



Commentary

Trends in Intensive Management of Alaska's Grizzly Bears, 1980–2010

STERLING D. MILLER,¹ *National Wildlife Federation, 240 N. Higgins, Suite #2, Missoula, MT 59802, USA*

JOHN W. SCHOEN,² *Audubon Alaska, 441 West Fifth Ave., Suite 300, Anchorage, AK 99501, USA*

JIM FARO, *P.O. Box 2151, Sitka, AK 99835, USA*

DAVID R. KLEIN, *University of Alaska Fairbanks, Institute of Arctic Biology, Wildlife, P.O. Box 757000, Fairbanks, AK 99775, USA*

ABSTRACT Hunting regulations for grizzly bears (*Ursus arctos*) in much of Alaska since 1980 increasingly were designed to reduce bear abundance in the expectation such regulations would lead to increased harvests by hunters of moose (*Alces alces*) and caribou (*Rangifer tarandus*). Regulations were liberalized during 1980–2010 primarily in the area we termed the Liberal Grizzly Bear Hunting Area (hereafter Liberal Hunt Area) which encompassed 76.2% of Alaska. By 2010, these changes resulted in longer hunting seasons (100% of Liberal Hunt Area had seasons > 100 days, 99.7% > 200 days, and 67.8% > 300 days), more liberal bag limits (99.1% of the Liberal Hunt Area with a bag limit \geq 1/yr and 10.1% with a bag limit \geq 2/yr), and widespread waiver of resident tag fees (waived in 95.7% of the Liberal Hunt Area). During 1995–2010, there were 124 changes that made grizzly bear hunting regulations more liberal and two making them more conservative. The 4-year mean for grizzly bear kills by hunters increased 213% between 1976–1980 (387 grizzly bears) and 2005–2008 (823 grizzly bears). Since 2000, long-term research studies on grizzly populations in the Liberal Hunt Area have been terminated without replacement. Management of large predators by the State of Alaska is constrained by a 1994 state statute mandating “intensive management” in areas classified as important for human consumptive use of ungulates. Current grizzly bear management in the Liberal Hunt Area is inconsistent with the recommendations of the National Research Council’s 1997 report on predator management in Alaska. Current attitudes, policies and absence of science-based management of grizzly bears in Alaska are increasingly similar to those that resulted in the near extirpation of grizzly bears south of Canada in the 19th and 20th centuries. If current trends continue, they increase risks to portions of the largest and most intact population of grizzly bears in North America. © 2011 The Wildlife Society.

KEY WORDS Alaska, brown bears, grizzly bears, hunting, intensive management, moose, predation, predator control, *Ursus arctos*.

During the 19th and 20th centuries, Alaska—unlike the lower 48 states—largely avoided declines in grizzly bear (*Ursus arctos*) populations that were both permanent and widespread because of Alaska’s remoteness, low density of humans, and persistence of intact habitat (Miller and Schoen 1999). These circumstances still exist in most places in Alaska although there are localized areas where grizzly bear habitat is being developed and fragmented.

Severe winters in the late 1960s and early 1970s in interior Alaska combined with high hunter harvests of ungulates and high predator numbers were suspected of playing a role in reduced availability of moose (*Alces alces*) and caribou (*Rangifer tarandus*) available for hunter harvest (Gasaway

et al. 1983, Van Ballenberghe 1987, Ballard 1992a). In some but not all of these areas, high rates of grizzly bear predation on neonatal moose were reported (Ballard et al. 1981, 1990; Boertje et al. 1988; Ballard and Miller 1990; Gasaway et al. 1992). In response to these findings, grizzly bear management in most of Alaska shifted from conservative management toward management designed to reduce grizzly bear abundance even though a causal link between bear predation and ungulate abundance remained unestablished (Miller and Ballard 1992). The Alaska Department of Fish and Game (ADFG) recently acknowledged this link remains unestablished: “. . . it might be possible to harvest more moose by reducing bear predation. [but this possibility has] not been adequately tested in Alaska, and programs of this nature need to be viewed as experiments” (ADFG 2007d:3). Regardless, there has been a dramatic trend toward increasingly liberal general bear hunting regulations in the 76% of Alaska that we identified as the Liberal Hunt Area (Fig. 1).

These trends of increasingly liberal bear hunting regulations accelerated following passage of an “Intensive

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¹E-mail: millerS@nwf.org

²Present Address: 13240 Mountain Place, Anchorage, AK 99516, USA.



Figure 1. Alaskan game management units. Unshaded area includes game management units classified as part of a Liberal Hunt Area for regulations reported during 1975–2011 (totaling 76.2% of Alaska’s area). The grizzly bear population in the Liberal Hunt Area includes about 44% of Alaska’s grizzly bears based on an estimate made in 1992 (Miller 1993).

Management” Law by the Alaska Legislature in 1994. This statute is a legal mandate which prioritizes consumptive use of ungulates by hunters over other resource values. The intensive management statute mandated that:

“The Board of Game shall adopt regulations . . . to restore abundance or productivity of . . . big game populations [that are identified as important for human consumptive use] as necessary to achieve human consumptive use goals [in areas where]:

1. Consumptive use of game is a preferred use;
2. Depletion of big game or reduced productivity has occurred that may cause reduced human harvest;
3. Enhancement is feasible using recognized and prudent active management techniques” (Alaska Statutes 16.05.255e).”

The Intensive Management Law further specifies that:

“[The Alaska Board of Game] may not significantly reduce the taking of an identified big game prey population [by adopting restrictive regulations] unless [it] has adopted regulations . . . that provide for intensive management to increase [the human harvest of that prey population, e.g. moose]” (Alaska Statutes 16.05.255e).

The term “consumptive use” in the Intensive Management Law was intended and is interpreted to mean use of wild ungulate meat for human food (see Titus 2007). Many of the periodic grizzly bear management reports also acknowledge that production of wild ungulate meat is the intent of the Intensive Management Law (e.g., Gross 2007, Tobey

and Kelleyhouse 2007). The Alaska Board of Game (BOG) is a citizens’ committee appointed by the Governor that sets hunting regulations in Alaska based on input from the ADFG, the public, and other agencies and organizations.

There is confusion about the geographic extent of predator reduction efforts in Alaska because predator reduction efforts via liberalization of the general hunting regulations were not defined by ADFG or the BOG as being part of an active predator reduction program. Only efforts in small, specially designated Predation Control Areas (PCAs) were defined as being predator control efforts. Boertje et al. (2010), Titus (2007), and ADFG (2007a, b), for example, confined their description of the extent of predator control programs in Alaska to these small PCAs that they reported constituted <10% of Alaska. Although not defined as control efforts, ADFG (2007a:3) acknowledged that “Take of predators by conventional hunting and trapping may be increased through liberalized seasons and bag limits to reduce the effects of predation on prey populations.” One distinction between the predator reduction efforts in PCAs and via liberalization of general hunting regulations is that in the PCAs, “. . . fair chase ethics are not applied” (2007a:3).

In 1995, controversies surrounding the extent of predator reduction efforts led the Alaska Governor to ask the National Research Council (NRC) to undertake a scientific and economic review of management of wolves (*Canis lupus*) and grizzly bears in Alaska. The NRC report reached 17 conclusions and associated recommendations, most of which urged that predator management efforts have a more

cautious, research-based, conservative, experimental, and adaptive approach that included public involvement and economic evaluations (NRC 1997).

The recommendations of the NRC (1997) are inconsistent with Alaska's 1994 Intensive Management Law. Under this law, grizzly bears, black bears, and wolves were, and remain, viewed as species that in many areas must be reduced in abundance to reduce competition with humans for wild ungulates (Van Ballenberghe 2006; ADFG 2007*a, b, c*). Some of the concerns raised by the NRC were shared by the Alaska Chapter of The Wildlife Society. The Chapter found that "The restrictions on Board of Game authority to regulate taking of identified big game prey populations embodied in AS 16.05.255(e-g) are unnecessary and inappropriate for progressive wildlife management ... [and] ... may be counterproductive ..." and that "[In the absence of appropriate objectives and techniques] legislatively mandated prescriptions for management, such as AS 16.05.255(e-g) seldom benefit wildlife or wildlife users in the long run" (Alaska Chapter of the Wildlife Society 1995:2).

Our objectives were: 1) to report on trends in the general season hunting regulations for grizzly bears during the period 1975–2010, 2) to report on increases in grizzly bear harvests by hunters in response to more liberal grizzly hunting regulations, 3) to document the predator reduction rationale for most of the regulatory changes, 4) to describe the 1994 Intensive Management Law that has accelerated predator reduction efforts, and 5) to report on Alaska's non-compliance with the NRC's (1997) recommendations. We did not report declines in grizzly bear populations as a consequence of the trends we documented. Such trends, if they occurred, would be difficult to document because of declines in research and inadequacies in the way monitoring efforts were conducted and reported in the Liberal Hunt Area. Additionally, trends in bear abundance are technically difficult and expensive to document (Miller et al. 1997, Schwartz et al. 2003*a*, Reynolds et al. 2011).

We have a long history with grizzly bear research and management in Alaska. S. Miller, J. Schoen, and J. Faro retired following full careers with ADFG totaling 72 years; our jobs with the department largely focused on bear research and management. D. Klein worked for ADFG early in his career and worked during the bulk of his career as a professor of wildlife management at the University of Alaska Fairbanks.

STUDY AREA

We confined our analysis of the pattern of liberalized hunting regulations to the portion of Alaska we defined as the Liberal Hunt Area (Fig. 1). We excluded the area outside of the Liberal Hunt Area from our analysis, as moose and caribou were uncommon or non-existent (caribou, however, were abundant on the Alaska Peninsula, Unit 9, and intensive management of wolves is ongoing in Unit 9). Deer (*Odocoileus hemionus sitkensis*) were the most common ungulates outside of the Liberal Hunt Area but, so far, predator

reduction efforts in Alaska have not focused on reducing predation on deer.

Outside of the Liberal Hunt Area in the more southern coastal areas of Alaska, grizzly bear densities were typically 5–10 times higher than densities in the Liberal Hunt Area (Miller et al. 1997). Outside of the Liberal Hunt Area, grizzly bears had access to runs of multiple species of Pacific salmon (*Oncorhynchus* spp.) as a food source. As a consequence, grizzly bears in southeastern Alaska and coastal areas of southcentral Alaska including Kodiak Island had higher densities and individuals were much larger than more northern and interior grizzly bears, which generally did not have access to abundant salmon (Miller et al. 1997, Hilderbrand et al. 1999). The larger grizzly bears living in salmon-rich habitats were commonly referred to as brown bears and had higher value as trophies especially to non-resident hunters who pay high tag fees and are required to hunt with registered big game guides. These circumstances ensured that there was an invested constituency for conservative management of the larger bears living in the salmon-rich habitats of outside of the Liberal Hunt Area. The 76% of Alaska in the Liberal Hunt Area supported about 43% of Alaska's total population of grizzly bears (Miller 1993).

We did not include the area of 5 national parks and preserves (including Denali Park) totaling 93,029 km² in the denominator (1,157,489 km²) for percentage calculations of area impacted by hunting regulations in the Liberal Hunt Area.

METHODS

Hunting regulations applied to game management units (Fig. 1) and to game management subunits (e.g., A, B, C). There were 40 subunits in the Liberal Hunt Area. We reported trends for each regulation as a percentage of the area of subunits in the Liberal Hunt Area. In the infrequent cases where a regulation applied only to a portion of a subunit, such as a specific watershed, we calculated area affected as if the regulation extant in the largest portion of the subunit applied to the whole subunit.

We determined the geographic extent of various hunting regulations from ADFG's Alaska Hunting Regulations booklet for selected years. We selected regulatory years 1975–1976, 1985–1986, 1995–1996, 2005–2006, and 2010–2011 as snapshot years to illustrate trends. A regulatory year extends from 1 July of one year to 30 June of the following year.

Alaska has a subunit-specific long-term database on known grizzly bears kills since the late 1960s. We used these ADFG data to illustrate trends in numbers of bears taken by hunters. The most recent year for which hunter kill data were available was regulatory year 2008–2009. Efforts to reduce grizzly abundance by liberalized regulations largely began in 1980. We reported trends since 1975–1976 to permit meaningful comparisons of recent grizzly harvests and regulations with a pre-1980 baseline.

We calculated the ratio between regulatory changes making hunting more liberal (designed to increase harvest) and more conservative (designed to reduce harvest). To calculate this

ratio, we used data from a page in the regulation book that listed major changes in regulations from the preceding year. This page was available beginning in regulatory year 1995–1996. By state law, continuation of waivers of resident grizzly bear tag fees must be done annually but we tabulated only the initial waiver of this fee.

RESULTS

Trends in Regulations and Harvests

Between 1995 and 2010, grizzly bear hunting regulations in game management subunits in the Liberal Hunt Area were liberalized 124 times and only twice were made more conservative during the same period. The most frequent liberalization ($n = 55$) was to increase the resident bag limit. Season extensions ($n = 40$) and waiver of the \$25 tag fee for resident hunters ($n = 28$) were the next most common regulations changes.

Period open for grizzly bear hunting has expanded greatly in the Liberal Hunt Area. Liberalized seasons for grizzly bear hunting began with addition of spring hunting opportunities. During 1975–1976, 71% of the Liberal Hunt Area subunits had spring seasons. The proportion of subunits with spring seasons increased to 99% during 1985–1986 and to 100% during 1995–1996 through 2010–2011. In 1975–76, no place in the Liberal Hunt Area had a grizzly bear hunting season >100 days. By 2010–2011, 100% of the Liberal Hunt Area subunits had seasons >100 days, 67.8% had seasons >300 days, and 15.9% had seasons >350 days (Fig. 2). The number of subunits in the Liberal Hunt Area where regulations were adopted extending season length exceeded the number where reductions occurred for all the intervals we examined (Table 1). After the Intensive Management Law was passed in 1994, there was a decline in the proportion of subunits where season lengths were reduced and an increase in the proportion where seasons were liberalized (Table 1). Prior to this, the proportion of

subunits with increases and decreases in season length was more equivalent (Table 1).

Number of grizzly bears that hunters could harvest annually increased in the Liberal Hunt Area. Prior to 1980, everywhere in Alaska had a bag limit of 1 grizzly bear every 4 years. By 2007, 99.6% of the Liberal Hunt Area had bag limits ≥ 1 bear/year. In 1995, no portion of the Liberal Hunt Area had a bag limit of 2 bears/year. By 2007, 10.2% of the Liberal Hunt Area had an annual bag limit ≥ 2 bears/year. In Unit 13, the bag limit briefly reverted to 1 bear per 4 years during 1989–1994 but this reversion was reversed in 1995 (Tobey and Kelleyhouse 2007).

Grizzly bears taken in areas with a bag limit of 1 bear/year did not count against the 1 bear per 4-year bag limit that remained in most areas outside of the Liberal Hunt Area (Fig. 1). This exemption was designed to encourage harvests of grizzly bears in areas in the Liberal Hunt Area (where there were 1-bear-per-year bag limits) by not constraining hunters' ability to also take large trophy bears in the coastal areas outside of the Liberal Hunt Area such as during the drawing permit hunt for Kodiak Island (Unit 8).

Requirements that resident hunters purchase special tags to hunt grizzly bears were also greatly reduced in the Liberal Hunt Area. All resident hunters were required to purchase a \$25 tag in advance of hunting for grizzly bears in 1980. To encourage more grizzly bear kills by Alaska residents (e.g., for Unit 13 see Tobey and Kelleyhouse 2007), this requirement was waived in 21% and 95% of the Liberal Hunt Area by 1985 and 2010, respectively. During its 26 February–7 March 2010 meeting, the BOG waived resident tag fees in 14 additional subunits. This action increased the area with waivers from 42% of the Liberalized Hunt Area during 2009–2010 to 95% during 2010–2011.

Corresponding with the liberalizations in hunting regulations, hunter harvests of grizzly bears in the Liberal Hunt Area increased during 1975–2008 (Fig. 3). The mean annual harvest during 1976–1980 was 387 bears compared to 827 during 2004–2008. The slope of a regression line plotted

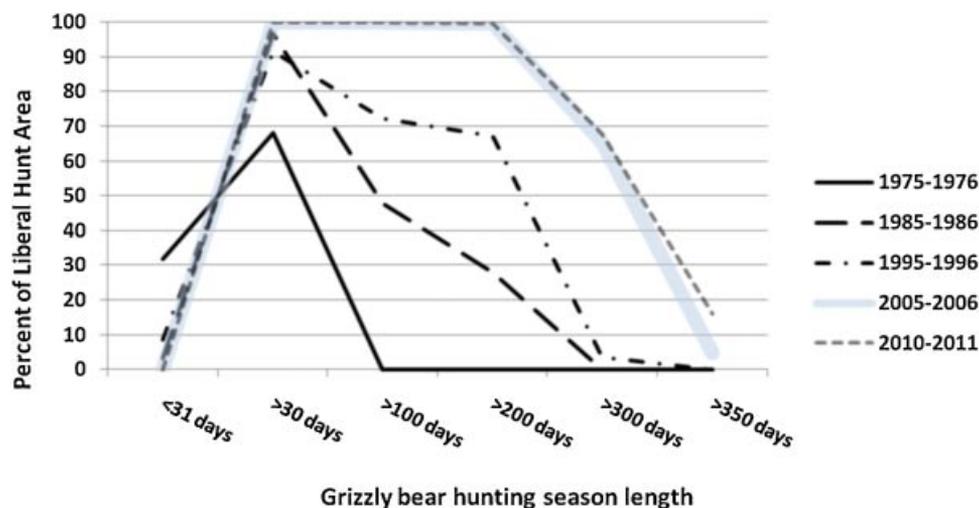


Figure 2. Trends in general hunting season length for Alaskan grizzly bears in the Liberal Hunt Area shown as season lengths during the snapshot regulatory years of 1975–1976, 1985–1986, 1995–1996, and 2010–2011.

Table 1. Comparisons of changes (increase, decrease, no change) in grizzly bear hunting season length between regulatory years 1975–1976 and 1985–1986, 1985–1986 and 1995–1996, 1995–1996 and 2005–2006, and 2005–2006 and 2010–2011 in the portion of Alaska classified as the Liberal Hunt Area.

	Regulatory years compared			
	1975–1976 and 1985–1986 (11 yr)	1985–1986 and 1995–1996 (11 yr)	1995–1996 and 2005–2006 (11 yr)	2005–2006 and 2010–2011 (6 yr)
Subunits with season increase (%)	57.50	57.50	82.50	32.50
Subunits with season decrease (%)	42.50	35.00	5.00	0
No change in season length (%)	0	7.50	12.50	67.50

through annual harvests ($R^2 = 0.82$) indicated an increase of 14.8 bears/year or an average increase of 4%/year (Fig. 3).

Trends in and Effectiveness of Research and Monitoring Efforts

Research on grizzly bears in the Liberal Hunt Area was greatly reduced after 2000. Prior to 2000 there were numerous research projects conducted by ADFG focused on grizzly bears in the Liberal Hunt Area (e.g., Reynolds 1980, 1992, 1999; Boertje et al. 1987; Miller et al. 1987, 1997, 2003; Miller and Miller 1988; Ballard et al. 1993; Miller and Nelson 1993; Miller 1997; Testa et al. 1998). There was also one federal study in a National Wildlife Refuge based on data collected before 2000 (Van Daele et al. 2001, Kovach et al. 2006) and one federal study in Denali National Park also based on pre-2000 data (Keay 2001).

In contrast, subsequent to 2000 there was only one ADFG-sponsored grizzly bear study in the Liberal Hunt Area that had a focus on grizzly bear demographics or density. This study in a small PCA for grizzly bears in Unit 20E was designed to estimate grizzly bear density using DNA hair snaring techniques (C. Gardner, ADFG, unpublished data). Our tabulation of grizzly bear research studies was similar to another ADFG tabulation that listed 6 grizzly bear studies

only one of which occurred after 2000 (Boertje et al. 2010). After 2000, there was one grizzly bear demographic study on the Togiak National Wildlife Refuge conducted by federal biologists; this study (Walsh et al. 2010) established a baseline density from which possible impacts of increased hunting pressure potentially could be determined.

Monitoring trends in bear abundance is a difficult, expensive and imprecise undertaking with all available techniques (Garshelis 1990; Miller 1990a, b; Miller et al. 1997; Reynolds et al. 2011). Subsequent to 2000, grizzly bear abundance monitoring in Alaska including the Liberal Hunt Area was conducted using an approach based on aerial observation of bears using double blind techniques combined with distance sampling along a transect line (Quang and Becker 1997, 1999; Becker and Quang 2009). This double-blind monitoring work resulted in a density estimate (26.3 bears/1,000 km²; SE = 3.59) (Becker and Quang 2009) in one portion of the Liberal Hunt Area. However, the management utility of this work was unclear as the area encompassed by the density estimate included 4 subunits (13E, 14B, 16A, and 16B) that were parts of 3 different management units. These different units were managed independently. These management units also differed in the abundance of salmon available for bears so the density estimate reported by Becker and Quang (2009) likely incorporated a significant range of grizzly bear densities. If the Becker and Quang (2009) estimate was replicated in the same area, a trend in density might be detectable but it would not be possible to determine which portions (Unit or Subunit) of the area was responsible for the trend. Reflecting this problem, density and population estimates based on the results reported by Becker and Quang (2009) were reported in Unit and Subunit management reports without confidence intervals (e.g., Kavalok 2007, Tobey and Kelleyhouse 2007, Peltier 2008) because no confidence intervals were available for the individual units. Federal biologists used the Becker and Quang (2009) approach to estimate density and population size in one well-defined area managed as a unit (the Togiak National Wildlife Refuge) (Walsh et al. 2010). A subsequent analysis indicated the power to detect grizzly bear density trends in this refuge was low (Reynolds et al. 2011). Bear population trends cannot reliably be determined based on the sex and age composition of harvested bears (discussed below).

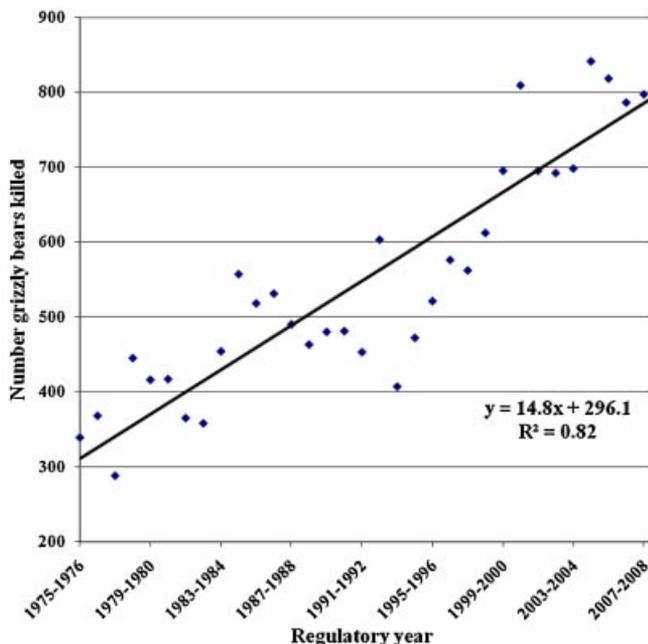


Figure 3. Trend in number of grizzly bears taken annually by hunters in the Liberal Hunt Area from regulatory years 1975–1976 through 2008–2009.

DISCUSSION

There was widespread liberalization of grizzly bear hunting regulations during the period 1980–2010 in the Liberal Hunt Area. There also was a corresponding large increase

in grizzly bear harvests by hunters during this period. Since 2000, these changes in regulations and harvest occurred simultaneously with declines in grizzly bear research efforts and inadequate reporting of monitoring results. Correspondingly, the liberalizations of grizzly hunting regulations and the resulting increased harvest have occurred in an environment where impacts on the abundance of grizzly bears, if they have occurred, would be difficult to detect. All of the Liberal Hunt Area is in the portion of Alaska where grizzly bear densities were low ($<40/1,000 \text{ km}^2$ [Miller et al. 1997]). The low density in the Liberal Hunt Area increased the likelihood of failing to detect declines in grizzly bear abundance because smaller sample sizes would make significant declines more difficult to document.

The reliance by Alaskan managers on detecting trends in bear populations based on sex and age composition of bear harvests (see Harper 2007) was an inappropriate substitute for well-designed and executed research and monitoring programs. No theoretical or empirical basis exists for interpreting trend based on these harvest composition data (Harris 1984, Harris and Metzgar 1987, Miller and Miller 1988, Garshelis 1990). Available studies show that sex and age composition of harvest reflected vulnerability to harvest of different cohorts. Correspondingly, trends that might exist in these data likely would reflect changes in seasons, bag limits, tag fees, and other factors that affect vulnerability rather than trend in population size (Harris and Metzgar 1987, Miller and Miller 1988, Garshelis 1990). Geographically patchy distribution of harvest caused by differences in accessibility further complicated interpretation of harvest data (Miller and Miller 1988, Garshelis 1990). Declines in mean age of harvested bears, for example, resulted in completely opposite inferences about population trend (Garshelis 1990, Miller 1990*b*). Dramatic changes in grizzly bear hunting regulations occurred in the Alaskan Liberal Hunt Area during 1975–2010 so vulnerability to harvest also must have changed. This change in vulnerabilities would make it impossible to detect population trends based on any model that assumed temporal stability in vulnerability to harvest of different sex–age cohorts (Garshelis 1990), except possibly in circumstances where most bears ultimately occur in the harvest (Fieberg et al. 2010).

Although ADFG (2007*a, b, c*), Titus (2007), and Boertje et al. (2010) defined as predator control only the regulations existing in small Predator Control Areas, efforts to reduce predator abundance by liberalization of general hunting regulations were much more widespread in Alaska. Unit 13 is an example of an area not designated as a Bear PCA where efforts to reduce grizzly bears have nevertheless been ongoing since 1980 (Tobey and Kelleyhouse 2007). Unit 13 is a popular moose and caribou hunting area between the population centers of Fairbanks and Anchorage. In Unit 13, there is no closed season for hunting grizzly bears, no grizzly bear tag is required for resident hunters (except in Denali State Park), the bag limit is 1 bear/year, and annual harvests have increased from 61 (mean for 1975–1978) to 139 (mean for 2005–2008). The current management objective for griz-

zly bears in this unit is to maintain a minimum population of 350 bears (Tobey and Kelleyhouse 2007). Based on the range of population estimates available for this unit (Tobey and Kelleyhouse 2007), this minimum would represent a reduction of $>70\%$. Unit 13 is a designated PCA for wolves.

An independent review of the science and policy for predator management in Alaska made numerous conclusions and recommendations (NRC 1997). We asked the chairman of the NRC panel to evaluate whether Alaska has complied with the NRC (1997:10–12) recommendations. After consulting with ADFG, the panel's Chairman provided the following statement (G. Orians, University of Washington, personal communication):

“Despite the range of viewpoints represented among [the NRC panel's] members, the committee unanimously concluded that all previous predator reduction and control operations in Alaska were so poorly designed that the results, even if they had been adequately monitored, could not have assessed the relative contributions of various factors to any observed changes in populations of either predators or their prey. Specifically, all previous predator reduction operations were deficient in one or more (usually more) of the following essential features of a well-designed program: Clear articulation of the hypotheses to be tested, determination of pre-experimental baseline conditions, manipulation of variables one at a time, establishment of appropriate controls, and adequate monitoring of the results. Moreover, the committee noted that insufficient research had been conducted to determine the range and nature of potential social and economic impacts of low population densities of moose and caribou, whatever their causes. The unanimous consensus report offered a set of recommendations that, if followed, would improve the scientific basis for wolf, bear, and prey management in Alaska. Enactment of the recommendations would enable Alaskans to know if the expenditures of valuable state financial and intellectual resources on predator reductions were really yielding benefits to the State that exceeded the costs.

Evidence provided to me at my request, from the ADFG's Division of Wildlife Conservation in December 2007 and other sources leads me to conclude that most of the recommendations of the NRC committee have not been followed by the State of Alaska in its predator control activities since our report (NRC 1997). Basic research on predators, design of experiments, pre- and post-manipulation monitoring, and socioeconomic research all fall short of the standards recommended by the NRC committee. Indeed, recent predator control efforts have not been designed to test whether predators are actually controlling prey populations. Rather, control efforts have been initiated under the assumption (or conviction) that predators are the cause and that the solution to the “problem” is intensive predator control.”

D. Klein (University of Alaska Fairbanks, personal observation), who was on the NRC panel, concurred with Chairman Orians' statement.

There may be circumstances in which grizzly bear predation on neonatal moose calves may inhibit moose population growth or cause population declines as concluded by Testa (2004). However, there are no studies demonstrating that increased grizzly bear hunting or reduced grizzly bear

abundance resulted in more harvestable moose (Ballard 1992*b*; Miller and Ballard 1992, Ballard and Van Ballenberghe 1998) or caribou. Boertje et al. (2009, 2010) reported that “predator” (a term they used to implicate both wolves and grizzly bears) reductions in an area south of Fairbanks (Subunit 20A) resulted in a recovered moose population. However, Boertje et al. (2009, 2010) documented no change in grizzly bear abundance and reported low rates of grizzly predation on moose neonates in Unit 20A. Regardless, Boertje et al. (2010) infer from the 20A study that in areas where bear predation is higher, it would be limiting to moose population growth. Fifteen years following the initiation of grizzly bear population reduction efforts through regulation liberalization in Unit 13, Testa (2004) concluded that the moose population began declining primarily because of bear predation on neonatal moose; he also reported adverse nutritional impacts on moose parturition rates. Keech et al. (2011) documented increases in moose abundance following reductions in wolf and black bear populations but did not document any change in grizzly bear abundance correlated with the reported increase in moose. Ballard and Van Ballenberghe (1998:93) concluded “We simply do not know whether bear predation is density-dependent or density-independent nor do we know anything about possible compensatory relationships among individuals within a bear population, between bear species, or between wolf and bear populations.” This situation persists and was recently acknowledged by Boertje et al. (2010:924): “... where bear habitat is contiguous and access is poor, no data are available to evaluate whether private take of bears can be a successful, long-term management tool to decrease bear numbers and to elevate sustained yield of moose.”

Regardless of whether it is good public policy to reduce grizzly bears to increase ungulate harvests, there is no evidence in Alaska that efforts to date have accomplished the objectives desired by the Intensive Management Law. Conclusion 7 of the NRC panel was “The design of most past experiments and the data collected do not allow firm conclusions about whether wolf and bear reductions caused an increase in prey populations that lasted long after predator control ceased” (NRC 1997:11). With respect to grizzly bear reduction efforts, this statement remains true although numerous studies have shown that grizzly and black bears can be effective predators on moose calves (Ballard et al. 1981, Boertje et al. 1988, Ballard 1992*a*, Keech et al. 2011). Although grizzly bear reduction efforts through liberalization of hunting regulations has been widespread in Alaska and ongoing for 30 years, there are no places where the regulation liberalizations have been reversed because ungulate objectives have been achieved. Liberal grizzly hunting regulations remain in place even in one area (Unit 20A) where managers are challenged to find ways to convince hunters to take a surplus of antlerless moose (Boertje et al. 2007).

The situation in the former grizzly bear PCA in Subunit 20E is instructive about the casual approach toward grizzly bear population reduction efforts in Alaska. In Subunit 20E, grizzly bear population reduction efforts

were initiated in the early 1980s, but that area was eliminated as a PCA in 2009. In a report to the BOG that gave ADFG’s rationale for eliminating the 20E PCA it was acknowledged,

“... results of the recent brown bear population survey (C. Gardiner et al., ADFG, unpublished data) indicate bear density within burned portions of the control area is likely lower than initially thought which may benefit moose calf survival in those areas. The Department recommends that bear control be eliminated from the (20E Grizzly Bear Predation Control Area). Benefits to moose calf survival associated with the fires of 2004 and wolf control efforts appear to be adequate to make progress toward prey population objectives” (ADFG report to the BOG, 2009:6–7, Division of Wildlife Conservation Report to the BOG, March).

The conclusion in this report to the BOG was similar to other findings that habitat conditions influence ungulate abundance more than black or grizzly bear predation on calves (Schwartz and Franzmann 1991, Zager and Beecham 2006).

In addition to grizzly bears, black bears (*Ursus americanus*) were targeted for population reductions in large portions of Alaska. For the 2010–2011 season, the BOG reclassified black bears as furbearers in all of Alaska in all areas of the state. This reclassification allowed snaring of black bears and the sale of hides, skulls, and meat of snared bears taken anywhere in Alaska with a general trapping license. Because of procedural missteps by the BOG, implementation of black bear take as a furbearer has been delayed. Black bear snaring is currently allowed, however, in the Unit 16B PCA in an effort to reduce black bears by >50% and thereby help a moose population thought to be declining because of predation (Peltier 2008). In this PCA there is no limit to the number of black bears that can be taken by hunters with control permits, hunters can take females with cubs, bears can be taken over bait or other methods on the same day the permittee has flown, and sales of hides and skulls (tanned or untanned) are allowed (Peltier 2008). For the 2011–2012 season, snaring of grizzly bears was also authorized as a predator control measure to benefit moose populations in Unit 16B. Unit 16 is in the Liberal Hunt Area (Fig. 1).

The current Alaskan emphasis on widespread reductions of large carnivores is a familiar path for those who have studied the history of predator reduction efforts south of Canada in the late 19th and early 20th centuries (e.g., Leopold 1949, Schwartz et al. 2003*b*, Taber and Payne 2003). Whether because grizzly bear populations have not declined to date as a consequence of the increased harvests or whether undocumented declines have occurred, grizzly bears in the Liberal Hunt Area are potentially vulnerable to overharvest. This is because grizzly bears have reproductive rates among the lowest for North American mammals (Schwartz et al. 2003*a*) and monitoring methods are both expensive and imprecise (Miller et al. 1997, Schwartz et al. 2003*a*, Kendall et al. 2009, Walsh et al. 2010, Reynolds et al. 2011). South of Canada, human influences eliminated grizzly bears from 98% of their former range (Servheen 1999).

For a species with this sensitivity and history combined with these management limitations, a conservative and cautious approach toward human harvests of grizzly bears is appropriate (Bunnell and Tait 1980, Miller 1990a, Schwartz et al. 2003a, Kendall et al. 2009). The overall level of risk is further exacerbated when liberalizations of hunting regulations are as geographically widespread as is the case in the Liberal Hunt Area. In a state as large as Alaska, consequential management errors are unlikely if they are confined to small geographic areas. Fortunately, there is no evidence in Alaska or elsewhere in North America that heavy hunting pressure resulted in a dispensatory response in cub and subadult survival (Miller et al. 2003, Schwartz et al. 2003a, McLellan 2005, Czetwertynski et al. 2007) such as has been suggested for European grizzly bear populations (Swenson 2003).

We suggest that in the bulk of the Liberal Hunt Area that grizzly population management in Alaska be based on demographic data consistent with an overall objective of assuring that healthy and stable populations of grizzly bears are maintained. In small areas, such as the current bear PCAs, we suggest that grizzly bear reduction efforts should be designed and conducted as experiments as recommended by the NRC (1997). We suggest that such research could follow the design used by Keech et al. (2011) but modified to permit identification of which predator species was responsible for any ungulate responses observed.

MANAGEMENT IMPLICATIONS

Because predator reduction in Alaska has been mandated by a state statute since 1994, ADFG biologists who may be concerned about the widespread nature of efforts to reduce grizzly bear abundance have limited ability to change management direction or emphasis. This amounts to politically driven rather than scientifically supported management of Alaska's large predators. Statutes like Alaska's intensive management law constrain the ability of managers to restrict the hunting of ungulates in response to conditions, such as a severe winter, that reduce ungulate abundance. The ability to modify human hunting pressure on ungulates in response to stochastic events is an important tool for wildlife managers and constraints on this tool limits management responsiveness and effectiveness. Although predator reductions may be an appropriate tool in some circumstances, we recommend modifications of Alaska's Intensive Management Law to allow managers to use a wider array of tools to achieve management objectives.

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LITERATURE CITED

- Alaska Chapter of the Wildlife Society. 1995. Position statement of the Alaska Chapter of the Wildlife Society on Alaska Statutes, Title 16.05.255(e-g) (Intensive Management of Big Game) and Amendments. <<http://joomla.wildlife.org/alaska/images/documents/Intensive%20Management.pdf>>. Accessed 21 Apr 2011.
- Alaska Department of Fish and Game. 2007a. Predator management in Alaska. Booklet published by Alaska Department of Fish and Game, Division of Wildlife Conservation, Juneau, USA. <http://www.wc.adfg.state.ak.us/management/control/pdfs/predator_management.pdf>. Accessed 7 Oct 2010.
- Alaska Department of Fish and Game. 2007b. Understanding predator management in Alaska. Brochure published by Alaska Department of Fish and Game, Division of Wildlife Conservation, Juneau, USA. <http://www.wildlife.alaska.gov/management/control/pdfs/predator_booklet.pdf>. Accessed 7 Oct 2010.
- Alaska Department of Fish and Game. 2007c. Understanding intensive management and predator control in Alaska. Booklet published by Alaska Department of Fish and Game, Division of Wildlife, Conservation. Juneau, USA.
- Alaska Department of Fish and Game. 2007d. Overview of relationships between bears, wolves, and moose in Alaska. Brochure published by Alaska Department of Fish and Game, Division of Wildlife Conservation, Juneau, USA. <<http://www.adfg.alaska.gov/index.cfm?adfg=intensivemanagement.predatorprey>>. Accessed 5 May 2011.
- Ballard, W. B. 1992a. Bear predation on moose: a review of recent North American studies and their management implications. *Alces Supplement* 1:162-176.
- Ballard, W. B. 1992b. Modeled impacts of wolf and bear predation on moose calf survival. *Alces* 28:79-88.
- Ballard, W. B., L. A. Ayres, D. J. Reed, S. G. Fancy, and K. E. Roney. 1993. Demography of grizzly bears in relation to hunting and mining development in northwestern Alaska. Scientific Monograph NPS/NRRO/NRSM-93/23. U.S. Department of the Interior, National Park Service, Denver, Colorado, USA.
- Ballard, W. B., and S. D. Miller. 1990. Effects of reducing brown bear density on moose calf survival in south-central Alaska. *Alces* 26:9-13.
- Ballard, W. B., S. D. Miller, and J. S. Whitman. 1990. Brown and black bear predation on moose in southcentral Alaska. *Alces* 26:1-8.
- Ballard, W. B., T. H. Spraker, and K. P. Taylor. 1981. Causes of neonatal moose calf mortality in south central Alaska. *Journal of Wildlife Management* 34:335-342.
- Ballard, W. B., and V. Van Ballenberghe. 1998. Moose-predator relationships: research and management needs. *Alces* 34:91-105.
- Becker, E. F., and P. X. Quang. 2009. A gamma-shaped detection function for line-transect surveys with mark-recapture and covariates. *Journal of Agricultural, Biological and Environmental Statistics* 14:207-223.
- Boertje, R. D., W. C. Gasaway, D. V. Grangaard, and D. G. Kelleyhouse. 1988. Predation on moose and caribou by radio-collared grizzly bears in eastcentral Alaska. *Canadian Journal of Zoology* 66:2492-2499.
- Boertje, R. D., W. C. Gasaway, D. V. Grangaard, D. G. Kelleyhouse, and R. O. Stephenson. 1987. Factors limiting moose population growth in Subunit 20E. Federal Aid in Wildlife Restoration, Progress Report, Project W-22-5. Alaska Department of Fish and Game, Juneau, USA.
- Boertje, R. D., M. A. Keech, D. D. Young, K. A. Kellie, and C. T. Seaton. 2009. Managing for elevated yield of moose in interior Alaska. *Journal of Wildlife Management* 73:314-327.

- Boertje, R. D., M. A. Keech, and T. F. Paragi. 2010. Science and values influencing predator control for Alaska Moose management. *Journal of Wildlife Management* 74:917–928.
- Boertje, R. D., K. A. Kellie, C. T. Seaton, M. A. Keech, D. D. Young, B. W. Dale, L. G. Adams, and A. R. Alderman. 2007. Ranking Alaska moose nutrition: signals to begin liberal antlerless harvests. *Journal of Wildlife Management* 71:1494–1506.
- Bunnell, F. E., and D. E. N. Tait. 1980. Bears in models and reality—implications to management. *International Conference on Bear Research and Management* 4:15–23.
- Czetwertynski, S., M. S. Boyce, and F. K. Schmiegelow. 2007. Effects of hunting on demographic parameters of American black bears. *Ursus* 18:1–18.
- Fieberg, J. R., K. W. Shertzer, P. B. Conn, K. V. Noyce, and D. L. Garshelis. 2010. Integrated population modeling of black bears in Minnesota: implications for monitoring and management. *PLoS ONE* 5(8). <<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0012114>>. Accessed 1 Jul 2011.
- Garshelis, D. L. 1990. Monitoring effects of harvest on black bear populations in North America: a review and evaluation of techniques. *Proceedings of the Eastern Workshop Black Bear Research and Management* 10:120–144.
- Gasaway, W. C., R. D. Boertje, D. V. Grangaard, D. G. Kelleyhouse, R. O. Stephenson, and D. G. Larsen. 1992. The role of predation in limiting moose at low densities in Alaska and Yukon and implications for conservation. *Wildlife Monographs* 120.
- Gasaway, W. C., R. O. Stephenson, J. L. Davis, P. E. K. Shepherd, and O. E. Burris. 1983. Interrelationships of wolves, prey and man in interior Alaska. *Wildlife Monographs* 84.
- Gross, J. A. 2007. Unit 20E brown bear. Pages 240–252 *in* P. Harper, editor. Brown bear management report of survey and inventories activities 1 July 2004–30 June 2006. Alaska Department of Fish and Game, Juneau, USA.
- Harris, R. B. 1984. Harvest age-structure as an indicator of grizzly bear population status. Thesis, University of Montana, Missoula, USA.
- Harris, R. B., and L. H. Metzgar. 1987. Estimating harvest rates of bears from sex ratio changes. *Journal of Wildlife Management* 51:802–811.
- Harper, P., editor. 2007. Brown bear management report of survey-inventory activities 1 July 2004–30 June 2006. Alaska Department of Fish and Game, Juneau, USA.
- Hilderbrand, G. V., C. C. Schwartz, C. T. Robbins, M. E. Jacoby, T. A. Hanley, S. M. Arthur, and C. Servheen. 1999. The importance of meat, particularly salmon, to body size, population productivity, and conservation of North American brown bears. *Canadian Journal of Zoology* 77:132–138.
- Kavalok, T. 2007. Unit 16 brown bear. Pages 164–174 *in* P. Harper, editor. Brown bear management report of survey and inventories activities 1 July 2004–30 June 2006. Alaska Department of Fish and Game, Juneau, USA.
- Keay, J. A. 2001. Grizzly bear population ecology and monitoring, Denali National Park and Preserve, Alaska. U.S. Department of the Interior, U.S. Geological Survey, Alaska Biological Science Center, Anchorage, USA.
- Keech, M. A., M. S. Lindberg, R. D. Boertje, P. Valkenburg, B. D. Taras, T. A. Boudreau, and K. B. Beckmen. 2011. Effects of predator control, individual traits, and environment on moose survival in Alaska. *Journal of Wildlife Management* 75: in press.
- Kendall, K. C., J. B. Stetz, J. Boulanger, A. C. MacLeod, D. Paetkau, and G. C. White. 2009. Demography and genetic structure of a recovering grizzly bear population. *Journal of Wildlife Management* 73:3–17.
- Kovach, S. D., G. H. Collins, M. T. Hinkes, and J. W. Denton. 2006. Reproduction and survival of brown bears in southwest Alaska, USA. *Ursus* 17:16–29.
- Leopold, A. 1949. *A Sand County almanac*. Oxford University Press, Oxford, United Kingdom.
- McLellan, B. N. 2005. Sexually selected infanticide in grizzly bears: the effects of hunting on cub survival. *Ursus* 16:141–156.
- Miller, S. D. 1990a. Population management of bears in North America. *International Conference on Bear Research and Management* 8:357–373.
- Miller, S. D. 1990b. Detection of differences in brown bear density and population composition caused by hunting. *International Conference Bear Research and Management* 8:393–404.
- Miller, S. D. 1993. Brown bears in Alaska: a statewide management overview. Alaska Department of Fish and Game, Division of Wildlife Conservation Wildlife, Technical Bulletin 11, Juneau, USA.
- Miller, S. D. 1997. Impacts of heavy hunting pressure on the density and demographics of brown bear populations in southcentral Alaska. Federal Aid in Wildlife Restoration, Research Final Report 1 July 1993–30 June 1996, Grants W-24-2, W-24-3, W-24-2, Study 4.26. Alaska Department of Fish and Game, Juneau, USA.
- Miller, S. D., and W. B. Ballard. 1992. Analysis of an effort to increase moose calf survivorship by increased hunting of brown bears in southcentral Alaska. *Wildlife Society Bulletin* 20:445–454.
- Miller, S. D., E. F. Becker, and W. B. Ballard. 1987. Black and brown bear density estimates using modified capture–recapture techniques in Alaska. *International Conference Bear Research and Management* 7:23–35.
- Miller, S. D., and S. M. Miller. 1988. Interpretation of bear harvest data. Federal Aid in Wildlife Restoration, Research Final Report, Project W-23-1, Study 4.18. Alaska Department of Fish and Game, Juneau, USA.
- Miller, S. D., and R. R. Nelson. 1993. A brown bear density and population estimate for a portion of the Seward Peninsula, Alaska. Federal Aid in Wildlife Restoration, Management Report Supplement, Projects W-23-4 and W-23-5, Study 4.0. Alaska Department of Fish and Game, Division of Wildlife Conservation, Juneau, USA.
- Miller, S. D., and J. Schoen. 1999. Status and management of the brown bear in Alaska. Pages 40–45 *in* C. Servheen, S. Herrero, and B. Peyton, editors. Bears: status survey and conservation action plan. International Union for Conservation of Nature/Species Survival Commission, Bear and Polar Bear Specialist Groups. International Union for Conservation of Nature, Gland, Switzerland, and Cambridge, United Kingdom.
- Miller, S. D., R. A. Sellers, and J. A. Keay. 2003. Effects of hunting on brown bear cub survival and litter size in Alaska. *Ursus* 14:130–152.
- Miller, S. D., G. C. White, R. A. Sellers, H. V. Reynolds, J. W. Schoen, K. Titus, V. G. Barnes, Jr., R. B. Smith, R. R. Nelson, W. B. Ballard, and C. C. Schwartz. 1997. Brown and black bear density estimation in Alaska using radiotelemetry and replicated mark–resight techniques. *Wildlife Monographs* 133.
- National Research Council. 1997. Wolves, bears and their prey in Alaska: biological and social challenges in wildlife management. National Academy Press, Washington, D.C., USA.
- Peltier, T. 2008. Black bear management report, game management unit 16. Pages 187–191 *in* P. Harper, editor. Black bear management report of survey-inventory activities, 1 July 2004–30 June 2007. Alaska Department of Fish and Game, Juneau, USA.
- Quang, P. X., and E. F. Becker. 1997. Combining line transects and double count sampling techniques for aerial surveys. *Journal of Agricultural, Biological, and Environmental Statistics* 2:230–242.
- Quang, P. X., and E. F. Becker. 1999. Aerial survey sampling of contour transects using double-count and covariate data. Pages 87–97 *in* G. W. Garner, J. L. Laake, D. G. Robertson, and S. C. Amstrup, editors. Marine mammal survey and assessment methods. Balkema Press, Rotterdam, The Netherlands.
- Reynolds, H. V., III. 1980. North slope grizzly bear studies. Federal Aid in Wildlife Restoration, Project Progress Report, Project W-17-11, Jobs 4.14R and 4.15R. Alaska Department of Fish and Game, Division of Wildlife Conservation, Juneau, USA.
- Reynolds, H. V., III. 1992. Grizzly bear population ecology in the western Brooks Range, Alaska. Progress Report to National Park Service, Alaska Department of Fish and Game, Alaska Regional Office, Fairbanks, USA.
- Reynolds, H. V., III. 1999. Effects of harvest on grizzly bear population dynamics in the northcentral Alaska Range. Federal Aid in Wildlife Restoration, Research Progress Report, Grants W-24-5, W-27-1, Study 4.28. Alaska Department of Fish and Game, Division of Wildlife Conservation, Juneau, USA.
- Reynolds, J. H., W. L. Thompson, and B. Russell. 2011. Planning for success: identifying effective and efficient survey designs for monitoring. *Biological Conservation* 144:1278–1284.
- Schwartz, C. C., and A. W. Franzmann. 1991. Interrelationship of black bears to moose and forest succession in the northern coniferous forest. *Wildlife Monographs* 113.
- Schwartz, C. C., S. D. Miller, and M. A. Haroldson. 2003a. Grizzly bear (*Ursus arctos*). Pages 556–586 *in* G. A. Feldhamer, B. C. Thompson, and J. A. Chapman, editors. *Wild mammals of North America: biology,*

- management, and conservation. Second edition. The Johns Hopkins University Press, Baltimore, Maryland, USA.
- Schwartz, C. C., J. E. Swenson, and S. D. Miller. 2003*b*. Large carnivores, moose and humans: a changing paradigm of predator management in the 21st century. *Alces* 39:41–63.
- Servheen, C. 1999. Status and management of the grizzly bear in the lower 48 United States. Pages 50–54 in C. Servheen, S. Herrero, and B. Peyton, editors. Bears: status survey and conservation action plan. International Union for Conservation of Nature/Species Survival Commission, Bear and Polar Bear Specialist Groups. International Union for Conservation of Nature, Gland, Switzerland, and Cambridge, United Kingdom.
- Swenson, J. E. 2003. Implications of sexually selected infanticide for hunting of large carnivores. Pages 171–190 in M. Festa-Bianchet and M. Apollonio, editors. Animal behavior and wildlife conservation. Island Press, Covelo, California, USA.
- Taber, R. D., and N. F. Payne. 2003. Wildlife, conservation, and human welfare. Krieger, Malabar, Florida, USA.
- Testa, J. W. 2004. Population dynamics and life history trade-offs of moose (*Alces alces*) in south-central Alaska. *Ecology* 85:1439–1452.
- Testa, J. W., W. P. Taylor, and S. D. Miller. 1998. Impacts of heavy hunting pressure on the density and demographics of brown bear populations in southcentral Alaska. Federal Aid in Wildlife Restoration, Research Progress Report, Grant W-27-1, Study 4.26. Alaska Department of Fish and Game, Division of Wildlife Conservation, Juneau, USA.
- Titus, K. 2007. Intensive management of wolves and ungulates in Alaska. *Transactions North American Wildlife and Natural Resources Conference* 72:366–377.
- Tobey, R. W., and R. A. Kelleyhouse. 2007. Unit 13 brown bear. Pages 143–154 in P. Harper, editor. Brown bear management report of survey and inventories activities 1 July 2004–30 June 2006. Alaska Department of Fish and Game, Juneau, USA.
- Van Ballenberghe, V. 1987. Effects of predation on moose numbers: a review of North American Studies. Pages 431–460 in G. Göransson, editor. Proceedings Second International Moose Symposium, Supplement 1, Part 2. Swedish Wildlife Research, Stockholm, Sweden.
- Van Ballenberghe, V. 2006. Predator control, politics, and wildlife conservation in Alaska. *Alces* 42:1–11.
- Van Daele, L. J., J. R. Morgart, M. T. Hinkes, S. D. Kovach, J. W. Denton, and R. H. Kaycon. 2001. Grizzlies, Eskimos, and biologists: cross-cultural bear management in southwest Alaska. *Ursus* 12:141–152.
- Walsh, P., J. Reynolds, G. Collins, B. Russell, M. Winfree, and J. Denton. 2010. Application of a double-observer aerial line transect method to estimate brown bear population density in southwestern Alaska. *Journal of Fish and Wildlife Management* 1:47–58.
- Zager, P., and J. Beecham. 2006. The role of American black bears and brown bears as predators on ungulates in North America. *Ursus* 17:95–108.

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