

THE USE OF SCIENCE-BASED LITERATURE FOR PREDATOR CONTROL TO ENHANCE BIGHORN SHEEP, MULE DEER AND PRONGHORN IN NEVADA

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ABSTRACT: A bill was introduced in the Nevada Legislature during 2007 to consider increasing finances for the predator control program to enhance wild ungulate populations and other wildlife. The Assembly bill evoked much public interest, however, technical based information relative to predator-prey relations was not readily available. Consequently, conservation organizations requested a concise but comprehensive review of science-based literature regarding the influence of predator control programs on bighorn sheep (*Ovis canadensis*), mule deer (*Odocoileus hemionus*), and pronghorn (*Antilocapra americana*) in Nevada and adjacent states. Therefore, this report was accomplished documenting more than 50 technical publications of predation relations with large native wild ungulates. Case histories, findings, and management strategies were provided for predator control programs to enhance large wild ungulates.

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Key Words: Bighorn sheep, bobcat, coyote, cougar, golden eagle, mule deer, Nevada, political services, predator control programs, pronghorn, science-based wildlife management literature.

INTRODUCTION

Public interest regarding predator relations to big game in Nevada increased during 2007. For example, 8 articles were published in the Reno Gazette-Journal newspaper (Rice 2006, 2007a, 2007b, 2007c, 2007d, Lent 2007, Heath 2007, and Molde 2007). Also, the Nevada Bighorns Unlimited News printed a lengthy article regarding the objectives and results of various predator control programs (Mason 2007). The state legislature became involved with Assembly Bill Number 259 that proposed major changes in the management of cougars (*Felis concolor*), and increased funds for lethal control of predators (Nevada Legislature 2007).

With the above events, there was an accelerated demand by the public for sound wildlife management information. Therefore the objectives of this paper are: (1) to provide a concise review of science-based publications regarding the effects of predators on wild ungulates, (2) to assess the results of recent predator control strategies to enhance wild ungulates in Nevada, and (3) to make these findings readily available to conservation organizations and other interested sources.

SCIENCE IN WILDLIFE MANAGEMENT TODAY

Modern "wildlife management" has been hailed as a major conservation endeavor for the enhancement of natural resources in North America. In their book *Return of Royalty: Wild Sheep of North America*, Toweill and Geist (1999) traced the history of this success to U.S. President Theodore Roosevelt's leadership some 100 years ago. While president, he gave a unique twist to the North American philosophy of wildlife conservation, one that bears his name to date: The Roosevelt Doctrine. This Doctrine proclaimed that the management of

wildlife was to be based on the best science available. Information in this article emphasizes science-based studies because these findings remain the foundation for applying wildlife management strategies today (Sinclair 1999).

CASE HISTORIES

Numerous publications have reported the influences of predators on large wild ungulates. These documents will be reviewed for pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), and bighorn sheep (*Ovis canadensis*).

Pronghorn Antelope

More than 30 studies during the past 60 years have evaluated the effects of predators on pronghorn in Canada, Mexico and the United States (O'Gara and Shaw 2004, Yoakum et al. 2004). These investigations substantiated that adult pronghorn were seldom victims of predation as they have the ability to outrun predators. However, fawns less than 3 months old were frequent prey for golden eagles (*Aquila chrysaetos*), bobcats (*Lynx rufus*), and especially coyotes (*Canis latrans*). Within the last decade, cougars (*Felis concolor*) have been added to the list of minor predators (Yoakum et al. 2004). These studies verified that predators frequently kill small fawns, but none reported predator control practices to increase fawn recruitment resulted in increased wild free-roaming pronghorn numbers (Yoakum et al. 2004). The following long-term investigation supports this assessment.

Hart Mountain National Antelope Refuge (HMNAR)

The HMNAR is located in Oregon within sight of the Nevada northwestern border. During severe winters,

pronghorn travel from Hart Mountain to crucial habitats in Nevada. A decade ago it was assumed predators were responsible for low fawn recruitment and thus limiting population numbers on the HMNAR (Greg et al. 2001).

To clarify the influences of predators on fawns, the U.S. Fish and Wildlife Service initiated a field study at the HMNAR in 1996 (Dunbar and Valarde 1998, Greg et al. 2001). New-born fawns were caught, instrumented with radio mortality transmitters and released for 3 months of continuous monitoring. This project was the only long-term (more than 10 consecutive years) instrumented fawn mortality research project conducted for free-living native pronghorn in western North America. Results indicated that neonate mortality rates from predation ranged from some 10 to 90 percent; however, the average loss to predation per annum was close to 50 percent (Yoakum et al. 2004). This mortality rate appeared high, but pronghorn females generally produce 2 fawns per year; a higher rate than generally needed to maintain adequate fawn recruitment for population numbers (O’Gara 2004). The major finding for this HMNAR study was that a 10-year average of 50 percent loss annually was attributed to predation; however, population numbers almost doubled during the investigation. Evidently, high predation losses were not sufficient to limit pronghorn population increases for this study. This 10-year research study alluded to the ascertainment that vegetation conditions were relatively healthy; thus the herd increased in spite of the lack of a predator control program (Yoakum et al. 2004). Similar long-term studies are needed for other pronghorn habitats.

Additional Pronghorn Studies

Hess (1986) analyzed 38 years of fawn survival data for the interstate region of California, Nevada and Oregon. He concluded “Fawn predation, starvation, abandonment, and weak fawn syndrome are symptoms of DD (density dependence) in the Great Basin, not causes of low fawn survival. With the pronghorn population >4X that of the 1950s, it is questionable if fawn predation is a real biological problem.” These findings were supported by a 2-year research project conducted on the Sheldon National Wildlife Refuge, Nevada (McNay 1980). The study was designed to determine the cause of low fawn recruitment. Results indicated vegetation condition and not predation was the predominant factor influencing fawn survival. More recently in 2002, the Nevada Department of Wildlife reported that their limited coyote control program had no discernable benefit for pronghorn fawn:doe ratios (Hack and Menzel 2002).

The *Pronghorn Management Guides* (Autenrieth et al. 2006) provide a compilation of ecological and

management findings for Canada, Mexico, and the United States. The Guides were produced during the last 30 years by representatives from state/provincial and federal government agencies, universities, wildlife consultants, conservation organizations, and interested persons. Regarding the interactions of pronghorn and predators, it was recognized that predators could be deleterious to wild free-living pronghorn herds when pronghorn numbers were low and predator numbers were high. Although pronghorn were subject to predation annually, it was generally not a factor limiting herd numbers. Rather, habitat conditions were reported as the major agent.

An additional benefit of conducting lengthy quantitative studies of predation on pronghorn was experience gained regarding how to effectively determine whether a carcass was possibly killed by a predator or died from other causes and later scavenged by predators (Fig. 1). Guides for such diagnostic procedures are now available (O’Gara 1978, O’Gara and Shaw 2004).

Mule Deer

Some 50 years ago, the Nevada Legislature employed professor Starker Leopold from the University of California, Berkeley, to evaluate mule deer issues in Nevada (Leopold 1959). Leopold concluded that forage conditions in general were not in quality condition and were responsible for limited deer numbers. Predators were not identified as a major mortality problem. Leopold and colleagues conducted other investigations of mule deer for interstate herds between Nevada and California (Longhurst et al. 1952). They concluded that nutrition intake of deer during critical seasons determined productivity and mortality. Starker Leopold concluded “Putting all this in much simpler form, good forage ranges generally have many deer; poor ranges have few. All other influences are secondary” (Leopold 1966:57).

More recently, the Nevada Department of Wildlife published Biological Bulletin number 14 regarding current trends in mule deer populations (Wasley 2004). The report states “There is no question that coyotes eat fawns. However, if coyote predation of fawns were limiting mule deer populations, fawn ratio data and coyote harvest data should display some type of cause and effect relationship. Although a general trend consistent with this hypothesis exists for a period, data fail to substantiate the hypothesis, especially over the last 10 years” (Wasley 2004:27).

Another comprehensive report regarding the influences of predation on mule deer was completed in 2003 by a team of wildlife biologists for western state wildlife agencies (Ballard et al 2003). Their findings stated that while predation occurred in all mule deer

populations, in most cases, predation had little impact on population. The importance of predation depended on the relation of deer herds to habitat carrying capacities. When deer populations were low and habitat conditions were poor, predation could limit population growth. Wildlife management agencies were often asked to implement predator reduction programs. To be effective, these programs needed to be well planned and implemented only when predation had been documented as the factor suppressing the mule deer population. The authors concluded most mule deer and predator studies were short-term (3 years), conducted in relatively small areas, and few actually demonstrated increased fawn recruitment resulting in subsequent larger harvests by humans. Also, conditions that led to a particular deer population being limited by predation were poorly documented. In addition, the authors reported that a recent survey of state/provincial wildlife agencies found few agencies had predator control programs to benefit ungulate populations.

Predation studies using radio telemetry to document mule deer neonate mortality have been limited (Linnel et al. 1995, Ballard et al. 2003). One in Colorado stated the primary reason why some western states have lost half their peak mule deer populations during the past 2 decades was because mule deer were suffering from poor nutrition and disease created by deteriorating forage quality (Saile 2000). While predation and other factors contribute to mule deer decline, their effects are less than those of deficient and poor quality forage. "Coyotes are often portrayed as muley killers. But in a recent study of fawn mortality in Colorado, state researchers found that only 21 percent of fawn deaths could be linked to coyotes, and in some cases, the carcass-feeding may have occurred after the fawn died" (Saile 2000:12).

Persons interested in other reports pertaining to mule deer production and mortality may find a wealth of information in the following literature: Hornocker (1970), Tueller and Monroe (1976), Connolly (1978), Salwasser et al. (1978), Smith and LeCount (1979),



Figure 1. Pictured here is an adult pronghorn carcass found on the Hart Mountain National Antelope Refuge in Oregon. An autopsy disclosed the animal had apparently not been killed by predators but died of other causes. Evidently a bobcat found the carcass, consumed parts, and then attempted to bury with surrounding vegetation. Bobcats characteristically cover their food cache as an attempt to conceal the carcass from other predators or scavengers. (Photo by Jim D. Yoakum, Verdi, Nevada).

Connolly (1981), Walimo (1981), Russo (1984), Gruell (1986), Skogland (1991), Clements and Young (1997), Salle (2000), Spalinger (2000), Ballard et al. (2001) and (2003).

Bighorn Sheep

The Desert Bighorn Council published recommended management guides for bighorn sheep occupying arid habitats (Wilson et al. 1980). Regarding predation, early reports verified predation by coyotes, bobcats, golden eagles, and cougars, but predation was not deemed a limiting factor for free-living bighorn populations having adequate cover (Blaisdell 1961, Elliot 1961, Jantzen 1961, Weaver 1961). The qualifier "free-living" is inserted here for certain bighorn transplants during the 1950s-1960s placed transit animals in small fenced enclosures. Such enclosures on the HMNAR in Oregon and the Sheldon National Wildlife Refuge in Nevada were successful, however, the site near Hawthorne, Nevada experienced major mortality problems as it apparently had been constructed in a cougar travel corridor.

Compared to pronghorn or mule deer, few instrument monitoring studies of neonatal mortality were conducted for bighorn on deserts, and these studies

were with low numbers of lambs (Linnell et al. 1995). More recently, cougars in various southwestern states have been implicated as major predators on recently translocated bighorn (Ernest et al. 2002, Kamler et al. 2002, Rominger et al. 2005) (see Table 1). These studies used telemetry to monitor released animals. When bighorn losses to cougars were verified, management commenced removal of mountain lions until the herd had grown large enough to sustain predation (Kamler et al. 2002).

During 1999, a 4-day meeting was conducted in Reno, Nevada for the Second North American Wild Sheep Conference with attending representatives from the Northern Wild Sheep and Goat Council (Alaska, Canada and northwestern United States), and the Desert Bighorn Council (Mexico and southwestern United States). These international wild sheep groups meet periodically to report ecological and management strategies. A subsequent 470 page report for the Conference documented technical papers presented and business meeting accomplishments (Thomas and Thomas 2000).

A major section of the conference transactions reported on management practices conducted to enhance wild sheep by state agencies in the United States.

Table 1. Results of questionnaire survey to state wildlife agencies reported in the 2nd North American Wild Sheep Conference Transactions (Thomas and Thomas 2000). These responses were to the question: Did you use predator control to benefit bighorn?

State Wildlife Agency	Rocky Mt. Bighorn	California Bighorn	Desert Bighorn
Arizona	No		No
California		No	No
Colorado		No	No
Idaho	No	No	
Montana	No		
Nebraska	No		
New Mexico	Yes**		Yes**
Nevada	No	No	No
Oregon	No	No	
South Dakota	No		
Texas	Yes**		Yes**
Utah	Yes**	No	Yes**
Washington	No	No	
Wyoming	No		

** Denotes cougars killed bighorns, and that permits were issued to hunt cougars in area.

Table 1 provides a review of findings regarding the use of predator control programs reported to benefit bighorn (generally cooperative control programs with Animal Damage Control or Animal and Plant Health Inspection Services in the federal government). From these findings, it appeared that (1) predator control practices to benefit wild sheep were not a major management activity, (2) most wildlife programs that used predator control were southwestern States where ecological carrying capacities were inherently low, and (3) successful predator control programs were conducted after documentation that cougars were killing bighorns following translocation projects. A review of papers in the Desert Bighorn Council Transactions since 2000 indicated predator control programs were being used prior to, during, and immediately following translocation endeavors. Apparently predator control programs for bighorn enhancement were most frequently implemented where low bighorn numbers existed following translocation projects.

THE LEOPOLD AND OTHER REPORTS ON PREDATOR CONTROL

During 1963, a panel of senior wildlife biologists reviewed the objectives and effectiveness of the Predator and Rodent Control Branch of the U.S. Fish and Wildlife Service (Leopold 1964). The panel charged the predator controllers with catering to the livestock industry, ignoring science, and wasting taxpayer's dollars by unnecessarily killing thousands of wildlife. The committee concluded: "It is the unanimous opinion of this Board that control as actually practiced today is considerably in excess of the amount that can be justified in terms of total public interest" (Leopold 1964:29).

The 1964 report was one of the first published review and evaluation of United States federal government wildlife control programs. Since then, 3 more reports have been accomplished to assess the values, procedures, expenditures, and results of predator control on wildlife (Cain et al. 1972, Phillips and Jonkel 1975, and U.S. Fish and Wildlife Service 1978). The 2007 North American Wildlife and Natural Resource Conference conducted an all day workshop pertaining to "Predators and Prey", and plan to publish a compendium of technical papers presented.

CONCLUSIONS AND SUMMARY

During 2007, much interest and activity emerged regarding the justification, procedures, results, and values of predator control programs to enhance wild ungulates in Nevada. However, conservation organizations noted the paucity of science-based literature to inform

the public of effective practices facing predator/prey management strategies. This resulted in the assessment of more than 50 publications that contributed to the following findings and conclusions:

1. Wild predators have preyed on native large ungulates for centuries, and this will continue for centuries to come, for this is a natural phenomena of ecological carrying capacities.

2. Predator relations to wild prey and effective predator damage control programs for enhancing wildlife are highly controversial management concepts in North America. Apparently reasons for some of these controversial attitudes include lack of field training and experience to justify predator control programs for enhancing wildlife species based on best science-based data by some wildlife biologists and managers. Also, certain hunters, political delegates, conservationists and other public interest sources at times lack technical training in science-based programs, and mix personal opinion with science findings--matters that may not contribute to effective wildlife management goals.

3. Predator control programs are generally under the administration of state and federal wildlife management agencies today. Before wildlife damage control programs are undertaken, careful assessment should be made of the problem, a management plan developed, and assurance provided that the control technique(s) to be used will be effective and biologically and socially appropriate.

4. The majority of science-based publications within the last 25 years have indicated that wildlife predation generally had not been and were not now the limiting factor controlling most free-living ungulate populations.

5. These publications have provided data indicating that the primary factor limiting populations of bighorn, mule deer and pronghorn were the quality and quantity of forage and survival vegetation cover conditions. All other factors were generally secondary.

6. These reports support the contention that one of the most effective expenditure of current public wildlife management funds should generally be to improve vegetation conditions for forage and security cover instead of predator control.

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