

WHAT WE LEARNED ABOUT HARVEST MANAGEMENT OF ALASKAN DALL SHEEP: 1971-1997

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Abstract: Prior to the 1960s knowledge of Dall sheep (*Ovis dalli dalli*) was fragmentary and anecdotal. Systematic scientific investigation of Dall sheep ecology for application to Dall sheep management by the Alaska Department of Fish and Game began with Lyman Nichols's Kenai Peninsula work in the late 1960s. This work subsequently expanded to Interior Alaska, and by 1967, a significant Dall sheep research effort which would run continuously for 25 years was underway in the eastern Alaska Range. For 21 of these years, I was principle investigator for this program. During this time, the program established the biological basis upon which Dall sheep are managed throughout most of Alaska. These research efforts defined many characteristics of Alaskan Dall sheep including population identity, population performance, reproductive timing and rates, management-relevant reproductive behaviors, nutritional needs, mineral physiology, habitat constraints, hunter preferences, and societal values. Data from these studies indicated classic density-dependent nutritional constraints are not generally applicable to Dall sheep, and established that, in undisturbed ecosystems, harvest-management-alterable sheep behaviors are of greater importance than density-dependent nutrition. This review article contains a brief history of Dall sheep in Alaska and highlights those aspects relevant to harvest management.

INTRODUCTION

Since the United States purchased Alaska from Russia 130 years ago, Dall sheep have been ignored, exploited, and managed by varying approaches. Present-day management practices range from total protection in state-created viewing areas and Congressionally established national parks, through biologically based harvest management on state and selected federal lands, to highly permissive management for subsistence uses on other federal lands. How this spectrum of management practices evolved is a fascinating, sometimes rough-and-tumble, human adventure in the biology and politics of wildlife conservation in Alaska.

The opportunity to hunt has been the historic linchpin of North American wildlife conservation. Where hunting opportunity has been maintained, wildlife populations thrive through active management programs. World experience shows that where public hunting is not allowed, public interest in wildlife suffers and wildlife conservation becomes an exclusive, expensive "government function" instead of an individual human activity. Broadly stated, preserving hunting opportunity is, at present, the key to maintaining Dall sheep abundance and use through conservation.

Without special effort, funding, and aggressive input from Dall sheep hunters, Dall sheep management would probably be on a less secure course than it is in Alaska today.

EARLY HISTORY

Except for those populations heavily exploited by aboriginal hunters, Dall sheep were basically untouched when Alaska was purchased from Russia in 1867. Early accounts recall that Eskimos harvested significant numbers of sheep from readily accessible populations in the Northern Brooks Range for their own use and for barter to whalers and explorers. During this period, aboriginal use of Dall sheep was part of the nomadic seasonal cycle or as a back-up source of meat when other sources failed (Campbell 1974, S. Pedersen, ADF&G Div. of Subsistence, Fairbanks pers commun.). The harvest activities of these aboriginal hunters may have had significant impacts on locally used Dall sheep populations. At least one modern anthropologist (Campbell 1974), suggested aboriginal overharvest of Dall sheep was responsible for the scarcity of Dall sheep documented in the Brooks Range during the late 19th and early 20th centuries.

As the Territory of Alaska developed, explorers and naturalists became interested in Dall sheep. It was the explorer/naturalists who gave Alaska's wild white sheep their rather intriguing name, Dall's sheep. One of these early explorers, a fellow named Nelson, had an interest in mammals, and named many of them throughout Alaska. Nelson offered the first Latin scientific name for these white sheep in 1884. It was simply "*Ovis*" (the sheep genus) plus "*montana*" (for mountain) as the species name. Nelson also proposed the subspecies name, "*dalli*". Tradition says that Nelson offered the "*dalli*" subspecies name in honor of another early Alaskan explorer, William H. Dall. W. H. Dall was primarily a mariner and river traveler, and there's no record of him ever having been in Dall sheep country. In 1897, another namer of animals, J. A. Allen, changed the species name from "*montana*" to "*dalli*," and the taxonomic designation has remained *Ovis dalli dalli* ever since (Bee and Hall 1956).

Dall's name continues to be associated with Alaska's white sheep because the accepted rules of scientific naming call for it. These rules say the species name (in this case "*dalli*," the Latinized form of Dall) should be "de-Latinized" and its possessive form (Dall's) used as the scientifically accepted "common name." Under these rules, the scientifically correct common name would be "Dall's sheep."

This technical naming rule causes some confusion where Alaska's wild white sheep are concerned. No wild white sheep were ever possessed by W. H. Dall, and it's unlikely he had anything to do with wild sheep. Eventually common usage by Alaskans who were involved with these sheep changed the "correct" but confusing possessive-form common name to the descriptive form, "Dall" sheep. I prefer "Dall sheep," and will use it rather than the possibly more correct possessive form because I find "Dall's" not only confusing, but hard to pronounce and even harder to type.

Besides being taken by aboriginals and explorer/naturalists, Dall sheep were exploited by the trappers, miners, market hunters, and homesteaders who followed. Some sheep populations were decimated because of harvesting by humans during the early 20th century (Capps 1916).

DALL SHEEP MANAGEMENT DURING TERRITORIAL DAYS

Within a decade after some populations had been decimated, the first closed seasons and restrictive bag limits were established (in 1926) as the emerging science of wildlife management began to influence the Alaska scene. Under this scheme, the open harvest season was scheduled during early fall, primarily because of traditions attending wildlife management in other places. The fall season also made sense to early wildlife managers because Dall sheep were not breeding at that time, and were at their fattest. The bag limit was restricted to two rams. Ram-only hunting appeared to be biologically sustainable because a single mountain sheep ram will breed many ewes. The regulation was also consistent with the "males only" harvest seasons characteristic of early conservation efforts.

During this period, no systematic population monitoring or regulatory program existed, and managers applied their knowledge of local Dall sheep populations over what today would be unthinkable huge areas. For example, the Territory-wide closure of Dall sheep hunting in 1942 was based on the assumption that the harsh weather which decimated Dall sheep populations on the Kenai Peninsula occurred throughout all Alaska. Ram harvest was again allowed in 1943. The one-year closure in 1942 was probably an ineffective management action. Modern studies of population dynamics and weather patterns suggest it was unlikely Dall sheep had suffered throughout the entire Alaska Territory. Additionally, we now know that Dall ewes don't usually reproduce until age three or four years, and twinning has never been seen (Nichols 1978 Heimer and Watson 1986g). Hence the one-year closure was insufficient time for any significant population recovery.

Nevertheless, when the harvest season was re-opened in 1943, the general bag limit was more conservative (one ram) except in the Brooks Range where the limit remained at two rams. Although ewe harvests were prohibited, the more liberal bag limit in the Brooks Range provided greater harvest opportunities for Eskimos and Indians with a history of Dall sheep use there. These bag limits persisted until 1951 when they were revised to an even more conservative harvest regulation.

In 1951, only rams with horns that had grown through 3/4 of a "curl" (the circle described by the outside surface of the horn helix) were legally harvestable. This regulation went a step beyond "males only" hunting, and appears to have been designed either to assure harvest of rams with larger horns or protect young rams from harvest. The 3/4-curl rule was initially a federal regulation which came to the Territory of Alaska from Washington D.C. via Wyoming, where it was first applied to bighorn sheep in 1930 (Dimarchi 1978). Under the 3/4-curl rule, the bag limit remained two legal rams in the Brooks Range until 1970.

By 1970, non-local harvest of rams in the Brooks Range was increasing because of growth in the commercial guiding industry for Dall sheep. At that time, the sheep harvest season opened ten days earlier in the Brooks Range than any big game hunting season in Alaska, and commercial guides were not tightly restricted to specific areas so many guides were offering an early sheep hunt in the Brooks Range. Managers of that day apparently thought it more important to standardize the harvest season at Aug. 10-Sept. 20 (as it remains) and meet a perceived need to limit overall ram harvests for conservation purposes than to provide additional harvest

opportunities for resident Indians and Eskimos. Hence the Brooks Range bag limit was reduced from two 3/4 curl rams to one. Besides, it was common knowledge that these Natives had never limited their harvests to rams as specified in regulations 20 years earlier. Managers chose to regulate those who would comply and benignly ignore illegal local uses.

Since 1930, the legal size/age of rams for harvest has been defined by the portion of the "curl" attained by each ram's horns. This still works because horns continue to grow throughout a sheep's life, and unbroken Dall ram horns describe a complete circle (when viewed along their helical axes) at maturity. The horn size/age limit commonly applied throughout North America was arbitrarily set at 3/4-curl in an effort to provide both biological safety and maximum ram harvests among bighorns.

While the 3/4-curl regulation may have been compatible with bighorn sheep biology, it was poorly suited to Dall (or thinhorn) sheep biology. Bighorn (Rocky Mountain, California, and Desert subspecies) and thinhorn (the Dall and Stone subspecies) sheep are behaviorally different. One significant difference is in the frequency and extent of ram horn brooming (the breaking of horn tips during dominance fighting). Virtually all bighorn rams broom both horns back to 3/4-curl by maturity. Brooming in Dall rams is common, but Dall rams seldom break both horns or broom as severely as bighorns. Consequently, many 3/4-curl bighorns are mature, but virtually all 3/4-curl Dall rams are simply young. The 3/4-curl rule, when applied to Dall sheep allowed harvest of juvenile rams. As sheep hunting increased in Alaska, application of the 3/4-curl rule to thinhorned Dall sheep caused subtle, long-term negative effects to the heavily hunted populations where mature rams were completely removed. It took the newly formed State of Alaska decades to discover and rectify this situation.

EVOLUTION OF THE STATE'S BIOLOGICALLY-BASED HARVEST REGULATIONS

The history of Dall ram harvest regulations in Alaska is tied to the re-emergence of Rocky Mountain bighorn sheep in the American West (Heimer and Watson 1986b). Prior to settlement of the western United States by Europeans, bighorn sheep were abundant in suitable habitats. Settlement of the West greatly reduced their numbers, and by 1900 only small relict populations remained in mountainous areas which had limited appeal to stockmen and miners.

The introduction of domestic livestock diseases to bighorn sheep was the primary factor in their demise, but the decline was also aggravated by competition with domestic livestock for grazing lands and overhunting for the frontier meat market (Buechner 1960). When wildlife managers began to practice conservation and restoration of bighorn sheep, the first approach was total protection throughout the western states.

This total protection (along with control of predator populations to benefit the livestock industries) eventually brought many bighorn populations back from the brink of extinction (Trefethen 1975, Hoefs 1985). As sheep populations returned to viable levels, managers sought a balance between protection and use. This meant allowing some harvest but still allowing herds to grow. Wildlife managers understood that herd growth would produce benefits. These benefits included the conservation-funding revenues produced by license and tag sales, the economic

benefits from developing and maintaining guiding and outfitting industries, and the high public interest in conservation and management which result from hunting (Heimer and Watson 1986a).

A review of mountain sheep hunting regulations across North America (Dimarchi 1978) shows the most common attempt to balance herd growth and hunter use was the limited harvest of surplus males (rams). Rams, which could be removed by hunters without noticeably compromising lamb production, were defined as surplus. The conclusion reached by most sheep managers was that harvesting rams at the youngest acceptable age (before natural mortality removed any more of them than necessary from the shootable population) would give the greatest sustainable harvest. This data-free assumption, in 1930, came 14 years before the first data on mountain sheep survival were collected (Murie 1944). Although survival of rams in unharmed mountain sheep populations shows a consistently low mortality between one and eight years of age (Deevey 1947, Bradley and Baker 1967) tightly regulated 3/4-curl harvest persisted as the dominant rule governing harvest of bighorn sheep throughout the western United States through the 1980s. In the 1990s a trend toward "any ram" or "any sheep" bag limits gained popularity among bighorn managers. These more permissive regulations don't appear biologically threatening to sheep populations because harvests are specifically held to biologically insignificant levels. Also, harvests under this bighorn management regime are strictly controlled by limited entry permit hunts.

However, when managers formulate broad harvest regulations where general open harvest seasons are provided (such as for 3/4 curl rams in Alaska) the risk is greater. Consequently, the regulations must be more conservative. In these circumstances, it is generally understood that the resource must be conserved even if the allowed harvest takes place at the maximum level. It was in this respect that the 3/4-curl regulation originally developed for bighorn sheep in Wyoming failed when it was applied to thinhorn sheep in Alaska.

When the harvest level of sheep is so low as to be biologically insignificant, it doesn't matter what the regulations are, or even if any regulations exist. Hence, before the human population of Alaska and the interest in Dall sheep hunting increased to the point that harvests could negatively affect local Dall sheep populations, regulations were largely irrelevant. As hunting pressure increased to the point where virtually all legal rams were removed from hunted Dall sheep populations, the 3/4-curl regulation was insufficient to protect the populations from negative impacts. Here's why.

The 3/4-curl regulation provided some conservation benefit in that it protected ewes from harvest; but the overharvest of virtually all mature rams from some populations resulted in social disruption which was harmful to Dall sheep as well as hunter welfare (Heimer and Watson 1986a, 1990). Lamb production declined, and mortality among young rams greatly increased.

Mountain sheep in general, and Dall sheep in particular are intensely social herd animals. In mountain sheep society, each individual has a clearly defined social position keyed to horn size. The behavior, reproductive success, and nutritional condition of each sheep are determined by this social rank (Geist 1968, 1971). This powerful influence on Dall sheep population dynamics was not recognized when the 3/4-curl regulation was implemented.

The two important aspects of Dall sheep ecology which were disrupted by near-total harvest of rams down to the 3/4-curl limit (average ram age of 4.5 years) were lamb production and immature ram survival. When virtually all dominant rams aged seven to eight years and older, were removed, lamb production declined significantly. Some lambs were still produced by adult ewes, but 95 percent of these adult ewes reproduced only in alternate years. This appeared to be linked to a prolonged lactation period associated with low ram abundance and/or the absence of mature rams. Consecutive-year reproductive success among adult ewes was only five percent (Heimer and Watson 1986b). Additionally the frequency of reproductive activity among 18-months old ewes rose from about five percent to 25 percent. These young ewes typically conceived late, and delivered stunted lambs well after the normal peak of lambing by adult ewes.

Survival of young rams was also seriously compromised because immature rams became active breeders and began to pay the energetic and mortality costs associated with dominance before they were behaviorally and physically mature (Heimer et al. 1984, Heimer and Watson 1986b). This decreased immature ram survival. The cumulative management effect of biological disruption resulting from mature ram overharvesting was lowered sustainable ram harvest (Heimer and Watson 1990).

In 1984, an experimental full-curl regulation was established in a heavily hunted portion of the Alaska Range to see if this single change in ram harvest (which was expected to increase lamb production and immature ram survival) would actually lead to increased harvests of mature rams. Alaska Department of Fish and Game funding for this effort was supplemented by a sheep hunter's organization, the Alaska Chapter of the Foundation for North American Wild Sheep (FNAWS). Additionally, FNAWS members contributed as volunteer field observers during the required field research.

Cumulative results of managing for overall increased ram numbers (and the concomitant increase in mature ram abundance) by implementing a full curl regulation showed highly significant increases in ram harvests through 1989. These increases were results of doubled (annual, not alternate-year) lamb production and an apparent dramatic increase in young ram survival attending the presence of mature rams in the populations (Heimer and Watson 1986b). Eventually harvests of full-curl rams exceeded those sustained by the same populations under the 3/4 curl rule (Heimer and Watson 1990).

Once aware of these results, Dall sheep hunters proposed an end to the 40-year span of 3/4-curl ram harvests in Alaska. This 1989 proposal was the first to factor the subtleties of animal behavior into harvest management of big game in Alaska, and perhaps the entire United States. Consequently, it was highly controversial. Paradoxically, the proposal was opposed by the state's wildlife management agency which had approved the research and analysis upon which it was based. As a result of compelling public testimony, the Alaska Board of Game passed the present regulation limiting ram harvests to full-curl or eight-year-old rams, or rams with horns broomed on both sides.

This regulatory change, assuring the presence of mature rams even in heavily hunted Dall sheep populations, also simplified sheep management (Heimer and Watson 1990). Hunter success was not affected. With few local exceptions, thinhorn sheep throughout North America are now managed for the harvest of full-curl rams. Legal definitions differ between states and provinces (Northern Wild Sheep and Goat Council Workshop 1990).

So, we see it took 39 years (including 29 years of Alaska statehood) to rectify the biologically incorrect 3/4-curl regulation established by a well-meaning, but biologically naive Federal Territorial Government. The State of Alaska now attempts to manage Dall sheep in accordance with a published, biologically based working management hypothesis (Heimer 1988). Unfortunately for sheep hunters, the 3/4-curl regulation was not the end of federal intervention limiting sheep hunting opportunity in Alaska.

FURTHER FEDERAL INTERVENTION

Development of the vast oil reserves in arctic Alaska during the late 1970s caused the most extensive federal intervention in state wildlife management in U. S. history. This story began with Alaska's attempt to settle historic Native land claims.

After the oil discovery at Prudhoe Bay in the 1960s, it became clear that the pipeline required to get the oil to market could not be built until these Native land claims were settled. Not everyone thought building the oil pipeline was a good idea. Alaska Natives joined the environmental preservation community in opposing the pipeline. Compromises between Alaska Native/environmental preservation interests and oil-development interests to allow building the trans-Alaska oil pipeline resulted in a Congressional mandate to place huge tracts of federal public land in federal conservation systems. In these compromises, the Alaska Natives and the environmental community agreed to stop fighting pipeline construction. The final settlement in 1980 resulted in one billion dollars and 44 million acres of land for Alaska Natives and the reclassification of at least 80 million acres of federal land as new wildlife refuges, national forests, wild and scenic rivers, and new national parks for the conservationists.

Initially, lands selected for transfer to the National Park Service contained a large fraction (up to half in some proposals) of the Dall sheep habitat in Alaska. Everyone understood that if these lands were to become National Parks, there would be no opportunity to harvest sheep on them in the future. Consequently, the State of Alaska resisted these land transfers to the National Park Service, at least partly to maintain sheep hunting.

An intense, protracted, and bitter Congressional debate followed. It was during the Congressional debate in the mid to late 1970s that the same organized sheep hunters (who were instrumental in changing to a biologically based harvest system) first became active in Alaska. With contributions of money and grassroots political support from these hunters, Alaska mounted an effort to maintain as much sheep hunting in Alaska as possible. Compromises ending this debate resulted in a 25 percent loss of sheep hunting in Alaska and federal recognition of a subsistence harvest priority for rural residents of Alaska (Heimer 1978, 1980, 1982, 1986).

That is, the state's hunter supported effort was successful in preserving general hunter access to sheep on about 75 percent of the state's sheep habitat. The remaining 25 percent was classified as National Park land where only rural subsistence hunters were allowed to harvest sheep. All others, including non-rural Alaska Natives, permanently lost Dall sheep hunting opportunity on these lands. Subsistence seasons on federal lands are typically lengthy (most last for seven months), and bag limits are liberal (up to three sheep-including ewes and lambs). Subsistence harvest reporting is voluntary. As anecdotal evidence accumulates, it's beginning to look like this liberal approach to management is inconsistent with Dall sheep conservation. Unfortunately, the politicization of harvest allocation for preferential subsistence uses has reduced biological considerations to low, almost incidental, priority (see Heimer's accompanying paper, this symposium).

The most notable state success in maintaining sheep hunting opportunity was in the Northern Wrangell Mountains where a population of 12,000 Dall sheep were kept available for public hunting on federal land. Over the 15 years since ram harvest opportunity was preserved on these sheep habitats, ram harvests from this area have averaged about 250-300 rams per year. This cumulative harvest grossed the state economy approximately \$28.9 million dollars and had no negative effect on the overall population of sheep in the Northern Wrangell Mountains. During this same time period, the statewide Dall ram harvest averaged about 1,100 rams per year.

Calculation of the dollar value of Dall ram harvest was made possible by an economic study funded, again, by the hunters interested in Dall sheep conservation. This project (Watson 1990) proved to be a ground breaking effort which foreshadowed other economic assessments of hunting in Alaska. Updated estimates of the dollar value of Dall sheep hunting in Alaska are approximately \$12,000,000 per year (McCollum and Miller 1994).

Additionally, fines as high as \$5,000 per ram for illegally taken Dall rams have been levied in Alaska. Although this fine is less than half the defined "market value" of a Dall ram, it is ten times higher than the traditional \$500 which had been imposed prior to the economic work.

PRESENT CONDITIONS AND FUTURE PROSPECTS

During the late 1980s and early 1990s, Dall sheep populations throughout much of Alaska declined because of difficult weather (Heimer et al. 1994, Heimer 1995). Predator pressure, primarily exerted by wolves on adult sheep, is an additive factor; and may be expected to slow population recovery because it increases what we call "environmental resistance" to population growth. Recent developments have resulted in the addition of major coyote predation on lambs as an additional component of environmental resistance.

Environmental resistance has three components: weather, harvest by humans, and harvest by predators. Wildlife managers can manipulate two of these. The history of changes in hunting management in Alaska shows human harvest is now generally managed so that harvest by humans has a negligible effect on population welfare (except where federal subsistence seasons place populations at risk through long, liberal seasons for ewe sheep with no harvest reporting requirement). The other manageable component of environmental resistance is predation;

managers cannot control weather. At the present time, wildlife managers in Alaska are taking no steps to limit predation to foster Dall sheep population recovery.

The distribution of weather-related population declines and absence of lowering environmental resistance due to predation has significantly decreased mature ram harvests in Alaska. The short term outlook is bleak because these weather-related lamb production failures (Heimer 1995) are just beginning to be reflected in the absence of legal rams. If sheep managers in Alaska are to do more than tally the harvest of mature rams, the time has come to attempt active management. The option available to managers is lowering the non-human component of environmental resistance to facilitate population recovery. This means wolf and coyote control. After all, predation is the only management-alterable factor which has not already been manipulated to favor Dall sheep. It may be difficult, but I remain optimistic for the longer-term future, primarily because of the high public interest in Dall sheep which drives Dall sheep conservation in Alaska.

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