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Field notes from a sandbox: Learning wild patience with wild bees

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Abstract

This creative non-fiction essay discusses challenges of insect identification and wild bee collection. It engages themes of early childhood education, love of nature, and the links between patience and passion for discovery. It argues in defense of perseverance and slow knowledge acquisition, reminding readers of the importance of such qualities for biodiversity conservation, even amidst the age of instant gratification tools that make naturalism accessible to the layman.

KEYWORDS
arthropod conservation, biodiversity, ecological education, native bees of North America, naturalism, taxonomy

My four-and-a-half-year-old child was engrossed with making imaginary pasta out of sand at the playground. From my bench, I feigned interest while myself being transfixed by the nearby ground. There, I'd spotted a peculiar-looking insect digging holes at his feet. It was a winged, black one with a distinctive yellow horseshoe-type shape on its back. A wasp most likely, or perhaps a hornet. The creature kicked up sand, then stopped, moved to another spot, and dug again. On repeat. With just a picture and two clicks on my phone, I got a rough identification: A sand wasp in the tribe *Bembicini*. While my kid's noodles "cooked" in a large plastic bucket, Google and my iNaturalist app offered me a tutorial about the natural world, and assuaged my protective instincts with the reassurance that this wasp is almost entirely harmless.

The English writer Aldous Huxley (1894–1963) wrote that "We can only love what we know, and we can never know completely what we do not love. Love is a mode of knowledge." I wonder whether Huxley had the early 19th-century naturalists in mind when he wrote those words. The naturalists formed an unlikely community of farmers and aristocrats alike, who bonded over insatiable nerdiness about the wonders of the natural world. In penned letters and using postal systems still sometimes dependent on horses, they shared observations and amassed personal collections of specimens through hunting, trapping, netting, trading, purchases, and adventure travel, when resources allowed. One such amateur naturalist was an itinerant miner named Edwin Carter, who died in a one-room cabin in Colorado in 1900, leaving a legacy that included specimens including a grizzly bear, mountain goats, rabbits, chickadees, and over 3000 other taxidermic wonders of Colorado's fauna (Cain, 2012). The collection became the foundation of the Colorado Museum of Natural History. Carter was one among many amateur naturalists who sent specimens to scientists at Harvard and the

Smithsonian Institution for their subsequent identification and "discovery."

In Carter's day, observations about common weeds and the indigenous names and uses for plants could be found in farm journals. By the late 19th century, high schoolers were learning zoology and physiology, and elementary school children were learning to collect specimens. One young naturalist, Duncan Putnam, accumulated over 25,000 specimens of insects, representing 8000 species in his collection when he died at the tender age of 26. A sense of exuberance about nature's limitlessness drove much of the enthusiasm for the natural world. People understood that nature was awesome—and it was easy to be engaged in naturalism when the abundance of the land was baked into society. Given such conditions, it is easier to appreciate how becoming a lover of nature (*amateur*, which comes from French, literally means one who loves) was enmeshed with the endeavor to gain knowledge.

Today, Insta-naturalism allows me to sit comfortably on a park bench, snap a photo, and immediately teach a thing or two to my child. I have an app for that bug—or that leaf, or that birdsong, or that mushroom. "That's a sand wasp, and it makes false, dead-end burrows to confuse parasites! How cool is that?!" I read Wikipedia out loud with enthusiasm, though my sweet boy doesn't yet appreciate the vocabulary of parasitism. I could share that knowledge in two more minutes with a photo and a community of followers, if I felt so inclined. But there is sand to be turned into noodles on this particular day. Instant learning is gratifying, but nothing like the real patience and perseverance required for a deep knowledge about biodiversity.

It occurs to me that naturalism these days is less about cataloguing nature's abundance and more about salvage. There are over 4200 native bees in North America, and over 20,000 wild bees worldwide (Moisette & Buchmann, 2016). While public attention often focuses on the plight of honeybee keepers, we are losing native bees faster than we can even identify them. When we teach ecology to children, often it's with the specter of the biodiversity crisis looming: Love it before you lose it. Save the bees, save the polar bears, save the rainforest, and so on. Even as we mobilize to save it, undercurrents of loss permeate the call to love nature. Scientists collect specimens now with an eye to identify species before they're gone.

There's a dire need for more people to be trained in the work of insect taxonomy, so that at minimum, we can match names and the locations to the species we hope to protect. The idea of the insect apocalypse reached the public zeitgeist, but policies to address insect losses and biodiversity losses more generally are woefully lacking. In Europe, a recent study highlighted a risk of insect *taxonomist* extinctions (Directorate-General for Environment [European Commission] et al., 2022). The tiny creatures that run the world (Wilson, 1987) are dying off at alarming rates (Wagner et al., 2021) and we don't have the capacity to even assess the species that are being lost, let alone the political will to change course.

Gaining that capacity, however, entails much more than the instant gratification offered by my cell phone. To accurately identify wild bees, the prerequisites are a meticulous mindset and basic familiarity with microscopy technique using a taxonomic key. The key allows for a more fruitful and accurate engagement with the question of who, exactly, a wild bee is. The Discover Life key is the gateway for those learning to identify bees, wasps, and moths in North America. It's a publicly accessible, free tool for approaching identification of over 1.4 million different species (https://www.discoverlife.org/). The key is especially adroit at identifying insects based on their visual characteristics, and birds, based on their songs.

In *theory* it works like this: Answer about 15 yes/no questions, hit "Search" and boom! Identification complete. In *practice*, for a non-expert like me, it goes something like this: Is my bee one of the 3077 that are catalogued in the Andrenidae family? Or one of among the 6090 catalogued Apidae, or among the 4510 Halictidae, or maybe even a Megachilidae? Or a Colletidae? At the top of the page, in red, there's a directive: "Check boxes for all that apply. If uncertain, skip character or select several states." OK, so my bee is a shiny metallic shade of green. I have a suspicion Agapostemon is a good match, but I'm only about 80% confident. I can count whether there are 12 or 13 segments on the bees' antennae, which allows me to distinguish between whether the bee is female or male (see Figure 1). Deeper into the key, there are questions involving bee anatomy that strain my anatomical vocabulary to its limits. By questions #3 and 4, words like "integument," "clypeus," and "labrum" appear. It feels dauntingly like doing a choose-your-own-adventure book based on microscopic-level facts. The key has pictures to help out—and assuming I counted those antennae correctly—I can jump to question 7. Is there a small tooth on the underside of the hind leg femur of the male, about one fifth of the way to the end with the tibia? The key cautions: "Careful, can be hard to see when the legs are folded." Here, a simple yes or no answer is only simple to the highly trained eye. After a 4-day intermediate level course offered through Oregon State University, you could get reasonably good at identifying bumblebees to the species level, and other bees to the level of their genera. At the advanced level, you'll learn about another family's nuances of taxonomy.

My sandbox research in fact started a few months ago. Captivated by Sam Droege's stunning macro photography of bees and his lectures about native bee ecology, I enthusiastically jumped at the chance to do some wild bee collection fieldwork with him on the Maryland shore. Sam works at the US Geological Survey's Pautuxent Wildlife Research Center in Maryland. Along with my child—ever my trusty sidekick—we were joined by Mike Slater, a Pennsylvanian wild bee amateur collector. Mike is introduced to me as one of the rare specialists in this arena—among only about 25 people in the region with enough experience to catch and identify our local wild bees. The work of collecting and identifying bees is painstaking, tedious, sweaty, and anything but mechanized. Just after sunrise, Sam laid out hundreds of bee traps: small, colorful cups, laid out in transects. The rest of the day is spent walking somewhat aimlessly through different areas using a bee net to capture whatever creatures of interest we find.

FIGURE 1 *Agapostemon virescens*, female. Photo from USGS lab (public domain).

Sunhats and long sleeves protect us from the unusually hot June sun, poison ivy, and deer flies (see Figure 2). Sam finds the spots of interest based on close examination of Google maps, using satellite imagery. We venture into sandy areas just off the Maryland shore and partially-forested managed hunting area. We even have bee-hunting permits on hand, just in case someone stops and cares. We collect along roadside strips which haven't been mowed recently; when Mike spots what he suspects to be a blossoming native dogwood from his car, we pull over excitedly. Actually, it turns out, the plant is not a dogwood at all, but rather an arrowwood of the genus *Viburnum*. No matter—it's got an abundance of bees interested in its flowers, so it makes for bounteous catches, even though the bees interested in viburnums are probably not the most unusual, rare, or interesting.

Wild bee hunting is a little like fly fishing without the feedback of a bite at the end of the line. A hand-held bee net is the tool of choice: picture a 38-centimeter diameter and nearly meter-long windsock on a hand-held pole. Netting bees is all about mastering a dramatic swoop of the net, followed by a quick twist of the wrist to contain

FIGURE 2 Getting ready for a day of wild bee hunting. Image credit: Eve Bratman under CC BY-NC-SA.

anything captured. Bees crawl upwards, to the top of the netting—so then there's a grab-hold gesture, which crucially serves to make sure the bug goes to the top of the net and doesn't just fly right back out. For low-flying bees near the ground, there's a different technique. Sam demonstrates with barely a warning: "stand back!" A split second later, the net smacks to the ground, nearly skinning my toes. He holds the net up with a smiling twinkle in his eyes, as the bee crawls upward to the top of the net. As a beginner, the work is frustratingly unrewarding. My first hour, I netted all of one bee, and instead found myself covered in leaves and plant blossoms thanks to my clumsy *whooshes*. Sam, in contrast, collected about 25 bees within his first 5 min.

We catch every bee we can in hopes of contributing to Sam's long-term project of inventorying the wild bees in the region. While we meander in the sun, my child is awarded the morbid job of occasionally tapping netted bees to their death in collection vials filled with soapy water. We explain to him that the point is not to kill other creatures for fun, but rather that is a necessity so that we can learn enough about them and to help more bugs thrive. Whatever gets netted ends up going to a lab for processing and later identification. This includes flying ants, beetles, moths, spiders, and flies, in addition to the bees that were our primary focus. Back at the car, Sam notes the GPS coordinates of each site on his clipboard, along with the details on the specific ecology of the place—mowed roadside, soil characteristics, and the like. Back at the bee lab, Sam's team will first freeze the specimens, then meticulously wash and dry them, and mount them on collection pins. The bugs each get assigned numbers and are subsequently examined under a microscope. All the identification information is entered into a database for public use. It may take months before the species we are collecting today are finally catalogued.

Despite his expertise, Sam can only usually tell with his naked eye the general genus of most of the bees we collect. There's no immediate sense of satisfaction, in the spirit of a fisherman's "caught a big one today!" nor is there even a pretense of knowing which little-known gems of the day we may have caught. Insights that unfold from a day in the field will take time, becoming revealed in slow motion, composing an image of the region through meticulous and mundane daily labor. Often, the "aha's" of recognition of a rare species are achieved only through a microscope's eyepiece. The satisfaction found in having a breakthrough of discovery comes—if ever—only after looking at the larger dataset for trends in distribution and prevalence. Saving biodiversity is more urgent than ever, but in practice, it takes patience.

The satisfaction found in arthropod identification can only come from a passionate commitment to gain and revise knowledge about the other species with whom we share the planet. Underpinning that passion is a desire to love. If you don't even have a name for a living being, how can you come to love it? Entomologists urge hands-on educational experiences oriented toward children to combat the negative perception that insects are deplorably "creepy crawlies." (Donkersley et al., 2022) iNaturalist and other apps help ignite and nurture a sense of curiosity for those eager to learn more, and certainly we need more naturalists in the world, working both as amateurs and experts. But the poet Hai-Dang Phan captures a more profound understanding of what it really means to seek, to know, and to love:

> So we began our search, checked known locations.
>
> At the first spot, magpies. The next: babblers.
>
> But we kept looking, listening, knowing the forest.
>
> Gives up its secrets slowly. And passion we knew.
>
> From experience associates with wild patience. (Phan, 2023)

Cultivating that wild patience will take more hours of sweaty days with bee nets, more sunscreen-slathered adventures, impulsive turnoffs onto un-mowed roadsides, and walks in forest patches. It'll take hours of dedicated study, practice to hone that flick of the wrist, and learning awkward new vocabularies. To find greater love, ultimately means more time sitting on park benches and wandering in the sun, staring at the sand.

AUTHOR CONTRIBUTIONS

Eve Bratman: Conceptualization; data curation; formal analysis; investigation; methodology; project administration; writing – original draft.

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ETHICS STATEMENT

The author has read, agreed to, and abided by the ESA's code of ethics.

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