New Tools for Grizzly Bear Biologists

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Grizzly bears in North America face serious conservation challenges, including habitat destruction, poaching, and mortality on roads and railways. In the United States, grizzlies are listed as a threatened species and, in Canada, as a species of special concern. However, the promising convergence of noninvasive genetic sampling (NGS) techniques with hormone and isotope analyses gives scientists more tools to identify individuals and populations at risk and to understand the physiological mechanisms at work behind population declines.

NGS—the collection of DNA from animals without handling them or piercing their skin—is a study method that has gained traction over the past decade. Most commonly, DNA samples are tufts of hair snared on barbed wire when a bear comes to investigate an irresistible smell (without food reward), such as rotted fish guts or deer blood. DNA from the hair roots is then used to identify individual bears.

Gord Stenhouse is a senior grizzly bear biologist with the Foothills Research Institute in Alberta, Canada. He spearheaded the 2008 Alberta grizzly bear census, during which hair samples from bears across the province were analyzed and cataloged. Armed with the identity of each individual, he is now looking at cortisol levels isolated from their hair as an indicator of physiological stress. Stenhouse says that this information could be a useful tool in understanding how bears are responding to climate change and more direct anthropogenic changes to the landscape.

The preliminary results, published by Stenhouse and colleagues in PLOS ONE in December 2013 (doi:10.1371/journal.pone.0083768) showed that long-term stress may indicate poor food availability and distribution around anthropogenic landscape developments and may be influenced by habitat segregation by sex. Differentiating between stress from natural causes such as competition and human-imposed stressors, though, can be difficult.

"One might expect that bears living in the backcountry of Jasper National Park [Canada], where there are very few people, are in some kind of nirvana," says Stenhouse. But the reality is more complex, he explains. Some of these bears, particularly females, have stress levels exceeding those of bears exposed to all sorts of anthropogenic change and human activities.

To better understand why, Stenhouse is analyzing pregnancy and lactation hormones in hair. He hopes to create female reproductive profiles to learn the proportion of bears reproducing under certain conditions and in various landscapes. If it is successful, this effort would allow monitoring of reproductive success over time.

Heather Bryan, a postdoctoral fellow in the Applied Conservation Science Lab at the University of Victoria, British Columbia (BC), is also looking at cortisol levels as an indicator of physiological stress—this time in salmon-eating grizzlies from coastal BC. She wondered how recent declines in salmon populations are affecting grizzly bear health. "Salmon often make up more than 80 percent of [grizzlies'] yearly dietary protein uptake," says Bryan.

Among other hormones, Bryan compared cortisol levels from coastal BC grizzlies with levels in a reference population from interior BC that lacks access to salmon. Her results, published in PLOS ONE in November 2013 (doi:10.1371/journal.pone.0080537), showed that cortisol levels were higher in the bears with low amounts of dietary salmon, perhaps indicating nutritional stress. Bryan hopes that, coupled with genetic information, hormone data will help her understand what factors drive population-level trends, including specific environmental stressors.

While Bryan is using these techniques to understand conservation issues at a population level, Michael Sawaya, carnivore research ecologist and consultant with Sinopah Wildlife Research in Missoula, Montana, is working to identify individuals at risk of being struck by trains in Banff National Park.

Of the 61 grizzly bear deaths (including natural deaths and deaths of unknown cause) reported between 1990 and 2007 in Canada’s mountain national parks, 15 were on railways. Bears are drawn to the railway to feed on spilled grain or to scavenge other animals struck on the tracks. Sawaya hypothesized that the difference in diet between rail-habituated bears and those elsewhere in the park may be detected by certain isotopes isolated from their hair.

Indeed, as he and his colleagues wrote in September in Isotopes in Environmental and Health Studies, higher levels of nitrogen and sulfur in hair samples collected from train-killed bears were distinct from those of bears elsewhere in the park (doi:10.1080/10256016.2014.922555). The observed differences in nitrogen (Δ15N), for example, may be associated with a diet higher in meat consumption, with rail-dependent bears getting more "fast food" (rail-killed prey).

"We are at the nexus of many exciting social and technological developments that will take advantage of the newfound, widespread availability of biological samples," Sawaya says. "In the coming years, we’ll answer research questions at scales never before thought possible."


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