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Big Little Bites

The Eloise Butler Wildflower Garden is a beautiful, wooded property just outside Minneapolis. I went there one warm June day with the idea of gathering information for a story about "botanizing," the art of collecting, identifying, drawing, and preserving plant species. Botanizing was a popular activity in the 19th Century, and I wondered when and why it had fallen out of favor. Its practitioners had ranged from gentle Victorian ladies to tough plant hunters; the former confining their explorations to the local countryside while the latter collected exotic species from remote jungles and mountains for their wealthy employers.

I had every intention of writing about this garden and its delicate inhabitants. But then — I was bitten by a mosquito. At first it was an annoyance, then a distraction, and finally a revelation. I was raised on the East Coast; I thought I knew mosquitoes. They came out at dusk, and whether they found you on the beach or playing outside, their bites raised itchy little welts that persisted for hours. This bite, however, seemed different. Surprisingly, I'd been bitten in broad daylight. The bite was itchy enough but there was no welt. Instead, there was a good deal of swelling around the thumb where I'd been bitten.

I was just visiting from Arizona at the time, so I casually asked my long-distance significant other, who'd lived in Minnesota for a while, whether there was more than one type of mosquito here. "Oh yes," he said cheerfully, "it's our "state bird. We have three species, including "tree hole mosquitoes," which arrived in the United States in imported tires." A few hours later he'd emailed me a correction. It was the "Asian tiger mosquito" that had stowed away in a shipment of tires. Also, there were not three but fifty-one species of mosquitoes in

Minnesota. Twenty-four of them feasted on mammals, including humans. The others preferred birds, frogs, or turtles.

How many of these mosquitoes were native species, I wondered, and how many were newcomers? How many years does a species need to be established in a location before it's considered to be a "native," or at least, naturalized?

It seemed best to consult an expert to learn about the dynamics of such a diverse mosquito population. I contacted Dr. Scott Larson of the Metropolitan Mosquito Control District (MMCD), which monitors the population within the 7-county metro region of Minneapolis. I'd assumed that all fifty-one species couldn't be native to Minnesota, and I was right: but just barely. Larson told me that only two of the mosquito species they collect are non-native. These are the Japanese rock pool mosquito (*Aedes japonicus*), first observed in the United States in 1998 and the Asian tiger mosquito (*Aedes albopictus*), notorious for doing exactly as my significant other had said: hitching a ride to the Port of Houston in a shipment of imported tires in 1985. As of 2008 *Ae. albopictus* was one of the 100 world's worst invasive species, according to the Global Invasive Species Database maintained by the International Union for Conservation of Nature (IUCN).

These arrival dates are important because they reflect a disturbing trend. Invasiveness in itself is nothing new. The spread of species into new ecosystems has for centuries occurred through the forces of man and natural processes alike, forces that are constantly revising and reshaping our encounters with nature. It's the accelerating pace of invasiveness that worries scientists, and rightly so.

The statistics are mind boggling. According to a study published in *Nature Communications* in 2017, in the past 200 years, new invasive species introductions have

continuously increased worldwide. A third of all new introductions occurred between 1970 and 2014. For most species, that number is expected to increase in the coming years. Analyzing records in the Global Invasive Species Database, the authors found a definite increase of invasive vascular plants in the 19th century which probably relates to greater activity in horticulture. Here, perhaps, was an unexpected connection to those Victorian botanizers I'd first set out to study. The rate at which other organisms such as algae, mollusks or insects were introduced has increased steeply since 1950. The growth in global trade bears the bulk of the responsibility for the situation, but tourism also plays a role in introducing new species, particularly to more remote countries.

Back in Minnesota, the picture was not so clear. Once introduced, each of the two non-native mosquito species had followed distinctly different paths. The Japanese rock pool mosquito had caused nary a ripple in the ecosystem, nor had it displaced any other mosquitoes. According to Larson, "it breeds quite readily in containers as well as tree holes, where it occurs with other, native species larvae."

But wait: weren't all newly introduced species invasive by definition? It turns out nature doesn't always get the memo on how we expect it to behave. Although news stories throw the word "invasive" around a lot, a better description for many species that are transported to another location appears to be "introduced." In their excellent research paper, *The evolutionary impact of native species* (2017), Mooney and Cleland state that "The actual numbers of individuals and species being transported across biogeographical barriers every day is presumably enormous. However, only a small fraction of those transported species become established, and of these generally only about 1% become pests. Over time however, these additions have become substantial. There are now as many alien established plant species in New Zealand as there are

native species. Many countries have 20% or more alien species in their plant populations." Not unlike human cultures, the world's flora and fauna are becoming homogenized both between and within continents.

That it's merely been "introduced" doesn't completely clear the Japanese rock pool mosquito from potential future mischief. Mooney and Cleland also report that, "Introduced species" may stay at a fairly low population size for years and then explode at some later date—the so-called lag effect." There seems no point in adding this to our collective worries about the future.

The 1% of introduced species that become pests —the truly invasive species—are worth worrying about. The Asian tiger mosquito is a case in point. Given its "top 100" ranking on the invasive species database, it isn't surprising to learn that it's considered to be the most invasive mosquito species in the United States. In Minnesota, the winters are too harsh to allow it to overwinter. But it's reintroduced to the state every year, still through the tire trade. Larson says the MMCD "has extra surveillance around some tire facilities and this is where we first find the species each year." These mosquitoes can displace other species. They also can act as a vector, the means of transmission, for more than twenty types of disease-causing viruses including those that cause dengue fever, West Nile and Zika. So far, Asian tiger mosquitoes in the United States have been found to carry just five viruses, only two of which affect humans. But researchers worry about their potential to spread more. Should the Asian tiger mosquito becoming established in Minnesota through global warming, Larson says the MMCD "would make all attempts at eradicating it."

I thought of all the invasive species that had gotten press in recent years. Most of them were highly visible —the northern snakehead fish in Maryland waters, cane toads in Australia,

kudzu in the South or purple loosestrife just about everywhere. Yet there are other invasive scenarios taking shape on an entirely different, nearly invisible scale.

As for the bite I received, it could have been from an Asian tiger mosquito. Unlike the mosquitoes I've known, they bite during the day, from dawn to dusk. Their bites are not necessarily painful, but they are, according to published reports, more noticeable than those from other kinds of mosquitoes.

When I first heard there were fifty-one species of mosquito in Minnesota, I was momentarily thrown. I had to replace my childhood model of a single, ubiquitous type of mosquito with a model that allowed for an undreamed-of diversity of mosquito kind. I felt sure that many of these species must be newly arrived and invasive. I envisioned intense Darwinian competition, a kind of "March Madness," wherein species were eliminated until the winners emerged. Learning there were already forty-nine established species, I assumed they occupied separate niches. Instead, they largely share habitats and feeding preferences, jumbled together in a harmonious, dynamic equilibrium.

I came away from the wildflower garden with no insight into why botanizing had lost its allure. Perhaps it had just been the fancy of the idle, in a time with far fewer distractions. The mosquito bite I received, though, caused me to reflect on the remarkably complex processes of ecosystems. I left with a very different respect for the intricate nature of nature.