

BIGHORN SHEEP

The Small-population Strategy Does Not Work



Montana Fish, Wildlife & Parks claims that 125 bighorn is a “minimum viable population”. Abundant science disagrees. In the long term, 125 bighorn is not a minimum population that is surely viable. In the short term, it may be a population that is minimally viable. (“Minimally” is the more appropriate term, as it inserts a realistic degree of uncertainty and it clearly modifies “viable”, not “population”.)

Compared to other big game, abundant resources are dedicated to bighorn management. Yet, bighorn herds struggle throughout the West. Very many herds remain small and are subject to periodic outbreaks of disease. The most common and most apparent source of bighorn problems is pneumonia that is most often related to contact with domestic sheep.

Consequently, avoiding contact between wild and domestic sheep has become the most overriding management prescription. Small bighorn herds, with no wandering/exploring animals, on small bighorn ranges have become acceptable goals. Many herds have limited or variable recruitment and remain small on very limited ranges for several reasons discussed below. However, ewes are sometimes harvested to maintain small populations. Wandering bighorns that may encounter widely distributed domestic sheep have been “administratively removed”, limiting range expansion.

Bighorn were once very abundant and widely distributed in mountains, canyons and river breaks across the West. They have declined and disappeared for a variety of reasons, most of which persist. Today, most herds are limited by combinations of more than one of these same problems. As a result, management that is focused on only the most apparent problem will fail, or at best provide little improvement in bighorn numbers, productivity or distribution.

Five interrelated problems of bighorn herds are: habitat degradation and loss, small populations, predators, disease, and genetic deterioration. Note, the interrelationships are just as important as the problems themselves. Hence, some redundancy below.

Habitat Loss: Very much bighorn habitat has been lost and degraded by human developments, agriculture, highways, railroads and reservoirs. Partly due to fire control, habitats have been degraded by forest and shrubland growth that diminishes visibility, a key component of good bighorn habitat.

Once, healthy herds accessed four to several seasonal ranges connected by consistently used migration corridors. Loss of these range components has left many herds with fewer and smaller seasonal ranges and few options for responding to variation in weather and plant phenology. Limited diversity of range resources limits herd health and productivity and herd size.

Small Populations: Small bighorn herds have little resiliency for responding to random or periodic losses of even a few animals due to accidents, weather events, predation or disease. They have inadequate genetic diversities and are predisposed to genetic deterioration. They produce few animals that will explore and foster range expansion.

Predation: Mountain lions and perhaps coyotes are the primary killers of bighorn in the United States. Effects of predation are enhanced by small herd size and by poor habitat security. Small herds may experience high predator/prey ratios and have ineffective communal vigilance. Habitat security is often limited by relatively dense vegetation resulting in poor visibility along migration corridors, at watering sites and at foraging areas near escape terrain. Poor visibility inhibits predator detection and visual communication of danger among bighorn sheep.

Disease: Bighorn are subject to several diseases. In recent decades, pneumonia acquired from almost any contact with domestic sheep has been, by far, the most significant concern. Periodic all-age dieoffs followed by years with persisting lamb infections and mortality have been common across the West. Populations have declined by 50-90 percent, exacerbating other small-population effects, including predation and genetic deterioration.

Limited data indicates that larger bighorn herds suffer smaller rates of mortality and their numerical recovery occurs more rapidly. Within small herds, inbred animals have poorer disease resistance, higher mortality rates, and – if they survive – longer recovery times. Inbred animals are more likely to persist as disease carriers and may be responsible for years of post dieoff lamb mortalities.

With the high frequency of bighorn dieoffs related to contact with domestic sheep, almost all bighorn management programs emphasize complete separation of the species. This involves limiting the sizes of bighorn ranges and herds to minimize the numbers of wandering/exploring bighorn. Bighorn with or approaching domestic sheep have been euthanized. It is a small-population strategy used abundantly throughout the West, generally exceeding most other management activity.

Genetic Deterioration: Among the problems of bighorn herds, genetic deterioration has been largely ignored until recently. It may be the least understood problem, especially among practicing wildlife managers. Three components of genetic deterioration are inbreeding, loss of genetic diversity and evolutionary potential, and a dismantling of the adapted wild genome. The latter components are due to a process called genetic drift. Inbreeding effects can become serious within a few generations. Serious effects of genetic drift generally require several generations, but some are irreversible.

Inbreeding can negatively affect many aspects of behavior, physiology and anatomy, often in

unnoticeable ways. The most frequently described effects have been poor reproduction and juvenile survival, and poor disease resistance. Obvious effects of inbreeding may be episodic, depressing survival and reproduction more during times of stress, such as severe weather or during periodic disease challenges. As carriers, inbred animals can prolong the persistence of a population disease event. This may account for persisting lamb mortality following a bighorn dieoff. Likely, inbred animals have an increased susceptibility to predation. Thus, disease, predation and inbreeding can be intertwined.

Geneticists refer to a genetically-effective population size (N_e) for evaluating inbreeding and other genetic trends. N_e varies among species according breeding habits; does not include young pre-breeding animals; varies with the sex ratio of breeders, population fluctuations, and other factors. For a bighorn herd, N_e may be only 10-15 percent of the total population (N).

Over 35 years ago, geneticists suggested an N_e of 50 animals is necessary to avoid “significant” levels of inbreeding in wildlife. More recent suggestions, based on additional information, are that an N_e of 100 is necessary. Note: even if N_e is 15% of N , an N_e of 50 requires $N = 333$, and an N_e of 100 requires $N = 667$.

For wildlife, genetic drift occurs when alleles (types of genes) that are passed between generations are determined by random factors rather than by natural selection. Ultimately, natural selection is necessary to maintain wild-adapted genomes. Genetic drift results in a slow loss of alleles from the population, diminishing its evolutionary potential for responding to future changes in the environment. Drift also dismantles the adapted genome, producing fewer animals with the best combinations of alleles for survival and reproduction in the local environment.

Negative effects of drift are most pronounced in smaller populations. For wildlife, dismantling of the wild genome is also enhanced by human actions that weaken or replace natural selection, including wildlife feeding, maintaining a stable population, vehicle and train mortalities, and harvests. For some wildlife populations, very few adult animals are exposed to natural selection and drift replaces natural selection.

Likewise, over 35 years ago, geneticists suggested that an N_e of 500 animals is needed to avoid “significant” losses of alleles due to drift. Again, recent suggestions, including a concern for loss of natural selection, are that an N_e of 1000 is necessary. Moreover, if N_e is 15% of N , an N_e of 500 requires $N = 3333$; an N_e of 1000 requires $N = 6667$.

A Minimum Viable Population

Montana Fish, Wildlife & Parks claims that 125 bighorn is a minimum viable population (MVP), one that has a good chance to persist for a long time. By contrast, in a review of MVP estimates, in the journal *Biological Conservation*, the vast majority of MVP estimates, for long-term survival of mammal populations, were a few to several thousand adult breeding-age animals!

FWP’s claim is bizarre in light of experience throughout the West, discussions of MVP in scientific literature, and abundant genetics information. FWP makes no allowance for genetic deterioration. Its MVP claim suggests that many Montana bighorn populations are safe from extinction. Yet, FWP’s objectives are even less than 125 for 16 of 43 herds with objectives. It is a small-population strategy, offered as sufficient, when it is not.

Ram Harvest and Genetics

In small wildlife populations, a skewed sex ratio among breeding animals has a relatively large negative effect on N_e , the genetically-effective population size. Montana allows harvest of mature rams from herds as small as 75 animals, and from even smaller herds if they exhibit appropriate sex-age structures. Note, a herd of 75 bighorn has a predicted N_e of fewer than 12 animals. It is likely that removal of some, but not all, prime-age rams will significantly reduce N_e , increasing the number of half-siblings born to the herd and accelerating inbreeding within a few years.

Complex Limiting Factors

With multiple, interrelated problems limiting most bighorn herds, we must expect that solving one problem while ignoring others will eventually fail. In particular, if we are able to isolate bighorn from domestic sheep (or solve this disease issue with some yet undiscovered technology), we will still have small populations on inadequate ranges, subject to serious predation, with deteriorating genetics, and liable to still other types of disease. A more comprehensive strategy is necessary.

Failure of the Small-Population Strategy

In practice, the small population strategy is often doubly small. Small bighorn herds are managed by dealing with a small number of their problems. Montana is not alone in this situation. Many states are similarly, and expensively, struggling with the small population strategy.

Wildlife managers may respond that, given the widespread distribution of domestic sheep, losses of habitat due to increasing human demands, and strong, effective political opposition from competing interests, they have no alternative but the small population strategy. However, the small population strategy should not be presented to the public as a viable solution. Agency quiescence, avoiding the conflict, and resulting public ignorance, only perpetuate management that will be ineffective in the long term. Moreover, promoting the small population strategy as a compromise with other, incompatible land uses is a delusion.

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Supporting references available on request, jabailey34@aol.com