex results in a higher fitness in that sex than in the other. This would make it more beneficial to the mother to invest in the sex with higher fitness, especially when resources are plentiful (Oku and Nishida, 1999). The tube diameter utilized by Hymenoptera may limit food provisions (Charnov et al., 1981), so females using tubes that are of a larger diameter than is necessary tend to be female-biased (Krombein, 1967). Partial bivoltinism works under the assumption that one generation would be biased to males or females if they could survive to mate with the next generation (Werren and Charnov, 1978). The last hypothesis is that females with little or no sperm are constrained to produce only males (in a haplodiploidy system), so unconstrained females would produce an excess of females (Godfray, 1990). Oku and Nishida (1999) found evidence to support the local mate competition theory in *Trypoxylon malaisei* with female-biased sex ratios. In my results, there was a female-sex bias for all taxa except *Megachile rotundata*, though the cause remains unclear. For *Megachile rotundata*, there was a male bias in the

3-6 mm nests (i.e., 20% more males), whereas 7-9 mm nests produced an excess of females (i.e., 72% more females). These results support the resource quality theory of sex-biased ratios, with more females being produced in the larger diameter tubes, although the overall sex ratio was male-biased.

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# APPENDICES

# APPENDIX A

## LIST OF ALL HYMENOPTERA TAXA AT BPMC

**Apoidea: Apiformes: Andrenidae**

- *Andrena p. pronorum* Cockerell
- *Andrena* sp. 2
- *Andrena* sp. 3
- *Calliopsis andreniformis* Smith
- *Calliopsis coloradensis* Cresson
- *Perdita* sp. 1

**Apoidea: Apiformes: Apidae**

- *Apis mellifera* L.
- *Bombus centralis* Cresson
- *Bombus fervidus* (F.)
- *Bombus griseocollis* (D Geer)
- *Bombus huntii* Greene
- *Bombus mixtus* Cresson
- *Bombus rufocinctus* Cresson
- *Bombus terricola occidentalis* Greene
- *Bombus* sp. 1
- *Melissodes* sp. 1
- *Melissodes* sp. 2
- *Melissodes* sp. 3
- *Nomada* sp. 10
- *Nomada* sp. 11
- *Nomada* sp. 12
- *Triepeolus* sp. 1
- *Triepeolus* sp. 2

**Argidae**

- *Schizocerella pilicornis* (Holmgren)
- *Sphacophilus nigrceps* (Kanow)

**Bethylidae**

- Bethylid sp.

**Braconidae**

- Braconid spp.

**Chalcididae**

- *Brachymeria* sp. 1

**Chrysididae**

- Chrysididae spp.

**Apoidea: Apiformes: Colletidae**

- *Colletes fulgida* Swenk
- *Colletes petalostemonis* Swenk
- *Colletes phaceliae* Cockerell
- *Colletes* sp. 1
- *Hylaeus bisinuatus* Foster
- *Hylaeus episcopalis* (Cockerell)
- *Hylaeus stevensi* Crawford
- *Hylaeus* sp. 3
- *Hylaeus* sp. 4

**Crabronidae**

- *Bicyrtes* sp.
- *Cerceris echo* Mickel
- *Cerceris frontata* Say
- *Cerceris fumipennis* Say
- *Cerceris fulvipes* (Cresson)
- *Cerceris nigrescens* Smith
- *Cerceris stigmosalis* Banks
- *Eucerceris superba bicolor* Cresson
- *Glenostictia* sp.
- *Lindenius* sp.
- *Dryudella* sp.
- *Oxybelus* sp.
- *Passaloecus melanocrus* (Rohwer)
- *Psenulus pallipes parenosus* (Pate)
- *Solierella* sp.
- *Stictiella* sp.
- *Tachytes aurulentus* F.
- *Tachytes sayi* Banks
- *Tachytes* sp. 2
- *Tachytes* sp. 3
- *Tachysphex* sp.
- *Trypoxylon* sp.

**Apoidea: Apiformes: Halictidae**

- *Agapostemon angelicus* Cockerell
- *Agapostemon angelicus/texanus* (Female of the species indeterminable)
- *Agapostemon femoratus* Crawford
- *Agapostemon texanus* Cresson
- *Agapostomon virescens* (F.)
- *Halictus confusus Smith*
- *Halictus ligatus* Say
- *Halictus rubicundus* (Christ)
- *Halictus virgatellus* Cockerell

- *Lasioglossum* spp.
- *Sphecodes* sp. 1
- *Sphecodes* sp. 2

**Ichneumonidae**

- Ichneumonidae spp.

**Megachilidae**

- *Anthidium* sp. 1
- *Ashmeadiella cactorum* (Cockerell)
- *Ashmeadiella bucconis* (Cresson)
- *Ashmeadiella gilletei* Titus
- *Coelioxys mesae* Cockerell
- *Dianthidium sayi* Cockerell
- *Dianthidium* sp. 1
- *Heriades carinata* Cresson
- *Hoplitis* sp. 1
- *Hoplitis* sp. 2
- *Megachile brevis* Say
- *Megachile concinna* Smith
- *Megachile inimica* Cresson
- *Megachile lippiae* Cockerell
- *Megachile litamanus/perihirta* (one ♀)
- *Megachile parallela* Smith
- *Megachile rotundata* (F.)
- *Osmia* sp.

**Mutillidae**

- *Dasymutilla bioculata* (Cresson)

**Pompilidae**

- Pompilidae sp.

**Proctotrupidae**

- Proctotrupidae sp.

**Sapygidae**

- *Sapyga pumila* Cresson

**Scoliidae**

- Scoliidae sp.
- *Trielis octomaculata*

**Apoidea: Speciformes: Sphecidae**

- *Isodontia mexicana* (Saussure)
- *Podalonia* sp.
- *Prionyx canadensis* Provancher
- *Sphex ichneumoneus* (L.)

**Tiphiidae**

- Tiphidae sp.

**Vespidae**

- *Eumeninae* sp.
- *Euodynerus* sp.
- *Odynerus* sp.

# APPENDIX B

ALL SPECIMENS COLLECTED USING SWEEP SAMPLES

,PAN TRAPS AND INDIVIDUALS FOR POLLEN ANALYSIS

*Achillea millefolium* (2006)

| Family | Hymenoptera Taxa | Total Collected by Sweep Samples | Total Collected for Pollen | Hymenoptera Type |
|---|---|---|---|---|
| Andrenidae | *Andrena p. pronorum* | 1 | - | Pollen forager |
| | *Andrena* sp. 2 | 2 | - | Pollen forager |
| Apidae | *Apis mellifera* | 1 | - | Pollen forager |
| | *Nomada* sp. 10 | 1 | - | Cleptoparasite |
| | *Nomada* sp. 12 | 1 | - | Cleptoparasite |
| Colletidae | *Colletes fulgida* | 2 | - | Pollen forager |
| | *Colletes phaceliae* | 3 | - | Pollen forager |
| | *Hylaeus bisinuatus* | 2 | - | Pollen forager |
| | *Hylaeus* sp. 4 | 2 | - | Pollen forager |
| | *Hylaeus* sp. 3 | 2 | - | Pollen forager |
| Crabronidae | *Cerceris echo* | 1 | 1 | Predator |
| | *Cerceris nigrescens* | 6 | - | Predator |
| | *Lindenius* sp. | 3 | - | Predator |
| | *Oxybelus* sp. | 12 | - | Predator |
| | *Tachytes sayi* | 2 | 1 | Predator |
| | *Tachytes* sp. 3 | 1 | - | Predator |
| Halictidae | *Agapostemon angelicus/texanus* | 4 | - | Pollen forager |
| | *Agapostemon femoratus* | 6 | - | Pollen forager |
| | *Halictus confusus* | 4 | 1 | Pollen forager |
| | *Halictus ligatus* | 33 | 6 | Pollen forager |
| | *Halictus rubicundus* | 4 | - | Pollen forager |
| | *Lasioglossum* spp. | 73 | - | Pollen forager |
| Ichneumonidae | | 2 | - | Parasite |
| Megachilidae | *Heriades carinata* | 5 | - | Pollen forager |
| Sphecidae | *Prionyx canadensis* | - | 1 | Predator |
| Vespidae | *Eumenine* sp. | 2 | - | Predator |

*Astragalus cicer* (2006)

| Family | Hymenoptera Taxa | Total Collected by Sweep Samples | Total Collected for Pollen | Hymenoptera Type |
|---|---|---|---|---|
| Andrenidae | *Andrena p. prunorum* | 1 | - | Pollen forager |
| Apidae | *Apis mellifera* L. | 3 | - | Pollen forager |
| | *Bombus centralis* | 4 | 1 | Pollen forager |
| | *Bombus fervidus* | 1 | 4 | Pollen forager |
| | *Bombus griseocollis* | 7 | 1 | Pollen forager |
| | *Bombus huntii* | 10 | 16 | Pollen forager |
| Argidae | *Schizocerella pilicornis* | 1 | - | Herbivore |
| Halicidae | *Halictus rubicundus* | 1 | - | Pollen forager |
| | *Lasioglossum* spp. | 3 | - | Pollen forager |
| Ichneumonidae | | 1 | - | Parasite |
| Megachilidae | *Osmia* sp. | 2 | 2 | Pollen forager |

*Camelina* sp. (2006)

| Family | Hymenoptera taxa | Total Collected by Sweep Sample | Total Collected for Pollen | Hymenoptera Type |
|---|---|---|---|---|
| Apidae | *Apis mellifera* L. | 12 | - | Pollen forager |
| Colletidae | *Colletes phaceliae* | 1 | - | Pollen forager |
| Halictidae | *Hylaeus bisinuatus* | 1 | - | Pollen forager |
| | *Lasioglossum* spp. | 7 | - | Pollen forager |

*Cirsium arvense* (2006)

| Family | Hymenoptera Taxa | Total Collected by Sweep Sample | Total Collected for Pollen | Hymenoptera Type |
|---|---|---|---|---|
| Apidae | *Apis mellifera* | - | 4 | Pollen forager |
| Halictidae | *Agapostemon angelicus/texanus* | 4 | - | Pollen forager |
| | *Agapostemon virescens* | 2 | - | Pollen forager |
| | *Lasioglossum* spp. | 4 | - | Pollen forager |

*Convolvulus arvensis* (2006)

| Family | Hymenoptera Taxa | Total collected by Sweep Sample | Total Collected for Pollen | Hymenoptera Type |
|---|---|---|---|---|
| Apidae | *Apis mellifera* | 6 | - | Pollen forager |
| | *Bombus huntii* | 1 | 2 | Pollen forager |
| | *Dianthidium* sp. 1 | - | 7 | Cleptoparasite |
| Chalcididae | *Brachymeria* sp. 1 | 1 | - | Parasite |
| Colletidae | *Colletes phaceliae* | 1 | - | Pollen forager |
| Crabronidae | *Oxybelus* sp. | 1 | - | Predator |
| | *Tachytes sayi* | 1 | - | Predator |
| Halictidae | *Agapostemon angelicus* | 1 | - | Pollen forager |
| | *Agapostemon angelicus/texanus* | - | 6 | Pollen forager |
| | *Agapostemon femoratus* | 1 | - | Pollen forager |
| | *Halictus confusus* | - | 32 | Pollen forager |
| | *Halictus ligatus* | 3 | 6 | Pollen forager |
| | *Halictus rubicundus* | 3 | - | Pollen forager |
| | *Halictus virgatellus* | - | 4 | Pollen forager |
| | *Lasioglossum* spp. | 20 | 7 | Pollen forager |
| Ichneumonidae | | 1 | - | Parasite |
| Megachilidae | *Megachile lippia* | - | 1 | Pollen forager |
| Tiphiidae | | 8 | - | Parasite |
| Vespidae | *Eumenine* sp. | 1 | - | Predator |

*Dalea candida* (2006 and 2007)

| Family | Hymenoptera Taxa | Total Collected by Sweep Samples 2006 | Total Collected by Sweep Samples 2007 | Total Collected for Pollen | Hymenoptera Type |
|---|---|---|---|---|---|
| Andrenidae | *Andrena p. prunorum* | 1 | 8 | 1 | Pollen forager |
| | *Andrena* sp. 3 | 1 | - | - | Pollen forager |
| | *Calliopsis coloradensis* | 6 | - | 1 | Pollen forager |
| Apidae | *Apis mellifera* | 1301 | 183 | 46 | Pollen forager |
| | *Bombus centralis* | 1 | - | - | Pollen forager |
| | *Bombus griseocollis* | 35 | 8 | 41 | Pollen forager |
| | *Bombus huntii* | 37 | 11 | 29 | Pollen forager |
| | *Bombus ruficinctus* | 1 | - | - | Pollen forager |
| | *Bombus* sp. 1 | 1 | - | - | Pollen forager |
| | *Melissodes* sp. 1 | - | 3 | - | Pollen forager |
| | *Melissodes* sp. 2 | 1 | - | - | Pollen forager |
| | *Melissodes* sp. 3 | 2 | - | - | Pollen forager |
| | *Triepeolus* sp. 1 | - | 1 | - | Cleptoparasite |
| Argidae | *Sphacophilus nigrceps* | 5 | 10 | - | Herbivore |
| Braconidae | | 2 | - | - | Parasite |
| Colletidae | *Colletes fulgida* | 1 | - | - | Pollen forager |
| | *Colletes petalostemonis* | - | - | 10 | Pollen forager |
| | *Colletes phaceliae* | 103 | 37 | 17 | Pollen forager |
| | *Colletes* sp. | 1 | - | - | Pollen forager |
| | *Hylaeus* sp. 3 | 1 | - | - | Pollen forager |
| Crabronidae | *Cerceris frontata frontata* | - | - | 2 | Predator |
| | *Eucerceris superba bicolor* | - | - | 2 | Predator |
| | *Podalonia* sp. | - | - | 2 | Predator |
| | *Stictiella* sp. | - | - | 1 | Predator |
| | *Tachytes sayi* | - | - | 6 | Predator |
| | *Tachytes* sp. | - | - | 1 | Predator |

*Dalea candida* continued

| Family | Hymenoptera Taxa | Total Collected by Sweep Samples 2006 | Total Collected by Sweep Samples 2007 | Total Collected for Pollen | Hymenoptera Type |
|---|---|---|---|---|---|
| Halictidae | *Agapostemon angelicus* | 4 | - | 1 | Pollen forager |
| | *Agapostemon angelicus/texanus* | 3 | 5 | 11 | Pollen forager |
| | *Agapostemon femoratus* | 11 | 1 | 1 | Pollen forager |
| | *Agapostemon texanus* | 3 | - | 1 | Pollen forager |
| | *Agapostemon viescens* | - | - | 1 | Pollen forager |
| | *Halictus confusus* | 3 | 3 | 2 | Pollen forager |
| | *Halictus ligatus* | 32 | 8 | 4 | Pollen forager |
| | *Halictus rubicundus* | 6 | 12 | 6 | Pollen forager |
| | *Halictus virgatellus* | - | - | 1 | Pollen forager |
| | *Lasioglossum* spp. | 123 | 69 | 10 | Pollen forager |
| | *Sphecodes* sp. 2 | - | 1 | - | Cleptoparasite |
| Ichneumonidae | | 7 | 2 | - | Parasite |
| Megachilidae | *Coeleoxys mesae* | 1 | - | 1 | Cleptoparasite |
| | *Heriades carinata* | 3 | - | 1 | Pollen forager |
| | *Hoplitis* sp. 1 | 1 | - | - | Pollen forager |
| | *Megachile brevis* | 1 | - | - | Pollen forager |
| | *Megachile lippiae* | 2 | 1 | 3 | Pollen forager |
| | *Megachile rotundata* | 2 | - | - | Pollen forager |
| Pompilidae | | 1 | - | - | Predator |
| Proctotrupidae | | 1 | - | - | Parasite |
| Scoliidae | | - | 2 | - | Parasite |
| Sphecidae | *Prionyx canadensis* | - | - | 3 | Predator |
| | *Sphex ichneumoneus* | 23 | 13 | 24 | Predator |
| Vespidae | *Eumenine* sp. | 3 | 2 | - | Predator |

*Lotus corniculatus* (2006)

| Family | Hymenoptera Taxa | Total Collected by Sweep Samples | Total Collected for Pollen | Hymenoptera Type |
|---|---|---|---|---|
| Apidae | *Apis mellifera* | 12 | 1 | Pollen forager |
| | *Dianthidium* sp. 1 | - | 1 | Cleptoparasite |
| Megachilidae | *Anthidium* sp. 1 | - | 1 | Cleptoparasite |
| | *Megachile brevis* | - | 4 | Pollen forager |
| | *Megachile concinna* | - | 1 | Pollen forager |
| | *Megachile lippiae* | - | 1 | Pollen forager |
| | *Megachile rotundata* | - | 1 | Pollen forager |

*Medicago sativa* (2006)

| Family | Hymenoptera Taxa | Total Collected by Sweep Samples | Total Collected for Pollen | Hymenoptera Type |
|---|---|---|---|---|
| Halictidae | *Agapostemon femoratus* | 3 | - | Pollen forager |
| | *Agapostemon texanus* | 1 | - | Pollen forager |
| | *Halictus ligatus* | 4 | - | Pollen forager |
| | *Lasioglossum* spp. | 6 | - | Pollen forager |
| Vespidae | *Eumenine* sp. | 1 | - | Predator |

*Melilotus alba* (2006)

| Family | Hymenoptera Taxa | Total Collected by Sweep Samples | Total Collected for Pollen | Hymenoptera Type |
|---|---|---|---|---|
| Apidae | *Apis mellifera* | 1 | - | Pollen forager |
| Halictidae | *Agapostemon femoratus* | 1 | - | Pollen forager |
| | *Lasioglossum* spp. | 1 | - | Pollen forager |

*Onobrychis viciifolia* (2007)

| Family | Hymenoptera Taxa | Total Collected by Sweep Samples | Total Collected for Pollen | Hymenoptera Type |
|---|---|---|---|---|
| Apidae | *Apis mellifera* | 113 | - | Pollen forager |
| | *Bombus griseocollis* | 3 | - | Pollen forager |
| | *Bombus huntii* | 10 | - | Pollen forager |
| | *Nomada* sp. 11 | 1 | - | Cleptoparasite |
| Braconidae | | 1 | - | Parasite |
| Chalcidae | *Brachymeria* sp. 1 | 1 | - | Parasite |
| Crabrondiae | *Cerceris nigrescens* | 1 | - | Predator |
| | *Lindenius* sp. | 1 | - | Predator |
| Halictidae | *Agapostemon angelicus/texanus* | 2 | - | Pollen forager |
| | *Halictus confusus* | 1 | - | Pollen forager |
| | *Lasioglossum* spp. | 27 | - | Pollen forager |
| Megachilidae | *Megachile rotundata* | 1 | - | Pollen forager |

*Ratibida columnifera* (2006 and 2007)

| Family | Hymenoptera Taxa | Total Collected by Sweep Samples 2006 | Total Collected by Sweep Samples 2007 | Total Collected for Pollen | Hymenoptera Type |
|---|---|---|---|---|---|
| Andrenidae | *Andrena p. pronorum* | - | 2 | - | Pollen forager |
| | *Calliopsis andreniformis* | - | 4 | - | Pollen forager |
| | *Calliopsis coloradensis* | - | 1 | - | Pollen forager |
| Apidae | *Apis mellifera* | 12 | - | 4 | Pollen forager |
| | *Bombus griseocollis* | - | - | 2 | Pollen forager |
| | *Bombus huntii* | 9 | 9 | 4 | Pollen forager |
| | *Diadasia* sp. 1 | - | - | 1 | Pollen forager |
| | *Melissodes* sp. 1 | - | 7 | 21 | Pollen forager |
| | *Melissodes* sp. 2 | 27 | 47 | - | Pollen forager |
| | *Melissodes* sp. 3 | 4 | 8 | - | Pollen forager |
| | *Nomada* sp. 12 | 3 | 1 | - | Cleptoparasite |
| | *Triepeolis* sp. 1 | 2 | - | 1 | Cleptoparasite |
| Braconidae | | 1 | - | - | Parasite |
| Chalcididae | *Chalcis* sp. 1 | - | 1 | - | Parasite |
| Colletidae | *Colletes fulgida* | - | 6 | - | Pollen forager |
| | *Colletes petalostomonis* | 1 | 5 | - | Pollen forager |
| | *Colletes phaceliae* | - | 1 | - | Pollen forager |
| | *Hylaeus bisinuatus* | 4 | - | - | Pollen forager |
| Crabronidae | *Bicyrtes* sp. | - | - | 2 | Predator |
| | *Euodynerus* sp. | - | - | 3 | Predator |
| | *Odynerus* sp. | - | - | 1 | Predator |
| | *Tachytes sayi* | - | - | 3 | Predator |
| | *Trielis octomaculata* | - | - | 1 | Predator |

*Ratibida columnifera* continued

| Family | Hymenoptera Taxa | Total Collected by Sweep Samples 2006 | Total Collected by Sweep Samples 2007 | Total Collected for Pollen | Hymenoptera Type |
|---|---|---|---|---|---|
| Halictidae | *Agapostemon angelicus/texanus* | 3 | - | 2 | Pollen forager |
| | *Agapostemon femoratus* | 21 | - | - | Pollen forager |
| | *Halictus confusus* | 2 | - | - | Pollen forager |
| | *Halictus ligatus* | - | 1 | 15 | Pollen forager |
| | *Halictus rubicundus* | 115 | 61 | - | Pollen forager |
| | *Perdita* sp. 1 | 5 | 5 | - | Pollen forager |
| | *Sphecodes* sp. 1 | - | 1 | - | Cleptoparasite |
| Ichneumonidae | | 5 | - | - | Parasite |
| Megachilidae | *Coeleoxys mesae* | 1 | 1 | 3 | Pollen forager |
| | *Dianthidium* sp. 1 | - | - | 1 | Cleptoparasite |
| | *Megachile lippiae* | - | 1 | - | Pollen forager |
| | *Megachile parallela* | - | 1 | 9 | Pollen forager |
| | *Megachile rotundata* | 4 | - | 1 | Pollen forager |
| Mutillidae | *Dasymutilla bioculata* | 2 | - | - | Parasite |
| Scoliidae | | 3 | - | - | Parasite |
| Vespidae | *Eumenine* sp. | 1 | 3 | - | Predator |

*Sonchus* sp. (2006)

| Family | Hymenoptera Taxa | Total Collected by Sweep Samples | Total Collected for Pollen | Hymenoptera Type |
|---|---|---|---|---|
| Apidae | *Apis mellifera* | 25 | 19 | Pollen forager |
| | *Bombus centralis* | - | 1 | Pollen forager |
| | *Bombus fervidus* | 1 | - | Pollen forager |
| | *Bombus huntii* | 5 | 1 | Pollen forager |
| | *Bombus mixtus* | - | 1 | Pollen forager |
| | *Bombus occidentalis* | 1 | - | Pollen forager |
| | *Melissodes* sp. 1 | 1 | - | Pollen forager |
| | *Melissodes* sp. 3 | 4 | - | Pollen forager |
| Halictidae | *Agapostemon angelicus/texanus* | 3 | - | Pollen forager |
| | *Halictus ligatus* | 20 | - | Pollen forager |
| | *Halictus rubicundus* | - | 1 | Pollen forager |
| | *Lasiglossum* spp. | 27 | 1 | Pollen forager |
| Ichneumonidae | | 1 | - | Parasite |
| Sphecidae | *Sphex inchneumoneus* | - | 1 | Predator |

*Symphoricarpos* sp. (2006)

| Family | Hymenoptera Taxa | Total Collected by Sweep Samples | Total Collected for Pollen | Hymenoptera Type |
|---|---|---|---|---|
| Andrenidae | *Andrena* sp. 2 | 1 | - | Pollen forager |
| Apidae | *Apis mellifera* | 25 | - | Pollen forager |
| | *Bombus centralis* | 4 | 1 | Pollen forager |
| Braconidae | | 10 | - | Parasite |
| Chrysididae | | 1 | - | Parasite |
| Colletidae | *Hylaeus bisinuatus* | 1 | - | Pollen forager |
| | *Hylaeus* sp. 4 | 1 | - | Pollen forager |
| | *Hylaeus* sp. | 1 | - | Pollen forager |
| Crabronidae | *Cerceris fumipennis* | 1 | - | Predator |
| | *Cerceris nigrescens* | 2 | - | Predator |
| | *Lindenius* sp. | 1 | - | Predator |
| | *Philanthus crabroniformis* | 1 | - | Predator |
| Halictidae | *Agapostemon angelicus/texanus* | - | 1 | Pollen forager |
| | *Agapostemon femoratus* | 1 | - | Pollen forager |
| | *Halictus confusus* | 1 | - | Pollen forager |
| | *Halictus rubicundus* | 3 | - | Pollen forager |
| | *Lasiglossum* spp. | 37 | - | Pollen forager |
| Ichneumonidae | | 2 | - | Parasite |
| Megachilidae | *Heriades carinata* | 2 | - | Pollen forager |
| Sphecidae | *Sphex ichneumoneus* | 4 | - | Predator |
| Vespidae | *Eumenine* sp. | 3 | 1 | Predator |

*Symphyotrichum chilensis* (2006 and 2007)

| Family | Hymenoptera Taxa | Total Collected by Sweep Samples 2006 | Total Collected by Sweep Samples 2007 | Total Collected for Pollen | Hymenoptera Type |
|---|---|---|---|---|---|
| Apidae | *Apis mellifera* | 4 | - | 2 | Pollen forager |
| | *Melissodes* sp. 1 | 1 | 21 | 17 | Pollen forager |
| | *Melissodes* sp. 2 | - | 1 | 1 | Pollen forager |
| | *Melissodes* sp. 3 | 6 | 6 | 8 | Pollen forager |
| Braconidae | | 21 | - | - | Parasite |
| Colletidae | *Perdita* sp. 1 | - | 1 | - | Pollen forager |
| Crabronidae | *Oxybelus* sp. | - | 1 | - | Predator |
| Halictidae | *Agapostemon angelicus/texanus* | - | 2 | - | Pollen forager |
| | *Agapostemon femoratus* | 2 | - | - | Pollen forager |
| | *Halictus ligatus* | 17 | 36 | 15 | Pollen forager |
| | *Lasioglossum* spp. | 1 | 9 | - | Pollen forager |
| Ichneumonidae | | 1 | - | - | Parasite |
| Megachilidae | *Ashmeadiella gilletei* | - | - | 1 | Pollen forager |
| | *Dianthidium* sp. 1 | - | - | 2 | Cleptoparasite |
| | *Heriades carinata* | - | 1 | - | Pollen forager |
| | *Megachile inimica* | - | 1 | - | Pollen forager |
| Vespidae | *Eumenine* sp. | 2 | - | - | Predator |

Pan Traps collected in *D. candida* (2006 and 2007)

| Family | Hymenoptera Taxa | Total Pan Trap 2006 | Total Pan Trap 2007 | Hymenoptera Type |
|---|---|---|---|---|
| Andrenidae | *Andrena p. prunorum* | 2 | - | Pollen forager |
| | *Calliopsis andreniformis* | 4 | 1 | Pollen forager |
| | *Calliopsis coloradensis* | 6 | 1 | Pollen forager |
| | *Perdita* sp. 1 | 1 | 1 | Pollen forager |
| Apidae | *Bombus fervidus* | 1 | - | Pollen forager |
| | *Bombus ruficinctus* | 1 | - | Pollen forager |
| | *Dianthidium sayi* | 4 | - | Cleptoparasite |
| | *Melissodes* sp. 2 | - | 1 | Pollen forager |
| | *Melissodes* sp. 3 | 1 | 1 | Pollen forager |
| | *Nomada* sp. 11 | - | 1 | Cleptoparasite |
| | *Nomada* sp. 12 | 1 | - | Cleptoparasite |
| Bethylidae | | 1 | - | Parasite |
| Braconidae | | 1 | - | Parasite |
| Colletidae | *Colletes phaceliae* | 2 | - | Pollen forager |
| | *Hylaeus bisinuatus* | 1 | - | Pollen forager |
| | *Hylaeus episcopalis* | 1 | - | Pollen forager |
| | *Hylaeus* sp. | - | 1 | Pollen forager |
| Crabronidae | *Glenostictia* sp. | 1 | - | Predator |
| | *Lindenius* sp. | 1 | - | Predator |
| | *Oxybelus* sp. | 8 | - | Predator |
| | *Sticriella* sp. | 1 | - | Predator |
| | *Tachytes sayi* | 25 | 12 | Predator |

Pan Traps collected in *D. candida* (2006 and 2007) continued

| Family | Hymenoptera Taxa | Total Pan Trap 2006 | Total Pan Trap 2007 | Hymenoptera Type |
|---|---|---|---|---|
| Crabronidae | *Tachytes* sp. 2 | 1 | - | Predator |
| | *Tachytes* sp. 3 | 1 | - | Predator |
| | *Tachytesphex* sp. | - | 3 | Predator |
| Halictidae | *Agapostemon angelicus/texanus* | 17 | 12 | Pollen forager |
| | *Agapostemon femoratus* | 5 | - | Pollen forager |
| | *Agapostemon texanus* | 1 | - | Pollen forager |
| | *Agapostemon virescens* | 1 | 3 | Pollen forager |
| | *Halictus confusus* | 11 | 7 | Pollen forager |
| | *Halictus ligatus* | 27 | 22 | Pollen forager |
| | *Halictus rubicundus* | 5 | 5 | Pollen forager |
| | *Lasioglossum* spp. | 90 | 14 | Pollen forager |
| | *Sphecodes* sp. 1 | 3 | - | Cleptoparasite |
| Ichneumonidae | | 6 | - | Parasite |
| Megachilidae | *Anthidium* sp. 1 | - | 1 | Cleptoparasite |
| | *Hoplitis* sp. 2 | 1 | - | Pollen forager |
| | *Megachile brevis* | 10 | - | Pollen forager |
| | *Megachile lippiae* | 2 | 1 | Pollen forager |
| | *Megachile litamanus/perihirta* | 1 | - | Pollen forager |
| | *Megachile rotundata* | 1 | 2 | Pollen forager |
| | *Osmia* sp. | 4 | - | Pollen forager |
| Pompilidae | | 9 | 3 | Predator |

Pan Traps collected in *D. candida* (2006 and 2007) continued

| Family | Hymenoptera Taxa | Total Pan Trap 2006 | Total Pan Trap 2007 | Hymenoptera Type |
|---|---|---|---|---|
| Sphecidae | *Prionyx canadensis* | 4 | 4 | Predator |
| | *Sphex ichneumoneums* | 2 | - | Predator |
| Tiphiidae | | 2 | - | Parasite |
| Vespidae | *Eumenine* sp. | - | 3 | Predator |

Trap nests collected at BPMC (2006)

| Family | Hymenoptera Taxa | Total 2006 | Hymenoptera Type |
|---|---|---|---|
| Chyrsididae | | 8 | Parasite |
| Colletidae | *Hylaeus stevens* | 17 | Pollen forager |
| Crabronidae | *Passaloecus melanocrus* | 11 | Predator |
| | *Psenulus pallipes patenosus* | 15 | Predator |
| | *Solierella* sp. | 24 | Predator |
| | *Trypuxylon* spp. | 48 | Predator |
| Megachilidae | *Ashmeadiealla cactorum* | 9 | Pollen forager |
| | *Ashmeadiella bucconis* | 1 | Pollen forager |
| | *Ashmeadiella gilletei* | 4 | Pollen forager |
| | *Heriades carinata* | 65 | Pollen forager |
| | *Megachile rotundata* | 1414 | Pollen forager |
| Sapygidae | *Sapyga pumila* | 23 | Cleptoparasite |
| Sphecidae | *Isodontia mexicana* | 81 | Predator |
| Vespidae | *Eumenine* sp. | 11 | Predator |

# APPENDIX C

## POLLEN COUNT DATA

**Key to Tables**

SWPC = slender white prairieclover (*Dalea candida)*
BW = bindweed (*Convolvulus arvensis)*
A = aster (*Symphyotrichum chilensis*)
CF = prairie coneflower (*Ratibida columnifera)*
BFTF = birdsfoot trefoil (*Lotus corniculatus*)
CT = Canada thistle (*Cirsium arvense)*
SC = sweetclover (*Melilotus alba* or *Melilotus officinalis*)
Y = yarrow (*Achillea millefolium)*
Cic = cicer milkvetch (*Astragalus cicer)*
Sow = sowthistle (*Sonchus* sp.)
Snow = snowberry (*Symphoricarpos* sp.)

All insects were collected in 2006.

*Achillea millefolium*: Family Crabronidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Cerceris nigrescens* | M | 0 | 0 | 0 | 0 | 0 | 400 | 0 | 0 | 0 | 0 | 0 | 400 |
| 7/13 | *Cerceris nigrescens* | M | 0 | 0 | 0 | 0 | 0 | 980 | 0 | 0 | 0 | 35 | 0 | 1015 |
| 7/13 | *Oxybelus* sp. | M | 0 | 0 | 0 | 0 | 0 | 1400 | 0 | 50 | 0 | 0 | 0 | 1450 |
| 7/13 | *Tachytes sayi* | M | 160 | 0 | 0 | 0 | 0 | 320 | 0 | 0 | 0 | 0 | 0 | 480 |

*Achillea millefolium*: Family Halictidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Halictus confusus* | M | 38 | 75 | 0 | 0 | 0 | 38 | 0 | 38 | 0 | 0 | 0 | 188 |
| 7/13 | *Halictus ligatus* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 35888 | 0 | 0 | 0 | 35888 |
| 7/13 | *Halictus ligatus* | F | 0 | 0 | 0 | 0 | 0 | 77550 | 0 | 0 | 0 | 0 | 0 | 77550 |
| 7/13 | *Halictus ligatus* | F | 0 | 0 | 0 | 0 | 0 | 26910 | 0 | 0 | 0 | 0 | 0 | 26910 |
| 7/13 | *Halictus ligatus* | F | 0 | 8840 | 0 | 0 | 0 | 18720 | 0 | 0 | 0 | 0 | 0 | 27560 |
| 7/13 | *Halictus ligatus* | F | 270 | 0 | 0 | 0 | 0 | 6510 | 0 | 0 | 0 | 0 | 0 | 6780 |
| 7/13 | *Halictus ligatus* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19113 | 0 | 0 | 0 | 19113 |

*Achillea millefolium*: Family Sphecidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Prionyx canadensis* | M | 28 | 0 | 0 | 0 | 0 | 908 | 0 | 0 | 0 | 0 | 0 | 935 |

*Astragalus cicer*: Family Andrenidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/3 | *Andrena p. prunorum* | F | 0 | 65000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 187000 | 252000 |

*Astragalus cicer*: Family Apidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/3 | *Bombus centralis* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38750 | 0 | 0 | 38750 |
| 7/21 | *Bombus fervidus* | F | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 990 | 0 | 0 | 1020 |
| 7/13 | *Bombus fervidus* | M | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 80 | 80 |
| 7/3 | *Bombus fervidus* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 88200 | 0 | 0 | 88200 |
| 7/3 | *Bombus fervidus* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 330150 | 0 | 0 | 330150 |
| 7/3 | *Bombus griseocollis* | F | 0 | 0 | 0 | 0 | 0 | 258 | 0 | 0 | 141368 | 0 | 0 | 141625 |
| 7/3 | *Bombus huntii* | F | 525 | 0 | 0 | 1050 | 0 | 0 | 0 | 0 | 452550 | 0 | 0 | 454125 |
| 7/3 | *Bombus huntii* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 53250 | 0 | 0 | 53250 |
| 7/3 | *Bombus huntii* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 238650 | 0 | 0 | 238650 |
| 7/3 | *Bombus huntii* | F | 0 | 0 | 0 | 0 | 0 | 253 | 0 | 0 | 69438 | 0 | 0 | 69690 |
| 7/3 | *Bombus huntii* | F | 0 | 138 | 0 | 0 | 0 | 275 | 0 | 0 | 79338 | 0 | 0 | 79750 |
| 7/3 | *Bombus huntii* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 92668 | 0 | 0 | 92667.5 |
| 7/3 | *Bombus huntii* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 788 | 0 | 0 | 788 |
| 7/3 | *Bombus huntii* | F | 0 | 0 | 0 | 0 | 0 | 510 | 0 | 0 | 156570 | 0 | 0 | 157080 |
| 7/3 | *Bombus huntii* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 181225 | 0 | 0 | 181225 |
| 7/10 | *Bombus huntii* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 153750 | 0 | 0 | 153750 |
| 7/10 | *Bombus huntii* | F | 0 | 0 | 825 | 0 | 0 | 0 | 0 | 0 | 30525 | 0 | 0 | 31350 |
| 7/10 | *Bombus huntii* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 118125 | 0 | 0 | 118125 |
| 7/10 | *Bombus huntii* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1140 | 0 | 0 | 1140 |
| 7/10 | *Bombus huntii* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 413075 | 0 | 0 | 413075 |
| 7/10 | *Bombus huntii* | F | 0 | 5250 | 0 | 0 | 0 | 0 | 0 | 0 | 664650 | 0 | 0 | 669900 |
| 7/10 | *Bombus huntii* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 801150 | 0 | 0 | 801150 |

*Astragalus cicer*: Family Megachilidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/3 | *Osmia* sp. 1 | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 89250 | 0 | 0 | 89250 |
| 7/3 | *Osmia* sp. 1 | F | 0 | 0 | 0 | 0 | 0 | 125 | 0 | 0 | 19375 | 0 | 0 | 19500 |

*Cirsium arvense*: Family Apidae

| Date | Species | Sex | SWPC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Apis mellifera* | F | 675 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 675 |
| 7/13 | *Apis mellifera* | F | 33 | 0 | 0 | 0 | 0 | 0 | 0 | 1398 | 0 | 130 | 0 | 1560 |
| 7/13 | *Apis mellifera* | F | 1050 | 0 | 0 | 0 | 1050 | 0 | 0 | 176400 | 0 | 0 | 0 | 178500 |
| 7/13 | *Apis mellifera* | F | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 550 | 0 | 0 | 0 | 578 |

*Cirsium arvense*: Family Halictidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Agapostemon angelicus/texanus* | F | 0 | 293 | 0 | 0 | 0 | 358 | 0 | 0 | 0 | 0 | 0 | 650 |
| 7/13 | *Agapostemon angelicus/texanus* | F | 0 | 0 | 0 | 0 | 0 | 4293 | 0 | 16918 | 0 | 0 | 0 | 21210 |
| 7/13 | *Agapostemon angelicus/texanus* | F | 0 | 275 | 0 | 0 | 0 | 275 | 0 | 31900 | 0 | 0 | 0 | 32450 |
| 7/13 | *Agapostemon angelicus/texanus* | F | 40618 | 0 | 0 | 0 | 0 | 109720 | 0 | 51695 | 0 | 0 | 0 | 202033 |

*Cirsium arvense*: Family Halictidae continued

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Agapostemon virescens* | F | 513 | 9738 | 0 | 0 | 0 | 0 | 0 | 97375 | 0 | 0 | 0 | 107625 |
| 7/13 | *Agapostemon virescens* | F | 0 | 8600 | 0 | 0 | 0 | 42463 | 0 | 73638 | 0 | 0 | 0 | 124700 |
| 7/21 | *Lasioglossum* spp. | M | 210 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 210 |
| 7/21 | *Lasioglossum* spp. | M | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| 7/21 | *Lasioglossum* spp. | M | 0 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| 7/21 | *Lasioglossum* spp. | M | 0 | 638 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 0 | 0 | 675 |

*Convolvulus arvensis*: Family Apidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/21 | *Bombus huntii* | F | 0 | 520 | 0 | 0 | 0 | 130 | 0 | 0 | 0 | 0 | 0 | 650 |
| 7/21 | *Bombus huntii* | F | 0 | 1240 | 0 | 0 | 49290 | 1240 | 0 | 0 | 0 | 0 | 0 | 51770 |

*Convolvulus arvensis*: Family Halictidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/18 | *Agapostemon angelicus/texanus* | F | 698 | 930 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1628 |
| 7/21 | *Agapostemon angelicus/texanus* | F | 0 | 3000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3000 |
| 7/21 | *Agapostemon angelicus/texanus* | F | 115 | 1093 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1208 |
| 7/21 | *Agapostemon angelicus/texanus* | F | 80 | 760 | 0 | 0 | 0 | 40 | 0 | 0 | 0 | 0 | 0 | 880 |
| 7/21 | *Agapostemon angelicus/texanus* | F | 58 | 58 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 115 |

*Convolvulus arvensis*: Family Halictidae continued

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/21 | *Agapostemon angelicus/texanus* | F | 1470 | 735 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2205 |
| 7/18 | *Halictus confusus* | F | 0 | 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 60 |
| 7/18 | *Halictus confusus* | F | 0 | 660 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 660 |
| 7/18 | *Halictus confusus* | F | 0 | 1365 | 0 | 110 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1475 |
| 7/18 | *Halictus confusus* | F | 103 | 0 | 0 | 21315 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21418 |
| 7/18 | *Halictu confusus* | F | 0 | 0 | 0 | 110 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 110 |
| 7/21 | *Halictus confusus* | F | 53 | 263 | 158 | 0 | 0 | 473 | 0 | 0 | 0 | 0 | 0 | 945 |
| 7/21 | *Halictus confusus* | F | 0 | 3360 | 0 | 0 | 0 | 53 | 0 | 0 | 0 | 0 | 0 | 3413 |
| 7/21 | *Halictus confusus* | F | 0 | 75 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 75 |
| 7/21 | *Halictus confusus* | F | 28 | 110 | 0 | 0 | 275 | 0 | 0 | 0 | 0 | 0 | 0 | 413 |
| 7/21 | *Halictus confusus* | F | 0 | 120 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 120 |
| 7/21l | *Halictus confusus* | F | 0 | 83 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 83 |
| 7/21 | *Halictus confusus* | F | 0 | 390 | 0 | 0 | 0 | 60 | 0 | 0 | 0 | 0 | 0 | 450 |
| 7/21 | *Halictus confusus* | F | 0 | 38 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 |
| 7/21 | *Halictus confusus* | F | 0 | 300 | 0 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 330 |
| 7/21 | *Halictus confusus* | F | 33 | 325 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 358 |
| 7/21 | *Halictus confusus* | F | 0 | 193 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 193 |
| 7/21 | *Halictus confusus* | F | 0 | 135 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 135 |
| 7/21 | *Halictus confusus* | F | 0 | 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 60 |
| 7/21 | *Halictus confusus* | F | 0 | 138 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 138 |
| 7/21 | *Halictus confusus* | F | 0 | 375 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 375 |
| 7/21 | *Halictus confusus* | F | 0 | 38 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 |

*Convolvulus arvensis*: Family Halictidae continued

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/21 | *Halictus confusus* | F | 0 | 358 | 0 | 55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 413 |
| 7/21 | *Halictus confusus* | F | 0 | 450 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 450 |
| 7/21 | *Halictus confusus* | F | 0 | 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 65 |
| 7/21 | *Halictus confusus* | F | 0 | 120 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 120 |
| 7/21 | *Halictus confusus* | F | 0 | 1050 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1050 |
| 7/21 | *Halictus confusus* | F | 0 | 113 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 113 |
| 7/21 | *Halictus confusus* | F | 0 | 300 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 300 |
| 7/21 | *Halictus confusus* | F | 2933 | 230 | 0 | 1955 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5118 |
| 7/21 | *Halictu confusus* | F | 0 | 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 65 |
| 7/21 | *Halictus confusus* | F | 0 | 150 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 150 |
| 7/21 | *Halictus confusus* | F | 65 | 2145 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2210 |
| 7/18 | *Halictus ligatus* | F | 440 | 55 | 0 | 3825 | 0 | 0 | 110 | 0 | 0 | 0 | 0 | 4430 |
| 7/18 | *Halictus ligatus* | F | 0 | 2398 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2398 |
| 7/21 | *Halictus ligatus* | M | 0 | 60 | 0 | 0 | 0 | 60 | 0 | 0 | 0 | 0 | 0 | 120 |
| 7/21 | *Halictus ligatus* | F | 550 | 3025 | 0 | 7645 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11220 |
| 7/21 | *Halictus ligatus* | F | 38 | 300 | 0 | 713 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1050 |
| 7/21 | *Halictus ligatus* | F | 28 | 0 | 0 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 55 |
| 7/18 | *Halictus virgatellus* | F | 0 | 225 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 225 |
| 7/18 | *Halictus virgatellus* | F | 0 | 85 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 85 |
| 7/21 | *Halictus virgatellus* | F | 83 | 908 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 990 |
| 7/21 | *Halictus virgatellus* | F | 0 | 6500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6500 |
| 7/21 | *Lasioglossum* spp. | M | 0 | 963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 963 |

*Convolvulus arvensis*: Family Halictidae continued

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/21 | *Lasioglossum* spp. | M | 0 | 75 | 0 | 0 | 0 | 38 | 0 | 0 | 0 | 0 | 0 | 113 |
| 7/21 | *Lasioglossum* spp. | spp. | F | 11875 | 125 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7/18 | *Lasioglossum* spp. | spp. | F | 0 | 230 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7/21 | *Lasioglossum* spp. | spp. | F | 0 | 150 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7/21 | *Lasioglossum* spp. | spp. | F | 0 | 450 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7/21 | *Lasioglossum* spp. | spp. | F | 0 | 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Convolvulus arvensis*: Family Megachilidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/18 | *Dianthidium* sp. 1 | M | 0 | 88 | 0 | 0 | 0 | 0 | 525 | 0 | 0 | 0 | 0 | 613 |
| 7/18 | *Dianthidium* sp. 1 | F | 0 | 270 | 0 | 263 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 533 |
| 7/21 | *Dianthidium* sp. 1 | F | 0 | 613 | 0 | 0 | 0 | 1750 | 0 | 0 | 0 | 0 | 0 | 2363 |
| 7/21 | *Dianthidium* sp. 1 | F | 2400 | 7860 | 0 | 613 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10873 |
| 7/21 | *Dianthidium* sp. 1 | M | 240 | 120 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 360 |
| 7/21 | *Dianthidium* sp. 1 | F | 0 | 65 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 71 |
| 7/21 | *Dianthidium* sp. 1 | F | 1575 | 6650 | 0 | 525 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8750 |
| 7/21 | *Megachile lippiae* | F | 600 | 12300 | 0 | 0 | 3600 | 0 | 0 | 0 | 0 | 0 | 0 | 16500 |

*Dalea candida*: Family Andrenidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Andrena p. prunorum* | M | 0 | 0 | 0 | 0 | 0 | 120 | 0 | 0 | 0 | 0 | 0 | 120 |
| 7/3 | *Calliopsis coloradensis* | F | 2450 | 100 | 0 | 2150 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4700 |

*Dalea candida*: Family Apidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8/15 | *Apis mellifera* | F | 69188 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 69188 |
| 7/18 | *Apis mellifera* | F | 372075 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 372075 |
| 7/13 | *Apis mellifera* | F | 7350 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7350 |
| 7/13 | *Apis mellifera* | F | 563 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 563 |
| 7/13 | *Apis mellifera* | F | 130 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 130 |
| 7/13 | *Apis mellifera* | F | 4418 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4418 |
| 7/13 | *Apis mellifera* | F | 650 | 0 | 0 | 0 | 0 | 98 | 0 | 0 | 0 | 33 | 0 | 780 |
| 7/13 | *Apis mellifera* | F | 14760 | 0 | 0 | 0 | 0 | 60 | 0 | 60 | 0 | 0 | 0 | 14880 |
| 7/13 | *Apis mellifera* | F | 21580 | 0 | 0 | 0 | 0 | 0 | 0 | 130 | 0 | 0 | 0 | 21710 |
| 7/13 | *Apis mellifera* | F | 825 | 0 | 0 | 0 | 0 | 38 | 0 | 0 | 0 | 0 | 0 | 863 |
| 7/13 | *Apis mellifera* | F | 24750 | 0 | 0 | 0 | 0 | 150 | 0 | 0 | 0 | 0 | 0 | 24900 |
| 7/13 | *Apis mellifera* | F | 767000 | 0 | 0 | 0 | 0 | 6500 | 0 | 0 | 0 | 0 | 0 | 773500 |
| 7/13 | *Apis mellifera* | F | 20550 | 0 | 0 | 188 | 0 | 38 | 0 | 0 | 0 | 0 | 0 | 20775 |
| 7/13 | *Apis mellifera* | F | 4388 | 130 | 0 | 293 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4810 |
| 7/13 | *Apis mellifera* | F | 990 | 30 | 0 | 0 | 0 | 30 | 0 | 0 | 0 | 0 | 0 | 1050 |
| 7/13 | *Apis mellifera* | F | 29708 | 0 | 0 | 128 | 0 | 510 | 0 | 0 | 0 | 0 | 0 | 30345 |
| 7/13 | *Apis mellifera* | F | 28500 | 0 | 0 | 0 | 0 | 1000 | 0 | 0 | 0 | 0 | 0 | 29500 |
| 7/13 | *Apis mellifera* | F | 301863 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 301863 |
| 7/13 | *Apis mellifera* | F | 173910 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 173910 |
| 7/13 | *Apis mellifera* | F | 4978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4978 |
| 7/13 | *Apis mellifera* | F | 1020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1020 |
| 7/13 | *Apis mellifera* | F | 963 | 0 | 0 | 28 | 0 | 165 | 0 | 0 | 0 | 0 | 0 | 1155 |

*Dalea candida*: Family Apidae continued

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Apis mellifera* | F | 236513 | 0 | 0 | 1050 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 237563 |
| 7/13 | *Apis mellifera* | F | 2008 | 0 | 0 | 138 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2145 |
| 7/13 | *Apis mellifera* | F | 12500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12500 |
| 7/13 | *Apis mellifera* | F | 180033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 180033 |
| 7/13 | *Apis mellifera* | F | 43625 | 0 | 0 | 125 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 43750 |
| 7/13 | *Apis mellifera* | F | 449500 | 0 | 0 | 1550 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 451050 |
| 7/13 | *Apis mellifera* | F | 46538 | 0 | 0 | 383 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 46920 |
| 7/13 | *Apis mellifera* | F | 2940 | 0 | 0 | 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3000 |
| 7/13 | *Apis mellifera* | F | 26008 | 0 | 0 | 2273 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28280 |
| 7/25 | *Apis mellifera* | F | 271625 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 271625 |
| 7/25 | *Apis mellifera* | F | 117500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 117500 |
| 7/25 | *Apis mellifera* | F | 320250 | 750 | 0 | 2250 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 323250 |
| 6/23 | *Apis mellifera* | F | 55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 55 |
| 7/13 | *Apis mellifera* | F | 59375 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 59375 |
| 8/11 | *Apis mellifera* | F | 430350 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 430350 |
| 7/10 | *Apis mellifera* | F | 37763 | 0 | 0 | 265 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38028 |
| 7/10 | *Apis mellifera* | F | 45675 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 45675 |
| 7/10 | *Apis mellifera* | F | 45675 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 45675 |
| 7/10 | *Apis mellifera* | F | 83000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 83000 |
| 7/10 | *Apis mellifera* | F | 190 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 190 |
| 7/10 | *Apis mellifera* | F | 197400 | 0 | 0 | 525 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 197925 |
| 7/10 | *Apis mellifera* | F | 24300 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24300 |

*Dalea candida*: Family Apidae continued

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/10 | *Apis mellifera* | F | 36250 | 0 | 0 | 250 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 36500 |
| 7/10 | *Apis mellifera* | F | 9350 | 0 | 0 | 550 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9900 |
| 7/13 | *Bombus griseocollis* | F | 2008 | 0 | 0 | 0 | 0 | 55 | 0 | 0 | 0 | 0 | 0 | 2063 |
| 7/13 | *Bombus griseocollis* | F | 110000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 110000 |
| 7/13 | *Bombus griseocollis* | F | 1725 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1725 |
| 8/15 | *Bombus griseocollis* | M | 600 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 600 |
| 7/3 | *Bombus griseocollis* | F | 185153 | 0 | 0 | 0 | 1552960 | 3165 | 0 | 0 | 0 | 0 | 0 | 1741278 |
| 7/3 | *Bombus griseocollis* | F | 372000 | 5600 | 0 | 0 | 0 | 2400 | 0 | 0 | 0 | 0 | 0 | 380000 |
| 7/13 | *Bombus griseocollis* | F | 2008 | 0 | 0 | 0 | 0 | 55 | 0 | 0 | 0 | 0 | 0 | 2063 |
| 7/13 | *Bombus griseocollis* | F | 110000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 110000 |
| 7/13 | *Bombus griseocollis* | F | 1725 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1725 |
| 7/3 | *Bombus griseocollis* | F | 185153 | 0 | 0 | 0 | 1552960 | 3165 | 0 | 0 | 0 | 0 | 0 | 1741278 |
| 7/3 | *Bombus griseocollis* | F | 372000 | 5600 | 0 | 0 | 0 | 2400 | 0 | 0 | 0 | 0 | 0 | 380000 |
| 7/25 | *Bombus griseocollis* | F | 232050 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 232050 |
| 7/25 | *Bombus griseocollis* | F | 314050 | 0 | 0 | 0 | 0 | 275 | 0 | 0 | 0 | 0 | 0 | 314325 |
| 7/25 | *Bombus grsieocollis* | F | 1057800 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1057800 |
| 7/25 | *Bombus griseocollis* | F | 707630 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 707630 |
| 7/25 | *Bombus griseocollis* | F | 44375 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 44375 |
| 7/25 | *Bombus griseocollis* | F | 1398100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1398100 |
| 7/25 | *Bombus griseocollis* | F | 105040 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 105040 |
| 8/11 | *Bombus griseocollis* | F | 98500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 98500 |

*Dalea candida*: Family Apidae continued

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8/15 | *Bombus griseocollis* | F | 360 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 360 |
| 8/15 | *Bombus griseocollis* | F | 2860 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2860 |
| 7/10 | *Bombus griseocollis* | F | 528938 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 528938 |
| 7/10 | *Bombus griseocollis* | F | 18870 | 3910 | 0 | 170 | 55930 | 0 | 0 | 0 | 0 | 0 | 0 | 78880 |
| 7/10 | *Bombus griseocollis* | F | 132600 | 0 | 0 | 510 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 133110 |
| 7/10 | *Bombus griseocolls* | F | 665725 | 0 | 100750 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 766475 |
| 7/10 | *Bombus griseocollis* | F | 361150 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 361150 |
| 7/10 | *Bombus griseocollis* | F | 233500 | 12500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 246000 |
| 7/10 | *Bombus griseocollis* | F | 267750 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 267750 |
| 7/10 | *Bombus griseocollis* | F | 18000 | 0 | 0 | 75 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18075 |
| 7/10 | *Bombus griseocollis* | F | 245175 | 0 | 0 | 125 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 245300 |
| 7/10 | *Bombus griseocollis* | F | 865000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 865000 |
| 7/10 | *Bombus griseocollis* | F | 673960 | 0 | 0 | 3000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 676960 |
| 7/10 | *Bombus griseocollis* | F | 116550 | 0 | 0 | 500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 117050 |
| 7/10 | *Bombus grisecollis* | F | 687305 | 0 | 0 | 278 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 687583 |
| 7/18 | *Bombus griseocollis* | F | 570180 | 3900 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 574080 |
| 7/18 | *Bombus griseocollis* | F | 150 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 150 |
| 7/18 | *Bombus griseocollis* | F | 2125 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2125 |
| 7/18 | *Bombus griseocollis* | F | 92055 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 92055 |
| 7/18 | *Bombus griseocollis* | F | 324975 | 1050 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 326025 |
| 7/13 | *Bombus griseocollis* | F | 12265 | 1815 | 0 | 0 | 1815 | 0 | 0 | 0 | 0 | 0 | 0 | 15895 |
| 7/13 | *Bombus griseocollis* | F | 1050 | 0 | 0 | 75 | 0 | 113 | 0 | 0 | 0 | 0 | 0 | 1238 |

*Dalea candida*: Family Apidae continued

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Bombus griseocollis* | F | 11055 | 0 | 0 | 0 | 0 | 55 | 0 | 0 | 0 | 0 | 0 | 11110 |
| 7/13 | *Bombus griseocollis* | F | 54288 | 0 | 0 | 0 | 253 | 0 | 0 | 0 | 0 | 0 | 0 | 54540 |
| 7/13 | *Bombus griseocollis* | F | 130200 | 0 | 0 | 0 | 25200 | 0 | 0 | 0 | 0 | 0 | 0 | 155400 |
| 7/13 | *Bombus griseocollis* | F | 77750 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 77750 |
| 7/13 | *Bombus griseocollis* | F | 187650 | 0 | 0 | 0 | 1800 | 0 | 0 | 0 | 0 | 450 | 0 | 189900 |
| 8/11 | *Bombus huntii* | F | 349500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 349500 |
| 8/11 | *Bombus huntii* | F | 525 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 525 |
| 8/15 | *Bombus huntii* | F | 33 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33 |
| 8/15 | *Bombus huntii* | F | 1073 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1073 |
| 7/25 | *Bombus huntii* | F | 1360163 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1360163 |
| 7/25 | *Bombus huntii* | F | 98500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 98500 |
| 7/25 | *Bombus huntii* | F | 790900 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 790900 |
| 8/15 | *Bombus huntii* | F | 630 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 630 |
| 7/13 | *Melissodes* sp. 2 | M | 113 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 113 |

*Dalea candida*: Family Colletidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Colletes petalostemonis* | F | 44100 | 70 | 0 | 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 44240 |
| 7/13 | *Colletes petalostemonis* | F | 1850 | 0 | 0 | 0 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 1900 |
| 7/13 | *Colletes petalostemonis* | M | 150 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 150 |
| 7/13 | *Colletes petalostemonis* | F | 31125 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 31125 |
| 7/13 | *Colletes petalostemonis* | F | 11825 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11825 |
| 7/13 | *Colletes petalostemonis* | F | 51383 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 51383 |

*Dalea candida*: Family Colletidae continued

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Colletes petalostemonis* | F | 4615 | 0 | 0 | 0 | 0 | 33 | 0 | 0 | 0 | 0 | 0 | 4648 |
| 7/13 | *Colletes petalostemonis* | M | 660 | 0 | 0 | 0 | 0 | 60 | 0 | 0 | 0 | 0 | 0 | 720 |
| 6/23 | *Colletes petalostemonis* | M | 275 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 275 |
| 7/10 | *Colletes petalostemonis* | F | 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2000 |
| 8/15 | *Colletes phaceliae* | F | 640 | 40 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 680 |
| 7/10 | *Colletes phaceliae* | F | 52785 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 52785 |
| 7/18 | *Colletes phaceliae* | F | 228 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 228 |
| 7/18 | *Colletes phaceliae* | F | 488 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 488 |
| 7/13 | *Colletes phaceliae* | F | 2818 | 0 | 920 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3738 |
| 7/13 | *Colletes phaceliae* | F | 8280 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8280 |
| 7/13 | *Colletes phaceliae* | M | 193 | 0 | 0 | 55 | 0 | 28 | 0 | 0 | 0 | 0 | 0 | 275 |
| 7/13 | *Colletes phaceliae* | M | 245 | 0 | 0 | 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 315 |
| 7/13 | *Colletes phaceliae* | F | 28875 | 0 | 0 | 0 | 0 | 105 | 0 | 0 | 0 | 0 | 0 | 28980 |
| 7/13 | *Colletes phaceliae* | F | 22620 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 23140 |
| 7/25 | *Colletes phaceliae* | F | 8905 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8905 |
| 7/25 | *Colletes phaceliae* | F | 13140 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13140 |
| 7/25 | *Colletes phaceliae* | F | 92750 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 92750 |
| 7/13 | *Colletes phaceliae* | F | 1830 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1830 |
| 8/11 | *Colletes phaceliae* | M | 83 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 83 |
| 8/11 | *Colletes phaceliae* | F | 67500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 67500 |
| 8/15 | *Colletes phaceliae* | F | 1348 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1348 |

*Dalea candida*: Family Crabronidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8/15 | *Cerceris frontata* | M | 2990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2990 |
| 7/25 | *Cerceris frontata* | F | 48000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 48000 |
| 7/25 | *Eucerceris superba bicolor* | F | 1020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1020 |
| 7/10 | *Eucerceris s uperba bicolor* | M | 193 | 0 | 0 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 220 |
| 7/13 | *Stictiella* sp. | M | 863 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 863 |
| 7/13 | *Tachytes* sp. | M | 150 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 150 |
| 7/25 | *Tachytes sayi* | F | 3465 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3465 |
| 7/25 | *Tachytes sayi* | M | 1050 | 0 | 0 | 0 | 0 | 35 | 0 | 0 | 0 | 0 | 0 | 1085 |
| 7/25 | *Tachytes sayi* | M | 81250 | 0 | 0 | 0 | 780 | 260 | 0 | 0 | 130 | 0 | 0 | 82420 |
| 7/25 | *Tachytes sayi* | M | 495 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 495 |
| 7/25 | *Tachytes sayi* | F | 4170 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4170 |
| 7/13 | *Tachytes sayi* | F | 55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 55 |

*Dalea candida*: Family Halictidae

| Date | Genus | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8/15 | *Agapostemon angelicus* | M | 468 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 468 |
| 7/18 | *Agapostemon angelicus/texanus* | F | 240 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 240 |
| 7/18 | *Agapostemon angelicus/texanus* | F | 35100 | 260 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 47320 |
| 7/18 | *Agapostemon angelicus/texanus* | F | 30 | 0 | 0 | 0 | 0 | 60 | 0 | 0 | 0 | 0 | 0 | 90 |
| 7/18 | *Agapostemon angelicus/texanus* | F | 71205 | 3788 | 0 | 0 | 0 | 4040 | 0 | 0 | 0 | 0 | 0 | 90900 |
| 7/13 | *Agapostemon angelicus/texanus* | F | 38740 | 780 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 39650 |

*Dalea candida*: Family Halictidae continued

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Agapostemon angelicus/texanus* | F | 4750 | 1875 | 250 | 0 | 0 | 250 | 0 | 0 | 0 | 313 | 0 | 7438 |
| 7/13 | *Agapostemon angelicus/texanus* | F | 750 | 75 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 825 |
| 7/25 | *Agapostemon angelicus/texanus* | F | 4888 | 0 | 0 | 0 | 0 | 3278 | 0 | 0 | 690 | 0 | 0 | 8855 |
| 7/25 | *Agapostemon angelicus/texanus* | F | 36658 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 36658 |
| 7/25 | *Agapostemon angelicus/texanus* | F | 4083 | 575 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4658 |
| 7/25 | *Agapostemon angelicus/texanus* | F | 963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 963 |
| 8/15 | *Agapostemon femoratus* | M | 360 | 0 | 0 | 45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 405 |
| 8/11 | *Agapostemon texanus* | M | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28 |
| 7/13 | *Agapostemon virescens* | F | 0 | 70760 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 70760 |
| 8/11 | *Halictus confusus* | M | 5310 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5310 |
| 8/11 | *Halictus confusus* | M | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 |
| 7/13 | *Halictus ligatus* | | 27795 | 85 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27880 |
| 7/13 | *Halictus ligatus* | | 275 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 275 |
| 7/13 | *Halictus ligatus* | F | 27750 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27750 |
| 7/25 | *Halictus ligatus* | F | 630 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 630 |
| 7/25 | *Halictus ligatus* | F | 62620 | 0 | 0 | 2525 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 65145 |
| 7/10 | *Halictus ligatus* | F | 375 | 0 | 0 | 23250 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 23625 |
| 7/10 | *Halictus rubicundus* | F | 5003 | 0 | 0 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5030 |
| 7/18 | *Halictus rubicundus* | F | 180608 | 1035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 181643 |
| 7/13 | *Halictus rubicundus* | F | 1800 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1800 |
| 7/13 | *Halictus rubicundus* | M | 83 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 83 |
| 7/13 | *Halictus virgatellus* | F | 11248 | 303 | 0 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11578 |

*Dalea candida*: Family Halictidae continued

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Lasioglossum* spp. | F | 110 | 55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 165 |
| 7/13 | *Lasioglossum* spp. | F | 3320 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3320 |
| 7/13 | *Lasioglossum* spp. | F | 8085 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8085 |
| 7/25 | *Lasioglossum* spp. | F | 990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 990 |
| 6/23 | *Lasioglossum* spp. | F | 120 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 120 |
| 6/23 | *Lasioglossum* spp. | F | 1470 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1470 |
| 6/23 | *Lasioglossum* spp. | F | 4345 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4345 |
| 7/13 | *Lasioglossum* spp. | F | 4500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4500 |
| 7/13 | *Lasioglossum* spp. | F | 33005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33005 |
| 7/13 | *Lasioglossum* spp. | F | 5310 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5340 |

*Dalea candida*: Family Megachilidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/10 | *Coelioxys mesae* | M | 105 | 0 | 0 | 250 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 355 |
| 7/3 | *Heriades carinata* | F | 68080 | 320 | 0 | 0 | 0 | 880 | 0 | 0 | 0 | 0 | 0 | 69280 |
| 7/25 | *Megachile lippiae* | F | 12355 | 0 | 0 | 0 | 140 | 35 | 0 | 0 | 0 | 0 | 0 | 12530 |
| 7/25 | *Megachile lippiae* | F | 187680 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 187680 |
| 7/13 | *Megachile lippiae* | F | 3250 | 6000 | 0 | 0 | 268000 | 0 | 0 | 0 | 0 | 0 | 0 | 277250 |

*Dalea candida*: Family Sphecidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/18 | *Podalonia* sp. | F | 1225 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1225 |
| 7/25 | *Podalonia* sp. | M | 9438 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9438 |
| 7/13 | *Prionyx canadensis* | F | 1750 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1750 |
| 7/10 | *Prionyx canadensis* | F | 13750 | 0 | 0 | 563 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14313 |
| 7/18 | *Prionyx canadensis* | F | 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 63 |
| 7/10 | *Sphex ichneumoneus* | F | 450 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 450 |
| 7/18 | *Sphex ichneumoneus* | F | 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 68 |
| 7/18 | *Sphex ichneumoneus* | F | 250 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 250 |
| 7/18 | *Sphex ichneumoneus* | F | 85 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 85 |
| 7/13 | *Sphex ichneumoneus* | F | 0 | 0 | 0 | 105 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 105 |
| 7/13 | *Sphex ichneumoneus* | M | 0 | 788 | 0 | 0 | 0 | 0 | 0 | 219713 | 0 | 0 | 0 | 220500 |
| 7/13 | *Sphex ichneumoneus* | F | 105 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 105 |
| 7/13 | *Sphex ichneumoneus* | F | 690 | 0 | 0 | 0 | 0 | 30 | 0 | 0 | 30 | 0 | 0 | 750 |
| 7/13 | *Sphex ichneumoneus* | F | 105 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 105 |
| 7/13 | *Sphex ichneumoneus* | M | 195 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 195 |
| 7/13 | *Sphex ichneumoneus* | F | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28 |
| 8/11 | *Sphex ichneumoneus* | F | 220 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 220 |
| 7/10 | *Sphex ichneumoneus* | M | 550 | 0 | 0 | 150 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 700 |
| 7/13 | *Sphex ichneumoneus* | F | 1430 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1430 |
| 7/3 | *Sphex ichneumoneus* | F | 810 | 30 | 0 | 570 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1410 |
| 7/3 | *Sphex ichneumoneus* | M | 510 | 0 | 0 | 810 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1320 |
| 7/3 | *Sphex ichneumoneus* | F | 1008 | 65 | 0 | 943 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2015 |
| 7/25 | *Sphex ichneumoneus* | F | 138 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 138 |
| 7/13 | *Sphex ichneumoneus* | F | 358 | 0 | 0 | 0 | 0 | 98 | 0 | 0 | 0 | 0 | 0 | 455 |

*Dalea candida*: Family Sphecidae continued

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/25 | *Sphex ichneumoneus* | F | 193 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 193 |
| 6/23 | *Sphex ichneumoneus* | F | 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 65 |
| 7/13 | *Sphex ichneumoneus* | F | 1275 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1275 |
| 8/15 | *Sphex ichneumoneus* | F | 85 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 85 |
| 7/10 | *Sphex ichneumoneus* | F | 2153 | 105 | 0 | 298 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2555 |

*Lotus corniculatus*: Family Apidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/21 | *Apis mellifera* | F | 0 | 0 | 63 | 0 | 17063 | 0 | 0 | 0 | 0 | 0 | 0 | 17125 |

*Lotus corniculatus*: Family Megachilidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/21 | *Anthidium* sp. 1 | M | 0 | 150 | 0 | 0 | 5138 | 0 | 975 | 0 | 0 | 0 | 0 | 6263 |
| 7/21 | *Dianthidium* sp. 1 | F | 39128 | 833 | 0 | 0 | 14985 | 0 | 0 | 0 | 0 | 0 | 0 | 54945 |
| 7/21 | *Megachile concinna* | M | 0 | 150 | 0 | 0 | 2663 | 113 | 0 | 0 | 0 | 0 | 0 | 2925 |
| 7/21 | *Megachile brevis* | F | 225 | 525 | 0 | 0 | 300 | 0 | 0 | 0 | 0 | 0 | 0 | 1050 |
| 7/21 | *Megachile brevis* | F | 0 | 1275 | 765 | 0 | 95370 | 0 | 70890 | 0 | 0 | 0 | 0 | 168300 |
| 7/21 | *Megachile brevis* | F | 173058 | 0 | 0 | 0 | 5075 | 0 | 0 | 0 | 0 | 0 | 0 | 178133 |
| 7/21 | *Megachile brevis* | F | 0 | 58 | 0 | 38 | 0 | 0 | 2358 | 0 | 0 | 0 | 0 | 2453 |
| 7/21 | *Megachile lippiae* | F | 46800 | 0 | 130 | 2040 | 86580 | 0 | 0 | 0 | 0 | 0 | 0 | 135550 |
| 7/21 | *Megachile rotundata* | M | 0 | 98 | 0 | 0 | 98 | 98 | 0 | 0 | 0 | 0 | 0 | 293 |

*Ratibida columnifera*: Family Apidae

| Date | Genus | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/18 | *Apis mellifera* | F | 278 | 0 | 0 | 24938 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25215 |
| 7/18 | *Apis mellifera* | F | 0 | 0 | 0 | 58553 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 58553 |
| 7/13 | *Apis mellifera* | F | 1000 | 0 | 0 | 60000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 61000 |
| 7/13 | *Apis mellifera* | F | 0 | 0 | 0 | 6720 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6720 |
| 7/18 | *Bombus huntii* | F | 139000 | 0 | 0 | 1500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 140500 |
| 7/13 | *Bombus huntii* | F | 750 | 250 | 0 | 19313 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20313 |
| 7/13 | *Bombus huntii* | F | 0 | 0 | 0 | 8415 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8415 |
| 7/13 | *Bombus huntii* | F | 0 | 4200 | 0 | 25200 | 0 | 0 | 1241100 | 0 | 0 | 0 | 0 | 1270500 |
| 7/13 | *Bombus griseocollis* | F | 75 | 750 | 0 | 7200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8025 |
| 7/13 | *Bombus griseocollis* | F | 55 | 0 | 0 | 29260 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 29315 |
| 7/18 | *Diadasia* sp. 1 | F | 0 | 0 | 0 | 59175 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 59175 |
| 7/18 | *Melissodes* sp. 1 | F | 0 | 0 | 0 | 5E+05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 475410 |
| 7/18 | *Melissodes* sp. 1 | M | 880 | 0 | 0 | 5040 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5920 |
| 7/18 | *Melissodes* sp. 1 | F | 0 | 0 | 0 | 1E+05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 146850 |
| 7/18 | *Melissodes* sp. 1 | F | 0 | 0 | 0 | 4E+05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 367950 |
| 7/18 | *Melissodes* sp. 1 | M | 165 | 0 | 0 | 1E+05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 123365 |
| 7/18 | *Melissodes* sp. 1 | M | 0 | 0 | 0 | 110 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 110 |
| 7/21 | *Melissodes* sp. 1 | F | 0 | 1500 | 0 | 3E+05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 315608 |
| 7/21 | *Melissodes* sp. 1 | F | 513 | 0 | 0 | 3E+05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 305763 |
| 7/21 | *Melissodes* sp. 1 | F | 9450 | 0 | 11550 | 3E+05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 325425 |
| 7/13 | *Melissodes* sp. 1 | F | 470 | 705 | 0 | 95880 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 97055 |
| 7/13 | *Melissodes* sp. 1 | F | 3105 | 0 | 0 | 9E+05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 870435 |
| 7/13 | *Melissodes* sp. 1 | F | 3038 | 0 | 0 | 7E+05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 695588 |
| 7/13 | *Melissodes* sp. 1 | M | 130 | 0 | 0 | 12220 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12350 |

*Ratibida columnifera*: Family Apidae continued

| Date | Genus | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Melissodes* sp. 1 | M | 30 | 0 | 0 | 3960 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3990 |
| 7/13 | *Melissodes* sp. 1 | F | 0 | 0 | 0 | 1E+06 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 983250 |
| 7/13 | *Melissodes* sp. 1 | M | 0 | 0 | 0 | 4560 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4560 |
| 7/13 | *Melissodes* sp. 1 | M | 83 | 0 | 0 | 4483 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4565 |
| 7/13 | *Melissodes* sp. 1 | M | 30 | 60 | 0 | 4770 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4860 |
| 7/13 | *Melissodes* sp. 1 | M | 0 | 0 | 0 | 4550 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4550 |
| 7/13 | *Triepeolis* sp. 1 | M | 0 | 0 | 0 | 713 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 713 |

*Ratibida columnifera*: Family Crabronidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Bicyrtes* sp. | M | 0 | 0 | 0 | 220 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 220 |
| 7/10 | *Bicyrtes* sp. | M | 0 | 0 | 0 | 90 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 90 |
| 7/18 | *Tachytes sayi* | F | 0 | 0 | 0 | 278 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 278 |
| 7/13 | *Tachytes sayi* | M | 0 | 0 | 0 | 13455 | 0 | 0 | 1380 | 0 | 0 | 0 | 0 | 14835 |
| 7/13 | *Tachytes sayi* | M | 250 | 125 | 0 | 14563 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14938 |

*Ratibida columnifera*: Family Halictidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Agapostemon angelicus/texanus* | F | 0 | 0 | 0 | 18480 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18480 |
| 7/13 | *Agapostemon angelicus/texanus* | F | 0 | 125 | 0 | 13563 | 0 | 0 | 63 | 0 | 0 | 0 | 0 | 13750 |
| 7/18 | *Halictus ligatus* | F | 0 | 0 | 0 | 2E+05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 182325 |
| 7/18 | *Halictus ligatus* | F | 0 | 0 | 0 | 78400 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 78400 |

*Ratibida columnifera*: Family Halictidae continued

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/18 | *Halictus ligatus* | F | 0 | 0 | 0 | 24160 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24160 |
| 7/18 | *Halictus ligatus* | F | 5775 | 275 | 0 | 3E+05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 353250 |
| 7/21 | *Halictus ligatus* | F | 263 | 0 | 0 | 1E+05 | 1050 | 0 | 0 | 0 | 0 | 0 | 0 | 118188 |
| 7/13 | *Halictus ligatus* | F | 513 | 0 | 0 | 2E+05 | 0 | 513 | 0 | 0 | 0 | 0 | 0 | 173738 |
| 7/13 | *Halictus ligatus* | F | 0 | 0 | 0 | 1E+05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 113043 |
| 7/13 | *Halictus ligatus* | F | 250 | 0 | 0 | 1E+05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 102000 |
| 7/13 | *Halictus ligatus* | F | 780 | 0 | 0 | 45760 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 46540 |
| 7/13 | *Halictus ligatus* | F | 0 | 0 | 0 | 2E+05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 174070 |
| 7/13 | *Halictus ligatus* | F | 0 | 0 | 0 | 1E+05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 119480 |
| 7/13 | *Halictus ligatus* | F | 0 | 0 | 0 | 60250 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 60250 |
| 7/13 | *Halictus ligatus* | F | 280 | 0 | 0 | 9440 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9720 |
| 7/13 | *Halictus ligatus* | F | 0 | 0 | 0 | 15938 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15938 |
| 7/10 | *Halictus ligatus* | F | 500 | 0 | 0 | 10313 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10813 |

*Ratibida columnifera*: Family Megachilidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/18 | *Coelioxys* mesae | M | 0 | 0 | 0 | 29000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 29000 |
| 7/13 | *Coelioxys* mesae | M | 350 | 0 | 0 | 2485 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2835 |
| 7/13 | *Coelioxys* mesae | M | 0 | 65 | 0 | 1723 | 0 | 0 | 33 | 0 | 0 | 0 | 0 | 1820 |
| 7/18 | *Dianthidium* sp. 1 | F | 0 | 1420 | 0 | 3150 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4570 |

*Ratibida columnifera*: Family Megachilidae continued

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/18 | *Megachile parallela* | F | 588 | 0 | 0 | 6E+05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 574788 |
| 7/18 | *Megachile parallela* | F | 290 | 0 | 0 | 3E+05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 281703 |
| 7/21 | *Megachile parallela* | F | 780 | 0 | 4680 | 0 | 0 | 542100 | 0 | 0 | 0 | 0 | 0 | 547560 |
| 7/21 | *Megachile parallela* | M | 0 | 0 | 0 | 56160 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 56160 |
| 7/13 | *Megachile parallela* | F | 188 | 0 | 0 | 6688 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6875 |
| 7/13 | *Megachile parallela* | M | 0 | 0 | 0 | 1760 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1760 |
| 7/13 | *Megachile parallela* | F | 3075 | 0 | 0 | 1E+06 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1448325 |
| 7/10 | *Megachile parallela* | M | 200 | 0 | 0 | 1000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1200 |
| 7/10 | *Megachile parallela* | M | 165 | 0 | 0 | 1348 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1513 |
| 7/10 | *Megachile rotundata* | F | 1750 | 0 | 0 | 500 | 0 | 0 | 0 | 0 | 14250 | 0 | 0 | 16500 |

*Ratibida columnifera*: Family Vespidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Euodynerus* sp. | M | 1138 | 0 | 0 | 813 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1950 |
| 7/13 | *Euodynerus* sp. | F | 28 | 0 | 0 | 495 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 523 |
| 7/13 | *Euodynerus* sp. | M | 0 | 0 | 0 | 510 | 0 | 0 | 0 | 0 | 0 | 0 | 90 | 600 |
| 7/13 | *Odynerus* sp. | F | 248 | 0 | 0 | 2750 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2998 |

*Ratibida columnifera*: Family Scoliidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Trielis octomaculata* | F | 0 | 0 | 0 | 24585 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24585 |

*Sonchus* sp.: Family Apidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Apis mellifera* | F | 103 | 205 | 0 | 0 | 0 | 513 | 0 | 513 | 0 | 20193 | 0 | 21525 |
| 7/13 | *Apis mellifera* | F | 0 | 195 | 0 | 0 | 0 | 780 | 0 | 1268 | 0 | 15503 | 0 | 17745 |
| 7/13 | *Apis mellifera* | F | 0 | 138 | 0 | 0 | 0 | 275 | 0 | 963 | 0 | 16500 | 0 | 17875 |
| 7/13 | *Apis mellifera* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1075 | 0 | 350988 | 0 | 352063 |
| 7/13 | *Apis mellifera* | F | 0 | 1480 | 0 | 0 | 0 | 0 | 740 | 555 | 0 | 26270 | 0 | 29045 |
| 7/13 | *Apis mellifera* | F | 0 | 4200 | 0 | 0 | 2100 | 0 | 0 | 1575 | 0 | 74550 | 0 | 82425 |
| 7/13 | *Apis mellifera* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 253 | 0 | 16918 | 0 | 17170 |
| 7/13 | *Apis mellifera* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 255 | 0 | 6375 | 20528 | 27158 |
| 7/13 | *Apis mellifera* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 128 | 0 | 7905 | 0 | 8033 |
| 7/13 | *Apis mellifera* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1605 | 0 | 303345 | 0 | 304950 |
| 7/13 | *Apis mellifera* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 405 | 0 | 9585 | 0 | 9990 |
| 7/13 | *Apis mellifera* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1313 | 0 | 40163 | 0 | 41475 |
| 7/13 | *Apis mellifera* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 175 | 0 | 19338 | 0 | 19513 |
| 7/13 | *Apis mellifera* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 263 | 0 | 44888 | 0 | 45150 |
| 7/13 | *Apis mellifera* | F | 1530 | 16320 | 0 | 0 | 0 | 765 | 0 | 0 | 0 | 0 | 0 | 18615 |
| 7/13 | *Apis mellifera* | F | 1545 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17253 | 0 | 18798 |
| 7/13 | *Apis mellifera* | F | 265 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6625 | 0 | 6890 |
| 7/13 | *Apis mellifera* | F | 2060 | 0 | 0 | 0 | 258 | 0 | 0 | 0 | 0 | 8755 | 0 | 11073 |
| 7/13 | *Apis mellifera* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7613 | 0 | 7613 |
| 7/18 | *Bombus centralis* | M | 2640 | 0 | 400 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3040 |
| 7/13 | *Bombus huntii* | F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 298 | 723 | 1020 |
| 7/13 | *Bombus mixtus* | M | 0 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 |

*Sonchus* sp.: Family Halictidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Halictus rubicundus* | F | 0 | 35 | 0 | 0 | 0 | 0 | 525 | 0 | 0 | 0 | 0 | 560 |
| 7/13 | *Lasioglossum* spp. | F | 8085 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8085 |

*Sonchus* sp.: Family Sphecidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/21 | *Sphex ichneumoneus* | F | 33 | 163 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 195 |

*Symphyotrichum chilensis* sp.: Family Apidae

| Date | Genus | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Apis mellifera* | F | 0 | 520 | 149760 | 0 | 0 | 2080 | 0 | 0 | 0 | 0 | 0 | 152360 |
| 7/13 | *Apis mellifera* | F | 90 | 30 | 11370 | 1170 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12660 |
| 7/18 | *Melissodes* sp. 1 | F | 3478 | 0 | 12840 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16318 |
| 7/18 | *Melissodes* sp. 1 | F | 105 | 0 | 2870 | 0 | 0 | 770 | 0 | 0 | 0 | 0 | 0 | 3745 |
| 7/18 | *Melissodes* sp. 1 | F | 250 | 0 | 18000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18250 |
| 7/18 | *Melissodes* sp. 1 | F | 0 | 0 | 600 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 600 |
| 7/18 | *Melissodes* sp. 1 | F | 0 | 0 | 78110 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 78110 |
| 7/18 | *Melissodes* sp. 1 | F | 4260 | 0 | 114488 | 0 | 0 | 12248 | 0 | 0 | 0 | 0 | 0 | 130995 |
| 7/18 | *Melissodes* sp. 1 | F | 290 | 0 | 9570 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9860 |
| 7/18 | *Melissodes* sp. 1 | F | 0 | 0 | 12875 | 0 | 0 | 2318 | 0 | 0 | 0 | 0 | 0 | 15193 |
| 7/21 | *Melissodes* sp. 1 | F | 758 | 505 | 84588 | 0 | 0 | 1768 | 0 | 0 | 0 | 0 | 0 | 87618 |
| 7/21 | *Melissodes* sp. 1 | F | 0 | 0 | 1900 | 0 | 0 | 200 | 0 | 0 | 0 | 0 | 0 | 2100 |
| 7/21 | *Melissodes* sp. 1 | F | 513 | 0 | 147600 | 0 | 0 | 2563 | 0 | 0 | 0 | 0 | 0 | 150675 |
| 7/21 | *Melissodes* sp. 1 | F | 308 | 308 | 19065 | 0 | 0 | 1845 | 0 | 0 | 0 | 0 | 0 | 21525 |
| 7/13 | *Melissodes* sp. 1 | F | 0 | 0 | 3245 | 660 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3905 |

*Symphyotrichum chilensis* sp.: Family Apidae continued

| Date | Genus | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13 | *Melissodes* sp. 1 | F | 0 | 0 | 51758 | 258 | 0 | 0 | 515 | 0 | 0 | 0 | 0 | 52530 |
| 7/13 | *Melissodes* sp. 1 | F | 525 | 0 | 109200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 109725 |
| 7/13 | *Melissodes* sp. 1 | F | 0 | 0 | 31250 | 4500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 35750 |
| 7/13 | *Melissodes* sp. 1 | M | 0 | 0 | 14750 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14750 |
| 7/18 | *Melissodes* sp. 2 | F | 0 | 1450 | 283475 | 0 | 0 | 5075 | 0 | 0 | 0 | 0 | 0 | 290000 |
| 7/18 | *Melissodes* sp. 3 | F | 0 | 705 | 248160 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 248865 |
| 7/21 | *Melissodes* sp. 3 | F | 0 | 1300 | 13488 | 0 | 0 | 40463 | 0 | 0 | 0 | 0 | 0 | 55250 |
| 7/13 | *Melissodes* sp. 3 | F | 0 | 0 | 2925 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 675 | 3600 |
| 7/13 | *Melissodes* sp. 3 | F | 0 | 0 | 123113 | 0 | 0 | 503 | 0 | 0 | 0 | 0 | 0 | 123615 |
| 7/13 | *Melissodes* sp. 3 | F | 0 | 0 | 23265 | 0 | 0 | 0 | 165 | 0 | 0 | 0 | 0 | 23430 |
| 7/13 | *Melissodes* sp. 3 | F | 600 | 0 | 232200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 232800 |
| 7/13 | *Melissodes* sp. 3 | F | 750 | 250 | 58750 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 59750 |
| 7/13 | *Melissodes* sp. 3 | F | 0 | 0 | 78120 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 78120 |

*Symphyotrichum chilensis* sp.: Family Halictidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/18 | *Halictus ligatus* | F | 1130 | 0 | 36725 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 37855 |
| 7/18 | *Halictus ligatus* | F | 0 | 0 | 24360 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24360 |
| 7/21 | *Halictus ligatus* | F | 0 | 0 | 5775 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5775 |
| 7/21 | *Halictus ligatus* | F | 630 | 0 | 12600 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13230 |
| 7/21 | *Halictus ligatus* | F | 0 | 0 | 15750 | 0 | 0 | 450 | 0 | 0 | 0 | 0 | 0 | 16200 |
| 7/21 | *Halictus ligatus* | F | 133 | 0 | 10600 | 0 | 0 | 133 | 0 | 0 | 0 | 0 | 0 | 10865 |
| 7/21 | *Halictus ligatus* | F | 0 | 130 | 61750 | 0 | 0 | 260 | 390 | 0 | 0 | 0 | 0 | 62530 |

*Symphyotrichum chilensis* sp.: Family Halictidae continued

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/21 | *Halictus ligatus* | F | 0 | 0 | 4785 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4785 |
| 7/21 | *Halictus ligatus* | F | 0 | 0 | 10238 | 0 | 0 | 813 | 0 | 0 | 0 | 0 | 0 | 11050 |
| 7/13 | *Halictus ligatus* | F | 0 | 0 | 2698 | 293 | 0 | 0 | 845 | 0 | 0 | 0 | 0 | 3835 |
| 7/13 | *Halictus ligatus* | F | 0 | 0 | 24990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24990 |
| 7/13 | *Halictus ligatus* | F | 0 | 0 | 9488 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9488 |
| 7/13 | *Halictus ligatus* | F | 0 | 0 | 5125 | 313 | 0 | 0 | 125 | 0 | 0 | 0 | 0 | 5563 |
| 7/13 | *Halictus ligatus* | F | 0 | 0 | 17875 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17875 |
| 7/13 | *Halictus ligatus* | F | 0 | 0 | 31238 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 31238 |

*Symphyotrichum chilensis* sp.: Family Megachilidae

| Date | Species | Sex | DC | BW | A | CF | BFTF | CT | SC | Y | Cic | Sow | Snow | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/21 | *Ashmeadiella* sp. 1 | F | 0 | 0 | 38100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38100 |
| 7/18 | *Dianthidium* sp. 1 | M | 0 | 163 | 195 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 358 |
| 7/21 | *Dianthidium* sp. 1 | M | 0 | 0 | 225 | 0 | 0 | 38 | 0 | 0 | 0 | 0 | 0 | 263 |

APPENDIX D

TRAP NEST DATA

**Keys to Table**

Tube ID denotes collection date/capped date and the number represent the number of trap nest tubes collected on that date.

A = 7/10/2006
B = 7/18/2006
C = 7/25/2006
D = 7/21/2006
E = 8/1/2006
F = 8/8/2006
G = 8/15/2006
H = 8/26/2006
I = unknown capped date

Pre or Post refers to emergences either:

-Pre-overwintering
-Post-overwintering

Trap Nest Location B1

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| A 1 | 3 | 5/29/2007 | Sapygidae | *Sapyga* | *pumila* | 1 | 1 | 2 | Post |
| A 2 | 3 | 7/19/2006 | Megachilidae | *Heriades* | *carinata* | - | 1 | 1 | Pre |
| A 2 | 3 | 5/16/2007 | Megachilidae | *Heriades* | *carinata* | 1 | - | 1 | Post |
| A 3 | 3 | 5/1/2007 | Colletidae | *Hylaeus* | *stevensi* | 6 | 7 | 13 | Pre |
| A 3 | 3 | 7/19/2006 | Colletidae | *Hylaeus* | *sevensi* | 1 | - | 1 | Post |
| A 4 | 3 | 7/25/2006 | Chrysididae | | | - | - | 1 | Pre |
| A 4 | 3 | 7/31/2006 | Crabronidae | *Solierella* | sp. | 2 | - | 2 | Pre |
| A 4 | 3 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| A 42 | 10 | 7/31/2006 | Sphecidae | *Isodontia* | *mexicana* | 2 | - | 2 | Pre |
| B 14 | 9 | 7/25/2006 | Tachinidae | | | - | - | 1 | Pre |
| B 14 | 9 | 5/16/2007 | Tachinidae | | | - | - | 1 | Post |
| B 14 | 9 | 5/24/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | - | 1 | Post |
| B 17 | 9 | 6/3/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | - | 1 | Post |
| B 18 | 9 | 5/29/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| B 34 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| B 34 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| B 34 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| B 35 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| B 35 | 4 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 1 | 3 | Post |
| B 35 | 4 | 6/18/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| B 36 | 3 | 7/19/2006 | Megachilidae | *Heriades* | *carinata* | - | 2 | 2 | Pre |
| B 36 | 3 | 5/18/2007 | Megachilidae | *Heriades* | *carinata* | 1 | - | 1 | Post |
| B 37 | 3 | 5/24/2007 | Megachilidae | *Heriades* | *carinata* | 2 | 2 | 4 | Post |

Trap Nest Location B1 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| B 37 | 3 | 5/25/2007 | Sapygidae | *Sapyga* | *pumila* | 1 | - | 1 | Post |
| C 8 | 9 | 5/29/2007 | Sphecidae | *Isodontia* | *mexicana* | - | 2 | 2 | Post |
| C 8 | 9 | 6/12/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | 1 | 2 | Post |
| C 10 | 3 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| C 14 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 5 | 4 | 9 | Post |
| C 17 | 3 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| C 17 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | 3 | 6 | Post |
| C 17 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| C 23 | 5 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| C 23 | 5 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 6 | - | 6 | Post |
| D 14 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 9 | 9 | Post |
| D 23 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| D 23 | 4 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 1 | 9 | 6/4/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | - | 1 | Post |
| E 8 | 6 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 1 | 2 | Post |
| E 8 | 6 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 8 | 6 | 7/3/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 12 | 3 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 12 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 21 | 6 | 5/28/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 21 | 6 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| E 23 | 6 | 5/29/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |

Trap Nest Location B1 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| E 23 | 6 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 23 | 6 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 2 | 3 | Post |
| E 23 | 6 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 25 | 9 | 5/21/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 25 | 9 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 25 | 9 | 5/29/2007 | Dermestidae | | | - | - | 4 | Post |
| E 25 | 9 | 6/1/2007 | Dermestidae | | | - | - | 2 | Post |
| E 25 | 9 | 7/3/2007 | Dermestidae | | | - | - | 1 | Post |
| E 32 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 2 | 4 | Post |
| E 32 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 33 | 7 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 34 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 6 | 7 | Post |
| E 34 | 3 | 6/7/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 35 | 3 | 6/15/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 41 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 7 | - | 7 | Post |
| E 41 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 41 | 4 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| E 45 | 5 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 5 | 6 | Post |
| E 53 | 3 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| F 35 | 5 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 35 | 5 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 35 | 5 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 35 | 5 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |

Trap Nest Location B1 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| F 35 | 5 | 6/15/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 42 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 42 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 42 | 4 | 6/15/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 45 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 7 | 7 | Post |
| F 45 | 3 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | - | 3 | Post |
| F 49 | 3 | 5/28/2007 | Megachilidae | *Ashmeadiella* | *bucconis* | 1 | - | 1 | Post |
| F 50 | 6 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 50 | 6 | 6/7/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| F 50 | 6 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| F 50 | 6 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 1 | 2 | Post |
| F 59 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 5 | 3 | 8 | Post |
| F 59 | 3 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| F 63 | 6 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| F 63 | 6 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| F 63 | 6 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| F 63 | 6 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| F 63 | 6 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 4 | 1 | 5 | Post |
| F 64 | 7 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 4 | 4 | Post |
| F 64 | 7 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| F 64 | 7 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 64 | 7 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 4 | - | 4 | Post |
| F 64 | 7 | 6/15/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |

Trap Nest Location B1 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| G 1 | 3 | 5/16/2007 | Megachilidae | *Heriades* | *carinata* | - | 2 | 2 | Post |
| G 1 | 3 | 5/18/2007 | Megachilidae | *Heriades* | *carinata* | 1 | - | 1 | Post |
| G 5 | 3 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| G 13 | 6 | 6/20/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 2 | 4 | Post |
| G 13 | 6 | 7/3/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| G 15 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 1 | 3 | Post |
| G 15 | 4 | 5/28/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| G 15 | 4 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| G 16 | 6 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| G 16 | 6 | 6/18/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| G 24 | 5 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| G 24 | 5 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| G 24 | 5 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| G 24 | 5 | 6/18/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| G 26 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| G 29 | 3 | 5/30/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| I 33 | 3 | 6/3/2007 | Crabronidae | *Trypuxylon* | sp. | 1 | - | 1 | Post |
| I 39 | 3 | 5/18/2007 | Crabronidae | *Trypuxylon* | sp. | 1 | - | 1 | Post |
| I 42 | 3 | 5/25/2007 | Sapygidae | *Sapyga* | *pumila* | - | 1 | 1 | Post |

Trap Nest Location B2

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| A 6 | 3 | 7/31/2006 | Crabronidae | *Trypuxylon* | Sp. | 2 | - | 2 | Pre |
| A 7 | 4 | 6/20/2007 | Megachilidae | *Megachile* | *rotundata* | 5 | - | 5 | Post |
| B 1 | 4 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| B 15 | 9 | 8/10/2006 | Sphecidae | *Isodontia* | *mexicana* | 6 | - | 6 | Pre |
| C 5 | 3 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| C 5 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| C 6 | 7 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | 1 | 4 | Post |
| C 6 | 7 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| C 6 | 7 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| C 18 | 3 | 5/21/2007 | Megachilidae | *Ashmeadiella* | *bucconis* | - | 1 | 1 | Post |
| C 18 | 3 | 5/28/2007 | Megachilidae | *Ashmeadiella* | *bucconis* | 1 | - | 1 | Post |
| C 22 | 6 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | | 4 | 4 | Post |
| C 22 | 6 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| C 22 | 6 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| D 6 | 3 | 5/24/2007 | Sapygidae | *Sapyga* | *pumila* | 1 | 2 | 3 | Post |
| D 6 | 3 | 5/25/2007 | Sapygidae | *Sapyga* | *pumila* | 1 | - | 1 | Post |
| D 6 | 3 | 5/29/2007 | Sapygidae | *Sapyga* | *pumila* | 1 | - | 1 | Post |
| E 36 | 9 | 5/24/2007 | Sphecidae | *Isodontia* | *mexicana* | - | 1 | 1 | Post |
| E 36 | 9 | 6/4/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | - | 1 | Post |
| E 43 | 4 | 9/25/2006 | Crabronidae | *Passaloecus* | *melanocrus* | 1 | 2 | 3 | Pre |
| E 44 | 3 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 3 | 4 | Post |
| E 49 | 3 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 4 | 4 | Post |
| E 49 | 3 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |

Trap Nest Location B2 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| E 50 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| E 50 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 50 | 3 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | - | 3 | Post |
| E 52 | 5 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 52 | 5 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| E 52 | 5 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| E 54 | 3 | 4/18/2007 | Crabronidae | *Passaloecus* | *melanocrus* | 1 | - | 1 | Post |
| E 54 | 3 | 4/30/2007 | Crabronidae | *Passaloecus* | *melanocrus* | 1 | - | 1 | Post |
| E 54 | 3 | 5/1/2007 | Crabronidae | *Passaloecus* | *melanocrus* | 1 | - | 1 | Post |
| E 54 | 3 | 5/3/2007 | Crabronidae | *Passaloecus* | *melanocrus* | 1 | - | 1 | Post |
| F 29 | 6 | 5/25/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| F 29 | 6 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| F 29 | 6 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| F 29 | 6 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 44 | 3 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 1 | 2 | Post |
| F 54 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 1 | 3 | Post |
| F 54 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| G 3 | 3 | 9/7/2006 | Crabronidae | *Solierella* | sp. | 1 | 1 | 2 | Pre |
| G 3 | 3 | 5/1/2007 | Crabronidae | *Passaloecus* | *melanocrus* | - | 2 | 2 | Post |
| G 14 | 3 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | 2 | 5 | Post |
| G 14 | 3 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| I 25 | 9 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | - | 3 | Post |
| I 49 | 9 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |

Trap Nest Location B2 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| I 49 | 9 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| I 49 | 9 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| I 49 | 9 | 7/3/2007 | Dermestidae | | | - | - | 1 | Post |
| I 51 | 3 | 5/2/2007 | Crabronidae | *Trypuxylon* | sp. | 4 | - | 4 | Post |
| I 63 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 6 | - | 6 | Post |

Trap Nest Location B3

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre or Post |
|---|---|---|---|---|---|---|---|---|---|
| A 8 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 1 | 2 | Post |
| A 10 | 4 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 6 | 1 | 7 | Post |
| A 10 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 7 | 7 | Post |
| B 4 | 4 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 4 | 3 | 7 | Post |
| B 4 | 4 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| B 6 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 4 | 2 | 6 | Post |
| B 6 | 3 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| B 8 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 4 | 4 | Post |
| B 8 | 4 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| B 8 | 4 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| B 16 | 5 | 5/24/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| B 16 | 5 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | 7 | - | 7 | Post |
| B 16 | 5 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| B 19 | 3 | 5/30/2007 | Megachilidae | *Ashmeadiella* | *gillettei* | 3 | - | 3 | Post |
| C 2 | 3 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| C 2 | 3 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| C 7 | 7 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 7 | 8 | Post |
| C 7 | 7 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| C 11 | 3 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| C 11 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 6 | 7 | Post |
| C 11 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| C 12 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 4 | 4 | Post |
| C 12 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 8 | - | 8 | Post |

Trap Nest Location B3 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre or Post |
|---|---|---|---|---|---|---|---|---|---|
| C 20 | 3 | 6/3/2007 | Megachilidae | *Ashmeadiella* | *gillettei* | 3 | 1 | 4 | Post |
| C 27 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| C 27 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| C 29 | 6 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| C 29 | 6 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 6 | 7 | Post |
| D 2 | 5 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| D 2 | 5 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 4 | 2 | 6 | Post |
| D 2 | 5 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| D 2 | 5 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| D 7 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 8 | 9 | Post |
| D 7 | 3 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | - | 3 | Post |
| D 22 | 3 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| D 22 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 4 | 4 | Post |
| D 22 | 3 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| D 30 | 6 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 3 | 5 | Post |
| D 30 | 6 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| D 30 | 6 | 6/15/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| D 30 | 6 | 6/22/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 3 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 2 | 3 | Post |
| E 11 | 8 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| E 11 | 8 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 6 | - | 6 | Post |
| E 11 | 8 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 13 | 5 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |

Trap Nest Location B3 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre or Post |
|---|---|---|---|---|---|---|---|---|---|
| E 14 | 4 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 4 | 4 | Post |
| E 14 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 14 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| E 14 | 4 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 14 | 4 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 20 | 9 | 5/30/2007 | Sphecidae | *Isodontia* | *mexicana* | - | 1 | 1 | Post |
| E 20 | 9 | 6/4/2007 | Sphecidae | *Isodontia* | *mexicana* | 2 | - | 2 | Post |
| E 20 | 9 | 6/5/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | - | 1 | Post |
| E 20 | 9 | 6/6/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | - | 1 | Post |
| E 22 | 8 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 22 | 8 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 7 | - | 7 | Post |
| E 22 | 8 | 6/20/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| E 24 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| E 28 | 5 | 5/30/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 28 | 5 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 1 | 2 | Post |
| E 28 | 5 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| E 28 | 5 | 5/24/2007 | Dermestidae | | | - | - | 1 | Post |
| E 30 | 4 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | 5 | - | 5 | Post |
| E 30 | 4 | 6/11/2007 | Sphecidae | *Isodontia* | *mexicana* | 2 | - | 2 | Post |
| E 40 | 5 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 3 | 5 | Post |
| E 40 | 5 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 46 | 3 | 5/30/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 46 | 3 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 5 | 5 | Post |

Trap Nest Location B3 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre or Post |
|---|---|---|---|---|---|---|---|---|---|
| E 46 | 3 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 25 | 8 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| F 25 | 8 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | - | 3 | Post |
| F 25 | 8 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| F 28 | 3 | 6/1/2007 | Megachilidae | *Heriades* | *carinata* | 1 | - | 1 | Post |
| F 28 | 3 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| F 32 | 4 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| F 32 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | 3 | 6 | Post |
| F 32 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 33 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 2 | 3 | Post |
| G 4 | 4 | 6/15/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| G 4 | 4 | 6/20/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| G 9 | 7 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | 4 | 7 | Post |
| G 9 | 7 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| G 11 | 3 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| G 11 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| G 11 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| G 25 | 7 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 2 | 3 | Post |
| G 25 | 7 | 6/15/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| H 3 | 3 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| H 5 | 4 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| H 5 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | - | 3 | Post |
| H 5 | 4 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |

Trap Nest Location B3 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre or Post |
|---|---|---|---|---|---|---|---|---|---|
| H 8 | 4 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| H 12 | 5 | 6/22/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | 1 | 4 | Post |
| H 13 | 7 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 4 | - | 4 | Post |
| H 13 | 7 | 6/4/2007 | Dermestidae | | | - | - | 2 | Post |
| H 18 | 5 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 1 | 3 | Post |
| H 19 | 4 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| H 24 | 3 | 6/28/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| H 26 | 3 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| H 28 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| H 34 | 4 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| H 34 | 4 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 6 | 6 | Post |
| H 34 | 4 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| I 2 | 6 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| I 2 | 6 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| I 22 | 6 | 5/29/2007 | Megachilidae | *Megachile* | *rotundata* | - | 5 | 5 | Post |
| I 22 | 6 | 6/7/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| I 22 | 6 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| I 35 | 4 | 5/29/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| I 43 | 3 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |

Trap Nest Location B4

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| A 11 | 9 | 8/2/2006 | Sphecidae | *Isodontia* | *mexicana* | 5 | - | 5 | Pre |
| A 11 | 9 | 5/31/2007 | Sphecidae | *Isodontia* | *mexicana* | 2 | - | 2 | Post |
| A 12 | 9 | 8/1/2006 | Sphecidae | *Isodontia* | *mexicana* | 1 | 1 | 2 | Pre |
| A 12 | 9 | 8/2/2006 | Sphecidae | *Isodontia* | *mexicana* | 1 | - | 1 | Pre |
| A 12 | 9 | 8/13/2006 | Sphecidae | *Isodontia* | *mexicana* | 1 | 1 | 2 | Pre |
| A 42 | 9 | 6/4/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | - | 1 | Post |
| A 13 | 9 | 5/29/2007 | Sphecidae | *Isodontia* | *mexicana* | - | 1 | 1 | Post |
| A 13 | 9 | 6/4/2007 | Sphecidae | *Isodontia* | *mexicana* | 3 | - | 3 | Post |
| B 2 | 4 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| B 2 | 4 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 8 | 1 | 9 | Post |
| B 3 | 9 | 5/24/2007 | Sphecidae | *Isodontia* | *mexicana* | - | 2 | 2 | Post |
| B 3 | 9 | 5/31/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | 1 | 2 | Post |
| B 3 | 9 | 6/3/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | - | 1 | Post |
| B 5 | 6 | 6/1/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | - | 1 | Post |
| B 5 | 6 | 6/20/2007 | Megachilidae | *Megachile* | *rotundata* | 5 | - | 5 | Post |
| B 11 | 7 | 6/1/2007 | Sphecidae | *Isodontia* | *mexicana* | - | 1 | 1 | Post |
| B 12 | 9 | 5/25/2007 | Sphecidae | *Isodontia* | *mexicana* | - | 1 | 1 | Post |
| B 12 | 9 | 5/31/2007 | Sphecidae | *Isodontia* | *mexicana* | - | 1 | 1 | Post |
| B 12 | 9 | 6/1/2007 | Sphecidae | *Isodontia* | *mexicana* | - | 1 | 1 | Post |
| B 12 | 9 | 6/4/2007 | Sphecidae | *Isodontia* | *mexicana* | 2 | - | 2 | Post |
| B 13 | 9 | 5/29/2007 | Sphecidae | *Isodontia* | *mexicana* | - | 2 | 2 | Post |
| B 13 | 9 | 5/31/2007 | Sphecidae | *Isodontia* | *mexicana* | - | 1 | 1 | Post |
| B 13 | 9 | 6/1/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | - | 1 | Post |

Trap Nest Location B4 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| B 13 | 9 | 6/3/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | - | 1 | Post |
| B 33 | 3 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 5 | 6 | Post |
| B 33 | 3 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | - | 3 | Post |
| C 16 | 3 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| C 24 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 6 | 7 | Post |
| C 24 | 3 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | - | 3 | Post |
| C 24 | 3 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | - | 3 | Post |
| C 25 | 4 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 5 | 5 | Post |
| C 25 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | 3 | 6 | Post |
| C 25 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| D 4 | 9 | 6/1/2007 | Sphecidae | *Isodontia* | *mexicana* | - | 2 | 2 | Post |
| D 4 | 9 | 6/4/2007 | Sphecidae | *Isodontia* | *mexicana* | 2 | - | 2 | Post |
| D 11 | 3 | 7/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| D 25 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 5 | 5 | Post |
| D 25 | 4 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | 2 | 5 | Post |
| D 27 | 3 | 5/16/2007 | Megachilidae | *Heriades* | *carinatas* | 8 | - | 8 | Post |
| D 27 | 3 | 5/18/2007 | Sapygidae | *Sapyga* | *pumila* | 1 | 1 | 2 | Post |
| D 28 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 6 | 6 | Post |
| D 28 | 3 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| D 31 | 3 | 5/17/2007 | Megachilidae | *Heriades* | *carinata* | 6 | 2 | 8 | Post |
| D 31 | 3 | 5/18/2007 | Sapygidae | *Sapyga* | *pumila* | - | 2 | 2 | Post |
| D 31 | 3 | 5/24/2007 | Sapygidae | *Sapyga* | *pumila* | - | 1 | 1 | Post |
| D 31 | 3 | 5/24/2007 | Dermestidae | | | - | - | 1 | Post |

Trap Nest Location B4 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| D 32 | 4 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 4 | 4 | 8 | Post |
| D 33 | 3 | 5/25/2007 | Megachilidae | *Heriades* | *carinata* | 4 | - | 4 | Post |
| D 33 | 3 | 5/25/2007 | Sapygidae | *Sapyga* | *pumila* | 1 | 1 | 2 | Post |
| E 5 | 3 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 4 | 4 | Post |
| E 5 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| E 5 | 3 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 6 | 4 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 7 | 3 | 5/22/2007 | Megachilidae | *Heriades* | *carinata* | 4 | - | 4 | Post |
| E 10 | 3 | 5/16/2007 | Megachilidae | *Heriades* | *carinata* | 2 | 3 | 5 | Post |
| E 10 | 3 | 5/16/2007 | Sapygidae | *Sapyga* | *pumila* | - | 1 | 1 | Post |
| E 15 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| E 15 | 4 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 3 | 4 | Post |
| E 16 | 6 | 6/3/2007 | Sphecidae | *Isodontia* | *mexicana* | - | 1 | 1 | Post |
| E 16 | 6 | 7/3/2007 | Dermestidae | | | - | - | 2 | Post |
| E 17 | 3 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| E 17 | 3 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 17 | 3 | 6/7/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 17 | 3 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| E 17 | 3 | 6/18/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 18 | 3 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 19 | 9 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 4 | 4 | Post |
| E 19 | 9 | 6/4/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | - | 1 | Post |

Trap Nest Location B4 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| E 26 | 9 | 5/25/2007 | Tachinidae | | | - | - | 1 | Post |
| E 30 | 4 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | 5 | - | 5 | Post |
| E 30 | 4 | 6/11/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | 1 | 2 | Post |
| E 39 | 3 | 9/7/2006 | Crabronidae | *Trypuxylon* | sp. | 8 | - | 8 | Pre |
| E 55 | 3 | 9/9/2006 | Crabronidae | *Passaloecus* | *melanocrus* | 1 | - | 1 | Pre |
| E 55 | 3 | 4/30/2007 | Crabronidae | *Passaloecus* | *melanocrus* | 1 | - | 1 | Post |
| F 30 | 4 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| F 30 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 7 | 7 | Post |
| F 30 | 4 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 31 | 4 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 3 | 4 | Post |
| F 31 | 4 | 6/15/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 43 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| F 47 | 4 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| F 47 | 4 | 6/15/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 57 | 3 | 9/9/2006 | Megachilidae | *Heriades* | *carinata* | - | 1 | 1 | Pre |
| F 57 | 3 | 5/14/2007 | Megachilidae | *Heriades* | *carinata* | - | 6 | 6 | Post |
| F 57 | 3 | 5/16/2007 | Megachilidae | *Heriades* | *carinata* | 2 | - | 2 | Post |
| F 57 | 3 | 5/18/2007 | Sapygidae | *Sapyga* | *Pumila* | 1 | 2 | 3 | Post |
| F 60 | 9 | 6/11/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | - | 1 | Post |
| G 7 | 5 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| G 7 | 5 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| G 17 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 6 | 6 | Post |
| G 17 | 4 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 8 | - | 8 | Post |

Trap Nest Location B4 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| G 17 | 4 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| G 27 | 4 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | 6 | - | 6 | Post |
| G 27 | 4 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| G 27 | 4 | 5/29/2007 | Dermestidae | | | - | - | 1 | Post |
| H 32 | 3 | 5/17/2007 | Megachilidae | *Heriades* | *carinata* | 2 | - | 2 | Post |
| I 46 | 4 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| I 64 | 3 | 5/21/2007 | Megachilidae | *Heriades* | *carinata* | 1 | - | 1 | Post |
| I 67 | 3 | 9/9/2006 | Crabronidae | *Psenulus* | *pallipes parenosus* | 5 | - | 5 | Pre |
| I 67 | 3 | 4/30/2007 | Crabronidae | *Psenulus* | *pallipes parenosus* | - | 8 | 8 | Post |
| I 67 | 3 | 5/2/2007 | Crabronidae | *Psenulus* | *pallipes parenosus* | 1 | - | 1 | Post |
| I 67 | 3 | 5/3/2007 | Crabronidae | *Psenulus* | *pallipes parenosus* | - | 1 | 1 | Post |

Trap Nest Location B5

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| A 15 | 7 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 4 | - | 4 | Post |
| A 18 | 3 | 7/24/2006 | Chrysididae | | | - | - | 1 | Pre |
| A 18 | 3 | 7/24/2006 | Crabronidae | *Solierella* | sp. | - | 1 | 1 | Pre |
| A 23 | 3 | 7/24/2006 | Crabronidae | *Solierella* | sp. | 1 | - | 1 | Pre |
| A 24 | 10 | 7/20/2006 | Tachinidae | | | - | - | 3 | Pre |
| A 24 | 10 | 7/21/2006 | Tachinidae | | | - | - | 4 | Pre |
| B 26 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 2 | 3 | Post |
| B 26 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| B 31 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 9 | 9 | Post |
| B 31 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 1 | 2 | Post |
| B 31 | 3 | 6/7/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| B 31 | 3 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| B 31 | 3 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| B 31 | 3 | 6/22/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| B 38 | 6 | 5/2/2007 | Vespidae | *Eumeninae* | sp. | 2 | 3 | 5 | Post |
| C 4 | 9 | 6/3/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | - | 1 | Post |
| C 34 | 9 | 6/3/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | - | 1 | Post |
| C 37 | 6 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| C 37 | 6 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 1 | 2 | Post |
| C 41 | 3 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| C 49 | 3 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| C 49 | 3 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| C 49 | 3 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | 2 | 5 | Post |

Trap Nest Location B5 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| C 52 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 5 | 5 | Post |
| C 52 | 3 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 1 | 3 | Post |
| C 52 | 3 | 6/15/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| C 55 | 3 | 5/16/2007 | Megachilidae | *Ashmeadiella* | *cactorum* | - | 5 | 5 | Post |
| C 55 | 3 | 5/24/2007 | Megachilidae | *Ashmeadiella* | *cactorum* | - | 1 | 1 | Post |
| C 55 | 3 | 5/25/2007 | Megachilidae | *Ashmeadiella* | *cactorum* | 1 | - | 1 | Post |
| D 21 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 5 | 7 | Post |
| E 59 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 3 | 5 | Post |
| E 65 | 6 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| E 65 | 6 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 3 | 5 | Post |
| E 65 | 6 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 80 | 3 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 4 | 4 | Post |
| E 82 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| E 83 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 6 | 8 | Post |
| E 83 | 3 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 84 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 6 | 5 | 11 | Post |
| E 85 | 6 | 5/2/2007 | Vespidae | *Eumeninae* | sp. | 5 | 1 | 6 | Post |
| E 91 | 5 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| F 23 | 6 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| F 24 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| F 24 | 3 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 24 | 3 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| G 38 | 3 | 5/29/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |

Trap Nest Location B5 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| G 38 | 3 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| G 38 | 3 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 1 | 2 | Post |
| G 38 | 3 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| G 41 | 3 | 5/28/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| G 42 | 3 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| G 42 | 3 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| G 43 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| G 43 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | - | 3 | Post |
| G 45 | 3 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| G 45 | 3 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| H 14 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 4 | 4 | Post |
| H 14 | 3 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | 1 | 4 | Post |
| H 22 | 5 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 4 | 5 | Post |
| H 22 | 5 | 6/15/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| H 29 | 3 | 6/7/2007 | Megachilidae | *Megachile* | *rotundata* |  | 1 | 1 | Post |
| H 29 | 3 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 1 | 2 | Post |
| I 18 | 5 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| I 18 | 5 | 6/7/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| I 18 | 5 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| I 23 | 3 | 5/18/2007 | Megachilidae | *Heriades* | *carinata* | 1 | - | 1 | Post |
| I 28 | 3 | 5/16/2007 | Megachilidae | *Heriades* | *carinata* | 5 | 5 | 10 | Post |
| I 29 | 4 | 5/30/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| I 29 | 4 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |

Trap Nest Location B5 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| I 29 | 4 | 5/30/2007 | Dermestidae | | | - | - | 1 | Post |
| I 37 | 3 | 5/25/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| I 37 | 3 | 5/25/2007 | Dermestidae | | | - | - | 1 | Post |
| I 70 | 3 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| I 76 | 3 | 5/21/2007 | Megachilidae | *Ashmeadiella* | *gillettei* | 6 | 3 | 9 | Post |

Trap Nest Location B6

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| A 19 | 3 | 7/21/2006 | Chrysididae | | | - | - | 3 | Pre |
| A 19 | 3 | 7/24/2006 | Chrysididae | | | - | - | 1 | Pre |
| A 19 | 3 | 7/24/2006 | Crabronidae | *Solierella* | sp. | - | 1 | 1 | Pre |
| A 19 | 3 | 7/25/2006 | Crabronidae | *Solierella* | sp. | 1 | - | 1 | Pre |
| A 19 | 3 | 7/31/2006 | Crabronidae | *Solierella* | sp. | 3 | - | 3 | Pre |
| B 20 | 4 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | - | 7 | 7 | Post |
| B 22 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 7 | 7 | Post |
| B 22 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| B 22 | 4 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 1 | 2 | Post |
| B 22 | 4 | 6/18/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| B 23 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| B 23 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 5 | 5 | Post |
| B 23 | 3 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| B 24 | 4 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 6 | 3 | 9 | Post |
| B 24 | 4 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 1 | 2 | Post |
| B 25 | 4 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | - | 4 | 4 | Post |
| B 25 | 4 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 7 | - | 7 | Post |
| B 28 | 3 | 5/30/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| B 28 | 3 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| B 28 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 5 | - | 5 | Post |
| B 30 | 3 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 4 | 4 | Post |
| B 30 | 3 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 4 | - | 4 | Post |
| B 41 | 5 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |

Trap Nest Location B6 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| B 41 | 5 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 1 | 2 | Post |
| C 31 | 6 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | - | 4 | 4 | Post |
| C 32 | 5 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 5 | 5 | Post |
| C 32 | 5 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| C 32 | 5 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| C 32 | 5 | 6/18/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| C 43 | 3 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| C 44 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| C 56 | 3 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 4 | 4 | Post |
| C 56 | 3 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| C 56 | 3 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| C 56 | 3 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| D 8 | 9 | 9/7/2006 | Tachinidae | | | - | - | 2 | Pre |
| D 9 | 5 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | - | 4 | 4 | Post |
| D 10 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 5 | - | 5 | Post |
| D 10 | 4 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| D 10 | 4 | 6/7/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| D 10 | 4 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| D 10 | 4 | 6/20/2007 | Megachilidae | *Megachile* | *rotundata* | 4 | - | 4 | Post |
| D 20 | 3 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 2 | 3 | Post |
| D 26 | 5 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 8 | 10 | Post |
| D 26 | 5 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| D 29 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |

Trap Nest Location B6 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| D 29 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 5 | 1 | 6 | Post |
| E 60 | 3 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 60 | 3 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 67 | 3 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| E 67 | 3 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 71 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 4 | 4 | 8 | Post |
| E 87 | 4 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 87 | 4 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 87 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 4 | 5 | Post |
| E 87 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| E 87 | 4 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 87 | 4 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 88 | 6 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 88 | 6 | 6/7/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 1 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| F 4 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 6 | 1 | 7 | Post |
| F 4 | 4 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 4 | 4 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 6 | 6 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 1 | 3 | Post |
| F 6 | 6 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 1 | 3 | Post |
| F 12 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| F 20 | 4 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 5 | 6 | Post |
| F 20 | 4 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |

Trap Nest Location B6 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| F 20 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 20 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| G 18 | 9 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| G 18 | 9 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| G 18 | 9 | 6/1/2007 | Dermestidae | | | - | - | 2 | Post |
| G 36 | 9 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 2 | 4 | Post |
| G 40 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| G 40 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| G 40 | 4 | 6/15/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| H 2 | 3 | 5/1/2007 | Crabronidae | *Trypuxylon* | sp. | 1 | - | 1 | Post |
| H 6 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| H 6 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| H 6 | 3 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| H 6 | 3 | 6/5/2007 | Dermestidae | | | - | - | 1 | Post |
| H 7 | 4 | 7/3/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| H 25 | 4 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 1 | 2 | Post |
| H 25 | 4 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| H 33 | 3 | 4/30/2007 | Crabronidae | *Trypuxylon* | sp. | 3 | 1 | 4 | Post |
| I 4 | 9 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| I 6 | 3 | 4/18/2007 | Crabronidae | *Trypuxylon* | sp. | 3 | - | 3 | Post |
| I 8 | 3 | 5/14/2007 | Megachilidae | *Ashmeadiella* | *cactorum* | - | 3 | 3 | Post |
| I 8 | 3 | 5/18/2007 | Megachilidae | *Ashmeadiella* | *cactorum* | 2 | - | 2 | Post |
| I 8 | 3 | 5/22/2007 | Megachilidae | *Ashmeadiella* | *cactorum* | 3 | - | 3 | Post |

Trap Nest Location B6 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| I 8 | 3 | 7/3/2007 | Dermestidae | | | - | - | 1 | Post |
| I 11 | 7 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | 6 | - | 6 | Post |
| I 30 | 3 | 5/31/2007 | Crabronidae | *Trypuxylon* | | 2 | - | 2 | Post |
| I 44 | 6 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| I 61 | 3 | 5/28/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| I 63 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 6 | - | 6 | Post |

Trap Nest Location B7

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| A 20 | 3 | 8/1/2006 | Crabronidae | *Solierella* | sp. | 4 | - | 4 | Pre |
| A 20 | 3 | 8/2/2006 | Crabronidae | *Solierella* | sp. | 3 | - | 3 | Pre |
| A 21 | 3 | 8/2/2006 | Crabronidae | *Solierella* | sp. | 4 | - | 4 | Pre |
| A 21 | 3 | 8/2/2006 | Chrysididae | | | 1 | - | 1 | Pre |
| A 22 | 3 | 8/1/2006 | Colletidae | *Hylaeus* | *sevensi* | 1 | - | 1 | Pre |
| A 22 | 3 | 8/2/2006 | Colletidae | *Hylaeus* | *stevensi* | - | 1 | 1 | Pre |
| B 40 | 6 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 4 | 6 | Post |
| B 40 | 6 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| C 42 | 4 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| C 42 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| C 42 | 4 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 1 | 3 | Post |
| C 45 | 6 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| C 45 | 6 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 5 | 6 | Post |
| C 45 | 6 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| C 45 | 6 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| C 46 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 5 | 5 | Post |
| C 46 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | - | 3 | Post |
| C 48 | 3 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| C 48 | 3 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| C 53 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| C 53 | 4 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| D 3 | 6 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| D 3 | 6 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |

Trap Nest Location B7 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| D 3 | 6 | 6/7/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| D 3 | 6 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| D 3 | 6 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| D 3 | 6 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| D 3 | 6 | 6/18/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| D 16 | 4 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 6 | 1 | 7 | Post |
| D 16 | 4 | 6/15/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 15 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| E 15 | 4 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 3 | 4 | Post |
| E 64 | 6 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 4 | 5 | Post |
| E 64 | 6 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 64 | 6 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 70 | 4 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| E 70 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | - | 3 | Post |
| E 78 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| E 89 | 6 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 89 | 6 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 4 | 6 | Post |
| E 89 | 6 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 89 | 6 | 5/28/2007 | Sphecidae | *Isodontia* | *mexicana* | - | 1 | 1 | Post |
| E 92 | 6 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 3 | 5 | Post |
| E 92 | 6 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | 1 | 4 | Post |
| F 2 | 5 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| F 2 | 5 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 6 | 2 | 8 | Post |

Trap Nest Location B7 continued

| **Tube ID** | **Tube size** | **Date Emerged** | **Family** | **Genus** | **Species** | **Female** | **Male** | **Total** | **Pre/Post** |
|---|---|---|---|---|---|---|---|---|---|
| F 3 | 4 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| F 3 | 4 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 13 | 4 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| F 21 | 3 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 4 | 4 | Post |
| G 37 | 3 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 3 | 5 | Post |
| G 46 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| G 46 | 4 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| G 46 | 4 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| I 73 | 3 | 9/7/2006 | Crabronidae | *Trypuxylon* | sp. | 7 | - | 7 | Pre |

Trap Nest Location B8

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| A 16 | 3 | 7/31/2006 | Crabronidae | *Solierella* | sp. | 2 | - | 2 | Pre |
| A 17 | 3 | 5/18/2007 | Chrysididae | | | - | - | 1 | Post |
| B 21 | 4 | 5/30/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| B 21 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 6 | 2 | 8 | Post |
| B 21 | 4 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| B 22 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 7 | 7 | Post |
| B 22 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| B 22 | 4 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 1 | 2 | Post |
| B 22 | 4 | 6/18/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| C 33 | 5 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| C 33 | 5 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 1 | 2 | Post |
| C 33 | 5 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| C 33 | 5 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 4 | - | 4 | Post |
| C 33 | 5 | 6/18/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| C 36 | 9 | 6/1/2007 | Sphecidae | *Isodontia* | *mexicana* | - | 2 | 2 | Post |
| C 36 | 9 | 6/4/2007 | Sphecidae | *Isodontia* | *mexicana* | - | 2 | 2 | Post |
| C 36 | 9 | 6/5/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | - | 1 | Post |
| C 38 | 8 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 2 | 4 | Post |
| C 38 | 8 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | - | 3 | Post |
| C 38 | 8 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| C 38 | 8 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| C 39 | 6 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 4 | 2 | 6 | Post |
| C 40 | 7 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 3 | 4 | Post |

Trap Nest Location B8 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| C 47 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 6 | 6 | Post |
| C 50 | 4 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| C 50 | 4 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| C 51 | 5 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 4 | 4 | Post |
| C 51 | 5 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 1 | 2 | Post |
| C 51 | 5 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 9 | - | 9 | Post |
| C 51 | 5 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| C 54 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 4 | 4 | Post |
| C 54 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 4 | 1 | 5 | Post |
| C 54 | 4 | 6/7/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| C 57 | 4 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| C 57 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| C 58 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 10 | 10 | Post |
| C 58 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | - | 3 | Post |
| C 58 | 4 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| D 1 | 3 | 9/7/2006 | Crabronidae | *Trypuxylon* | sp. | 6 | - | 6 | Pre |
| D 13 | 7 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 4 | 1 | 5 | Post |
| D 13 | 7 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| D 13 | 7 | 6/7/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 58 | 9 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 61 | 5 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 4 | 5 | Post |
| E 61 | 5 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 6 | - | 6 | Post |
| E 66 | 3 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |

Trap Nest Location B8 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| E 66 | 3 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| E 66 | 3 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| E 68 | 7 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 4 | 4 | Post |
| E 68 | 7 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| E 68 | 7 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 6 | - | 6 | Post |
| E 68 | 7 | 6/15/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 69 | 4 | 9/8/2006 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Pre |
| E 69 | 4 | 9/11/2006 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Pre |
| E 73 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 2 | 4 | Post |
| E 73 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| E 73 | 4 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 73 | 4 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 76 | 3 | 9/7/2006 | Crabronidae | *Trypuxylon* | sp. | 4 | - | 4 | Pre |
| E 77 | 9 | 6/1/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | - | 1 | Post |
| E 77 | 9 | 6/4/2007 | Sphecidae | *Isodontia* | *mexicana* | 2 | - | 2 | Post |
| E 81 | 3 | 6/1/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| E 81 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 2 | 3 | Post |
| E 81 | 3 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| E 81 | 3 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 8 | 3 | 5/30/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| F 8 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 8 | 3 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |

Trap Nest Location B8 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| F 8 | 3 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| F 8 | 3 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 8 | 3 | 5/30/2007 | Dermestidae | | | - | - | 1 | Post |
| F 10 | 6 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 2 | 2 | Post |
| F 10 | 6 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 2 | 3 | Post |
| F 10 | 6 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| F 14 | 9 | 6/4/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | - | 1 | Post |
| F 14 | 9 | 6/12/2007 | Sphecidae | *Isodontia* | *mexicana* | 1 | - | 1 | Post |
| F 16 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 5 | 7 | Post |
| F 16 | 4 | 6/5/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| F 16 | 4 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 16 | 4 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| F 17 | 3 | 7/3/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| F 18 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| F 19 | 9 | 5/1/2007 | Crabronidae | *Trypuxylon* | sp. | 5 | - | 5 | Post |
| F 19 | 9 | 5/31/2007 | Sphecidae | *Isodontia* | *mexicana* | - | 2 | 2 | Post |
| F 22 | 7 | 6/8/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| F 22 | 7 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | 2 | 5 | Post |
| G 19 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 4 | 4 | Post |
| G 19 | 3 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| G 19 | 3 | 6/14/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| G 19 | 3 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 1 | 2 | Post |
| G 22 | 9 | 5/31/2007 | Sphecidae | *Isodontia* | *mexicana* | - | 1 | 1 | Post |

Trap Nest Location B8 continued

| Tube ID | Tube size | Date Emerged | Family | Genus | Species | Female | Male | Total | Pre/Post |
|---|---|---|---|---|---|---|---|---|---|
| G 22 | 9 | 6/3/2007 | Sphecidae | *Isodontia* | *mexicana* | - | 1 | 1 | Post |
| G 28 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| G 30 | 3 | 5/18/2007 | Colletidae | *Hylaeus* | *stevensi* | 1 | - | 1 | Post |
| G 33 | 3 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| G 33 | 3 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| G 33 | 3 | 6/20/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| H 10 | 6 | 6/22/2007 | Megachilidae | *Megachile* | *rotundata* | - | 3 | 3 | Post |
| H 10 | 6 | 6/28/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | - | 2 | Post |
| H 15 | 4 | 6/11/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 3 | 4 | Post |
| H 15 | 4 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 4 | - | 4 | Post |
| H 15 | 4 | 6/12/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| H 39 | 4 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | 2 | 1 | 3 | Post |
| H 39 | 4 | 5/21/2007 | Dermestidae | | | - | - | 2 | Post |
| I 27 | 9 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| I 27 | 9 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| I 41 | 3 | 5/22/2007 | Megachilidae | *Ashmeadiella* | *gilletei* | 4 | - | 4 | Post |
| I 41 | 3 | 5/25/2007 | Megachilidae | *Ashmeadiella* | *gilletei* | 1 | - | 1 | Post |
| I 52 | 5 | 5/31/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | 1 | 2 | Post |
| I 52 | 5 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | 1 | - | 1 | Post |
| I 53 | 3 | 6/6/2007 | Megachilidae | *Megachile* | *rotundata* | 3 | 2 | 5 | Post |
| I 56 | 5 | 6/3/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |
| I 77 | 4 | 6/4/2007 | Megachilidae | *Megachile* | *rotundata* | - | 1 | 1 | Post |

# APPENDIX E

## LIFE HISTORY OF THE SWEETCLOVER ROOT BORER

# INTRODUCTION

## Pest of Slender White Prairieclover

Little information exists about the pests found on slender white prairieclover (*Dalea candida* Willd). One known lepidopteran pest, *Walshia miscecolorella* (Chambers), was discovered damaging the plant's root system (Sherry White, unpublished data and BPMC personnel Mark Majerus). This pest has been reported in South Dakota, Nebraska, Oklahoma, Kansas, and Texas. Larval stages of this pest are known to attack *Lupinus arbooreus* Sims, *L. chamissionis* Esch., *Astragulus* sp., *Arachis* sp., *Cirsium vulgare* (Savi) Ten., as well a *Melilotus* sp. Evidence of *W. miscecolorella* infestation include yellow discoloration of leaves with folding of the leaves along the mid-veins, which progresses until the death of the plant. Further examination of the root system, once excavated, sometimes reveals gall-like swelling of the roots. The larvae are usually located near the crown of the plant, just under the root epidermis (Manglitz et al., 1971; and personal observation). Based on the purposed species life cycle of *W. miscecolorella*, female adults appear to fly and lay eggs from early May to June. Larval development begins in June and they remain in the host overwinter until April, when they crawl out of the plant, pupate, and emerge as adults.

Repeated infestations of plants accumulate plant damage and eventually appear to be the cause of death of the plant (Manglitz et al., 1971). Control of internal insect pests typically involves the use of systemic insecticides, which are translocated through plant tissue rather than a contact (foliar) pesticide. The use of a systemic pesticide for control of this small chewing pest might not give the desired control of the pest (Pedigo, 1999);

since timing is an important aspect of application and very little is know about the life history of this pest. Foliars might be effective in treatment of the pest if there was a better understanding of the susceptible stages of the insect. Use of a systemic pesticide would have to be evaludated for impacts on pollinators since pollination of SWPC is very important for seed production at USDA, NRCS-Plant Materials Center, Bridger, MT. Contamination of nectar and pollen food sources can have detrimental effects on honey bees as well as native pollinators (Colin et al., 2004). Further research into the life history of this pest on SWPC as well as the affects of systemic pesticides on it is needed before a pest management strategy can be devised.

## Objectives

My study site, Bridger Plant Material Center (BPMC), grows plants for seeds suitable for use in land reclamation. Interest in the pests of a specific plant species grown at BPMC followed the death of a 5-year old stand of slender white prairieclover (SWPC). The overall objective of my research was to obtain baseline information on the pests and pollinators of SWPC at the BPMC. The focus of my research was on pollination of SWPC. My specific objectives were to: (1) determine when the adults of the lepidopteran pest, *Walshia miscecolorella*, were flying, through the use of sticky traps; and (2) characterize injury on roots inflicted by *W. miscecolorella* larva.

# METHODS

## Determination of Pest's Life History

Previous work in the lab identified the lepidopteran species as *Walshia miscecolorella* (Chambers), when larvae extracted from *D. candida* roots were reared to the adult stage. The life history of this pest has been determined on *Melilotus* (sweetclover) species (Manglitz et al., 1971), but not on *D. candida*. Therefore, in an attempt to discover when female adults were flying and potentially laying eggs, 30 yellow sticky traps (28 x 23 cm) were placed throughout the upper field at BPMC on 13 June 2007. Traps were replaced once a week until 6 July 2007 when the field began to flower. Adults were not found on the sticky traps, so no conclusions are possible.

## Biology of Root-Boring Pest

Although I was unable to determine the flight season of adult *W. miscecolorella*, I was able to quantitatively assess root damage caused by the moth. Forty root samples, defined as the entire plant, collected on 23 October 2005 and 2 June 2006 were dissected to look for *W. miscecolorella* larvae inside the roots. The majority of the larvae were found in the crown region. Larvae were removed and placed in 70% ethanol. Root diameter (largest and smallest width), the number of above-ground shoots, and the number of larvae and pupae were recorded for each plant.

# RESULTS

## Biology of the Root-Boring Pest

### Pest Identity

Previous work in Kevin O'Neill's lab identified the lepidopteran species, *Walshia miscecolorella* (Lepidoptera; Cosmopterigidae) as the potential pest of *D. candida*, through rearing of larvae extracted from *D. candida* roots.

### Characterization of Root Damage to *D. candida*

Damage Caused by the Moth. The moth typically produces tunnels near the crown of the plant, but sometimes they occur deeper, near the center of the taproot. Tunnels are produced as the moth larva feeds on the internal tissues of the root. The tunnels themselves are brown in appearance and contrast with the white tissue of the root. These tunnels are typically located near the outer epidermis of the root and rarely penetrate deep into the core of the plant.

Root Damage. External damage to the root can vary from no visible damage to a brittle appearance, with the shoots easily pulled off the root. Exit holes can be visible on the outside of the plant, usually at the crown of the plant, but can be found elsewhere. Damage appears to accumulate as larval infestations occur each year and secondary pathogens weaken this perennial plant. Infestations can range from 0 to 10 larvae per taproot (Fig. 1). No association was found between the root diameters, the number of shoots and the number of larva collected (Fig. 2). Neither of these characters seem to be strong indicators of the number of larva found on a plant.

Figure 1. Frequency distribution of the number of larvae per root sample for A) June, B) October and C) both months combined for USDA, NRCS-Plant Materials Center, Bridger, MT.

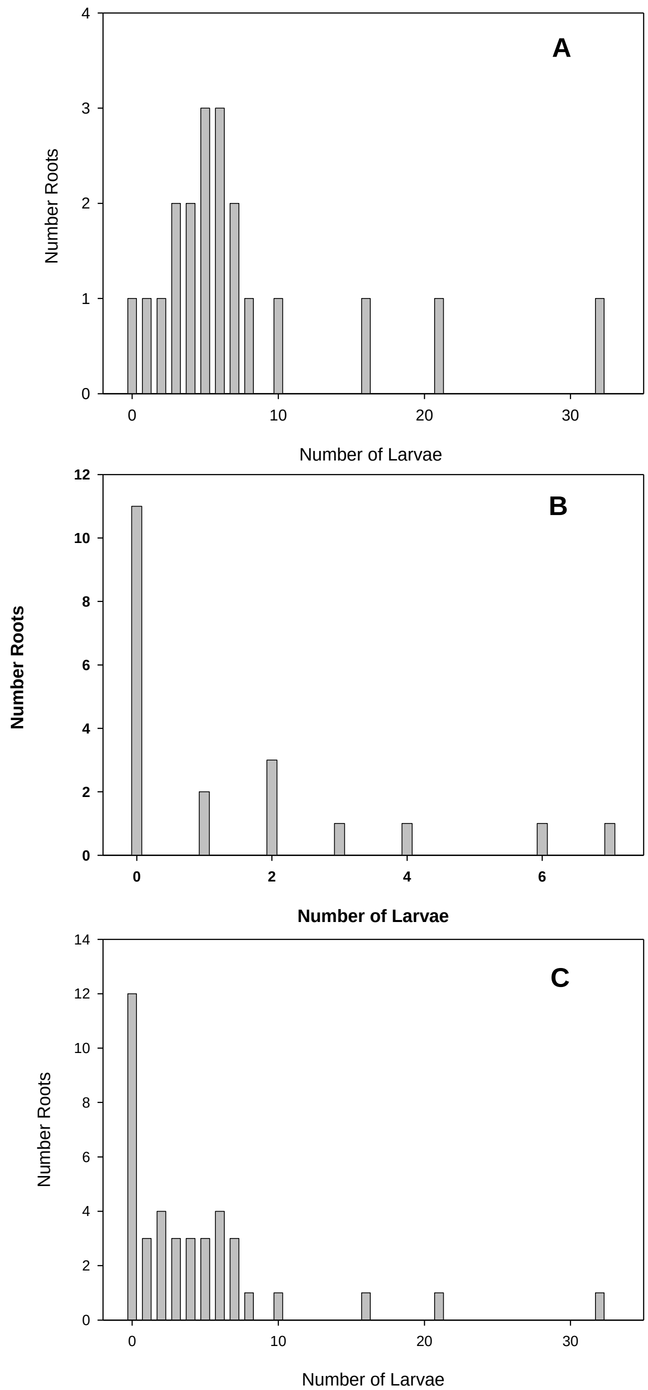
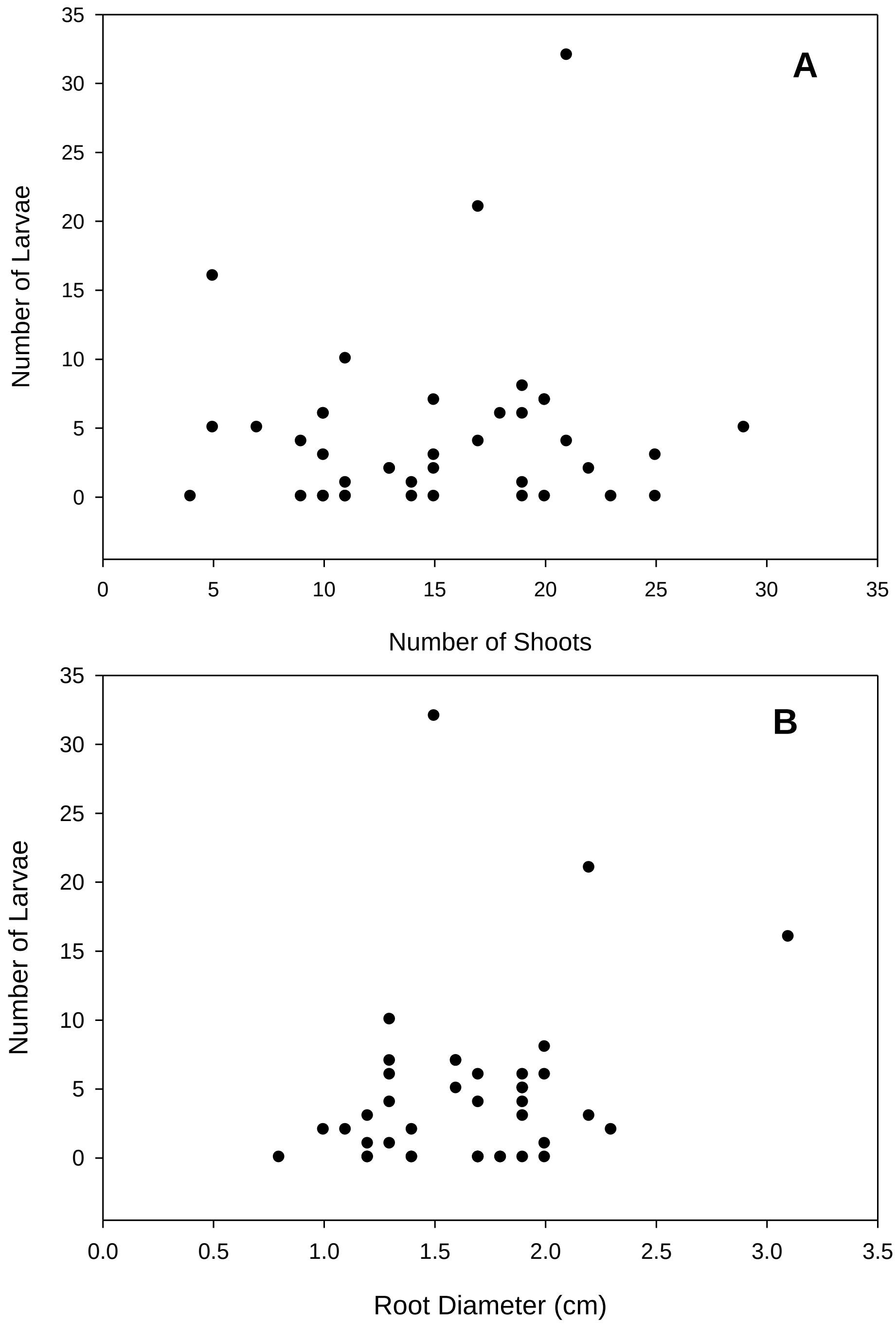


Figure 2. Number of larvae per A) number of shoots and B) diameter or root for June and October combined for USDA, NRCS-Plant Materials Center, Bridger, MT. ($P < 0.05$).



# DISCUSSION

## Biology of the Root-Boring Pest

The lepidopteran species, *Walshia miscecolorella* (Lepidoptera: Cosmopterigidae), was identified as the potential pest of *D. candida*, through rearing of individuals removed from the roots. Sticky traps were used in an attempt to determine when adults was flying but none were collected. Damage to the root is not indicative of the level of infestation and can include exit holes, tunnels inside the root, brittle appearance of shoots, and sometimes secondary opportunistic infection by what appears to be a white fungus (species unknown). There was no correlation between the number of larvae present in a root and the number or shoots on the plant or the diameter of the root. Previous studies of this pest on sweetclover (*Melilotus* spp.), which is also a legume, revealed that infestation rates vary and that a plant could have as many at 2.2 borers/plant (Manglitz et al., 1971). Infestation rates on *D. candida* also varied, but as many as 32 borers/plants were found (though only in one case). Damage to the root was similar for *D. candida* and sweetclover, but there also were noticeable effects on the above-ground vegetation in sweetclover that were not observed in *D. candida*. Sweetclover was observed to have a yellowish discoloration of the leaves, fewer leaves, and the leaves tended to fold along the mid-veins (Manglitz et al., 1971). No noticeable damage was observed on the above-ground vegetation in *D. candida*.