RESOURCE NOTES

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Summary Recommendations-BLM Wild Horse and Burro Population Viability Forum, April 21, 1999

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The final Note in a series of 13, Session 4

RECOMMENDATION #1:

BLM should carefully consider its mandate (The Wild Free-Roaming Horse and Burro Act) with respect to long-term genetic viability of populations of wild horses and burros.

EXISTING POLICY: BLM regulations and policy state that wild horses and burros shall be managed as viable, self-sustaining populations of healthy animals in balance with other multiple uses and the productive capacity of their habitat (CFR 4700.0-6).

DEFINITION: Self-sustaining refers to the process whereby established populations are able to persist and successfully produce viable offspring which shall, in turn, produce viable offspring, and so on over the long term. The absolute size which a population must attain to achieve a self sustaining condition varies based on the demographic and sociological features of the herd (and adjoining herds), and these aspects should be evaluated on a case by case basis. In many cases it is not necessary that populations be isolated genetic units, but both naturally-occurring and management-induced ingress and egress activity can be considered, in order to maintain sufficient genetic diversity within these populations.

DISCUSSION: Reproductive capacity is, to a large degree, dictated by the genetic fitness of a population. Generally speaking, the higher the level of genetic diversity, within the herd, the greater its long-term reproductive capacity. Inbreeding, random matings (genetic drift), and/or environmental catastrophes can all lead to the loss of genetic diversity within the population. In most herds, though, genetic resources will tend to be lost slowly over periods of many generations (~10 years/generation), and there is little imminent risk of inbreeding or population extinction. Potential negative consequences of reduced diversity, however, may include reduced foal production and survival, as well as reduced adult fitness and noted physical deformities. Smaller, isolated populations (<200 total census size) are particularly vulnerable when the number of animals participating in breeding drops below a minimum needed level. This minimum level can be calculated and is different for each population (see subsequent recommendations).

RECOMMENDATION #2:

BLM should continue to use (and improve upon) defensible scientific aerial and/or ground survey techniques in census activities for all managed wild horse and burro herds. In order to fully evaluate genetic viability issues, populations which participate in a measurable level of natural ingress or egress activity and which are, in reality, a component of larger metapopulations, should be identified, and the genetic impact of this activity should be estimated.

EXISTING POLICY: BLM regulations and policy state that HMAs should be inventoried and monitored for population size, animal distribution, herd health and condition and habitat characteristics at least every 4 years (CFR 4710.2). As such, BLM is required to provide reliable estimates of population size and distribution within each herd management area on a regular interval.

DEFINITION: Metapopulation refers to two or more local breeding populations which are linked to one another by dispersal activities of individual animals. These populations may have unique demographic features (birth and death rates) but ultimately may share some genetic material if interbreeding is occurring between individuals. This sharing of genetic material may act to enhance genetic diversity within participating herds, and as such, these populations should be evaluated as one larger metapopulation.

DISCUSSION: A complete population census of each herd management area is unrealistic, especially for the larger populations (>200 total census size). However, population size can and should be estimated using reliable scientific techniques. These survey techniques are under continual revision and BLM continues to participate in these research efforts. On a more critical level, however, is the determination of size of the many smaller populations (<200 total census size) over which BLM has responsibility. Available data indicates that almost 70% of the managed herds have AMLs (appropriate management levels) set at 150 animals or less. In fact, almost 40% of the herds in Nevada, Utah, Wyoming, Colorado, and Arizona (71 out of 177 total HMAs) are indicated to have population sizes of less than 50 animals. There is a real possibility that some of these populations will be unable to maintain self-sustaining reproductive ability, over the long term, unless there is a natural or management induced influx of genetic information from neighboring herds. An exchange of only 2 to 3 breeding age animals (specifically females), every 10 years, is often sufficient to maintain genetic diversity within a given herd. Estimates of existing genetic diversity can be calculated for each wild horse and burro population (see subsequent recommendations).

RECOMMENDATION #3:

BLM should establish baseline genetic diversity information for each population over which it has management responsibility.

EXISTING POLICY: BLM regulations and policy state that HMAs should be inventoried and monitored for population size, animal distribution, herd health and condition and habitat characteristics at least every 4 years (CFR 4710.2). Furthermore, the purpose of monitoring is to collect data necessary to evaluate progress (or lack thereof) in achieving the objectives of management. Within the context of wild horse and burro populations, the ability to maintain the quality of "reproductively self sustaining" is required. This can primarily be accomplished through evaluation and the maintenance of an acceptable level of genetic diversity within the population over the long term.

DEFINITION: Establishing baseline genetic diversity, for a wild horse population, often refers to typing up to 29 genetic marker systems from a sample of individual animals (~25 individuals or up to 25% of the population) within a specific herd. Traditionally, these marker systems have included blood group and biochemical systems, and have required fresh blood samples. These systems were originally developed for verifying parentage or founder animals within a herd. Analysis of genetic diversity, however, can also be done through the use of DNA genetic marker systems, and direct testing can utilize almost any bodily product including hair or even feces. Only DNA marker analysis can be used for burros, however, due to the very limited variation in blood protein genes.

DISCUSSION: Most wild horse herds, sampled to date, have shown fairly high levels of genetic diversity. In some cases, however, this diversity is attributed to a large number of low frequency and relatively rare genetic material which is often easily lost from the herd. Thus, it becomes important to understand the genetic makeup of individual herds. Baseline data needed to establish current levels of genetic diversity in populations is relatively easy to gather. Individual samples cost about $25 to process, and if ~25-50 individuals are sufficient to establish baseline information for herds ranging in size from 100 to 200 animals, then the cost would be approximately $1250 for herds of this size. As a result, a comparison of genetic viability levels in the tested population can be made to existing information from over 100 domestic and wild horse populations representing different herd sizes and demographic backgrounds.

RECOMMENDATION #4:

BLM should establish a realistic management goal for maintenance of genetic diversity within all managed populations. Previous wildlife conservation research, and current efforts with wild horses, suggest management should allow for a 90% probability of maintaining at least 90% of the existing population diversity over the next 200 years. Existing diversity should be sufficient to ensure a self-sustaining (see earlier definition) reproductive capacity within the herd.

EXISTING POLICY: BLM regulations and policy state that wild horses and burros shall be managed as viable, self-sustaining populations of healthy animals in balance with other multiple uses and the productive capacity of their habitat (CFR 4700.0-6). By definition this requires BLM to manage to allow established populations to successfully produce viable offspring which shall, in turn, produce viable offspring, and so on over the long term. This suggests that management monitor levels of genetic diversity within the population in order to mitigate the effects of genetic drift and possible inbreeding and population-associated problems due to loss of diversity.

DEFINITION: Genetic diversity, within wild horse and burro populations, refers to the entire complement of genetic material representative of all individuals (or a sample of individuals) from within the population. Some populations may possess genetic uniformity to a certain "type" or breed of horse, but management interests are specific to maintaining a maximum diversity of genetic material which appears representative of each herd. Promotion of diversity will minimize the effects of genetic drift, or the random loss of genetic material due to mating processes, and maximize genetic health of the herds.

DISCUSSION: Once baseline genetic data has been established, the main focus of genetic management, especially for the smaller populations (<200 total census size), becomes the attempt to preserve as much of the existing genetic diversity as possible. Establishing a genetic conservation goal will require re-testing of herd diversity on at least a five-year cycle, with subsequent evaluations of the potential impact of management decisions (including the establishment and/or revision of appropriate management levels) on that diversity. Management may need to evaluate ways to introduce genetic material into a herd which appears genetically deficient in order to be self-sustaining over the long-term (see subsequent recommendations). Baseline genetic data can also be incorporated into PVA (population viability analysis) models, which attempt to predict the impact of management decisions (as well as environmental catastrophes) on existing diversity levels. Most models require reasonably accurate data in terms of age class foaling and mortality rates, as well as individual genetic information. As such, the means to collect accurate data necessary for a genetically-based PVA, for most herds, is probably unavailable at the present time.

RECOMMENDATION #5:

BLM should, in its efforts to evaluate the genetic diversity and self sustaining nature of managed herds, estimate the genetic effective population size (Ne) of all populations, or metapopulations, with a total census size of 200 animals or less.

EXISTING POLICY: BLM regulations and policy state that wild horses and burros shall be managed as viable, self-sustaining populations of healthy animals in balance with other multiple uses and the productive capacity of their habitat (CFR 4700.0-6). By definition this requires BLM to manage to allow established populations to successfully produce viable offspring which shall, in turn, produce viable offspring, and so on over the long term.

DEFINITION: The genetic effective population size (Ne) is a measure of the total number of mares and stallions which contribute genetically, through successful breeding, to the next generation. Although no standard goal for Ne currently exists for wild horse and burro herds, a goal of Ne=50, which comes from domestic breeding guidelines, can be conservatively applied. Populations, where Ne is calculated to be less than 50, may experience higher rates of loss of genetic diversity than would be considered acceptable under recommended management goals (see earlier recommendation).

DISCUSSION: Limited research into wild horse herds (Pryor Mountain Wild Horse Range and Assateague Island National Seashore populations) has demonstrated that the "Ne", for a herd under a natural age structure, is about 30-35% of the total census population size. In other words, a total population size of about 150 animals might support only a minimum (Ne=50) genetic effective population size. Ne, however, is difficult to calculate for wild horses, since the calculation is complicated by a number of issues. The harem structure of the population, for example, greatly limits male participation in breeding, creating an uneven ratio of breeding sexes which reduces Ne and contributes to a high variation in individual reproductive success. Extreme fluctuations in population size, due to the effects of removals, can also act to reduce the value of Ne. Ne is also highly influenced by the sex ratio and age class structure of a population. A sex ratio which favors males and results in larger numbers of smaller sized harems, within the herd, will act to increase Ne (and male participation in breeding) to a point. A population with an age structure involving high numbers of young animals (<5 years of age) will have a lower value of Ne than a similar sized population with a larger component of older breeding-age animals (>5 years of age). Also, there is no single, uniformly accepted method to calculate Ne. However, researchers have used and applied several formulas to certain wild horse herds and have found this comparative approach to provide the best estimates. Generally, the best possible data on population sex ratios and age structures, coupled with reasonable estimates of foaling and mortality rates, will enable managers to evaluate the genetic health of most herds.

RECOMMENDATION #6:

BLM should evaluate viable management alternatives for conserving or enhancing genetic diversity within populations (or metapopulations) having a known limited level of diversity, a total census size of less than 200 animals and/or an estimated genetic effective population size (Ne) of less than 50.

EXISTING POLICY: BLM regulations and policy state that wild horses and burros shall be managed as viable, self-sustaining populations of healthy animals in balance with other multiple uses and the productive capacity of their habitat (CFR 4700.0-6). By definition this requires BLM to manage to allow established populations to successfully produce viable offspring which shall, in turn, produce viable offspring, and so on over the long term. This suggests that management monitor levels of genetic diversity within the population in order to mitigate the effects of genetic drift and possible inbreeding.

DEFINITION: Viable management alternatives for conserving genetic diversity within managed wild horse and burro herds may take several forms. Some options to be considered might include: altering population age structure (through removals) to promote higher numbers of reproductively-successful animals; altering breeding sex ratios (through removals) to encourage a more even participation of breeding males and females; increasing generation intervals (and reducing the rate of loss of genetic material) by removing (or contracepting) younger versus older mares; and/or introducing breeding animals (specifically females) periodically from other genetically similar herds to help in conservation efforts. In this last scenario, only one or two breeding animals per generation (~10 years) would need to be introduced in order to maintain the genetic resources in small populations of less than 200 animals.

DISCUSSION: Simply increasing the total herd size by adding additional animals (adjusting the management AML upward) is not the only viable technique for enhancing the genetic effective population size (Ne) of a wild horse and burro population. With sound knowledge of existing herd demographic information, management alternatives for specific populations can be evaluated through research modeling efforts. As such, management also has the option of adjusting certain aspects of herd structure in order to promote genetic conservation. Major options for consideration were presented in the above definition. It should also be noted that any adjoining herds, which are naturally participating in an exchange of animals and genetic material through interbreeding, are probably self-maintaining their genetic diversity and management should consider both supporting and estimating this type of activity.

RECOMMENDATION #7:

BLM should continue to evaluate incidences of club foot and parrot mouth, and other such physical deficiencies, within individuals of wild horse and burro populations, on a case by case basis. Currently, there is no solid evidence that these physical conditions are purely genetically-based and that they may contribute to a long-term loss of genetic health in the herd.

EXISTING POLICY: BLM regulations and policy state that HMAs should be inventoried and monitored for population size, animal distribution, herd health and condition and habitat characteristics at least every 4 years (CFR 4710.2). Furthermore, the purpose of monitoring is to collect data necessary to evaluate progress (or lack thereof) in achieving the objectives of management.

DEFINITION: Physical deficiencies may be encountered at different rates for different wild horse and burro herds. Conformational deformity and/or misalignment is often expressed in the legs, feet and mouth but may be apparent in other structural areas as well.

Despite the existence of a specific deficiency, however, an individual animal may otherwise be healthy, bear acceptable condition and be fit enough to contribute socially and genetically to the herd. If an individual animal is successful in these merits, there seems little reason to remove it simply on the grounds of physical imperfection by human standards.

DISCUSSION: These types of physical deficiencies are thought, by researchers, to potentially be both genetically and environmentally (poor forage base during fetal development) induced. As such, efforts to remove individual animals bearing this condition from herds may or may not result in a significant loss of expression of that trait from the herd. Success in this area will be related to the source of the genotype and whether it results from inbreeding, founder effect, and/or genetic drift. However, since multiple genes are probably responsible for the expression of these traits, it is likely that the genetic predisposition will remain in the herd despite the fact that minimal expression is observed. Eventually over time, then, the trait may continue to reappear. Future research may illuminate different theories regarding this situation. In the meantime, the impact of human-induced selection, over factors of natural selection, should be evaluated carefully and with due consideration as to the possible long-term impacts on individual herds. In other words, if the animal is otherwise healthy, maintaining a status within the social structure of the herd, and contributing to the gene pool through successful breeding, it might be left on the range. However, if a population excess has been determined, and an individual animal is young and has yet to contribute to the gene pool, it may be a candidate for removal and adoption or sanctuary-placement. Likewise, if the animal is older, less healthy, and has withdrawn from the herd, it may also be a candidate for removal with sanctuary placement.

RECOMMENDATION #8:

BLM should continue to manage wild horse and burro herds, beneath the level which is scientifically referred to as the ecological carrying capacity (EEC) of the population. This is the level at which science has determined that density-dependent population regulatory mechanisms would take effect within the herd. Most herds are currently managed close to their “economic carrying capacity” which is approximately 50-65% of EEC. At this level of management, health of both the horse herd and range ecosystem are prioritized.

EXISTING POLICY: BLM regulations and policy state that wild horses and burros shall be managed as viable, self-sustaining populations of healthy animals in balance with other multiple uses and the productive capacity of their habitat (CFR 4700.0-6). Thus appropriate management levels (AMLs) are established which provide for a level of use by wild horses and burros which results in a thriving natural ecological balance and avoids deterioration of the range. Furthermore, proper management requires that wild horses and burros be in good health and reproducing at a rate that sustains the population and that population control methods be considered before the herd size causes damage to the rangeland.

DEFINITION: Ecological carrying capacity (EEC) of a population, is a scientific term which refers to the level at which density-dependent population regulatory mechanisms would take effect within specific herds. At this level, however, the herds would show obvious signs of ill fitness including poor individual animal condition, low birth rates, and high mortality rates in all age classes due to disease and/or increased vulnerability to predation. In addition, supporting range conditions would be noticeably deteriorated, with much of the available habitat showing symptoms of irreparable over-grazing.

DISCUSSION: Populations of wild horses on western rangelands have the capacity for rates of increase as high as 20-25% per year. Recent research has shown that unmanaged populations of wild horses and/or burros might eventually stabilize (due to density-dependent regulatory mechanisms) at very high numbers, near what is known as their food limited ecological carrying capacity. At these levels, however, the herds would show obvious signs of ill-fitness including poor individual animal condition, low birth rates, and high mortality rates in all age classes due to disease and/or increased vulnerability to predation. In addition, supporting range conditions would be noticeably deteriorated, with much of the available habitat showing symptoms of irreparable over-grazing. Most wild herds are currently managed close to economic carrying capacity which allows the herds to be healthy with strong foal production and high individual survival rates. This approach should be continued, as it benefits the populations and also allows for the maintenance of healthy and in-balance rangeland systems.

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