

Study reveals space use, movement of bighorn sheep in Nebraska

February 24 2022, by Scott Schrage



From 2018 to 2020, collars affixed to 51 female bighorn sheep in the Nebraska Panhandle reported the precise locations of those ewes up to 24 times a day. Credit: Todd Nordeen | Nebraska Game and Parks Commission

In the Nebraska Panhandle, where the flatlands of the state's eastern expanse occasionally give way to rocky buttes and canyons that preview the mountainous terrain farther west, reside pockets of bighorn sheep, a species once gone, now returned.

Amid the Wildcat Hills and the Pine Ridge, the iconic cloven-hooved mammal—known for navigating the steepest of slopes—has maintained a foothold since being reintroduced to the Cornhusker State in the early 1980s.

"Typically, most people are like, 'You have bighorn [sheep](#) in Nebraska?' And that's kind of what I thought before I came here," said John Benson, assistant professor of vertebrate ecology at the University of Nebraska–Lincoln.

Named for the signature curlicue horns that spiral from the heads of its males, bighorn sheep flourished throughout western North America for more than half a million years. As recently as 1800, several 100,000 bighorn sheep remained. Unregulated hunting, respiratory disease and habitat change combined to leave just a fraction of that number by the early 20th century, when they disappeared from Nebraska.

Since helping oversee the relocation of bighorn sheep to the Panhandle about 40 years ago, the Nebraska Game and Parks Commission has monitored two subpopulations: one in the Wildcat Hills, near Scottsbluff, and another on the Pine Ridge, near Chadron.

A group of Husker researchers led by Benson—who's accustomed to studying wolves, mountain lions and other [large predators](#) that would consider bighorn sheep a worthy meal—has teamed up with the commission for several years. With the aid of GPS-enabled collars, that team is now getting a better sense of where, exactly, the bighorn sheep live, how much space they use, and whether and how far they migrate.

Homing in on those answers should ultimately improve management and conservation efforts, Benson said. That's particularly crucial on the Pine Ridge, where sometimes-devastating pneumonia outbreaks have thinned three herds of the species.

"We believe, and there's good evidence to suggest, that understanding space-use behavior can give us information about patterns that influence mortality and potentially disease transmission," Benson said of the bighorn sheep, which remain at risk in Nebraska.

From 2018 to 2020, collars affixed to 51 female bighorn sheep reported the precise locations of those ewes up to 24 times a day. The collars dropped off the ewes at designated dates and were later collected. The resulting data has revealed that Nebraska's bighorn ewes occupy seasonal home ranges as small as any documented to date—in some cases, just 2 square miles, with none larger than 5 square miles. And the vast majority of those ewes maintained the same home ranges over time.

Benson said the findings could speak to the unique ecological conditions of the Nebraska Panhandle, which differs from the habitats occupied by most bighorn sheep in other states.

"There's been a ton of research on bighorn sheep over the years, but most of it is in high-elevation mountain populations and desert populations," he said. "This would be along the easternmost periphery of their range, here in Nebraska, and a very different landscape than, say, the Rocky Mountains or Sierra Nevada or the deserts in the Southwest."

Bighorn sheep likely adapted to living among and climbing slopes because those slopes serve as so-called escape terrain—ground up which the sheep can flee when pursued by mountain lions, coyotes and other predators. In more mountainous regions, that escape terrain tends to be abundant and far-reaching. Conversely, Nebraska's Wildcat Hills and Pine Ridge are environmental outliers: relatively small, isolated areas of elevation that abruptly meet massive stretches of flat, exposed terrain where predators reclaim the advantage.

"It stands to reason that if there are relatively few areas of true rugged,

steep escape terrain, then that might serve to anchor them to those areas," Benson said, "and might be one of the reasons they have a relatively small range."



Credit: Google Earth

The remoteness of those escape routes might also help explain why most of the bighorn ewes migrated relatively short distances between seasons. Of the 51 ewes, 45 spent the winter in areas that overlapped with the territory they occupied during the summer, when they birth and begin rearing lambs that are especially vulnerable to predators.

Though few in number, the other six ewes did hint at a potentially interesting aspect of bighorn migration in Nebraska. It's not unusual for a species to include both residents and migrants—individuals that stay put versus those that migrate, respectively, even in the same population.

In some species, the residents of one year tend to remain residents the next, as do the migrants. By contrast, the four migrating ewes that were tracked across multiple years actually migrated in only one of those years, staying put in the others.

"So they have this kind of flexibility and switching behavior," Benson said. "Presumably, they're gaging: What are the resources like this year? What's the weather doing? How risky is it where I am relative to where I might go? And something tells them, 'OK, we're going this year,' or, 'Not this year.'

"I think there's a ton that we can learn about the environmental conditions that drive their behavior with further investigation into this plasticity in migratory behavior across years."

As much as the "where" is influencing range size and migration, Benson said the "when" could be factoring in, too. Prior research has indicated that recently relocated populations may migrate less, on average, than native populations that have continuously occupied an area. One study found evidence of that migratory reluctance dissipating over time, suggesting that it might stem partly from an unfamiliarity with a landscape. The researchers plan to keep an eye out for a similar trend in Nebraska's bighorn sheep, which, by ecological standards, are still relatively recent arrivals.

Despite the Panhandle's reputation as a sparsely populated, largely undeveloped area, Benson and the team also sought out signs of a relationship between home ranges and the density of nearby roads. Historically, studies have concluded that more roads can equate with larger home ranges in wild animals, which presumably need to travel more in order to reach food or other resources separated by those roads.

Sure enough, the team found that the bighorn ewes tended to occupy

larger ranges in the road-adjacent areas of both the Wildcat Hills and Pine Ridge. Moreover, the ewes in the region with the higher density of roads—Pine Ridge—favored larger ranges than their counterparts in the Wildcat Hills. Because more travel requires more energy, and larger energy expenditures demand more food, the presence of roads could also be tilting survival odds. The fact that bighorn ewe numbers have recently declined on the Pine Ridge, but not in the Wildcat Hills, might suggest that a fragmented landscape can exacerbate the herds' issues with respiratory disease.

There's also the possibility that the small ranges of bighorn ewes in the Nebraska Panhandle are rooted, at least partly, in a more heartening explanation, Benson said.

"Typically, we think of home range size as some indication of habitat quality, with smaller home ranges reflecting high habitat quality or abundant food resources," he said. "Because why go farther if you've got everything you need right there?"

"The Wildcat Hills is the subpopulation that's been pretty stable, so the smaller [home ranges](#) could be an indication that habitat quality is better there. We know that what's driving (bighorn mortality) is disease, but it certainly stands to reason that better habitat quality could help a population withstand a disease outbreak better."

Benson said the team needs to analyze its data more thoroughly before it can gage, with confidence, how much any of the behavioral factors may actually be influencing the survival rates and population dynamics of Nebraska's bighorn sheep. He's especially interested in using statistical models to help tease out which resources and habitat conditions the bighorn sheep are prioritizing in deciding when, where and how much to move.

"What we learned in this study may not lead us immediately to strong management recommendations for [bighorn sheep](#)," Benson said. "But it's really valuable baseline information that is needed to help manage in a more effective way—and has led us to additional questions that will continue to benefit managers."

The team reported its latest findings in the *Journal of Wildlife Management*. Erin Wood, a recent master's graduate and advisee of Benson's in the School of Natural Resources, was lead author of the study. It was co-authored by Todd Nordeen and Will Inselman of the Nebraska Game and Parks Commission; Peter Mahoney, a former postdoctoral researcher in Benson's lab now with the National Oceanic and Atmospheric Administration; and Benson.

More information: Erin Wood et al, Spatial ecology of female bighorn sheep in a prairie landscape in Nebraska, *The Journal of Wildlife Management* (2022). [DOI: 10.1002/jwmg.22201](https://doi.org/10.1002/jwmg.22201)

Provided by University of Nebraska-Lincoln

Citation: Study reveals space use, movement of bighorn sheep in Nebraska (2022, February 24) retrieved 17 July 2024 from <https://phys.org/news/2022-02-reveals-space-movement-bighorn-sheep.html>

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