# Elk bones tell stories of life, death, and habitat use at Yellowstone National Park

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The bared vertebrae of an elk lie on a riverbank in Yellowstone National Park. Credit: Joshua Miller

Josh Miller likes to call himself a conservation paleobiologist. The label makes sense when he explains how he uses bones as up-to-last-season information on contemporary animal populations.

Bones, he says, provide baseline ecological data on animals complementary to aerial counts, adding a historical component to live observation. In his November cover article for the Ecological Society of America's journal *Ecology*, he assesses elk habitat use in Yellowstone National Park by their bones and antlers, testing his method against several decades of the Park Service's meticulous observations.

Now an assistant research professor in the new Quaternary and

Anthropocene Research Group in the Department of Geology at the University of Cincinnati, Miller located and recorded the elk bone data while a doctoral student in paleontology at the University of Chicago, and finished analyzing the data during a brief stint at the Florida Museum of Natural History at the University of Florida, in Gainesville. His work with modern animals grew out of curiosity about the fidelity of the fossil record in archiving animals and ecosystems of the distant past.

"It turns out that bones are really informative," he said. At Yellowstone, bone and antler concentrations mirror patterns of animal landscape use known from years of aerial surveys. "This opened up a completely unexpected opportunity for studying modern ecosystems, particularly for areas where our knowledge of animal populations is more limited."

Reconstructing animal community structure and habitat use through the bones of past generations is a new idea. Until recently, common knowledge held that, on the landscape, bones just don't last that long. But Miller has found that they can last for hundreds of years. Bones weather in a stereotypical pattern, from fresh to falling apart. He calibrated weathering in the Yellowstone bones through radiocarbon dating, gaining a familiarity that would allow him to pick up a bone and know it had seen a year, 20 years, or 80 to 100 years or more on the open ground.

Field assistant Jared Singer maps a carcass near a lake in Yellowstone National

Park. Flags mark bone locations. Credit: Joshua Miller

Bull elk shed their antlers in late winter, when forage is sparse. Too poor in nutrients to interest most scavengers, heavy, and awkwardly shaped for displacement by the elements, antlers tend to stay where they fall. Miller found that, for the most part, the bones of calves don't travel far either, even in the mouths of predators. The bones of calves mark the range where their mothers sought plentiful food to fuel months of nursing, and shelter to hide their vulnerable newborns.

Old bones from past decades outline a range consistent with the living herd. Miller saw only moderate shifts in a few areas, even given the many recent changes at Yellowstone: the prodigious wildfires of 1988, repatriation of grey wolves starting in 1995, and regrowth of willows, aspen, and cottonwoods over the last couple of decades following a long decline during the 20th century.

Because bones can last decades to centuries in the Yellowstone environment, Miller says they can put relatively recent data from direct observation into broader context for managers looking at long-range planning, helping to sort out important changes from the noise of cyclical booms, busts and shifts in landscape use. Bones are a minimally invasive tool for tracking the history of range animals. They are data just lying on the ground, waiting to be collected.

**More information:** Spatial fidelity of skeletal remains: elk wintering and calving grounds revealed by bones on the Yellowstone landscape (2012) Joshua H. Miller. Ecology 93:11, 2474-2482. www.esajournals.org/doi/abs/10.1890/12-0272.1