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MEDIA RELEASE

UP Zoology prof part of study that finds hummingbirds drop body temperature to near freezing point to survive cold nights

PRETORIA – A University of Pretoria (UP) professor of zoology was part of a team that recently published a study that reveals that tiny hummingbirds living in the Andes Mountains in Peru drop their body temperature from 40°C to 3.3°C, near freezing point, to survive bitterly cold nights. "It is the lowest body temperature reported so far in any bird or non-hibernating mammal," says UP's Professor Andrew McKechnie.

Prof McKechnie, Professor of Zoology at UP and South African Research Chair in Conservation Physiology at the South African National Biodiversity Institute, is part of the scientific team that recently published its findings in the journal *Biology Letters*. He explains that these tiny nectar-feeders go into a state called "torpor" to save energy on bitterly cold nights.

"Torpor is the most effective means of energy conservation used by mammals and birds," he says. "It is a state of inactivity devoid of movement and with the purpose of reducing energy requirements either in the cold or in a very dry climate. The energy savings occur because the animal reduces its body temperature and metabolic rate far below normal levels."

The hummingbirds studied in the region live at an elevation of about 4 000m. To survive the nights, they drop their body temperature, which is usually 40°C, to extremely low values. Six species were studied, from the bronze-trailed comet (4.9g) to the giant hummingbird (which is comparatively bigger, weighing in at 24g). Most hummingbirds weigh between 3g and 7g.

While all the species lowered their body temperatures to different degrees, all dropped below 10°C at some point, according to Prof McKechnie. The black metaltail's (*Metallura phoebe)* temperature dropped to 3.3°C, which is close to freezing point. The previous record for birds was 4.3°C, recorded in the common poorwill, a North American nightjar.

Torpor is critical for the survival of these hummingbirds, because they are often unable to store enough energy during the day to last through the night. They feed on the nectar of flowers that grow in abundance even at such high elevations. But, Prof McKechnie adds, the nectar is sometimes not very rich in energy. Some hummingbirds have to drink up to three or four times their own body mass each day to obtain sufficient energy. They also have very limited fat reserves.

Some of the birds remained in torpor for just three hours, while others remained in that state for up to 13 hours. To heat up again in the morning, or sometimes during the night, they start to shiver. "While shivering they generate a lot of heat internally," Prof McKechnie explains. "Their muscles contract rapidly. One sees them shivering, then suddenly their eyes open and they fly away." To get out of torpor, the hummingbird raises its temperature by 1.5°C a minute; this can take up to half an hour.

Hummingbirds also have extremely high heart rates of up to 1 200 beats a minute, but during torpor their heart rate can be as low as 50 to 80 beats a minute. While in torpor, they are potentially vulnerable to predators, because they can't move at all. Many hummingbirds of the high Andes roost in caves, clinging to the walls in suspended animation, surviving in the most extraordinary way. Caves are just one of the known places they go at night; there is even evidence that some hummingbirds enter torpor while in their nests incubating eggs.

But how did the researchers manage to measure the body temperatures of these tiny birds at night?

The team caught 26 hummingbirds representing the six species with mist nets, and kept them in tents that were adapted to serve as aviaries. Each bird was kept for one or two nights at most. An extremely fine Teflon-coated thermocouple wire was inserted into the cloaca of each bird. The cloaca is the bird's single opening for the urinary, digestive and reproductive tracts.

"About 30 minutes before dark, food was withheld and the birds were transferred into individual roosting enclosures so their temperatures could be measured," explained by Prof McKechnie. "The thermocouples were held in place by tiny pieces of tape secured to each bird's tail feathers."

Another novel finding to emerge from the study is that the six species varied substantially in terms of torpor depth and duration despite experiencing the same weather conditions. These differences suggest evolved differences among these species, rather than torpor patterns being determined wholly by environmental conditions.

(Ends)

Captions: *Humming bird 1.jpg – A giant hummingbird, a high-elevation species from the Andes.*

Hummingbird 2.jpg - Sparkling violetear, one of six species involved in the study.

Hummingbird 3.jpg - Hummingbirds were housed overnight in tents outfitted as make-shift aviaries.

Hummingbird nests 4.jpg - A hummingbird nest constructed among rocks along the edge of a stream at 3 800m above sea level.

Nest.jpg - An active hummingbird nest built in a cactus; the spines provide protection from predators.

All the photos were taken by Prof Blair Wolf of the University of New Mexico at a field research station at Bosque Japani, Peru, at 3 800m above sea level in the Andes.

Picture 6 Prof Andrew McKechnie of UP

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ABOUT THE UNIVERSITY OF PRETORIA

The University of Pretoria (UP) is one of the largest contact and residential universities in South Africa, with its administration offices located on the Hatfield Campus, Pretoria. This 112-year-old institution is also the largest producer of research in South Africa.

Spread over seven campuses, it has nine faculties and a business school, the Gordon Institute of Business Science (GIBS). It is the only university in the country that has a Faculty of Veterinary Science which is ranked top in Africa, and overall has 120 academic departments, as well as 92 centres and institutes, accommodating more than 55 000 students and offering about 1 100 study programmes.

UP is one of the top five universities in South Africa, according to the 2019-2020 rankings by the Center for World University Rankings. It is also ranked among the top 100 universities worldwide in three fields of study (veterinary science, theology and law), and among the top 1% in eight fields of study (agricultural sciences, clinical medicine, engineering, environment/ecology, immunology, microbiology, plant and animal sciences and social sciences).

In June 2019, the annual UK Financial Times Executive Education Rankings once again ranked GIBS as the top South African and African business school. The University also has an extensive community engagement programme with approximately 33 000 students involved in community upliftment. Furthermore, UP is building considerable capacities and strengths for the Fourth Industrial Revolution by preparing students for the world beyond university and offering work-readiness and entrepreneurship training to its students.

As one of South Africa's research-intensive universities, UP launched the *Future Africa Campus* in March 2019 as a hub for inter- and transdisciplinary research networks within UP and the global research community to maximise 4IR innovation and address the challenges and stresses our continent and world is facing. In addition UP also launched the Javett Art Centre in September 2019 as a driver of transdisciplinary research development between the Humanities and other faculties. In 2020 UP will launch Engineering 4.0. as a hub not only for Smart Cities and Transport, but also to link the vast resources in technology and data sciences to other faculties via Future Africa. These initiatives are stimulating new thinking at the frontier of 'science for transformation'.

For more information, go to www.up.ac.za