

Yellowstone bison

Bison x



Gober, Joy <joy_gober@fws.gov>

1/13/1

5

to Justin, Bridget

Justin,

Please see the attached for my two cents worth. I hope it helps. I always enjoy working on *Bison bison bison*, Thanks!

Attachments area

Review of 2014 Petition to list Yellowstone Bison as a DPS (Completed by Joy Gober, January 13, 2015)

The petitioners assert that the Yellowstone bison herd is the **only** bison without cattle introgression. I don't think we can say that. Firstly, with improved technology, introgression may eventually be detected in Yellowstone bison; there are already hints of it (see table). Secondly, published literature notes a few other, albeit smaller, pure bison herds. The petitioners cite a powerpoint that may or may not be valid to assert that Yellowstone is the only non-introgressed herd. The petitioners also assert that Yellowstone bison have been continuously wild. I don't think we can say that either. They are more wild than other herds, but were substantially augmented early on with captive bison from other locations. Additionally, they were herded, corralled, and winter fed in early days and are still hazed, vaccinated, and culled.

However, Yellowstone bison do have unique attributes. They are the largest herd of **apparently** pure bison. They are managed less intensively than most other herds (although still culled, hazed, vaccinated). And, they are part of an intact predator-prey-scavenger community that moves, migrates, and disperses across a vast heterogeneous landscape where the expression of their genes is subject to a full suite of natural selection factors including competition, disease, predation, and substantial environmental variability (White & Wallen 2012).

I think you could argue either way regarding discrete and significant. In our 2011 90-day, we were looking at four ecotypes throughout the range that were proposed by petitioners. Yellowstone was part of the Rocky Mountain Ecotype. So you can't exactly compare conclusions with this petition.

I think the petitioners overstate threats. Everything excepting predation is a threat. Typically, they describe many threats in terms of the Greater Yellowstone Ecosystem, but they don't include the Grand Teton NP/Natl Elk Refuge/Jackson bison herd in any discussions. I think you have to use the same scale for both—either just look at Yellowstone Park for threats, or include the Grand Teton NP/Natl Elk

Refuge/Jackson bison herd in all discussions. The Grand Teton NP/Natl Elk Refuge/Jackson bison herd is not continuously wild (foundation stock includes: 20 bison from Yellowstone in 1948 and 12 from T.Roosevelt NP in 1964) and may or may not have cattle introgression.

In summary, I believe there are many overstatements in the petition, and they only cite literature or portions of literature that support their assertions. However, based on information in the petition, it might be appropriate to do a 12-month finding to resolve discrepancies. This would also allow for the opportunity to receive input from the National Park Service.

(Please see following table for additional considerations)

Table 1. Considerations Related to 2014 Petition to list Yellowstone Bison as a DPS

Petition Assertion	Response
Historic conservation efforts increased bison numbers, but widespread hybridization with cattle, loss of genetic diversity due to multiple bottlenecks, founder effects, small population sizes, and systematic domestication poses risk of genomic extinction and a drastic reduction in evolutionary potential. (pp. 5 & 11)	Hybridization is widespread, but the proportion of cattle DNA is typically quite low (0.56–1.8%). It occurred chiefly in the late 1800s during early restoration attempts. It does not now occur in conservation herds. We are only aware of a single bottleneck, occurring in the late 1800s. However, the bottleneck was short-lived and citations provided by petitioners note that there was likely little resultant loss in genetic diversity.
Yellowstone bison are the only surviving naturally occurring wild bison population in the U.S. (pp. 5, 24, and 28) This is justification for “significant.”	A more accurate statement would be that Yellowstone bison are descendants, in part , of the only naturally occurring wild bison population in the U.S. — The Yellowstone bison herd was reduced to somewhere around 25–30 individuals by 1902. At that time 18 females from the Pablo-Allard herd in MT and 3 bulls from the Goodnight herd in Texas were purchased and added to Yellowstone. Recent estimates are that 30–40% of bison genetics derive from original animals.
Yellowstone bison are the only remaining native population of plains bison that retain genetic integrity. (p. 6) This is justification for “significant.”	If this means free from introgression with cattle genes, with current technology there may be 7 herds without introgression (Yellowstone NP, Elk Island NP, Grand Teton NP, Henry Mts, Sullys Hill, Wind Cave NP, and Castle Rock). Only Wind Cave and Yellowstone had sample size sufficient for statistical confidence (Halbert & Derr 2006) and many other herds have not yet been tested. As techniques improve and more extensive sampling occurs, some herds previously without evidence of introgression may be found to contain cattle alleles. Bison from Pablo-Allard and Goodnight herds were crossed with cattle, so it is possible that low levels of introgression may eventually be detected even in Yellowstone. Halbert et al 2005 noted a single allele shared between Hereford cattle (frequency 3.1%) and Yellowstone bison (frequency 1.8%); this allele was classified as potentially alien.
Yellowstone bison are discrete population because they are physically and genetically isolated from other public/private herds. (p. 6)	Yellowstone bison are physically isolated, but were augmented in 1902 with bison from Pablo-Allard and Goodnight herds, so not entirely, genetically isolated.
Yellowstone bison are significant because their continued persistence represents the only	Largely true, but 60–70% genetics attributed to Pablo-Allard and Goodnight introduced animals.

surviving natural occurrence of wild bison that has never been extirpated from its range. (p. 6)

Petitioners disagree with 2011 finding characterization of Yellowstone herd and cite a portion of that finding. (pp. 7 and 25)

Petitioners neglect to cite statement in 2011 finding noting that it differed from the 2007 finding in scope (2007 finding was specific to Yellowstone herd; 2011 finding addressed 4 ecotypes/DPSs per petitioners (northern Great Plains, southern Great Plains, Rocky Mts, and Great Basin-Colorado Plateau). The Yellowstone herd would constitute a portion of the proposed Rocky Mt DPS.

No other herd demonstrates the level of genetic diversity found in Yellowstone bison. (p. 7) This is justification for “significant.”

Halbert 2003 stated that Natl Bison Range, Yellowstone, Neal Smith and Wind Cave have the highest allelic diversity (in descending order) and Natl Bison Range, Wind Cave, Wichita Mts, and Yellowstone contribute the most to allelic richness and gene diversity.

Schnabel 2011 found that only the Yellowstone bison remained free of cattle-gene introgression. (p. 13)

The Schnabel 2011 reference that I found (there may be another, but the page numbers match) was a powerpoint from Univ. of Missouri. It was difficult to interpret much beyond the table presented by petitioners. I don’t have other references that corroborate Yellowstone being the only herd free of cattle introgression.

Yellowstone bison are an isolated meta-population of 2–3 genetically distinct herds (Halbert et al. 2012). (pp. 16, 24, and 27)

White & Wallen 2012 give a very good rebuttal, which petitioners don’t cite. Essentially, the distinct genetics are likely due to the fact that the central herd derives largely from the original resident bison (with occasional additions from northern herd) and the northern herd derives largely from the 21 TX & MT bison introduced in 1902 (with occasional additions from central herd). So genetic uniqueness is manmade. White & Wallen then go on to say that *YNP bison are a valuable conservation population because they represent the largest wild population of plains bison and are one of only a few populations to continuously occupy portions of their current distribution and show no evidence of hybridization with cattle in their genomic ancestry. Perhaps more importantly they are part of an intact predator-prey-scavenger community and move, migrate, and disperse across a vast heterogeneous landscape where the expression of their genes is subject to a full suite of natural selection factors including competition, disease, predation, and substantial environmental variability.* I think that is a very good synopsis of what makes Yellowstone

	bison special.
The petitioners note that Yellowstone bison population numbers have fluctuated from ~2,100–4,800 over the last 25 years. (p. 21, Figure 3)	Population numbers vary (based on culling and winter severity), but the overall trend appears to be stable to increasing, based on Figure 3.
Culling is still having differential impacts on individual herds, with more being removed from northern herd. (p. 22)	White & Whalen 2012 also rebut this, noting that subpopulations are considered during culling. On a more practical note, if the northern herd reflects more genetic influence from introduced bison, that would seem to be the herd that you would want to cull from.
With the exception of the Yellowstone bison herds, all other plains bison herds have been created solely by human intervention. (p. 25) This is justification for “significant.”	True, but there has been quite a bit of intervention in Yellowstone as well. In early years there were introductions from captive herds, bison were fenced and fed during winter, bison continue to be hazed, vaccinated, and culled).
The extant Yellowstone bison include some 40% of the original wild bison strain. (p. 25)	The extant Yellowstone bison include some 60–70% introduced, captive strain.
Yellowstone bison are geographically and physically isolated for >100 years. (p. 25) This is the justification for “discrete.”	No new bison have been introduced into Yellowstone since 1902. Several Yellowstone bison have been sent to start other conservation herds. I’m not sure if isolation only matters to new animals being introduced into Yellowstone, maybe?
Threat #1: Range has been curtailed. (p. 32)	For historical range (20,000 km ²), Greater Yellowstone Ecosystem is used, but unsuitable habitats such as dense forest, above timber, etc. are not considered. Therefore, it is a measurement of range. For current range (3,175 km ²), it is a measure of occupied habitat, so it appears to be apples and oranges.
Threat #1: Livestock grazing has altered habitat. Petitioners note some grazing allotments north and west of Park. (p. 33)	Probably so, but no citations specific to Greater Yellowstone Ecosystem to support assertion.
Threat #1: Development outside of Park in Greater Yellowstone Ecosystem has occurred. (p. 34)	Some development has occurred, but does it rise to the level of being a threat?
Threat #1: Invasive plants negatively impact the ecosystem. (p. 35)	The presence of invasives has been documented, but does it rise to the level of being a threat?
Threat #2: Hunting and culling are a threat. (p. 36)	Hunting and culling are carefully managed, population trends are stable to increasing.
Threat #3: Disease is a threat, particularly hemorrhagic septicemia, malignant catarrhal fever, and bovine brucellosis. (p. 37) Brucellosis has a significant reproductive effect on Yellowstone bison. (p. 38) Management issues for brucellosis are even more concerning. (p. 38) Disproportionate culling may exacerbate impacts	No recent cases of the first disease, and no cases of the second disease in Yellowstone are noted. Brucellosis is not a direct threat because reproduction is only marginally limited, but bison can be indirectly affected by potential risk posed to livestock. However, there is a joint bison mgt plan for Yellowstone and the State of Montana,

to bison. (p. 39)

with a goal of preserving Yellowstone bison and minimizing potential risk to cattle. Population trends are stable to increasing, so brucellosis mgt may be adequate. See White and Wallen 2012 discussions above regarding disproportionate culling.

Threat #4: Inadequate regulatory mechanisms are a threat. (p. 40)

I didn't have time to go through the many cited regulations, but would note the stable to increasing population trends do not support assertion that regulatory mechanisms are a threat.

Threat #5: Genomic extinction poses one of the most imminent threats to bison conservation. (p. 45)

Hybridization is widespread in conservation herds, but the proportion of cattle DNA is typically quite low (0.56–1.8%). Introgression is due to early attempts at cross-breeding with cattle, which no longer occurs in conservation herds. This level of introgression is steady. If you cross 1% cow with 1% bull, you get 1% calf (per literature). There is a lot of research and monitoring to preserve bison genome. If introgression truly is 0 in Yellowstone bison, and there are no outside introductions, then it isn't a threat.

Threat #5: Climate change is a threat. As climate dries, more bison will move out of the park due to forage competition. If the climate dries, it could facilitate bison moving out of Park. If climate warms, it could facilitate bison dispersal south to the Jackson herd. (p. 47)

Given the extent of the historical range (Canada to Mexico, Rockies to Florida to New York), the bison would appear pretty flexible with regard to climate. Regarding drought-related dispersal, citations are needed. Regarding dispersal south, citations are needed—you would need to factor in topography; I don't think the current snow pack is what's keeping them from dispersing south. And it would seem to be outside the realm of "foreseeable."