Technical Assistance Report - Grand Canyon National Park Bison EIS

Submitted by Glenn Plumb, PhD, Chief Wildlife Biologist, NPS-NRSS-Biological Resources Division, Fort Collins, CO, 970-267-7203, glenn_plumb@nps.gov

Summary Findings

Through consensus, the convened Technical Assistance Request team recommends that the Grand Canyon Bison Environmental Impact Statement should:

- Identify free ranging wild bison that may occupy Grand Canyon National Park North Rim lands and adjacent jurisdictions as native wildlife at the southwest edge of their continental historic range.

- Identify that the prevailing genetics of the current bison population are not in conflict with the National Park Service mission for native bison conservation, and that the National Park Service could potentially be responsive to Arizona leadership to improve long-term population conservation genetics.

- Reference a multi-jurisdictional bison range of ~215,000 acres, including ~ 51,000 acres of lands of the Grand Canyon National Park North Rim, and that there will likely be local or site specific sensitive resources within this large landscape that may require specific management.

- Analyze two population abundance levels 1) very low density of 80-200 bison (0.0004 – 0.001 bison/ac) and 2) low density of 200-400 bison (0.001-0.002 bison/ac) for two respective Environmental Impact Statement action alternatives that are expected to yield recognizable and analyzable differences in impact analyses.

Background

On April 3, 2015, the Grand Canyon National Park (GRCA) Superintendent sent the National Park Service (NPS) Biological Resources Division (BRD) a Technical Assistance Request (TAR) for the BRD Chief Wildlife Biologist to rapidly assemble and lead an inter-agency group to deliberate on 1) nativity of bison at GRCA, 2) the relationship of herd genetics to the conservation objectives of the NPS, 3) recommend a landscape size and configuration, and 4) recommend a range of densities to be used in calculating bison abundance for action alternatives in the GRCA Bison Management Plan/Environmental Impact Statement (EIS). The TAR was requested in two steps: an initial assessment by the convened team within two weeks to be shared at an internal NPS meeting on April 27 meeting and a more detailed report by end of May as a reference in conducting EIS analyses.

During April 5-7, 2015 Glenn Plumb contacted and invited the GRCA TAR Team including Angela Gatto, United States Forest Service Kaibab National Forest; Greg Holm, Grand Canyon National Park; Chirre Keckler, United States Forest Service, Kaibab National Forest; Carl Lutch,

Arizona Game and Fish Department; Craig McMullen, Arizona Game and Fish Department; Amber Munig, Arizona Game and Fish Department; Mark Sturm, National Park Service - Intermountain Regional Office (IMRO); and Rick Wallen, Yellowstone National Park. Dr. Tom Sisk, Northern Arizona University was also invited and initially accepted but was unable to participate due to schedule conflicts. Dan Niosi, NPS Environmental Quality Division and Margaret Stewart, Louis Berger Group volunteered to listen in on regularly scheduled conference calls for the EIS administrative record.

The TAR Team was convened via four one-hour conference calls hosted by BRD on April 8, 15, 29 and May 6, 2015. Additional side calls occurred amongst TAR team members to deliberate on key points of discussion in preparation for group discussion via conference calls. During the first conference call, the Team agreed to facilitated and open scholarly deliberation and discussion. It was also agreed that the team would seek consensus but would not be entirely dependent on consensus to generate summary findings and would note dissent where appropriate, and that Glenn would be responsible for submitting the final report to the GRCA Superintendent. The Team agreed to deliberations with an emphasis to inform formal planning, and also awareness of how to eventually communicate information and findings about these topics to internal and external stakeholders. On April 27, BRD presented a preliminary draft interim report to an internal NPS meeting at Inter-Mountain Regional Office.

Bison Nativity

There is limited archeological and historical evidence of wild bison in northern Arizona. This includes limited bison parts (bones, hoof, etc.), historical reference to bison from a 16th century conquistador's report and some examples of Native American rock art of bison in northern Arizona and along the Utah border (Huffer 2013). The limited archeological extent of bison parts could also suggest trade between native people that occupied the landscape, and therefore may be not indicative of persistent localized presence and/or frequent use (hunting) of bison in the region. The limited discovery of historic bison artifacts and artwork, or stories and knowledge within currently associated tribes to the greater Grand Canyon region suggests that wild bison likely only occurred infrequently and at very limited abundances. Huffer (2013) concluded that "If bison were present in the Southwest, as the evidence suggests, they likely entered the region only occasionally as small, dispersed herds."

It is known that the wild free-ranging bison that now occupy northern Arizona are descendants of bison brought to northern Arizona in 1906, and as noted below in the genetics section of this report, the original herd of bison was known to have been crossbred with cattle (Wakeling 2006). Recent publications on continental scale bison conservation have included the Grand Canyon area of northern Arizona, along with New Mexico and northern Mexico, as within the southern and southwestern extent of the species continental historic range (Sanderson et al. 2008, Gates et al. 2010, NPS 2014, Plumb et al. 2014). Steen and Barrett (2015) recently illustrated that even populations at the edges of a species' range have value to the overall conservation of that species and are integral parts of ecological communities wherever they occur; and urged decision makers and biologists to consider such arguments and not reflexively deprioritize the conservation of species at the edges of their geographic ranges.

While there remains uncertainty about historic temporal and spatial variability of bison occupancy and movement patterns across the full extent of the species historic range, there are places within the historic range where bison were perennially present and other places in the historic range where bison likely occurred at far lower densities, and where bison were likely absent from specific areas for prolonged periods of time before reoccurring (Plumb et al. 2014). Such variability in temporal and spatial occupancy patterns throughout the bison's range should be closely considered anywhere today where long term bison conservation is contemplated (Gates et al. 2010). Upon extensive review, the Department of Interior Bison Conservation Initiative (see NPS 2014a) adopted Sanderson et al. (2008) and Gates et al. (2010) as the best available science describing the bison continental historic range for purposes of DOI bison conservation planning and stewardship activities, including areas at the edge of the species' historic range such as the Grand Canyon region (see Figure 1).

All parks in the NPS system share in the common mission of stewardship of our national heritage. The NPS has authority to manage wildlife populations and habitats under the NPS Organic Act (16 USC 1, 2-4), the General Authorities Act, as amended (16 USC 1a-1 et seq.), and other authorities. NPS policies for wildlife management are set out in section 4.4 and other provisions of NPS Management Policies 2006 (NPS 2006). NPS policy defines native species as those that "have occurred, currently occur or may occur as a result of natural processes on lands designated as units of the national park system" (NPS 2006). The bison that today occupy areas on the Kaibab Plateau within the greater Grand Canyon region, including the GRCA North Rim, came to do so by migrating and dispersing on their own out of the House Rock Wildlife Area, where they had been managed by AGFD as wildlife for decades. Since arriving on the Kaibab Plateau they have exhibited strong fidelity for areas in and around GRCA. The recent exhibited ecologies of these bison as free ranging wildlife (e.g. habitat, movement, and population ecology) are indicative of, and consistent with NPS Policy as, a reoccurring, or newly arrived, native species at the edge of its historic range.

Arizona statute guides bison management on lands adjacent to GRCA in Arizona. In Arizona Revised Statutes (A.R.S.) Title 17, ARTICLE 1. Definitions and Authority of the State: Sec. 101A23 "Wild" means, in reference to mammals and birds, those species that are normally found in a state of nature. In Sec. 101A24. "Wildlife" means all wild mammals, wild birds and the nests or eggs thereof, reptiles, amphibians, mollusks, crustaceans and fish, including their eggs or spawn. Specifically, A.R.S. 17-101B2 lists bison (buffalo) as a game mammal and A.R.S. 17-101B3 lists bison as a big game animal in Arizona. In A.R.S. 17-102, Wildlife as state property; exceptions, is stated, "Wildlife, both resident and migratory, native or introduced, found in this state, except fish and bullfrogs impounded in private ponds or tanks or wildlife and birds reared or held in captivity under permit or license from the commission, are property of the state and may be taken at such times, in such places, in such manner and with such devices as provided by law or rule of the Commission. As such, bison at House Rock Wildlife Area and adjacent lands are managed as native wildlife by the Arizona Game and Fish Department (AGFD). Bison big game seasons, methods of take, permit numbers, etc. is ordered annually by the Arizona Game and Fish Commission at a public meeting. A recent Memorandum of Understanding between the U.S. Forest Service (USFS) and AGFD, states that the USFS agrees "To recognize the Commission's and the Department's responsibility to make determinations as to which fish and wildlife species are native or naturalized to the state of Arizona, and in which

areas of the state those species should be established or maintained." Per statute and agreements, the AGFD considers the free-ranging wild bison at the North Kaibab National Forest, including the House Rock Wildlife Area, to be native wildlife.

In 2014, the USFS issued the Final EIS for the Kaibab National Forest Land and Resource Management Plan (USDA 2014) and stated therein in response to public comments, that as the IUCN/SSC Bison Specialist Group has documented that the Kaibab NF is within the historic range of bison and that they are considered native to this area (see Potter et al. 2010); and while history of the herd that was re-introduced to the Grand Canyon Preserve in 1906 has shown the introduction of cattle genes to the herd; and that the AGFD has determined that this is a native wildlife herd; and therefore, the USFS considers bison on the Kaibab National Forest as native wildlife.

Ultimately, the NPS action selected through the EIS process and subsequent joint bison management plan will provide the basis for GRCA's participation in a long term, interagency approach to manage the current and future impacts of bison in the park, while supporting the DOI Bison Conservation Imitative and AGFD and USFS goals for a free-ranging bison population on the Kaibab National Forest. Our recommendation after careful consideration of the above information is that bison are wildlife native to the greater Grand Canyon region and should therefore be managed accordingly. It is important to highlight that designating bison as a native wildlife species within the greater Grand Canyon region aligns with NPS, AGFD and USFS management goals and that doing so does not preclude them from being managed to the degree needed to protect other park resources. As part of ongoing formal NEPA planning processes, succinct and straightforward talking points should be developed though collaboration of science, stewardship and communication specialists from the EIS lead and cooperating agencies to share with internal and external stakeholders regarding nativity of bison at GRCA and adjacent jurisdictions.

Summary Finding – Through consensus, the TAR team recommends that the EIS should identify free ranging wild bison that may occupy GRCA North Rim lands and adjacent jurisdictions as native wildlife at the southwest edge of their continental historic range.

Bison Genetics

Information obtained to date about the genetic composition of the bison that currently occur in and around GRCA, Kaibab National Forest and House Rock Wildlife Area confirm the historic, experimental, ranching origins of the population (Wakeling 2006; Hedrick 2010). Indeed, the cross breeding of bison and domestic cattle which occurred nearly a century ago lead the NPS for a time to consider today's descendants of those efforts as hybridized non-native animals. However, closer consideration of the genetic composition of the bison population indicates that the extent of historic cross-breeding does not invalidate the overall value of the population as wild bison.

Hedrick (2010) found that the overwhelming majority (97.5%) of individuals sampled from the population in question possessed cattle mitochondrial (mt) DNA, while at the same time cattle autosomal DNA was estimated at <2%. Hedrick (2010) goes on to explain how incipient

reproductive isolation between the species differentially influenced the ancestry for these two types of genes. Hendrick (2010) observes that the initial interspecific cross between bison bulls and domestic cows virtually always resulted in female offspring and no viable male offspring (see discussion in Hedrick 2009) which in turn supports Haldane's rule which states: 'When if the F1 of two different animal races one sex is absent, rare or sterile, that sex is the heterozygous sex' (Haldane 1922). Haldane's rule implies evolutionary incompatibility of the two species' allosome DNA (sex chromosomes) and suggests significant reproductive isolation has occurred between the two species. Further supporting this hypothesis, results from recent molecular genetic studies of whole mtDNA sequence (Achilli et al. 2008) estimate that bison and the ancestor of domestic cattle diverged approximately two million years ago suggesting that there should be significant reproductive isolation between these two species. Finally, it is important to also highlight Hendrick's (2010) finding that only a few bison conservation populations today are thought to have never been exposed to cattle cross-breeding introgression at some point in the past.

After assessing the overall conservation genetics of bison as a species, as well as the current status of the bison population that occurs in and around GRCA, we found that: many other valued bison conservation populations exhibit evidence of cattle introgression (see Dratch and Gogan 2010); the presence of cattle autosomal DNA within the population in question has already been, and could continue to be, reduced over time; the population in question currently produces viable male and female offspring, indicating allosome compatibility; and individuals in the population look and behave like wild bison. Accordingly, we conclude that although the current genetic status of the population needs to be understood, the genetics of population should not interfere with the continued management of this population as ecologically restored wild free ranging bison.

Summary Finding – Through consensus, the TAR team recommends that the EIS should identify that the prevailing genetics of the current bison population are not in conflict with NPS mission for native bison conservation, and that NPS could potentially be responsive to Arizona leadership to improve long-term population conservation genetics.

Bison Landscape

The TAR Team discussed the spatial extent of the landscape that should be considered for the purposes of managing a multi-jurisdictional wild and free ranging bison population. Rough maps and supporting descriptions were initially provided by GRCA, USFS, and AGFD representatives. A GRCA bison distribution map was prepared in the fall of 2014 that was derived from radio collar data and other types of data, including seasonal visual observations of bison distribution. Arc GIS was used to estimate acreages of the range within the park. Some data indicate bison seasonally use certain areas of the park more than others. For example, there are ~ 1,100 acres of meadow habitat in the GRCA North Rim area which seem to be preferred habitats for bison. The USFS denoted visual observations from recent years and indicated that bison will move north of Road 223, which lies just north of the park's boundary, but generally stay to the south of the Road 223 in small drainages. Bison also spend time in the meadows west of Highway 67 and usually south of Road 22, and also that in 2014, bison moved further north into Pleasant Valley meadow. Discussion between AGFD and USFS indicated a joint vision to

consider bison habitat on the Kaibab NF up to 8 miles north of park boundary and that roads, and other man made or natural geologic features could be identified in future conversations to refine the range limits further. The USFS indicated that perhaps bison had historically used the North Canyon area, but that due to sensitive riparian resources, the USFS would prefer that bison not use the North Canyon area in the future. USFS and AGFD indicated that these distributions were conceptual and the product of conversations for the purposes of this TAR Report.

The team discussed that increasing spatial density leads to dispersal behavior by bison (see Plumb et al. 2009), and that a bison landscape may be limited by natural features or conversely, at least in part, determined by the lack there of, and that bison population density scenarios as described below would be a couple orders of magnitude below what occurs in other wild bison populations in the core of continental historic range. Accordingly, we may expect to see exploration behavior but not density-dependent dispersal movements. Ungulate males are hardwired to disperse in order to reduce the probability of inbreeding effects. Bison are no exception and, depending on the direction they choose to explore, could end up in some unexpected areas. Exploratory movements are just as likely to end in return movements as they are to result in expanded boundaries of the population. There are other free ranging bison populations that occur on DOI Bureau of Land Management lands under such low density conditions, for example Utah's Henry Mountain and Book Cliffs populations (see NPS 2014a). In the Kaibab National Forest, there are no natural barriers that are contiguous and that would serve as a barrier to bison movement to the north; and though hunting on lands adjacent to the park could be used to limit bison density and distribution, some exploratory movement behavior may occur. Since bison can exhibit random movement behaviors, it may be worth considering whether there is a need for a designated bison conservation area for the population, with a focus to preserve wild bison behavior and movement ecology.

Based upon these team discussions, NPS-IMRO prepared a compiled map that includes habitats as denoted by the TAR Team and there was consensus agreement by the TAR to recommend this multi-jurisdictional bison range. The team noted that there will likely be sensitive resources within this large landscape that may require additional protection (see Figure 2, e.g. ~215,000 total acres comprised of GRCA ~51,000 acres, Kaibab NF - Kaibab Plateau ~110,000 acres, Kaibab NF - House Rock Wildlife Area ~54,000 acres).

Summary Finding – Through consensus, the TAR team recommends that the EIS should reference a multi-jurisdictional bison range of ~215,000 acres, including ~ 51,000 acres of lands of the GRCA North Rim, and there will likely be local or site specific sensitive resources within this large landscape that may require specific management.

Bison Abundance

The TAR Team discussed and agreed to several key elements that would underpin overarching recommendations for bison population abundance, including: 1) that density (e.g. bison abundance ÷ landscape size) of the bison population at GRCA and adjacent lands should reflect the very southwestern edge of the historic range and be 1-2 orders of magnitude lower (e.g. order magnitude 0.001/bison ac to 0.0001 bison/acre), compared to NPS bison conservation herds located in the northern grasslands and northern Rockies of the core historic range (e.g. order

magnitude 0.01 bison/acre to 0.001 bison/acre (for more information see NPS site-specific bison population and density in NPS 2014a); 2) that population abundance should be referred to as a single population and density across the proposed ~215,000 acre landscape as discussed above, and not be piecemeal pro-rated to respective jurisdictions (e.g. 50 here, 50 there, etc.); 3) that population abundance should be well below where forage abundance across the larger landscape could be a governing constraint and thereby seek to mitigate most habitat impacts at the larger landscape level, though site-specific impacts to locally sensitive resources may still need to be addressed by a suite of management tools; 4) that under the low density conditions described above, the population annual population growth rate should be expected to approach the upper limit for the species (e.g. ~20%, λ=1.2), 5) that total population size and resultant annual population growth should not exceed potential for hunting on lands adjacent to the park to effectively and consistently serve as the primary population growth rate control mechanism in the long-term, and 6) the population abundance should not exceed a lower threshold of a wild free ranging bison population.

After discussion to establish these key elements (see Table 1), the TAR team further discussed and agreed by consensus that two levels of long-term population abundance (e.g. 80-200 and 200-400 bison) seem to best satisfy the above elements and could serve for two action alternatives for EIS analyses, and specifically that 1) < 80 bison (< 0.0004 bison/ac) does not satisfy the minimum for a wild free ranging bison population (see further discussion of this topic below); 2) that 80-200 bison (0.0004 bison/ac to 0.001 bison/ac) is expected to be potentially most feasible; that 200-400 bison (0.001 to 0.002 bison/acre) is expected to be potentially less feasible, and that > 400 bison (> 0.002 bison/acre) exceeds multiple population criteria (see Table 1).

The determination that a viable and free ranging bison population at GRCA and adjacent lands should minimally be comprised of 80 individuals reflects upon NPS prior experience determining the minimum viable population for a wild free ranging horse population at Assateague Island National Seashore (ASIS) (Zimmerman et al. 2006). Regarding this experience, in 2006, the NPS convened a population and habitat viability assessment (PHVA) workshop with the assistance of International Union for the Conservation of Nature's (IUCN) Conservation Breeding Specialist Group (CBSG). At the time the NPS engaged a multitude of stakeholders and subject matter experts, including conservation geneticists from academia, the non-governmental organization sector and the federal government's Smithsonian Conservation Biology Institute. During this PHVA the NPS' desire was to develop an expert informed opinion regarding the lower limit of a viable, free-ranging wild ungulate population, something seldom contemplated when planning the long term conservation of species or populations. The assumptions that were considered in determining the ungulate population's viable lower limit threshold included: a closed (isolated) population, and periodic controlled abundance and distribution via NPS management. For wild horses at ASIS, the population parameters that were considered in determining the ungulate population's viable lower limit threshold included: genetic diversity of the population; the likelihood of females to contribute to future generations; the rate of retention of rare alleles in the population; individual survivorship, the probability of population extinction from a mass mortality event, predation, disease and fitness. The expert informed opinion resulting from this process was a lower limit threshold of 80 individuals

necessary in order to successfully manage and maintain a healthy and viable wild horse population at ASIS over the long term.

The circumstances of this prior NPS experience can assist in considering bison abundance at GRCA and adjacent lands. For example, like the ASIS horse example, bison at GRCA are minimally vulnerable to predation; constitute an isolated population, are similarly known to have been forced through a genetic bottleneck upon foundation, many decades prior; population growth is expected to be able to be managed, in this case by hunting on lands outside GRCA; and there could be periodic new genetics introduced into the population. Given the NPS' prior experience in determining the lower limit threshold for maintaining a viable population of wild, free-ranging, dominant, large, ungulate species and the similarities of the circumstances relating to bison today at GRCA the TAR team recommends a lower limit threshold for the bison population in question of not less than 80 individuals. Coincidentally, this lower limit population threshold also aligns with the lower end of the population abundance that AGFD described in TAR discussions as required for maintaining a huntable bison population on lands adjacent to the park, which is identified as one of the objectives of the ongoing GRCA bison EIS.

It is worth considering how population abundance objectives may underpin whether the herd is able to function as a population that interacts with the surrounding landscape in an ecologically meaningful way, e.g. freedom to seasonally move and select habitat, preservation of mate selection, age-sex class demography, birth synchrony, etc. Thus, a smaller population size at the edge of the historic range brings a challenge to maintain these evolutionary adaptations. In the long term, periodic meta-population management, e.g. population genetics supplementation may be needed to maintain long-term ecological and improve genetic integrity values for the population.

Summary Finding – Through consensus, the TAR team recommends that the EIS should analyze two population abundance levels: 1) very low density of 80-200 bison (0.0004 – 0.001 bison/ac) and 2) low density of 200-400 bison (0.001-0.002 bison/ac) for two respective EIS action alternatives that are expected to yield recognizable and analyzable differences in impact analyses.

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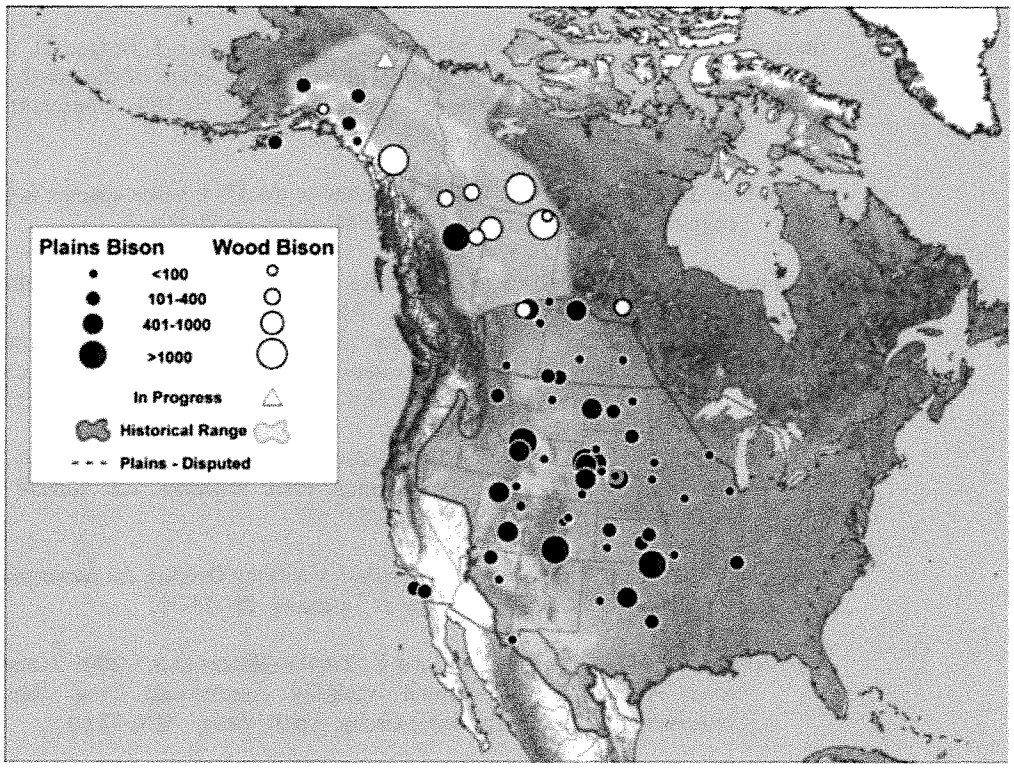

Figure 1. Locations and size classes of bison conservation herds in North America. Historic ranges of wood and plains bison were based on Stephenson et al. (2001) and Sanderson et al. (2008), as reported in Gates et al. (2010), and adopted in NPS (2014a). Used by permission.

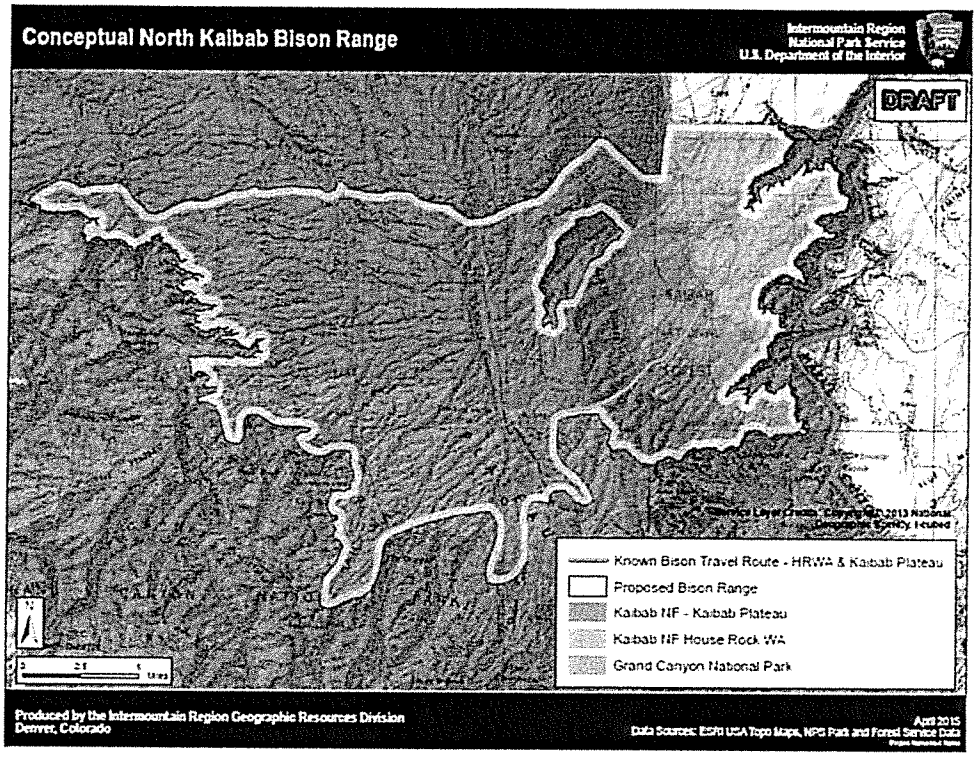

Figure 2. Proposed multi-jurisdiction landscape for wild free-ranging bison at Kaibab National Forest. House Rock Wildlife Area and Grand Canyon National Park.

Table 1. Qualitative elements and bison density and abundance across a proposed ~215,000 acre multi-jurisdiction bison landscape.

Element	Density < 0.0004 bison/ac Population <80	Density 0.0004 bison/ac to 0.001 bison/ac Population 80-200	Density 0.001 bison/ac to 0.002 bison/ac Population 200-400	Density > 0.002 bison/acre Population >400
density at southwestern edge of the historic range	Yes	Yes	Maybe	No
single population at ~215,000 acre landscape	No	Yes	Yes	Yes
well below where forage abundance across the larger landscape could be a governing constraint	Yes	Yes	Maybe	No
annual population growth rate at upper limit for the species (e.g. ~20%)	Maybe	Yes	Yes	Yes
not exceed potential for hunting on lands adjacent to the park to effectively and consistently serve as the primary population growth rate control mechanism in the long-term,	Yes	Yes	Maybe	No
not exceed a lower threshold of a wild free ranging bison population.	No	Yes	Yes	Yes