

## Sierra Nevada Bighorn Sheep: 2006-07 Status

John D. Wehausen, Ph.D.  
University of California  
White Mountain Research Station

Heather Johnson  
California Department of Fish and Game  
Sierra Nevada Bighorn Sheep Recovery Program

Thomas R. Stephenson, Ph.D.  
California Department of Fish and Game  
Sierra Nevada Bighorn Sheep Recovery Program

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This report synthesizes population information for bighorn sheep herds in the Sierra Nevada developed over the past year beginning in July 2006 as part of the Sierra Nevada Bighorn Sheep Recovery Program lead by the California Department of Fish and Game. We were greatly assisted in the collection of data by Lori Bowermaster, Tammy Branston, Dave German, Lacey Greene, Dennis Jensen, Kathleen Knox, and Cody Schroeder. This report reviews prior information where needed to interpret data developed during this time period. As in previous reports, the number of sheep represents numbers present in the first half of the sampling year, the summer of 2006 for this report.

Efforts are made every year to develop some data on every herd in the Sierra Nevada. Over the years these efforts have used knowledge of habitat use patterns of each herd to attempt to count as many sheep as possible when they are most concentrated. Such counts all represent minimum numbers present by population, but those minima can vary in what percentage of the population was accounted for. Recent rapid increases in sizes of some, while very desirable, have made population monitoring more difficult in some situations because each herd has a higher number of sheep that need to be found in a short time period for a complete count. A result is that some counts can be well below actual population levels. The judgment on the completeness of counts is based on recorded numbers and reproduction in previous years tempered by potential mortalities, and sometimes coupled with interpretation of field evidence of additional groups of sheep not seen. Increasing numbers of radio collars have provided more information for that assessment. Better counts in subsequent years also have been used to evaluate and correct past counts to higher minimum numbers present by sex and age categories. These are known as reconstructed populations.

We have also supplemented minimum and reconstructed count data with mark-resight estimates using collared sheep. With the recent large effort to place collars on numerous sheep in many herd units, there is considerable opportunity to engage this approach. This is particularly needed given the growth of sheep numbers in a number of herd units to levels where minimum counts miss a considerable portion of the sheep. However, the radio collars that allow mark-resight estimates also enable more complete minimum counts because radio signals expose groups otherwise missed. Consequently, a sampling approach that is now often employed

involves multiple observers first finding as many sheep as possible without the aid of telemetry for mark-resight estimates, followed by the use of telemetry in attempts to find sheep groups not yet sampled to maximize the minimum count. Our population surveys focus primarily on females because they are the reproductive base of the population. However, at Wheeler Ridge and the Mono Basin there are enough telemetered males to allow focus to extend to that gender as well. It has been our experience that, for most bighorn sheep populations, it will be difficult to develop consistent good minimum counts once the number of females has increased beyond 30 unless aided by extra technology like telemetry.

### **Highlights of the Past Year**

Following three winters of notably early initiation and precipitation levels well over average, the 2006-07 winter represented the other end of the spectrum: relatively late initiation with the first major snow storm not occurring until late January, and total winter precipitation the lowest in over 35 years. These weather conditions significantly limited our ability to assess the sizes of some populations. Those were populations for which the best data have been developed when sheep concentrated on low elevation winter ranges (Mount Baxter, Sawmill Canyon, and Wheeler Ridge herd units). During the winter period when that would have occurred in 2007, there was a paucity of snow at higher elevations, limited forage growth, and few sheep on those winter ranges.

In our last report (Wehausen and Stephenson 2006), we gave a conservative estimate of the total bighorn sheep population in the Sierra Nevada at 386 for the summer of 2005. Given limitations on population data over the past year, we can project from summer reproduction that the total population last summer undoubtedly crossed 400; but information gaps preclude estimating the population more precisely.

Efforts to radio collar bighorn sheep in the Sierra Nevada continued this past year, bringing the current total number of sheep carrying functional telemetry collars to 70 or about 17% of the total population: 17 females in the Mount Langley herd unit, 4 females in the Mount Baxter herd unit, 3 females and 1 male in the Sawmill Canyon herd unit, 15 females and 9 males in the Wheeler Ridge herd unit, 3 females and 3 males in the Mount Gibbs herd unit, and 5 females and 10 males in the Mount Warren herd unit. Four telemetered sheep were killed by mountain lions during the past winter: 1 in the Wheeler Ridge herd unit, 2 in the Sawmill Canyon herd unit, and 1 in the Mount Baxter herd unit.

### **Mount Langley Herd Unit**

The Mount Langley herd unit exhibited a major increase in the use of low elevation winter ranges beginning in 2004. While this was a dramatic change in habitat use patterns, the number of adult and yearling females observed on the winter range has been only about two-thirds of the total accounted for in summer. Consequently, the virtual absence of sheep on those winter ranges in 2007 has not significantly affected our ability to track the dynamics of the population, which is done in summer.

A particularly good minimum count of 33 females was made in 2004 and was probably a

complete count. That count was the final value in a series of excellent population data that indicated more than a tripling of the population in four years. During that increase, the summer lamb:adult ewe ratio declined 60% from 1.00 to 0.40. In the summer of 2005 only 28 females could be counted, but the lamb:ewe ratio doubled to 0.80 – probably a reflection of the influence of increased winter range use beginning in 2004.

During the summer of 2006, four separate sampling efforts involving multiple biologists attempted to sample as many sheep as possible. During that time period 8 telemetered females were available for use in mark-resight estimates and to help improve minimum counts. Total numbers of sheep seen in those surveys varied greatly from 28 to 88. From those four counts a minimum total of 91 sheep (34 adult females, 11 yearling females, 18 lambs, 7 yearling males, and 21 adult males) could be accounted for including the additional marked sheep not seen. That minimum total lacked at least the other animals that accompanied the 2 telemetered females not observed and probably additional males, which were not the focus of those surveys. Ratios of lambs to adult females varied among the surveys from 0.45 to 0.61, and averaged 0.54 for the total sample of 81 adult females. Use of telemetry receivers did not add any female groups beyond those found initially without telemetry. This occurred because telemetered sheep not seen were in areas very difficult to access.

The Bowden mark-resight estimator (Bowden and Kufeld 1995) was used to produce population estimates because it is considered better suited for bighorn sheep populations due to varying sightability probabilities among individuals (McClintock and White 2007); however, these estimates were complicated by multiple sampling problems. First were 24 sheep including 10 adult and 5 yearling females that lacked any collars that appeared to spend the summer in the Lone Pine Peak area. They were all seen on the second count, but were potentially not well represented in the other counts. Second, there was a high variance in sampling success of the four counts, ranging from 11 to 42 total females. Third, there was a high variance in the percentage of adult and yearling females collared among the samples: 16.7 and 14.3% in the first two counts, and 29.2% for each of the final two counts. This means that considerably more sampling was needed for the estimate to stabilize. Estimates for adult females (29; 95%CL:24-36) and adult and yearling females (37; 95% CL:30-46) were well below the minimum number that could be accounted for. Estimates also were made only for sheep sampled south of Lone Pine Peak, yielding 24 adult females (95% CL:20-30); and 29 adult and yearling females (95% CL:24-36). Adding the 10 adult and 5 yearling females observed on Lone Pine Peak to these estimates yields respective estimates of 34 and 44 (approximate 95% CL: 30-40; 39-51); but these still do not exceed the minimum numbers accounted for except through confidence intervals. The total population at Mount Langley in 2006 undoubtedly exceeded 100.

### **Mount Williamson Herd Unit**

The Mount Williamson population has been notoriously difficult to monitor for numerous years. Few sheep have been seen during annual summer monitoring efforts beginning in 1996, while a maximum of only 6 sheep has been documented on a small winter range in Shepherd Creek. However, fecal genotyping documented as many as 7 different lambs each year in 2001 and 2002, and at least 10 females at the end of the previous decade. In the summer of 2004, some verification of those numbers finally occurred when 7 females and 4 lambs were seen in

one group on the north ridge of Mount Williamson above North Bairs Creek, and fresh tracks possibly from a couple more females were observed in neighboring South Bairs Canyon.

No further summer sightings were made in 2005 or 2006 and winter ranges were not investigated during the past very dry winter. In 2005 a new analysis of fecal DNA was initiated to assess sheep numbers in this population through different genotypes. Laboratory analyses were made of 3 lamb samples collected in the summer of 2004 and 21 adult and lamb samples collected in 2005. With the exception of 3 samples collected for us by Elizabeth Wenk near Vacation pass, those samples all came from the east side of Mount Williamson. Thirteen different genotypes were identified from those 24 samples, but two of those genotypes (1 adult, 1 lamb) are not considered reliable because the DNA was quite degraded. The 11 reliable genotypes were 5 adult ( $\geq 1$  year old) females, 2 female lambs, and 4 adult males for 2005, plus 1 male lamb from 2004.

In September 2006 a sampling trip was made from North Bairs Creek to Georges Creek, during which numerous fecal samples were collected. Some of the first of those collected high in North Bairs Canyon were still wet; apparently those sheep were missed by half a day. Genetic analyses of 22 fecal samples from 2006 identified 10 different sheep: 6 adult females, 2 lambs (1 female, 1 male), and 2 adult males. Two of the adult females matched adult females sampled the previous year, while a third adult female matched a female lamb from 2005. One of the adult males matched the male lamb from 2004.

Fecal DNA analyses for the past 2 years have identified 9 different adult ( $\geq 1$  year old in 2006) females, 6 adult males, and 3 lambs (1 females in 2005, and 1 of each sex in 2006) that have not yet been identified as adults, for a total of 18 different sheep. As occurred in a similar genotyping effort in the late 1990s, a considerable number of new genotypes were identified in the second year, suggesting that numerous additional sheep may remain to be sampled. More extensive sampling will be attempted in 2007. The total population undoubtedly exceeds 20.

### **Bubbs Creek Herd Unit**

A helicopter survey in late March of 2006 produced the highest count of this herd to date: 20 sheep composed of 7 adult females, 1 yearling female, 5 (2005) lambs, 6 adult males, and one unclassified sheep. No flight was made in 2007.

### **Mount Baxter Herd Unit**

This herd has shown increasing use of low elevation winter ranges for a few years, including Sand Mountain, where most of the sheep translocated during 1979-88 were caught. Particularly good winter range counts were obtained in 2005 and 2006 when, respectively, 26 and 31 females were documented as the reproductive base. Summer range counts mostly have not been feasible and few sheep were seen on winter ranges during the dry winter of 2006-07; thus there are no new population data available. The one radio collared male in this herd unit was killed by a mountain lion in late winter just south of Oak Creek.

### **Sawmill Canyon Herd Unit**

The Sawmill Canyon herd also has been showing increasing use of low elevation winter ranges, including Goodale Creek, where 13 sheep were seen in 2006. The total number of females in this herd unit during winter 2006 was 15, including 3 translocated from Wheeler Ridge. Similar to the Mount Baxter herd unit, few sheep were observed on winter ranges this past season; thus no new information on population size is available. However, 2 of the 3 ewes translocated from the Wheeler Ridge herd in 2005 that ended up in this herd unit were killed in May by a mountain lion in Goodale Canyon in proximity to each other over a short time period.

### **Wheeler Ridge Herd Unit**

The Wheeler Ridge herd has offered consistently excellent opportunities to track population size on low elevation winter ranges since it re-colonized those ranges in the late 1990s. This population has exceeded 100 sheep for 2 years: 108 in 2004-05; and 113 in 2005-06. Numbers of adult and yearling females have been 36 in 2003-04, 40 in 2004-05, and 45 in 2005-06, while numbers of adult and yearling males have unexpectedly exceeded females: 41 in 2004-05 and 50 in 2005-06.

During the summer of 2006 Wheeler Ridge was surveyed 3 times by multiple observers to develop a mark-resight estimate and minimum counts. Totals counted were quite consistent, varying from 41 to 55 total sheep (15-22 adult and yearling females). Bowden estimates (95% CL) were 43 (29-66) for adult females, 51 (34-79) for adult and yearling females, 52 (30-92) for adult males, and 59 (33-105) for adult and yearling males. Because ages advance in spring, summer values for adults are comparable to winter values for adults and yearlings. The summer 2006 mark-resight estimates compare well with minimum values from the previous winter, but have wide confidence intervals.

Similar to other herd units, this population also made little use of low elevation winter ranges in 2007, and thus provided little opportunity to update population data. The best sampling opportunity occurred in mid April, but could account for a minimum total of only 79 sheep (34 adult females, 4 yearling females, 11 lambs, 26 adult males, and 4 yearling males). Mark-resight estimates from that single sample were of limited value due to wide confidence intervals: 49 adult and yearling females (95% CL:37-61) and 59 adult and yearling males (95% CL:26-92). However, both estimates are very close to those from the previous summer and thereby provide corroboration. The two data sets were not combined for a joint analysis because of a large change in numbers of collars and some likely population change due to mortalities.

Sampling in the three summer surveys yielded an overall ratio of lambs to adult females of 0.65, whereas the April survey yielded only 0.42 for that ratio.

Mountain lion activity on low elevation winter ranges on Wheeler Ridge has increased in recent years. Of concern this past winter was evidence that one lion spent the winter at high elevations (ca. 11,000 feet), where sheep would have been essentially the only prey base. Because of the access difficulties of that habitat, data are lacking relative to the numbers of sheep that might have been killed. Among the radio-collared sample, 2 male bighorn sheep were

confirmed as having been killed by mountain lion.

### **Mount Gibbs Herd Unit**

In 2002 and 2003, the female component of this herd unit contained 3 adult females, 1 lamb, and 1 yearling male. In 2003, 5 adult males also were known to exist. In 2004 the population increased by one to 3 adult females, 1 yearling female, 1 lamb, and 5 adult males; but 2005 counts indicated that this herd had declined by 2 to 3 adult females, 1 lamb, and 4 adult males. Counts in 2006 indicated the loss of another male and the gain of a female to 3 adult females, 1 yearling female, 2 lambs, and 3 adult males. This composition was verified multiple times, and is only the second time that 2 lambs have been present in this population in summer since 3 females with two lambs colonized this area from Lee Vining Canyon in 1986. One of the lambs in 2006 was quite small when first seen in late July and probably was born in late June or early July. These females and lambs again used Mount Lewis extensively in 2006.

### **Mount Warren Herd Unit**

In recent years this population has been documented to move between Mount Warren, Tioga Crest, and the north side of Lundy Canyon. The summer of 2006 was no exception. While these sheep can use lower elevations back in Lundy Canyon later in spring, females in this population have not used low elevation winter ranges since they abandoned use of Lee Vining Canyon after a lion was hunting them there in 1998.

During the summer of 2003, a minimum total of 28 sheep could be accounted for in the Mount Warren herd unit. The following summer that total dropped by 1, comprised of 7 adult females, 1 yearling female, 5 lambs, 2 unidentified females or yearlings, and 12 males. During summer 2005, counts from Mount Warren, Tioga Crest, and the north side of Lundy Canyon totaled 7 adult females, 2 yearling females, 3 lambs, 2 yearling males, and 11 adult males, for a total of 25. Most recently, field efforts during the summer of 2006 accounted for 7 adult females, 2 yearling females, 4 lambs, and 10 adult males, for a total of 23. That composition was re-verified on the ground and during winter helicopter capture efforts. Thus, over a 3 year period of heavy winters, while wintering in alpine habitats, this population declined by 5 sheep (18%). One older collared female is known to have died during the past dry winter.

The total Mono Basin population was 32 in 2006, which constitutes a 16% population decline from 38 over 3 years. On a positive note, the number of adult and yearling females has increased by 2 during that time period (a 23% increase). Given the nature of the winters involved and the winter habitat selection by those sheep, these population dynamics are quite modest and speak to the adaptations of these sheep as alpine specialists. Nevertheless, resumption of low elevation winter range use may be necessary for bighorn sheep in the Mono Basin to increase substantially in population size.

### **Synthesis**

Table 1 summarizes the most recent data for each occupied herd unit. In our previous report we provided a conservative estimate of 386 bighorn for the entire Sierra Nevada for the

summer of 2005. Addition of new lambs in 2006 in the Mount Langley, Mount Baxter, Sawmill Canyon, and Wheeler Ridge herd units undoubtedly increased that total to over 400. Given (1) recent losses of collared sheep to lions in a few herd units and the potential that numerous uncollared sheep may have similarly died, and (2) the lack of new information for a number of herd units, there is no basis to project how much over 400 the total population might be.

Table 1. Summary of most recent data for Sierra Nevada bighorn sheep herd units. Figures are minimum counts and conservative estimates where counts are lacking (marked by ~).

| <u>Herd Unit &amp; Year</u> | <u>adult ewes</u> | <u>yrlyg ewes</u> | <u>total ewes</u> | <u>lambs</u> | <u>yrlyg rams</u> | <u>adult rams</u> | <u>total rams</u> | <u>unid.</u> | <u>total</u> |
|-----------------------------|-------------------|-------------------|-------------------|--------------|-------------------|-------------------|-------------------|--------------|--------------|
| Old (2005-06) Data          |                   |                   |                   |              |                   |                   |                   |              |              |
| Bubbs                       | 7                 | 1                 | 8                 | 5            |                   | 6                 | 6                 | 1            | 20           |
| Baxter                      | 26                | 5                 | 31                | 16           | 2                 |                   | ~22               |              | ~69          |
| Sawmill                     | 12                | 3                 | 15                | 11           | 3                 |                   | ~10               |              | ~36          |
| Wheeler                     | 35                | 10                | 45                | 18           | 4                 | 46                | 50                |              | 113          |
| New (2006-07) Data          |                   |                   |                   |              |                   |                   |                   |              |              |
| Langley                     | 34                | 11                | 45                | 18           | 7                 | 21                | 28                |              | 91           |
| Williamson                  |                   |                   | 9                 | 2            |                   |                   | 6                 |              | 17           |
| Gibbs                       | 3                 | 1                 | 4                 | 2            |                   | 3                 | 3                 |              | 9            |
| Warren                      | 7                 | 2                 | 9                 | 4            |                   | 10                | 10                |              | 23           |

## Literature Cited

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