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Assessment of Tribal Bison Worker Hazards Using Trusted Research Facilitators

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ABSTRACT

Objectives: Agriculture is one of the most hazardous industries in the United States. Within agriculture, livestock handling is particularly dangerous. While injury and fatality rates for bison handlers have not been reported, workers in many of the newly established tribal bison herds have limited safety training and animal handling experience, making this a vulnerable workforce. Veterinarians and herd managers, working with tribal bison herds, recognized the need for improvement in the working environment and for worker safety training. In response, partnerships were established and a pilot project was developed in order to characterize risks and hazards associated with bison handling under contemporary reservation field conditions. Individuals and organizations working as change agents included veterinarians at the University of Nebraska – Lincoln School of Veterinary Medicine, a tribal advocacy organization, the Intertribal Buffalo Council and researchers at the Central States Center for Agricultural Safety and Health at the University of Nebraska Medical Center. Methods: This is a mixed-methods study and data were gathered through closed and open-ended questions pertaining to bison worker safety hazards. A veterinarian gathered data through observational safety audits at bison herding locations. American Indian bison herd managers completed surveys using a convenience sampling method. Results: Findings indicate that the most common worker safety risks are associated with the use of high-stress handling methods and substandard facilities and equipment. Adverse environmental conditions also contribute to worker health risks. Most common causes of injuries included those caused by equipment and tools, adverse weather, and direct contact with animals. Conclusion: This collaborative research study contributes to a better understanding of hazards faced by tribal bison workers. Findings from this research influenced the ITBC in their decision to add worker safety and health training to the agenda of their yearly conference and promote tailgate trainings for their workers. UNL veterinarians have taken the lessons learned from this research and provided safety and health information to mangers of other non-tribal bison herds. This research partnership will continue with a 5-year research study focusing on best management practices and establishing training to improve the health and safety bison workers.

KEYWORDS

Bison worker; hazards; Native American; research facilitators; risks

Introduction

Agriculture is one of the most hazardous industries in the United States with a reported fatality rate of 22.2 deaths per 100,000 workers in 2013 and approximately 150 hired agricultural workers suffering from a lost-work-time injury daily.[1–3] Within agriculture, livestock-handling is particularly dangerous. Indeed, several studies indicate that having livestock doubles the risk of injuries compared to those who have no livestock. Livestock-handling injuries are also among the most severe of all agricultural injuries.[4,5]

Bison, while similar in some ways to cattle, are not traditionally included in the term livestock. They have not been bred for docility like other livestock and are known to attack humans if provoked. Injury and fatality rates for bison handlers have not been documented. Bison are the largest native land mammal in North America, with males weighing up to 2,000 pounds.[6] Despite their large size, bison can run up to 35 miles per hour and pivot quickly.[6] Bison are the most dangerous animal in Yellowstone National Park.[7,8]

Bison, raised primarily in free-range environments, are generally only exposed to humans during bison roundups. A bison roundup entails herding bison into a holding facility for health

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Figure 1. Bison being corralled using all-terrain vehicles, horses, and helicopters.

inspection, vaccination, and culling (Figure 1). Herding is typically done using all-terrain vehicles (ATVs), utility vehicles (UTVs), horses, and other vehicles including helicopters. Once the bison are corralled, workers usually enter the pens to encourage the animals to move forward into a chute.

The demand for bison meat has increased in the United States, which has led to an increase in the number of employees in the field of bison production.[9] As bison production expands, more workers will be exposed to bison in close quarters. Workers in many of these newly established bison herds have not received formal training and may have limited animal handling experience, making this workforce vulnerable to injury and fatalities.

There are approximately 420,000 head of bison in the United States and Canada.[10] Bison reached near extinction in the late 19th century, but were reintroduced to tribal lands in the 1990s by the Intertribal Buffalo Council (ITBC).[11,12] ITBC has a membership of 58 tribes in 19 states with a collective herd of over 15,000 bison. ITBC represents most of the tribal bison herds in the United States. ITBC reestablishes bison herds on Indian lands in ways that promote cultural enhancement, spiritual revitalization, ecological restoration, and economic development.[12] ITBC acts as a facilitator in coordinating education and training programs, developing marketing strategies, coordinating the transfer of surplus buffalo from national parks to tribal lands, and providing technical assistance to its membership.[12] The organization is governed by a Board of Directors and is a federally chartered Indian Organization under Section 17 of the Indian Reorganization Act.[12]

After working for many years to improve the health of bison herds managed by Native American tribes, veterinarians and herd managers increasingly recognized the need for improvements in the working environment and for safety training for those working with bison. Minimal data exist on the occupational safety and health risks for those working with these animals. Research conducted in this field has been focused on low-stress bison handling, with the goal of animal safety rather than worker safety.[13,14]

In 2012 there were 58,475 American Indian farmers in the United States operating 5.6% of the farmland. Two-thirds of these farmers specializing in livestock production.[15] Although agriculture is historically and currently important to American Indians, there is a lack of research and resources focused on this population. There are known health disparities related to agricultural accidents and injuries among American Indians, a population that already experiences stark health disparities.[16,17] Untrained workers, handling large, powerful bison in facilities that may be inadequate, are all factors that contribute to increased risk of injury and illness.

A collaborative pilot research project was developed between the Central States Center for Agricultural Safety and Health (CS-CASH) at the University of Nebraska Medical Center (UNMC), the University of Nebraska – Lincoln (UNL) School

of Veterinary Medicine, and the ITBC. The aim of this project was to assess the hazards associated with bison handling in the American Indian population.

UNL veterinarians and members of ITBC served as change agents from the onset of the pilot project, providing the CS-CASH research team with a vision of the wide range of safety and health problems, knowledge of the issues, and with appropriate questions to ask to determine the wide range of hazards. These partners have long-term, trusted relationships with bison herd managers and workers, the subjects of this research. In creating the survey instrument, UNL veterinarians lent an understanding of animal handling practices and facilities and first-hand knowledge of past incidents involving bison workers. ITBC served as a trusted partner providing a cultural framework, a clear understanding of the issues, and the motivation and desire to improve worker safety practices. CS-CASH researchers and outreach professionals brought expertise in livestock worker safety practices and research techniques to this collaborative effort. Results from this pilot research will be used to develop best practice guidelines and safety and health interventions that will address the occupational safety and health needs of tribal bison handlers.

Methods

Human Subjects Research approval was obtained from the UNMC Institutional Review Board. This mixed-methods (quantitative and qualitative) project utilized primary data, which were collected using direct observational audits of tribal bison workers and convenience surveys of herd managers. The two surveys were designed to gather similar information on bison worker safety and health practices, hazards, and injuries from two different populations. Data were analyzed to identify hazards and provide information on the occupational safety and health needs of American Indian bison handlers. This research project did not directly gather data from tribal bison handlers due to the transient nature of this population. These workers are generally members of the tribe that own the bison herd. The bison are processed just a few times a year. While the herd managers generally have livestock handling expertise, tribal workers may have little to no livestock experience when they are hired to assist with the roundup. The worker population is not consistent from year to year.

Data collection

This project was a university, institution, and community partnership between UNL, ITBC, CS-CASH, and the tribal herd worker community. UNL's School of Veterinary Medicine has an established trusted working relationship with tribal herd managers, expertise in animal handling practices, and knowledge of the issues. UNL veterinarians, who have worked to improve the health of tribal herds for 6 years, recorded observational surveys during tribal roundups and provided a trusted and knowledgeable agent for this method of data collection. CS-CASH researchers and outreach professionals provided expertise in health promotion, conducting research with American Indian communities, livestock worker safety, and mixed-methods research expertise. Members of ITBC are an influential tribal advocacy organization, served as a trusted partner providing cultural framework and "front-line" understanding of the issues, and provided access to tribal herd managers and on-site bison roundups.

Observational safety survey

The observational safety survey instrument (Appendix A, see supplemental data) was created by experts in the fields of health promotion, veterinary medicine, and agricultural and occupational safety and health. This survey was observational and was completed on-site by a UNL veterinarian with expertise in bison handling and health. Survey questions addressed working conditions, environment and facilities, worker attire, bison handling techniques, animal behavior, injuries, and safe use of animal medication. This survey used close-ended questions inquiring about the occurrence of specific behaviors or outcomes with three answer options (Yes, No, and Not Applicable) and two open-ended questions ("If safety hazards were present, please list them here" and "If worker injuries were observed, please list how many and their causes"). The observational surveys were conducted over 17 days at 10 working locations during bison roundups at Sitting Bull College Bison Herd (Mobridge, South Dakota), Standing Rock Sioux Tribe West Pasture (Fort Yates, North Dakota),

Standing Rock Sioux Tribe North Pasture (Fort Yates, North Dakota), and Pine Ridge Reservation (South Dakota) during 2014 and 2015.

Herd manager: Perceptions of hazards survey

This survey (Appendix B, see supplemental data) was distributed to American Indian free-range bison herd managers attending the ITBC conference in Las Vegas, Nevada, in 2014. The aim of this survey was to assess the safety hazards observed by bison herd managers during roundups. Managers were asked to recall the environment and facilities, worker attire, bison handling techniques, animal behavior, injuries, and safe use of medications at their roundup sites. This survey utilized close-ended questions inquiring about the occurrence of specific behaviors or outcomes with three answer options (Yes, No, and Not Applicable) and two open-ended questions ("What do you consider to be the greatest safety hazards to bison workers?" and "If you have observed worker injuries, please list the type and cause of the injury"). Additionally, participants were encouraged to write in any other comments on the survey. The survey contained no personal identifiers.

Data analysis

Quantitative data were analyzed using IBM SPSS Statistics software. The qualitative data from open-ended questions were analyzed using a two-step process. A First Cycle Descriptive Coding Method was conducted to analyze each open-ended question.[18] This first cycle decoded the data by specifying keywords and phrases that were common across the responses. After codes were categorized in the first cycle, they were compared to each other. Next a Second Cycle Pattern Coding Method was used to further the divide the categories into subcategories, or consolidate if necessary.[18]

Results

Quantitative data

Observational safety survey

The observational audit survey was completed by a veterinarian at 10 different locations over a total of 17-days during bison roundups between 2014 and 2015. Bison roundups and processing took between 1–2 days to complete, depending on the number of bison in the herd. Table 1 demonstrates safety and health risks observed during the bison roundups.

Herd manager: Perceptions of hazards survey

This survey was distributed to tribal bison herd managers attending the 2014 ITBC Conference. There were 33 respondents to this survey with a response rate of 37.5%. Tribal bison herd manager's perceptions of hazards are shown in Table 2.

Qualitative analysis

The following are results of the qualitative data from the open-ended questions "If safety hazards were present, please list them here" and "What do you consider to be the greatest safety hazards to bison workers?" from the Observational Safety Audit Survey and the Herd Manager – Perceptions of Hazards Survey, respectively. The first cycle of descriptive coding of the raw data developed the following 14 labels: obsolete equipment, poor facility design, broken equipment, inadequate equipment, use of high-stress handling techniques, stressed animals, adverse weather, excessive dust, handler behaviors, dangerous use of ATVs and/or other vehicles, direct injuries to workers, alleyways, footwork on the ground, and bison escaping. These labels represent various safety risks to bison handlers. The second-level pattern coding phase of the qualitative data analysis summarized or consolidated the initially discovered codes. During this level of coding, the data from the first-level coding were recorded by grouping the 14 labels into 7 categories or themes. Table 3 lists the seven categories derived in the second-level coding and their respective first-level coding labels.

The following are the results from the qualitative data from the open-ended questions "If injuries occurred, please list them here" and "If you have observed worker injuries, please list the type and cause of the injury" from the Observational Safety Audit Survey and the Herd Manager – Perceptions of Hazards Survey, respectively. The first cycle descriptive coding of the raw data developed the following 16 labels: head injury from contact with equipment, cut in hand from knife, gate fell on worker's foot, frost bite, hypothermia, kicked by bison, pinched fingers, lacerations from

Table 1. Summary of responses from the observational safety survey (10 sites) N/A = not applicable.

	Percentage response		
Evaluation statement	Yes	No	N/A
Environment and facilities			
Dust was present during processing.	60.0	40.0	0.0
The corral system needs modification.	70.0	30.0	0.0
The corral system needs repair.	70.0	30.0	0.0
The animals exited the chute with no chance of worker contact.	50.0	50.0	0.0
Trip slip and fall hazards were present.	60.0	40.0	0.0
Light was diffused so that minimal shadows were present.	30.0	70.0	0.0
Moving or flapping objects were present.	40.0	60.0	0.0
The working chute was the appropriate width.	100.0	0.0	0.0
Worker attire and safety equipment			
Safety glasses were worn.	0.0	100.0	0.0
Gloves were worn.	70.0	30.0	0.0
Long pants were worn.	100.0	0.0	0.0
Work boots with appropriate soles were worn.	90.0	10.0	0.0
Respirators were worn.	10.0	90.0	0.0
No loose, baggy clothing or hanging jewelry was present.	100.0	0.0	0.0
Long hair was pulled back.	100.0	0.0	0.0
Telephone or communication device was available[a].	100.0	0.0	0.0
Fire extinguisher was present[a].	0.0	100.0	0.0
Bison handling			
Bison were gathered at a slow pace.	30.0	70.0	0.0
Personnel moved slowly without making excessive noise.	40.0	60.0	0.0
Excessive poking, beating on, or multiple electric prod use on animals occurred.	40.0	60.0	0.0
Workers always had an escape route.	100.0	0.0	0.0
Young bison kept close to mothers.	100.0	0.0	0.0
Appropriate number of workers present.	100.0	0.0	0.0
Workers maintained safe distance from animal's head.	100.0	0.0	0.0
Panting observed in animals.	70.0	30.0	0.0
Injuries			
Bison injuries occurred.	90.0	10.0	0.0
Worker injuries occurred.	30.0	70.0	0.0
Safe use of medications			
Syringes and needles disposed of properly[b].	100.0	0.0	0.0
Needle sticks did not occur.	100.0	0.0	0.0

[a]Questions were not included in the original survey, responses represent 7 observation sites.
[b]The observer skipped this question on one survey, responses represent 9 observation sites.

horn caps, arm hurt in chute, slipping and falling, ATV accident, injuries caused by horses, feet stepped on by bison, fingers squeezed in chutes, fingers slammed in gates, and twisted ankles. During the second level of pattern coding, the data from the first-level coding were recorded by grouping the 16 labels into 7 categories, or themes. Table 4 lists the seven categories derived in the second-level coding and their respective first-level coding labels.

Discussion

Findings from the mixed-methods survey research demonstrate a wide range of safety and health hazards present during tribal bison roundups and handling. This collaborative research used partners who are trusted in the tribal community to inform and facilitate the collection of data, and these partners will put the lessons learned into safety practice.

Environment and facilities

Results indicate that dust was present during handling at over 50% of the facilities. Additionally, very few workers used respiratory protection. Agricultural and specifically livestock dust exposures are known to contribute to the development of chronic obstructive pulmonary disease (COPD).[18–20] Age-adjusted rates for death caused by COPD indicated that American Indians died second most often from this disease, falling just behind the rates for non-Hispanic whites.[21] This project identified dust exposure as a health risk to bison workers.

Results show problems with the integrity of the corral structures including obsolete equipment,

Table 2. Summary of responses from herd managers – perceptions of hazards survey (N = 33) N/A = not applicable.

	Percentage response		
Evaluation statement	Yes	No	N/A
Environment and facilities			
Dust is present in the air during processing.	69.7	27.3	3.0
The corral system needs modifications.	81.8	18.2	0.0
The corral system needs repair.	63.6	33.3	3.0
Trip, slip, and fall hazards are present.	66.7	30.3	3.0
Animals can exit the chute with no chance of worker contact.	69.7	21.2	9.1
Light is diffused so that minimal shadows are present.	45.5	36.4	18.2
Moving or flapping objects are present.	24.2	69.7	6.1
Working chute is the appropriate width.	90.9	6.1	3.0
Worker Attire and Safety Equipment			
Gloves are worn.	78.8	18.2	3.0
Long pants are worn.	87.9	9.1	3.0
Work boots with appropriate soles are worn.	69.7	27.3	3.0
Dust masks are worn.	15.2	75.8	9.1
No loose, baggy clothing, or hanging jewelry is present.	39.4	51.5	9.1
Long hair is pulled back.	72.7	15.2	12.1
Telephone or communication devices are available.	93.9	0.0	6.1
Fire extinguishers are present.	39.4	48.5	12.1
Bison Handling			
Bison are gathered at a slow pace.	69.7	18.2	12.1
Personnel move slowly without making excessive noise.	72.7	21.2	6.1
Excessive, poking, beating on, or multiple electric prod use occurs.	4.2	63.6	12.1
Workers always have an escape route.	57.6	33.3	9.1
Young bison are kept close to their mothers.	54.5	24.2	21.2
The appropriate number of workers is present.	69.7	24.2	6.1
Workers maintain a safe distance from animal's head when in head catch.	81.8	3.0	15.2
Panting is commonly observed in corralled animals.	48.5	36.4	15.2
Injuries			
Bison injuries have occurred.	66.7	21.2	15.2
Worker injuries have occurred.	30.3	54.5	15.2
Safe Use of Medications			
Syringes and needles are disposed of properly every time.	54.5	12.1	33.3
Needle sticks have occurred.	6.1	48.5	45.5

Table 3. Safety risks to bison handlers, qualitative analysis secondary coding.

Inadequate facilities	High-stress bison handling	Adverse working conditions	Handler behavior	Direct injuries to workers	Alleyways	Footwork on the ground
Obsolete equipment	Use of high-stress handling techniques	Adverse weather	Handler behavior	Injuries caused by workers	Alleyways	Footwork on the ground
Poor facility design	Stressed animals	Excessive dust	Dangerous use of ATVs and/or other vehicles	Injuries caused by bison		
Broken equipment						
Inadequate equipment						

Note. Data analyzed are from the open-ended questions "If safety hazards were present, please list them here" (N = 17) and "What do you consider to be the greatest safety hazards to bison workers?" (N = 33) from the Daily Bison Handling Worker Survey and the Causes of Bison Worker Safety Hazards, respectively.

Table 4. Most common injuries incurred by bison handlers, qualitative analysis secondary coding.

Injury caused by equipment	Injury caused by tools	Injury caused by weather	Injury caused by animals	Injury caused by ATV	Injury caused by horses	Injury caused by footwork
Head injury from contact with equipment	Cut in hand from knife	Frost bite	Kicked	Injury caused by ATV	Injury caused by horses	Twisted ankles
Gate falling on worker	Pinched fingers	Hypothermia	Stepped on			
Arm injured in chute		Slipping and falling on ice	Lacerations from horn caps			
Fingers squeezed in chute						
Fingers slammed in gates						

poor facility design, and broken equipment. Observations by the veterinarian indicate that 50% of the facilities had inadequate barriers in place to ensure that bison cannot make contact with the workers after exiting the chute. Although specific details of the deficiencies were not indicated in this study, it can be inferred that the corral structures and lack of barriers can be identified as a safety hazards.

Slip, trip, and fall hazards were recognized in over half the survey data. This is not surprising, as roundups take place in the late fall and winter months, exposing workers to rain, snow, ice, humidity, and slippery and uneven surfaces. These findings were in keeping with previous studies. For example, research looking at workers' compensation claims data for non-fatal injuries among agriculture and agri-business workers in Colorado found that falls or slips were among the most frequent causes of injury.[22] This study clearly recognized slips, trips, and fall hazards as a risk to bison handlers.

Problems were also identified with the diffusion of light and with flapping objects, causing the animals to balk or startle as they move through the chute. These disruptions may require workers to move into closer proximity with animals in order to herd them through the handling facility, thereby increasing the possibility of contact with the animal and injury to the worker.

Worker attire and safety equipment

Although tribal bison workers wear gloves and long pants, 27% of the managers indicated that their workers did not wear appropriate footwear, possibly resulting in an increase in slips, trips, and falls. Deficiencies were noted with the use of personal protective equipment (PPE) including dust masks, as previously discussed, and safety goggles. The need for safety goggles while working bison may not be clear, but goggles are an important component of an ATV rider's safety equipment. Herd managers noted ATVs, commonly used to round up bison, as the cause of worker injury. Tribal bison handlers are not unique in their low rate of PPE use; in general, use of PPE by many agricultural workers is low.[23,24] Herd managers indicated that loose clothing and jewelry are worn by workers, resulting in possible entanglement, choking, or dismemberment and is, therefore, noted as a risk. The study also noted that fire extinguishers are not present at many sites. It is likely that uncontrolled fires at roundups may emanate from cigarettes, vehicle exhaust systems, or sparks from wood being burned for warmth, presenting a worker safety risk.

Bison handling

High-stress handling is a human-centered method of working with livestock that entails using techniques that cause stress in the animals including loud noises, hitting animals excessively, using stressful facilities (e.g., walls without solid sides), and other stressful techniques.[14,25] Research indicates that human injury risks are higher when cattle were moved by high-stress methods.[26] The observing veterinarian indicated that high-stress handling (gathering at a fast pace, excessive noise, and prodding animals) was occurring at a higher rate than was indicated by the herd managers. A veterinarian noted that "ATVs were used on the hillside to chase bison at high speeds." This discrepancy in findings may result from a difference in perception, gaps in knowledge regarding proper use of low-stress techniques, or reluctance by managers to indicate that these methods were being used. Both managers and the observing veterinarian recorded that panting was observed in corralled bison, an indicator that the animals have been moved at a fast pace and may be experiencing stress.[25] This observation is in-line with observations of high-stress handling by the veterinarian and validates that high-stress handling methods are being employed.

Bison and worker injury

Bison injuries were recorded by the observing veterinarian at 9 out of 10 sites, and 67% of managers indicated that bison injuries had occurred during roundups at their sites. This may be reflective of high-stress bison handling, as discussed previously, and could result in worker injury.[26]

The observing veterinarian recorded injuries to workers occurring at 3 of the 10 sites, and 30% of the managers indicated that worker injuries had occurred at their handling facilities. The most common injuries to workers were caused by equipment, tools, weather (frost bite, hypothermia, and slipping and falling on ice), contact with bison, ATV use, horses, and footwork. One manager noted that there had been "several

high speed ATV wrecks at the facility, in each case workers were going too fast and not paying attention." Another reported that "a worker was kicked in the chest by a bison calf." There is no other research available that could be used to compare the types of injuries. However, there is data on injuries incurred when working with large livestock, such as cattle.[5,27,28] Injuries from cattle are primarily caused by cattle themselves, such as cattle making contact with workers or cattle pushing structures into workers.[4,27] Also, there are interventions targeting safety during livestock handling, but none of these interventions focus directly on bison handling.[29–34] Our research indicates that many of the bison worker injuries are likely due to hazards inherent in the tribal bison roundup. These bison are free-range and must be herded long distances, using ATVs and horses, into holding corrals, and subsequently moved into chutes and head gates. Unlike most cattle herds, tribal bison herds usually have little to no contact with humans most of the year and docility has not been bred or selected for in these animals. Adverse weather conditions in the fall and winter seasons may lead to injury. Due to the unique nature of bison and tribal bison roundups, existing research related to cattle handling hazards is not entirely applicable.

Safe use of medications

The veterinarian did not witness any needle sticks over 17 days of observations but two herd managers indicated that needle sticks had occurred during handling at their facilities. Research found that performing medical tasks is a risk factor in cattle handling.[4] Because of the danger posed to human health by veterinary pharmaceuticals[35] and the possible transmission of zoonotic diseases, needle sticks should be indicated as a health hazard for bison handlers. There are 15 cattle diseases with zoonotic potential in the United States, including anthrax, brucellosis, cryptosporidiosis, dermatophilosis, *Escherichia coli*, giardiasis, leptospirosis, listeriosis, pseudocowpox, Q fever, rabies, ringworm, salmonellosis, tuberculosis, and vesicular stomatitis.[36]

Agents of change

The collaborative institutional partnership of UNL veterinarians, ITBC, and CS-CASH worked effectively to collect tribal herd worker data. These data validated anecdotal observations by UNL veterinarians and tribal herd managers regarding unsafe worker practices and workplace hazards. UNL veterinarians continue to travel to round-ups monitoring tribal herd health. Knowledge gained from this research will allow them to suggest work-site safety improvements to tribal herd managers and to protect themselves.

This research raised awareness of safety and health concerns in ITBC herd managers and administration. ITBC has begun to include safety training in the agenda of their annual conference. Materials to conduct tailgate trainings, 10-minute on-site safety sessions produced by CS-CASH, have been disseminated to all the ITBC member tribes. Herd managers have been encouraged by the ITBC to use these materials.

Tribal communities are oftentimes inaccessible to researchers, making these trusted institutional partners crucial for completion of this project. Importantly, UNL veterinarians and ITBC will continue to be the impetus for behavioral change in the herd workers after the researchers are no longer involved.

CS-CASH has contacted other influential gatekeepers including private veterinarians and managers of nontribal bison herd workers to enlist their assistance in promoting safe and health practices in bison workers.

Strengths and limitations

A strength of this study was the strong university–community partnership between the three different entities. Collaboration with trusted tribal partners, the UNL School of Veterinary Medicine, and ITBC provided CS-CASH researchers an opportunity to collect hazard data. Trust between American Indian community members and researchers is critical to the success of research conducted with these communities.[37,38] Many American Indian communities have been analyzed, stereotyped, and exploited by outside groups, resulting in uneasiness with nontribal members. American Indian populations may be suspicious of unfamiliar individuals who come to their community and want to conduct research.[39] Data collection would have been difficult, if not impossible, without these partnerships. ITBC invited

researchers to attend their annual conference to survey herd managers, providing a convenient location to reach these individuals. All of the partners are committed to continuing to research potential hazards, determine best practices, and ultimately implement safety and health applications for tribal bison workers.

There were limitations in this study. First, data were gathered from bison herd managers and not directly from the bison handlers. As previously described, the transient nature and accessibility to American Indian bison herders made it very difficult to directly sample these primary stakeholders. Therefore, we cannot conclude that observations by the veterinarian and perceptions of the herd managers represent a complete picture of the hazards faced by these workers.

Second, the herd manager surveys were retrospective and relied on their ability to remember details regarding the working environment and behaviors of bison herd workers, leading to possible recall bias. Third, the number of observational (10 tribal herd sites) and herd manager surveys (n = 33) was admittedly small in this pilot project. Lastly, surveying took place in a limited geographic location (North Dakota and South Dakota) preventing generalization of the findings. A full-scale project is underway at the time of this writing. This project will continue to survey for work hazards affecting tribal herd workers as well as non-tribal bison handlers in a wider geographic region.

Conclusion

Hazards faced by tribal bison workers have not been previously researched. The findings of this collaborative research are novel and provide data on exposure hazards, causes of bison handler injuries, and types of injuries incurred by tribal bison workers in North and South Dakota. This information will assist bison producers, both tribal and nontribal, in formulating and implementing best management practices to improve the health and safety of workers when handling bison. Trusted institutional partners, UNL veterinarians, and ITBC continue to use the knowledge gained from this research to improve health and safety in the tribal herd worker community. This project is an example of how institutions can collaborate to promote enduring change in a community of workers.

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References

1. Agricultural safety. National Institute of Occupational Safety and Health (NIOSH). http://www.cdc.gov/niosh/topics/aginjury/. Accessed February 16, 2015.
2. Rautiainen RH, Reynolds SJ. Mortality and morbidity in agriculture in the United States. *J Agric Saf Health*. 2002;8(3):259–276. doi:10.13031/2013.9054.
3. Injuries Illnesses, and Fatalities. Census of fatal occupational injuries (CFOI) – Current and revised data. U. S. DOL department of labor, bureau of labor statistics website. http://www.bls.gov/iif/oshcfoi1.htm. Accessed April 10, 2016.
4. Browning SR, Westneat SC, Sanderson WT, Reed DB. Cattle-related injuries and farm management practices on Kentucky beef cattle farms. *J Agric Saf Health*. 2013;19(1):37–49. doi:10.13031/2013.42541.
5. Sprince NL, Hyesock P, Zwerling C, et al. Risk factors for animal-related injury among Iowa large-livestock farmers: a case-control study nested in the Agricultural Health Study. *J Rural Health*. 2003;19(2):165–175. doi:10.1111/j.1748-0361.2003.tb00558.x.
6. Wildlife-human conflicts in Yellowstone, when animals and people get too close. Greater Yellowstone science website. http://www.greateryellowstonescience.org/files/pdf/YS_Olliff.pdf. Accessed January 28, 2016.
7. Notes from the field: injuries associated with bison encounters – Yellowstone National Park. 2015. Morbidity and mortality weekly report website. http://dx.doi.org/10.15585/mmwr.mm6511a5. Accessed March 20, 2016.
8. Carter D, Kremeniuk T. Today's bison business. In: *The Bison Producers' Handbook: a Complete Guide to Production and Marketing*. Colorado, USA: National Bison Association & Canadian Bison Association, ASM Books; 2010:15–20.

9. Bison Profile. Agricultural marketing and research center website. http://www.agmrc.org/commodities__products/livestock/bison-profile/. Accessed April 13, 2015.
10. Pickering B. The history of bison. In: National Bison Association & Canadian Bison Association. *The Bison Producers' Handbook: a Complete Guide to Production and Marketing*. Colorado, USA: Press; 2010:1–13.
11. Who we are. Intertribal Buffalo Council. Intertribal Bison Cooperative (ITBC) website. http://itbcbuffalo.com/node/3. Accessed February 11 2016.
12. National Park Service. U.S. Department of the Interior. Frequently Asked Questions: Bison. http://www.nps.gov/yell/naturescience/bisonfaq.htm. Accessed January 28, 2016.
13. The calming of the American bison during routine handling. Dr. Temple Grandin's website. http://www.grandin.com/references/bison.paper.html. Accessed April 13, 2016.
14. Stockmanship Journal Glossary. Stockmanship Journal website. http://stockmanshipjournal.com/glossary/. Accessed April 13, 2016.
15. Census of agriculture highlights. 2012 https://www.agcensus.usda.gov/Publications/2012/Online_Resources/Highlights/American_Indian_Farmers/Highlights_American_Indian_Farmers.pdf. Accessed April 30 2017.
16. Jones DS. The persistence of American Indian health disparities. *Am J Public Health*. 2006;96(12):2122–2134. doi:10.2105/AJPH.2004.054262.
17. Disparities. Indian Health Service (IHS). http://www.ihs.gov/newsroom/factsheets/disparities/. Accessed February 18, 2016.
18. Saldana J. *The Coding Manual for Qualitative Researchers*. London, England: SAGE Publications; 2009.
19. Bailey KL, Meza JL, Smith LM, Von Essen SG, DeSpiegelaere H, Romberger DJ. Agricultural exposures in patients with COPD in Health Systems serving rural areas. *Chest*. 2005;128(4_MeetingAbstracts):215S. doi:10.1378/chest.128.4_MeetingAbstracts.215S-b.
20. Szcyrek M, Krawczyk P, Milanowski J, Jastrzebska I, Zwolak A, Daniluk J. Chronic obstructive pulmonary disease in farmers and agricultural workers: an overview. *Annals Ag Env Med*. 2011;18(2):310–313.
21. Ford ES, Croft JB, Mannino DM, Wheaton AG, Zhang X, Giles WH. COPH surveillance—United States, 1999–2011. *Chest*. 2013;144(1):284–305. doi:10.1378/chest.13-0809.
22. Douphrate D, Rosecrance J, Wahl G. Workers' compensation experience of Colorado agriculture workers, 2000–2004. *Am J Ind Med*. 2006;49(11):900–910. doi:10.1002/(ISSN)1097-0274.
23. Schenker MB, Orenstein MR, Samuels SR. Use of protective equipment among California farmers. *Am J Ind Med*. 2002;42:455–464. doi:10.1002/ajim.10134.
24. Cramer M, Wendl M, Sayles H, Duysen E, Achutan C. Knowledge, attitudes, and practices for respiratory and hearing health among Midwestern farmers. *Public Health Nurs*. 2016;Nov14. doi:10.1111/phn.12306. [Epub ahead of print].
25. Grandin T, Shivley C. How farm animals react and perceive stressful situations such as handling, restraint, and transport. *Anim (Basel)*. 2015;5(4):1233–1251. doi:10.3390/ani5040409.
26. Lindahl C, Pinzke S, Keeling LJ, Lundqvist P. The effect of stress, attitudes, and behavior on safety during animal handling in Swedish dairy farming. *J Agric Saf Health*. 2015;21(1):13–34.
27. Morbidity and Mortality Weekly Report, Centers for Disease Control and Prevention - Fatalities caused by cattle – four states, 2003–2008. *Mmwr*. 2009;58(29):800–804.
28. Fox S, Ricketts M, Minton JE. Worker injuries involving the interaction of cattle, cattle handlers, and farm structures or equipment. *J Agric Saf Health*. 2015;21(1):3–12.
29. Animal Care Training. Beef cattle institute, Kansas state university, college of veterinary medicine website. https://www.animalcaretraining.org/index.aspx. Accessed April 25, 2016.
30. Ag Safety and Health. Extension Animal Safety Video Resources website. http://www.extension.org/pages/67432/animal-safety-video-resources#.VTve6yHBzGd). Accessed April 26, 2016.
31. Show Me Farm Safety. Livestock website. http://farmsafety.mo.gov/safety-topics/livestock/. Accessed April 26, 2016.
32. Livestock Worker Training Opportunities. Colorado state university college of veterinary medicine website. http://www.cvmbs.colostate.edu/ilm/proinfo/workertraining.html. Accessed April 26, 2016.
33. Livestock Safety. Auburn agriculture department website. http://www.ag.auburn.edu/~schmisp/safety/. Accessed April 26, 2016.
34. Agricultural Tailgate Training Safety (ATTS). The Ohio state university college of food, agricultural, and environmental sciences website. http://agsafety.osu.edu/programs/cfaes-osha/tailgate-safety-traininig-employees. Accessed February 10, 2016.
35. Weese J, Faires M. A survey of needle handling practices and needlestick injuries in veterinary technicians. *Can Vet J*. 2009;50(12):1278–1282.
36. Virginia Polytechnic Institute and State University. *Zoonotic Diseases of Cattle*. Virginia, USA: Virginia Cooperative Extension, VCE Publication 400; May 1, 2009.
37. Rajaram S, Grimm B, Giroux J, Peck M, Ramos AK. Partnering with American Indian communities in health using methods of strategic collaboration. *Prog Commun Health Partnersh*. 2014;8(3):387–395. doi:10.1353/cpr.2014.0036.
38. Oetzel J, Villegas M, Zenone H, White Hat E, Wallerstein N, Duran B. Enhancing stewardship of community-engaged research through governance. *Am J Public Health*. 2015;105(6):1161–1167. doi:10.2105/AJPH.2014.302457.
39. Christopher S, Watts V, McCormick A, Young S. Building and maintaining trust in a community-based participatory research partnership. *Am J Public Health*. 2008;98(8):1398–1406. doi:10.2105/AJPH.2007.125757.