Bees in Pennsylvania: Diversity, Ecology, and Importance

At least 437 species of bees contribute to pollinating Pennsylvania's natural areas, gardens, and agricultural crops. Learn more about how they are classified, their lifestyles, and how documenting bee species in Pennsylvania improves our knowledge about their populations and distributions.

Bombus pensylvanicus. Photo: Laura Russo, University of Tennessee

Bees comprise a group of insects that pollinate the majority of our crops. Through pollination, bees transfer pollen from the anther of one flower to the stigma of the same or another flower. This process initiates the production of many of the seeds, fruits, and vegetables that we harvest. Crops that either completely rely on or benefit from bee pollination include blueberries, cucurbits such as melons and pumpkins, and tree fruits like apples and cherries.

In recent decades, some studies have revealed declines in the populations of both managed honey bees and wild bee species around the world. A variety of causes have been linked to bee declines, including habitat fragmentation and loss (e.g., reduced food and nesting resources), parasites and diseases, pesticides, climate change, the introduction of non-native species to new regions, and interactions between these factors. However, documenting bee population declines, increases, or stability over time can be a challenging task since baseline data about bee biodiversity for most species and regions is not available. The recently-updated checklist of the bees of Pennsylvania provides the first, necessary step for detecting declines in bee populations by making information about each bee species known in the state publicly available.

The species found in Pennsylvania are categorized into six of the seven bee families in the world (Photo 1). The family Apidae has the greatest number of species in the state (118 species). Common names for apid bees include honey, bumble, carpenter, long-horned, and cuckoo bees. Halictidae, the second largest group in the state (110 species), are commonly known as sweat bees. Andrenidae (100 species) are mining bees. Megachilidae (81 species) include the leafcutter, mason, resin, and wool carder bees. Colletidae (24 species) are cellophane and masked bees. Melittidae, the smallest family in Pennsylvania (4 species), generally do not have common names.

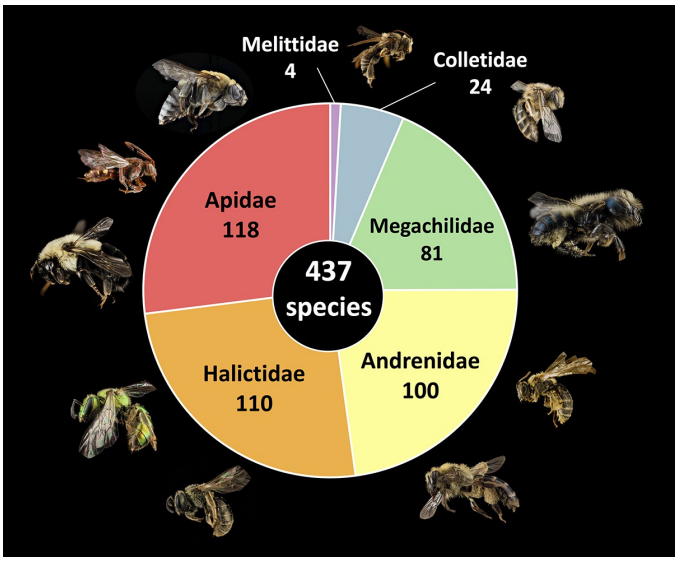

Photo 1. Bee biodiversity in Pennsylvania. Examples of species found in each of the six families are shown. Bee photo credit: USGS Bee Inventory and Monitoring Lab.

Most bee species in Pennsylvania nest in the ground; all mining and melittid bees, and many species of cellophane, masked, sweat, and apid bees (Photos 2A, 3A). Masked bees may use hollow twigs/stems or pre-existing cavities in wood, and some species of sweat bees nest in decaying wood (Photo 2B). Most notably in Pennsylvania, apid bees that nest in wood include the small carpenter bees (species in the genus *Ceratina*) and the eastern carpenter bee (*Xylocopa virginica*) (Photos 3C–D). Large cavities are also used by two groups of apid

bees: honey bees (*Apis mellifera*) and bumble bees (species in the genus *Bombus*) (Photos 2C, 3B). Depending on the species, leafcutter, mason, resin, and wool carder bees nest in wood or pre-existing cavities such as hollow twigs, stems, pine cones, and snail shells (Photos 4A–C).

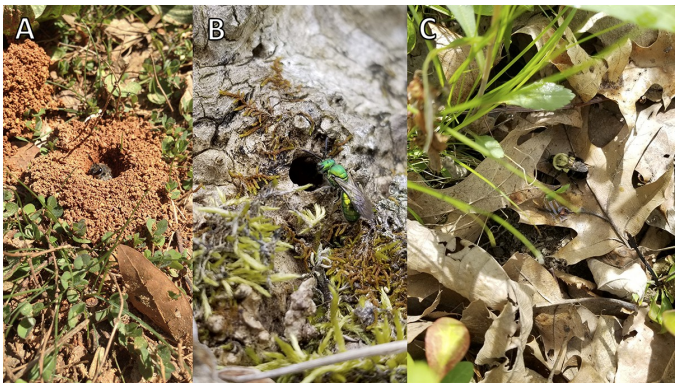

Photo 2. Examples of bees that use different nesting strategies in Pennsylvania: (A) a female solitary ground-nesting mining bee in the genus *Andrena*, (B) a female sweat bee in the tribe Augochlorini at the entrance of its nest in decaying wood, and (C) a primitively social bumble bee queen (*Bombus impatiens*) searches for a cavity to establish her colony in. Photo credit: Margarita M. López-Uribe (A) and Shelby Kerrin Kilpatrick (B–C).

Nearly all of the Pennsylvanian bee species are solitary. Female solitary bees are responsible for constructing nests and collecting food for their young on their own. Some species of solitary bees will form nesting aggregations in which many individual females nest close together (e.g., species in the genera *Andrena*, *Colletes*, *Eucera*, *Melissodes*) (Photos 2A, 3A). In contrast, honey bees are the only fully social species of bee in the state, living in perennial colonies composed of tens of thousands of individuals with workers (non-reproductive females), drones (males), and the queen (reproductive female) which have distinct roles (Photo 3B).

Fourteen species of bumble bees in Pennsylvania also form colonies, but they are only active from the spring through fall, and are considered primitively social because the queen overwinters in solitude and looks very similar to the workers (Photo 2C). Some species, like the eastern carpenter bee and closely-related small carpenter bees (in genus *Ceratina*), may be solitary or exhibit cooperative breeding, in which a group of females share a single nest entrance, and a weak or brief social structure (Photos 3C–D). There are also several groups of parasitic bee species in the state. Parasitic bees are either “cuckoos”, which invade the nest of a host bee and lay their own egg in it for the host to care for (e.g., species in the genera *Nomada*, *Triepeolus*, *Epeolus*, *Sphecodes*, and *Coelioxys*) (Photo 3E), or social parasites that infiltrate a colony and effectively replace its queen so that their own offspring are reared instead (e.g., four Pennsylvanian species of bumble bees in the subgenus *Psithyrus*).

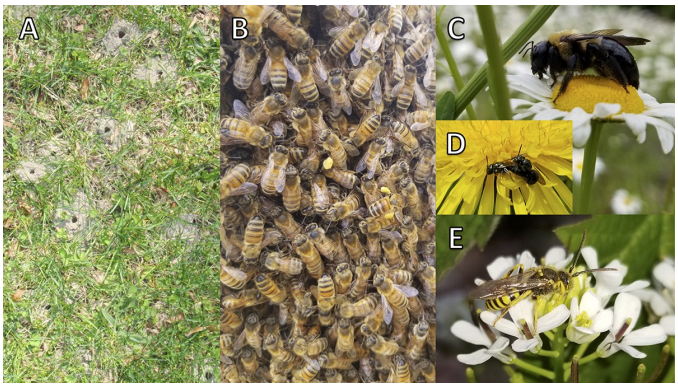

Photo 3. Examples of bees that exhibit different social behaviors in Pennsylvania: (A) an aggregation of solitary *Colletes* cellophane bee nests, (B) social honey bee (*Apis mellifera*) workers in their hive, (C) a female solitary or cooperatively-breeding eastern carpenter bee (*Xylocopa virginica*), (D) a mating pair of solitary or cooperatively-breeding small carpenter bees in the genus *Ceratina*, and (E) a cuckoo bee in the genus *Nomada* visiting a flower for nectar. Photo credit: Margarita M. López-Uribe (A), Brooke Lawrence (B), and Shelby Kerrin Kilpatrick (C–E).

All bees forage for nectar as an energy source for themselves and, in the case of females of non-parasitic species, for their larvae to feed on. Female non-parasitic bees also forage for pollen, primarily to provide their young with a source of protein. Different species of bees require pollen from different plants. Some bees are specialists, relying on pollen from a single or a few closely-related species of plants. For example, in Pennsylvania, three species of melittid bees (species in the genus *Macropis*) are pollen specialists of loosestrife plants (genus *Lysimachia*). Notably, these melittid bees also harvest floral oils from the loosestrifes, which are used to line their ground nests and feed their offspring. Many species of mining bees in the state are also pollen specialists. A specialist species that is important for crop pollination in the region is the squash bee (*Eucera pruinosa*), which relies on pollen from cultivated pumpkins and squash (genus *Cucurbita*). In contrast, other bee species are generalists, which collect pollen from a wide range of plants. Pollen generalists in the state include many wild species as well as two species commonly used for crop pollination: honey bees and the common eastern bumble bees (*Bombus impatiens*) (Photos 2C, 3B).

At least 13% of the bee species in the state have not been recorded in the past 18 years. These species may be rare or could be in decline. One species of potential conservation concern has not been detected in Pennsylvania since 1911: *Epeoloides pilosulus*, a cuckoo bee that parasitizes bees in the genus *Macropis*. An endangered species, the rusty patched bumble bee (*Bombus affinis*), was last recorded in 2006. Other species of bumble bees that are currently threatened or declining are the American bumble bee (*Bombus pensylvanicus*) and yellow bumble bee (*Bombus fervidus*), both last recorded in 2018, and the yellow-banded bumble bee (*Bombus terricola*) most recently detected in 2009. While these species have been found relatively recently, further studies are needed to determine the status of their and other

species' populations within the state.

At least 23 exotic bee species are found in Pennsylvania. Some of these species were introduced to North America accidentally, while others were intentionally introduced to provide crop pollination services. Non-native species in the state include the honey bee (*Apis mellifera*), the alfalfa leafcutting bee (*Megachile rotundata*), the sculptured resin bee (*Megachile sculpturalis*), three mason bee species (*Osmia caerulescens*, *Osmia cornifrons*, and *Osmia taurus*), and three wool carder bee species (*Anthidium manicatu* m, *Anthidium oblongatum*, and *Pseudoanthidium nanum*) (Photos 3B, 4A–C). Exotic bee species may be beneficial, as pollinators of agricultural crops and interesting cases for studying how organisms adapt to new environments. Exotic species may also have negative impacts such as out-competing native species for food and nest sites, introducing or spreading diseases and parasites, and influencing interactions between plants and their native pollinators. Tracking the distribution of exotic species in the state will allow their impact on native species and ecosystems to be evaluated.

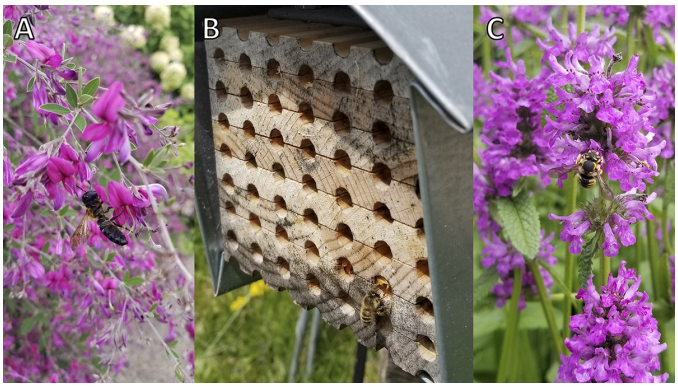

Photo 4. Examples of non-native bee species in Pennsylvania: (A) a female sculptured resin bee (*Megachile sculpturalis*), (B) a female mason bee (either *Osmia cornifrons* or *Osmia taurus*), and (C) a wool carder bee (*Anthidium manicatum*). Photo credit: Shelby Kerrin Kilpatrick, Penn State

Understanding the distribution and ecology of each bee species in any given area allows conservation strategies to be developed, implemented, and evaluated for effectiveness over time. You can help encourage and protect wild bee populations by planting food sources that are available year-round, providing nesting habitat, and reducing pesticide use. Conserving bee biodiversity ensures the preservation of these ecologically important species that provide critical pollination services in natural and agricultural systems, bringing us high quality, nutritious food, and other products.

References and Resources

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