Mason Bees as Pollinators

Background

Humans rely on pollinators. The **ecosystem services** they provide are essential for agriculture and global food security, but the extent of this contribution can be difficult to quantify. In 2014, the White House estimated that insect pollination services in the United States are valued at $24 billion per year for all insect pollinators, $9 billion of which is from native pollinators. Of course, these exact numbers are difficult to estimate, but with over 90% of angiosperms utilizing insect pollination for reproduction the overwhelming importance of insect pollination is clear.

Up to 85% of major commercial crops depend, at least partially, on animal pollination for seed and fruit production and for achieving maximum yields. The demand for fruits and vegetables to feed our growing population has only continued to increase. However, we are facing a decline in wild pollinators under threats from climate change, habitat loss, pesticides, and disease (see **Drivers of Bee Decline and What You Can Do**). Historically, we have utilized managed populations of the European honeybee, *Apis mellifera*, to supplement our pollination needs, but honeybees are not always the best pollinators for the job.

Mason Bee Pollination

Bees can be classified as specialists or generalists depending on the diversity of plants they forage from. There are two categories of specialist bees, **oligolectic** bees, which forage on plants within a single family or genera and **monolectic** bees which are only known to collect pollen from a single species or handful of closely related species of plants. Generalists bees, or **polylectic** bees, forage on a wide variety of flowering plants in different taxonomic groups. Honeybees are the most well known generalist bees, but many mason bees, including *Osmia lignaria* are also generalists. It is important to note that generalist species don't forage indiscriminately, in fact, many generalists focus on a diverse set of preferred taxonomic groups. *O. lignaria* for example, forages primarily on plants which flower in early spring, which coincides with nest provisioning (see **Foraging Behavior in Mason Bees** and **Nesting and Mating Behavior**).

Figure 1. *Osmia* are extremely efficient pollinators due to both their anatomy and behavior. This pollen covered *Osmia georgica* female shows us why (Image: Missouri Department of Conservation).

This may beg the question, why should we care about specialist bees if generalist bees pollinate a broader array of plants? Not only does biodiversity increase an ecosystem's resilience to change, potentially reducing the impacts of climate change, urbanization, and environmental contamination, but specialist bees and narrow generalist bees may be the only suitable pollinators for certain plants or just more efficient pollinators. As an example, the focal bees of this program, *Osmia,* are incredibly efficient pollinators of spring blooming flowers in the family Rosaceae, which includes grocery store staples like apples, pears, and cherries (Figure 2). Honey bees, which are broad generalists, are inefficient in comparison (we will discuss why in the next section).

Some farmers noticed how efficient mason bees are as pollinators and now manage populations on their farms. Farmers can either set out artificial nests and collect bees from local wild populations or nowadays bees can even be purchased online from a supplier. The process of managing mason bees can vary from a relatively hands off approach to a much more complex process where farmers will use refrigerators to manipulate the timing of bee emergence, matching it with the peak of their crop's bloom, and ensuring maximum pollination. However the basic process is about the same, a population of bees is placed in the field and allowed to pollinate crops and build nests in artificial structures. At the end of the bee's active period and following the bloom the nests are collected, screened for parasites, and then stored for the winter. In early spring the nests are returned to the field to pollinate the next year's crop, allowing the process to restart.

Mason bees vs honeybees

Honeybees are finicky and it may come as a surprise, but they are not particularly good pollinators either. For the early spring flowers, like those favored by some mason

Figure 2. An Apple orchard in full bloom. Apple trees bloom in early spring when the weather can be variable (Image: Bonnie Moreland, Flickr)

bees, they are downright inefficient. Honeybees will not forage in poor weather, which is risky for apple and cherry farmers — and anyone that enjoys the fruit they produce — who depend on crop pollination during a short window in the spring when weather can be variable. Mason bees are less picky and will forage even under poor weather conditions, such as on cool and cloudy days with light wind and rain (see **Foraging Behavior in Mason Bees**).

However, mason bees aren't only more active in spring conditions they are simply more efficient, with female mason bees pollinating virtually every flower they visit. Their anatomy and behavior explain why.

First, let us start with anatomy. Mason bees store and transport dry pollen in their abdominal **scopa** (see **Bee Anatomy**). When the bee visits each flower there is contact between the bee's scopa and the flower's female reproductive structure, the **stigma**. The pollen easily falls off of the bee's scopa and on to the stigma during almost every visit, which facilitates efficient pollination. In contrast, when a honeybee visits a flower, it stores pollen as a sticky mixture with nectar attached to the sides of their hind legs which limits pollen transfer to the plant's stigma.

Second, let us consider the differences in bee behavior. Honeybees cheat. Mutualistic biological relationships rely on both parties doing their part and plant-pollinator relationships are no different. However, honeybees don't always do their part. Specifically, they will often collect nectar from off to the side of the flowers they visit, never coming in contact with the plant's reproductive structures (Figure 3). This behavior is called **nectar robbing** and allows honeybees to "steal" floral resources without fulfilling their end of the deal, pollinating the plant (youtu.be/PICUGaDY5FM). Mason bees' more direct, "headfirst" approach results in contact between the bee's abdomen and the flower's reproductive structures, facilitating pollination at nearly every visit (youtu.be/xyd9DgvjhF4). More discussion about the foraging behavior of mason bees and how this impacts pollination can be found in the **Foraging Behavior in Mason Bees** module.

Concerns with mason bees as managed pollinators

There are downsides to all managed pollinators and mason bees are no exception. The introduction of non-native mason bee species to the United states for use as

Figure 3. A honeybee "sideworking" an apple blossom. Notice how there is no contact between the bee and the reproductive structures of the flower (Image: born1945, Flickr, cropped)

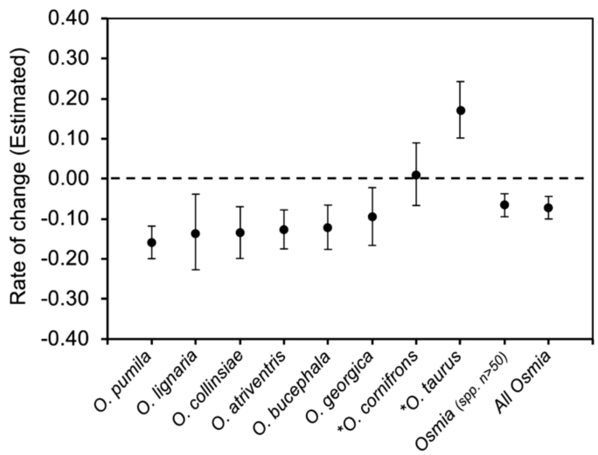

Figure 4. Many native *Osmia* species in the eastern US are in decline, however, two introduced species are increasing in abundance (Figure from LeCroy et al. 2020).

managed pollinators has facilitated the spread of disease, led to the introduction of invasive bee species, and resulted in increased competition for native bees. Unfortunately, even the process of shipping pollinators within the United States is not without risk and can facilitate disease spread to new areas placing managed and wild bee species at risk.

Recent research has documented the impacts of introduced mason bees in the eastern United States, where many native species are in decline. Here, populations of introduced species, such as *Osmia cornifrons* and *Osmia taurus,* are stable or even increasing (Figure 4). Of course, these concerns aren't unique to mason bees. In fact, we can hypothesize that many of the same threats to native bees followed from the introduction of honeybees to North America in 1622 and the introduction of managed populations of nonnative bumblebees. Careful practices, such as prioritizing the use of native bee species, using locally reared managed bee populations, and parasite/disease screening, can help limit, although likely not eliminate, the impact of managed pollinators on wild species (See **Divers of Bee Decline and What You Can Do**).

Common misconceptions

Honeybees are not the only bees used to pollinate crops. There are a number of alternative managed crop pollinators which are used and can be even more effective for certain crops. Native bees also play an important role in crop production and pollination of wild plants.

Glossary

Ecosystem services - The benefits to humans provided by natural ecosystems.

Monolecty - Refers to highly specialized bees which forage for pollen from a single plant species. Occasionally the term will also be used to refer to bees which specialize on a few closely related plant species within the same genus.

Nectar Robbing - A foraging behavior in which a bee (or other pollinator) collects nectar from a flower without facilitating pollination by avoiding contact with the reproductive structures.

Oligolecty - Refers to bees which specialize on plants from a single family or genus.

Polylecty - Refers to generalist bees which collect pollen from a diverse group of plants.

Scopa - Specialized hairs (setae) used to collect and transport pollen.

Stigma - A flower structure on which pollen germinates during plant reproduction, which is located at the end of the pistil, the female reproductive organs.

Resources

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