

**SIERRA NEVADA BIGHORN SHEEP: 2000 POPULATION SURVEY RESULTS
A REPORT TO THE CALIFORNIA DEPARTMENT OF FISH AND GAME**

John D. Wehausen, Ph.D.
White Mountain Research Station
November 2000

This report follows the same format as its predecessor from 1999. That report provided a detailed history of each population. This report will not repeat that history; instead, it will simply provided new information obtained over the past year. However, it will do this in the context of what was known about each population in 1999.

These results are organized by the larger traditional population designations. Because of substructuring withing some of these, the data are further broken down by those subpopulations (groups) of females. Monitoring efforts have been oriented toward females, the reproductive base. This emphasis of this report is lamb production and recruitment, rather than total sheep numbers. Consequently, males will be mentioned only occasionally because data on this sex has been incomplete.

I. Mount Langley Herd

In 1999, the documented reproductive base of this population consisted of 9 females, and those females had 5 lambs accompanying them. During the summer of 2000 we again totaled 9 adult females. They were accompanied by 5 yearlings (3 male, 2 female) and 9 lambs. Of the lambs, 1 was born very late (August).

Since recent attempts at detailed monitoring of this population began in 1996, there have been naturally marked females that have aided this effort. With the recruitment of additional females since 1996, the number of naturally-marked individuals has also increased. Currently, of the 9 adult and 2 yearling ewes known, there are 6 that are individually recognizable.

No sheep from this herd were observed in low elevation winter ranges this past winter.

II. Mount Williamson Herd

Three summer trips into the range of this population during the past summer failed to find any sheep. Sign of sheep was also unexpectedly sparse in the South Bairs cirque area that had shown a notable increase in use by groups of females, lambs, and yearlings in 1999. In a September trip this year, a set of 3 beds with adult pellets was found on the Mount Williamson east plateau above Georges Creek, as well as a few other adult samples from the S. Bairs cirque wall. The only other sign of sheep use there this year were a couple of pellet groups from one or two adults in late June. There was no sign of any lambs, in contrast to 1999. Initial genetic testing of the fecal samples collected in 2000 indicate that these were all male sheep. Thus, we could find no evidence of any females using the South Bairs Creek area of Mount Williamson this past summer.

During the September trip, a few weathered fecal samples were also located and collected from the Mount Williamson north ridge above North Bairs Creek cirque, including samples from small lambs. Sheep sign was also sparse in this area.

Genotyping of samples collected from 1997-99 is almost complete. While some small details may change with further testing, interesting and noteworthy patterns in the data that have important bearing on future field work make them worth reporting at this time. Samples analyzed were from female-lamb groups in the South Bairs cirque and high on the Williamson north ridge between the North Bairs cirque and upper Williamson Creek. These areas were chosen for sampling because of high use there by ewe-lamb groups when this population previously used low elevation winter ranges. Samples analyzed were (1) 1997: 2 adults from South Bairs cirque, 5 adults, 1 lamb from the north ridge; (2) 1998: 3 adults, 2 lambs from the north ridge; and (3) 1999: 10 adults, 3 lambs from South Bairs cirque.

Currently, the genotyping results identify the following individual sheep: (1) 1997 -- 4 adults (1 male, 3 female), 1 female lamb, with the two South Bairs samples being the same female, which was also part of the north ridge group sampled; (2) 1998 -- 3 different females and 2 male lambs, none of which matched any 1997 individuals; (3) 1999 -- 6 adult females, 1 adult male, and 3 female lambs, of which 3 females were the same as the 1998 females, and the male matched one of the male lambs in 1998. In total, these 26 samples have been from 16 distinct genotypes: 9 adult females, 6 lambs (4 females, 2 males), and 2 adult (probably both yearling) males, one of which was the same genotype as a lamb. Of 3 lambs that might have been documented as yearlings, this was the only one documented as such. A conservative assessment would put this population at 10 adults, but this does not include mature rams that have not been adequately sampled yet. The yearly progression of new adult female genotypes encountered in this sampling (1997-99) has been 3, 3, and 3. The linearity of this pattern suggests that there are more that are as yet unsampled.

Two patterns in field and genotyping data are of notable interest. First, none of the sheep sampled in 1997 have appeared in later samples. Second, use of what was once core summer range of ewe groups apparently now receives only sporadic use. These observations indicate that the areas of Mount Williamson investigated for sheep over the past 5 summers are now margins, rather than core areas of the range used by these sheep. The north-to-south pattern of decreasing use suggests that the core area is further north.

A hypothesis that will be explored in future field efforts is that the core range is further down Williamson Creek on the north ridge of Mount Williamson. Use of west side of Williamson Creek is apparently also sparse. I have traversed the high sloping plateau between Williamson Creek and Shepherd Pass every summer for 4 years without encountering any bighorn sign. The core area of use is also not likely to be in the North Bairs drainage, because of the thick mountain mahogany vegetation there. The lower east side of the Williamson Creek drainage, however, contains an expanse of relatively open, rocky terrain that will be a focus of field work in the next year.

III. Mount Baxter Herd

All data on the three female groups constituting this herd were derived in high elevation

summer ranges. The only sheep seen on lower elevation winter ranges was a lone ram in Onion Valley.

A. Black Mountain Group

In 1999, 5 females and 4 lambs were known in this group. This year 5 females there were accompanied by 3 yearlings and another 4 lambs. These sheep were located very early in the summer under a circumstance in which the sexes of all yearlings could not be determined. At least 2 of the yearlings were female.

B. Sand Mountain Group

The mechanical failure in 1999 of an automated video camera on Baxter Pass precluded any summer data for that group that year. Additionally, because no sheep were sighted on the Sand Mountain winter range during the past winter, there was a data gap of a full year for this group. In 1998, this group was known to contain 3 adult females, 1 yearling female, 1 lamb, and 1 2-yr male that used Baxter Pass. An additional 2 females that spent time on the winter range just south of Sawmill Canyon may have been additional sheep. This past summer the Baxter Pass video camera provided excellent data. It ran for about 2 months beginning in late June and recorded sheep on 14 different days (10 in the month of July). This represents a substantial increase in the use of this pass compared with recent years. The sheep identified in the video footage were 5 females, 4 yearlings (2 female, 2 male), and 5 lambs.

C. Sawmill Canyon Group

In 1999, 6 females and 1 lamb were observed, and sign found suggested that there existed at least a couple of yearlings in addition.

A short trip through this summer range this fall netted the following evidence of sheep: (1) fresh sign of a group of 2 different lambs and probably 4 adults at the west base of Mount Perkins; (2) recent sign west of Woods Lake of probably 3 adults and 2 lambs, one of which appeared from fecal pellet size to be an out-of-season lamb born well into summer; and (3) 2 ewes, 2 yearling ewes, 1 lamb, and 1 2-year old ram seen in the canyon south of Woods lake. This information suggests the possibility of a minimum of 9 adults and yearlings (excluding the 2-yr. old ram seen) and 5 different lambs in female groups in this region in 2000. Genotyping of fecal samples collected the past two years will help clarify the size of this group.

IV. Wheeler Ridge Herd

Winter Surveys

In contrast to other herds in the Sierra Nevada, this population has been monitored primarily in winter. In recent years, this has been possible because these sheep frequented low slopes in upper Pine Creek during winter, where minimum counts have been made. Details on ages of sheep seen in subsequent years have allowed these minima to be corrected for missed animals to produce

reconstructed minimum population sizes. In particular, in 1998 a significant fraction of the herd could not be accounted for (Figure 1). The following year the likely explanation became apparent; these sheep were no longer spending winter primarily in the upper Pine Creek area, but were dropping to lower elevation winter ranges above Round Valley. In 1999, about three-quarters of the females, lambs, and yearlings were documented to move out Pine Creek to lower elevations, while the rest remained in Pine Creek through the winter. During this past winter (2000), all sheep that could be accounted for left Pine Creek in mid winter and occupied the lower-elevation front country canyons. Of particular note is the 60% increase in winter lamb:ewe ratios that correlates with this change in winter habitat use patterns (Figure 1).

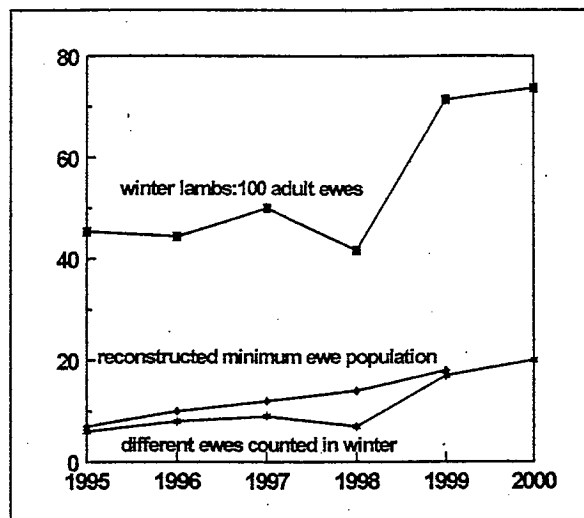


Figure 1. Wheeler Ridge herd data.

During the past winter, 16 adult ewes, 4 yearling ewes, 14 lambs (11 female, 3 male), and 4 yearling rams could be accounted for in the Wheeler Ridge herd. This best minimum count involved 4 groups monitored simultaneously. Only 3 of the 4 yearling females were in these groups at that time; the fourth had been with them earlier in the winter. Her absence suggested that other sheep also were not available for counting. Other sheep were documented to join and leave these groups. This included an old collared female moved to Wheeler ridge in 1986 that joined one group. She is now 16 years old and has not been seen since the early 1990's. Based on minimum numbers in different sex and age classes that were accounted for in 1999, the minimum count this past winter was missing 2 adult ewes and 2 yearlings, at least one of which was male. Late in the season (March 28), 5 adult females and 3 yearling males appeared in the northernmost wintering canyon south of Ainsley Meadow. Some or all of these might have been additional sheep, but it was too late in the season to verify this. Previous groups had fragmented and moved to higher elevations, precluding a recheck on numbers.

Summer Surveys

Two summer surveys of this population were made this year. The first took place in late August and produced a sample of 15 ewes, 2 yearling ewes, 11 lambs, and 3 yearling rams, including all 4 functional radio collars and a 2 yr. old female with just ear tags. In early September a more intensive effort was made to see how many females, lambs, and yearlings could be counted in the summer season. This involved climbing or descending through canyons above Pine Creek that few people venture into. The Mount Morgan high country also was searched one day. During these 4 days, a total sample of 59 sheep was logged, all of which were ewes, lambs, and yearlings, and included numerous duplicate sightings. What we found was that these sheep were distributed from near the mouths of these steep rocky canyons at about 7,400 feet, where there was lush forage along creeks, to over 13,000 feet. It became clear that getting a complete count under these circumstances is not possible.

While the 4 telemetered ewes were expected to help this effort at finding sheep, in the end all groups containing telemetered sheep were glassed up before the receiver was turned on, or stumbled into just over a ridge that blocked the signal in one case. That allowed the data to be used to make mark-resight population estimates. A total of 6 marked ewes exist – 4 functional radio collars, a 2-yr. old with just ear tags, and a 16 year old collared ewe released there in 1986. We encountered this old collared ewe feeding alone along a creek deep in one of these canyons. Overall we saw 5 of the 6 marked ewes, 4 of which were seen twice. Two types of estimators can be used – the Bailey estimator which assumes sampling with replacement and a binomial distribution, and the Chapman estimator, which assumes sampling without replacement and a hypergeometric distribution. For the latter, 19 ewes (including 5 yearlings) and 5 marked sheep were seen. This yields an estimate of 22.3 ewes and a 95% confidence interval of 7.1 - 37.5. For the Bailey estimator, 32 ewes and 9 marked ones were recorded, yielding an estimated 19.8 ewes and a 95% confidence interval of 13.2 - 39.5. For the Chapman estimator, I used the equations provided by Seber and recently used for the Peninsular Ranges populations (see Rubin et al. 1998. *Wildl. Soc. Bull.* 26:539-551). For the Bailey estimate I used the reciprocal approach of Jensen (see Jensen. 1989. *Biometrics* 45:1233-1237).

Both of these estimates demonstrate the low resolution inherent in this approach. This second survey netted 14 adult and 5 yearling females, and 4 yearling males. If the telemetered ewe not seen on this second survey is added, along with another individually recognizable ewe seen only in the August survey, a minimum of 21 ewes results from these two summer surveys. There are certainly more than that. Based on winter counts, a minimum of 31 ewes, including yearlings, is expected. Females known in 1999 but not counted this past winter could bring the population to 33 ewes if all are still alive. Thus, it appears that both of the mark-resight estimates are low.

The September survey logged 11 lambs for 14 different adult ewes. This compares closely with the August sample of 11 lambs for 15 adult ewes. Combined, these produce a ratio of 75.9:100, which fits well with the pattern in Figure 1. The rapid increase in the population appears to be continuing.

V. Lee Vining Canyon Herd

A. Mount Warren Group

In October of 1999, after a summer of searching, 1 ewe, 1 lamb, and two yearling rams were finally found on Mount Warren. This group matched the sparse sign seen that summer that clearly indicated at least a lamb and a yearling. That same day 10 additional rams were found nearby. They had also been missing all summer. This area was searched repeatedly this past summer and fall, but the only sheep seen was a 2-year old ram on one occasion. However, on two occasions, fecal pellets were found that suggested an adult and a yearling. Early in the season, fecal pellets from about three adults were found on the Gilcrest Plateau, but laboratory testing found those to be from rams. As was the case in 1999, rams also could not be found around Mount Warren during summer. This is a notable change from a few years ago. This year efforts were again made to find where these rams were living during summer without success. Radio telemetry is needed to answer this question.

The Lee Vining Canyon winter range was utilized for a few weeks by three rams beginning in early December 1999 – a pattern typical of recent years. There was no use in spring, except a brief sighting of some rams at higher elevations. However, 7 rams were sighted in Deer Creek in spring.

B. Tioga Crest Group

In 1999, 2 ewes and 2 lambs were known in this group. This past summer we found 2 ewes, 1 yearling male, and 1 lamb (probably female) and no evidence of additional sheep.

C. Mount Gibbs Group

Genotyping from fecal samples collected in 1998 and 1999 from Mount Gibbs indicated an additional (third) ewe there in 1999 that had not been known in yearly field surveys beginning in 1995. In July, a combination of sheep observed and lab results on sexes of lamb and yearling pellets collected verified that a third female was present. Later in summer a third female was observed; two are dark-colored and one is light-colored. Three ewes, 1 yearling male, and 2 lambs (1 of each sex) apparently were in this group this summer. We did not observe the adult males there, but a reported observation suggested that the 4 rams known previously are still alive.

Areas south of Bloody Canyon were investigated this summer. Of particular note was an investigation of the south side of Mount Lewis. This steep rocky face is frequently snow free in winter. It was found that there are springs and associated meadows as well as other excellent forage resources on this face, making it good bighorn sheep habitat. There were bighorn sheep fecal pellets present at the meadows, but all were from adult, presumably male sheep.

VI. Synthesis

The past winter was unusual. No significant storms occurred until late January. This meant that forage was delayed in greening up, which in turn decreased the attraction of low elevation winter ranges to sheep. This delayed initiation of forage growth was followed by particularly warm winter temperatures. South-facing slopes melted out quickly up to high elevations, which offered sheep more habitat alternatives and early forage growing conditions at higher elevations. In late March I found a perennial grass (*Stipa coronata*) already putting out some new growth at 10,000 ft. elevation on Wheeler Ridge. Under conditions like this, sheep can acquire adequate nutrition without dropping to the lowest elevation winter ranges. This is the most parsimonious explanation for the minimal use of winter ranges by the Mount Baxter and Langley herds. Despite intensive monitoring of these areas, the only sheep observed was a lone ram in Onion Valley (not a low elevation winter range). However, evidence was found that at least a few sheep visited these low elevation ranges briefly on more than one occasion beginning in January. The sign suggested that they may have remained at these low elevations for only a few hours. It would not take them long to assess the forage conditions relative to where they had come from and make a decision whether remaining low was worth the risks. In short, the limited use of winter ranges this past winter should not be taken by itself as a bad sign. Similar conditions occurred in 1994.

In 1999, 95 different adult sheep (49 females, 46 males) and 22 lambs were observed throughout the Sierra Nevada; and an additional 22-34 adults and 4-14 lambs were suggested to exist based on sign observed. This year, a total of 24 different yearlings have been documented, which is more than the number of lambs seen last year. An additional 8 yearlings are projected to exist (Table 1). This includes none for the Mount Williamson herd, for which no data exist this year. If that population is excluded, the projected number of yearlings this year is 94% of the number of lambs projected last year. While this value should not be taken as an actual survivorship value, it points to what clearly has been a very high survivorship of 1999 lambs. Similarly, the projected number of yearlings in 2000 is 27% of the highest number of adults projected for 1999, with the Mount Williamson herd again omitted. Given the higher vulnerability of lambs compared with adults, it is reasonable to expect that adult survivorship has been at least as high as that of lambs. For the groups of females that have been followed well from 1999 to 2000 (Langley, Black Mountain, Wheeler, and Lee Vining), survivorship was at least 92% (35/38) and probably closer to 100%. Thus, the estimated 27% yearling recruitment is likely not far above the overall rate of population increase. This is a very favorable situation. The number of lambs documented this summer is 54% higher than a year ago, while the projected number is 20% higher. These are clearly signs of a rapidly increasing population. Winter conditions have played a major role in this pattern, but so have the recent change in wintering habits of the Wheeler Ridge herd, which accounts for more than one-third of the projected lambs this year and nearly one-half of the yearlings. Future demographic patterns can be expected to reflect an interaction between winter conditions and winter habitat use patterns more than anything else.

Table 1. Reproduction and recruitment data for 2000.

Herd	Group	Lambs		Yearling Ewes		Yearling Rams	
		Seen	Probable	Seen	Probable	Seen	Probable
Langley		9		2		3	
Williamson		0	?	0	?		
Baxter	Black	4		3?			
	Sand Mt.	5		2		2	
	Sawmill	1	4	2			
Wheeler		12	3?	5	6	4	
Lee Vining	Tioga	1				1	
	Warren	0		0	1		
	Gibbs	2					1
TOTAL		34	7	14	7	10	1