Beautiful Bees, Persistent Parasites

Rising Temperatures Leading to a Loss of our Arthropodic Furry Friends

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Due to climate change, it is important to know how different diseases function at different temperatures. Some climates result in higher virality of a given disease while other climates may result in their extinction. However, this is not necessarily the result of a specific temperature eradicating diseases, but rather eradicating the vectors that can transfer them. For example, a disease like malaria is not present in Ohio because all mosquitoes that could transmit it are not around in the winter. Thus, the disease cannot survive. However, with climate change altering temperatures and making the Earth hotter, a lot of these paradigms about thinking about disease are now under investigation.

Climate change is already bad for bees, as it results in several ecological shifts that jeopardize resources they rely on. For one, they lose habitat; a recent study has found that bee territories have shrunk by nearly 231 km in North America and Europe. Another issue is the shifting temperatures that they face. Increasingly varied temperatures across seasons disrupts the timing from when flowers produce pollen and when bees are ready to feed on it. Bees rely on specific timing mechanisms to pollinate flowers properly. This was shown by German researchers from the University of Würzburg; when bees leave their nest three to six days before a flower blooms, they suffer from low reproduction rates,

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are less active, and face greater risk from predators and parasites. This results in decreased reproduction and lowered resistance to external threats. On top of this, due to their hair-covered bodies, increased temperature will result in the overheating of bees and a loss of population. So now the question becomes, how do bees' parasites respond to the changing climate?

The parasite was the *Crithidia bombi,* which can be exposed to varying temperatures inside or outside the host. In previous research about bumblebees, parasite prevalence (number of hosts infected) and infection intensity (proportion of hosts infected in a population) correlate with a fluctuation in temperature. An important distinction is that the *C. bombi* infects bumblebees, not honeybees. This is significant because, after the winter, a lone bumblebee queen produces the rest of the colony. So, if she is infected, the entire colony could be infected.

Besides temperature, the researchers knew that the only thing that could infect the *C. bombi* transmissibility was sunlight, where if the pathogen was placed on a petal in the sun, it had decreased virality compared to its shaded counterpart. This was one of the reasons the researchers set up this experiment in a closed environment.

What are the effects of *C. bombi*? Why do we care? Mainly, what it does is limit bee pollinating productivity. On top of this, other papers have found that infection reduced colony size and overall fitness of a nest by up to 40 percent. However, in some cases, when the bee is exposed to stressful conditions, the parasite can have a mortality rate of 50 percent. Especially since new research shows that climate change can lead to increased stressful conditions for bees, now more than ever, we need to know more about *C. bombi*.

They exposed the bees and the parasites to five different incubation temperatures, ranging 10–50 degrees Celsius. They expected the parasite prevalence and infection intensity to peak around 30 degrees Celsius and gradually decrease as the temperature increased. However, these were different from the results that came from this paper. For the most part, the infection intensity and parasite prevalence remained the same throughout all incubation times and temperatures.

So, what are the implications of this? This means that this disease is potent and can survive at various temperatures. This is good for *C. bombi* but bad for bees and people who rely on their pollination, as it has been shown that bees cannot survive at the temperatures that climate change offers. On top of this, the disease that infects bees and decreases their productivity has no issue functioning at various temperatures and conditions. So, this parasite and its relationship with bees provide yet another reason to lower emissions and stop the progression of climate change.

What is being done to prevent this? Besides limiting the effects of climate change, what are humans doing to aid their arthropod allies? Currently, researchers are now looking at ways to help bees fight these gut parasites. One such parasite is *Nosema ceranae*, which works similarly to *C. bombi,* infecting the bees' gut and decreasing their fitness. These researchers are creating a symbiont that proliferates in the bee gut and reduces the proliferation of species in the *Nosema* genus. So, more solutions such as this are on the way to the fight against bee parasites.


Drones
are not
tolerated
in this
hive of
industry