Wildlife Society Bulletin; DOI: 10.1002/wsb.670

Original Article

Gray Wolf Harvest in Idaho

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ABSTRACT Regulated harvest is a relatively new phenomenon for gray wolves (*Canis lupus*) in the contiguous United States. Most studies of wolf harvest have been conducted in northern latitudes where wolf populations are large and human densities are low. Insights from wolf harvest in northern North America may not accurately describe wolf harvest in the lower 48 states. I assessed the efficacy of the recently (2009, 2011–2014) reinstated wolf harvest in Idaho, USA, to test whether it was selective for certain characteristics of individual wolves. I predicted that males and females would be harvested at similar rates, pups would be more common in trap than rifle harvest, most harvest would be from trapping, and harvest effort would not decline over time. Additionally, I predicted that black wolves would be selected as trophies and more frequent in rifle than trap harvest. Male wolves were more vulnerable to rifle harvest than females, pups were not more vulnerable to trapping, trapping did not comprise most of the harvest, and effort did not appear to change over time. Lastly, black wolves were not effectively targeted as trophies. I recommend continued monitoring of wolf harvest to further test harvest-related predictions that provide insights specific to wolves and ecological systems of the conterminous United States. © 2016 The Wildlife Society.

KEY WORDS *Canis lupus*, gray wolves, harvest, hunting, trapping, vulnerability.

Regulation of harvest is commonly used to manage human access to animal populations and ensure population sustainability over time (Mills 2013). Harvest management and its associated responsibilities (i.e., monitoring, obtaining stakeholder input) have been key facets of the wildlife profession for decades (Leopold 1933). Although many species have been influenced by regulated harvest (hereafter, harvest) for long periods of time, species such as gray wolves (*Canis lupus*) have undergone recent shifts in distribution and abundance, and harvest of specific populations is a relatively new event. Gray wolves were reintroduced to Yellowstone National Park, Wyoming, and central Idaho, USA, in 1995–1996 (Bangs and Fritts 1996) and these populations have expanded following reintroduction, leading to removal of Endangered Species Act (ESA) protections in 2009 (estimated 770 wolves Dec 2014; USFWS 2009, USFWS et al. 2015). Harvest of wolves began immediately after ESA protections were removed in Idaho, Montana, and Wyoming (i.e., the Northern Rocky Mountains of the United States; NRM) and more recently (~2012) harvest began in Great Lakes wolf populations (i.e., MI, MN, WI, USA). Litigation and subsequent court decisions, however, have delayed further implementation of harvest in the Great Lakes and Wyoming as well (USFWS 2014). Recent work has shown that harvest can reduce pup recruitment in wolves (Ausband et al. 2015) but we do not have a full understanding of how harvest affects wolf populations in the NRM.

Although wolf harvest is still in its relative infancy in the NRM, perceptions and beliefs about the efficacy of wolf harvest abound. Both public and agency perceptions have led to beliefs that few wolves will be harvested by rifle hunters, pups are curious and naïve and more likely to be trapped than adults, and interest in wolf harvest will decrease over time. Although existing published literature can provide some insights into the aforementioned perceptions, much of the literature regarding harvest of gray wolves in North America is derived from studies in northern climes (e.g., AK, USA; YT, Canada; Peterson et al. 1984, Ballard et al. 1987, Hayes and Harestad 2000, Adams et al. 2008). Such areas are typically characterized by low human densities surrounded by expansive, optimal wolf habitat. Human populations in the conterminous United States are generally more dense, available wolf habitat is not as expansive, and wolves are less abundant than in the northern climes of North America (Paquet and Carbyn 2003).

In many northern climes and even those closer to the conterminous United States (e.g., AB, Canada), trapping is the dominant form of harvest (Peterson et al. 1984, Ballard et al. 1987, Adams et al. 2008, Robichaud and Boyce 2010, Rutledge et al. 2010). Wolves exist at relatively low densities and typically are difficult to observe in the wild, making harvest by rifle challenging. There is uncertainty surrounding the effectiveness of rifle harvest in the conterminous United States where human densities are greater than historical northern areas of harvest. Conclusions from studies of wolf harvest in northern North America, though useful, may not

Received: 21 October 2015; Accepted: 13 April 2016

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accurately describe wolf harvest in the conterminous United States.

Harvest can be selective when hunters are able to identify a desirable trait in the animals they pursue. For example, large males make up a larger portion of the harvest of African lions (*Panthera leo*), to the point that restrictions were put in place to ensure that there are not negative population-level effects arising from the selective harvest (Whitman et al. 2004, 2007). Because animals are observed before harvest when rifle hunting, but not observed before capture in traps, wolves with desirable phenotypic traits (i.e., black pelts) may be disproportionally represented in rifle harvest. Alternatively, some traits, such as sex in wolves, are not easily distinguished from a distance and we might expect both sexes to be equally abundant in harvest assuming an equal sex ratio in the population as found by Ballard et al. (1987). Some harvest can be selective not because of human decisions, but because a certain class of animals may be more behaviorally inclined to respond to a stimulus. For example, young animals may be more naïve and thus disproportionally represented in trap harvest. Using data from south-central Alaska, where the dominant source of harvest was trapping, pups were disproportionally represented in harvest (57% of harvest vs. ~31% of the population; Ballard et al. 1987). Windberg and Knowlton (1990), however, found no such difference between pups and adults in coyotes (*C. latrans*) in Texas, USA. Hunters may actively select for traits of individuals but harvest can also select for certain traits indirectly because of an individual's relative vulnerability.

I assessed the efficacy of the reinstated wolf harvest in Idaho and tested whether differential harvest was selecting for certain characteristics of individual wolves. Specifically, I predicted that males and females would be harvested at similar rates, pups would occur more frequently in trap than rifle harvest, most harvest would be from trapping, and harvest effort (i.e., no. of licenses sold) would not decrease over time. I also predicted that because they are rarer (20.3% of radiocollared wolves in Idaho since 1995, $n = 804$), black wolves would be selected as trophies and occur more frequently in rifle harvest than trap harvest.

METHODS

Wolves were harvested in 13 wolf management zones that encompassed the entire occupied wolf range in Idaho (Fig. 1). Harvest regulations depended on year and were liberalized from 2009 (2009, 2011–2014; Table 1). There was a cessation in harvest in 2010 due to litigation and temporary restoration of ESA protections. Harvested wolves were required to be checked by Idaho Department of Fish and Game personnel. The check-in procedure required presenting the hunting or trapping license along with the head and hide of the harvested animal. Idaho Department of Fish and Game personnel recorded the method of take, location, date, pelt color, and sex of the animal. Personnel also removed 2 tissue samples for later genetic analyses and extracted a tooth. Teeth were sent to Matson's Laboratory (Milltown, MT) for cementum aging.

I summarized license sales and harvest statistics by harvest year (generally 30 Aug–31 Mar of following yr), method of take, age, sex, and pelt color. Because trapping was only permitted in some wolf management zones depending on the year, I assessed rifle harvest versus trap harvest in just those areas. I tested for differences in frequency for each prediction using 2×2 contingency tables with $\alpha = 0.05$

RESULTS

Wolf harvest was greatest in 2011 and decreased each year thereafter even though regulations were liberalized (Tables 1 and 2). Contrary to my prediction, trapping did not comprise most of the harvest, with take by rifle accounting for >60% of the harvest statewide (not including 2009 when trapping was not permitted; Table 2). In zones where both rifle and trapping were permitted, trapping averaged 44.5% ($n = 466$) whereas rifle averaged 55.5% ($n = 581$) of the harvest annually. Trapping harvest (60.2%; $n = 214$) exceeded rifle harvest (39.8%; $n = 141$) in just one zone (Panhandle). The majority of rifle harvest occurred in October (the beginning of the big game hunting season), whereas harvest by trapping occurred somewhat evenly between December and March (Fig. 2a and b).

Trapping license sales did not vary appreciably from 2009 to 2014. The decline in number of hunters purchasing rifle tags was likely due to the inclusion of wolf rifle tags in the "Sportsman's Package," a combination big-game license (Fig. 3a and b). This change in regulations yielded an increase of nearly 10,000 hunters to approximately 40,000 rifle hunters annually (Fig. 3a) with the ability to harvest a wolf. It is unknown how many "Sportsman's Package" hunters actively targeted and hunted for wolves specifically.

I found no support for my prediction that pups were more vulnerable to trapping because they were not disproportionally represented in trap harvest versus rifle harvest (36.9% trap vs. 37.9% rifle [Table 3; Fig. 4]). Additionally, black wolves were not selected as trophies during rifle harvest as evidenced by almost equal proportion of black pelts in rifle and trap harvest (24.0% rifle vs. 24.4% trap; Table 3). I found a significant male-bias in rifle but not in trap harvest (Table 3; $\chi^2_1 = 16.52$, $P < 0.001$).

DISCUSSION

I found that commonly held beliefs related to wolf harvest in the northern Rocky Mountains were not supported by harvest data. Further, inferences from wolf harvest studies in northern climes do not accurately depict wolf harvest in the conterminous United States. Specifically, male wolves were more vulnerable to rifle harvest than females, pups were not more vulnerable to trapping than rifle harvest, trapping did not comprise the bulk of the harvest, hunter and trapper effort did not diminish over the course of our study, and black wolves were not effectively targeted as trophies. Although some individuals may target certain wolves based on trail-camera photos or other sightings, most wolf harvest appears to be opportunistic and harvest by rifle is common.

Differences in dispersal behaviors and life history strategies between sexes may explain why males were more vulnerable

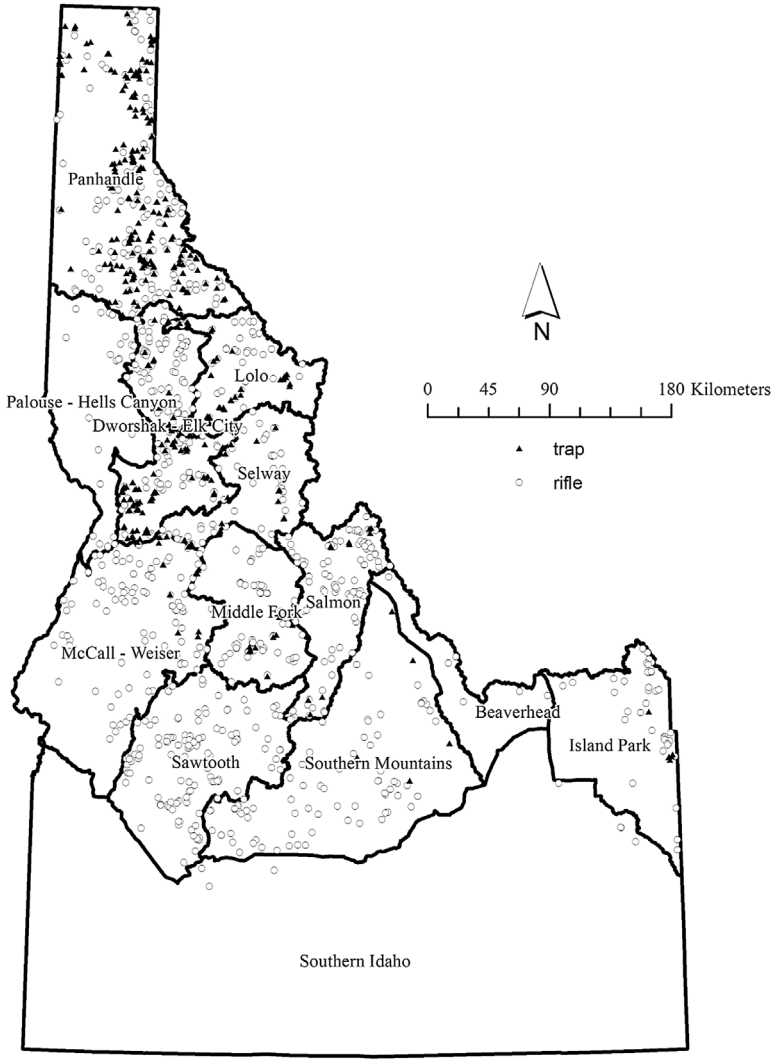


Figure 1. Wolf management zones ($n = 13$) and locations of wolves harvested in Idaho, USA (2009, 2011–2014).

Table 1. Regulations regarding season length, method of take, bag limits, and quotas for gray wolf harvest in Idaho, USA (2009, 2011–2014).

Harvest yr	Rifle	Electronic calls	Bait	Trapping	Snares	Use of pursuit dogs	Bag limit	Quotas
2009	1 Oct–31 Mar[a]	No	No	No	No	No	1	Statewide ($n = 220$)
2011	30 Aug–31 Mar[b]	Yes	Yes[c]	15 Nov–31 Mar[d]	Yes	No	2 (+3 for trapping)	No quotas except in 5 zones ($n = 165$)
2012	30 Aug–31 Mar[e]	Yes	Yes	15 Nov–31 Mar[f]	Yes	No	5 (+5 for trapping)	No quotas except in 5 zones ($n = 180$)
2013	30 Aug–31 Mar[g]	Yes	Yes	15 Nov–31 Mar[h]	Yes	No	5 (+5 for trapping)	No quotas except in 5 zones ($n = 185$)
2014	30 Aug–31 Mar[i]	Yes	Yes	15 Nov–31 Mar[j]	Yes	No	5 (+5 for trapping)	No quotas except in 5 zones ($n = 185$)

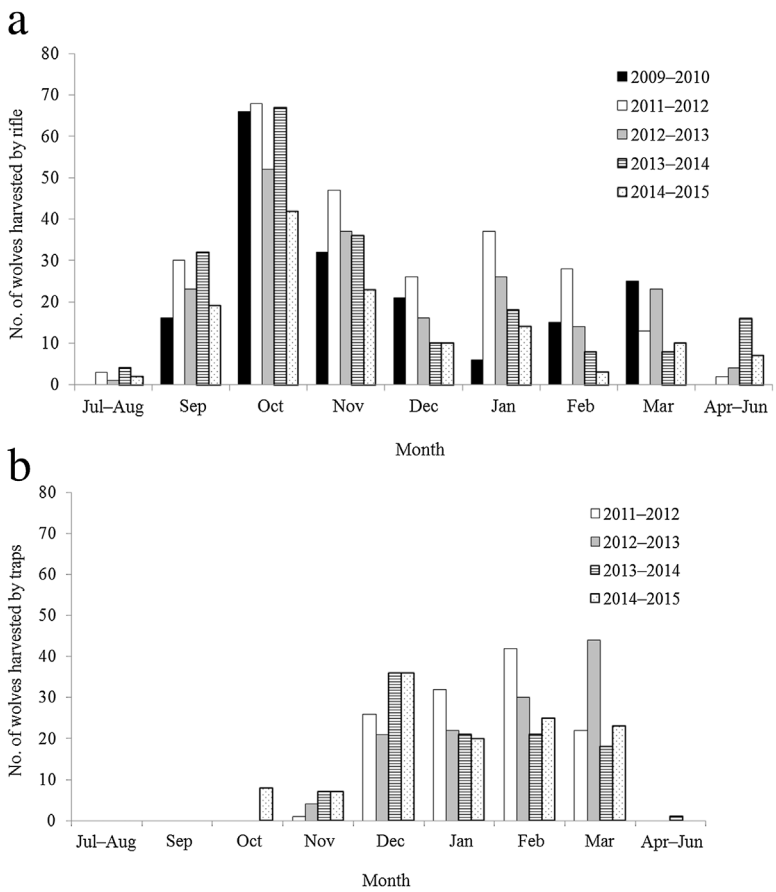
[a] Two wolf-management zones began 15 September and 2 began 1 September.
[b] Two wolf-management zones ended 31 December and 2 ended 30 June (of following yr).
[c] Harvest incidental at bear baiting sites only.
[d] Trapping allowed in 5 of the 13 wolf management zones.
[e] Harvest allowed on private land 1 July in 1 wolf management zone, 2 zones ended 30 June and 2 zones ended 31 January of the following year.
[f] Trapping allowed in 6 of the 13 wolf management zones, ended 15 March in 1 zone with 3 trapping tags allowed.
[g] Harvest allowed on private land year-round in 1 wolf management zone, 4 zones ended 30 June of the following year.
[h] Trapping allowed in 9 of the 13 wolf management zones and 2 zones ended 15 March.
[i] Harvest allowed on private land year-round in 5 wolf management zones, ended 30 June of following year in 3 zones and portions of 2 other zones.
[j] Trapping allowed in all or portions of 12 of the 13 wolf management zones and on private land year-round in 5 of the zones, trapping began 10 October in 2 zones and portions of 1 zone, ended 15 March in 2 zones.

Table 2. Number of gray wolves legally harvested and method of take in Idaho, USA (2009, 2011–2014).

Harvest yr	No. harvested	No. by rifle (%)	No. by trap (%)	No. by archery (%)
2009	181	181 (100.0)	0 (0.0)	N/A
2011	377	248 (65.8)	123 (32.6)	6 (1.6)
2012	317	192 (60.6)	121 (38.2)	4 (1.3)
2013	303	193 (63.7)	104 (34.3)	6 (2.0)
2014	249	124 (49.8)	119 (47.8)	6 (2.4)
Total	1,427	938 (65.7)	467 (32.7)	22 (1.5)

than females to rifle harvest. Female wolves inherit breeding positions in their natal packs more often than do males (vonHoldt et al. 2008). Adult males, therefore, may be more likely to disperse, be alone, wander into unfamiliar terrain, and thus be more vulnerable to encountering—and not first detecting—rifle hunters. A pulse in dispersal does begin in the autumn in the NRM (M. J. Jimenez, U.S. Fish and Wildlife Service, unpublished data). Alternatively, males are more aggressive during inter-pack conflicts (Casidy et al. 2015), and may be more likely to investigate foreign objects in the environment (in this case a rifle hunter). Skewed sex ratios in litters could also explain male-biased harvest because most rifle harvest occurs prior to the trapping season. If true, male pups should be more common in rifle than trap harvest, yet the data show the opposite trend in male pup harvest (35.5% rifle vs. 39.6% trap). Additionally, sex ratios in litters of pups in Idaho do not appear to be male-biased and in recent years have even been female-biased (60 F:40 M; D. Ausband, unpublished data).

I assumed that rifle harvest was opportunistic and trapping would target more naïve animals (e.g., pups). Despite the assumed naiveté of young animals, wolf pups were not more vulnerable to trapping than rifle harvest. Given that trapping is a relatively new form of harvest, young wolves may become more prevalent in the harvest over time as older, adult wolves become more wary of lure and other signs of trapping activity. It is possible that pups are more susceptible than adults to harvest generally, but data from wolf packs in long-term research areas in Idaho indicate no such vulnerability (pups 46% of preharvest population yet only 37% of harvest; $n = 21$ wolf-pack yr [Stenglein et al. 2010, Stansbury et al. 2014]). Harvest may affect social structure in groups of



Figures 2. Number of wolves harvested with (a) rifle, and (b) traps by month in Idaho, USA, (2009, 2011–2014).

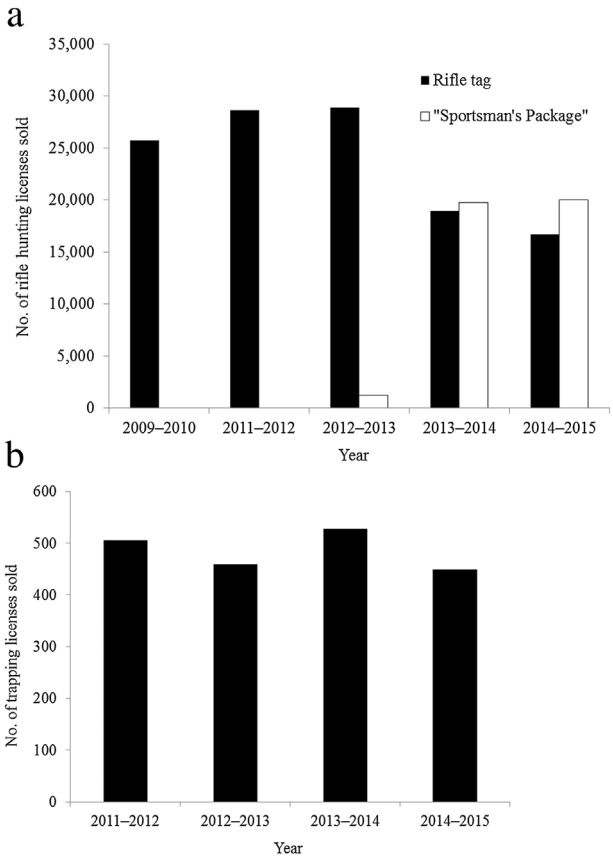


Figure 3. Number of licenses sold permitting harvest of wolves with (a) rifle, and (b) trap in Idaho, USA, (2009, 2011–2014). "Sportsman's Package" is a combination big-game license that includes a rifle tag for wolves.

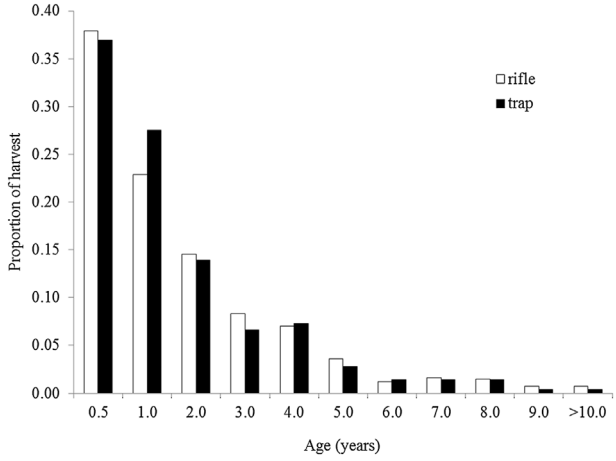


Figure 4. Ages (yr) of harvested wolves taken by rifle and traps in Idaho, USA (2009, 2011–2014; $n = 960$).

wolves in unexpected and undesirable ways (Haber 1996, Rutledge et al. 2010). Differences in vulnerability by harvest method can be informative because harvesting pups may not be as impactful to social structure as harvesting several adults from a group. Rifle and trap harvest appear to indiscriminately affect age classes of wolves; thus, we can expect both forms to affect wolf social structure equally.

Although rifle harvest was the dominant form of take in most areas, the proportion of the harvest attributable to trapping increased in later years of the study. Increases in trapping harvest cannot be attributed to increased licenses sold but may be attributable to wolves' increased wariness during big-game season, increasingly liberalized regulations, and trappers becoming more skilled as they learn to target and capture wolves. Mech (2010) suggested that interest in wolf harvest would decline over time. I did not find clear evidence to support this prediction, at least over the course of my 6-year study, because hunting and trapping efforts did not appear to decrease based on license sales alone. Total number of wolves harvested in Idaho has declined from a peak in 2011, but this likely also reflects a peak, or near peak, in wolf population size (Mack et al. 2010). During the first year of wolf harvest in 2009, harvest was relatively small compared with subsequent years. Thus, 2011 may have held Idaho's largest wolf population since wolf recovery began. It is difficult to know whether recent decreases in harvest are a result of documented population declines since harvest began (USFWS et al. 2015), changes in wolf behavior and wariness, or less hunter interest in harvesting wolves despite an increased number of licenses being sold.

Hunters and trappers of gray wolves in Idaho did not appear to discriminate based on pelt color prior to harvest. Black wolves, thought to be desired as trophy animals because of their relative rareness, were not effectively selected for in rifle harvest. Rifle harvest appears to be opportunistic and incidental to hunting other big game animals as suggested by Mech (2010). Sightings of wolves are commonly short in duration and the ability to discriminate and select among individuals in a group is likely low. Additionally, discriminating and selecting individual wolves to harvest may be made even more difficult in areas of the state with dense vegetation (i.e., Panhandle zone). Wolves that are heterozygotic for black

Table 3. Color, age, and sex of gray wolves legally harvested in Idaho, USA (2009, 2011–2014)[a].

Harvest method	Black pelt (% of harvest)	Gray pelt (% of harvest)	Pup (% of harvest)	Adult (% of harvest)	Males (% of harvest)	Females (% of harvest)
Rifle	200 (24.1)	631 (75.9)	254 (37.3)	427 (62.7)	511 (54.5)	427 (45.5)
Trap	104 (24.4)	322 (75.6)	104 (36.9)	178 (63.1)	224 (48.1)	242 (51.9)
Archery	4 (22.2)	14 (77.8)	4 (30.8)	9 (69.2)	15 (68.2)	7 (31.8)
Total	308 (24.2)	967 (75.8)	362 (37.1)	614 (62.9)	750 (52.6)	676 (47.4)

[a] Column totals may be less than those in Table 2 because some data were not always recorded during mandatory check-in.

coat color have greater overall fitness than gray-colored wolves (Coulson et al. 2011) and monitoring of pelt color in harvested wolves is recommended to ensure these alleles are maintained within the population.

Mandatory reporting requirements and enforcement allowed Idaho Department of Fish and Game to gather a great deal of information and permitted insights on the efficacy of harvest regulations and the relative vulnerability of different classes of wolves. Given the differences observed in harvest between the northern Rocky Mountain population and those of more northern latitudes (i.e., relatively large proportion of wolves harvested with rifles in NRM), I urge further harvest monitoring and testing of predictions that provide insights into how harvest affects wolves in the conterminous United States.

ACKNOWLEDGMENTS

I thank S. Roberts for early manuscript reviews. I thank B. Ackerman, S. Crea, J. Hayden, D. Hribik, M. Hurley, J. Husseman, and J. Struthers. Two anonymous reviewers and WSB Editors and Editorial staff at *Wildlife Society Bulletin* provided me with thoughtful feedback on earlier drafts and greatly improved this manuscript. I thank them for their time.

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Associate Editor: Nielson.