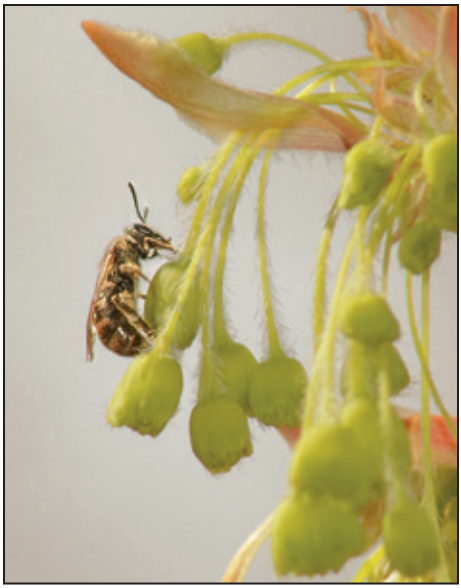
The Secret Life of Forest Bees

Kass Urban-Mead

It's a cool April day in the woods around Trumansburg, a small town on the shores of Lake Cayuga in the Finger Lakes region of New York state. Despite our heavy packs, my friend Greg and I step gingerly to avoid crushing bloodroot, early meadow-rue, and trout lily. An hour later, at the base of a large sugar maple tree, we've unpacked and begun our safety run-down using an alphabet-based mnemonic. **A**nchor? Check; safely in place. **B**elts and buckles? Check; all tight. **C**arabiner? Check; and three extra for good measure. **D**evices? Check; my extra-long-handled butterfly net and several jars tied onto the climbing belt. **E**nd of rope? Check; securely tied and tangle free. And finally: **F**riends? Of course, one never climbs alone.

A slight breeze rustles the branches overhead, and I take the first big step of my long vertical climb.

By the time forest trees leaf out in late spring, there has been a burst of activity from bees foraging on the flowers blooming on the forest floor and in the canopy. Photograph by Kass Urban-Mead.



Trees have been called "meadows in the sky" because of their huge number of flowers. The author had the rare chance to study bees in the canopy. Photograph by Patrick Coin.

Slowly and steadily, I ascend to the strong crotch near the top of the tree, where the rope, which was flung up there using a giant slingshot before I began climbing, loops back to the ground. This is as high as I can go. I'm at about sixty-five feet, with a side view of the branches of oak, tulip tree, and the occasional sugar maple reaching to the sky. Some have begun to push out their sweet, pea-green, early spring leaves, while others are still bare twigs displaying only buds or early flowers. Midstory red maple, hop hornbeam, and black cherry grab the sunshine between them in the airspace below. My body gets accustomed to the regular swaying of the branches, and I wave to Greg, who is now tiny, distant on the dappled forest floor.

I grab my net as a gust of wind dies down, and focus on the dangling sugar maple catkins, waiting for the magic to begin. A bumble bee queen buzzes in, and three bee-mimicking flower flies land on a mature catkin bursting with pollen. I notice a metallic green sweat bee, and then several mining bees, both male and female. A cellophane bee, more commonly found on the earlier-blooming red maple, even deigns to drop by. The average sugar maple tree makes a hundred billion pollen grains; the oaks that bloom a few weeks later make even more; and—to my absolute delight—it seems that the bees have figured it out.

These climbs and observations were part of my dissertation work at Cornell University, where I collaborated with an amazing team of scientists to try to answer a simple question: Why do apple orchards with forests nearby have more bees in them? Indeed, there is consistent evidence that agricultural fields that are near forests, hedgerows, and woodlots have both more bees and more kinds of bees. Moreover, Mia Park, then also at Cornell, showed that having more nearby natural habitat somewhat mitigated the negative effects of high pesticide loads on bees visiting apple orchards.

Before Europeans arrived, the area that is now the northeastern United States was mostly covered in forest, so some sort of relationship between bees and woods makes sense. Forests have always included regular disturbances—gaps and patches of varying sizes were created by beaver dams, windstorms, and fire, often through intentional indigenous management—which created a varied matrix of heterogeneous habitat. This was true before colonial land clearing, and it is true now that our

second-growth forests have regrown, bearing with them the legacies of pastures and crop fields. So, although we correctly think of bees as creatures that vibrantly fill our gardens, meadows, and fields, the six hundred species that occur in the region evolved in a forested landscape. Some bees are harder to see, but there are many that you can discover with no climbing required.

At ankle height are the bees who visit spring ephemerals—flowers that bloom in sunshine during the period between winter and when the canopy trees fully leaf out, plunging the forest floor into the deep shadow of summer. One well-known forest-floor forager is the spring beauty mining bee (*Andrena erigeniae*). As with other solitary species, each female builds her own nest, a series of small chambers off of an underground tunnel, each chamber supplied with a pile of pollen large enough to feed a single baby bee. She is a specialist, collecting pollen only from the flowers of two species of spring beauty (*Claytonia*). Her leg hairs are adapted to be just the right size and shape for gathering spring beauty pollen, and are so efficient that she barely drops any of it as she forages. There are other mining bee species that specialize on plants such as bellwort, geranium, and trout lily. This specialization is possible because the bees are active as adults for only the brief window during which their host flowers bloom, and otherwise wait out the year turning slowly from eggs to larvae to pupae, deep underground in their nests.

Shift your gaze from the flowers toward the leaf litter, and you're perfectly poised to find bees scouting for nest sites. Bumble bee queens, having mated in the fall and hibernated all winter, diligently pursue their need to establish nests. I usually see bumble bees searching for nest sites in the woods, on well-drained, sloping hillsides that are cov-

The spring beauty mining bee forages only on spring beauty, a wildflower that blooms on the forest floor early in the year. By the time the tree canopy leafs out, the flowers and the bees disappear, and the cycle repeats the next year. Photograph by Judy Gallagher.

ered with leaf litter. Because bumble bees are active all season, they cannot afford to specialize on just a single type of flower—they'd be hungry when it stops blooming!—so you'll instead see them visit a wide range of flowers for the energy to support their colonies. They are hairier and messier than the specialists, and as a result are particularly good pollinators, dropping pollen onto flowers as they look for food.

Another bee you're likely to see weaving across the forest floor in early spring is a master of disguise. Bees in the genus *Nomada* are cuckoo bees, meaning they don't build nests of their own. Instead, a cuckoo bee camouflages itself with a special chemical perfume, sneaks inside another bee's nest, and lays an egg on the pollen the host bee has gathered. Cuckoos have a wasp-like look, with red or yellow markings and thickened exoskeletons to protect them in case they get caught. When the cuckoo larva hatches, it kills the mining bee larva and eats all of the pollen. It's easy to imagine someone casting cuckoos as villains, but researchers believe that seeing them year after year is actually a good sign, since abundant cuckoo bees suggest an abundant population of host bees.

The next strategy for forest-bee spotting: if it's green and glinting, check it out! Many forest insects are gorgeously iridescent, probably because their sheen confuses predators when they fly between dappled sun and shade. Two of my favorite forest bees shimmer in the dappled light: the metallic green *Augochlora pura* and the shiny blue *Lasioglossum coeruleum*. They're active all summer, have generalist diets, and will usually build their burrows in abandoned beetle holes of an eighth to five-sixteenths of an inch (three to eight millimeters) in diameter in dead wood. Stumps, standing snags, and debris are crucial habitat for these bee species. Other stem- and cavity-nesting bees, such as mason bees, also using pre-

Cuckoo bees in the genus *Nomada*, commonly called nomad bees, do not make their own nests. They lay eggs in the nests of other bees, frequently those of mining bees. Photograph by Bryan E. Reynolds.

The metallic-hued *Augochlora* bees nest in tunnels in rotting wood such as standing snags and fallen logs. They may have two or three generations each year. Photograph by Katja Schulz.

existing beetle holes or hollow pithy stems of plants.

You may be surprised that sugar maple and oak trees host bees. Indeed, trees in the northeastern forest have not usually been considered bee forage because many, such as poplar, ash, birch, alder, hickory, and oak, are wind-pollinated. This makes sense: it is windy, cold, and often rainy in spring, so most spring-blooming trees take advantage of that air movement and spread their pollen in the breeze, rather than relying on small insects that don't like the cold to make the journey up to their flowers. But, since the trees make billions of protein-filled grains, many bees gather and bring the pollen home to rear their young anyway.

Although not widely studied, one recent review paper pulled together every incidental mention in old literature records of pollen collection from wind-pollinated plants. They found two hundred pollen-collection records from more than a hundred genera of wind-pollinated plants. For example, old natural-history papers note that mason and mining bees love oak, while metallic green sweat bees visit walnut trees. In New York apple orchards, Laura Russo, while a postdoc at Cornell, had identified lots of pollen carried by bees and found that they also carried some maple, willow, ash, and birch pollen.

Inspired by this prior research, I started my dissertation field work in March 2017 and continued it during the next two springs. Using special bee traps in eleven forests and woodlots adjacent to orchards, I found more than ninety species of wild bees active in the forest canopy between March and the end of May. After then spending long pandemic months staring at bees under a microscope, I found that tree pollens often make up between 25 and 100 percent of the pollen in an individual bee's digestive tract. Oak and maple were the primary trees visited for pollen, but I also occasionally found beech, walnut, ash, and birch. In my study area, the canopy trees were a big part of bees' diets before apple orchards bloomed; once the fruit trees bloomed, the bees were more abundant in the orchards, and their diets

Orchards that are adjacent to forests have more diversity and abundance of bees. In the early spring the forests support bee populations, which then move into the orchards when the fruit trees bloom. Photograph by the Xerces Society / Kelly Gill.

transitioned to include both canopy pollens and lots of apple pollen. It was obvious that many bees moved from the forests to the orchards during apple bloom.

Although research on forest bees is increasing, we have really just scratched the surface when it comes to understanding them. These bees forage for pollen in forests, but also use canopy trees as places in which to collect honeydew and resins, glean resources for self-medication, hide out in microclimates buffered against temperature extremes, and gather on tall trees sought out as mating sites. We have much more to learn there about each of these!

One thing we do know is that for these bees to persist, they need the right forest conditions. Most forest ownership in the Northeast is private, so actions taken on back woodlots and private properties can have huge implications for conservation. These bees might rely on the presence of the tree canopy, but it is vital that we not stop managing woodlands or cease cutting trees: the openings in these forests are also very important for supplying the resources that help provide for the entire life cycle of bees. Ecological forestry also helps maintain tree diversity, creates a variety of niches for wildlife, and keeps forests resistant to pathogens and resilient in the face of climate change. According to research from Rutgers University, about a third of bee species in the Northeast seem to rely heavily on forest habitats, while other species need both forests and fields, and move frequently between them. Still other bees can thrive in more-developed landscapes. So, in order to support all of the species, we

need a landscape with forests, openings, meadows, and every habitat in between.

Luckily, there are many programs that foster healthy forest management for wildlife. For a land manager, working with a certified forester to address climate resilience, tree diversity, structural diversity, and wildlife elements for other animals usually creates synergy with forest-bee conservation. Snags for raptor nests, for example, are also homes for wood-nesting bees. Piles of logs for salamanders can also protect bumble bee nests. Clear-cutting a monoclonal beech stand that is dying of beech-bark disease can regenerate a healthy tree community that provides forage for bees. Similarly, in the case of ecologically sensitive prescribed burns, most soil-nesting bees can either rapidly recolonize afterward, or are nesting deeply enough to not be impacted and then will be thrilled to see the flush of flowers after the burn. Excessive deer browsing is one of the major threats to forest health and thus forest bee health, so perhaps most important of all are fences and other deer-management protocols to protect regenerating tree seedlings and our delicate and beautiful spring ephemerals and the bees that rely on them.

Although bees are commonly thought of as animals of open places—indeed, one of the best-known lines of poetry about bees is Emily Dickinson's "To make a prairie it takes a clover and one bee," which reinforces this perception—the forests that abut our communities and farmlands play an essential role in sustaining diverse bee populations. Few people have, or perhaps even desire, the opportunity that I've had for close-up exploration of the forest canopy, but all of us can find opportunities to appreciate bees at ground level.

Kass Urban-Mead completed her PhD research at Cornell University before joining Xerces as a pollinator conservation specialist and NRCS partner biologist. She grew up raising 4-H dairy goats in the Hudson Valley.

Leaf litter, rotting wood, and spring flowers support a diverse community of forest bees. Photograph by Liz West.