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MONTANA EIGHTEENTH JUDICIAL DISTRICT COURT, GALLATIN COUNTY

WESTERN WATERSHEDS PROJECT, GALLATIN WILDLIFE ASSOCIATION, BUFFALO FIELD CAMPAIGN, & YELLOWSTONE BUFFALO FOUNDATION, Petitioners, v. STATE OF MONTANA and MONTANA DEPARTMENT OF FISH, WILDLIFE & PARKS, an agency of the State of Montana, Respondents	Cause No. DV-10-317A DECLARATION OF JAMES A. BAILEY

1. My name is James A. Bailey, and I reside in Gallatin County, Montana.
2. I am a retired professor of wildlife biology at Colorado State University. I have a PhD in wildlife biology from the State University of New York, College of Forestry at Syracuse University. In addition to Colorado State University, I have taught at the University of Montana.
3. I also was previously a research biologist with the Illinois Natural History Survey and the assistant Division Chief for Conservation Services at the New Mexico Department of Game and Fish.
4. I am a member of the Gallatin Wildlife Association, and have been involved with wildlife conservation efforts for many years. I have a particular interest in wild bison conservation in Montana and across North

America.

5. I am currently writing a book on the future of wild plains bison. Research for this book has included review of literature on bison genetics and discussions of bison genetics with several bison biologists and geneticists.
6. Based on my training, research and experience, it is my opinion that the bison from the quarantine project undertaken by the Montana Department of Fish, Wildlife and Parks (the Department) are a valuable and important public trust resource. Their value exists in their number, in their unique genetics, and in their important but limited genetic diversity. They may not be replaced except at considerable public expense.
7. The Department indicated since initiating the quarantine study in 2005, that along with being a test of the feasibility of producing *Brucella*-free bison, bison completing the study were to be used for conservation and restoration purposes. Therefore, the number and the genetic diversity of these bison have important public trust values. However, throughout the study, the issue of retaining genetic diversity of these bison has been neglected due to the emphasis upon studying *Brucella* prevalence. I have not seen any efforts made by the Department to protect the genetic integrity of the quarantine population.
8. Because the numbers and genetic diversity have been largely neglected in this study, I view the herd now at the Green Ranch as already genetically compromised. Removing 75% of the bison born during 2010-2014 at the Green Ranch will further diminish the value of this public herd for conservation and restoration by reducing both the number of bison and their potential for passing on their already limited genetic diversity.
9. The significance of the limited genetic diversity of the public bison coming out of the Green Ranch has not been measured. However, small population phenomena (founder effects and genetic drift) have produced deleterious effects in many species of vertebrates, including humans. Among these deleterious effects, poor resistance to disease and occurrences of unusual diseases have been common.

10. Moreover, loss of genetic diversity will diminish beneficial traits of a population, including its ability to adapt to a changing environment. The more rare genetic alleles are most likely to be lost due to founder effects and genetic drift. In vertebrates, valuable alleles of the Macro Histopathology Complex are known to be relatively rare and to be important in disease resistance. Undoubtedly, there are other relatively rare alleles that enhance beneficial traits of wildlife. This phenomenon has received little study. Given all this uncertainty, prudent conservation dictates saving and using as much genetic diversity as possible for wildlife restoration projects.
11. Based on my training, experience and research, it is my opinion that the genetic diversity of bison now at the Green Ranch has been limited due to founder effects and probably diminished further due to management and genetic drift in the small experimental population. My primary points of concern are outlined in the sections below.

FOUNDER EFFECTS HAVE DIMINISHED GENETIC DIVERSITY OF THE PUBLIC QUARANTINE BISON HERD

12. Founder effects are evidenced by several factors. The genetic diversity of a transplanted population will be limited by founder effects including (1) taking only a small number of animals from the donor population; (2) taking a non-random sample of animals from the donor population; (3) taking unequal numbers of males and females from the donor population; and (4) not allowing the new population to reproduce and expand rapidly.
13. All of these factors have occurred in creating the bison herd now on the Green Ranch. The founding population of the Green Ranch quarantine bison herd consisted of a non-random selection of only 41 animals, including only 8 males. This is a herd with a compromised genetic diversity. However, retaining all offspring from the original bison transferred to the Green Ranch could greatly increase the small number of animals having rare alleles and retained within the public herd. The

factors occurred in this herd as follows:

a. The Green Ranch herd began as cohort 1 of the quarantine study. There were 102 bison calves brought to Corwin Springs in 2005-2006. This was not a random sample of Yellowstone Park bison. Presumably, most or all the calves were taken from that portion of the herd leaving the Park on the north side, rather than the west side. Bison with behavioral traits that favored leaving the Park in spring would have been selected for quarantine. Bison less likely to leave the Park were not selected. These deviations from randomness should have limited the genetic diversity of cohort 1.
b. During 2005-2010, many bison were removed from cohort 1 due to accidents, birth complications, unknown causes and to sampling the herd for *Brucella* (Interim Summary, May 2010, Bison Quarantine Feasibility Study, Veterinary Services). Some calves born to these bison did not survive or were euthanized. These non-random removals almost certainly diminished the genetic diversity of cohort 1.
c. There were 87 bison from cohort 1 used to establish the Green Ranch quarantine herd. However, only 41 of these were from the original removal from Yellowstone Park. The other 46 yearlings and calves were offspring and did not contain additional genetic diversity <u>unless</u> they were offspring from any animals that bred at Corwin Springs but did not survive for transfer to the Green Ranch. However, uncommon alleles will occur in very few of the adults in the Green Ranch herd. The number of animals with these uncommon alleles could easily be doubled, or more, by retaining all the offspring in the public herd, because we do not know which animals have the uncommon alleles.
d. For example, if one of the cows in the original 33 cows transferred to the Green Ranch had a rare allele, and this cow produced no calves with the allele at Corwin Springs and 4 calves during 2010-

2014, and 2 of these calves received the rare allele. Retaining all the offspring in 2014 would provide the public herd with 3 animals having the rare allele. Trading away 75% of the offspring could very well leave the public herd with only one animal having the rare allele. Given the vagaries of bison survival, the rare allele could easily become lost from the public herd of *Brucella-free* Yellowstone bison. This scenario may be repeated for several rare alleles spread across several animals in the Green Ranch herd.

e. Of the 41 adults transferred to the Green Ranch, only 8 were males. I do not know how many of the males had participated in breeding and producing the 46 yearlings and calves transferred to the Green Ranch with the 41 adults. Male participation in breeding may have been influenced by management practices and by bison social behavior. To the extent that some males may have bred more than others, the 46 offspring may be a biased sample of the genetics of the 41 adults. This is the small founding population, nonrandomly obtained from the Yellowstone herd that began the Green Ranch quarantine herd (Interim Summary). At its worst, the founding population consisted of 8 – the number of adult males.

f. In 2010, this trend of diminishing genetic diversity was finally reversed. The emphasis during 2010-2012 has been to grow the herd as rapidly as possible. I do not know the number of breeding males in the current herd. Likely, no one knows how bison social behavior is determining if all, most, or only a few of these males participate in breeding the cows. It is likely that some close inbreeding is occurring in the Green Ranch quarantine herd.

THE QUARANTINE BISON HERD REMAINS IMPORTANT FOR CONSERVATION PURPOSES

14. While the Green Ranch quarantine bison are compromised genetically, they are important for conservation purposes. The conservation interest in

these bison is based upon reasons that are sometimes exaggerated but nevertheless important to Native Americans and to some organizations and agencies involved in bison restoration. .

a. The Yellowstone bison herd appears to be free of cattle genes. No cattle genes have been found in the Yellowstone herd or in a private New Mexico herd derived from Yellowstone bison. Also, the Wind Cave National Park bison herd, derived from Yellowstone, appeared to be cattle-gene free until it mixed with cattle-introgressed bison from adjacent Custer State Park.
b. For conservation and restoration purposes, there are very few other potential donor herds of plains bison that are believed to be free of cattle genes. At least some of these herds (i.e. Henry Mountains, Utah) have been maintained in small numbers for long periods, committing them to inbreeding and loss of allelic diversity. Some conservation organizations, public agencies, and Native American tribes place a high priority on having bison with no cattle genes.
c. Some of the Yellowstone bison lineage have been the only plains bison in the USA that have never been held in captivity and subjected to artificial selection toward domestication. This is an important cultural issue for some Native American tribes that are establishing new bison herds. For maintaining the wild bison genome, the significance of past and current domestication in all plains bison herds, other than the Yellowstone herd, has not been measured. However, it has been demonstrated with other species that domestication leads to a loss of ability to survive in the wild.
d. The Green Ranch quarantine bison are the only *Brucella*-free bison having the above characteristics.
e. A May, 2012 directive from the Secretary of Interior indicates increased federal interest in restoring bison in some new, large herds. Green Ranch bison will be prime candidates for this restoration effort.

THE CURRENT QUARANTINE BISON WOULD BE DIFFICULT TO DUPLICATE FOR CONSERVATION AND RESTORATION EFFORTS

15. The unique and valuable Green Ranch quarantine bison have been produced at great public expense. Duplicating these bison with a new operational quarantine program would be expensive and would take additional years.
    a. The Green Ranch bison spent 4-5 years at Corwin Springs with expenses for fencing and fence maintenance, feeding, irrigating and disease testing.
    b. If and when an operational quarantine program is established in Yellowstone Park, another cohort of *Brucella*-free Yellowstone bison might be produced in 2-3 years. The program would begin with yearling bison, not with calves. With better genetics management, this cohort could be somewhat more genetically diverse than the Green Ranch quarantine herd. If the same Corwin Springs facilities are used, this new cohort should be smaller than the 87 bison originally used to establish the Green Ranch herd because more males and fewer females would be used to initiate the operational quarantine. Thus, there would be fewer calves born during the quarantine. Initial capture costs would be greater, as more of the initially captured yearlings will be sero-positive for *Brucella*, compared to calves captured in 2005 and 2006. (Treanor et al. 2011) Seropositive yearlings will have to be handled and rejected. Annual costs for the fence maintenance, irrigation, feeding and disease testing would be about the same, plus cost inflation, as occurred during 2006-2010. Since an operational quarantine program has not begun, no bison can be produced by this method before 2015 at the earliest.
    c. In contrast, a larger number of *Brucella*-free Yellowstone bison should be available from the Green Ranch now, and certainly will be available for bison restoration in 2014. With annual calf crops,

these bison can produce more of these valuable bison each year, at far less public expense and with much less delay, compared to operational quarantine. Trading away 75% of the Green Ranch offspring will reduce the number of new and valuable calves produced for restoration over the next several years.

REMOVING OFFSPRING FROM THE PUBLIC QUARANTINE HERD WILL DELAY AND DIMINISH CONSERVATION AND RESTORATION EFFORTS

16. The value of quarantine bison retained from the Green Ranch by FWP for conservation and restoration efforts will depend upon the number of bison retained, their genetic diversity, and their ages. Trading away 75% of the Green Ranch offspring will delay and diminish opportunities for bison conservation and restoration efforts for several years.
    a. Obviously, having more bison from the quarantine study will provide FWP with more founders for establishing new herds or augmenting existing conservation herds. Having a smaller number of bison available for transfer to a new area will encourage use of limited numbers of animals in each conservation and restoration project, resulting in further loss of alleles due to founder effects and genetic drift.
    b. While the Green Ranch offspring probably do not have alleles that are not also present in the adults that will be retained by the Department, these offspring will have longer remaining reproductive lives than the adults. The potential for genetic drift to cause loss of uncommon alleles from the population would be diminished by retaining all the offspring bison because they will more likely produce several, rather than few, calves during their remaining reproductive lives.
    c. The genetic diversity of Green Ranch offspring may not be replaced over time by additional calves born to 25% of these offspring after removal from the Green Ranch in restoration projects. In these "3rd

generation" calves, additional uncommon alleles may be lost due to continued genetic drift in the small population of retained offspring.

REMOVING OFFSPRING FROM THE PUBLIC HERD RISKS DIMINISHED GENETIC DIVERSITY

17. Trading away 75% of the Green Ranch offspring incurs a risk that, in selecting the share to go to Turner Enterprises, the genetic diversity of FWP's 25% share of these bison will be diminished.
    a. Neither the Environmental Assessment Decision Notice (FWP, February 2010) nor the FWP/TEI Memorandum of Understanding (February 16, 2010) describe how the 25%/75% division of the Green Ranch offspring will be determined, nor who will select the animals.
    b. Removing 75% of the offspring from the public herd could result in loss of uncommon alleles from the public trust due to 1) chance selection, 2) intentional or even unconscious human selection, or 3) to bison behavior that can be associated with genetic characteristics. For example, in a Canadian study, the first bison of a cohort to enter handling chutes were, on average, heavier than the later entrants to the chutes. Since the first bison were sold, while the latter bison were retained, the Park was inadvertently retaining and selecting for genes associated with slower growth or with later birth dates (Personal communication, Wes Olson, wildlife biologist, Parks Canada). Since animal traits and alleles tend to be complexly linked – it isn't just one allele that affects one trait – the implications of such inadvertent selection are unknown.

MANY GENETIC EFFECTS ARE UNKNOWN AND PRUDENT CONSERVATION REQUIRES RETAINING AS MANY BISON AS POSSIBLE

18. The long-term evolutionary effects of losing small amounts of genetic diversity are mostly unknown and under-emphasized in most conservation literature. Consequently, prudent conservation – especially for rare or

declining species – dictates saving and using as much genetic diversity as possible. Given that all plains bison herds, both conservation herds and private commercial herds, in the USA are genetically compromised (based on personal review and field observations), it is my opinion that the Department should not risk severing any genetic diversity from the public herd by trading away offspring of Green Ranch quarantine bison.

a. Much literature in conservation biology emphasizes retaining large amounts of allelic diversity, for example: retaining 95% of allelic diversity over 100 years, as in a recent analysis of population genetics of Yellowstone bison (Perez-Figueroa et al. 2010). However, the implications of losing 5% of allelic diversity over 100 years are seldom discussed, because they are unknown. This has led to complacency regarding loss of the less common alleles in wildlife populations, or in wildlife transplants.
b. Literature on founder effects, genetic drift and inbreeding emphasizes the accumulation of deleterious, often recessive, genes because the results are easily noted and identified. These results often are a high frequency of unusual diseases or of abnormal anatomy, such as extra fingers and toes. In contrast, loss of beneficial alleles that would favor valuable traits, such as high energetic efficiency, has been neglected in studies of founder effects, genetic drift and inbreeding. Loss of these beneficial effects has not been so obvious, but must occur.

19. In conclusion, it is my professional opinion that all the Green Ranch quarantine bison, the original animals transferred to the Ranch and all their offspring, are important, rare and valuable components of this public bison herd – especially for conservation and restoration purposes. They may be replaced only at considerable public expense and delay. While the offspring probably have no additional genetic diversity beyond that present in the 41 original transferees from Corwin Springs, some offspring likely have rare or uncommon alleles that are represented in only one or

very few of the original bison. Also, for conservation and restoration purposes, the younger offspring have more remaining reproductive potential, compared to the older, original bison. Prudent conservation indicates that no offspring should be traded out of the public herd.

I declare under penalty of perjury that the foregoing is true and correct, to the best of my knowledge.

Dated: August 18, 2012

Signed: _____

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