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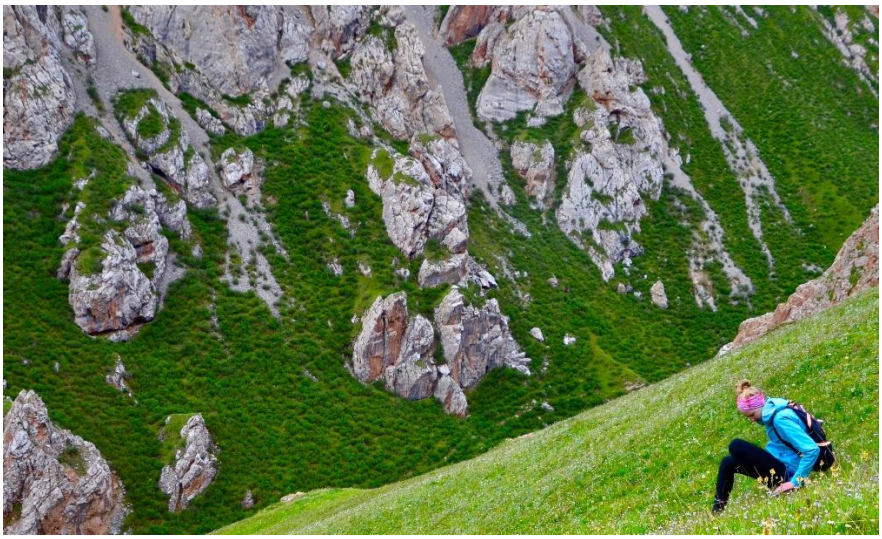
Opinion Piece

Snow leopards (*Panthera unica*) are charismatic big cats that can be found in 12 countries across Central Asia. What is a charismatic animal? Charisma, in the context of conservation biology, refers to a species that is well known to the public and bears a significant conservation concern because it garners special attention and support (Home et al., 2009). Until recently, snow leopards were on the endangered species list and have served as the face of many conservation campaign efforts. While they are no longer listed as endangered globally by the International Union for Conservation of Nature (IUCN), snow leopards remain *at risk* in the wild, and remain endangered in many countries.

Snow leopard captured on a camera as it walks on a trail in Qilianshan, Qinghai Province, China. The camera trap belongs to the Chinese Academy of Forestry and photo was provided by C. Hacker.

Despite snow leopards being a well-known animal, much remains to be discovered about these beautiful big cats. A large portion of snow leopards live in isolated, high altitude environments across the Tibetan Plateau. They are masters of camouflage, making them difficult to see and even harder to study. It requires patience and dedication to travel to remote locations of the world, without any guarantees that you will find what you are looking for. Conservation geneticist, Charlotte Hacker, has centered her graduate thesis work around this challenge. Hacker, a Ph.D. Candidate in Dr. Jan E. Janecka's lab at Duquesne University is currently in China on a Fulbright Scholarship where she is working with the Chinese Academy of Forestry to better understand snow leopard populations and the ecosystem in which they live.



Charlotte Hacker in Yushu Prefecture, Qinghai Province, China. Photo taken by Gopsa and provided by C. Hacker.

While Hacker's work takes her to beautiful locations around the world, it is by no means a vacation. She shares the difficult aspects of the fieldwork, "It's physically taxing, we're hiking miles a day through the mountains at times close to [an altitude of] 5,000m. We're eating a limited diet of sheep and yak, and the pressure to get samples and fulfill your research goals while so many things are out of your control is at times overwhelming."

Although remote fieldwork can be grueling, Hacker notes that she knows she is exactly where she is supposed to be. "In short, fieldwork is HARD, but it's also my favorite part of what I do. I'm really lucky to be able to work in a discipline that I thrive in and am passionate about, but I know that it definitely isn't for everyone."

There is a certain degree of caution that must be taken when studying animals, especially wild animals in their natural habitat. This becomes even more serious when it involves a species at risk of extinction. Conservation biologists have been working to find ways to study animals in

noninvasive ways. This insures that there is no harm to the animal and no disruption to the natural habitat that the animals live in.

One noninvasive method that has shown great success involves the analysis of scat samples. Scat, or feces, provides a rich assortment of information that can be used to analyze the organism that left it. Scat provides information on the identity of the animals, their overall health, and what they're eating. Hacker is on her fourth trip to China and in that time, she has personally collected close to 400 samples.

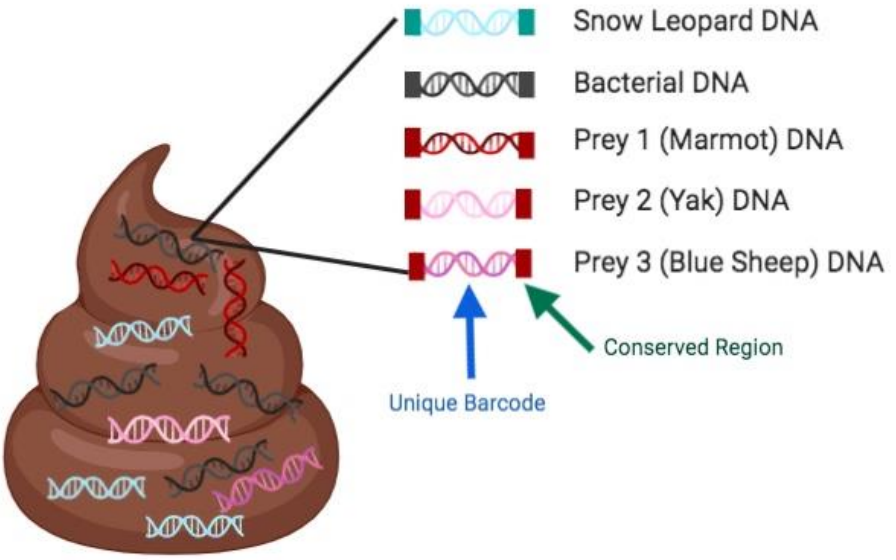
Snow leopard scat collected on the Tibetan Plateau in China. The sample is collected and preserved for DNA extraction. Photo taken and provided by C. Hacker.

So, what does she do with all that scat? Once collected, Hacker extracts the DNA and builds genetic profiles. A genetic profile allows scientist to collect genetic information from a specific organism to gain insights on its individual characteristics (e.g. their traits and the genes they inherited). This enables Hacker to not only verify if the scat she collected is from a snow leopard, its origin can sometimes be tricky to identify, but provides information on abundance and the composition of the whole ecological community. This technique is referred to as *noninvasive genetics.* Scat is used to gain genetic information on an organism, like snow leopards, without causing a disturbance to the animal.

Genetic profiles provide a unique opportunity to survey a population without ever coming in contact with a single snow leopard. Just by analyzing the snow leopard DNA in the scat, Hacker and other conservation geneticists can determine approximately how many snow leopards are in a given population and how closely they are related (i.e. are they all from a single family). This

information reveals areas where there are an abundance of snow leopards and areas where there are very few, as well as how individuals are moving through the landscape, allowing targeted conservation efforts to occur where the need is greatest and identification of important habitat corridors.

Snow leopard DNA is not the only DNA found in scat. There is bacterial DNA from the digestive tract of the snow leopard, as well as DNA that belongs to the prey that were eaten by the snow leopard. Just like the snow leopard DNA, bacterial and prey DNA can reveal a lot of useful information. How do scientists tell the difference between varying types of DNA? Like products on a shelf at a grocery store, DNA has a "barcode" that provides unique information about an organism. By targeting a specific conserved (non-variable) region on the DNA, a barcode can be isolated that only matches your target.



Scat is full of useful information that can be obtained from DNA targeting snow leopard, bacteria, or prey.

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Molecular diet analysis uses this method to target the DNA of prey remains found in snow leopard scat. A better understanding of what snow leopards are eating will provide insight into the current state of their habitats and the conditions that they are living in. Snow leopards typically eat large wild hoofstock species, when snow leopard diets consist of many small animals and/or livestock, this suggests that there may not enough prey in that given area, making it difficult for them to survive.

Studying wild snow leopard populations and the conditions in which they dwell bring conservationist one step closer to preserving the future of this big cat. “The most exciting part of my work is getting to play an active role in saving species, and getting to work with local communities to make it happen”, Hacker states. “It takes a vast coordinated effort of people from different background and areas of expertise to solve the challenges at-risk wildlife face. Being a part of that coordinated effort and helping to create effective conservation action plans backed by science and implemented by those who live among snow leopards is such a gnarly and rewarding process.” Through the efforts of Hacker and the Janecka lab, along with their collaborators, the road is being paved for noninvasive genetics, while also providing crucial information on the elusive snow leopard (Janecka et al., 2017; Zhang Y et al., 2019; Hacker CE et al., In Press).

For more information on the work that Charlotte Hacker is doing you can visit her website. For more information on conservation efforts and how you can help visit The Snow Leopard Conservancy and Panthera.

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