



The Mount Baxter Bighorn Herd:
Past and Future Censuses

John D. Wehausen

The Mount Baxter bighorn herd is the only large population in the Sierra Nevada that survived the decimation brought about by early white man and his domestic animals. Evidence that this population was over 170 animals and increasing led to initiation of a reintroduction program in 1977. Nine bighorn were trapped and relocated in 1979 and 31 in 1980. Critical to this reintroduction program is careful monitoring of the Mount Baxter herd so that it is in no way jeopardized. The desirability of a reliable census method that produces consistent results is obvious.

Four different census methods were planned for the winter of 1981 to assess each as a potential long-term method. These methods were: 1) ground census(es) by a single individual (the author) according to procedures used from 1976 to 1979, 2) a single day count by a crew of experienced biologists similar to that conducted in 1980, 3) a helicopter count the same day as the ground crew count, and 4) a combination of the helicopter and ground crew counts according to the mark-recapture methodology outlined by Magnusson et al (1978); all groups seen by the ground crew are equivalent to marked, while those seen both by the ground crew and from the helicopter are recaptures. This report explores the results of these and previous censuses, and addresses the problems of future censuses.

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<u>Year</u>	<u>Ewes</u>	<u>Lambs</u>	<u>Rams</u>	<u>Unclass.</u>	<u>Total</u>	<u>Method</u> ¹
1976	53	26	37	2	118	G2
1977	77	39	51	0	167	G1
	78	39	56	0	173	G2
1978	100	35	66	0	201	G1
	108	38	68	0	214	G2
1979	69	22	42	0	133	G1
	76	22	83	5	186	G2
1980	73	31	77	18	198	G3*
1981	74	26	28	2	130	G3
	74	26	34	2	136	G3*
					117	H
	79	27	39	11	156	HG
	87	30	53	11	181	HG**

- ¹ G1: most seen in a single census of the entire winter range by a single investigator on the ground.
 G2: summation of maxima seen on censuses of either side of Sawmill Creek by a single investigator on the ground.
 G3: single ground census by a crew of observers.
 H: single census from helicopter (3 observers plus pilot)
 HG: summation of sheep seen by simultaneous helicopter and ground crew counts.

* includes Goodale Creek winter range.

** includes count of Goodale Creek winter range taken at a later date.

Table 1 - Results of censuses of the Mount Baxter herd, 1976 to 1981.

1981 Census Results

The ground crew recorded more bighorn than the helicopter (Table 1). Of 156 different sheep seen between them (excluding Goodale Creek, which was not censused by helicopter), 91 were seen by both, 26 from the helicopter alone, and 39 by the ground crew alone. When these values are used to calculate a mark-recapture estimate (Magnusson et al 1978), the result is 168 with a standard error of 4.5. This is a relatively small gain over the combined total of 156.

A total of 6 bighorn were found in Goodale Creek by ground observers during the census, but a later ground count tallied 25. When added to 156 this provides a minimum population figure of 181 (Table 1). The remainder of the Baxter herd was checked regularly through the beginning of April for the opportunity to make a more complete count, but none materialized. The reasons are discussed below.

Bighorn Distribution and Weather Conditions

The completeness of counts of the Baxter herd is a function of their elevational distribution and degree of clumping at the time of the census. The ideal census condition occurs when the sheep are distributed at low elevation on the winter range in large groups. This is the situation under which I have obtained the most complete counts in past years. Snow depth and vegetation phenology determine the winter range distribution of bighorn. High snow fall years are ideal for census work because snow depths in the upper winter range areas allow few, if any, bighorn to remain there. In essence, the bighorn are pushed to lower areas. The other determinant of sheep distribution is vegetation phenology through its influence on nutrient content. This determines how much bighorn are

pulled to lower elevations. The winter range vegetation begins its spring growth in February and peaks in April and May. Since lower elevations precede higher ones in this development, bighorn may be drawn to the lowest elevations from late February through the beginning of April. The timing and intensity of spring vegetation growth appears to be a function of the amount of early winter precipitation, especially December. Since growth intensity and nutrient content are closely correlated, the degree to which bighorn are drawn to lower elevations is largely a function of early winter precipitation. In heavy snow years, precipitation usually begins in early winter; thus bighorn are both pushed and pulled to lower elevations. The most complete census results come from 1978 and 1980 (Table 1), both of which were winters of high precipitation. In years of less than heavy snow fall, a reasonable (although probably less than complete) winter census is possible if sufficient precipitation occurs in early winter, such as in 1977 and 1979 (Table 1). The results from 1977 are noteworthy in this regard, as this was an extreme drought year of 43% normal winter precipitation (Wehausen 1980), yet provided a reasonable census result. However, the opportunity for a census that year did not occur until April 1. Both 1976 and 1981 were years well below average winter precipitation, as well as lacking in early winter precipitation. In both years few or no sheep were evident on the winter range until February, whereas in other years they were present by late December or early January. Both years also provided poor census results (Table 1), because sheep never concentrated at low elevation.

Future Census Methods

The 1981 census results suggest that a helicopter is the least desirable means of censusing. All groups seen only from the helicopter were at upper elevations where sheep are rarely found during more normal winters. Perhaps the most significant finding was that all bighorn groups recorded from the helicopter were running from it. The ground crew observed the helicopter to fly over groups that did not flee, none of which was sighted from the air. The greatest disadvantage associated with a helicopter is the necessity of advance scheduling and the risk of poor weather conditions the day of the census. Strong winds were a problem in 1981. This problem also applies to the use of a ground crew, but is much more easily dealt with if the members are local.

No opportunity occurred in 1981 to compare ground crew census results with a single investigator (myself). It is hoped that such a comparison can be made in coming winters. Probably the ideal future census technique is the use of a small ground crew of local inhabitants that are interested and competent. Each observer can census the same portion of the range each year. The advantage of this is that once the observers know their area and bighorn habits, there will be little year-to-year variance attributable to the ability of observers. It will be necessary to have a leader who regularly checks census conditions and mobilizes the other members when needed. Late February will usually be the best time for censusing.

Data Limitations

It is not possible to know the total number of animals in a population like the Mount Baxter herd, because the number missed during a census cannot be determined. A census only provides a minimum number present in the area censused. Meaningful estimates of total number present require some statistical measure such as the double sampling scheme of Magnusson et al (1978), and thereby also provide confidence limits associated with the estimate. The major variable in Baxter herd census results is probably not the number of sheep missed in the area censused, but the number occupying areas not censused (and not easily censused). Comparisons of census results within and between years allow an analysis of relative completeness of the different censuses, such as discussed earlier. In essence, this provides an evaluation of the confidence limits, thus the accuracy, of these censuses as an index of population size.

It is clear that the accuracy of Baxter herd censuses has not been sufficient to use the results to determine year-to-year herd trends. Likewise, it is not possible to determine the relationship between recruitment rate (lambs per 100 ewes) and percent change in population on the basis of these census results. Recruitment rate is therefore not a clear indicator of population trend, except at large and small values. However, on a longer term basis, census results will probably provide a reasonable estimate of population trend, especially if results from years of similar precipitation patterns, particularly high snow years are compared.

The minimum population figures derived from these censuses have an important value in the management of the Mount Baxter herd. Decisions

on whether and how many sheep are to be trapped for reintroduction purposes should be based on the minimum number known to be present during the year in question, and a minimum number (by area) that should remain in the population. Such a system has a built in buffer that assures that the Mount Baxter herd is not jeopardized by removal of sheep.

Goodale Creek Winter Range

The discovery in 1980 of bighorn wintering along Goodale Creek has prompted the question of whether this is a recent colonization by the Baxter herd, or whether these sheep have simply been overlooked for many decades. The last reports of bighorn wintering in this area date from the 1920's (Wehausen 1979). Two bits of past information argue against these sheep having persisted there throughout the century: 1) Goodale Creek was surveyed for bighorn in 1964 or 1965 by McCullough (pers. comm.) with no evidence of occupation found, and 2) in 1977 I surveyed the crest immediately above Goodale Creek and found no sign of summer bighorn use.

Surveys of Goodale Creek during the winter of 1980 counted as many as 16 bighorn (6 ewes, 3 lambs, 8 rams) on two occasions. During 1981 we counted 25 (8 ewes, 3 lambs, 14 rams). Reproduction cannot account for this increase (there were more yearlings in 1981 than lambs the previous year) unless some sheep were missed in 1980. This would argue in favor of these sheep resulting from a recent extension of fall range north along and east of the crest. Continued growth of this wintering population will support the hypothesis of a recent colonization.

Literature Cited

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