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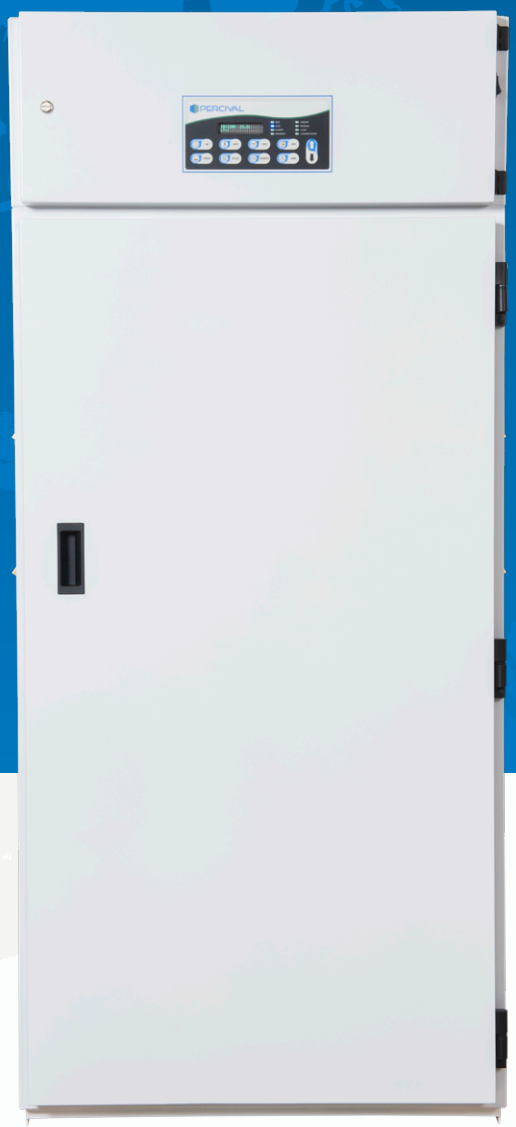
One-of-a-Kind Hummingbird Study Uses Percival Incubator and Infrared Imaging



CASE STUDY

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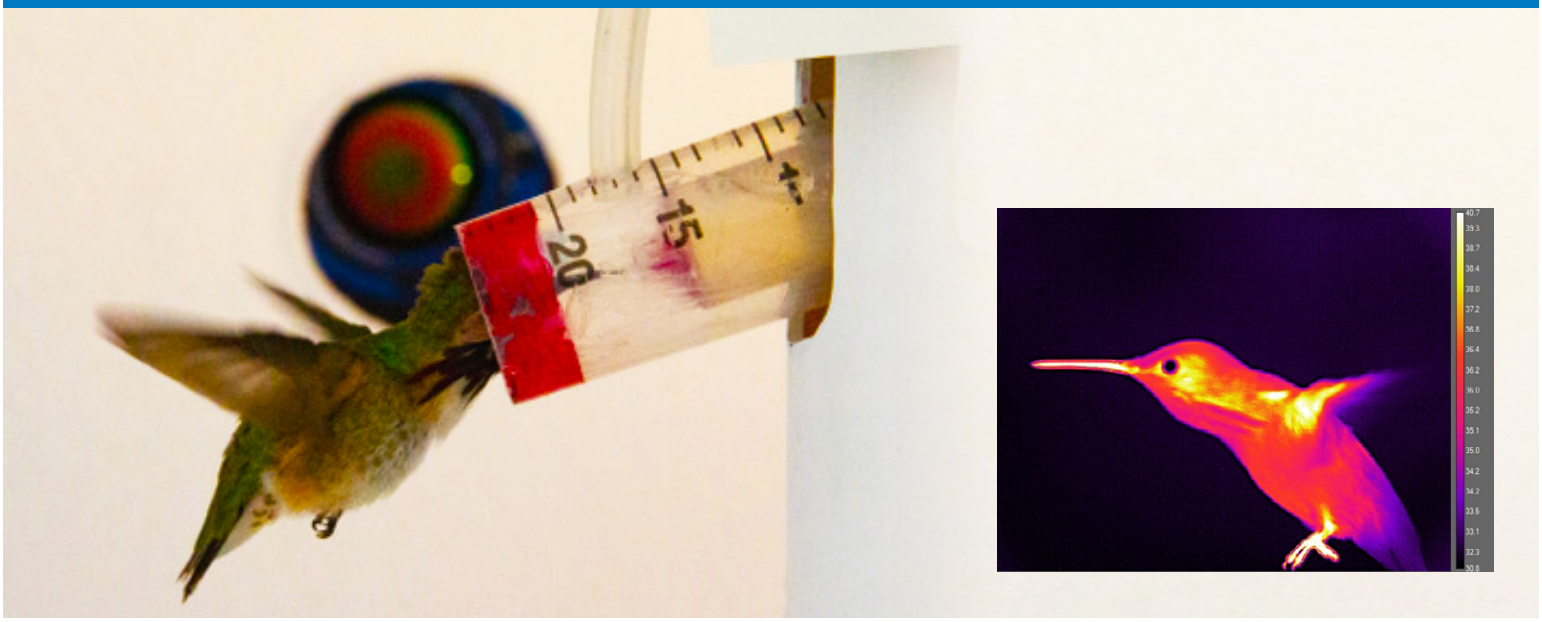


Hummingbirds, some of the tiniest vertebrates on the planet, make a tremendous impact on ecosystems throughout the Western Hemisphere. As pollinators for flowering plants, they maintain the survival of essential vegetation used by other animal species. But like so many organisms, they are susceptible to the effects of global warming, and some species have consistently been declining in number.

Professor of Biology Don Powers, Ph.D., and his students at George Fox University are working to understand the ecological ramifications of rising temperatures on the pollination services of hummingbirds. Specifically, they study how the birds dissipate body heat during flight and how a warming climate affects their ability to fly for extended periods.

Learning More About Hummingbirds in Flight

While studies of heat dissipation and temperature tolerance have been done with resting hummingbirds, very little on this subject is known regarding the birds in flight. Powers says his lab is the only one he knows of that studies hummingbird body-temperature management during flight, likely because capturing data while they're moving is so tricky.

Measuring the metabolic rates of hovering hummingbirds required considerable ingenuity from Powers and his students, who did not have the luxury of a large temperature-controlled room in their lab. Using acrylic panels, a laser cutter, and glue, they fabricated a flight box, installed a flow-through respirometry mask, and fit the box inside the I-35VL Percival Scientific incubator Powers purchased back in 1993.

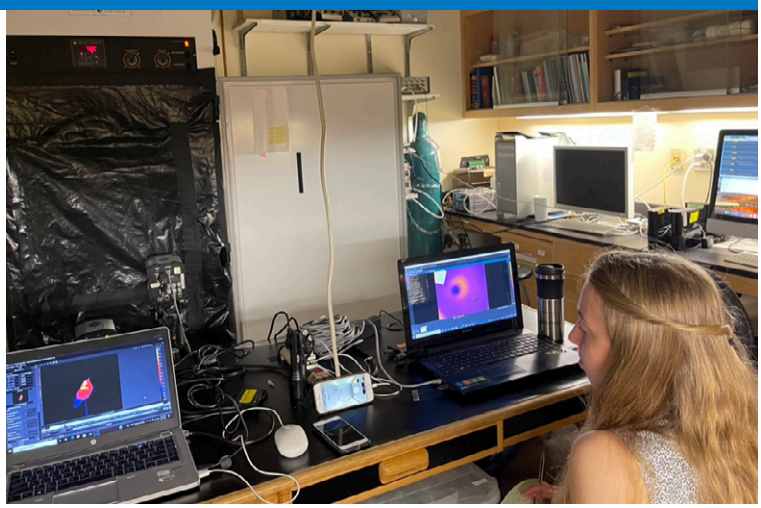
Adapting an Incubator for an Infrared Video Camera

Their experiments needed infrared imaging, so, leaving the door open, they taped heavy-duty plastic to the front of the incubator. Then they cut an opening for a high-resolution infrared video camera to record the birds in flight. With this setup, they could run the experiments across a wide range of temperatures. They recorded data on flight metabolism and visualized body regions where heat was being dissipated.

"The I-35VL performed brilliantly, maintaining temperature exceptionally well without breaking a sweat," says Powers. "In my experience, we wouldn't have maintained the same level of precise control in a temperature-controlled room."

New Data May Help Improve Future for Hummingbirds

After years of studying several hummingbird species this way, Powers and his students learned that the birds dissipate heat passively during flight in areas around their eyes, along their shoulders and through their feet to help manage their body temperature. However, this ability is eliminated at external temperatures between 36 and 40°C. Consequently, hummingbirds likely stop pollination activity when temperatures are too high because they only fly for short time periods.



Surprisingly, they also discovered that smaller species were more tolerant of higher external temperatures than the larger species they studied.

"Solutions are above my pay grade," says Powers, "but I'm providing useful information to land managers to help them protect entire ecosystems." He hopes his lab's discoveries will encourage land managers to plant more vegetation as refuge for overheated hummingbirds or change practices that eliminate natural areas of shade used by birds.

"We all have our roles to play. I am absolutely part of the solution for ecosystem management, but I'm just a piece of the puzzle."

NASA Uses Data From Powers' Lab

One entity interested in the discoveries coming out of Powers' lab is NASA, which funded the lab for several years. NASA provides remote sensing tools to scientists working on ecosystem problems. "NASA's mission isn't just space exploration," says Powers. "They're working to understand earth's landscapes and ecosystems as well, and we help provide them with data to broaden their understanding."

Reliability From Long-Lasting Incubators

Powers trusts Percival incubators for his research because of their precise temperature control. He used his original I-35VL for 23 years before the refrigeration unit finally gave out. The only issue he ever had with it was needing to recharge the refrigerant once. "The temperature control was still precise up to the very end."

His students have encountered even older Percival incubators when they've studied hummingbirds at the Southwestern Research Station owned by the American Museum of Natural History in the Chiricahua Mountains of southeast Arizona. The two Percival chambers there are over 40 years old. Even after the research station was shut down for two years because of the Covid pandemic, "... they still worked!" says Powers.

Powers recently ordered a new Percival incubator and is looking forward to its advanced programmability. "It's going to make it easier to jump back and forth between the experiments my students are doing."

Expanding Research to Other Bird Species

As Powers and his students continue their study with hummingbirds, his goal is to expand their heat dissipation experiments to include more bird species. "Bird diversity plays a huge role in a variety of ecosystems and global economies," he says. "Humanity needs birds."

For more information, please visit ***www.percival-scientific.com****, call* ***1.800.695.2743*** *or email* ***info@percival-scientific.com****.*

For more about Don Powers' research and publications, visit his ***George Fox University page****.*

* Don Powers' views do not represent those of George Fox University. The information in this case study reflects his individual, real-life experience regarding the use of Percival Scientific chambers. Powers received no goods, services, or incentives of any kind from Percival Scientific in exchange for information or opinions regarding Percival Scientific products and/or services.