**FAQ - Upcoming papers on bison**

Name of Paper, PI, Author(s)

* Stroupe, S., Forgacs, D., Harris, A. *et al.* Genomic evaluation of hybridization in historic and modern North American Bison (*Bison bison*). *Sci Rep* **12,** 6397 (2022). <https://doi.org/10.1038/s41598-022-09828-z>:
* Discovery of gene that drives albinism in bison, Blake McCann, Theodore Roosevelt National Park is one of the authors

Anticipated publication date(s): TBD

**NPS Subject Matter Experts**

* Yellowstone National Park -
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* Wind Cave National Park – Greg Schroeder, Chief of Resources [greg\_Schroeder@nps.gov](mailto:Greg_Schroeder@nps.gov)
* General questions on federal bison management, coordination, long-term planning and partnerships: Dr. Brendan Moynahan, Science Advisor and Chair, DOI Bison Working Group: [brendan\_moynahan@nps.gov](mailto:brendan_moynahan@nps.gov)
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**Yellowstone and Wind Cave Talking Points**

* Scientists at Texas A&M University recently published findings that all North American bison have some level of cattle introgression.
* All DOI herds have some level of cattle introgression. The Wind Cave and Yellowstone herds have such low-levels of introgression that it can only be detected by complete genome sequencing. Earlier studies have shown that other federal herds have modestly higher levels of introgression; overall, cattle introgression in federal herds is low. All DOI herds have some level of cattle introgression.
* DOI bison herds are managed differently under a variety of constraints. Individual herd managers will continue to use a range of tools for conserving bison genetic diversity and minimizing cattle introgression specific to the objectives and constraints of each unit.
* Yellowstone National Park will continue to manage bison as wildlife and allow ecological processes such as natural selection, migration, and dispersal to prevail and influence future population and genetic structure.
* The NPS is actively engaged in research supporting long-term conservation of bison genetic diversity.

**Questions – Introgression Paper:**

* What is meant by the term cattle introgression?
  + Introgression is the transfer of genetic material from one species to another through cross-breeding or hybridization. In bison, cattle introgression refers to the detection of genetic material, known to be specific to domestic cattle, in the bison genome. Cattle introgression in bison is the result of efforts to cross-breed cattle and bison in the early 1900’s for commercial production. These efforts were generally unsuccessful for a number of reasons, but some occurrences have resulted in small levels of cattle introgression that can be seen in genetic samples from bison populations today.
* Looking at the history of bison conservation in the US, do scientists today believe there are any bison without cattle introgression?
  + The short answer is scientists today believe all bison in North America have small but detectable amounts of cattle genetics. Before today’s sensitive genetic analysis proved it, many scientists looked at the history of bison and thought cattle genetics could exist in bison. Cattle ranchers in the 1800s played a key role in survival of bison – capturing wild bison and holding them from hunters in something of an early captive breeding program. Cross breeding occurred, and some of those bison were later introduced to public lands herds.
* If there are but small amounts of cattle DNA in bison, why not breed that out of bison and get back to being truly wild?
  + Removal of a bison with a small amount cattle introgression would also mean the removal of all the true bison DNA that same animal also carries. Given the fact bison populations fell from 30 million to a few hundred in the wild in the 1800s, one of our principal tasks is to protect the remaining genetic diversity in conservation herds. The simple presence of detectable cattle genetics doesn’t necessarily mean that bison are ‘affected.’ While we can identify tiny segments of cattle genetics in all bison herds, it’s not at all clear that that material has a negative, positive, or even any effect at all on bison.
* I had heard that bison at Yellowstone and Wind Cave National Parks were pure. Why did some think that? Does this finding mean that those bison aren’t as special as I thought?
  + Quite a few groups and individuals insisted on referring to bison from Yellowstone and Wind Cave as “pure,” even though bison managers were already aware of two complicating factors. First, the prior generation of genetic analysis techniques had low power to detect small amounts of cattle DNA spread throughout the entire bison genome. Second, we knew that even Yellowstone had an early-1900s augmentation of roughly 20 bison from the National Bison Range, which was discovered many years later to have a small amount of cattle introgression. Still, we know that bison from Yellowstone and Wind Cave are still among the most genetically diverse and with the least amount of introgression. Furthermore, Yellowstone bison are the only plains bison herd in the country that still experience the full complement of selective pressures with which they evolved: grizzlies, wolves, seasonal migration, competition for mates, even human hunting outside the park – all among the most critical factors that enable natural selection to occur.
* There are about 11,000 wild bison in the U.S., and they live on public lands. What does this discovery mean for wild bison on public lands? What is the NPS going to do about this?
  + This new information changes very little from the standpoint of conservation in practice. Bison managers are working today on research and a plan that will guide the occasional movement of bison among federal conservation herds. Such movements are important to offset the effects that can come with long-term isolation of herds like inbreeding and genetic drift.
* If bison don’t have 100 percent bison genetics, what is the mix of bison and cattle genetics in bison herds on America’s public lands?
  + Federal bison herds have low levels of cattle introgression. All indications are that all federal herds have greater than 98% bison nuclear DNA, and many have greater than 99%.
* Do scientists measure genetics of other wild species? How about elk? Geese? Ducks? The Bald Eagle? Mountain lions? Examples please and are they all 100 percent?
  + By comparison, fish conservation biologists work to conserve some subspecies of trout that are considered to still be of high conservation value with genetic introgression of other trout that can range as high as 15%.
* What are mitochondrial and nuclear DNA? Did this study find mitochondrial cattle DNA in the public lands herds?
  + There are two types of DNA. Nuclear DNA is the type that occurs in the nucleus of cells and is a 50:50 mix of the contributions of the father and mother. Nuclear DNA is the ‘blueprint’ of a species and is found in most cells in the body. Every individual of a species has a unique nuclear DNA blueprint. Mitochondrial DNA (mtDNA) is different; it occurs in cells’ mitochondria rather than in the nucleus, is non-adaptive (i.e., it doesn’t give the same kind of instructions as nuclear DNA), evolves faster than nuclear DNA, and is only handed down matrilineally (i.e., from the mother side of a family line). Although mtDNA is a lot smaller and simpler than nuclear DNA, it is still very useful for understanding the degree of relatedness among populations and allows researchers to trace populations maternally back in time. The recent study on cattle introgression in bison focused on nuclear DNA. Most federal herds have zero cattle mtDNA. Where cattle mtDNA does occur, it is possible reduce by placing female bison from herds with no mtDNA. Over time, those females with no cattle mtDNA will produce offspring without cattle mtDNA.
* If all bison have some level of cattle introgression, why doesn’t the NPS allow bison, such as those at GRCA, to be sent to private bison landowners rather than be dispatched by volunteers?
  + All federal bison are managed as wildlife. Most private bison are managed like cattle operations to produce commodities. Some of these herds have much higher levels of cattle introgression than do federal herds. Federal wild bison are regarded as the ‘gold standard’ for conservation of the species and managing them as wild animals is essential to allowing the highest degree of natural selection that can be afforded within the constraints of each individual herd. Nearly all federal bison that are removed to keep populations at sustainable levels (given food, water, space, and needs of other species) are captured and donated live. Fully 95% of those bison are donated to Native American Tribes; the balance are donated mainly to states and conservation organizations to start or augment other conservation herds. Grand Canyon National Park did pilot a lethal removal program in 2021. That approach has been discontinued because it was far less effective and far more costly than conducting live capture and subsequent donation of the bison.

**Questions – Albinism Paper:**

* How did scientists find the gene that produces albinism in bison?
* How do they know the gene identified is responsible for albinism? How did they test it? Has anyone been able to produce an albino bison knowing this information?
* Will scientists be able to use this new information to determine which bison will produce an albino calf?
* What are the cultural implications for this discovery?
* Albino bison have great meaning for Native Americans, what do they think about this discovery?

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