

MOUNTAIN SHEEP IN CALIFORNIA: A HISTORICAL PERSPECTIVE ON 108 YEARS OF FULL PROTECTION

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Abstract: Mountain sheep (*Ovis canadensis*) in California have been protected from hunting by legislative action since 1878, although enforcement only began about 1920. Since 1920, about 30% of the populations have disappeared. This loss represents about one-half of the total populations lost since the gold rush began in 1849, and suggests that protection has done little to slow population loss. Instead, legislative protection of sheep in California has worked against their conservation in that few funds were allocated to the species by the California Department of Fish and Game (DFG). A data base adequate to use selected populations as reintroduction stock has developed only in the past decade. State designation of the California subspecies (*O. c. californiana*) as rare helped set the stage for the initiation of a DFG reintroduction program in 1979. To date, 273 sheep have been trapped from four mountain ranges for relocations to ten sites in eight mountain ranges. Legislation was passed in 1986 that will permit very limited hunting of mountain sheep in California. This legislation was designed to help fund continuing conservation efforts for this species.

The three decades following the large influx of gold miners, beginning in 1849, saw rapid loss of mountain sheep (*Ovis canadensis*) populations in parts of California. Indiscriminate shooting was probably important in some locations. This was followed by a more significant factor: the grazing of domestic livestock, and the disease organisms they introduced to native mountain sheep. Livestock grazing in the Sierra Nevada began about 1861 with cattle, but was replaced by domestic sheep, which could be grazed over more extensive areas in the rugged high country. Stocking rates increased so rapidly that by 1873, Clarence King already noted changes from severe overgrazing (Vankat and Major 1978). In that same decade, a die-off of mountain sheep from scabies occurred in the Great Western Divide (Jones 1950). Presumably the disease was contracted from domestic sheep. Similarly, evidence suggests that no viable mountain sheep population remained in the Yosemite area of the Sierra Nevada past the early 1880's (Grinnell and Storer 1924), despite Muir's statement to Seton (1929) that a few still remained in 1899. In northeastern California, the population on Mount Shasta encountered by Muir in 1874 (Wolf 1979) apparently had been decimated by 1883 (Buechner 1960).

The obvious decimation of several wildlife populations in California led to the initiation of legal protection in the 1870's. At that time it was believed that wildlife populations afforded protection from hunting would flourish quickly and recolonize former ranges. For mountain sheep, protection first occurred in 1876, when the Act of 1872 that protected elk, deer, and pronghorn for eight months of the year was amended to include mountain sheep. Two years later, the Act was amended further to establish a four-year moratorium on the taking of any pronghorn, elk, mountain sheep, or female deer (Weaver 1982). In 1883 this moratorium was extended indefinitely. Total protection of mountain sheep lasted 108 years, until it was altered in 1986 with the passage and

signing of Assembly Bill (AB) 3117. That law made mature male mountain sheep a game animal in two Mojave Desert mountain ranges.

This paper explores the history of mountain sheep management in California during the 108 years of full protection in terms of: (1) what fully protected status did to prevent further loss of populations, (2) how the data base on mountain sheep progressed, (3) the types of management which occurred, and (4) the history of legislation that led to the change in status for just two populations. Finally, it explores what mountain sheep management in California has yet to accomplish. By definition, wildlife management is accomplished by people, and this occurs in the context of legal structure. The purpose of this paper is not to discuss the history of individuals in wild sheep management in California. Instead, it is intended to point out the role of legal constraints, notably full protection, on the history of sheep management.

POPULATION TRENDS UNDER FULL PROTECTION

Full protection did not stop the decline of mountain sheep in California. Populations disappeared not only during the end of the last century, before the fully protected status was enforced, but throughout the twentieth century to the present. Enforcement began about 1920. Since early data on populations were often poor, our approach to assessing the loss of populations since 1920 has produced both a minimum as well as a probable higher number of populations lost. The minimum figure was arrived at by including only those extirpated populations for which documentation of their existence since 1920 was substantial. This included populations for which: (1) early estimates of size exceeded 15, or (2) more than five sheep were actually seen. For the larger figure of populations probably lost, populations were added for which evidence of existence

Table 1. Mountain sheep populations lost in California since 1850.

| Populations lost by time period | Evidence of existence |
|---|--|
| Minimum losses since 1920 | |
| Northeastern California | |
| Observation Peak | Many died in winter 1922-23 (Jones 1950) |
| Sierra Nevada | |
| Convict/McGee Creek | Sightings listed by Jones (1949) |
| Wheeler Ridge | Inyo National Forest, Annual Fish and Game Reports (1921, 1923) |
| Mount Tom | Ober (1914, 1931) |
| Taboose Creek | Ober (1914), Inyo National Forest, Annual Fish and Game Reports (1921, 1923) |
| Mount Langley | Sightings listed in Jones (1949) and Wehausen (1979) |
| Cache Peak | 18 seen in 1933 (Jones 1949) |
| White Mountains | |
| Cottonwood Basin | Inyo National Forest, Annual Fish and Game Reports (1921, 1923) |
| Wyman Canyon | Inyo National Forest, Annual Fish and Game Reports (1921, 1923) |
| Mojave Desert | |
| Deep Springs | 1940 population estimate of 40, 29 seen in 1951 (Buechner 1960) |
| Coso Mountains | 1940 population estimate of 26 |
| Argus Mountains | 1940 population estimate of 19, 6-8 seen in 1955 (Buechner 1960) |
| Slate Range | 9 seen in 1938 (Buechner 1960) |
| Granite Mtns. (Ft. Irwin) | 1940 population estimate of 20 |
| Owlshead Mountains | 12 seen in 1938 (Buechner 1960) |
| Shadow Mountains | 1940 population estimate of 17 |
| Castle Peaks | Many observations in 1970's (Wehausen and Hansen 1986) |
| Ord Mountains | 1954 population estimate of 35 |
| Bullion Mountains | 1940 population estimate of 54 |
| Pinto Mountains | 40 seen in 1950 (Buechner 1960) |
| Whipple Mountains | 1948 population estimate of 20, 12 seen 1946 |
| Additional losses, probably since 1920 | |
| Sierra Nevada | |
| Olancha Peak | 3 seen in 1926 and other sighting (Jones 1949) |
| Mojave Desert | |
| Eagle Crags | 2 seen in 1939 (Buechner 1960), 1971 population estimate of 7 (Weaver 1975) |
| Quail Mountains | 4 seen in 1939 (Buechner 1960) |
| Bristol Mountains | 1946 population estimate of 4 |
| Little Maria Mountains | 1946 population estimate of 5 |
| McCoy Mountains | 1946 population estimate of 4 |

Table 1. (Continued).

| Populations lost by time period | Evidence of existence |
|---------------------------------|---------------------------------|
| Additional losses since 1850 | |
| Northeastern California | |
| Bogus Mountain | Buechner (1960) |
| Goosenest Mountain | Buechner (1960) |
| Mount Shasta | Buechner (1960), Wolfe (1979) |
| Lava Beds | Wolfe (1979) |
| Warner Mountains | Skulls |
| Hot Springs Peak | Buechner (1960) |
| Sierra Nevada Region | |
| Truckee River | Wistar (1937) |
| Sonora Pass | Jones (1950) |
| Sweetwater Mountains | Jones (1950) |
| Yosemite | Jones (1950) |
| Sawtooth Peak | Garlinger (1987) |
| Great Western Divide | Jones (1950) |
| White Mountains | |
| Silver Canyon | Wehausen (1983b) |
| Transverse Range | |
| Cobblestone Mountain | Newspaper accounts (Jones 1950) |
| Caliente Peak | Cowan (1940) |
| Mojave Desert | |
| Soda Mountains | Old trailing |
| Big Maria Mountains | Old trailing |
| Riverside Mountains | Old trailing |

since 1920 was not as strong. The results yielded a range of 21-27 populations lost since 1920 (Table 1), and averages about one population lost every three years. Currently, there are native populations of sheep inhabiting 49 mountain ranges in California. Because some of the larger ranges contain multiple populations, defined by distinct ranges of ewes, we estimate 59 current populations in the state. Thus, 26-31% of the populations existing in 1920 have been lost.

A minimum total number of populations lost in California since the gold rush also was determined based on all historical evidence of presence. This produced a figure of 45 populations lost overall (Table 1). Those populations lost since 1920 represent 47-60% of this total. Because 1920 is approximately midway between the gold rush and present, this suggests that the rate of population loss dropped little, if any, with the enforcement of full protection.

This continued loss of populations indicates that legislative protection did not affect the major factors underlying extirpation. This early management policy appears to have been founded on two assumptions: (1) that overhunting was the primary problem, and (2) that recolonization would quickly follow recovery of populations (Wehausen 1987). The latter premise represented a general misconception about the basic biology of mountain sheep, a species inherently slow to colonize (Geist 1971). The former did not recognize other adverse effects, such as domestic livestock. In defense of this early effort, the magnitude of the impacts of domestic livestock on mountain sheep, especially through introduced diseases, has been adequately assessed only recently (Goodson 1982, Foreyt and Jessup 1982, Jessup 1985, Wehausen et al. 1987). Legislative action was undoubtedly the only avenue of management available at the time it was enacted.

DATA COLLECTION UNDER FULL PROTECTION

DFG Supported Data Collection

Legislation to protect mountain sheep in California occurred before a Department of Fish and Game (DFG) existed. Many decades later, when DFG eventually added activities other than law enforcement to their programs, little was allocated to nongame species. In fact, the Fish and Wildlife Preservation Fund, derived from license fees, legally could not be used for nongame species. With no provision for funding of nongame species like mountain sheep, they were largely neglected. Consequently, little information was gathered on them.

Despite the existence of mountain sheep populations in over 50 mountain ranges in California, the DFG has never allocated a permanent biologist position exclusively to that species. Basic inventory data have consisted of cursory statewide surveys conducted about once a decade. These occurred in 1940, 1946, 1957, 1968-72, and one in progress that began in 1984. Only the first two of these were initiated within DFG. The 1957 survey came about because of Buechner's (1960) compilation of population status information for mountain sheep throughout the United States. The two most recent surveys have resulted from legislative resolutions (Senate Resolution 43 in 1968, and Assembly Concurrent Resolution 41 in 1981 for a study plan, followed by funding from the Environmental License Plate Fund beginning in 1984) which resulted from outside political pressure.

All these statewide surveys have relied on subjective population estimates. However, the first three inventories involved notably little field work, and a number of mountain ranges with sheep populations were never even visited. Consequently, the total estimates were crude.

The inventory during 1968-72 incorporated much more field time within mountain ranges than previous surveys. However, with the large number of mountain ranges involved, it still relied on subjective rather than valid empirical population estimates. This survey (Weaver 1973) was the first to address the state as a whole in terms of management needs relative to land use conflicts, water developments, and reintroduction.

The fifth state inventory, which began in 1984, was packaged with a statewide survey of diseases in mountain sheep, and a study of impacts of cattle on mountain sheep. This is the first time DFG has had a research program directed specifically at mountain sheep.

Other DFG-supported data collection in the early decades consisted of semi-regular summer population composition information, beginning in 1953, as well as some habitat use data from the Santa Rosa Mountains, where a state game refuge for mountain sheep is located

(Jones et al. 1957, Blong 1963, 1967, Blong and Pollard 1968, Wehausen et al. 1987). Prior to the most recent statewide inventory, data collected on mountain sheep by DFG consisted largely of occasional helicopter flights beginning in 1979, made in conjunction with a water development program. It was through such flights that two of the most productive populations in the Mojave Desert were discovered at Old Dad Mountain and in the Marble Mountains. An exception was the monitoring study of the first Sierra Nevada reintroduction (Ramey et al. 1980, Andaloro and Ramey 1981) that was funded by the DFG under the Endangered Species Decal Program.

Data Collection Not Initiated by DFG

Numerous studies of mountain sheep in California have occurred through federal, state park, or private support during the past four decades. Most data collection in the Sierra Nevada falls into this category, including the studies of Jones (1950), Riegelhuth (1965), McCullough and Schneegas (1966), Dunaway (1970, 1971a, 1971b, 1972), Elder (1977), Garcia (1977), Hicks (1977), Wehausen (1979, 1980, 1983a), and Wehausen et al. (1977). Other studies initiated by other than DFG include: (1) extensive work in the San Gabriel Mountains by Robinson and Cronmiller (1954), Light and Weaver (1973, Weaver's involvement was funded by DFG), DeForge (1980), Hamilton et al. (1982), Holl and Bleich (1983, Bleich's involvement was funded by DFG), Perry et al. (1987), and Holl and Bleich (1987), (2) in the White and Inyo Mountains by Jorgensen (1975), Kovach (1979), and Wehausen (1983b, 1984, 1986), (3) surveys of the Argus Range and Eagle Crags by DeForge et al. (1981), (4) basic ecology and impacts of burros in the Death Valley area (Dixon and Sumner 1939, Sumner 1959, Welles and Welles 1961, Ginett and Douglas 1982, Dunn and Douglas 1982), (5) studies around water sources in Joshua Tree National Monument (Douglas 1976, Douglas and White 1978, 1979), (6) annual water hole counts and other studies in Anza-Borrego State Park (Jorgensen 1974, Jorgensen and Turner 1972, 1973a, 1973b, 1974, 1975, Russi 1976, 1978, Russi and Monroe 1976, Olech 1979), (7) Bureau of Land Management (BLM) supported studies along the southern boundary of Anza-Borrego State Park (Hicks 1978, Cunningham 1982), and (8) studies of physiology, toxicology, introduced diseases, habitat use, behavior, and demography in the Santa Rosa Mountains (Turner 1973, 1977, 1979a, 1979b, 1979c, Merritt 1974, Berger 1979a, 1979b, 1982, Turner and Payson 1982, DeForge and Scott 1982, DeForge et al. 1982, DeForge 1984, Wehausen et al. 1987).

In summary, data collection by DFG has been sporadic and cursory over the past half century. Additionally, the past two statewide surveys have occurred because they were mandated by the State

Legislature. A number of land management agencies, notably the National Park Service, U.S. Forest Service, and California Department of Parks and Recreation have helped fill this information gap by underwriting considerable investigations of mountain sheep populations on their lands. The BLM has been a notable exception, despite authority over considerably more mountain sheep habitat than other land management agencies. However, congressional allocation of funds to BLM for this species may allow greater future involvement in data acquisition (Cooperrider 1986).

MANAGEMENT UNDER FULL PROTECTION

Protective Management

Until recently, management activities to benefit mountain sheep in California have focused largely on habitat management, but have included some additional measures of protection. In 1917, the State Legislature established Game Refuge 4D in the Santa Rosa Mountains to prohibit all shooting within that area. In the Sierra Nevada, a lack of evident recovery and recolonization by mountain sheep led to concern in the 1930's (Bailey 1932, Grinnell 1935, Dixon 1936) and, ultimately, to a proposal in 1940 by the Sierra Club and the National Park Service for a U.S. Forest Service sanctuary on the east slope (Blake 1940, Colby 1940a, 1940b). This proposal was rejected by the U.S. Forest Service and DFG on grounds that: (1) insufficient information existed by which to judge the need for such a refuge, and (2) the publicity associated with a sanctuary might attract further poaching rather than reduce it (Blake 1941). Three decades later, two such sanctuaries, known as Bighorn Sheep Zoological Areas, were established by the U.S. Forest Service on the bases of the hypothesis that human disturbance was a significant adverse factor (Dunaway 1971a, 1971b).

Following the lead of the federal Endangered Species Act, California compiled its own list of species of concern in the early 1970's. This list included the California (*O. c. californiana*) and peninsular (*O. c. cremnobates*) subspecies of mountain sheep under rare status. Recommendations were for the development and implementation of recovery plans for each, the protection of critical habitat for the peninsular subspecies, and field research and reintroduction for the California subspecies (Leach et al. 1974).

Habitat Management

Before 1971, DFG had an aggressive program of spring improvement in the desert, which included many springs used by mountain sheep (Weaver et al. 1958). This program also constructed many artificial water developments. These were aimed at gallinaceous birds or deer and, with the exception of two, were of no benefit to

mountain sheep. In response to recommendations from the 1968-72 statewide survey (Weaver 1973), DFG began a program in 1971 of building water developments in the desert to aid mountain sheep, in cooperation with BLM and the Society for the Conservation of Bighorn Sheep (Bleich et al. 1982a). These used storage catchments for surface water runoff, as well as horizontal well technology to rejuvenate springs that had become dry (Bleich 1982, 1983, Bleich and Weaver 1983, Bleich et al. 1982b). To date, 48 man-made developments have been built for mountain sheep.

The other major habitat management action has been the reduction of livestock and feral burros in mountain sheep ranges. In the Sierra Nevada, livestock reductions for the benefit of mountain sheep began in the 1930's, but grazing conflicts were not entirely eliminated until the 1960's (Wehausen 1987). Grazing reductions have likewise occurred in the White Mountains where they have been beneficial to mountain sheep, but these changes were not implemented for the purpose of aiding mountain sheep (Wehausen 1983b). Feral burros have long been recognized as having potentially adverse effects on mountain sheep populations (Russo 1956, Sumner 1959, Buechner 1960), but their reduction or removal in many areas of the desert by BLM, the U.S. Navy, and the National Park Service has been a recent phenomenon of the past six years, since the completion of the California Desert Conservation Area Plan by BLM (Kovach 1982, 1983, 1984, 1985). This plan also called for the elimination of livestock grazing in mountain sheep habitat south of Interstate Highway I-40. However, Amendment 81-21 to that plan altered that recommendation and, instead, expanded livestock grazing in the Old Woman Mountains (Wehausen and Hansen 1986).

Population Management

Under full protection, population management in California necessarily has been limited to removal of sheep from native populations for their relocation to vacant historic range. This did not begin in California until 1979, when the first translocation occurred within the Sierra Nevada. One earlier reintroduction occurred in California in 1971, when sheep were obtained from British Columbia and released in a pen at Lava Beds National Monument. This captive population was intended to be used to restock historic ranges in northeastern California. However, it suffered numerous setbacks (Blaisdell 1975, 1976), and only four sheep were moved successfully from it to the Warner mountains in 1980 before the rest died of pneumonia late that year, apparently contracted from neighboring domestic sheep (Foreyt and Jessup 1982). The sheep in the Warner mountains were supplemented in 1980 with ten from the

Mount Baxter herd in the Sierra Nevada, in what has become a successful reintroduction exhibiting an average annual increase of about 24%.

Removals of sheep from the Mount Baxter herd in the Sierra Nevada in 1979, 1980, 1982, and 1986 have totaled 93, 81 of which have been used to restock three areas on that mountain range: Wheeler Ridge, Mount Langley, and Lee Vining Canyon. All three populations have shown evidence of growth, but not at the high rate of the Warner Mountains population.

With documentation of a large population in the San Gabriel mountains (Holl and Bleich 1983) and the discovery of two large Mojave Desert populations capable of providing reintroduction stock, translocations in the Transverse and Mojave Desert ranges began in 1983. Sheep have been removed from Old Dad Mountain five times, totaling 113 animals, and from the Marble Mountains four times, totaling 57 animals. These have been moved to four mountain ranges. Two of these, for which there are adequate data, appear to have increasing populations.

In the Transverse Range, in 1983, 1985, and 1987, a total of 64 sheep were removed from the San Gabriel Mountains and relocated to two locations, one in the San Gabriel Mountains and one near San Rafael Peak in Ventura County. The success of these new populations is not yet clear. In total, reintroductions since 1979 have attempted to establish eight new populations, expand the range of one population, and augment one very low population. None of these show indications of failure.

LEGISLATIVE ATTEMPTS TO CHANGE FULL PROTECTION

There were early legislative attempts to change mountain sheep back to a game animal. One, Senate Bill (SB) 527 in 1922, proposed an open season with \$100 license fee and a tag system. For its time, this was a steep fee, and was strongly opposed in part because it would cater to a privileged few (Scofield 1923).

Recent legislative attempts began in 1979 with SB 833, that proposed making the Nelson subspecies a game animal, while maintaining the other two subspecies as fully protected. It was defeated. This was followed by AB 1548 in 1983, that proposed the same changes as the previous bill. In addition, it called for a statewide study of population status, competition, diseases, and reintroduction needs, in accord with the study plan prepared by DFG (Weaver 1982) in response to 1981 Assembly Concurrent Resolution 41. This bill passed the Assembly, but died in a Senate committee in 1984. The legislature instead allocated funds from California Environmental License Plate Funds for the studies called for in the legislation.

Assembly Bill 3117, that became law in 1986,

differed from the previous two bills in several important ways. First, it proposed to make mountain sheep a game animal in only two mountain ranges: Old Dad Mountain and the Marble Mountains. As noted previously, both of these populations have incurred substantial removals of both sexes for reintroductions in recent years, and natural sex ratios have been skewed through removals that have emphasized females. The choice of these two populations in AB 3117 circumvented arguments that limited sport hunting would somehow jeopardize populations. Second, AB 3117 provided for one tag to be available for fund raising purposes each year, as has been done in other states, with the proceeds of all hunting sanctioned by the bill to be put in an account within the Fish and Wildlife Preservation Fund and to be used only for the benefit of mountain sheep in California. Third, this bill set a low limit on the number of permits that could be offered, not to exceed 15% of mature rams counted annually in each population. Finally, the bill was of limited duration, to expire 1 January 1993. Thus, it was treated somewhat as an experiment.

CONCLUSIONS

Full protection of mountain sheep in California was legislated in good faith at a time when it was badly needed. However, as a conservation tool it was insufficient. Ultimately, it indirectly hindered other conservation needs due to a lack of allocation of resources to nongame species by DFG. As a result, inadequate inventory data existed for most populations until recently, with the consequent lack of awareness that populations were disappearing. In turn, there were no investigations as to causes of population losses, nor efforts to stop such losses. Secondly, as a nongame species, there was a lack of incentive for an active management program to restore extirpated populations through reintroductions. Additionally, the information on individual populations was inadequate to evaluate their use as reintroduction stock.

The overall result was a passive management policy. That policy basically ended in 1979 with the beginning of a reintroduction program in the Sierra Nevada, followed by expansion to other areas in 1983. The passage of AB 3117 in 1986 moved mountain sheep management in California one step further from its former passive approach. What set the stage for this radical change in management direction? Of particular importance was the rare status of the California subspecies because it specifically called for a reintroduction program. It was the only official DFG document which advocated the reintroduction of mountain sheep.

The rare status listing was followed shortly by federally funded intensive study of native sheep

populations in the Sierra Nevada. Information from this study allowed the beginning of a reintroduction program. This program served to establish the feasibility and techniques of hands-on management in California. With the establishment of adequate population data for some additional populations capable of serving as source stock, it was possible to expand the reintroduction program to the Mojave Desert and Transverse Range in 1983.

However, until now, there has remained no official overall commitment by DFG to mountain sheep reintroduction efforts in California, except for the California subspecies. AB 3117 filled that gap by mandating such a commitment and by providing a means to fund such a program.

Future management of mountain sheep in California must have two basic objectives: (1) the prevention of further population losses, and (2) the restoration of extirpated populations. Together, these require a program of continuing data acquisition. An adequate reintroduction program requires detailed monitoring of source populations, the search for new source populations, and the assessment of unoccupied sites and reintroduced populations. Much remains to be understood relative to the various causes of population losses. One aid to better understanding this phenomenon will be the development of reliable indices of population size so that dwindling populations can be detected in time for intensive investigation and possible management actions. However, as causative factors become better understood, the logical approach will be preventative measures.

Of the 45 populations known to be lost since 1850 (Table 1), only eight have been restored through reintroduction. While current land use practices will preclude reintroduction for some of these, much suitable vacant habitat remains to be filled in the coming decades.

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