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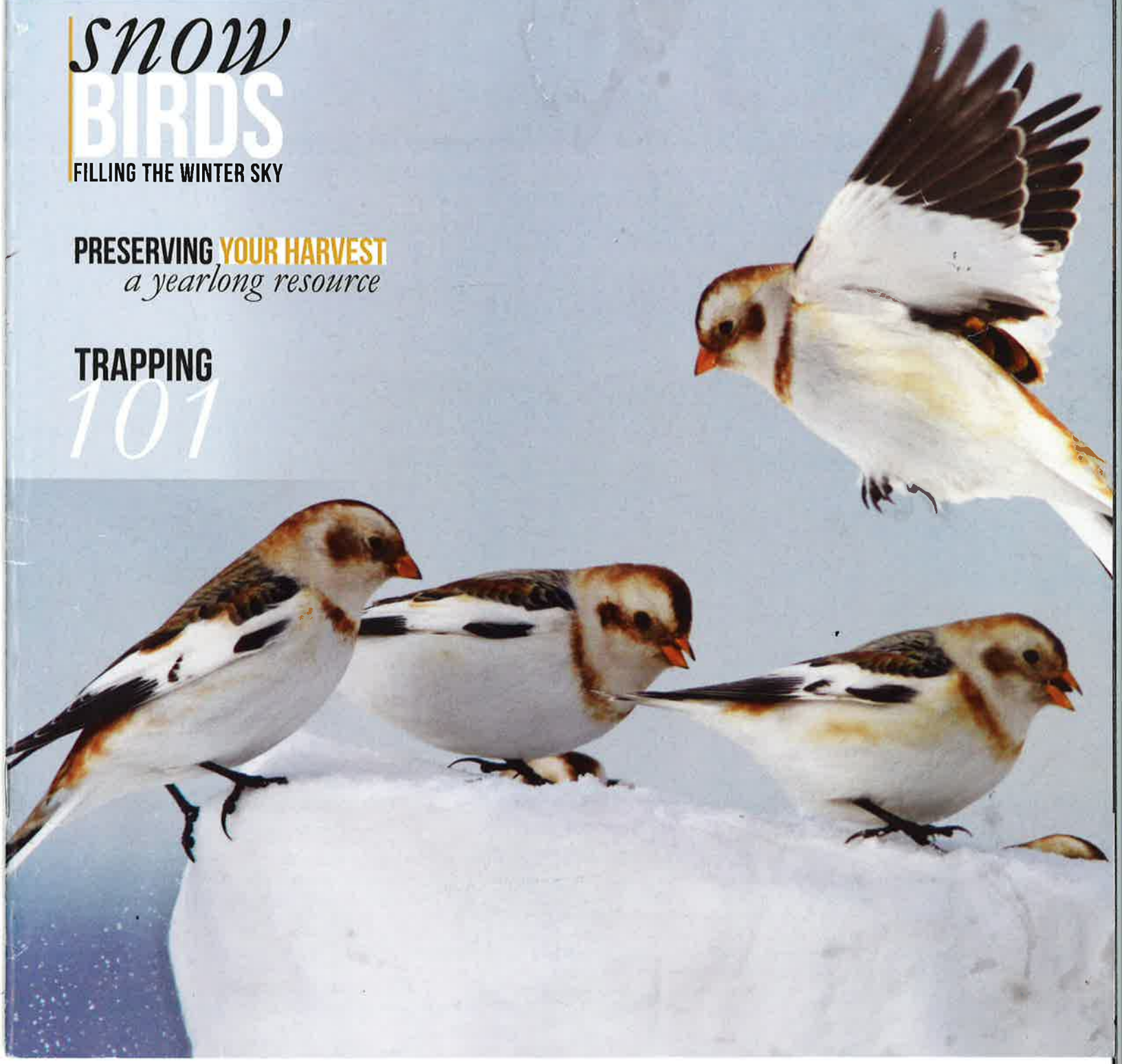
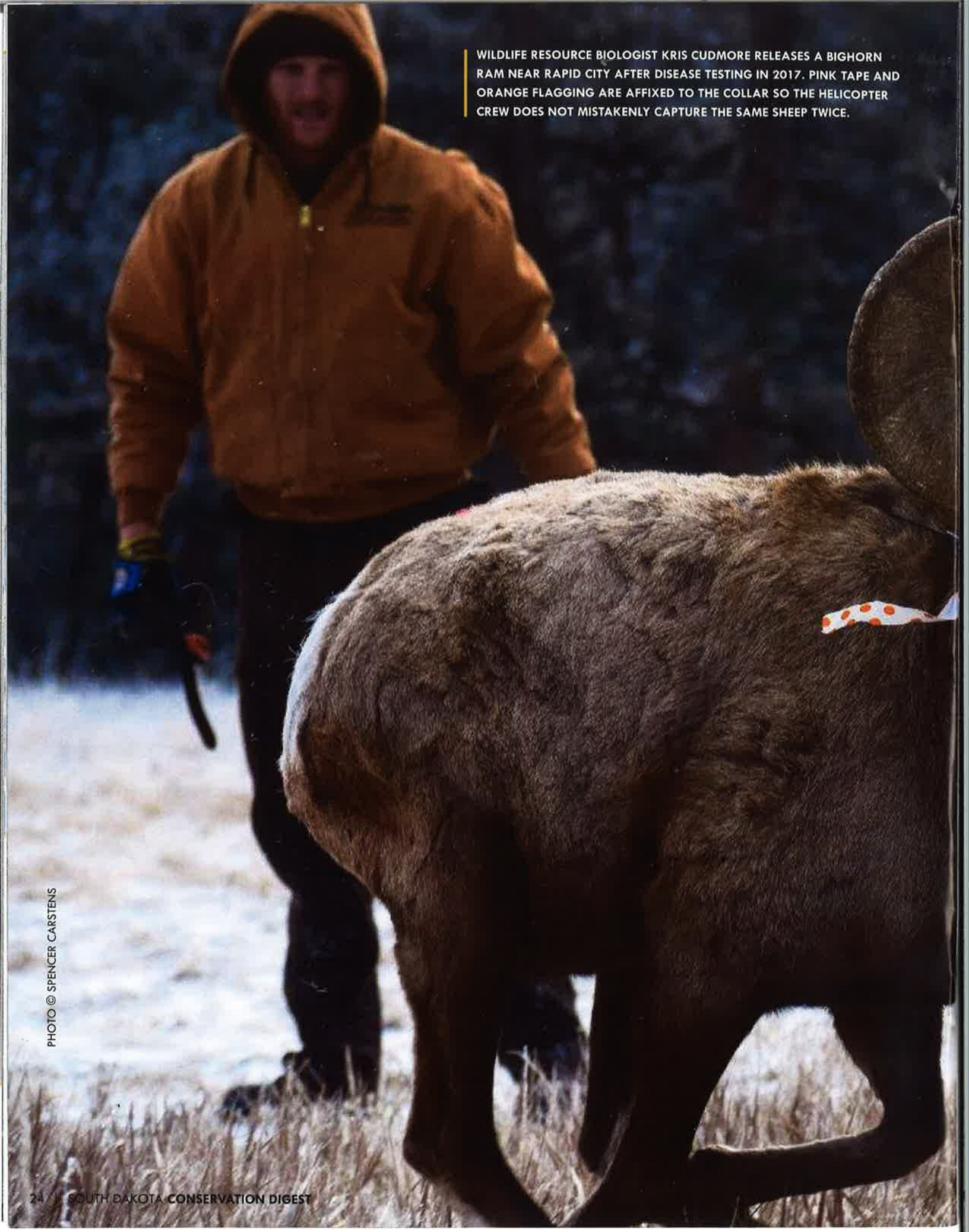




WILDLIFE RESOURCE BIOLOGIST KRIS CUDMORE RELEASES A BIGHORN RAM NEAR RAPID CITY AFTER DISEASE TESTING IN 2017. PINK TAPE AND ORANGE FLAGGING ARE AFFIXED TO THE COLLAR SO THE HELICOPTER CREW DOES NOT MISTAKENLY CAPTURE THE SAME SHEEP TWICE.

PHOTO © SPENCER CARSTENS

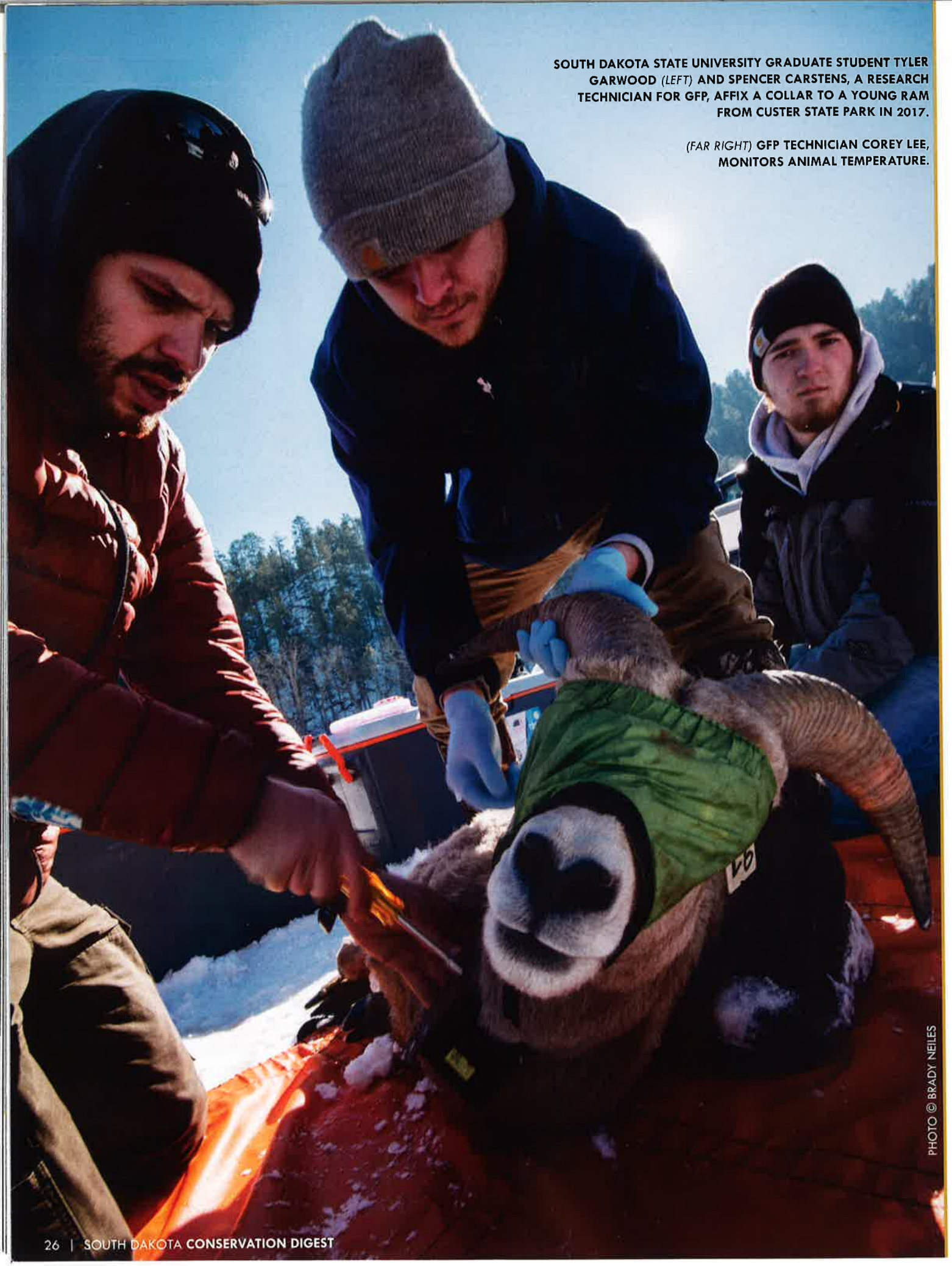
CHRISTIE **DELFANIAN** | SOUTH DAKOTA STATE UNIVERSITY RESEARCH WRITER

REMOVING 'TYPHOID MARYS' RESTORES HEALTH OF BIGHORN SHEEP HERD

Bighorn sheep in Custer State Park are healthy and thriving again, but two years ago their future was uncertain, at best.

An outbreak of bacterial pneumonia in 2004 decimated the herd—nearly 80 percent of the sheep died. More than a decade later, the herd was still struggling with most of the lambs dying annually from respiratory disease. The herd was destined for extinction, but Chad Lehman, South Dakota Game, Fish and Parks (GFP) senior wildlife biologist at Custer State Park, was not going to let that happen.

Meanwhile, professor Jonathan Jenks of the South Dakota State University Department of Natural Resource Management was part of a multi-institutional research team evaluating whether eliminating the "Typhoid Marys" that persistently shed a pathogen called Mycoplasma ovipneumoniae (Movi) could increase lamb survival.



SOUTH DAKOTA STATE UNIVERSITY GRADUATE STUDENT TYLER GARWOOD *(LEFT)* **AND SPENCER CARSTENS, A RESEARCH TECHNICIAN FOR GFP, AFFIX A COLLAR TO A YOUNG RAM FROM CUSTER STATE PARK IN 2017.**

(FAR RIGHT) **GFP TECHNICIAN COREY LEE, MONITORS ANIMAL TEMPERATURE.**

PHOTO © BRADY NEILES

The study was done in collaboration with wildlife biologist Frances Cassirer of the Idaho Department of Fish and Game, pathologist Tom Besser of Washington State University and quantitative ecologist Daniel Walsh of the U.S. Geological Survey National Wildlife Health Center in Wisconsin. It was funded by 11 state and federal agencies and wildlife groups.

PNEUMONIA IS THE NUMBER ONE DISEASE THREATENING BIGHORN SHEEP ACROSS THE WESTERN UNITED STATES AND CANADA, ACCORDING TO JOHN KANTA, WILDLIFE REGIONAL SUPERVISOR FOR THE SOUTH DAKOTA GAME, FISH AND PARKS DEPARTMENT.

Kanta has been working with Jenks to understand the disease mechanisms and develop management strategies to minimize its impact since 2010.

Typically, only a few animals in a herd are shedding the Movi pathogen, Jenks explained. Those individuals that test positive for the pathogen three times at six-month intervals are shedders. When pregnant ewes were segregated from the shedders at the SDSU Department of Natural Resource Management research facility, Jenks and doctoral student Brandi Felts saw a drastic improvement in lamb survival. The information from the captive work was used to transition to the field.

FIELD-TESTING SHEDDER REMOVAL THEORY

In 2014, Lehman and his interns began disease-testing the 25 remaining bighorn sheep at Custer State Park. "We darted and radio-collared them and did swab and nasal washes," he explained. They identified two animals as shedders.

Lehman and Jenks, along with other team members, obtained a three-year grant from the Pittman Robertson Fund to field test the Typhoid Mary hypothesis, with the Custer State Park herd as the treatment population and the Rapid City herd, which SDSU doctoral student Joshua Smith documented as being positive for Movi, as the control. The study began in 2016.

SDSU graduate student Tyler Garwood, who graduated in May, works with Jenks, Lehman and other team members. "We had good disease histories in Custer and good information on the Rapid City herd from the Game, Fish and Parks people there," explained Garwood, who was the SDSU Department of Natural Resource Management 2018 Master's Student of the Year.

Lehman said, "We did exactly the same work with both herds, but removed the shedders in Custer." All animals were tested and vaginal implants placed in the ewes, so the researchers could collar lambs within six to 48 hours after they were born to monitor lamb survival in both herds.

INCREASING LAMB SURVIVAL

"WHAT WE FOUND WAS PRETTY STRIKING - NOT A SINGLE RESPIRATORY DISEASE DEATH IN CUSTER," GARWOOD SAID.

In the first year, nine of 10 lambs survived; the second year, only four out of 10 survived because a mountain lion developed a taste for lamb, but there was no respiratory disease.

To add to the evidence, researchers were continuously disease-testing the ewes and rams they captured. They never confirmed another positive Movi test or any pneumonia among the adults in Custer herd.

In the Rapid City herd, Garwood reported, "The first year, three lambs survived out of the 18 we collared; the second year, we got nine lambs and none survived. The most common source of death was respiratory disease."

Lehman added, "This is the first time we have been able to demonstrate this [removing shedders] because we have a unique situation in South Dakota where we have access to all our sheep."
Though this approach can be applied to other herds, Jenks cautioned that the pathogen strain and herd characteristics are important factors to consider. "This approach works with smaller populations in which you can get full coverage so you don't miss a chronic shedder," he said.

This research project made it possible to bring in new animals without having to depopulate the Custer State Park herd to eliminate the disease and will also help officials manage the recovery of other bighorn herds. In February, after SDSU graduate student Austin Wieseler and other team members confirmed that the Badlands bighorn sheep herd was disease-free, 12 ewes from that herd were brought in to augment the now disease-free Custer herd.

In a March 23 note to Badlands National Park Superintendent Mike Pflaum, Gov. Dennis Daugaard wrote, "Thank you very much for doing this! We are very grateful for the chance to bolster our bighorn population."

Jenks and Lehman have recieved funding for a new project to continue this work in Rapid City. "This is cutting edge stuff that is leading research in the west. It's a really nice collaboration," Lehman added.

NATIONAL PARK SERVICE MONITORS HEALTH OF BADLANDS BIGHORN SHEEP

The Badlands bighorn sheep herd is healthy and thriving—and National Park Service Wildlife Biologist Eddie Childers wants to keep it that way.

"It's one of the largest populations in the state of South Dakota now and the healthiest," said Childers, who has been managing the Badlands bighorn sheep herd in the north unit since 1999. Through a three-year National Park Service-funded study, Childers is working with South Dakota State University Department of Natural Resource Management Distinguished Professor Jonathan Jenks and graduate student Austin Wieseler to examine survival and mortality in the Badlands herd.

"We are looking at a broad spectrum of diseases that can potentially hurt these populations," Childers explained. The research, which began in February 2017, involves monitoring adult and yearling sheep, as well as lambs.

BRINGING BIGHORNS BACK

The last Badlands bighorn sheep, an Audubon subspecies, was shot in the 1920s. In 1964, 22 Rocky Mountain bighorn sheep from Pike's Peak, Colorado, were reintroduced to the Badlands through the efforts of the National Park Service, S.D. Game, Fish and Parks Department and the Colorado Division of Wildlife, according to a U.S. Department of Interior/U.S. Geological Survey report. Those sheep were to be raised as a captive herd, but when the animals started dying, "they just opened the gate and let them roam," Childers explained.

In the 1990s, Francis Singer of the U.S. Geological Survey was one of two scientists to assess bighorn populations in and near 15 national parks. Singer collared animals from the Badlands herd, with the herd in the north unit numbering close to 150 animals, Childers recalled. With the data, he developed a model to predict population size.

Then in the late 1990s, the herd numbers crashed due to an outbreak of Pasteurella, a bacterial disease, Childers explained. In 2004, Teresa Zimmerman, then a SDSU doctoral student working under Jenks' supervision, looked at herd genetics and disease baseline after 23 animals from Wheeler Peak, New Mexico, were translocated to the Badlands.

"We know so much about them as far as genetics and disease resistance," Childers said, pointing out that population ecologists emphasize the need to have 1,000 ungulates to maintain healthy genetics. Managing these small herds means bringing in animals from other herds to maintain genetic diversity.

"Since then the population has grown—last year we had 180-plus animals in the north unit," Childers said.

DISEASE-TESTING, MONITORING MOVEMENT

Although the herd has previously been exposed to pneumonia-causing pathogens, none are shedders of Mycoplasma ovipneumoniae (Movi), the primary pathogen of pneumonia in bighorn sheep, according to Wieseler. "It's a healthy and growing population."

Last summer Wieseler collared 23 lambs and recorded a 74

These 12-week-old lambs are near the Pinnacles Overlook in Badlands National Park.

PHOTO © AUSTIN WIESELER

percent survival rate through six months of age.

WHEN A COLLARED LAMB DIES, THE RESEARCHERS QUICKLY DETERMINE THE CAUSE, WHETHER IT'S PREDATION, ABANDONMENT OR SIMPLY FALLING INTO A CREVICE.

"The goal is to get them to a year old," Wieseler said. By the end of May this year, Wieseler had collared 30 lambs.

In addition, the National Park Service monitors wild sheep, particularly young rams, that stray into neighboring domestic flocks. Due to the disease risk, these animals cannot be allowed back into the Badlands herd, according to Childers.

As part of Wieseler's project, the researchers hope to work with private landowners whose sheep and goats graze within eight miles of the park to help reduce the risk from pneumonia-causing pathogens. Meanwhile, researchers are working on potential treatments, including a vaccine for Movi, the primary pneumonia-causing pathogen.

Through this and other research projects, wildlife managers will have the tools to restore and maintain the health of bighorn sheep in the state and, perhaps, the region. •