# International Rock Gardener

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Travis Owen lives in semi-rural Rogue River, Oregon with his wife Anna and daughters Zia and baby Ayla. He has a large garden, chickens, a few beehives and a host of wild animals around whose goal, he says, is to give him reality checks on occasion through some sort of act of destruction. Travis writes a blog, The Amateur Anthecologist on the subject of anthecology (the study of pollination and the relationship between flowers and their pollinators and all it entails) and is a photographer. With the difficulties faced by pollinating insects around the world, in the face of pesticide use and so on, the need for us to better understand how these insects work who are so vital to our world is one that in my opinion bears study.

Cover picture*: **Xylocopa tabaniformis* on *Monarda* flower** photo, Travis Owen.

## **Native Bees of Southern Oregon (2016)**: **Travis Owen,** text and photos.

***Hoplitis albifrons*** ♂

When most people hear the word *bee*, images of honeybees (*Apis mellifera*, Apidae) and the associated tales of declines come to mind. However, bees are much more diverse and interesting than the honeybee leads one to believe. There are at least thirty-five hundred species of native bees in America north of Mexico alone, and over twenty-thousand described species worldwide (probably many more). They live diverse lifestyles, but unlike the honeybee most live solitary lives. A similar variance can be seen in wasps, particularly predatory wasps from which bees evolved.


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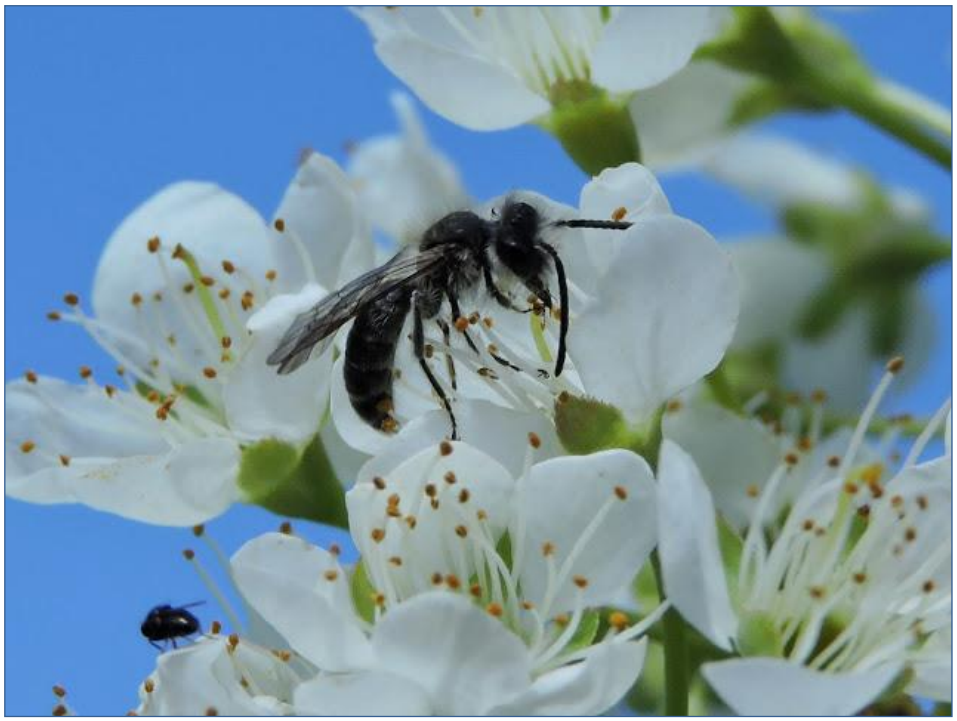
***Xylocopa tabaniformis***

Bees, wasps, ants, and sawflies make up the taxonomic order Hymenoptera, which literally means *membrane-winged.* Hymenoptera is derived from the Ancient Greek word humenópteros (ὑμενόπτερος), from ὑμήν (humḗn, *membrane*) and πτερόν (pterón, *wing*). The most primitive members of the Hymenoptera are the sawflies (Symphyta, includes horntails and wood wasps) which lack the constricted waist seen in the other clades. True wasps likely evolved from sawflies, and bees evolved from predatory wasps (Crabronidae sensu lato) whose modern descendants often look similar to and are mistaken for, true bees. The primary difference between wasps and bees is that bees have branched hairs on their bodies, believed to be an adaptation for carrying pollen, while wasps have simple hairs. While there is some truth in saying that bees are just fuzzy wasps, there are bees that are nearly hairless (i.e. Nomadinae and Hylaeinae) and wasps that are considerably hairy (i.e. Scoliidae).



***Andrena* sp.**

Another difference between wasps and bees, and this is a very large generalization, is their diets. Wasps, either predatory or parasitoid, are for all intents and purposes, carnivorous (at least in the larval stage) while bees are essentially vegan, feeding mostly on nectar and pollen. There are exceptions, for instance there are plant feeding wasps such as the gall forming wasps (i.e. Cynipidae) and bees that will *occasionally* be carnivorous such as when honeybees cannibalize their own larvae and eggs when other food sources are scarce. Also there are many adult wasps which drink flower nectar and others which do not eat at all in the adult stage. Ants, like bees, also likely evolved from predatory wasps or wasp-like ancestors, though unlike the other groups are entirely social (always live in colonies) and in general have a very wide spectrum of diets. Despite the name, velvet ants (or "cow killers," Mutillidae) are predatory wasps related to the social wasps (Vespoidea): the females are wingless but males are winged and seldom seen.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***Andrena pertristis*** ♀

Most bees, wasps, sawflies, and occasionally ants visit flowers for their nectar and sometimes pollen, and are now considered to be important, if not the *most* important, pollinators. However, the earliest hymenopterans (Triassic period, >250 million years ago) were probably plant tissue feeders as most sawfly larvae are today. The first flowering plants appeared in the early Cretaceous (~125 million years ago), and only produced pollen, and were wind pollinated. Nectar, or at least nectar-like sugary secretions, appeared at some time around the late Cretaceous. Sugars were already present in plant tissues (there is no better example than the sugar cane plant, *Saccharum* sp.) and at some point in their evolution the plants began excreting the sugars through specialized organs called nectaries. It is easy to imagine an insect that once bit into the tissue of a plant for the sugar content to become gradually persuaded to visit the nectary instead, which would be mutually beneficial as it is less work for the insect and less damaging to the plant. Plants have used this strategy for other purposes than enticing pollinators. Bracken ferns (*Pteridium* spp.) produce a nectar-like substance from specialized glands (dubbed *extra-floral* nectaries) to entice ants which protect the tender new growth from being eaten by herbivorous invertebrates.

***Apis mellifera***
**in *Ranunculus repens***

(This is an odd sight since pollen of *Ranunculus* is toxic to honeybee larvae. Specialists of *Ranunculus* pollen (i.e. *Chelostoma florisomne*, Osmiini) are able to metabolize the pollen just fine. Both *A. mellifera* and *R. repens* are of European origin, yet did not evolve together. My own observations of the bees in my area and the observations of countless others have shown that bees of different types have very different preferences when it comes to flower types.)


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Floral forms, to a great extent, dictate which types of bees (and other pollinators) can forage based on their body shape and tongue (proboscis) length. This is known as [the theory of] pollination syndromes. For example, large carpenter bees (*Xylocopa* sp.) have relatively long tongues and large bodies, while small carpenter bees (*Ceratina* sp.) have short tongues but their small size enables them to crawl into long floral tubes to reach nectar that may be inaccessible to the larger bees if it is deeper than their tongues can reach. The constituents of nectar and pollen vary considerably between plant species and the conditions in which they grow. This variation in nectar is also likely to contribute to which bees visit which flowers, though this is an understudied topic. Non-native weeds and garden plants present a unique opportunity to study the subjects of pollination syndromes and bee species-specific preferences, as the bees have never encountered the exotic flowers before they were introduced.

***Bombus vandykei*** ♂ **and** ***Ceratina*** **sp.** ♀

I work for a commercial beekeeper, and honeybees play an extremely important role in my life as they literally allow me to feed my family (by allowing me to earn a paycheck). For many others, honeybees are seen as the *most* important pollinator. In reality, honeybees are a commodity and are necessary to our food system primarily because we have plowed over the habitat of native bees and their native host flowers to place industrial scale farms and car-dependent low-density suburban wastelands that are inept at supporting much biodiversity.

Excuse me while I step up on my soap box, I promise it is restricted to this single paragraph. We need to provide habitat and flowers, preferably native flowers (or at least well behaved non-natives) in order to promote native insects. By increasing in number, native bees not only pollinate more plants (including some that honeybees are unable or unwilling to pollinate) but serve as a food source for birds and other wildlife. Native bees have also been shown to improve the efficiency of honeybees on fruit or seed crops by forcing them to switch between crop rows more often. Most native bees are not


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aggressive and will more likely flee than sting, and some are too small to sting through human skin anyway. Besides all those good things, native bees are beautiful and diverse and I would like to see more in my garden and the world that my daughters are growing up in. Less *Euonymus* (excepting a species native to the Pacific Northwest - *Euonymous occidentalis* ) or *Arborvitae*, which support little to no biodiversity and more *Madia* and *Horkelia*, which support abundant biodiversity.

***A male ♂ long horned bee* (*Melissodes* sp.), with a face full of pollen, perched on *Madia elegans.***

Now for a compilation all of the bees that I have photographed this year along with some of my observations of the species: They have been organized by their taxonomic classification (in other words, by scientific classification) for the sake of cleanliness. When I wrote about bees last year, I omitted honeybees from my report and focused solely on native bees that I had encountered. This year I have chosen to include them, mostly because I have been working with them intensely since April (Old Sol Bees). The bees in this report do not represent all of the bees in my area, just the ones that I was able to photograph. Please, enjoy:

**Family Andrenidae**

The Andrenidae represents one of the largest bee families (~3,000 species), and some of the most often encountered native bees. Many are small, much smaller than honeybees that is, though similar coloring would lead many lay observers to assume they are honeybees. This family includes the world's smallest bees, *Perdita* spp., which look nothing like their larger honeybee cousins and would most likely be mistaken for flies (Diptera). They are ground nesting bees which excavate their own branched tunnels two to three inches deep with a cell at the end of each branch (occasionally eight cells per burrow) with an egg laid atop a ball of pollen and nectar. They are solitary bees, though their nests may be in close proximity leading the uninitiated to believe they are eusocial and have colonies like honeybees. They often make their nests in sparsely vegetated areas, but are also known to nest in

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lawns where soil is showing. However, their small size and weak stinger equates to little or no threat to bare-footed children.

**Subfamily Andreninae**

There are approximately fifteen hundred species in this subfamily, around 480 north of Mexico. The majority are in the genus *Andrena*, one of the most commonly encountered bee genera in America, though many could be mistaken for honeybees to the unfamiliar.

***Andrena pertristis*, female ♀ on *Hypochaeris radicata* (May)**

This was one of the larger *Andrena* I have encountered, but still smaller than the average honeybee forager. It was foraging on the non-native and noxious weed hairy Cat's-ear (*Hypochaeris radicata*), often mistaken for a dandelion (*Taraxacum* spp.), though they grow taller and bloom into summer and fall while the dandelions in my area bloom in late winter and spring. Cat's-ear is perennial, grows from a thick and deep taproot, and seed is distributed by wind and birds. If plants are pulled, the taproot breaks and new crowns are formed. Any fragment of taproot forms a new plant, a highly successful species. Myriads of native bees flock to these flowers when in bloom.


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***Andrena* sp. ♂ stealing nectar from *Arctostaphylos viscida* (March)**

While all bees can fairly be called pollinators, sometimes they exhibit behavior that does not aid in pollination. Such is the case with the above photo of the male *Andrena* stealing nectar from the side of the manzanita (*Arctostaphylos viscida*) flower. Manzanita is in the heath family (Ericaceae) which includes blueberries (*Vaccinium* spp.), heather (*Erica* spp.), azalea (*Rhododendron* spp.), madrone (*Arbutus* spp.) and many others. The flowers of all of these require sonication, or buzz pollination, to release the pollen from the anthers. Andrenid bees are not typically capable of this, and it has been my observation that the andrenid bees in my area opt to rob the nectar instead. It is unclear whether they are the ones biting the holes or if it is done by other bees first.
Andrenid bees were the most numerous of all pollinators on my plum trees this year. When I would approach a tree a cloud of tiny bees would burst from the side I was on and move to the other side.

***Andrena* sp. ♂, left, with Andrena sp., right on plum blossoms (March)**

Unfortunately, the characteristics which define species of *Andrena* are minute and require a specimen to study or very detailed macro photos of various angles for a positive identification. My photos are not nearly detailed enough for this, something to strive for next year.


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***Andrena* sp. ♀ on male *Quercus kelloggii* catkins (April)**

Last year I had observed from a distance while pollinators visited the male catkins of the California black oak (*Quercus kelloggii*) but had not seen them close enough to determine what type of pollinator they were (hymenopteran or dipteran). Oak trees often bloom at the crown, so viewing pollinators visiting the typically wind-pollinated catkins is not typically practical. However, the oaks and many other spring flowers bloomed prolifically this year, and there were oak catkins within view enabling closer observation. Many *Andrena* appear to be generalists as in they visit a wide range of flowers across many families. It is doubtful whether pollinators contribute to the reproduction of oak trees since the female flowers, what will eventually grow to become acorns, offer no incentives for pollinators to go to them and are not located in the same area on the branches as are the catkins.

**Subfamily Panurginae**

This subfamily contains the world's smallest bees in the genus *Perdita*. Of the thirty-five genera, many are specialists which collect pollen from a single plant species thus efforts to conserve species require the conservation of the host plant. Generally speaking, panurgine bees are less hairy then their Andreninae cousins, though their lifestyles are otherwise very similar.


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**Tribe Calliopsini**

***Calliopsis* (*Nomadopsis*) ♀ female**, left and ♂ **male**, right **on *Horkelia daucifolia* (June)**

Species of *Calliopsis* are oligolectic, meaning they visit only a narrow range of flowers for pollen. I found a male and a female perched on flowers of *Horkelia daucifolia* (Rosaceae), a California and Southern Oregon endemic which is sometimes associated with serpentine. Some species of *Calliopsis* are specialists of a single plant species, though to my knowledge none are specialists of *Horkelia* spp., which appear to be generalist flowers (attracting many types of pollinators).
The male *Calliopsis* is identified by the lack of scopal hairs on the hind legs, which the female uses to collect pollen. Most bees (except for bees in the Apidae) have patches of thicker hair either on their hind legs or under the abdomen (as in *Megachile* spp.) which are used to hold pollen. Apidae bees have corbicula, similar to scopae except they form a sort of pouch sometimes referred to as a pollen basket. Males of any species of bee, as well as the kleptoparasitic bees (which do not collect pollen, but instead steal it from the nests of other bees), lack both scopae and corbicula.

## Family Apidae

Within the family Apidae are the most common and familiar bees in America, including honeybees and bumblebees, both in the subfamily Apinae. Carpenter bees (subfamily Xylocopinae) are another familiar member of the family. The Apidae is the largest family in the superfamily Apoidea (all true bees) with >5700 known species. While the most well-known members are eusocial, the majority live solitary lives. The family is composed of many unique and fascinating species, a few of which I will summarize here. Orchid bees (tribe Euglossini, mostly tropical) are an occasionally eusocial group, males of which collect oils produced from orchids (and plants in a few other plant families) to attract females, thus pollinating them. Cuckoo bees (subfamily Nomadinae) do not build their own nests, lack pollen carrying apparati, and lay their eggs in the nests of other solitary bees. Stingless bees (tribe Meliponini, tropical and subtropical) are small eusocial bees closely related to honeybees that are reared for honey and pollination in tropical parts of the world (not in the United States). Others include the digger bees and long horned bees, a group of fast flying solitary bees.

## Subfamily Apinae

The subfamily Apinae includes all the eusocial species and the most familiar bees to most. Although honeybees (*Apis* spp.), bumblebees (*Bombus* spp.) and stingless bees (tribe Meliponini, many genera) all exhibit eusocial behavior, their methods of communication among nest mates and nest construction vary widely (even within genera) thus it is believed the social behavior developed independently in each group. This subfamily also includes all the solitary ground nesting bees of the Apidae.


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**Tribe Apini**

The tribe Apini includes the single genus *Apis*, the honeybees. There are around twelve accepted species around the world, including the European honeybee (*A. mellifera*, which itself has around twenty six subspecies), the Asian honeybee (*A. cerana*), and the giant Southeast Asian honeybee (*A. dorsata*) which builds a large single wax comb in an exposed site like a branch or off the side of a cliff. Honeybees are probably the most evolutionarily advanced and complex of all bees, something I will attempt to explain in the following paragraphs. As mentioned earlier, many of my job duties involve working with honeybees (*A. mellifera*) in a variety of ways, so I should hopefully be able to adequately describe some facets of their complexity in a coherent manner. Though for me to think I can summarize a species whose literature can fill a modest library is absurd, I suggest that anyone interested in learning more about keeping honeybees should refer to the books *Natural Beekeeping* by Ross Conrad (Chelsea Green Publishing) or *The Backyard Beekeeper* by Kim Flottum (Quarry Books).

***Apis mellifera* queen ♀**

One of my job duties for much of the year had been to capture queens to sell. This entails ascertaining whether or not a nucleus colony (a small hive created for the purpose of queen rearing, in our case) is queenright, has eggs present (indicative of the presence of a *mated* queen), locating said queen, capturing her barehanded, and placing her in a cage to be sent to a customer. After a queen is captured, and a hive becomes queenless, a new queen cell is added rather than letting them raise their own. My employer has been grafting honeybee larvae for about two decades, a process that allows control over at least some of the genetics while simultaneously creating as many queens as possible. Queen cells are placed (über carefully!) into the now queenless units where they will be raised by the adopted hive and, once fully mated (laying fertilized eggs), will be captured and the process repeated.


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***Apis mellifera* queen -**
(I swear I'm not squishing her! We capture and hold queens by the thorax, never the wings or abdomen, before they are placed in a cage and given attendants to feed and groom them. We try to place them in the cage quickly since holding is certainly stressful, but if done right they will remain calm. Also, avoid breathing on them!)

Queens are created when a bee larvae feed exclusively on a diet of royal jelly, a protein rich substance excreted from the heads of nurse bees. All honeybees are fed royal jelly when they first hatch but only the new queens feed solely on the substance. In around sixteen days from the time the egg was laid by the previous queen, a newly pupated queen emerges, but she is a virgin. If there are other virgin queens present they will battle to the death, often by stinging. Queen bees, like wasps, have stingers that are not barbed like most bees. New queens will make a series of mating flights, mate with dozens of male honeybees (drones) and store all of their sperm in a special receptacle called a spermatheca. Once they are mated, they will never leave the nest again (unless they swarm). A mature queen is a workhorse, laying an estimated two thousand eggs a day in a strong colony.

***Apis mellifera* worker ♀ on *Rubus armeniacus* (Rosaceae)**


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Foragers are the most familiar of the honeybee castes. All forager honeybees are females, and all females can lay eggs, but they are only capable of laying males (drones) which will be explained in greater detail below. Queen honeybees suppress the tendency of worker bees from laying eggs with pheromones. Queen honeybees produce over two dozen distinct pheromones; the functions of some are as yet a mystery. Worker bees produce several pheromones themselves, which is a major part of their method of communicating with nest mates. They also communicate by touching one another, possibly taste as well, and by vibration. One of the most sophisticated of their communicatory expressions is known as the waggle dance. Dependant on the angle the dance is performed in relation to the sun, foragers are able to direct other foragers to choice sources of nectar or pollen.

***Apis mellifera* worker**

Newly hatched larvae of any caste are given royal jelly in the beginning, and then if they are to be a worker or a drone they are switched to a diet of honey and pollen for six days. After pupating for about a dozen days under a wax cap, they chew their way out. The fuzzy new honeybees begin their lives as laborers by cleaning cells, then becoming nurse bees, then comb builders, honey/pollen packers, queen attendants, guard bees, then finally they retire as foragers. The order isn't rigid; sometimes they skip steps or skip around, occasionally reverting to earlier tasks. Most live out their lives foraging; a physically taxing occupation for the small insects. Honeybees have been known to forage two to five miles (radius) away from their hive. In the busiest parts of the season (for a honeybee, this is probably spring and summer when there are the most flowers), a worker may live for two weeks. In the winter when they are not flying, a worker may live for months.

Below: ***Apis mellifera* stinger**

Like the predatory wasps, bees have stingers and venom. Unlike wasps, bees have barbed stingers which are torn out when they sting leaving a pulsing sack of venom, and some entrails, with the stinger. With the exception of queen honeybees, the bee dies after stinging. The honeybee stinger has multiple parts. The pointy section is made up of three parts, a thin channelled shaft (stylet) and two serrated parts (lancets) which glide up and down the stylet and drive the stinger into the victim. Meanwhile, two muscles continuously pump venom through the channel between the stylet and the lancets. In my experience, the sting of a honeybee is more painful than that of a yellowjacket wasp (*Vespula* spp.), but this is extremely variable and I suspect it is dependent on where the sting occurs on the body and the duration the honeybee stinger remains in the flesh (though I try to remove it as fast as I can).


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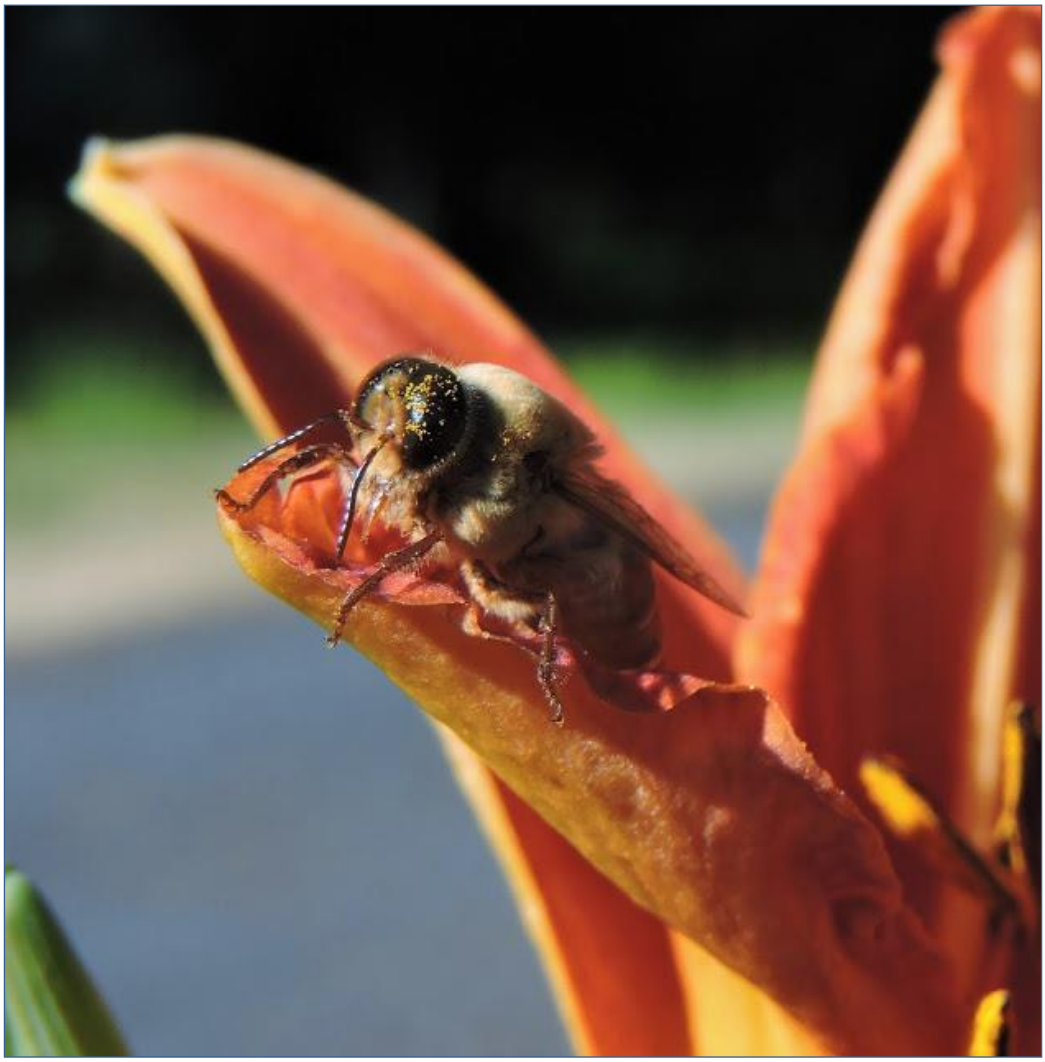
Many of the more notorious hymenopterans (yellowjackets, hornets, Africanized bees) are preceded by their reputation as being aggressive. Fear of being stung has a very real effect on our perception of the order Hymenoptera, and for good reason. For a very small percentage of the population (~5%) being stung just once can be life threatening. For the rest of us being stung is a painful warning and will have symptoms that go away. Thanks to the research of entomologist Justin Schmidt we now have a better understanding of insect stings, and the evolutionary significance of the fear they induce in us, which as it turns out is very important to their survival. Solitary hymenopterans, the bees and wasps that do not form colonies, have stings that, although occasionally extremely painful, do little actual harm. Eusocial hymenopterans, such as honeybees, bumblebees, and social vespid wasps, have venom that causes real harm by bursting cell membranes and destroying nerve tissue, among other things. This is significant, the social hymenopterans have nests full of valuable food stores and brood worth protecting while solitary hymenopterans, however, can abandon their small nest and create a new one elsewhere. Bees and wasps rely on the fear induced by the pain of their sting even though it is essentially a lie with the solitary species.



***Apis mellifera* drone (♂) perched on a daylily (*Hemerocallis* sp.)** but you are unlikely to see a drone visiting flowers, because this photo was set up. I brought a drone home from work to show my three year old daughter (she loved it!), then released him the following day. He stumbled around stupidly for a few minutes in the daylily before clumsily falling off. Not one of nature's more graceful subjects.

Male honeybees are called drones, and their sole purpose is to mate. Drones, as is the case with all Hymenoptera, are born of unfertilized eggs. In other words, they have no father, and when their family tree is mapped out the resulting pattern that emerges is the Fibonacci sequence. One drone has one parent (a queen), two grandparents, three great grandparents, five great great grandparents, eight great great great grandparents, et cetera, ad infinitum. Queen bees can fertilize eggs at will by having full control of the spermatheca (sperm-storing receptacle) and ovary. A drone's life in the hive is that of luxury and indolence, until the time comes when the drones are forced out of the hive to seek a queen (by her pheromones), mate, and die. Unlike their sisters, drones lack a stinger but have a penis, but it is broken off at the time of mating. They typically bleed hemolymph and die following copulation. Remember this next time you are having a bad day.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The following photos are a few examples of some typical honeybee apiaries, or bee yards. Typically there is a limited number of hives an area of land can support, based on the amount of resources available and if there are other apiaries nearby (though beekeepers tend to communicate on these things). Like other non-native agricultural animals, honeybees do have an impact on the native ecology, though the full effects are not fully known. Unlike cows which can be confined to an area with a fence, bees cannot be fenced and thus directly compete with native pollinators. My personal observations tend to suggest that while honeybees may be creating more competition, the larger threat to wild bee populations is most likely loss of habitat and lack of native wildflowers in heavily human-populated areas. Some of the apiaries I have seen were located in land with very few invasive plant species and were able to support a wide variety of native bees despite the forty to seventy honeybee hives in the area.



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**Tribe Bombini**

The bumblebees may be the second most recognizable group of bees after honeybees. The tribe contains the single genus, *Bombus* (46 species north of Mexico, ~260 worldwide). There are, however, species of bumblebee brood parasitoids that do not collect pollen and take over the established nests of pollen collecting species (by way of a coup d'état of sorts, and mimicry) and have occasionally been considered a separate genus, *Psythirus*. Besides the parasitoids, the genus *Bombus* is a eusocial species, but unlike honeybees which have perennial colonies, have annual colonies. In the spring, a new queen bumblebee seeks a suitable nest site, often in old rodent tunnels or other protected spaces (including gaps in walls, discarded mattresses, etc.) and builds a small wax urn-like vessel for storing nectar. Once enough resources are collected she lays a few eggs to raise a few workers. When enough workers have reached adulthood she ceases to forage and focuses solely on egg laying. Depending on the species, males and new queen are produced some time around late summer or fall. Males and new queens mate, males die, and the newly mated queens either return to the nest temporarily or seek a winter hideout (hibernacula). The current year's colony along with the old queen, dies, and the new queens start the process again the following year.

***Bombus vosnesenskii*** ♀ **foraging on** ***Lathyrus latifolius***



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Bumblebees, along with a few other local genera (i.e. *Habropoda*: Anthophorini), are able to perform sonication, or buzz pollination. This is the process of vibrating certain flight muscles while gripping onto flowers in order to release the pollen from the anthers. This sort of movement is required for many plants including those in the Solanaceae (nightshades: tomatoes, potatoes, eggplant, etc.), Ericaceae (blueberries, cranberries, manzanita), and a variety of genera in other families (i.e. *Dodecatheon*: Primulaceae). Honeybees are inefficient or unable to pollinate many of these plants, thus the importance of alternative pollinators.

***Bombus vosnesenskii*** ♂ **on *Hyssopus officinalis* (June)**

Bumblebees are not as sophisticated as honeybees when it comes to communication, but this has major benefits for people. This is because bumblebees do not communicate where good floral resources are like honeybees (the waggle dance). This may not seem beneficial right away, but in the case of greenhouse pollination it ensures pollination of the target crop. Honeybees, being the fickle little girls they are, will forsake one plant altogether if they find something more appealing. This could result in the target crop being ignored completely, which is an obvious drawback. In the case of greenhouse tomatoes, which require cross pollination, yet are not well liked by honeybees, bumblebees do a fine job. Many people are unaware that bumblebee colonies of a limited few species are commercially available, but once again they are "single use" as the colony will die at the end of the season. Being that there are a limited number of species that are reared commercially, it is of high importance to only use a species that is native to your area lest one should introduce yet another non-native species to what might have been healthy ecosystems.

***Bombus vandykei*** ♂ **on *Allium sphaerocephalon* (June):** males like this one are often found motionless on flowers early in the morning, offering excellent opportunities for the photographer.

A few more comparisons to the honeybee, the first being that bumblebees do not build hexagonal cells arranged on flat vertical combs as do honeybees, and the second is that they do not make honey (despite collecting nectar). Bumblebees are essentially a ground nesting genus as opposed to honeybees which prefer nest sites with a bit of elevation off the ground), and their nests are constructed by a non-uniform jumble of wax pots filled with nectar, some pollen, and brood. Since they don't form perennial colonies, they have no need to make honey (which is essentially created for the purpose of lasting a long time, as evident by unspoiled three thousand year old honey found in ancient Egyptian tombs).


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Despite these comparatively more primitive attributes, bumblebees were for thousands of years the dominant eusocial bees in the Americas before the introduction of the honeybee in the time of the European colonization.

***Bombus huntii*** ♀ **and *Echinacea purpurea* (July)**

***Bombus huntii*** ♀ **and *Echinacea purpurea* (July)**

I have observed a progression of species of bumblebees in my area. The first to appear are queens of *Bombus vosnesenski* and *B. vandykei*. In about a month's time their workers become apparent, and the bright yellow males of *B. vandykei* are conspicuous visitors to the garden. Later in the season, as *B. vandykei* become less numerous, *B. huntii* appear, though I have observed fewer of them than the previous two. I have seen a few other species, including *B. griseocollis* and a few other


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species whose identities remain a mystery. Bumblebees are not too difficult for the lay observer to identify. They differ from the large carpenter bees (*Xylocopa* spp.) by their hairy abdomens, whereas the abdomens of the carpenter bees are shiny and hairless. Bumblebees are identified by the bands of colors on their bodies, often by the location of particular colors on the abdomen. For instance, *B. vosnesenski* females differs from *B. vandykei* only by the location of a single yellow band on one abdominal segment rather than the one next to it (yellow band on abdominal segment T4 is *B. vosnesenski*, T3 is *B. vandykei*). In other instances identification is much less subtle and more readily apparent.

Bumblebees are generalist pollinators, like most bees, which means they will visit a wide range of flowers. In my garden they are quite fond of the masses of *Echinacea* I have grown from seed. Other plants they seem to be attracted to are, in no particular order, onions (*Allium* spp., including ornamental types), winter heath (*Erica* spp.), true hyssop (*Hyssopus officinalis*), manzanita (*Arctostaphylos* spp.), *Anchusa* spp., and Pacific Hound's Tongue (*Cynoglossum grande*), to name a few. Bumblebees are also important pollinators of many native orchids including *Spiranthes* spp., *Piperia* spp, and *Goodyera* spp. among others. In the case of orchids, the bumblebee is occasionally duped into visiting the flower which has no floral rewards, while in other cases some species of orchids actually produce nectar as an incentive to pollinators.

**Tribe Emphorini**

This is a rather poorly represented tribe of bees in the United States, with just thirty-one species in four genera north of Mexico, one hundred eighteen species in ten genera worldwide. They are known collectively as chimney bees for their occasional nest entrance featuring a turret made of mud. Most are pollen specialists of a relatively confined list of plant families, predominantly the mallows (Malvaceae) but also plants in the families Asteraceae, Cactaceae, Convolvulaceae, and Onagraceae.

***Diadasia* sp. ♂ inside *Sidalcea glaucescens* (May)**


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Like others in the tribe, *Diadasia* spp. are specialists. I have only observed this genus twice, but both times were in the waxy checkerbloom, *Sidalcea glaucescens* (Malvaceae), a common wildflower in my area. *S. glaucescens* has flowers that close at night, and this male was found inside this flower early in the morning. The fact that it was too cold for the bee to move yet the flower was open suggests the flowers are sensitive to light, but this is just conjecture.

**Tribe Eucerini**

This tribe is comprised of thirty six genera with around seven hundred fifty species worldwide, and two hundred twelve species in fourteen genera north of Mexico. They are known as long-horned bees because the males of most species have very long antennae. They are all ground nesting bees, occasionally building horizontal burrows in exposed banks. Like many of the ground nesting bees, females line the cells with a wax-like substance. Some species nest communally (multiple laying females sharing a nest) but most are completely solitary.

***Melissodes* sp. ♀ on *Madia elegans* (July)**

*Melissodes* are specialists of flowers in the Asteraceae, or sunflower family, while the species in my area appears to specialize on the native *Madia elegans*. The flowers begin blooming in mid simmer and continue until mid fall. They open in the evening and remain open until the sun comes out. The bees work the flowers in the cool mornings before the flowers close, and then disappear for the remainder of the day. July is one of the hottest months of the year here, often in the 90° F range but occasionally hotter.

These are very fast flying bees, and very difficult to sneak up on. Males sometimes fight over females, and males also attempt to mate while females are foraging. I witnessed a mating event in which a female visiting a flower was suddenly mounted by a male, and they struggled briefly before the female was able to fight him off. I have no idea if the mating was successful; it was less than thirty seconds.

***Melissodes* sp. ♂ on *Madia elegans* (July)**



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**Subfamily Xylocopinae**

The Xylocopinae is the third subfamily in the Apidae (following the Apinae and Nomadinae), and represents the carpenter bees. There are four tribes in the Xylocopinae (Allodapini, Ceratinini, Manueliini, and Xylocopini), only two of which are represented north of Mexico. The tribe Allodapini is represented by around fifteen genera, mostly in Southeast Asia, sub-Saharan Africa, and Australasia. They often form communal colonies where there are multiple laying females caring for brood, but what really makes this tribe strange is the larvae are entirely mobile within the nest, and must compete for food. The tribe Manueliini is represented by a single genus with a handful of species, and are only known from Chile and Argentina. The tribes Ceratinini and Xylocopini are a bit more familiar, and are described below.

**Tribe Ceratinini**

The single genus, *Ceratina*, represents this tribe. They are small bees that nest in the pith of broken stems of woody plants (such as *Rubus* spp.) or occasionally wood itself though I would assume it would be very soft wood. They are mostly solitary, though there have been reports of some species exhibiting eusocial behavior where one bee forages while the other lays eggs and guards the nest. They often appear black though they are typically dark metallic green or blue. Interestingly, females do not collect very much pollen on their sparsely hairy bodies, but rather eat it and store it in their crop until they return to their nest. There are other some other bees that collect pollen in this way (i.e. *Hylaeus* spp.in the family Colletidae, which I photographed here last year), mostly small bees.

***Ceratina* sp. on *Hypochaeris radicata* (May)**

There are about twenty one species of *Ceratina* in the United States, mostly found in non-desert habitats. Most American species are solitary and nest in broken pithy stems. The females create a linear row of brood cells, starting from the deepest, and separate the cells with the chewed up pith and their own saliva. When the nest is complete, the female will stand guard at the entrance of the nest, dying in winter or late fall (first hard frost), and remain in place to block the entrance from intruders. Larvae pupate in the fall and remain in the nest in diapause as adults through winter until they emerge in the following spring.

*Ceratina* appear to be quite fond of plants in the Asteraceae, though this could be that many composites have relatively accessible nectar and pollen. *Ceratina* are generalists, and readily accept foreign plants such as *Hypochaeris* and *Echinacea* as pollen sources. In general brood are more susceptible to different sources of pollen than adults are of nectar because pollen has so very much to


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do with development. Pollen is the primary source of protein for bees, and protein content varies greatly between plant genera. Wind pollinated plants have pollen that is practically devoid of protein, suggesting that protein in pollen was an adaptation to entice pollinators. Studies where pollen specialist bees were fed different pollen sources resulted in larvae that didn't survive to pupation, or were greatly reduced in size as adults. Generalist species like *Ceratina* have clearly adapted to be able to metabolize a wide variety of pollen types and complex sugars, and it is no surprise the genus is found in every continent except Antarctica.

**Tribe Xylocopini**

The most iconic members of the subfamily Xylocopinae, *Xylocopa* is the sole genus of the tribe Xylocopini. These large conspicuous bees make nests in living and dead wood or woody plant stems (i.e. bamboo, *Agave* spp., *Yucca* spp.) using their strong mandibles. Nests are usually linear, occasionally with brood cells coming off a main tunnel. Most are solitary, though a few are primitively eusocial as females of overlapping generations share a nest. Cell walls are lined with sawdust, and species of desert habitats line cells with a wax like substance to prevent desiccation. The eggs of some *Xylocopa* are the largest insect eggs known, some over a half-inch long! Females lay few eggs in their lifetime, often less than eight, and relative to other bees invest greater maternal care in rearing them.

***Xylocopa tabaniformis* visiting *Salvia sclarea* (July)**

Males of *Xylocopa* are often seen lurking around flower patches they have deemed good places to pick up hot dates, and will aggressively go after any intruder that happens by, even flies (Diptera), and sometimes people. There is nothing to worry about though, like most male hymenopterans, they have no stinger. When a female comes along, they will attempt to mount her and remain attached while she attempts to continue foraging.
Large carpenter bees were one of the only species to show interest in the clary sage (*Salvia sclarea*), along with carder bees (*Anthidium manicatum*), a few European paper wasps (*Polistes dominula*), and a hummingbird (*Selasphorus rufus*). They were, however, highly interested in this plant and there were at least a handful of them working the clary sage at any given moment while they were still active. Although clary sage is native to the Mediterranean, its reproductive structures are a good fit for the large carpenter bees. A few years ago I grew *Salvia farinacea* (before the voles killed all of my plants) and the carpenter bees were similarly attracted to those flowers as well. *Monarda fistulosa* is another plant in my garden that is attractive to *Xylocopa tabaniformis*.


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## Family Halictidae

Halictid bees are only second to Apidae in terms of numbers, and include some species that are readily recognized by some gardeners and naturalists. They are collectively known as sweat bees, though this is misleading as only some members of the family land on people and are attracted by sweat (some species in the tribe Halictini). Certain flies in the family Syrphidae (Diptera) are also known as *sweat bees* in some regions since some species are attracted to sweat. Halictid bees are typically ground nesting bees, some prefer clay soil while others prefer sandy soil at the edges of streams. Some have a single generation per year, but most probably have multiple overlapping generations. Most are fairly considered to be solitary, though some become eusocial as more generations emerge from pupation and share the nests with their mothers. Others are strange in that, within a single species, may be solitary in one region while eusocial in another. This is thought to be determined by climate and how many resources are available. Others may simply be communal, with females sharing a single nest entrance but provisioning their own brood cells.

## Subfamily Halictinae

This subfamily contains the most commonly encountered genera, including the small metallic green bees in the genera *Agapostemon* and *Augochlora* (Augochlorini). Some are even kleptoparasitic, the genus *Sphecodes* isn't commonly encountered and resembles a wasp (black mostly hairless body with a red abdomen), and it lays its eggs in the nests of other Halictinae.

### Tribe Halictini

The tribe Halictini contains at least 2,800 species in twenty two genera in the world, three hundred eighty species in five genera north of Mexico.

*Agapostemon* spp. are one of the easiest of the green metallic bees to identify by the lay observer. The head and thorax are metallic green and the abdomen has black and white stripes. These are typically small bees that visit a wide range of flowers, mostly Asteraceae in my observations.

Above and right: ***Agapostemon* sp. ♀ on *Hypochaeris radicata* (May)**

Although they are sometimes known as green sweat bees, *Agapostemon* spp. are not attracted to sweat.

*Agapostemon* spp. are not eusocial, but some live communally. Occasionally a single female will guard the communal nest entrance, blocking access with her body, and only her head visible from above ground.


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***Halictus ligatus*** **♀ visiting** ***Croton setigerus*** **(July)**

One of the most common native bees in my area is the sweat bee *Halictus ligatus*. This is a widespread species found from Canada to the Gulf of Mexico and from the Atlantic to the Pacific. This species, like others in the genus, are true *sweat bees* because they are attracted to sweat. *Halictus* nest in flat ground in what may best be described as sandy loam. Tunnels may be simple or branched, and brood cells are lined with a waxy substance from a special organ at the tip of their abdomen called the Dufour's gland.

***Halictus ligatus*** **visiting** ***Coreopsis*** **(June)**

Females begin foraging and creating solitary nests in the spring, but may develop into eusocial colonies. Eusociality ranges from having communal nest where overlapping generations remain in the nest to help care for younger generations to full hierarchical social systems with a single laying queen and worker caste. Dominant queens aggressively defend their role as the primary egg-layer (and the sole bee to pass on her genes), but


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depending on climatic conditions may have to contend with other laying queens in the nest. Favorable conditions this year will result in [relatively] large-bodied queens next spring, and if next year presents poor climatic conditions during the rearing of the first generation of workers they will be resultantly smaller in body size, thus easy to control by the dominant queen. The reverse scenario would lead to more laying workers, but unlike honeybees they would be entirely capable of mating and laying females. (In a honeybee hive, non-queen bees, known as laying workers, are only capable of laying drones, male honeybees, which have only one set of chromosomes from the mother.)

***Halictus rubicundus*** **♀ foraging on** ***Horkelia daucifolia*** **(May)**

Similar to *Halictus ligatus*, *H. rubicundus* is a somewhat abundant ground nesting species. Similar eusocial variability is found in this species, where cool climates encourage solitary nesting behavior, and warm climates encourage eusociality, and a mix in between.

I witnessed this bee only once (that I am aware of), and it was one of the many pollinators visiting *Horkelia daucifolia*. The plant is a rose relative (family Rosaceae) with a fairly restricted distribution in Southern Oregon and Northern California.

***Halictus rubicundus*** **♀ (May)**



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***Lasioglossum sisymbrii*** ♀
**(January)**

The genus *Lasioglossum* is very similar to *Halictus* in both morphological and variable eusociality. They are extremely common, but are easily missed due to the small size of many species. Like *Halictus* they are attracted to sweat, perhaps for nutrients in the salt needed for reproduction. Brood cells in underground burrows are lined with a glandular secretion of a mixture of chemicals called lactones, and some species line the entire nest with the waxy substance.

I discovered this sweat bee in mid-January, apparently attracted to my beehive. Often our native bees are mistaken for honeybees by the untrained eye, but seeing both this *Lasioglossum sisymbrii* and *Apis mellifera* together there are some clearly recognizable differences. This was an odd sighting for another reason since it was so very early in the year. Mated females of both *Halictus* and *Lasioglossum* overwinter as adults, so this one could have been overwintering in or around the beehive, attracted to the warmth generated by the honeybees and the sugars that abound in its presence.

***Lasioglossum sisymbrii*** ♀ **(left) and *Apis mellifera*** ♀ **(right)**


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***Lasioglossum* sp. ♀ (*Hemihalictus* series) on *Triteleia hendersonii* (May)**

This is one of the many small species of *Lasioglossum* that could be easily overlooked. The *Hemihalictus* series is a group of taxa that contains about nine subgenera of *Lasioglossum* with weak venation in the wings. They are short tongued bees, so often will be found on flowers with open and highly accessible floral rewards. This female was busy collecting the blue pollen from a yellow form of *Triteleia hendersonii*, a native wildflower that grows from a corm.
The pollination ecology of many native bulbs, particularly in the genus *Triteleia* (and others in the Brodiaeoideae, formerly Themidaceae), is relatively unknown and obscure. Bees have been assumed the primary pollinators of this group of plants, but few documented observations are available. Small bees like this weak-veined *Lasioglossum* may be responsible for their reproductive fitness.

**Family Megachilidae**

This family is diverse and widespread, found in every continent except Antarctica, represented by over four thousand species in around eighty genera. North of Mexico, there are at least six hundred thirty species in eighteen genera. They are probably most distinguished by their namesake, the leafcutter bees (*Megachile* spp.) whose species use leaf pieces to partition and seal brood cells, but not all taxa use leaf bits. For example, other taxa include the mason bees (*Chelostoma* and *Osmia* spp.), carder bees (*Anthidium* spp.), and the megachilid cuckoo bees (*Stelis* and *Coelioxys* spp.). The binding characteristic among all megachilid bees (with the exception of males and the cuckoo bees) is that they carry pollen on scopae on the underside of their abdomen rather than on their legs. Pollen on females (since neither males or cuckoo bees collect pollen) is often conspicuous since the underside of their abdomen will be brightly colored yellow or orange, or whatever color the pollen is on the plant they are foraging on.

**Subfamily Megachilinae**

The subfamily Megachilinae is the largest within the Megachilidae with over seventy genera worldwide. The blue orchard mason bee (*Osmia lignaria*) and the blueberry bee (*O. ribifloris*) are the most economically significant and recognized of this group, primarily because they are sometimes reared commercially and sold across the United States, often where they are not native.

**Tribe Anthidiini**

The European carder bee (*Anthidium manicatum*) is well introduced to the state of Oregon, where it is associated with *Stachys byzantina* (lambs ear), from which it gathers the hairs that cover the leaves to


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line its cells. They also use a variety of other materials in their nest construction, including plant resins and mud.

***Anthidium manicatum*** ♂ **on *Stachys byzantina***

The European carder bee (*Anthidium manicatum*) is well introduced to the state of Oregon, where it is associated with *Stachys byzantina* (lamb's ear), from which it gathers the hairs that cover the leaves to line its cells. They also use a variety of other materials in their nest construction, including plant resins and mud. Males are territorial and can be seen chasing off other males, or anything that flies nearby. I've even seen them go after and grapple with a bee fly (*Bombylius* sp.) trying to visit the *Stachys* flowers. Alas, these bees are fast and agile fliers which have the ability to hover and fly sideways, and have proven themselves to be a challenge for me to photograph. They are one of the few bees attracted by the flowers of clary sage (*Salvia sclarea*), and otherwise seem to have an affinity for plants in the Lamiaceae.

**Tribe Megachilini**

The most renowned members of the Megachilidae are the true leafcutter bees in the genus *Megachile*. To some they are considered to be pests because of the damage they can inflict on the leaves of some plants. As a rule, *Megachile* spp. use their mandibles to cut out semi-circular sections of certain leaves to use in their nests. Nests are often in pre-existing holes in wood, such as those from wood-boring

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beetles, and leaf tissue is used to partition cells and seal the nest entrance once the cells are full. Nests are linear, with some pollen, nectar, and a single egg in each cell.

***Megachile* sp. ♀ on *Lathyrus latifolius* (August)**

I have in years past seen *Megachile* bees on only a few plants. The first was on *Rudbeckia hirta*, and the second sightings were on the perennial sweet pea, *Lathyrus latifolius*. They have a characteristic sweeping motion as they collect pollen; being as the scopae is located under the abdomen they must brush themselves over the anthers to collect the pollen. I regret not having a better photo, but just as I was about to photograph the bee in this photo a second time a [expletive] honeybee came and bullied the leafcutter bee away.

**Tribe Osmiini**

The Osmiini is best known for the genus *Osmia*, commonly known as mason bees. There are roughly eleven hundred species in seventeen genera worldwide with three hundred species in eight genera north of Mexico. Nest types and materials vary widely, some *Osmia* sp. have even been known to nest in empty snail shells. Nests can either be in pre-existing holes in dead wood or in underground burrows, and anything from plant resin to leaf tissue to mud and pebbles is used to partition cells and seal nest entrances. Many specialize on one or a few plant families some specialize on a single genus.


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***Ashmeadiella* sp. on *Coreopsis* (June)**

Many of the osmiine bees are pollen specialists of plants in the Asteraceae: many genera in the Asteraceae are generalist flowers which have shallow and easily accessible floral rewards. *Hoplitis* build solitary nests with mud walls in a variety of locations depending on the species, from nests in the ground to aboveground nests in pithy stems of woody plants, holes in wood, or nests of mud dauber wasps (i.e. *Sceliphron* spp., *Trypoxylon* spp.). A few are even known to nest in old snail shells, and have been known to use rabbit dung to line the cells.

***Hoplitis albifrons* ♂ on *Wyethia angustifolia* (May)**


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Last year (2015) I observed bees within thirteen genera from five different families. Combined with this year's observations, I have photographed a total of nineteen genera in South-western Oregon. This amounts to at least twenty-six species, or twenty-four species of native bees (*Apis mellifera* and *Anthidium manicatum* are introduced) and probably many more that I have not yet seen. Perhaps I can inspire some of you to go watch some flowers, observe bees, and perchance make some interesting observations of your own. Observe how different types of bees prefer different types of flowers, how they move differently, whether they are collecting pollen or nectar. Trying to keep plants which are attractive to pollinators in our gardens at all times of year is a great help, of course. A word of caution: it can be quite addicting and, in our current world, a source of optimism and hope. T.O.

***Hoplitis albifrons*** ♂ **on *Wyethia angustifolia* (May)**

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Right: **Travis Owen with a winged friend!**

Below: **Mating pair of Osimiini bees on Iris chrysophylla.**


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