THIRD QUARTER REPORT OF THE SIERRA NEVADA BIGHORN SHEEP RECOVERY PROGRAM

Photo by Heather Johnson

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SIERRA NEVADA BIGHORN SHEEP RECOVERY PROGRAM
# CALIFORNIA DEPARTMENT OF FISH AND GAME

BIGHORN DEMOGRAPHY AND LAMB PRODUCTION

The survival rate for bighorn ewes during the 3rd quarter of 2007 was 98%; 1 ewe died in rockfall during the period. Ram survival was 100% during July - September. During this period, numerous field surveys were conducted that are being compiled and analyzed to estimate annual populations sizes for Sierra Nevada bighorn sheep. Summer surveys included 2 at Mt. Williamson, 2 at Mt. Baxter, and 3 in the Mt. Warren, Mt. Gibbs, Wheeler Ridge, and Mt. Langley herd units.

The Mt. Gibbs herd unit is our least populated but it is on its way up. This spring all 4 adult ewes in the population gave birth to a lamb and those lambs survived through the summer. The Mt. Gibbs population is one that essentially spends the entire year in the alpine at elevations above 11,000 feet and currently much of that time is spent within the boundaries of Yosemite National Park. The current productivity of this population illustrates the potential for bighorn to live almost exclusively at high elevations and yet continue to survive, reproduce, and increase in numbers. Undoubtedly, these alpine populations live in a harsher environment than those that use lower elevations but they are not only capable of persisting but also expanding. As this population grows, we expect it to surpass the carrying capacity of alpine winter ranges and to expand their range and begin using lower elevation winter ranges. The challenge for small populations such as Mt. Gibbs is to survive random events that affect all populations but which can affect small populations to a greater extent. Not until small populations increase towards recovery goals through augmentations or natural reproduction, are they buffered from events that limit populations living in all habitats, be they harsh or mild.

HISTORICAL DISTRIBUTION

Bighorn sheep once inhabited the Sierra Nevada from south of Olancha to Sonora Pass in the north and west to the Mineral King area of what is now Sequoia-Kings Canyon National Park. The evidence for this occupation is substantial and includes recorded sightings from naturalists such as John Muir, as well as recovery of animal remains. Figure 1 includes 280 separate observations that span the period from 1870 - 1971. Given that populations began to disappear throughout the 1900s, these sightings undoubtedly represent only a portion of the area that bighorn occupied. Nevertheless, such locations provide solid evidence for the broad distribution of bighorn throughout the Sierra Nevada. Widespread distribution would have existed only in the presence of a healthy population that was adapted to the environmental conditions associated with this mountain range. Historical evidence, in combination with knowledge of bighorn habitat preferences, provides the basis for current recommendations for the area required for recovery of Sierra Nevada bighorn sheep as represented by the units shown on the map.
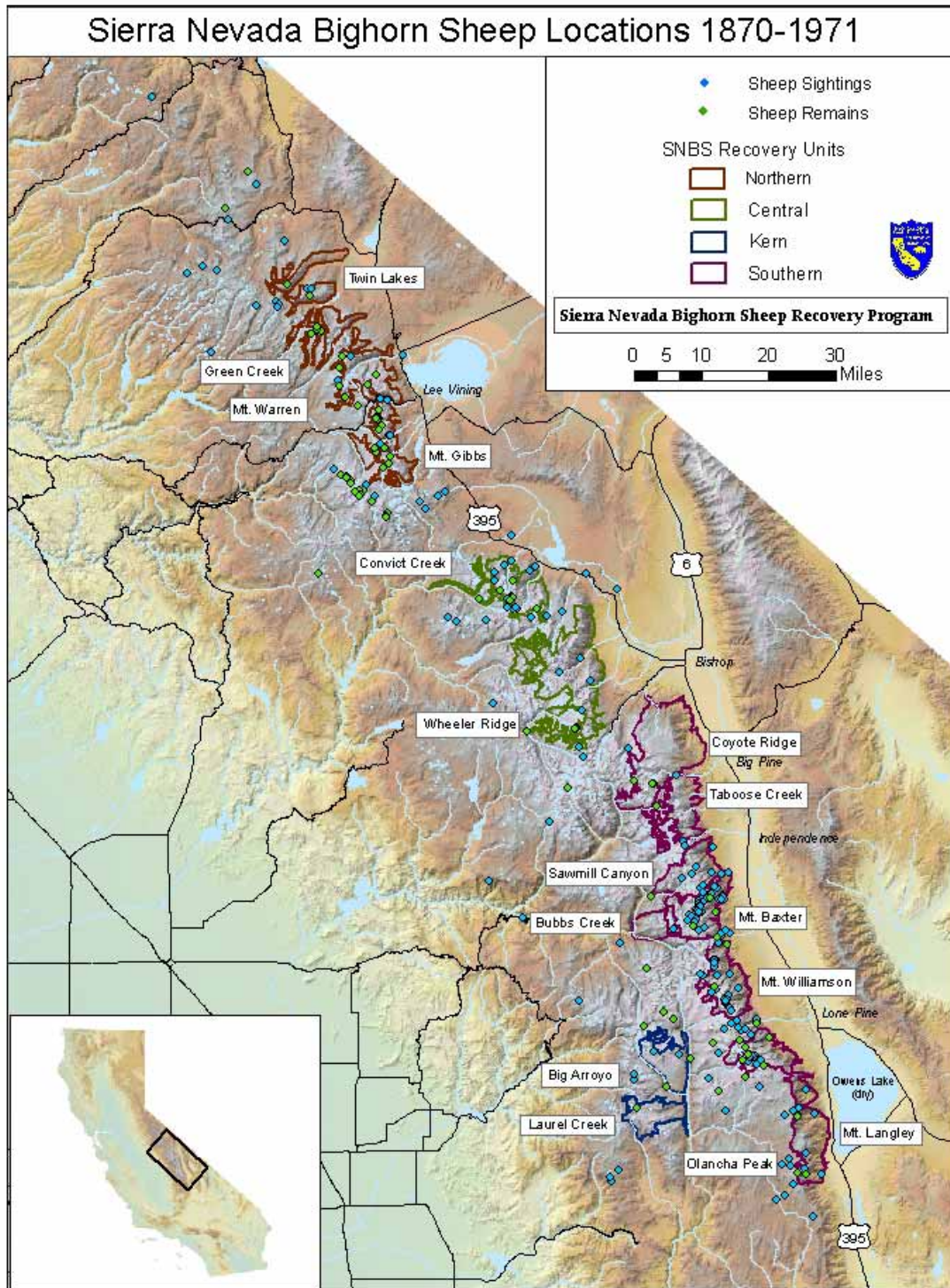
Figure 1. Observations associated with the historical distribution of Sierra Nevada bighorn sheep during 1870 – 1971.

GENETIC RESEARCH ON THE UNIQUENESS OF SIERRA NEVADA BIGHORN SHEEP

In a paper published in 1912, Joseph Grinnell, the well-known wildlife biologist from the Museum of Vertebrate Zoology at UC Berkeley, classified bighorn sheep in the Sierra Nevada as a separate subspecies based on 4 specimens of relatively young sheep collected from the east slope of Mount Baxter the previous year. He designated the oldest of those specimens, a 5-year old male, as a "type specimen" to represent that new subspecies, *O. c. sierrae*. In a revision of the classification of all North American wild sheep about 3 decades later, Ian M. Cowan did not recognize Sierra Nevada bighorn as a separate subspecies, instead placing them at the southern end of a subspecies called California bighorn that extended north to western British Columbia. Both of these classifications were largely subjective judgments based on few data and almost no statistical analysis. About 50 years later, this question was finally revisited in a doctoral dissertation by Rob Ramey. He found that the only statistically valid distinction within bighorn sheep in Cowan's skull measurements was the separation of the Rocky Mountain subspecies from other bighorn sheep. Rob also began looking at mitochondrial DNA (mtDNA) variation among North American sheep using a pre-sequencing method known as restriction fragment length polymorphism (RFLP). The RFLP data did not support Cowan's idea that bighorn sheep in the Sierra Nevada were related to those in British Columbia; Sierra Nevada bighorn appeared to be a unique form possibly related to desert bighorn to the east. During the 1990s, Rob Ramey and John Wehausen added a new detailed data set of skull measurements of bighorn sheep to look further at this question. Their analyses of skull shape found only three distinguishable groups of bighorn sheep that qualified as subspecies: Rocky Mountain, desert, and Sierra Nevada. Because of Grinnell's type specimen, Sierra Nevada bighorn have had to reassume the name *O. c. sierrae*. The oddity of Sierra Nevada bighorn being limited to a single mountain range led Drs. Ramey and Wehausen to begin more detailed genetic investigations in the late 1990s.

Because of the importance of the uniqueness of Sierra Nevada bighorn to their status under state and federal endangered species acts, the newest phase of this research became a component of the Sierra Nevada Bighorn Sheep Recovery Program. In this work, Drs. Ramey and Wehausen were joined by Clint Epps, then a graduate student at UC Berkeley, who developed mtDNA sequence data for a gene called "control region" for a large number of bighorn sheep from the southern deserts of California. As a complement to Dr. Epps' work, John Wehausen has been sampling bighorn sheep from the Sierra Nevada to Death Valley. Together, they have developed control region sequences for 571 individual sheep in California, mostly from fecal samples, as well as some from more distant locations in North America and Siberia. Most recently, John Wehausen has sequenced a second mtDNA gene (ND5) because it provides statistically more reliable analyses than control region. In Figure 2, we present the evolutionary tree from that gene. As was the case with skull shape, bighorn sheep fall into three groups: Rocky Mountain, desert, and Sierra Nevada bighorn. All bighorn sheep in the Sierra Nevada have the same mtDNA haplotype. Of interest, though, is the finding that a few related haplotypes exist east of the Sierra Nevada from the Inyo Mountains to southern Death Valley, all of which are mixed with numerous desert bighorn haplotypes. This does not mean that those populations are Sierra Nevada bighorn; they are desert bighorn in life history and skull morphology. Because mtDNA is inherited only from females, it traces only the history of female lineages. The mtDNA haplotypes east of the Sierra Nevada that are related to the Sierra Nevada appear to be vestiges of a distant history when, perhaps during one or more glacial periods, the distribution of Sierra Nevada bighorn sheep extended further east.
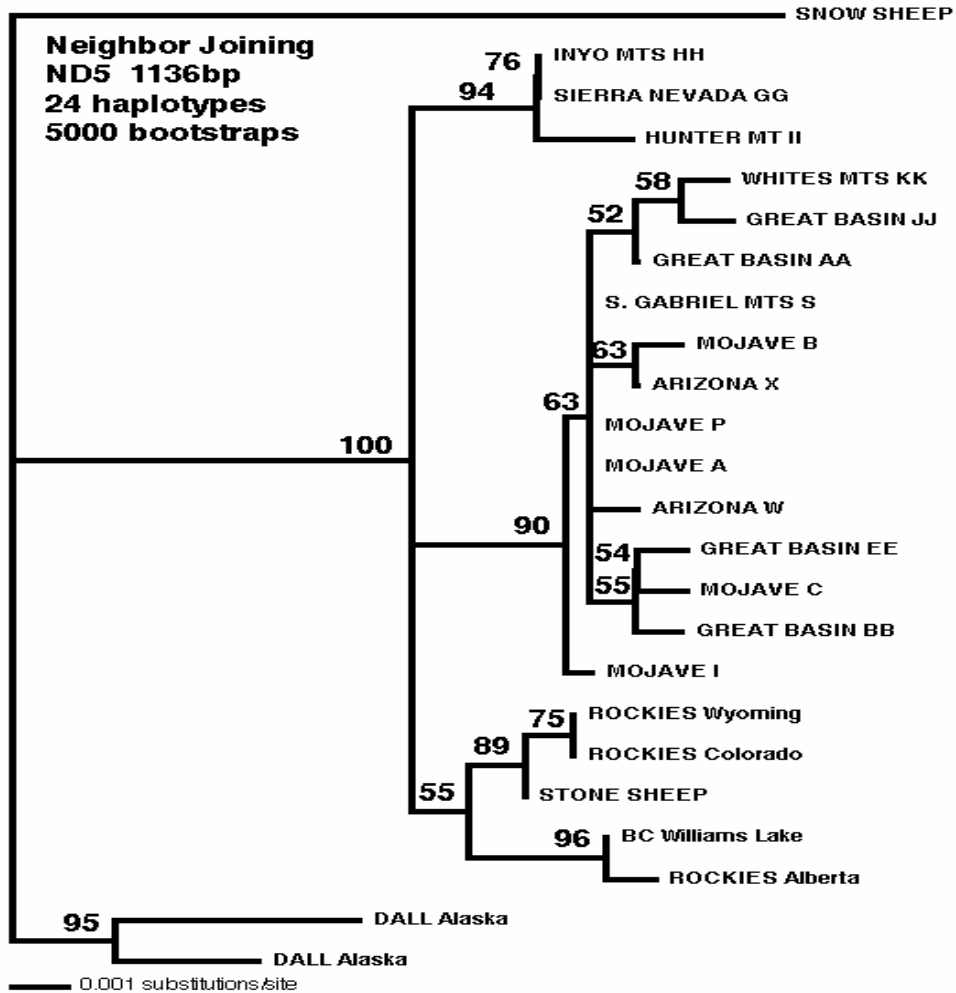
Figure 2. Phylogeny for North American wild sheep based on sequences of 1136 base pairs of the mtDNA gene ND5. Analysis is by the neighbor joining method with 5000 bootstraps, which assesses statistical support (numbers next to branch nodes). At the top is the snow sheep sample from Siberia. At the bottom is the branch for Dall's sheep. In the middle are bighorn sheep with the three branches from top to bottom being Sierra Nevada, desert, and Rocky Mountain. Samples for this analysis were chosen from different control region haplotypes identified from a sample of 571 individual sheep from California, 13 from Arizona, and 10 from more distant locations in North America and Siberia.

FIRE BURNS MT. BAXTER WINTER RANGE

During July 2007, a lightning strike ignited a number of wildfires in the eastern Sierra Nevada. The "Seven Oaks Fire", as it became known, is of particular interest relative to Sierra bighorn because it burned the majority of the low elevation winter range (<8,000 feet) for the Mt. Baxter herd (Figure 3). Fire is generally considered beneficial to bighorn sheep because it eliminates forest cover from ranges and creates the open landscapes that bighorn prefer. The Mt. Baxter winter range was already one of the most optimal in the eastern Sierra because of its openness, range of elevations, and diverse forage. Nevertheless, portions of the range included forested sections that were less suitable for bighorn and made them vulnerable to predators; bighorn may benefit from the burn in those areas.

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Although the fire largely scorched all above ground vegetation within its perimeter, rainfall this winter will likely produce resprouting and germination sufficient to provide adequate forage for bighorn. During the coming years, program personnel will be evaluating the effects of the "Seven Oaks Fire" on forage availability and quality and habitat selection by bighorn in the Mt. Baxter herd. Planning efforts are underway to implement prescribed burns in a number of Sierra bighorn herd units. Vegetation succession resulting in forest encroachment on some winter ranges has led to the need for such management actions. Evaluation of the Seven Oaks Fire and other burns on eastern Sierra winter ranges will enhance our understanding of the factors that create optimal habitat for bighorn sheep and facilitate development of recommendations for future prescribed burns.
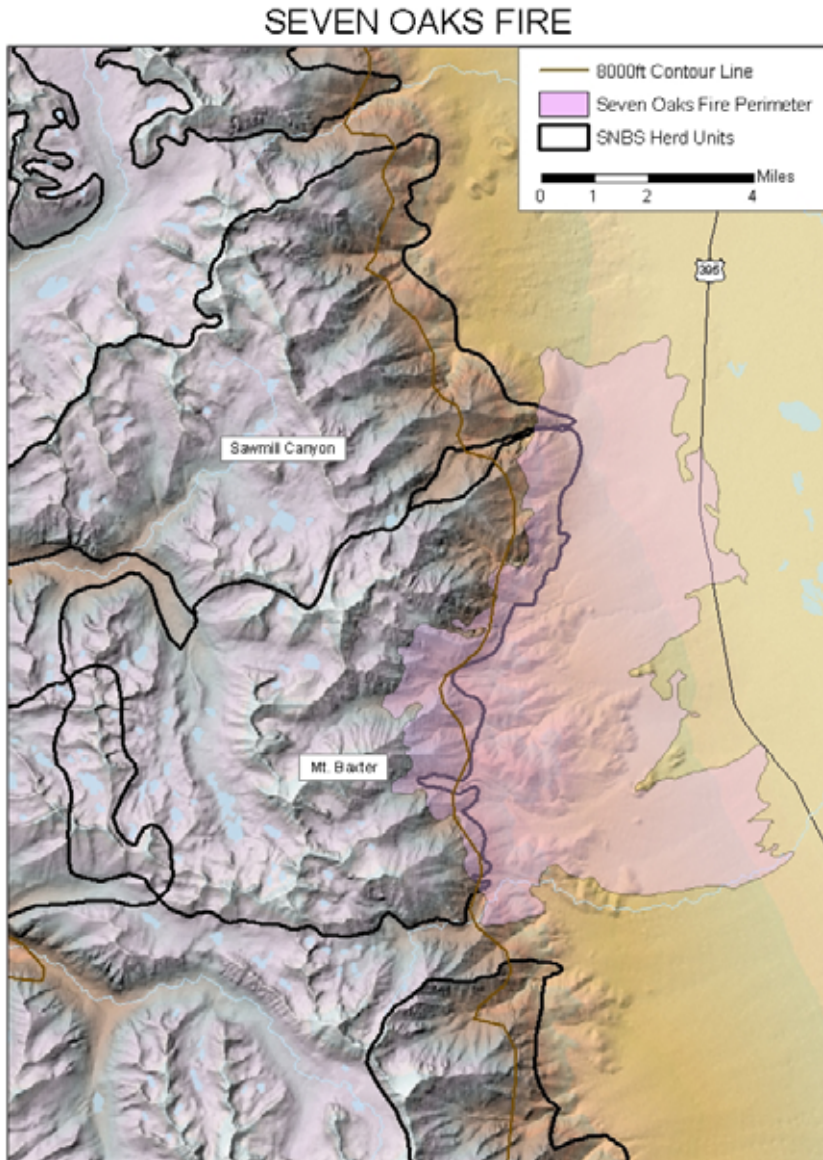
SEVEN OAKS FIRE

Figure 3. The perimeter of the Seven Oaks Fire overlaid on the Mt. Baxter herd unit boundary. During July 2007, the fire burned much of the low elevation winter range (<8,000 feet) for the herd.

MARIJUANA GROVES ON MT. WILLIAMSON WINTER RANGE

During July 2007, law enforcement officials raided a number of marijuana growing operations in canyons at the base of Mt. Williamson. The largest garden contained tens of thousands of marijuana plants and was within the low elevation winter range that is most heavily used by

bighorn sheep on Mt. Williamson, Shepherd Creek. There is concern that such growing operations have the potential to impact bighorn recovery because activity was occurring since the spring when bighorn would typically have been using the winter range. The level of activity associated with the growing operation, the use of toxic chemicals, the potential for harassment, and the threat of poaching create cause for concern for this population.

The Mt. Williamson population has been difficult to monitor because of its extremely rugged terrain and small population size. During 2004, 7 ewes and 4 lambs were observed on the north ridge of Mt. Williamson. DNA extracted from fecal droppings in recent years, indicated that at least 10 ewes occupied the range. Following the raid, we began implementing increased monitoring of this population and its habitat. Two survey efforts resulted in observations of 28 bighorn sheep, including 13 adult and yearling females, on the high elevation summer range. This recent count represents the largest observed number of bighorn on Mt. Williamson in over 2 decades. Efforts to recover this herd will continue and should include the exclusion of illegal harmful activities within their range.

Figure 4. Uprooted marijuana plants and trash in a garden in the Shepherd Creek drainage on the Mt. Williamson herd winter range. The slope above and adjacent to the garden is typical of low elevation winter range used by bighorn sheep in the Mt. Williamson herd unit.

PERSONNEL AND ACKNOWLEDGEMENTS

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