What Make Native Bees Such Uniquely Effective Pollinators?

Of all the pollinating insects, which include bees, wasps, flies, butterflies, moths and beetles, bees are by far the most important group of pollinators. Other than a few species of wasps, bees are the only pollinating insect to *deliberately* collect pollen. Female bees are specifically designed for the efficient collection and transport of pollen, which they use to provision nests for their offspring. In her quest for pollen, a female bee may visit hundreds of flowers on a single foraging trip, inadvertently transferring, large quantities of pollen from flower to flower along the way. Since bees also exhibit a trait known as "flower constancy", whereby the female tends to visit only one type of flower on a given foraging trip, the transferred pollen grains usually find their way to another flower of the same plant species. This is critical for effective pollination, because pollen deposited on flowers of another species is wasted.

Centris (digger or oil-collecting bee) female collecting pollen to provision a nest for her offspring. She carries the pollen loads, clearly visible in this photo, in specialized hairs on her hind legs. Photo by Rollin Coville.

In contrast, other flower-visiting insects are seeking immediate rewards - usually nectar - and sometimes fail to contact the pollen producing structures of the plant. Any pollen that does adhere to their bodies while they are drinking nectar, or otherwise feeding, mating or resting on a flower, is purely accidental. And the quantities of pollen that hitchhike on other insect pollinators are insignificant when compared to the pollen loads deliberately carried by female bees – the highly skilled and specially equipped collectors.

Convergent evolution of native plants and their pollinators

The interactions between flowering plants and their regional pollinators have, over the millennia, led to increasingly sophisticated and mutually beneficial partnerships. The collective characteristics exhibited in a plant's flower, including its color, size, shape, scent and bloom period, are designed to attract the most effective pollinators of the region. This is sometimes referred to as the plant's "pollination syndrome". Accordingly, bees have evolved numerous physical and behavioral traits which are highly adapted to the floral features of the local plant population. Variations which have occurred in body size and shape, tongue length, mode of pollen collection and foraging habit have enabled native bees to glean the greatest possible pollen and nectar rewards from their botanic partners. This evolutionary dance of plants and pollinators has fostered the great diversity of bee species we observe today.

Dazzling diversity of North America's native bees

Female Diadasia (sunflower, cactus, or mallow bee) collecting pollen from globe mallow. Some Diadasia species are specialists of sunflowers, others of cactus flowers, and still others of mallows. These bees have a close relationship with their botanic partners that has evolved over millennia. Photo by Rollin Coville.

North America's native bees range in size from slender bees measuring less than ¼ inch, to robust bees which can exceed a full inch. They also vary widely in colors and patterns, everything from metallic green or iridescent blue, to red, black, grey, brown, yellow, striped and banded. Some bees have become specialists, collecting pollen from only one plant or a closely related group of plants. Others have developed unique foraging abilities. For example some bees, such as bumble bees, are able to "buzz pollinate" certain plants; while holding onto a flower, the female bee rapidly vibrates her flight muscles to release a deep burst of pollen. The great biodiversity of North America's native bees in itself provides a crucial ecological safeguard for the health of our native plants and ecosystems. When one bee species declines due to climatic conditions or disease, others fill the void, and pollination continues.

Bombus (bumble bee) *Trachusa*

Megachile (leafcutter bee) *Agapostemon (green sweat bee)*

All photos by Rollin Coville.

Honey bees can be clumsy partners on the native plant/pollinator evolutionary dance floor

The non-native honey bee does not enjoy this long-standing, intimate relationship with North American plant communities. As generalists, honey bees will visit a wide variety of flowers for nectar, but they do not always adequately pollinate these plants – either because they are workers exclusively dedicated to collecting nectar, or because they lack the unique physical traits which would enable them to efficiently collect pollen from certain types of plants. Either way, due to their sheer numbers – 20,000 or more individuals in a single colony – honey bees can sometimes threaten the survival of rare or endangered native plant populations by depleting their nectar stores, yet not providing sufficient pollination services in return. Once a plant's nectar rewards have been drained by tens of thousands of honey bees, the native bees which are the true pollinating partners of these plants, will no longer visit the flowers. Healthy reproduction of the plant community can then be compromised, leading to corresponding declines in the native pollinators and other animal species that depend upon these plants.

Native bees as effective crop pollinators

Where sufficient habitat exists, North America's native bees also bring their superior pollinating talents to our orchards and farm fields. In fact, on a bee per bee basis, native bees have been shown to be more efficient than the European honey bee at pollinating many of our current crop plants, including apples, cherries, blueberries, cranberries, watermelon, tomatoes and squash. For example, the "blue orchard bee" (*Osmia lignaria*) is increasingly recognized as being a valuable orchard fruit pollinator. Just 250 *Osmia* females can pollinate an entire acre of apples, a task that would require roughly 25,000 honey bees!

Osmia (mason bee) female foraging on an apple blossom. Photo by Rollin Coville.

A few reasons for the greater crop pollinating efficiency of many native bees over honey bees:

- A significant percentage of honey bee workers forage only for nectar, and often do not contact the pollen-producing anthers of the flower. In contrast, female native bees necessarily seeking both pollen and nectar to provision their nests, make contact with the anthers on nearly every visit. Some bees, such as the blue orchard bee, can also manipulate the flowers of certain orchard fruit trees to increase their contact with the anthers.

- The pollen carried by North American native bees, other than bumble bees, is dry and a fair amount tends to brush off easily on the next flower. The pollen carried by honey bees is moistened with nectar, and does not transfer as easily to subsequent blooms.

- Native bees will often forage both earlier and later in the day than do honey bees, thereby spending longer hours in the fields. The blue orchard bee has been observed to spend twice as long foraging in cherry orchards than the honey bee on a given day.

- Many native bees, including bumble bees which are able to regulate their body temperature, will forage in wetter colder weather than honey bees do.

- Some native bees are specialists on certain crop plants, and have developed physical and behavioral traits which enable them to extract pollen from these plants with maximum efficiency. Good examples are the squash bee (*Peponapis*), a specialist of North American squash and gourds, and the alkalai bee (*Nomia*), which has a unique affinity for the alfalfa flower.

- The females of certain native bee species are able to greatly increase the yield of various crop plants, such as tomatoes, blueberries, cranberries and peppers, by a process known as buzz- pollination. The female bee grasps the flower, and disengaging her wings from her flight muscles, rapidly vibrates these muscles until pollen is sonically released from deep pores in the anthers. Because of this ability, not shared by the honey bee, bumble bees are often managed to buzz-pollinate the flowers of hot house tomatoes. The so-called Southeast blueberry bee, a digger bee (*Habropoda laboriosa*), is by virtue of her buzz-pollinating ability, an important pollinator of blueberry crops. She is also a specialist of the blueberry plant.

All of the fruit and vegetables in this photo depend upon bees for pollination. On a bee per bee basis, native bees are more efficient than the honey bee at pollinating these crop plants. Photo by Celeste Ets-Hokin.

Research supports the value in bringing back the natives

Numerous recent studies have demonstrated that, given enough habitat, native bees could pollinate nearly all of our current crops. Through her research on California watermelon crops, U.C. Berkeley environmental science professor, Dr. Claire Kremen, determined that by setting aside 20 to 30 percent of a field for bee habitat, the grower could receive all or most of the necessary pollination services from native bees. A recent article published in the journal, Science, which was based upon observations of bees in hundreds of farm fields around the world, concluded that wild bees are twice as effective as domesticated honey bees in prompting flowers to set fruit.

If instead of hitching our agricultural wagon to a single pollinating species - the European honey bee - we were to instead follow Nature's example and invite a diversity of native pollinators back into our orchards and fields, we would have a much safer, more resilient and sustainable system of food production. By creating a place for native bees in North America's vast agricultural landscape, we would really then be safeguarding not only their survival, but ultimately our own.