Sierra Nevada Bighorn Sheep: 2004-05 Status

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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 2004. This is a synthesis of data collected as part of the Sierra Nevada Bighorn Sheep Recovery Program lead by the California Department of Fish and Game and additional monitoring in the Mono Basin funded by the Yosemite Fund through Yosemite National Park. We were greatly assisted in the collection of data by Ali Feinberg, Greg Foote, Dave German, Dennis Jensen, Heather Johnson, and Cody Schroeder. Erica Shockley and Ali Feinberg worked in the Mono Basin during the summer of 2004, but also participated in some surveys further south. This report will review prior information where needed to interpret data developed during this time period.

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 herd sizes, while very desirable, have made population monitoring more difficult in that 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. Better counts in subsequent years also are used to evaluate and correct past counts to minimum numbers present by sex and age categories. These are known as reconstructed populations (McCullough 1979).

Highlights of the Past Year

The past year was particularly productive in providing multiple excellent counts. A couple of environmental factors were involved. Alpine habitats of the Sierra Nevada are alpine deserts because precipitation is generally scant and unpredictable during the season when temperatures are favorable for plant growth. Consequently, snowmelt plays a major role in plant growth and sheep nutrition. However, during the summer of 2004 a series of soaking summer rainstorms occurred with optimal spacing to allow excellent and prolonged forage growth. This meant that sheep did not have to disperse as much to maximize nutrient intake. This may have been the key variable in an excellent count at Mount Langley when probably every adult female, yearling, and lamb was counted and classified on a single day in a relatively small area east of

the crest.

A second important factor was the winter of 2004-05, which brought above-average snowfall. That produced increased winter range use for some herds that resulted in good counts for the Mount Baxter, Sawmill Canyon, and Wheeler ridge herd units.

After numerous attempts to find and count the sheep on Mount Williamson in summer beginning in 1997, 2004 finally brought some success, with the sighting of 11 females and lambs. While there is good evidence that additional females existed, that sighting was noteworthy in being the most sheep seen in that herd unit since 1985.

Further evidence emerged during 2004 that the Black Mountain deme is not a separate demographic group and will be hereafter dropped as a demographic designation. In the Mono Basin there was another shift in habitat use; females using Lundy Canyon returned to Mount Warren and occupied habitat there that has been used minimally since 1998. Count data from the past year also allowed some important analyses of density dependence in population growth.

Mount Langley Herd Unit

Based on a combination of direct observations and fecal genotyping, a minimum of 20 adult females, 4 yearling females, and 13 lambs could be accounted for at Mount Langley in 2003. One or more additional yearling females likely accompanied a distinct group identified by unique lamb genotypes, but were not accounted for. On September 8, 2004, after finding no sheep west of the crest, two observers working in coordination were able to count 27 adult females, 6 yearling females, 11 lambs, and 4 yearling males in 5 groups in the Tuttle and Diaz Creek drainages. This allowed the total female count for 2003 to be increased by 3.

The winter of 2004-05 saw another increase in use of low elevation winter range by this herd. That use began in mid January and continued through March, during which 41 different sheep were observed using this winter range. While this maximum count included only 64% of the females accounted for in summer, this is a notable increase from just two years ago, when winter range use by this herd was minimal.

Mount Williamson Herd Unit

This population has been notoriously difficult to monitor. During annual summer monitoring beginning in 1996, only an occasion sheep has been see, while as many as 6 sheep have been documented in a small winter range in Shepherd Creek. However, fecal genotyping has documented as many as 7 different lambs each year in 2001 and 2002, and 10 or more females at the end of the previous decade.

In late August of this year direct observations finally provided some support for those figures. On one day in which Mount Williamson was circumnavigated from the Williamson Lakes, 6 adult females, 1 yearling or 2-year old female, and 4 lambs were observed in a group in North Bairs Creek. Tracks of two female-sized sheep also were seen that day on the high plateau above South Bairs Creek. Given recent rain, those tracks were very fresh and unlikely to

be from the sheep observed. Additional sign in upper Williamson Creek suggested the possibility of another small group containing 1 lamb. Together, all this evidence is consistent with a total of 10-12 females in this herd unit. The 11 sheep observed in 2004 were the most sheep seen in this population since 1985, when the population still used escarpment base habitat for winter range.

No sheep were observed in this herd unit during the past winter, despite one ground visitation to the Shepherd Creek winter range, one short helicopter survey of that area, and a check of escarpment base winter ranges.

Mount Baxter Herd Unit

Bubbs Creek Deme

A survey of the region around Mount Gardiner by two groups of investigators failed to find any sheep for the third consecutive summer. A fixed wing flight over Bubbs Creek on January 16 found this winter range completely covered with snow, except cliff faces. However, only 11 days later, on January 27, a helicopter survey there found not only some open habitat along the lower elevations, but a large amount of new green grass visible from the helicopter. That flight found a lone ram and a group of 14 ewes, lambs, and yearlings. From photographs taken of this group, it appeared to contain 10 adult and yearling females, 2 lambs, and 2 yearling males. This group of females is clearly a separate deme and will be classified as a separate herd unit in the future, similar to the recognition of the Sawmill Canyon herd unit.

Mount Baxter Deme

When sheep made consistent use of the Black Canyon and Sand Mountain winter ranges prior to 1987, females spread south along the crest in summer as far as Mount Gould. Following the abandonment of those winter ranges, the females using Black Mountain and Mount Mary Austin in summer have been treated as a possible separate deme until evidence to the contrary emerged. Different genotypes obtained from fecal samples collected on Black Mountain during the summers of 2000 and 2001 indicated that there could be 9 different adult females using that area in 2002. In 2004 two types of evidence emerged indicating that the sheep using Black Mountain in summer were not different from the larger Mount Baxter herd.

During the winters of 2002-03 and 2003-04, 3 females were caught and collared on the Mount Baxter winter range (1 on Sand Mountain in 2003, and 2 near the mouth of Black Canyon in 2004). The genotype of one of those matched one obtained in earlier years at Black Mountain. While GPS location data from one of the females collared in 2004 indicated that it never ventured as far south as Black Mountain, the other one used that region extensively in summer. Additionally, a weak signal from the failing collar on the female collared in 2003 also was obtained on Black Mountain in 2004. While this information suggests that some geographic sub-structuring does occur in the Mount Baxter herd unit, it does not justify the continued recognition of a separate Black Mountain deme.

Data for the Mount Baxter herd have been inconsistent in recent years. The best recent

count occurred in July of 2002 in the Baxter Pass region, when 11 adult females, 4 yearling females, 5 lambs, and 3 yearling males were observed in one day. While that count was suspected to be slightly low, based on previous data, subsequent counts have not equaled that number of females, despite recruitment expected to produce further population increases. That changed in mid January of 2005, when a particularly good count was obtained on the winter range: 22 adult females, 4 yearling females, 14 lambs, and 5 yearling males. Additionally, 9 different adult males were recorded during this past winter, for a total of 54 different sheep. The suspicion that the 2002 count was not complete is supported by this recent count. From the 2005 count it can be stated that at least 22 adult and yearling females existed in the summer of 2003. If all 5 lambs seen in 2002 were female (which is unlikely), the total females in 2003 would come to only 19. During the winter of 2003-04 6 yearlings (3 of each sex) were recorded; thus, at least 1 lamb was missed in 2002 (as well as its mother). Subtracting those three yearling females from the 22 minimum total females for 2003 would project 19 total females in 2002. That projection could be high, because it assumes that there were no more yearling females than the 3 documented in 2004; a more conservative value might be 18 total females in 2002. Regardless, either number is certainly closer to the correct number than the 15 counted in 2002. When put in a larger time frame, these data indicate that the number of females is this herd unit has approximately quadrupled since 1998.

Sawmill Canyon Herd Unit

Fecal DNA data for the Sawmill Canyon herd for 1999-2001 suggested that it contained more than 10 females. In contrast, the numbers of females counted at high elevation in summer or at low elevation in winter did not exceed 6 during 1997-2002. This changed in 2003-04, when 13 different adult and yearling females could be accounted for between summer and winter counts.

A concerted effort to develop data on this herd unit during the summer of 2004 located only a single male sheep, despite the existence of telemetry collars on one female and two males. Summer locations of the males verified past knowledge that they make extensive use of the area from the White Fork to Pyramid Peak. However, data from the telemetered female showed that she also moved west to the upper White Fork area – summer distribution of females that was not previous known.

In contrast, this past winter again provided data comparable to 2003-04. For the first time since 1986, some sheep (2 females, 2 lambs, 1 adult male) were documented to use the Goodale Creek winter range. Counts in Sawmill Canyon totaled 9 adult females, 2 yearling females, 4 lambs, and an adult male; thus, for the second consecutive year, 13 different adult and yearling females were documented in this herd unit.

Wheeler Ridge Herd Unit

In the winter of 2003-04, the minimum count of adult and yearling females in this herd totaled 33, which included collared females not seen because they remained at higher elevations. On the basis of previous data and yearling recruitment, it was suspected that some uncollared females also were missed. Consequently, an attempt was made to estimate the number of

females in the population via mark-resight estimators using multiple sampling episodes. The resulting estimates ranged from 38 to 40, with 95% confidence limits ranging from a low of 31 to a high of 51, depending on the analytical method used; the smallest interval was 35-45. Of particular note was the finding that the first samplings, when the sheep were widely distributed across the winter range, produced notable overestimates compared with later samplings, when most sheep had returned to Pine Creek. Consequently, the cumulative sample showed a steadily declining estimate, which had not leveled when the sampling ceased in April. As a consequence of that pattern, the lower population estimate of 38 was used in subsequent analyses; but the question remained as to whether that might have been an overestimate due to sampling bias.

The winter of 2004-05 provided some good counting opportunities that produced minimum totals of 40 different females (36 adult and 4 yearling), 22 lambs, 9 yearling males, and 32 adult males, for a total of 103 sheep. This allows the minimum total females for the previous year to be increased by 3 to 36. Minimally that number is very close to the mark-resight estimate from 2004. Given uncertainties about biases in those estimates, this minimum total may account for every female or be only 1 female short. Regardless, this illustrates how complete such count data on these bighorn sheep populations can be when a reconstructed population approach is used (e.g. 95-100% of actual totals). Such data track population changes with a high degree of precision. Samplings that approach the total population have vanishingly small variances by the finite populations correction factor (Steele and Torrie 1960). The same concept can be applied to minimum counts that closely approach total counts. Consequently, they frequently have more resolution relative to population change than is provided by estimators like mark-resight methods. This is why they have been the method of choice in the Sierra Nevada for nearly three decades. Reliance on this approach has been possible only because habitat use patterns of the sheep in this mountain range provide periodic opportunities to count a very high proportion of the females and associated sheep in most herds.

Mount Gibbs Herd Unit

The small size and predictable summer habitat use patterns of this herd continue to provide excellent demographic information. In 2002 and 2003, the female part 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 there were 3 adult females, 1 yearling female, and 1 lamb that appeared to be female. Five adult males were documented as well.

Mount Warren Herd Unit

Despite its small size, females that use Mount Warren have been very difficult to track since 1998 in that sheep there cannot be found consistently, in contrast to years prior to 1999. In particular, while a consistent count has occurred for a small female group on Tioga Crest, the use of the Mount Warren area has been notably unpredictable since 1998. A likely explanation emerged this year.

In 2003 a group of female sheep that totaled 7 females and 4 (2003) lambs mostly used the north side of Lundy Canyon during spring and summer, but were observed once in late summer south of Lundy canyon on Dore Pass, where they were also seen (and documented by

fecal genotypes) the previous year in late summer. In contrast, in 2004 no females could be found on the north side of Lundy Canyon in spring or summer, despite repeated efforts to find them. Additionally, there was little recent sign of those sheep there in 2004; the only possible sign of that group was a couple of pellet samples that might have been from a female and yearling.

Coincident with the disappearance of those sheep from Lundy Canyon was the reappearance of females in the Mount Warren area and the first consistent use of that area by females since 1998. The simplest explanation for this pattern, and the occasional brief appearance of sheep in the Mount Warren area in recent years, is that a group of females has been moving between the north side of Lundy Canyon and Mount Warren. Fecal genotyping of the five adult females in Lundy Canyon in 2003 found 3 matches to earlier fecal samples from the Mount Warren region: an adult in 1998, a female lamb in 1999, and an adult in 2001. All this information suggests that the sheep that previously made predictable use of the Mount Warren area expanded their range after 1998 to include the north side of Lundy Canyon and mostly avoided the Mount Warren area until this year. That change in habitat use correlates with a mountain lion known to be hunting them in the Lee Vining Canyon area in 1998. One consequence of this habitat expansion is that the separate Lundy Canyon herd unit should be eliminated and included under the Mount Warren herd unit.

During the summer of 2004, a total of 9 males could be accounted for in this herd unit -- 2 in Lundy Canyon, and 7 south of Mount Warren. Female groups consisted of 5 sheep on Tioga Crest and 13 on Mount Warren. The compositions were 1 adult female, 1 yearling female, 1 yearling male, and 2 unidentified adults on Tioga Crest; and 6 adult females, 5 lambs, and 2 yearling males on Mount Warren. The total comes to a minimum of 27 sheep in this herd unit and 37 in the Mono Basin. In the summer of 2003, a minimum total of 28 sheep could be accounted for in the Mount Warren and Lundy Canyon herd units (including the telemetered male that was south of Mammoth Lakes, but subsequently returned). Three males and one adult female are known to have died in the intervening year. This herd appears to have replaced all but one of those losses via recruitment, and has declined in size by one.

While the best counts for Mono Basin herds are obtained in summer, data from early May 2005 already documented the survival of at least 26 sheep in those two herd units, including 4 lambs from 2004. Three older males are known to have died over the past winter.

Density Dependence

In our monitoring report for 2003-04, we included some detailed analysis of the Wheeler Ridge herd that included data indicating that a strong density-dependent relationship existed for winter lamb recruitment rates. Here we report further such data from the Mount Langley herd. A concerted effort was made to genotype every lamb in that population from fecal samples during 2001-03 as supplemental information to direct monitoring. That information greatly aided the overall data relative to numbers of females and lambs in that population. One result is a growth curve showing declining rates of increase with increasing population density (Figure 1).

The population growth data for the Mount Langley herd unit were broken into two

periods -- prior to and after the El Nino winter of 1998. Until the winter of 2003-04, the Mount Langley herd had shown only sporadic and low overall use of low elevation winter ranges. The El Nino winter of 1997-98 had an apparent negative effect on this herd that resulted in no population increase for one year (Figure 1). Consequently, we focused on the period of population growth since the influences of that winter (1999-2004), during which the number of females tripled, from 11 to 33. Over that range of population densities, the ratio of lambs to adult females in summer declined 60 percent in a nearly linear pattern (Figure 2).

The evidence of strong density-dependence in patterns of recruitment and population growth for bighorn sheep in the Sierra Nevada has important implications for conservation goals and management actions. Carrying capacities for some herd units are clearly considerably lower than values used in developing recovery goals. Those goals should be adjusted accordingly. Second, these density-dependent relationships can be used to estimate potential annual yields that can be removed from populations for translocations.

Density-dependent slowing of population growth rates of individual herds affects the increase in the overall population in the Sierra Nevada. Tables 1 and 2 synthesize data for the past year and additional years in which reasonably complete data existed for all herds. Over the past few years there is evidence of an overall decline in the rate of increase of females (Table 2). However, some herds have just begun extensive use of low elevation winter ranges (Mount Langley, Mount Baxter). Following the reoccupation of low elevation winter ranges at Wheeler Ridge, that herd exhibited a large increase in lamb recruitment rate and associated population gains presumably reflecting the increased nutrient intake and carrying capacity. A similar pattern can be expected for Mount Langley, and would be expected to begin with an increased ratio of lambs to adult females in the summer of 2005. Over the next several years, the Mount Langley and Mount Baxter herds can be expected to provide the bulk of additional population gains.

Literature Cited

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Table 1. 2004-05 data summary for Sierra Nevada bighorn sheep (minimum counts).

Herd unit	ad ewes	yrl ewes	total ewes	lambs	yrl. rams	unid.
Langley	27	6	33	11	4	
Williamson			~10	4		
Bubbs Cr.			10	2	2	
Baxter	22	4	26	14	5	
Sawmill	11	2	13	6		
Wheeler	36	4	40	22	9	
Gibbs	3	1	4	1		
Warren/Lundy	7	1	8 (10?)	5	1	2 (ewes?)
Totals			144 (146?)	66		

Table 2. Minimum total numbers of adult and yearling ewes in the Sierra Nevada by year.

Herd unit	2004-05	2003-04	2002-03	1995-96
Langley	33	27	20	6
Williamson	~10	~10	~10	~5
Bubbs Creek	10	8	8	3*
Baxter	26	22	16	5
Sawmill	13	13	9	7
Wheeler	40	37	34	10
Gibbs	4	3	3	1
Warren/Lundy	10 (12?)	11	9	14
Totals	144 (146?)	131	109	54
increase rate:	11.5%	20.2%		

*Kearsarge Peak

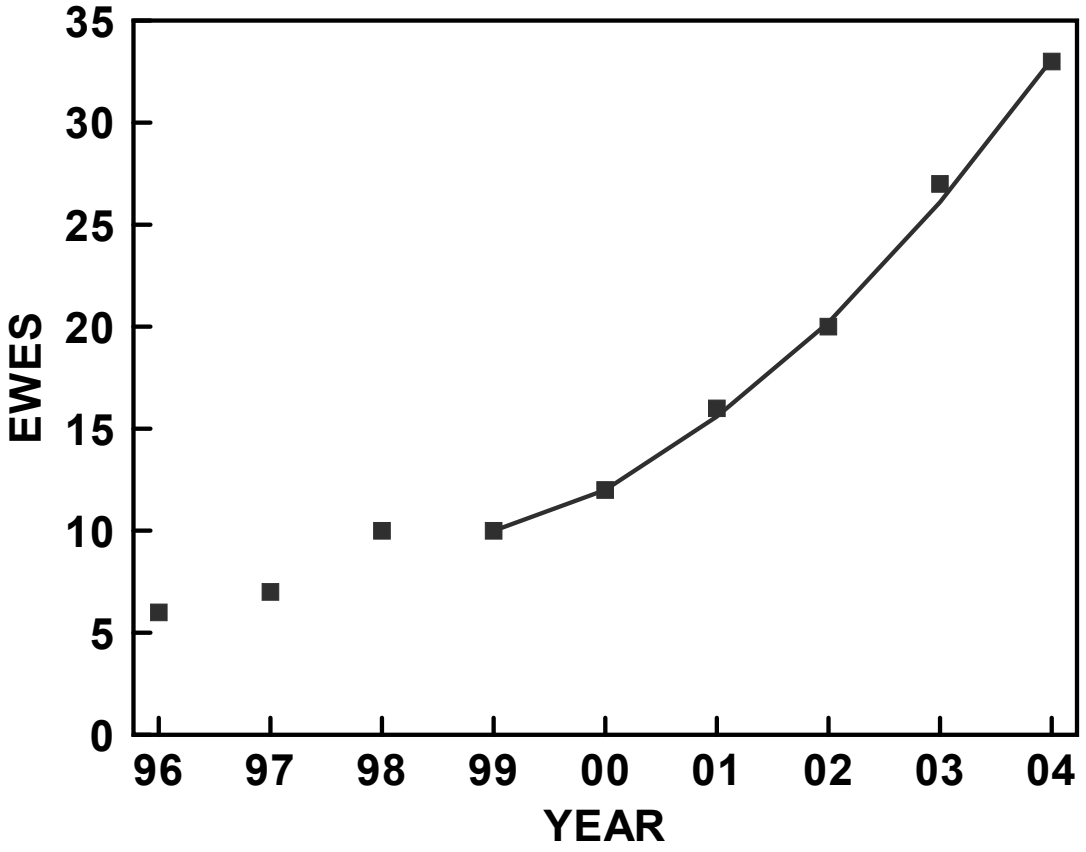

Figure 1. The number of adult and yearling ewes accounted for in the Mount Langley herd, 1996-2004.

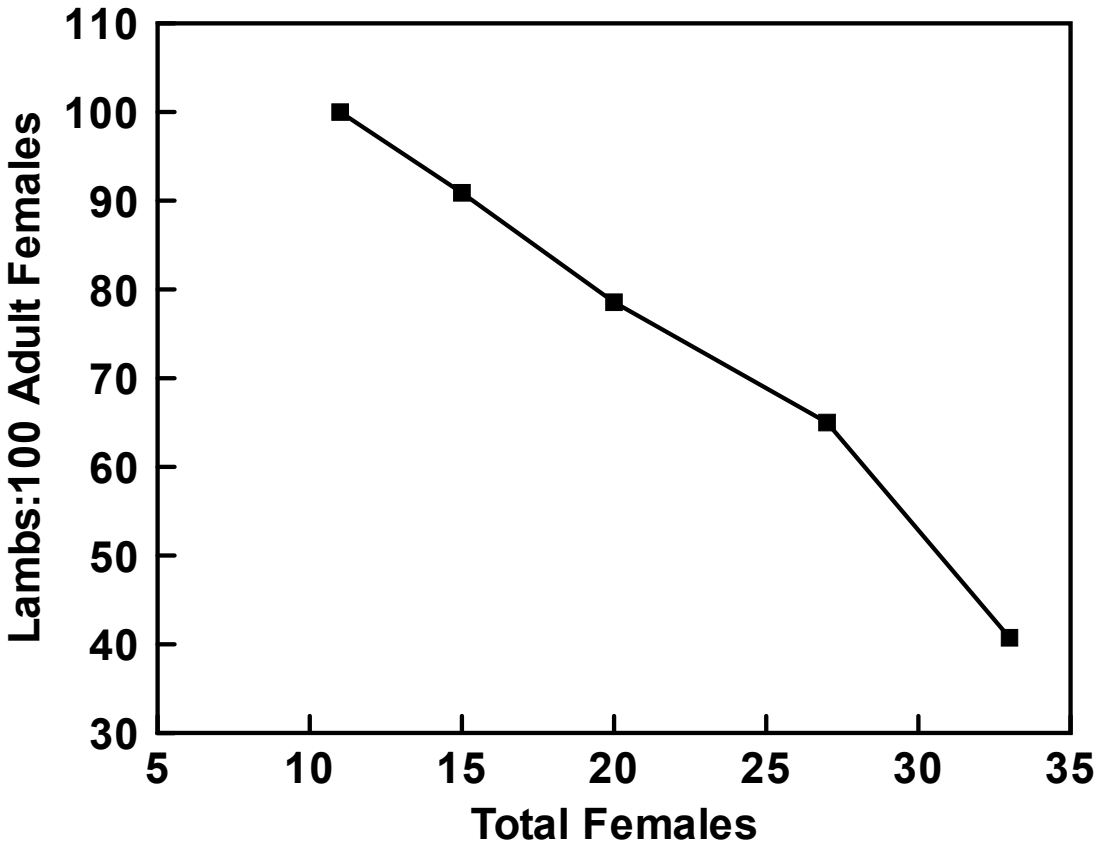

Figure 2. The relationship between summer ratios of lambs to adult ewes and population density for the Mount Langley herd.