The Genetic Extinction of the North American Plains Bison
Are they too late to save?

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Based on historical records, it is an undisputed fact that in the early 1900's, most of the ranchers of the so called "bison foundation herds" from which all modern day bison have their origins, experimented with bison cattle crosses. These included Charles Goodnight, Michael Pablo, Charles Allard, Charles "Buffalo" Jones, Scotty Phillip, and others (1-5). They called these hybrids "cattalo" and it was an attempt to integrate some of the bison traits into domestic cattle. They assumed these hybrids would display heterosis (hybrid vigor or outbreeding enhancement) whereby the offspring would be superior to the parents.

These ranching experiments to crossbreed bison and cattle did not produce the results they wanted or anticipated and, as commonly occurring when crossing distantly related animals, there was outbreeding depression (a reduction in fitness) rather than hybrid vigor. As a result, these early experiments were aborted as unsuccessful (although for some reason they continue by a few to this date).

There are also undisputed facts that modern-day domestic cattle genes exist within most bison populations, both private and public. These are not "ancient" Bovidae genes, but those arising from modern day cattle (6,7). It is reasonably presumed that these cattle genes in bison (a situation known as introgression) are a direct result of the inadvertent mixing of cattalo with pure bison. After all, as noted by these early experiments, some of these early F1 crosses were almost indistinguishable from the pure bison* (3,5).

Bison-cattle introgression was first inadvertently discovered in 1995 by Polzeihn and coworkers (8) while constructing the phylogeny of North American bison in the Custer State Park herd of South Dakota. Since that time there have many scientific articles attesting to the level of bison-cattle introgression throughout the bison populations (6,7). Although some articles have claimed that the level of cattle introgression is less than 1%, these estimates are not based on solid scientific evidence. Most recently, looking at 10,000 single nucleotide polymorphisms, the level of introgression may be as high as 4.6% or more in some animals (9).

Since the discovery of cattle introgression in bison in 1995, there have been no efforts by the industry to preserve what may be left of the pure* wild-type bison population, By disinformation, misinformation, general misunderstandings, and maybe even some dishonesty, the pure* bison population continues to diminish. Or maybe, sadly, nobody really cares, and pure* bison will go extinct. I estimate that about 30% of all bison today are actually cattle-bison hybrids.

As an example, 3 bred bison cows were purchased from a very well-known and respected bison producer. All 3 cows tested free of cattle introgression, but all 3 calves were hybrids indicating that the bull(s) is spreading cattle genes throughout this herd and this entire herd will likely be all hybrids in the future. Did anyone tell the Prairie Band Potawatomi Nation in Kansas, the Flandreau Santee Sioux Tribe in South Dakota, the Santee Sioux Tribe in Nebraska and the Modoc Nation and Quapaw tribe in Oklahoma that the bison they received from the Grand Canyon are all hybrids, leftovers from the abandoned cattalo project of Charles "Buffalo" Jones (10)? Or did no one care that these sacred animal were hybrids, part domestic cattle? Is part buffalo better than no buffalo?

Even the Bison Registry of the National Bison Association (NBA) requires genetic testing but allows bison to be registered with up to 3 distinct cattle alleles (introgression markers) as long as they look like bison. And the presence of cattle introgression within these registered bison is considered “proprietary” (hidden) information by the NBA and is not publically available. Which raises the question of what good is the registry if registered animals are hybrids? And why is this information not made public?

Bison hybrids (bison with evidence of cattle introgression) are usually indistinguishable from pure bison

Are there any pure* bison really out there? The answer is unequivocally YES. Based on currently available tests, which include 25 nuclear microsatellite alleles (markers) in conjunction with mitochondrial DNA (mtDNA) testing, as well as ongoing research looking at 10,000 single nucleotide polymorphisms, pure* bison still exist. The question is for how much longer?

Don’t believe those that claim that all bison have cattle genes and so their bison are technically pure (even with cattle genes). Also don’t believe those that claim their bison are pure because they had DNA tests done on the mitochondrial DNA (mtDNA). Statements such as animals “*were tested at … and confirmed to have bison mtDNA*” are meaningless and misleading. These claims are false and are being propagated due to misinformation, disinformation, misunderstanding, and/or dishonesty.

Very reputable bison producers are selling bison with the claim that mtDNA does not show signs of cattle introgression while knowing that such is only half the story. Is not “*half the story*” the same as a half-truth which is defined as “*used deliberately in order to deceive someone”*? It is this type of disinformation that is driving the North American bison into genetic extinction.

These bison hybrids will be indistinguishable from pure bison in just a few more back-crosses, but the cattle genes will still be present.

There are now 3 tests currently available commercially to test the genetic purity of bison*. The mitochondrial and nuclear microsatellite tests have been around for years. Both tests must be performed concurrently as doing just one can be meaningless. For example, if a bison cow is mated with an Angus bull, the 50-50 hybrid calf will be “pure bison” if only testing with mtDNA; because mtDNA is only passed by the cow (maternally derived). Unfortunately this seems to be a common misconception and many are only doing mtDNA testing and claiming they have pure bison. Both tests, nuclear microsatellite and mtDNA, are required to determine the genetic purity.*

It is also important to realize that these tests are not detecting cattle genes or even alleles (it is a misuse of the term allele), but are simply cattle introgression markers. An animal with 1 cattle “allele”, could have more cattle genes than a bison with 3 cattle “alleles”. Detection of even a single cattle “allele” simply indicates that a sire or damn in the animals’ past was a domestic cattle and the animal is essentially a hybrid.

Most recently, NeoGen has released their cattle introgression test that looks at 10,000 single nuclear polymorphisms (snp’s) and can determine the actual amount (percent) of introgression. Although this test is new and requires additional verification and publication, it offers another hybridization tool can separate pure* wild-type bison from those that have been hybridized with cattle. It is presently the most powerful tool available to determine bison purity.

It has been over 25 years since the industry has known that animals looking like North American bison are actually hybrids and have chosen to ignore the issue. Do we continue to ignore the issue and let the North American bison go genetically extinct?

The bison industry appears not to care about cattle introgression and the presence of cattle genes in bison for a variety of reasons. Only you can decide if those reasons are valid:

Many contend we were left with the genes from post-bottleneck herds, a part of history from over 100 years ago, and that it is our collective mission to preserve what we were left with.

While there is some legitimacy to this claim, it is also severely flawed. History left us with pure* bison and bison with cattle genes. If “our mission” is to preserve what we were left with, then we would be making an effort to preserve both the pure bison and the hybrids as distinct populations. We are doing neither and the continued indiscriminate breeding is not preserving what we were left with and will likely lead to the extermination of one and its extinction.

Many contend that a cattle marker or two in a bison is just part of history - they would never knowingly breed down, or away from bison. I believe the keyword here is “knowingly”.

If a pure bison is bred with a hybrid (bison with cattle genes), is not that offspring genetically more removed than the pure* wild-type bison? Is that not breeding down? In the example above with the 3 cows and their hybrid calves, are the calves more or less of a bison if they are in essence part cattle. Without testing and indiscriminate breeding, you may not be “knowingly” breeding down or away from bison, but you are.

Many contend that the number of bison tested is too low to make any rational conclusions (less than 1%) – too much is being made out of too little – the data is more algorithmically possible than statistically probable. This argument, although seems logical on its surface, is based on a lack of understanding.

There are about 350,000 bison in North America and over 40,000 bison have been genetically tested. Based on those conservative values, over 10% of the bison population has been tested (40/350x100),

From white to black, hybrids come in all colors

not less than 1%. Can conclusions be made from a 10% sample? Think of the advances in human genomics – from having your ancestry traced to the detection of disease susceptibilities and vulnerabilities. There have been about 26 million DNA tests performed on humans (2019 data) which represent only 0.3% of the human population. Even if that figure reaches the 100 million mark as predicted, that is only 1.2% of the population, If we can make major health, ethnicity, and heritage decisions based on 0.3% of the human population, we can certainly made decisions based on >10% of the bison population.

Many contend that, in addition to the low number of animals tested, those testing positive have less than 1.5% cattle introgression or genes. What is the big deal? Many have dropped the purity issue because, in their own words, it's not a big deal. There are actually 2 parts to this answer.

We do not have the genetic information to precisely detect the amount of cattle introgression and such most certainly cannot be estimated based on a few short tandem repeats (microsatellites). Recent data looking at 10,000 snp's suggest that the amount of cattle DNA may be as high as 4.6% in some animals (9). Is that no big deal? If you believe that a small amount of cattle genes in the genome of bison is meaningless, consider that the DNA difference between human and chimpanzees is approximately 1% and with the great apes about 2% (11,12). There is only a 0.04% difference in the nuclear coding DNA between a grey wolf and that cute little puppy lying next to you (13). The difference between you and I is only 0.1% on average (14, 15). Consider those facts when people claim a little bit of cattle DNA really doesn't matter and is no big deal. If <1% can make a such a big difference, what effect does 4-5% have?

Not all bison hybrids are this obvious.

Many contend that the presence of cattle genes could be beneficial to the survival of bison, such as greater resistance to parasites, malignant catarrhal fever, and other ailments.

While this could be true, there is no evidence to support this claim and the result of crossing distantly related animals is rarely beneficial. Although limited, all data to date suggests that bison with evidence of cattle introgression have depressed growth (16, 17). Thus, the suggestion of possible beneficial effects of cattle introgression has no basis in fact and is not supported by any evidence.

Last but not least, many contend that the breeding of cattle and bison in the early 1900's was done to save the bison and therefore should be preserved. This is a fallacy and I could find no evidence in the record to support such a claim. Like everything else, it was to make money.

The blizzards of 1885-1886, which catastrophically killed cattle populations by the thousands, but not any bison, and the price of buffalo meat reaching 50 cents per pound in 1889, were the primary driving forces to saving the bison.

> But the breeding of bison and cattle was not for the purpose of saving the bison, but was to domesticate bison and to create a hardy and sturdy half-breed buffalo that could be handled as easily as ordinary cattle (1-5). The effort was to combine some of the hardihood of the bison with the beef producing qualities of domestic cattle, the so-called "*bison domestic hybrid*" or "*cattalo*". As "*Buffalo*" Jones said, it is not in mere domestication, but in cross-breeding that the buffalo's value consists.
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> Unbeknown to these early pioneers, their domestication efforts would doom the wild bison genome. If your goal and vision is to domesticate the bison and remove their unique personalities and wild nature, then bison with cattle introgression may be your interest.

There are a few ranchers that are making an effort to maintain the original bison genome and some that maintain separate production herds with cattle genes and conservation herds of pure* bison. But these are far and few between.

Unless the industry as a whole takes a stand to at least recognize the existence of bison free of cattle introgression and have the desire to preserve the original wild bison genome, the original bison genome will be lost.

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*Although we may not know exactly what constitutes "pure bison", the term "pure bison" as used herein means that there is no evidence of cattle introgression based on all commercially available tests at the time the statement is made.

For additional information on bison cattle introgression, see
http://www.ozarkbisons.com/introgressions.php

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