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Hawaii's Endangered Bees

By Shannon Brown-*2 Million Blossoms,* April 2020

As sea levels rise, Hawaii may face various consequences: shorelines may erode, coastal roads may be washed out. But an unexpected casualty of rising seas may be several species of native bees.

Hylaeus, or yellow-faced bees, can be found worldwide. However, they were the only bee that managed to travel to the Hawaiian islands, likely arriving from Japan or East Asia between 400,000 to 700,000 years ago. Since their arrival, over 60 known species have evolved that are endemic to Hawaii, meaning they aren't found anywhere else in the world. Seven were declared endangered in 2016; and of these, three species (*Hylaeus anthracinus, Hylaeus*

longiceps, and Hylaeus hilaris) make their nests in porous coral and plants found along Hawaii's coasts.

Rising seas aren't an immediate concern, says Paul Krushelnycky, a researcher at the University of Hawaii at Manoa. But, he said, "if the coastal strand habitat the bees rely on isn't able to move backward, that will be a major problem." He's already seen several large wave events wipe out a coastal population, or artificial nesting blocks that are part of his current research.

Krushelnycky is working with other entomologists at the University of Hawaii and the Department of Land and Natural Resources to protect coastal *Hylaeus* bees. They are focusing on creating artificial nests to augment the bees' current nesting sites, and determine if that might help mitigate their decline.

One of the artificial nests' functions is to protect the bees from ants. Over 60 species of ants have been introduced to Hawaii—there are no native ants—and they eat the bees' eggs and larvae. Having evolved for hundreds of years without predators, the bees don't have defenses against the ants, or other invasive species. A non-toxic, sticky pest control substance called Tanglefoot seems to keep ants out of the nests. Additionally, the structures have a certain hole size that works well for *Hylaeus* and keeps out competing bees and wasps.

The nests will also serve as alternative nesting sites if sea levels continue to rise. The UN has projected a 3.2 foot increase in sea levels by 2100 and possibly as soon as 2060. A 2017 report on the impact of sea level rise in Hawaii found that the ocean would inundate many of Hawaii's beaches, including Sandy Beach on the Ka Iwi coast—one of the few habitats where yellow-faced bees can still be found on Oahu.

Hylaeus bees are crucial for Hawaii's ecosystems because they are pollinators of native plants, such as coastal *naupaka* shrubs and *ʻōhiʻa lehua* trees. Jonathan Koch, Ph.D., is a David H. Smith Postdoctoral Fellow at the University of Hawaii at Hilo, where he researches yellow-faced bees. His 2012 paper in *Pacific Science* found that *Hylaeus* bees comprised 64 to 91 percent of pollinators for some native plants. The relationship is mutual: with a few exceptions, the bees seem to prefer native plants and are found almost exclusively in areas with native vegetation. Native plants are also critical for several species of Hawaiian birds.

In his current project, *nalo meli 'āpa'akuma* ("endemic bee" in Hawaiian), Koch is sequencing the genome of *Hylaeus anthracinus*, a coastal-dwelling bee, and completed the sequencing in November 2019. His goal is to use the genomic data to guide breeding programs that promote healthy, genetically diverse populations of bees that can be used to repopulate areas where they've disappeared, and also guide conservation efforts more precisely.

"Genetic diversity is a trusted metric of how well a species is doing," he says. "We know that genetic disorders arise due to inbreeding in humans. It's the same with bees. If you have an isolated population of bees, maybe because there's not a viable corridor for them to move across, they may become inbred. We try to avoid that in conservation programs."

The data can also be used to measure other aspects of the bees' health. "We can begin identifying how genes within a certain population respond to small population size, or even potentially disease or poor nutrition. These are long-term projects that this genome will provide a foundation for," Koch says.

Krushelnycky also plans to study repopulation in the future, including trying to determine what qualities at certain sites promote successful relocation. This will ultimately help stabilize

the species. “In general, the more populations that are established, the more secure the bees are going to be,” he said, whether from the risk of rogue waves, invasive species, or some other factor.

Habitat loss and invasive species are the main threats for yellow-faced bees, but agriculture and pesticide use are also possible factors in their decline. The topic is a contentious one in the islands. Hawaii is the site of extensive agricultural testing due to its warm climate and regular rainfall—genetically modified corn fields on Oahu, Kauai, Maui, and Molokai are sprayed with up to 17 times more restricted-use pesticides than mainland fields. Hawaii was the first state to ban the pesticide chloropyrifos, citing its link to developmental delays in children. However, other pesticides are still in use, including neonicotinoids, which are particularly toxic to solitary bees.

In addition to these pressures, bees face conservation challenges that larger animals may not. “For a lot of insect species, we know very little about their population trends,” says Sarina Jepsen, the Endangered Species Program Director at the Xerces Society. This is because insect conservation efforts often receive less funding and attention, there’s little baseline data about their populations, and they’re difficult to track due to their tiny size. In fact, the seven *Hylaeus* species were the first bees to be added to the Endangered Species list.

“I think there are a lot of species that do face extinction, and whose extinctions potentially go unnoticed because of the lack of funding,” says Jepsen.

The Xerces Society helped write the endangered species petitions for the seven species of *Hylaeus*, along with another Hawaii entomologist, Karl Magnacca, in 2009. The bees were added

to the Endangered Species List in 2016—which, says Jepsen, is a relatively short period of time. “There are species that have been waiting to get through this process for decades,” she said.

Still, according to Jepsen there’s reason to be hopeful: in the past 10 years especially, bees have started to get more attention, and their value to the world’s ecosystems has begun to be recognized. “I think that in general, the public has started to care a lot about bees, and has started to recognize their importance,” she said. “And that sentiment will help conserve these very important pollinators.”