Management Plan for the Grey Wolf (*Canis lupus*) in British Columbia

Prepared by B.C. Ministry of Forests, Lands and Natural Resource Operations

BRITISH COLUMBIA

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Courtesy of Dr. Gerry Kuzyk

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Disclaimer

This management plan has been prepared by the B.C. Ministry of Forests, Lands and Natural Resource Operations as advice to the responsible jurisdiction and organizations that may be involved in managing Grey Wolves in British Columbia.

This document identifies the management actions that are deemed necessary, based on the best available scientific information, to manage Grey Wolf populations in British Columbia. Management actions to achieve the goals and objectives identified herein are subject to the priorities and budgetary constraints of participatory agencies and organizations. Recommendations provided in the plan will be used by the B.C. Ministry of Forests, Lands and Natural Resource Operations and the B.C. Ministry of Environment to guide the development of new, or modification of existing, provincial policies and procedures. While the recommendations herein are based on the best available science and expert judgment of the writers and reviewers, policy considerations may modify these recommendations, while respecting their intent, to address social and economic objectives in Grey Wolf management. These goals, objectives, and management actions may be modified in the future to accommodate new objectives and findings.

Success in the management and conservation of this species depends on the commitment and cooperation of many different constituencies that may be involved in implementing the directions set out in this management plan.

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EXECUTIVE SUMMARY

The Grey Wolf (*Canis lupus;* hereafter wolf) was designated as Not at Risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) because it has a widespread, large population with no evidence of decline over the last 10 years. The International Union for Conservation of Nature (IUCN) Red List of Threatened Species lists the status of the wolf as Least Concern and it is listed in Appendix II by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

In British Columbia (B.C.), the wolf is ranked S4 (apparently secure) by the Conservation Data Centre and is on the provincial Yellow list. The highest B.C. Conservation Framework rank for the wolf is a priority 3 under goal 1 (Contribute to global efforts for species and ecosystem conservation).

The wolf is common throughout much of B.C. and has recolonized areas in the south of the province from which it was extirpated by decades of bounties and poisoning. As one of B.C.'s top carnivores, wolves play an important role in structuring predator–prey systems, but they are also a threat to livestock and, in very rare cases, to human safety. The species attracts a highly polarized debate between those who see the wolves as emblematic of B.C.'s wilderness heritage and those who see them as a threat to game species and livestock. This plan presents an analysis of historical and current management, an updated range map and population estimate, and a proposed approach for managing wolves as an important component of B.C.'s predator–prey system, while minimizing conflicts with livestock production in a consistent, transparent, and effective manner.

Widespread poisoning and other control measures throughout the first half of the 20th century reduced the B.C. wolf population by the late 1950s, but several indicators suggest that the population and range of the species have increased since then. Direct census of wolves is infeasible over such a large area as B.C.; however, an estimate based on published wolf density and range estimates, as well as ungulate biomass estimates, suggests the current B.C. population is approximately 8,500 wolves (range 5,300 –11,600).

Trends in the wolf population are estimated primarily from changes in reported harvest, along with observational reports from Ministry staff, First Nations, stakeholders, and the general public. These indicators suggest that B.C.'s wolf population is currently stable to increasing throughout their range.

The following factors limit and/or regulate the distribution and abundance of wolves in B.C.: abundance and distribution of ungulate prey, human-caused mortality, space/intraspecific strife, and disease.

The threats assessment for this species indicates that hunting and trapping are considered the only measurable threats, and that these threats have a low impact on this species because of the wolf's natural resilience, adaptability, and expanding population. There is currently no evidence that there are significant conservation concerns for wolves in B.C. The hunting and trapping of wolves in B.C. currently have a standing non-detriment finding (see Appendix 1).

The goal of wolf management in B.C. is to ensure a self-sustaining population throughout the species' range and to ensure that, within the biological limits of the species, wolves are available in sufficient abundance to fulfill their ecological role, and to meet the cultural, recreational, and economic needs of society.

Further, the objectives of wolf management are:

1. to ensure a self-sustaining population throughout the species' range that fulfills the role of wolves as a top predator in B.C.'s diverse ecosystems;
2. to provide opportunities for economic, cultural, and recreational uses of wolves consistent with Ministry program plans;
3. to minimize impacts on livestock caused by wolves in a manner that does not jeopardize conservation objectives; and
4. to manage specific packs or individuals where predation is likely preventing the recovery of wildlife populations threatened by wolf predation[1].

Provincial policy supports the use of predator control[2] to protect livestock and species at risk. Predator control to enhance ungulate populations for hunting is not supported by policy.

Balancing the public interest where opinions are highly polarized is the challenge of managing wolves in B.C. Public consultation on this document resulted in more than 3,200 responses that spanned a wide range of perspectives. The plan was amended to address many recurring comments that were made through the consultation process.

The B.C. Ministry of Forests, Lands and Natural Resource Operations and B.C. Ministry of Environment will consider the recommended objectives and management actions within this plan when developing new, or modifying existing, provincial policies, procedures, and regulations related to wolf management.

[1] Wildlife threatened by wolf predation includes indigenous species or subspecies that have, or are candidates for Endangered or Threatened status in British Columbia (i.e. identified on BC's Red List) and for those populations where wolf predation has been identified as the primary limiting factor; or any other wildlife population considered to be threatened by wolf predation, as determined by the Minister of Forests, Lands and Natural Resource Operations.

[2] Predator control, as defined by provincial policy ("Control of Species") and as used in this management plan, refers to actively limiting or reducing a wolf population through means other than licenced harvest (i.e. in accordance with provincial hunting and trapping regulations).

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1 PURPOSE

This management plan has been prepared by the B.C. Ministry of Forests, Lands and Natural Resource Operations as advice to the responsible jurisdiction and organizations that may be involved in managing wolves in British Columbia.

This document identifies the management actions that are deemed necessary, based on the best available information, to manage wolf populations in British Columbia. Management actions to achieve the goals and objectives identified herein are subject to the priorities and budgetary constraints of participatory agencies and organizations.

Recommendations provided in the plan will be used by the B.C. Ministry of Forests, Lands and Natural Resource Operations and B.C. Ministry of Environment to guide the development of new, or modification of existing, provincial policies, procedures, and regulations. While the recommendations herein are based on the best available science and expert judgment of the writers and reviewers, policy considerations may modify these recommendations, while respecting their intent, to address social and economic objectives in wolf management. These goals, objectives, and management actions may be modified in the future to accommodate new objectives and findings.

Success in the management and conservation of this species depends on the commitment and cooperation of many different constituencies that may be involved in implementing the directions set out in this management plan.

2 SPECIES STATUS INFORMATION

Wolf[a]	
Legal Designation:	
Identified Wildlife:[b] N	B.C. *Wildlife Act:*[c] Yes
COSEWIC: Not at Risk (1999)	SARA Schedule: N/A
IUCN Red List of Threatened Species:[d] Least Concern (2008)	CITES:[e] Appendix II
Conservation Status[f]	
B.C. List: Yellow	B.C. Rank: S4 (2010)
National Rank: N4 (2005)	Global Rank: G4G5 (2006)
Other Subnational Ranks:[g] Alberta: S4, Manitoba: S4, New Brunswick: SX, Newfoundland Island: SX, Labrador: S4, Northwest Territories: SNR, Nova Scotia: SX, Nunavut: SNR, Ontario: S4, Prince Edward Island: SX, Quebec: S5, Saskatchewan: S4, Yukon Territory: S4	
B.C. Conservation Framework **(CF)**[h]	
Goal 1: Contribute to global efforts for species and ecosystem conservation.	Priority:[i] 3 (2009)
Goal 2: Prevent species and ecosystems from becoming at risk.	Priority: 6 (2009)
Goal 3: Maintain the diversity of native species and ecosystems.	Priority: 5 (2009)
CF Action Groups: No New Action	

[a] Data source: B.C. Conservation Data Centre (2014) unless otherwise noted.
[b] Identified Wildlife under the *Forest and Range Practices Act,* which includes the categories of species at risk, ungulates, and regionally important wildlife (Province of British Columbia 2002).
[c] Designated as wildlife under the B.C. *Wildlife Act* as a big game animal and as a fur-bearing animal (Province of British Columbia 1982). Designation under the *Wildlife Act* means that the hunting and trapping of wolves are regulated by the government. See http://www.env.gov.bc.ca/fw/wildlife/hunting/regulations/ (B.C. Ministry of Environment 2010) for a synopsis of the hunting and trapping regulations.
[d] Data source: IUCN (2011).
[e] Data source: CITES (2011). Grey Wolf is listed for "look alike" reasons, to protect populations at high risk in other parts of the world.
[f] S = subnational; N = national; G = global; X = presumed extirpated; 1 = critically imperiled; 2 = imperiled; 3 = special concern, vulnerable to extirpation or extinction; 4 = apparently secure; 5 = demonstrably widespread, abundant, and secure; NR = unranked. See NatureServe (2011) for U.S. data.
[g] Data source: NatureServe (2011).
[h] Data source: B.C. Ministry of Environment (2011).
[i] Six-level scale: Priority 1 (highest priority) through to Priority 6 (lowest priority).

2.1 Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Species Assessment Information

COSEWIC is a committee of experts that assesses and designates which wildlife species are in some danger of disappearing from Canada.

Date of Assessment: April 1999
Common Name (population):* Wolf, Northern Grey
Scientific Name:* *Canis lupus occidentalis*
COSEWIC Status: Not applicable
Reason for Designation: A widespread, large population with no evidence of decline over the last 10 years.
Canadian Occurrence: YT, NT, NU, BC, AB, SK, MB, ON, QC, NL
COSEWIC Status History: Designated Not at Risk in April 1999

*Known as Grey Wolf (*Canis lupus*) in B.C., referred to as "wolf" in this document.

2.2 International Union for Conservation of Nature (IUCN)

The IUCN Red List of Threatened Species is a global authority on the conservation status of plants and animals. The status of the wolf is Least Concern and the population trend is Stable (Mech and Boitani 2008).

2.2.1 Justification (from Mech and Boitani 2008)

Originally, the Grey Wolf was the world's most widely distributed mammal. It has become extinct in much of Western Europe, in Mexico, and in much of the United States; in addition, its present distribution is more restricted. Wolves occur primarily, but not exclusively, in wilderness and remote areas. Their original worldwide range has been reduced by about one-third by deliberate eradication due to their depredation on livestock and to fear of wolf attacks on humans. Since about 1970, legal protection, land-use changes, and rural human population shifts to cities have arrested wolf population declines and fostered natural recolonization in parts of its range and reintroduction in three areas of the United States. Continued threats include competition with humans for livestock and game species, exaggerated concern by the public regarding the threat and danger of wolves, and fragmentation of habitat.

Although wolves still face some threats, their global range and distribution do not meet the criteria for threatened or endangered status. However, in some parts of their range, wolf populations are seriously threatened (e.g., the Western-Central Alps population in Europe).

2.3 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

CITES is an international convention that controls the movement of animals and plants that are, or may be, threatened by international trade. The wolf is listed in Appendix II, which includes species that are not necessarily now threatened with extinction but that may become so unless their trade is closely controlled (CITES 2011). Grey Wolf is listed for "look alike" reasons, to protect populations at high risk in other parts of the world (e.g., Europe).

Specimens obtained though legal hunting and trapping in B.C. currently have a standing non-detriment finding (see Appendix 1). Canada also has a non-detriment finding for legally harvested wolves.[3]

3 SPECIES INFORMATION

3.1 Species Description

The wolf is the largest wild species of the canid family. Its size and appearance vary considerably. Most wolves in B.C. weigh between 30 and 50 kg with coats varying from nearly

[3] See http://www.ec.gc.ca/cites/default.asp?lang=En&n=BB314F25-1.

pure white to a mixture of grey, brown, black, and white to various shades of grey or black (Hatler *et al*. 2003, Hatler *et al.* 2008). The wolf is a highly adaptable, intelligent carnivore that inhabits most of B.C.

3.2 Population Size and Distribution

3.2.1 Global

The wolf is circumpolar in distribution and originally occupied most areas north of 12–15° N, except for tropical rainforests and deserts (Honghai 1999; Sillero-Zubiri *et al.*, eds. 2004). It has been largely extirpated from Mexico; from most of the United States (except Alaska and parts of Washington, Oregon, Idaho, Montana, Wyoming, Arizona, New Mexico, Wisconsin, Minnesota, and Michigan; U.S. Fish and Wildlife Service 2013); and from much of western Europe (Sillero-Zubiri *et al.*, eds. 2004).

3.2.2 Canada

In Canada, provincial wolf populations are considered fully viable and occupy a large majority of their historical range except the Maritime Provinces and the island of Newfoundland, where they were extirpated (Sillero-Zubiri *et al.*, eds. 2004).

3.2.3 British Columbia

Wolves are widespread and inhabit most of B.C. Wolves were considered extirpated in much of the Kootenay, Okanagan, and part of the Thompson regions in the 1970s (B.C. Ministry of Environment 1979) but have now re-established as far south as northern Washington, Idaho, and Montana (Sime *et al.* 2010; Wiles *et al.* 2011; Idaho Department of Fish and Game and Nez Perce Tribe 2013). Hatler *et al.* (2008) summarized available wolf density information for B.C. and other jurisdictions. Estimated densities measured in northern B.C. have ranged from 10 to 44 wolves per 1,000 km^2. On Vancouver Island, the density in Atkinson and Janz' (1994) study area in the Nimpkish Valley was estimated at 43 wolves per 1,000 km^2; in the Adam River watershed, Scott and Shackleton (1980) estimated a density of 59 wolves per 1,000 km^2. Darimont and Paquet (2000) used a density of 30–35 wolves per 1,000 km^2 to estimate the population in their study area on the central coast, based on estimates by Person (1997) for Prince of Wales Island, Alaska. Density estimates tend to be high in small study areas because researchers are more likely to study abundant populations (Smallwood and Shonewald 1996); therefore, extrapolating these densities over very large areas likely inflates population estimates.

In northern B.C., wolves are most commonly associated with the distribution of Moose (*Alces americanus*). Moose are sparser in the Southern Interior than in parts of the north but recovery of wolf populations has followed local increases in moose (Mowat 2007). Some wolf packs in the Southern Interior appear to be deer specialists. Moose are absent from the coast and Vancouver Island and wolves in these regions are deer specialists. In some jurisdictions, deer support higher densities of wolves than do moose (Hatler *et al.* 2008).

Figure 1 illustrates estimated high- and low-density range areas for wolves as interpreted from moose and Mule Deer (*Odocoileus hemionus)* densities reported by Shackleton (1999), ecosection information by Demarchi (1996), and input from Ministry staff. High wolf densities are assumed to be correlated with high moose densities in the north and Black-tailed/Mule Deer distribution on the coast. Low wolf density areas are found in the rugged terrain of the Coast and Rocky Mountains, as well as much of southern B.C. Wolves are absent from Haida Gwaii and are assumed to be largely absent from the southern Gulf Islands, Greater Victoria, Greater Vancouver, the Fraser Valley, and the south Okanagan Valley (Hatler *et al.* 2008).

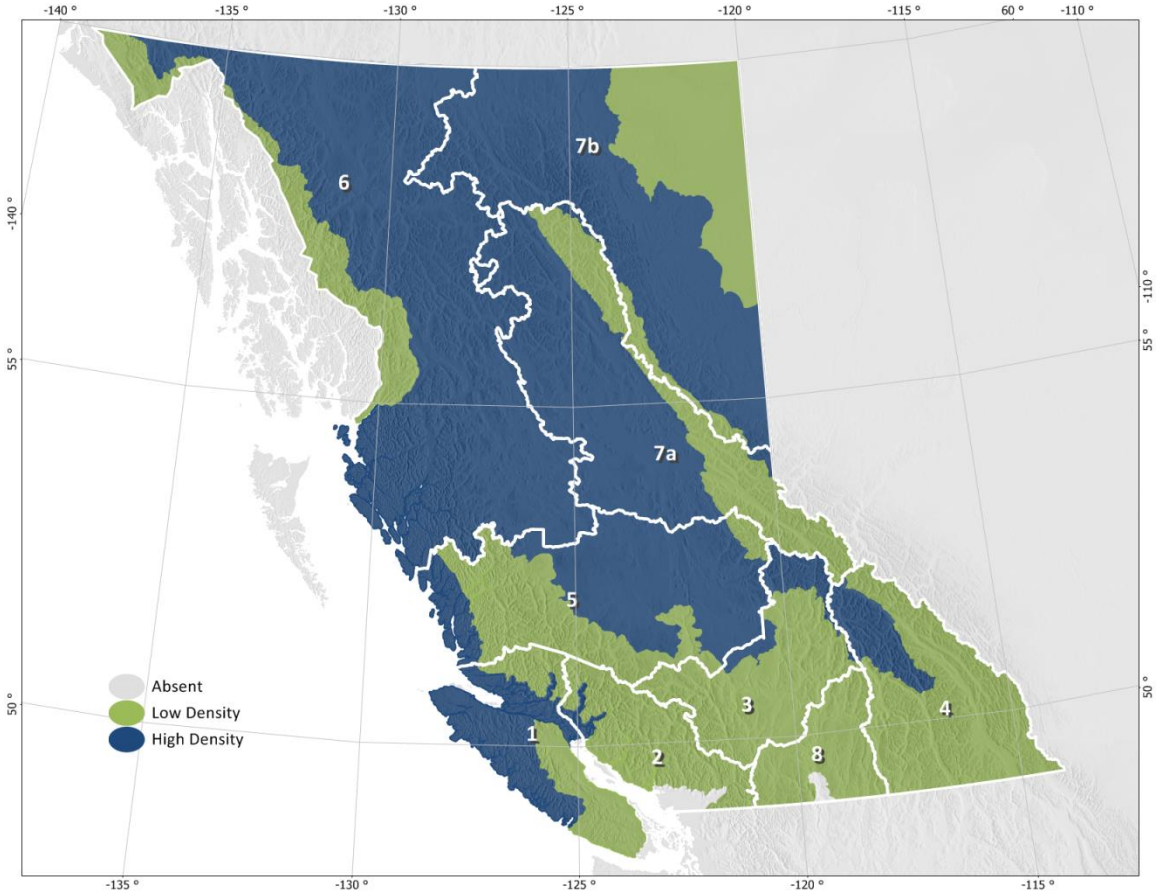

Figure 1. Estimated high- and low-density range of wolves in British Columbia. Distributions are based on moose densities in the Interior and deer densities on the Coast, and adjusted based on input from Ministry staff. Boundaries and numbers represent regions used for the harvest analysis.

Although wolves are widespread and abundant, establishing reliable population estimates and trends is difficult because wolves typically live in forested areas, are highly mobile with large home ranges, and are frequently nocturnal (B.C. Ministry of Environment, Lands and Parks 1998). However, indirect population estimates can be made based on wolf density extrapolations and relative densities of ungulate prey. To generate a wolf population estimate for B.C. from density extrapolations, a density of 5–15 wolves per 1,000 km^2 was applied in high wolf density areas. Hatler *et al.* (2008) reported a density of 10–20 from studies in Alaska for wolf–moose systems (Ballard *et al.* 1987; Gasaway *et al.* 1992), but lower densities have also been reported

from northern studies (Hayes *et al.* 2003; Culling *et al.* 2006; Adams *et al.* 2008). West-central Alberta studies have reported densities largely within this range (Fuller and Keith 1980; Bjorge and Gunson 1989; Kuzyk 2002; Webb *et al.* 2009). Few studies were available to estimate populations for the low-density wolf areas, but 2–5 wolves per 1,000 km^2 was used to correspond conservatively to estimates from Banff and Jasper National Parks (Dekker 1986; Huggard 1991; Hebblewhite 2006; Webb *et al.* 2009). Current population estimates in Idaho correspond to about 5 wolves per 1,000 km^2 (Idaho Department of Fish and Game and Nez Perce Tribe 2013).

A second wolf population estimate was based on ungulate prey biomass estimates (Kuzyk and Hatter in press). Fuller *et al.* (2003) regressed an index of ungulate biomass against wolf densities using data from 32 studies in North America and found a significant linear relationship. This relationship has recently been re-evaluated and improved for estimating wolf densities by using a curvilinear relationship (Cariappa et al 2011, Kuzyk and Hatter in press). The most current estimates of ungulate populations (2011) were used to generate estimates of wolf populations by region.[4] Ungulate biomass index values were 8 for Bison (*Bos bison*); 6 for moose; 3 for Elk (*Cervus canadensis*); 2 for Caribou (*Rangifer tarandus*); 1 for Mountain Sheep (*Ovis canadensis, Ovis dalli,*), Mountain Goat (*Oreamnos americanus*), Mule Deer, and White-tailed Deer (*Odocoileus virginianus*); and 0.75 for Black-tailed Deer (*Odocoileus hemionus columbianus*). Smaller, non-ungulate prey or livestock was not considered in the analysis (Fuller et al. 2003).

The two independent wolf estimates were assessed and a combined estimate was developed to generate a provincial population estimate of approximately 5,300 to 11,600 wolves (Table 1) or a best estimate of approximately 8,500. B.C.'s wolf population was previously estimated to be 6,300 (2,500–11,000) in 1979 (B.C. Ministry of Environment 1979) and 8,100 in 1991 (Theberge 1991). Changes in estimates over time likely reflect changes in both the abundance of wolves and in the precision and the method of estimation.

Table 1. Regional and provincial population estimate for wolves.

Region	Population range based on density estimates[a]	Population range based on prey biomass[a]	Combined estimate[a,b]
1 – Vancouver Island	150–480	220–400	180–440
2 – Lower Mainland	75–200	100–200	90–200[c]
3 – Thompson	150–400	420–800	290–600[d]
4 – Kootenay	200–500	800–1,500	500–1000
5 – Cariboo	430–1,250	650–1,200	550–1,250
6 – Skeena	2,300–4,600	950–2,100	1,600–3,300
7a – Omineca	550–1,550	900–1,800	700–1,650
7b – Peace	800–2,300	1,800–3,600	1,300–3,000

[4] See http://www.env.gov.bc.ca/fw/wildlife/management-issues/index.html#ungulate_pop.

Region	Population range based on density estimates[a]	Population range based on prey biomass[a]	Combined estimate[a,b]
8 – Okanagan	50–150	(50–150)[e]	50–150
Total	**4,700–11,400**	**6,000–11,900**	**5,300–11,600**

[a] Rounding rules for estimates: < 100, nearest 5; 100–499, nearest 10; 500–1,999, nearest 50; ≥ 2,000, nearest 100.
[b] Average of the density and biomass estimates used.
[c] Regional estimate based on observations during ungulate surveys is estimated to be 150–300 (D. Reynolds, pers. comm., 2011).
[d] Regional estimate based is conservatively estimated to be 190–275 (C. Proctor, pers. comm., 2011).
[e] Prey Biomass estimate not appropriate as wolf distribution still expanding, regional estimate based on reported observations is 75–100 , up from the previous estimate of 40–60 in 2007 (B. Harris, pers. comm., 2011).

In comparison, the wolf population in Alaska is estimated at 7,700–11,200; at 1674 in the northwestern United States (U.S. Fish and Wildlife Service 2013); and at 4,500–5,000 in the Yukon (Yukon Wolf Conservation and Management Plan Review Committee 2011).

3.3 Needs of the Wolf

3.3.1 Habitat and Biological Needs

Habitat

Wolves are generalists and can occupy nearly any habitat that supports sufficient prey (Mech 1995; Minnesota Department of Natural Resources 2001). Assessments of habitat suitability have been concerned primarily with factors that would influence the likelihood of human-caused mortalities such as road densities (as an index of human habitation, negative encounters, and direct mortalities) and agricultural land (as an index of likely control kills resulting from livestock depredation; e.g., Mladenoff *et al.* 1995; Gehring and Potter 2005). Barriers to dispersal also reduce habitat suitability (Mladenoff *et al.* 1995).

In British Columbia, wolves use predominantly low elevations where prey is most abundant, although they can be found at all elevations and will shift habitat use with seasonal changes in diet. They occupy nearly all habitat types in the province except highly developed urban and cultivated areas of the southwest B.C. and the southern Okanagan (Hatler *et al.* 2008).

Feeding Ecology

Wolves are opportunistic predators and feed primarily on large ungulates, supplementing their diet with a variety of smaller prey (Peterson and Ciucci 2003; Hatler *et al.* 2008). Wolves are not habitat specialists but will live anywhere prey are abundant and will adjust their diets according to local conditions (Minnesota Department of Natural Resources 2001; Hatler *et al.* 2008). As a result, the pattern of prey selection can be complex and highly variable (Peterson and Ciucci 2003). In general, adult ungulates are an important food in winter, while in summer wolves feed more often on juvenile ungulates and smaller prey, particularly American Beaver (*Castor canadensis*) (Peterson and Ciucci 2003).

Diets of wolves on the mid-coast of B.C. were overwhelmingly comprised of Black-tailed Deer, with a small component of salmon when available, and smaller proportions of various other prey (Darimont and Paquet 2000). On Vancouver Island, deer were also the most common prey item,

followed by Roosevelt Elk and beaver (Scott and Shackleton 1980; Hatter 1988). North Thompson and Columbia Mountains wolf diets were comprised of deer, moose, caribou, and beaver (Stotyn 2007). Scats from den sites in the Peace region contained mostly beaver, with minor components of birds and moose and caribou calves (Culling *et al.* 2006). Few studies from other areas of B.C. have examined diet composition, but anecdotal work and inferences from other jurisdictions (e.g., Alaska; Ballard *et al.* 1987) suggest that moose and caribou are the most common prey items in the north, while deer and elk are most common in the south (Hatler *et al.* 2008).

Social Organization

Wolves are highly social animals and live in packs typically composed of a breeding (i.e., "alpha") pair plus offspring 1–2 years old (Mech 1999; Hatler *et al.* 2008). Pack size appears related to their primary prey; packs that feed on moose are, on average, larger than those that feed on deer (Mech and Boitani 2003; Hatler *et al.* 2008). Wolves will also live on their own from time to time, most commonly when subadults disperse from their natal packs, often during the breeding season following their birth (Peterson *et al.* 1984). Dispersal distances of > 800 km have been reported (Mech and Boitani 2003). Lone wolves typically constitute 10–15% of the population (Minnesota Department of Natural Resources 2001).

Wolves generally are highly territorial and defend their territories against intruders (e.g., Van Ballenberghe *et al.* 1975; Peterson 1977; Ballard *et al.* 1987; Mech and Boitani 2003). Boundaries are relatively stable from year to year. Territories range in size from tens of, to several thousand, square kilometres (Mech and Boitani 2003). In a well-established population, a "territorial mosaic" forms where each pack assorts itself on the landscape according to pack size, prey abundance, and available space (Mech and Boitani 2003). Prey abundance explains about 33% of the variation in territory size, and overall wolf density is related to the biomass of ungulate prey (Fuller *et al.* 2003). Where prey is migratory, wolves generally track the migrations and can establish separate territories in the different seasonal ranges of their prey (Mech and Boitani 2003).

Social disruption through the loss of alpha members can lead to unstable pack dynamics as dominance relationships within and among packs and individuals are re-established. The result can be higher rates of intraspecific strife and "plural breeding" (i.e., mating by non-alpha members of pack; Packard 2003). Pack dynamics are highly complex and shift frequently as individuals age and gain dominance, disperse from, establish or join existing packs, breed and die (Mech 1999). The social and reproductive fates of individuals are based largely on the opportunities presented by these shifting dynamics (Packard 2003).

Reproduction/Demographics

Females reach sexual maturity at age 2, but typically do not breed until 3 years old (Hatler *et al.* 2008). The alpha female usually bears the only litter in a pack, and the proportion of females breeding and the sizes of litters strongly depend on nutrition (Boertje and Stephenson 1982).

Mating occurs in late winter and litters (typically 4–7 pups) are born in dens in April or May after a 63-day gestation period (Hatler *et al.* 2008). Dens are usually excavated burrows, although existing structures such as hollow trees or calves are also used (Trapp *et al.* 2008).

During about the first month following parturition, pups and the lactating female remain in the den while the male defends the den, hunts, and provisions his mate by carrying or regurgitating food (Mech 1999; Packard 2003). After a few weeks the alpha female will begin making forays from the den to hunt, leaving the pups unattended for short periods (Ballard *et al.* 1991).

Pups do not venture far from the den until late summer when they begin moving between "rendezvous sites" (Ballard and Dau 1983). By late fall, pups are nearly full-grown and begin travelling with the pack. Most disperse the following spring as yearlings (Packard 2003; Hatler *et al.* 2008).

Wolf survival is strongly related to prey abundance (Fuller *et al.* 2003). In the absence of human-caused mortality, starvation and intraspecific strife (related to competition for limited prey) are the most important mortality factors (Peterson *et al.* 1998). Wolves rarely live beyond 10 years in the wild (Hatler *et al.* 2008).

3.3.2 Ecological Role

As one of B.C.'s top carnivores, wolves play an important role in structuring predator–prey systems; a system that has challenged researchers and managers throughout the history of modern game management. Wolves typically remove a disproportionate number of young, old and debilitated prey (Kunkel *et al.* 1999, Mech and Peterson 2003), which in turn might lead to more productive prey populations (Mech and Boitani 2003).

Wolves compete for prey and interact with other predators like Cougars (*Puma concolor*; Kunkel *et al.* 1999; Kortello *et al.* 2007) and bears (Rogers and Mech 1981; Hatler *et al.* 2008) and can be an influential limiting factor for prey populations, in particular where wolves are not limited by harvest and where they co-exist with bears (Mech and Peterson 2003). Periods of intensive wolf removal in Alaska and Yukon have resulted in strong, positive but temporary responses in ungulate prey abundance (Gasaway *et al.* 1992; Hayes *et al.* 2003).

Although the effect of changing wolf abundance on ungulate prey has been observed and demonstrated experimentally, there is no scientific consensus on the significance of wolf predation in prey dynamics (Mech and Peterson 2003). This is because the systems are complex and those that have been studied have differed in a number of important characteristics. Some of the factors that affect the relationship between wolf and prey population dynamics include:

1. different prey assemblages and relative abundances;
2. presence and abundance of other predators;
3. extent of human-related effects on both local predators and prey;
4. inherent productivity of habitats to support prey; and
5. snow conditions.

The effects of wolves on ecosystems extend beyond prey populations. For example, the extirpation of wolves and Grizzly Bears (*Ursus arctos*) from Yellowstone Park initiated a "trophic cascade" that resulted in surprising ecosystem changes, ultimately affecting the species richness and nesting abundance of neotropical migrant birds (Berger *et al.* 2001). Similarly, the reintroduction of wolves to Yellowstone and predation on Rocky Mountain Elk (*Cervus canadensis nelson*) resulted in lower elk densities; it also indirectly increased the abundance of plant species such as trembling aspen (*Populus tremuloides*), cottonwood (*Populus* spp.), and willows (*Salix* spp.) (Ripple and Beschta 2003; Ripple *et al.* 2010; Ripple and Beschta 2012).

Another example of the effect of wolves on both prey populations and ecosystems was observed when wolves recolonized the Bow Valley in Banff National Park. Following the return of wolves, elk survival, recruitment, and population density declined, which in turn altered aspen recruitment, willow production, beaver density, and riparian songbird community structure and abundance. These effects were not observed in areas of the Bow Valley where wolves were excluded, largely due to the intensity of human activity (Hebblewhite *et al.* 2005).

There is also evidence that the presence of wolves and other "apex" predators influences the distribution of smaller "mesopredators" such as Coyotes (*Canis latrans*), foxes (*Vulpes* spp.), mustelids, and Raccoons (*Procyon lotor*). "Mesopredator release," where the absence of large predators can allow smaller predators to proliferate, has been identified as an important factor in observed ecological changes throughout the world and in particular in North America, following continent-wide declines in large predators (Prugh *et al.* 2009).

3.3.3 Population Limiting and Regulating Factors

Limiting factors are environmental factors that set the upper limit to population size (Berryman 2004). Population regulating factors are density-dependent phenomena that control population growth rates (Sinclair 1989). The following factors limit and/or regulate the distribution and abundance of wolves in B.C.:

1. Abundance and distribution of ungulate prey – this relationship has been demonstrated throughout the species range (Messier 1994; Fuller *et al.* 2003).
2. Human-caused mortality –this has resulted in regional extirpations (Mech 1995).
3. Space/intraspecific strife – the territoriality of wolves and the resulting intraspecific strife limit populations, even where prey is abundant (Mech and Boitani 2003; Cariappa *et al.* 2011).
4. Disease – the presence of canine parvovirus can significantly affect pup survival (Mech and Goyal 1993) . Mange and lice can affect haircoat quality and general health and kill juveniles or even adults, usually where population densities are high (Hatler *et al.* 2008). Parvovirus outbreaks in B.C. have been reported in both domestic and wild canid populations and may be related (H. Schwantje, pers. comm., 2011). Other viral, parasitic, and bacterial infections are common (Kreeger 2003). Wolves can also contract rabies, which may reduce wolf pack size and potentially limit some populations (Weller *et al.* 1995).

4 THREATS

Threats are defined as the proximate (human) activities or processes that have caused, are causing, or may cause the destruction, degradation, and/or impairment of biodiversity and natural processes. Threats can be past (historical), ongoing, and/or likely to occur in the future. Threats do not include intrinsic biological features of the species or population such as inbreeding depression, small population size, and genetic isolation, which are considered limiting factors.

4.1 Threat Assessment

The threat classification below is based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system and is consistent with methods used by the B.C. Conservation Data Centre and the B.C. Conservation Framework. For a detailed description of the threat classification system, see the CMP website (CMP 2010). For information on how the values are assigned, see Master *et al.* (2009) and table footnotes for details. Threats for wolves were assessed for the entire province (Table 2).

Table 2. Threat classification table for wolf in B.C.

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]
1	Residential & commercial development	Negligible	Negligible	Negligible	High
1.1	Housing & urban areas	Negligible	Negligible	Negligible	High
1.2	Commercial & industrial areas	Negligible	Negligible	Negligible	High
2	Agriculture & aquaculture	Not Calculated	Not Scored	Not Scored	Insignificant/Negligible
2.3	Livestock farming & ranching[e]	Not Calculated	Not Scored	Not Scored	Insignificant/Negligible
3	Energy production & mining	Negligible	Negligible	Negligible	High
3.1	Oil & gas drilling	Not a Threat	Negligible	Neutral or Potential Benefit	High
3.2	Mining & quarrying	Negligible	Negligible	Negligible	High
3.3	Renewable energy	Negligible	Negligible	Negligible	High
4	Transportation & service corridors	Not a Threat	Small	Neutral or Potential Benefit	High
4.1	Roads & railroads	Not a Threat	Pervasive-Large	Neutral or Potential Benefit	High
5	Biological resource use	Low	Pervasive	Slight	High
5.1	Hunting & collecting terrestrial animals	Low	Pervasive	Slight	High
5.3	Logging & wood harvesting	Not a Threat	Large	Neutral or Potential Benefit	High
6	Human intrusions & disturbance	Negligible	Large	Negligible	High

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]
6.1	Recreational activities	Negligible	Large	Negligible	High
7	Natural system modifications	Not a Threat	Small	Neutral or Potential Benefit	High
7.1	Fire & fire suppression	Not a Threat	Small	Neutral or Potential Benefit	High
8	Invasive & other problematic species & genes	Negligible	Small	Negligible	High
8.1	Invasive non-native/alien species	Negligible	Small	Negligible	High
11	Climate change & severe weather	Negligible	Pervasive	Negligible	Low
11.1	Habitat shifting & alteration	Negligible	Pervasive	Negligible	Low

[a] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each stress is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe as it is only considered to be in the past (e.g., timing is insignificant/negligible or low); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

[b] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10 year or 3-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit $\geq$ 0%).

[d] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

[e] Wolves taken as control kills as a result of wildlife conflicts on ranches and farms are included in IUCN-CMP 5.1.

4.2 Description of Threats

The overall province-wide Threat Impact for the wolf is Low.5 There were no threats classified as "Very High", "High", or "Medium" for wolves in British Columbia. The only "Low" threat identified was hunting and collecting terrestrial animals (Table 2). Details are discussed below under the Threat Level 1 headings.

IUCN-CMP Threat 5. Biological resource use

5.1 Hunting & collecting terrestrial animals
Regional harvest by resident hunters, non-resident hunters and trappers remained relatively constant from 1976 to the early 2000's, but has since increased in numerous regions (see Appendix 2). There is also considerable uncertainty in the current take of wolves by resident hunters and trappers as BC does not have a mandatory reporting system. Because of this, the reported estimates in Figure 4 and Appendix 2 are likely minimal estimates and the total harvests could be substantially higher. Without more reliable estimates of the harvest, it is difficult to assess the sustainability of BC's wolf harvest. Improved monitoring on the take of wolves, combined with an assessment of the impact of this take on wolf populations, will likely be required in order for BC to maintain its CITES non-detriment finding for wolves.

Other Factors Considered
Other threats were assessed but it was determined that the severity of the threat would result in less than a 1% reduction of the species' population (e.g., residential and commercial development; energy production and mining; recreational activities; and invasive and other problematic species, which includes hybridization with dogs and diseases and parasites such as canine distemper, parvovirus, and ectoparasites). The threat of agriculture (livestock farming and ranching) is considered negligible because little additional area is being converted. Wolves taken as control kills as a result of wildlife conflicts on ranches and farms are included in ICUN-CMP 5.1 (see above).

While other threats could have localized negative effects, they may also be beneficial. For example, most ungulate prey responds positively to early seral habitats created by forest harvesting. Fire can generate similar habitat benefits. Climate warming is expected to benefit wolves in many areas because ungulate prey is expected to increase as the frequency of severe winters declines (B.C. Ministry of Environment, unpublished data).

Only one threat with a low impact, hunting and collecting terrestrial animals, has been identified for this species. The threat is considered low because of many mitigating characteristics of the B.C. wolf population including:

Wolf range is currently expanding to reoccupy previous range – Wolves have dispersed into areas of B.C. where they were previously considered extirpated as recently as the late 1970s

[5] The overall threat impact was calculated following Master *et al.* (2009) using the number of Level 1 Threats assigned to this species where Timing = High. This includes 1 Low (Table 2). The overall threat considers the cumulative impacts of multiple threats.

(e.g., southern portions of the Kootenay and Thompson regions; B.C. Ministry of Environment 1979) and are expanding into northern U.S. states (Mech 1995; Wiles *et al.* 2011). Indicators suggest that the B.C. population is increasing (see below). The ranges of several of the wolf's most important prey species are expanding, including moose, White-tailed Deer, and elk (B.C. Ministry of Forests, Lands and Natural Resource Operations, unpublished data) and the trend is likely to continue with expected climate warming (although relationships are uncertain; e.g., Post and Stenseth 1999).

Wolves have high population growth rates – Litter sizes average 5 and survival can be high where prey is abundant. As a result annual growth rates for wolves can exceed 50% per year (Fuller *et al.* 2003). In addition, mortality that disrupts pack structure (e.g., the death of an alpha female) can result in "plural breeding," where more than one sub-dominant female bears litters (Packard 2003). Thus, wolves can sustain very high harvest rates (Fuller *et al.* 2003; Hayes *et al.* 2003; Adams *et al.* 2008; Webb *et al.* 2009), although this may impact the natural social structure of family-group units (Haber 1996, Rutledge et al. 2010).

Wolves can disperse large distances – The distribution of wolves in B.C. is unlikely to become fragmented because individuals can disperse hundreds of kilometres (Mech and Boitani 2003) and quickly re-occupy vacant territories, as demonstrated in northeastern B.C. when wolf packs were removed for control purposes (Bergerud and Elliott 1986).

5 MANAGEMENT HISTORY

5.1 First Nations Use

Historical information suggests that First Nations hunted and trapped wolves for fur and ceremonial purposes and wolves figure prominently in First Nations mythology (B.C. Ministry of Environment 1979; Darimont and Paquet 2000; Hatler *et al.* 2008). As such, wolf management may be of interest to a number of First Nation communities in B.C. Perspectives on wolf management vary among First Nations as they do among other stakeholders and the general public. Those First Nations whose traditional territories overlap areas of proposed wolf management and who have an asserted aboriginal right to hunt wolves will be consulted before any decisions being made or action taking place.

5.2 Early Management

Early records of fur sales in B.C. exist but trapping and hunting data were not recorded separately (B.C. Ministry of Environment 1979; Figure 2).

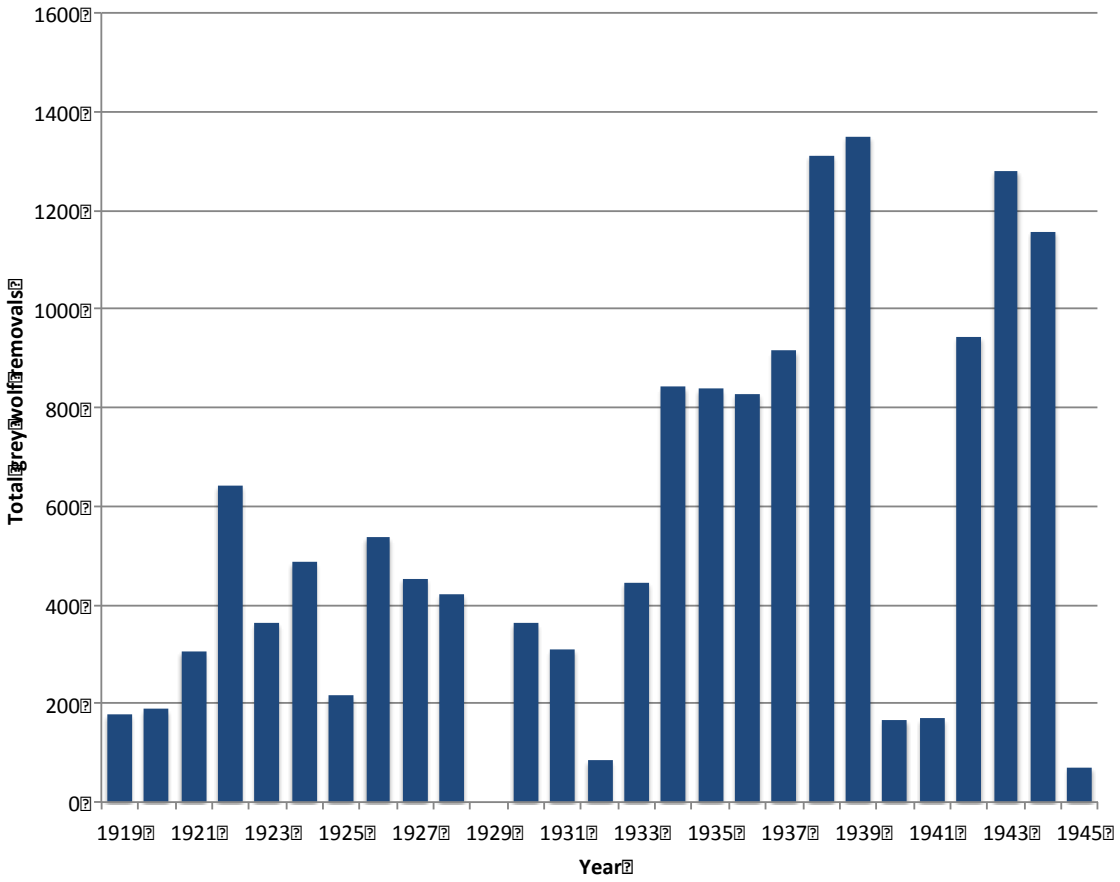

Figure 2. Available data on fur sales of wolf pelts, 1919–1945 (B.C. Ministry of Environment 1979).

Management of wolves began before 1907 with the introduction of a bounty (B.C. Ministry of Environment 1979). Bounties were in place (except 1932–1933) until 1955 (Figure 3). It is unclear how independent these data are from fur sales. Wolves were also taken for control purposes, both during the existence of the Predator Control Branch between 1947 and 1963, but also before and after this period under other government programs (B.C. Ministry of Environment 1979).

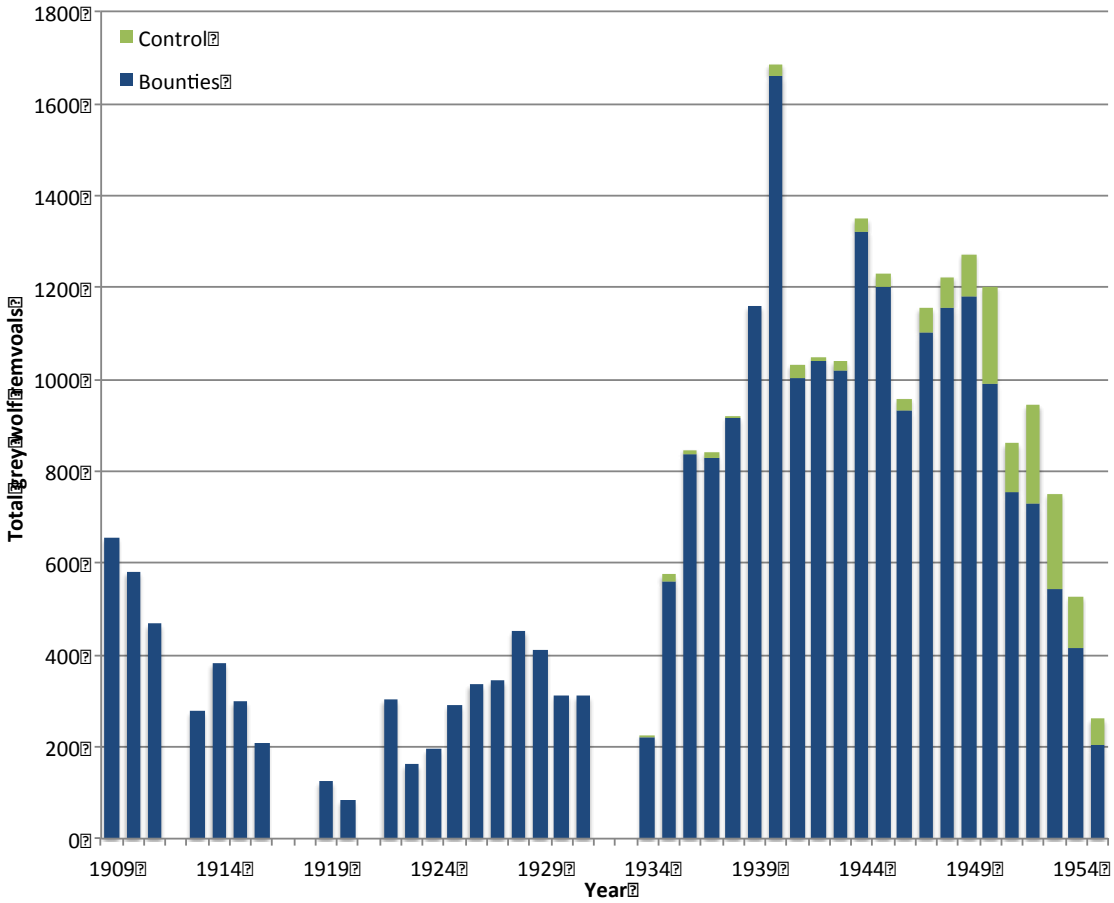

Figure 3. Available data on wolves removed under British Columbia's bounty and predator control programs. Bounties began before 1909 and ended in 1955. The bounty program was suspended during 1932–1933. Predator control continued after 1955 but data on removals are not available.

Beginning in 1950, baits laced with cyanide, strychnine, and sodium monofluoroacetate were used at bait stations and later air dropped onto frozen lakes and rivers. Poisoning was considered to be very effective in reducing wolf populations, but also caused mortality of non-target wildlife species. Large-scale poisoning in wilderness areas was suspended in 1961 but baiting continued in areas with livestock and in some heavily hunted areas. Targeted baiting as a response to livestock conflicts ended in 1999.

The 1979 draft wolf management plan (B.C. Ministry of Environment 1979) stated that predator control activities (bounties and government-sanctioned wolf poisoning) resulted in a decline in the provincial wolf population, which reached a minimum in the late 1950s. The population appeared to start increasing after bounties were removed in 1955 and when poisoning in wilderness areas ended in 1961.

5.3 Recent Management

Hunting and Trapping
Management of wolves as a game species began in 1966. The first outcome of this major policy change was the closure of wolf seasons on Vancouver Island and in the Kootenay region in 1968 due to conservation concerns (B.C. Ministry of Environment 1979). The wolf was declared a furbearer (i.e., a species with a commercially valuable hide on which royalties are paid to the Crown) in 1976. By 1977, the wolf population had recovered on Vancouver Island to the point that a hunting season was reopened.

In 1982, the provincial government initiated an experimental wolf control program in the Nimpkish Valley on northern Vancouver Island in an attempt to recover a declining Black-tailed Deer population (Hatter 1988; Atkinson and Janz 1994; Hatter and Janz 1994). Wolf control was also conducted in the Kechika and Muskwa areas during the late 1970s and early 1980s in response to declining ungulate populations (Bergerud and Elliot 1986, 1998). Government-sanctioned wolf control activities ceased in the 1990s, although undocumented efforts to remove wolves through non-government incentives involving hunting and trapping have continued in some regions.

Recent harvest regulations have been liberal and are assumed to have not limited hunter harvest opportunities because relatively few hunters have an interest in hunting wolves. Several non-government organizations have been providing incentives to increase the harvest of wolves.

Damage Prevention and Control
In 2003, the agricultural sector established a predator removal program designed to prevent and to respond to livestock depredation complaints. The number of wolves removed under this program was relatively small (see Section 5.6 Recent Harvest Trends; Figure 4). The program was most recently administered by the B.C. Agricultural Research and Development Corporation, in cooperation with the B.C. Sheep Producers, the B.C. Cattlemen's Association, the B.C. Ministry of Environment, and the B.C. Ministry of Agriculture and Lands. Field services to remove predators were provided to landowners where predator conflicts with livestock could be verified. As a result of discussions with stakeholders and the B.C. Ministry of Environment on how to manage mitigation of livestock predation, the Conservation Officer Service (COS) made a commitment to coordinate responses to suspected predator attacks on livestock. Since 2011, the COS has been working closely with livestock owners to mitigate livestock predation and is committed to continuing that partnership.

Management of Species at Risk
Attempting to control wolves to reduce predation risk on endangered caribou has been a provincial priority since 2001 with the initiation of a pilot reduction program in the Cariboo region (Roorda and Wright 2004, 2007, 2010). Wolf reduction occurred through removals and sterilization of dominant pairs. Wolf densities were reduced; however, a correlation between reduced wolf densities and caribou recovery could not be substantiated.

The provincial government hired trappers to remove wolves from within, and adjacent to, endangered caribou range in the Kootenay region. Although some wolves were removed, most caribou herds continued to decline (C. Ritchie, pers. comm., 2011). The rationale for the wolf removal is based on the hypothesis that increasing populations of moose and deer within caribou habitat have resulted in higher wolf populations that have incidentally increased predation pressure on caribou (Mountain Caribou Science Team 2005; Wittmer *et al.* 2005).

5.4 Harvest Data Collection and Analysis

Data on wolf harvest since 1976 have been collected from various sources. Resident hunter harvest is estimated from annual surveys that are mailed to approximately 20% of hunters who bought a license. The number of hunters reporting hunting wolves and the number reporting harvesting wolves are extrapolated to the entire population of hunters to estimate annual harvest. While this approach may produce an unbiased estimate, it is not efficient and precision levels (measured by 95% CI's) are low, especially at the WMU or Regional level.

Hunters are also likely to under-report the number of days they hunted wolves because the harvest is often opportunistic – hunters will take a wolf when encountered, often when hunting for other game, but rarely do they hunt wolves exclusively. This renders hunter effort and success statistics suspect but does not inflate harvest estimates.

Some regions have compulsory reporting programs, where anyone harvesting a wolf for any reason must report the harvest to the relevant regional office. Hunter sample survey estimates are considerably higher than the wolf harvest reported through compulsory reporting. Although some wolves are likely harvested but not documented through compulsory reporting, it is not known to what degree this discrepancy between the two reporting systems is due to non-compliance with compulsory reporting, or low accuracy and precision with wolf hunter sample estimates.

Hunting effort and success data by non-resident hunters have been collected since 1981. Data are provided annually by licensed guide-outfitters. Non-resident harvest data are provided through guide declarations, which indicate the total harvest of wolves by non-residents.

5.5 Indicators of Population Change

Changes in population can be indexed by changes in harvest, although there are confounding factors (e.g., opportunity and motivation for hunting, economics for trapping). Records of resident harvest began in 1976 and harvest was variable but without an apparent trend until it began increasing in 2005 (Figure 4). The increase has been most apparent in Region 3 (Thompson), Region 4 (Kootenays), Region 5 (Cariboo), and Region 7b (Peace; Appendix 2). Non-resident harvest has been increasing since records began in 1981 ($y = 1.9x + 28.0$, $r^2 = 0.69$; $n = 30$).

Figure 4. Total reported wolf removals in British Columbia during 1976–2010. Data for trapping and livestock depredation/predator control programs were not available before 1985.

Trapping harvest has increased since records became available in 1985 ($y = 4.0x + 79.2$, $r^2 = 0.36$; $n = 26$). There was a large increase in trapping harvest in 2009 and again in 2010, but an upward trend was evident before these years ($y = 2.9x + 88.8$; $r^2 = 0.24$; $n = 24$).

Livestock depredation and control programs have been inconsistent since the 1970s, and wolf removals from these programs do not show any apparent trends.

Other indicators of population change are more anecdotal. Interviews with Ministry biologists in 2011 indicated a general belief that the wolf population was increasing or stable in all regions. On Vancouver Island, the wolf population is likely lower now than in the 1980s and 1990s, but is considered to be currently stable (K. Brunt, pers. comm., 2011). First Nations, licensed hunters, and guide outfitters in several regions have reported increasing sightings of wolves in the B.C. Interior, and are concerned about their impact on moose abundance. Livestock producers in the Cariboo and Peace are also reporting more wolf activity.

6 MANAGEMENT GOAL AND OBJECTIVES

6.1 Management Goal

The goal of wolf management in B.C. is to ensure a self-sustaining population throughout the species' range and to ensure that, within the biological limits of the species, wolves are available in sufficient abundance to fulfill their ecological role, and to meet the cultural, recreational, and economic needs of society.

6.2 Management Objectives

Further, the objectives of wolf management are:

1. to ensure a self-sustaining population throughout the species' range that fulfills the role of wolves as a top predator in B.C.'s diverse ecosystems;
2. to provide opportunities for economic, cultural, and recreational use of wolves consistent with Ministry program plans;
3. to minimize impacts on livestock caused by wolves in a manner that does not jeopardize conservation objectives; and
4. to manage specific packs or individuals where predation is likely preventing the recovery of wildlife populations threatened by wolf predation.

7 CURRENT MANAGEMENT FRAMEWORK

Overall, wolf management in B.C. is characterized by a two-zone management strategy. In areas where livestock depredation or wildlife populations threatened by wolf predation are a concern, wolf management includes lengthy open seasons and/or no bag limits, and in some cases targeted removal of individuals. Elsewhere, wolf management is primarily concerned with ensuring that wolves continue to serve their ecological role as a top predator. This is accomplished through sustainable hunting and trapping seasons with specified season lengths, as well as bag limits and protected areas where hunting and trapping are prohibited.

This two-zone management strategy concept is embedded in the Wildlife Society technical review document, titled "Management of Large Mammalian Carnivores in North America" (Peek *et al.* 2012, p. 63). Specifically, the authors state:

> Predators commonly occur in multiple-use areas that emphasize management of natural resources and allow extensive human activity. These predators should be managed at levels that ensure their retention on the landscape at levels that are compatible with other land uses…In places where human presence and impact is minimized, wildlife populations of all species should be allowed to fluctuate with as little anthropogenic interference as possible. This does not mean that hunting and trapping should be prohibited, but rather that they are pursued at levels that do not unduly influence wildlife.

7.1 Hunting and Trapping

Sustainable harvest is considered a legitimate use of B.C.'s wolf population and regulations are developed in the context of several policy principles,[6] some of which include:

- Hunting regulations should maximize a variety of opportunities within the constraints of conservation;
- Regulations should be easy to interpret, and be stable, effective, and enforceable;
- Ethics such as fair chase and humane treatment are recognized;
- Population viability or genetic variability will not be compromised by harvest activities; and
- Interests of First Nations and stakeholders are recognized and considered in harvest management decisions.

7.1.1 Harvest Management

Wolves are managed as a game species in B.C. and there are hunting and trapping seasons in all regions (Table 3). Allowable harvests are determined using the same methods that are applied to manage other large carnivore species in B.C.; specifically, past harvest data and other available information related to the status of populations are used.

Wolf hunting seasons are generally closed in summer but open for most of fall through spring. Bag limits are either 2 or 3, except in specific management units (MUs) where there are no bag limits in an attempt to reduce predation on livestock or caribou (see Appendix 2 for details). Hunting of wolves is prohibited in national parks and some provincial parks.

There is no species license required for residents to hunt wolves. There are no age or sex restrictions because neither can be identified reliably in the field. Limited Entry Hunting (LEH) has not been considered for wolves because harvest pressure is generally low; rather, seasons have been closed where conservation has been a concern.

Wolves are classified as Class 3 furbearers, which are not considered sensitive to harvest. Trapping seasons start in the fall and end in the spring. Opening and closing dates vary by management region (Table 3).

[6] Big Game Harvest Management policy (4-7-01.07 March 2010).

Table 3. Harvest regulations by region 2012.

Region [a]	Trapping season	Hunting season	Hunting bag limit	Exceptions
1	Nov 01 – Jun 30	Sep 10 – Jun 15	3	Compulsory reporting program
2	Sep 10 – Jun 15	Sep 10 – Jun 15	3	
3	Oct 15 – Mar 31	Sep 10 – Jun 15	3	No bag limit and hunting season opens Aug 1 in the northwest (for caribou recovery), MUs 3-34 to 3-44.
4	Oct 15 – Mar 31	Sep 10 – Jun 15	2	No closed season in Rocky Mountain trench below 1100 m (for livestock protection). No bag limit and hunting season opens Sept 1 in MUs adjacent to caribou habitat (4-5 to 4-8, 4-17, 4-18, 4-20, 4-27 to 4-31, 4-33, 4-37 to 4-40).
5	Oct 15 – Mar 31	Aug 01 – Jun 15	3	In MU 5-10 and 5-11 (Tweedsmuir Park) hunting season is Sep 01 – Mar 31. In MUs 5-1 to 5-6 and 5-12 to 5-15 there is no closed hunting season and no bag limit.[b] (for caribou recovery) In MUs 5-1 to 5-6 and 5-12 to 5-14 there is no closed season for trapping but from Apr 1 – Oct 14 trapping permitted on private land only and only with modified leg-hold traps.[b]
6	Oct 15 – Mar 31	Aug 01 – Jun 15	3	Hunting season shorter in Tweedsmuir Park (Sept 1 to Mar 31).
7a	Oct 15 – May 31	Aug 01 – Jun 15	No bag limit	
7b	Oct 15 – May 31	Aug 01 – Jun 15	3	No closed season below 1100 m (livestock protection).
8	Oct 15 – Mar 31[c]	Sep 10 – Jun 15[c]	3	

[a] See Figure 1 for region boundaries.
[b] Protection for livestock production areas (MUs 5-1 to 5-6 and 5-12 to 5-15) and caribou recovery areas (MUs 5-2 and 5-15).
[c] Season opened in 2012, previously no season.

7.1.2 Harvest Data Capture, Summary, and Analysis

Data on hunter effort and success are collected via questionnaires, which are mailed to a subsample of licensed hunters each year. These data are summarized and made available to Ministry biologists to inform regulatory reviews and adjustments. There are also compulsory reporting programs in Regions 1 and 4. Harvest by trappers has been taken from royalty payments and represents the minimum number of wolves trapped, as not all wolf pelts may be sold.

7.1.3 Resident / Non-Resident Allocation

In general, wolves are abundant and are not a species in demand by either resident or non-resident hunters. Thus there is currently no need to apply the provincial current harvest allocation policy.

7.2 Damage Prevention and Control

Wolf predation on livestock is a growing concern, especially within agricultural areas of the Cariboo and Peace regions. Ranchers, First Nations, hunters, guide outfitters, and local citizens have requested more liberalized wolf hunting and trapping seasons to address these concerns. Regulations were adjusted in 2011 in areas of the Cariboo. However, as hunting pressure is generally limited by interest and trapping is limited by economics, these management techniques are unlikely to fully address the concerns of livestock producers.

The impact of predators can be mitigated in part through husbandry practices. The Conservation Officer Service promotes good livestock husbandry and other preventative measures, and encourages non-lethal control.[7]

The B.C. government supports the control of wolves where they pose a significant risk to livestock. The Wild Predator Loss Prevention Pilot Project operated by the B.C. Agricultural Research and Development Corporation ended in 2011 and the Conservation Officer Service resumed responsibility for livestock–predator conflict response. The Province is investigating ways to enable landowners to assume a greater responsibility for managing predator issues. The Conservation Officer Service will be partnering with all stakeholders that have an interest in this issue, including local livestock producers and producer groups, industry, the B.C. Ministry of Agriculture, the BC Wildlife Federation, the BC Guide Outfitters Association, the BC Trappers Association, and local hunters and trappers, on coordinating monitoring, verification, mitigation, compensation, and outreach efforts for livestock–predator conflicts (M. Badry, pers. comm., 2011).

Landowners who encounter wolves that are harassing livestock can hunt or trap the wolves on their property. Any wolves killed or injured must be reported and remain the property of the Crown. Landowners can also permit others to hunt or trap on their property if there is an open hunting season, and permits can be sought from the Province if the season is closed.

7.3 Management of Wildlife Threatened by Wolf Predation

As top predators, wolves have the potential to be a significant conservation threat to some species of wildlife, such as caribou (Bergerud 2006), and can reduce other wildlife species, such as moose, to very low densities (Gasaway *et al.* 1992). The broader scientific community generally accepts that predation by wolves is the most important proximate factor limiting caribou recovery across Canada (e.g., Environment Canada 2012). The ultimate reason that caribou have declined is likely habitat fragmentation and loss, but proximate factors such as predation continue to limit population recovery even where suitable habitat is extensive and secure, relative to the size of the caribou herd (Mountain Caribou Science Team 2005; Wittmer, McLellan, Seip *et al.* 2005; Wittmer, McLellan, Serrouya *et al.* 2007).

Despite the implementation of extension habitat protections, snowmobiling closures and operating practices for commercial backcountry recreation throughout southeastern and central

[7] See http://www.env.gov.bc.ca/cos/info/wildlife_human_interaction/docs/wolves.html.

B.C., many Mountain Caribou herds are continuing to decline. The Mountain Caribou Science Team has suggested that additional actions would be of limited value without addressing the issue of predation on the most critically endangered herds (C. Ritchie, pers. comm., 2013).

Peek *et al.* (2012) stated that "isolated caribou populations along their southern range (in British Columbia, Washington, and Idaho) where habitat fragmentation is occurring (and wolf populations are increasing) represent another situation where predator management is appropriate if these (caribou) populations are to be maintained."

To date, B.C.'s wolf management actions have not been successful in meeting Mountain Caribou recovery objectives. A recent review by the Mountain Caribou Science Team indicated that current predator control efforts were not sufficiently intense to be effective, and that an aerial reduction program for wolves that threaten caribou herds of fewer than 50 animals should be implemented (B.C. Ministry of Environment 2009).

To support predator control a well-designed, science-based analysis of predation pressure should be completed (Peek *et al.* 2012). The Mountain Caribou Recovery Implementation Program (MCRIP)[8] provides numerous information sources that summarize the predator–prey planning component for Mountain Caribou recovery. The MCRIP has also funded both wolf inventory and radio-telemetry studies to provide more precise information on wolf numbers within Mountain Caribou recovery areas (e.g., studies indicated there were approximately 260 wolves occupying the range of Mountain Caribou in 2008) (C. Ritchie, pers. comm., 2008)

Experience in other jurisdictions indicates that reducing wolves can benefit caribou and other ungulate populations, if the reductions are intense (e.g., 80%) and of sufficient duration (> 5 years). When reductions cease, wolf populations and predation rates quickly recover (e.g., Hayes *et al.* 2003). As a result, wolf removal should be viewed as an interim measure to forestall extirpation of caribou or other wildlife populations threatened by wolf predation while ecological conditions improve (Environment Canada 2012).

7.4 No Reduction of Wolves to Enhance Ungulate Populations for Hunting

In the 1980s, B.C. abandoned predator control programs aimed at increasing populations of game species and current policy does not support predator control for the purpose of enhancing ungulate populations for hunting.

7.5 Research

7.5.1 Research Summary

Research on wolves in B.C. has largely been limited to studying the response of wolves to direct control or to related changes to the predator–prey system. These include:

[8] See http://www.env.gov.bc.ca/wld/speciesconservation/mc/index.html.

- response of wolves and Black-tailed Deer to wolf reductions in the Nimpkish Valley on Vancouver Island (Atkinson and Janz 1994; Hatter and Janz 1994);
- response of ungulates and wolves to wolf reduction in the Kechika and Muskwa, northern B.C. (Bergerud and Elliot 1986, 1998);
- response of wolves and caribou to wolf reduction and sterilization in the Quesnel Highland (Hayes 2013);
- response of wolves and moose to wolf pack sterilization in the Kechika (J. Elliott, unpublished data);
- demography of Mountain Caribou in relation to changes and manipulations of predator–prey systems in the north Columbia Mountains (Serrouya 2013);
- in-progress study on the causes and magnitude of northern caribou mortality in relation to wolf and moose population dynamics in the Parsnip (D. Heard, pers. comm., 2011); and
- wolf population density associated with caribou herds within north-central B.C. (McNay *et al.* 2009).

Other notable studies conducted in B.C. include:

- study of food habits of Vancouver Island wolves (Scott and Shackleton 1980);
- study of the effects of wolf predation on recruitment of Black-tailed Deer on northern Vancouver Island (Hatter 1988); and
- ecology of central coast wolves (Darimont and Paquet 2000).

7.5.2 Knowledge Gaps

The role of wolves in the dynamics of B.C.'s multi-predator, multi-prey systems remains the most significant knowledge gap. These predator–prey systems are characterized by complex dynamics between and among predator and prey species, with resultant time lags, stochastic events, and changing local conditions, which makes generalizations difficult. Although research in B.C. and other jurisdictions will continue, management actions are required despite significant gaps in our knowledge. In this context, an adaptive management approach is most appropriate, where actions are conducted as experiments, outcomes are monitored, and policies and procedures are updated using the best available information.

Estimating population size will continue to be a challenge because wolves are secretive, range over large areas, and live primarily in forested habitats. However, accurate population estimates are not a requirement for management planning or to decide on conservation actions (Boitani 2003). Various indicators can be used to estimate trends in abundance and distribution sufficiently to meet most management needs. In some cases these data are being collected but are not centrally accessible and analyzed routinely. In other cases, such as the characterization of resident hunting and trapping of wolves, data collection and/or analyses need to be refined to generate more accurate estimates.

8 MANAGEMENT SYNTHESIS

A number of key conclusions can be drawn from the foregoing review of wolf ecology, as well as the outcomes of wildlife management in B.C. and other jurisdictions.

8.1 Wolf Populations Are Stable or Increasing

Methods to estimate the provincial wolf population have varied over time and no trend is evident from these estimates. However, the B.C. wolf population is likely stable to increasing, given the reoccupation of previous range, evidence of increasing harvest among trappers and hunters, feedback from First Nations and stakeholders, and observational reports by Ministry staff and the general public. There is no contrary evidence of a currently declining population or of a significant conservation threat.

Proportionately, most of the increase in the wolf population has occurred in the Southern Interior and densities there are still likely well below those in the north, where available evidence suggests that the population is stable or increasing in some areas.

8.2 Wolf Harvest Is Increasing

The number of wolves being harvested is higher (particularly in 2009 and 2010) than at any time since hunting records began in 1976. Trapping and non-resident harvest have generally been increasing since the 1980s. Resident hunter harvest has been increasing since 2005, although regional trends have been variable.

Three factors could be leading to this increase:

1. More wolves – wolf hunting is considered opportunistic, and harvest will increase when the population is higher because hunters are encountering wolves more often, although the recent significant increase in some regional harvests could not be explained by a population increase alone;
2. Higher bag limits – seasons have been liberalized in several areas and hunters may be responding by harvesting more wolves, although this is likely a minor factor because bag limits are not usually considered limiting; and/or
3. More motivated and/or efficient hunters and trappers – various incentives and informal campaigns in parts of B.C. have promoted the hunting and trapping of wolves. These programs may be having some effect. Without a separate species licence for wolves, it is difficult to identify trends in hunter interest.

8.3 Pressure to Reduce Wolves to Protect Livestock and Wildlife Threatened by Wolf Predation

As wolf abundance increases and range expands, there will be continuing pressure to reduce wolves in some parts of the province due to concerns regarding livestock depredation, the status and trend of caribou populations, and declining populations of other wildlife species.

Given the biology of wolves and their current population size and trend, efforts to mitigate livestock losses and to benefit other wildlife can be accommodated within wolf conservation goals. The question is how to deliver these programs most efficiently, humanely, and effectively. Resourcing and balancing public and private responsibility will continue to be issues.

8.4 Wolf Populations Respond Primarily to Prey Abundance and Distribution

Wolf populations can withstand high rates of exploitation (Fuller *et al.* 2003; Hayes *et al.* 2003, Adams *et al.* 2008). B.C. has few hunters relative to its size, and although some hunters will harvest wolves when encountered, most are disinterested. Trapping wolves is difficult and generally not economical. For these reasons, hunting and trapping management is not considered a primary driver of wolf population size or distribution in B.C. At large spatial and temporal scales, wolf numbers respond primarily to prey abundance and distribution. That is not to say that sufficient effort cannot substantially reduce or eradicate wolves over large areas, but historically this level of effort was associated with bounties, poisoning, or other intensive measures.

If effective efforts are implemented to remove wolves to benefit livestock producers or other wildlife populations threatened by wolf predation, there will be localized population declines; however, wolves will rebound quickly when measures are removed, if sufficient prey is available.

9 FUTURE MANAGEMENT

The likelihood that there are currently any substantial conservation concerns with the B.C. wolf population is low. The suspension of widespread control efforts and the resilience of the species have resulted in reoccupation of former range and a higher population in many parts of the province. The distribution of human settlement in B.C., the general disinterest in hunting wolves, and the adaptability of the species suggest that the majority of B.C.'s wolf population will be lightly harvested and will continue to contribute to the structure and functioning of the province's predator–prey system. Few additional management actions are required to mitigate conservation risks in the short term (see Recommended Management Actions); however, ongoing monitoring is required to ensure that risks remain low.

Recolonizing wolf populations in parts of south-central B.C. is creating concerns among livestock producers who may suffer higher economic losses as a result, hunters who are concerned with declines in big game species, and among many conservation biologists who believe that wolf predation is preventing the recovery of some caribou populations that have been weakened by other factors. As a result, the emphasis of short-term management will necessarily focus on mitigating risks associated with this expanding wolf population. These actions need to be constrained to areas as small as practicable to minimize conservation risks to the broader wolf population and unintended ecological consequences (e.g. trophic cascades; Berger *et al.* 2001; Ripple and Beschta 2012; Hebblewhite *et al.* 2005). However, trade-offs are inevitable and consequences of both action and inaction must be weighed carefully (Prugh *et al.* 2009).

Actions also need to be aligned with public expectations, although this is challenging given the polarized nature of the wolf management debate (Hoffos 1987). Under these circumstances, the most prudent approach is to be as transparent as possible regarding management decisions and to

ensure that outcomes are monitored, management results are assessed objectively, and actions adjusted accordingly.

9.1 Summary of Current Management Tools

The wolf's unique ecology and its desirability as a hunted or trapped species limit the management tools that can be used effectively to manage populations (Table 4).

Table 4. Summary of current management tools, advantages, and disadvantages, as well as estimated effectiveness in relation to wolves in B.C.

Management tools	Advantages	Disadvantages	Effectiveness	Comments
Length of hunting and trapping seasons	• Simple to implement • Enforceable • No additional resources required	• Limits opportunity	Low: Hunting and trapping success is more correlated with motivation and opportunity than to season length.	Seasons are very long throughout B.C.
Bag limit	• Simple to implement • Enforceable • No additional resources required	• Limits opportunity	Low: Only a small proportion of hunters are limited by bag limits each year.	Bag limit is 2–3, or no bag limit in specific areas.
Public campaigns	• Simple to implement	• Program costs and financial incentives required	Moderate: Motivation seems to be an important factor determining wolf harvest.	
Direct removal of individuals or packs	• Focussed management effort	• Requires permit outside hunting or trapping season	Moderate: Affects packs more than affects populations, effectiveness determined by intensity of effort.	Removal of some individuals within a pack can fragment packs and lead to high natality.
Harassment	• Non-lethal	• Labour-intensive and can be expensive	Low: Effects limited and temporary.	Various techniques have been developed for agricultural producers.
Reduction of ungulate prey	• Long-term solution	• Reduces ungulate hunting opportunities • Uncertain outcomes and benefits not realized for many years • Required over a very large area.	Moderate: Wolf populations are ultimately governed by abundance of ungulate prey	Effectiveness may be high, but more pilot studies are required.

9.2 Recommended Management Actions

The following are recommendations arising from the development of this management plan:

1. Improve the accuracy and precision of provincial and regional wolf population assessments by:
    a. centralizing the warehousing of harvest, animal control, compulsory reporting, sightings, and other data to enable more effective and efficient analysis of available data;
    b. exploring alternatives to compulsory reporting programs that might generate more reliable estimates of resident harvest;
    c. assessing the utility of a low cost or free species license for wolves, or other approaches to improve the accuracy and precision of hunter survey-based wolf harvest estimates;
    d. assessing other approaches, in addition to fur royalties, to improve the accuracy of trapper-based wolf harvest estimates; and
    e. monitoring research and inventory activities in B.C. and elsewhere to refine density estimates and other indicators of wolf population size and trend.
2. Consider a more structured approach to decision-making by formalizing a set of indicators and benchmarks to measure outcomes against objectives and trigger management change.
3. Review within 5 years the estimated effect of removing bag limits in certain management units on wolf harvest levels, population trends, and benefits to livestock production or caribou populations.
4. Clarify the responsibility for livestock damage prevention and control through a policy or strategy that articulates the roles and responsibilities of landowners, the Conservation Officer Service, and relevant agencies in delivering actions aimed at reducing conflicts.
5. Use the government website and other extension mechanisms to provide more comprehensive information to livestock owners regarding best practices to minimize depredation losses.
6. Formally articulate a two-zone management strategy in B.C. that recognizes the primacy of livestock depredation and recovery objectives for wildlife populations threatened by wolf predation while managing wolves elsewhere in the province primarily to maintain naturally regulated predator–prey systems.
7. Review and consider broadening BC's current policy on "Control of Species" to include the option of wolf control for wildlife populations threatened by wolf predation.

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APPENDIX 1. CITES non-detriment finding

Non-Detriment Finding (NDF): Export of legally obtained harvested Grey Wolf is considered non-detrimental.

Scope for this NDF: Grey Wolf (*Canis lupus*) specimens and parts from legally hunted and trapped wolves in British Columbia, including wolves killed in wildlife conflict situations. This NDF does not extend to wolf specimens obtained in any other manner.

Risk Analysis: The species was considered to be at low risk in 2011. The threats assessment was updated in 2014 and the species is now considered to be at low to medium risk. The provincial population is large and expanding, and the species is recolonizing areas where it had been extirpated. The species is relatively fecund and the breeding system allows for rapid expansion when conditions are favourable. Prey base in the province is considered robust, and is mostly stable to increasing. There is high rescue potential from adjacent jurisdictions. However, there is concern that the wolf take from incentive programs is largely unknown, but potentially considerable in some areas of the province. Increased management effort on reporting of take and improved monitoring of the population may be required in the near future to confirm the current risk analysis. This NDF is consistent with the NDF developed for Grey Wolf in Canada.[9]

The threats analysis was conducted in 2011, revised in 2014, and is included in the management plan for Grey Wolf.

Table A1. CITES checklist to assist non-detriment findings (Rosser and Haywood 2002), with an assessment for Grey Wolf in B.C.

Evaluation question	Estimate for Grey Wolf
2.1 Life history: What is the species' life history?	High reproductive rate, long-lived
2.2 Ecological adaptability: To what extent is the species adaptable (habitat, diet, environmental tolerance, etc.)?	Generalist
2.3 Dispersal efficiency: How efficient is the species' dispersal mechanism at key life stages?	Very good
2.4 Interaction with humans: Is the species tolerant to human activity other than harvest?	Tolerant
2.5 National distribution: How is the species distributed nationally?	Widespread, contiguous
2.6 National abundance: What is the abundance nationally?	Common
2.7 National population trend: What is the recent national population trend?	Increasing
2.8 Quality of information: What type of information is available to describe abundance and trend in the national population?	Quantitative data, recent
2.9 Major threats: What major threat is the species facing and how severe is it?	Limited/reversible
2.10 Illegal off-take or trade: How significant is the national problem of illegal or unmanaged off-take	Small

[9] See http://www.ec.gc.ca/cites/default.asp?lang=En&n=BB314F25-1.

Evaluation question	Estimate for Grey Wolf
or trade?	
2.11 Management history: What is the history of harvest?	Managed harvest: ongoing with adaptive framework
2.12 Management plan or equivalent: Is there a management plan related to the harvest of the species?	Approved provincial management plan (this document)
2.13 Aim of harvest regime in management planning: What is harvest aiming to achieve?	Population management/control
2.14 Quotas: Is the harvest based on a system of quotas?	Market-driven quota(s), arbitrary quota(s), or no quotas
2.15 Harvesting in Protected Areas: What percentage of the legal national harvest occurs in State-controlled Protected Areas?	Low
2.16 Harvesting in areas with strong resource tenure or ownership: What percentage of the legal national harvest occurs outside Protected Areas, in areas with strong local control over resource use?	High
2.17 Harvesting in areas with open access: What percentage of the legal national harvest occurs in areas where there is no strong local control, giving de facto or actual open access?	None
2.18 Confidence in harvest management: Do budgetary and other factors allow effective implementation of management plan(s) and harvest controls?	Medium confidence
2.19 Harvest trend to date: decreasing, stable, or increasing?	Increasing
2.20 Likelihood of change: What is the likelihood that the harvesting trend will change within the near future? Indicate likely direction of change (increase or decrease).	Low
2.21 Quality of information: What type of information is available to determine the harvest trend to date and the likelihood of change in harvesting trend?	Quantitative data, long-term
2.22 Methods used to monitor the harvest: What is the principal method used to monitor the effects of the harvest?	Quantitative indices
2.23 Monitoring frequency: Has baseline data been collected and how frequently has monitoring occurred?	Annually
2.24 Confidence in harvest monitoring: Do budgetary and other factors allow effective harvest monitoring?	Medium confidence
2.25 Utilization compared to other threats: What is the effect of the harvest when taken together with the major threat that has been identified for this species?	Neutral
2.26 Incentives for species conservation: How much conservation benefit to this species accrues from harvesting?	Medium
2.27 Incentives for habitat conservation: How much habitat conservation benefit is derived from harvesting?	None

Evaluation question	Estimate for Grey Wolf
2.28. Proportion strictly protected: What percentage of the species' natural range or population is legally excluded from harvest?	5–15%
2.29 Effectiveness of strict protection measures: Do budgetary and other factors give confidence in the effectiveness of measures taken to afford strict protection?	High confidence
2.30 Regulation of harvest effort: How effective are any restrictions on harvesting (such as age or size, season or equipment) for preventing overuse?	Effective

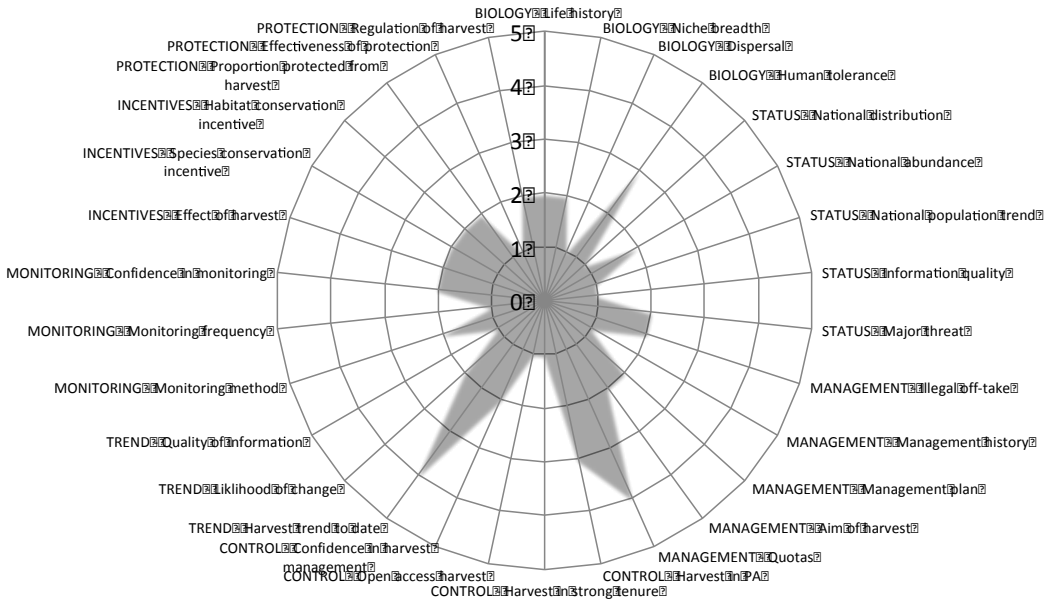

Figure A1. Radar plot of the factors affecting a CITES non-detriment finding assessment for Grey Wolf. Higher numbers represent areas that need to be considered in non-detriment findings.

David F. Fraser, Scientific Authority for CITES,
Province of British Columbia
October 6, 2011

APPENDIX 2. Harvest regulations and harvest data by region

This section presents harvest (trapping and hunting) data by region (see Figure 1 for region boundaries). Season dates for hunting and trapping, and bag limits for hunting are from the 2012-2014 Hunting and Trapping Regulations Synopsis. Note control and livestock depredation data are available only at a provincial scale and are found in Section 5.5.

Region 1 Vancouver Island

Wolf hunting is allowed in all management units in Region 1 from 10 September to 15 June, with a bag limit of 3. Trapping is allowed from 1 November to 30 June. There is a compulsory reporting program in place.

Harvest in recent years has been very low compared to the 1980s and late 1990s (Figure A1). Regional records suggest a much lower harvest by residents and, therefore, a lower harvest overall (K. Brunt, pers. comm., 2011).

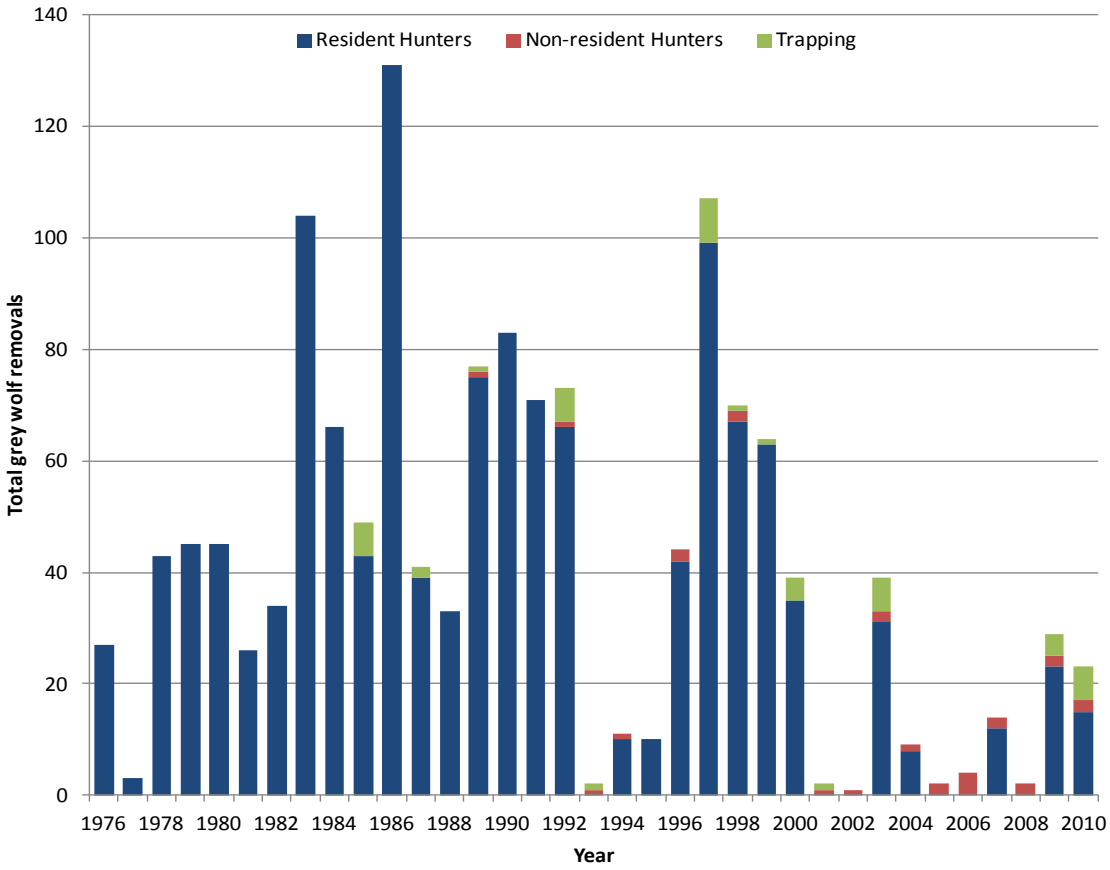

Figure A1. Reported harvest of wolves in Region 1 (Vancouver Island), 1976–2010. Non-resident harvest data were not available for 1976–1980. Trapping data were not available for 1976–1984.

Region 2 Lower Mainland

Wolf hunting is allowed in most management units in Region 2 from 10 September to 15 June, with a bag limit of 3. The trapping season runs from 10 September to 15 June. There is a compulsory reporting program in place.

The wolf harvest in Region 2 has been low for many years (Figure A2) and no kills by resident hunters have been reported in the hunter harvest survey since 2005; however, some wolves are being harvested and regional staff believe the regional population is increasing (D. Reynolds, pers. comm., 2011), based on direct observation and increasing prey availability (e.g., reintroduction and expansion of Roosevelt Elk populations).

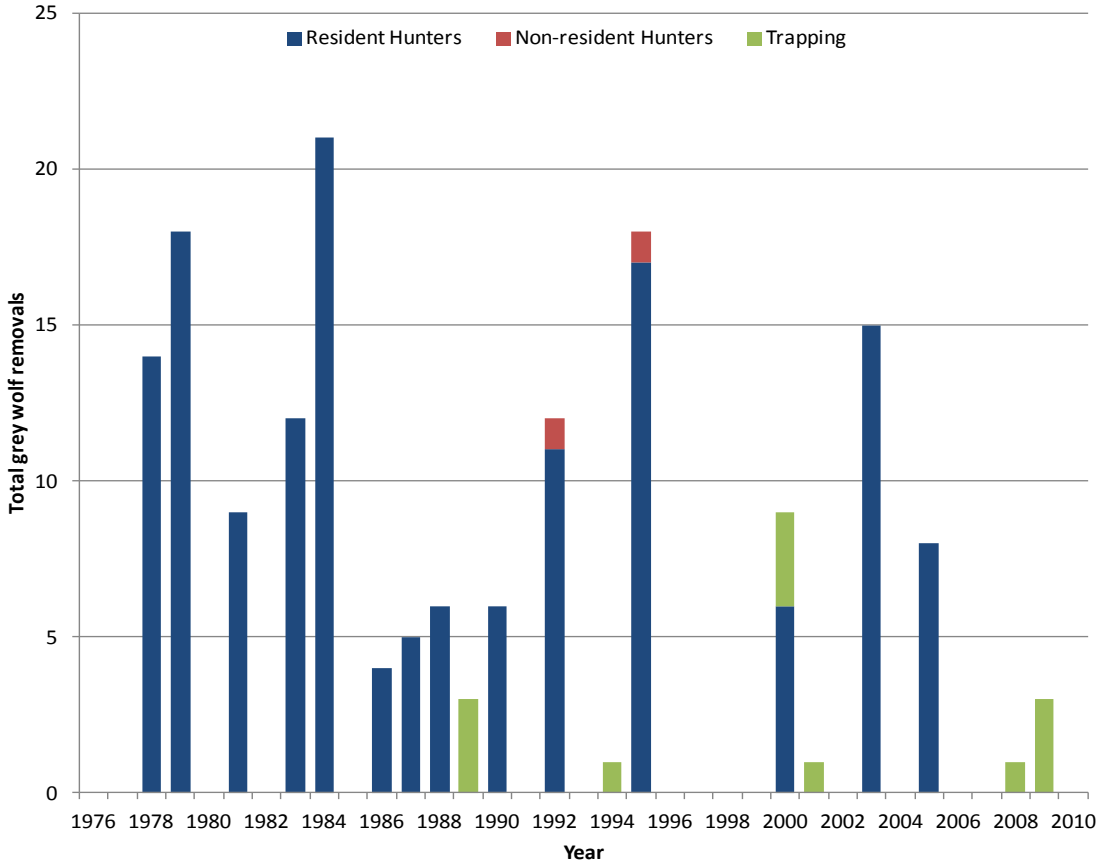

Figure A2. Reported harvest of wolves in Region 2 (Lower Mainland), 1976–2010. Non-resident harvest data were not available for 1976–1980. Trapping data were not available for 1976–1984.

Region 3 Thompson

There is a region-wide hunting season for wolves that opens 10 September and runs to 15 June. The bag limit is 3, except in the northwest where there is no bag limit and the season starts 1 August. This limit is in place to benefit caribou recovery. The trapping season runs from 15 October to 31 March.

Wolf harvest in the 1970s was low and sporadic, but became more consistent in the 1980s and 1990s. Record harvests were recorded in 2008 and 2009 (Figure A3).

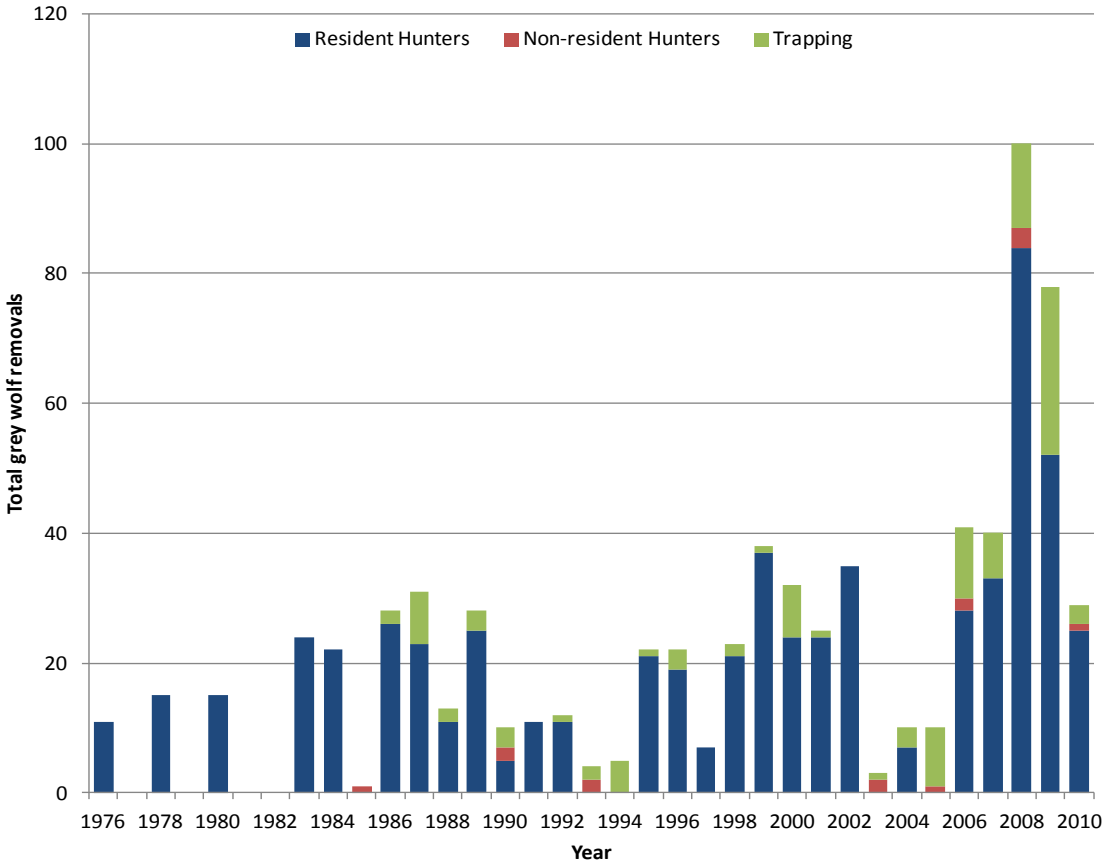

Figure A3. Reported harvest of wolves in Region 3 (Thompson), 1976–2010. Non-resident harvest data were not available for 1976–1980. Trapping data were not available for 1976–1984.

Region 4 Kootenay

Region 4 has a wolf hunting season that runs from 10 September to 15 June with a bag limit of 2 and a trapping season that runs from 15 October to 31 March. In areas below 1100 m in the Rocky Mountain Trench, there is no closed season for hunting or trapping to help protect livestock. In management units in or adjacent to Caribou habitat, the hunting season opens on 1 September and there is no bag limit. There is a compulsory reporting program in place.

Wolf populations were low and the season was closed throughout most of the region in the late 1970s. Hunting and trapping opportunities were opened again in the mid-1980s. Annual harvest has varied between 20 and 60 wolves per year since the mid-1990s (Figure A4). Both resident hunting and trapping harvest reached record levels in 2009.

Gaynor *et al.* (2007) estimated the wolf population in the West Kootenay Caribou recovery areas (Revelstoke, Central, and South Selkirks) to be about 80 animals, with only scattered lone wolves in the South Selkirks. Additional surveys in 2008–2009 suggested that the population in

Revelstoke had declined but was stable farther south in the West Kootenay. East Kootenay estimates from Creston, Moyie, and St. Mary's totalled 25 wolves (van Oort *et al.* 2010).

Guide-outfitters and the Province have been paying for carcasses from hunters for several years in connection with a compulsory reporting program. The number of carcasses purchased through this program has been very low. As a result, regional staff believe that this harvest analysis overestimates the resident kill (G. Mowat, pers. comm., 2011).

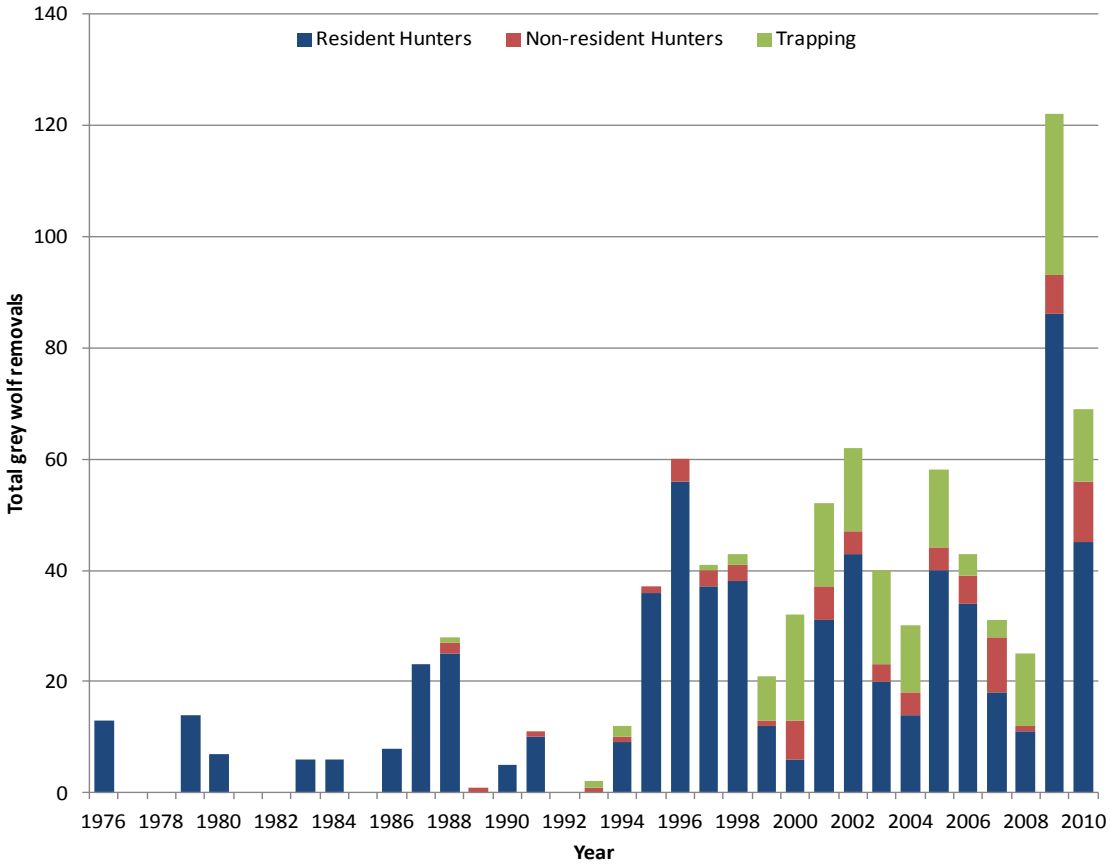

Figure A4. Reported harvest of wolves in Region 4 (Kootenay), 1976–2010. Non-resident harvest data were not available for 1976–1980. Trapping data were not available for 1976–1984.

Region 5 Cariboo

The Cariboo has two sets of hunting and trapping regulations: those applying to livestock production and caribou recovery areas, and those occurring outside of these areas. Within the livestock production areas (MUs 5-1 to 5-6 and 5-12 to 5-15) and caribou recovery areas (Quesnel Highland MUs 5-2, 5-15), there is no closed season and no bag limit for wolf hunting. There is also no closed season for wolf trapping in MUs 5-1 to 5-6, and 5-12 to 5-14, although from 1 April to 14 October trapping is restricted to modified leg-hold traps only and private land only. In MUs 5-7 to 5-9 (outside of livestock production areas and caribou recovery areas), the hunting season runs from 1 August to 15 June with a bag limit of 3. In MUs 5-10 and 5-11

(Tweedsmuir Park), the hunting season runs from 1 September to 31 March with a bag limit of 3. The trapping season on Crown and private land is open from 15 October to 31 March and all legal traps for wolf trapping are allowed.

Wolf harvest in the Cariboo is considerably higher than that in regions farther south, presumably because populations are larger. The predator–prey system is more dominated by wolves and moose than southern parts of the province, where Cougars and deer are more numerous.

Like in several other regions, the 2009 and 2010 data indicate a substantial increase in both resident harvest and trapping (Figure A5).

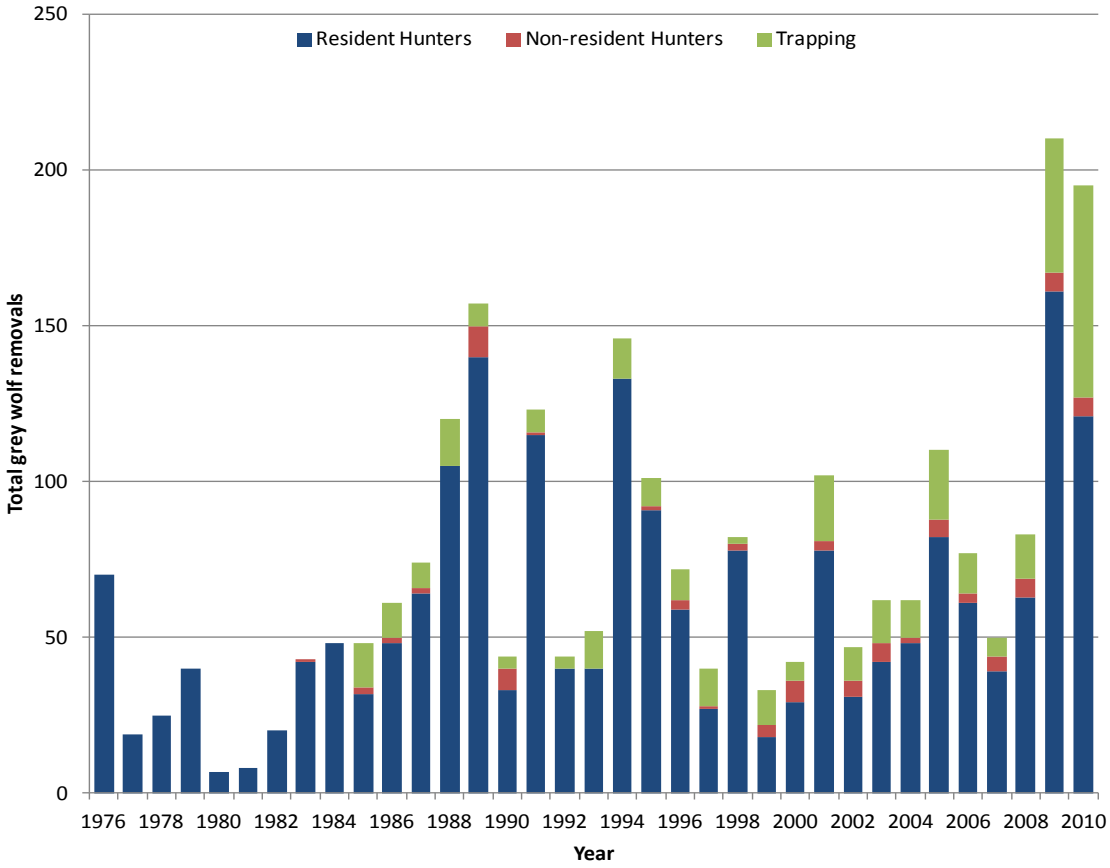

Figure A5. Reported harvest of wolves in Region 5 (Cariboo), 1976–2010. Non-resident harvest data were not available for 1976–1980. Trapping data were not available for 1976–1984.

Region 6 Skeena

Skeena has a region-wide wolf hunting season that runs from 1 August to 15 June (although shorter in Tweedsmuir Park) and a bag limit of 3. The trapping season is open from 15 October to 31 March.

A larger proportion of trapping kills than in other regions characterizes the harvest in Region 6 (Figure A6). Harvest peaked in 2007 with a slightly lower peak in 1989 and 2010. There is little information in the harvest data to infer a population change over the past 25 years.

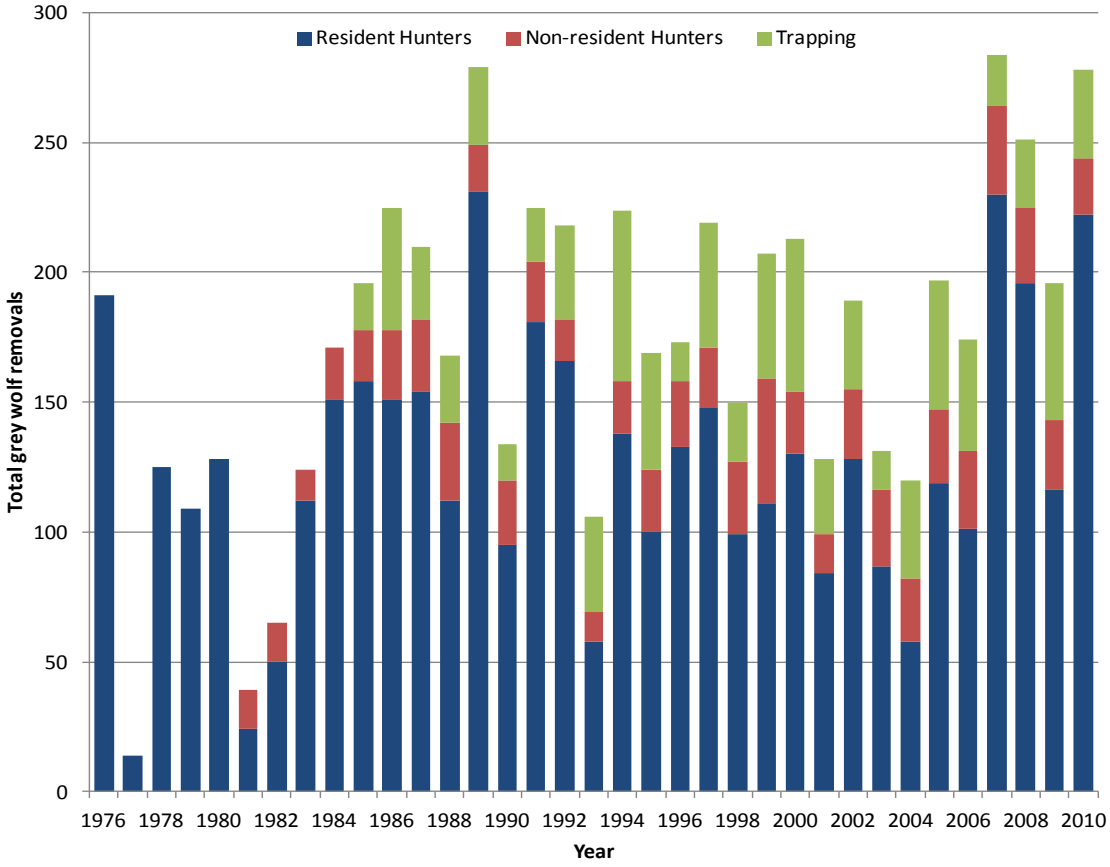

Figure A6. Reported harvest of wolves in Region 6 (Skeena), 1976–2010. Non-resident harvest data were not available for 1976–1980. Trapping data were not available for 1976–1984.

Region 7a Omineca

Nearly all of Region 7a is open to wolf hunting and the season extends from 1 August to 15 June. There is no bag limit. The trapping season runs 15 October to 31 May.

Wolf harvest had been stable in the Omineca until 2009 when the resident hunter harvest nearly tripled (Figure A7). The reasons for this increase are not clear.

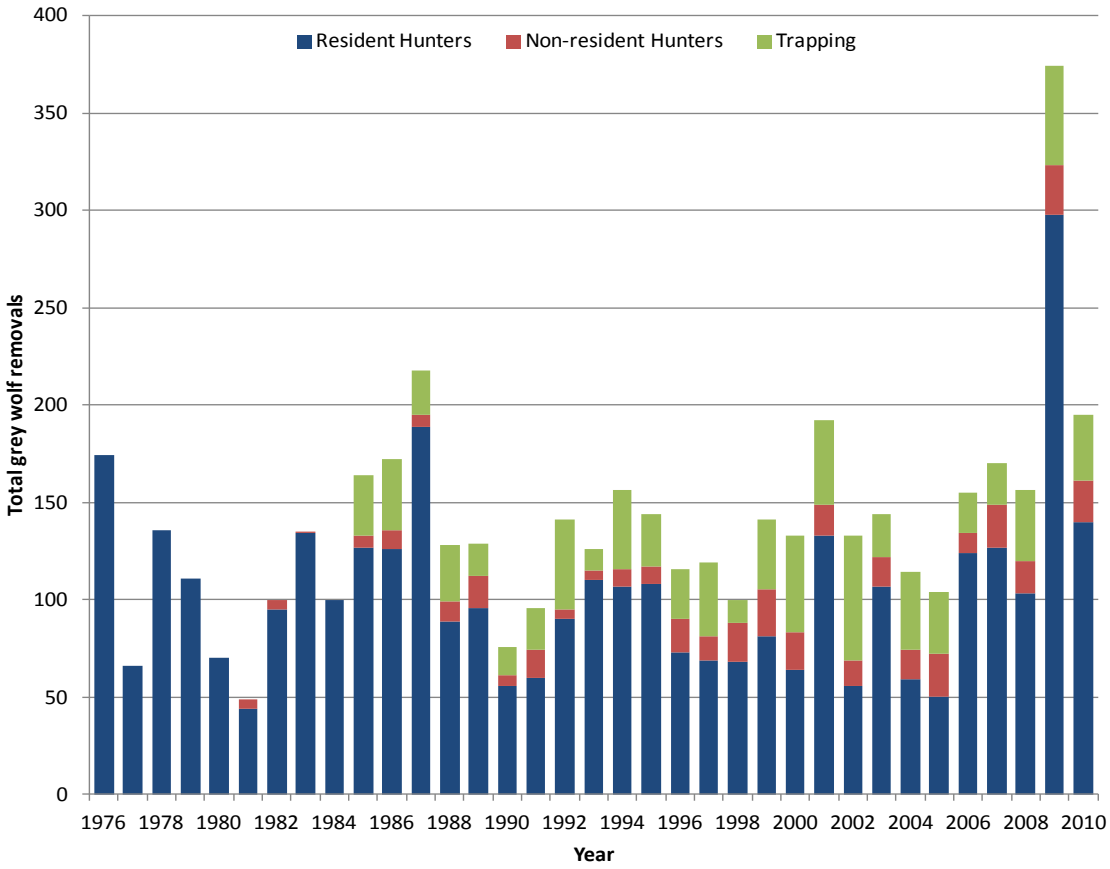

Figure A7. Reported harvest of wolves in Region 7a (Omineca), 1976–2010. Non-resident harvest data were not available for 1976–1980. Trapping data were not available for 1976–1984.

Region 7b Peace

The Peace region has a wolf season that opens on 1 August and closes 15 June. The bag limit is 3. There is no closed season below 1100 m to help protect livestock. The trapping season is open from 15 October to 31 May.

Wolf harvest has exceeded 150 animals for the last 16 years and 250 animals for the last 5 years (Figure A8). More wolves are harvested in the Peace than in any other region, likely because populations there are high and hunters are motivated to defend agricultural interests.

Regional guide-outfitters and trappers have recently focused activities on wolf harvesting as a result of external funding aimed at reducing wolf predation on ungulates.

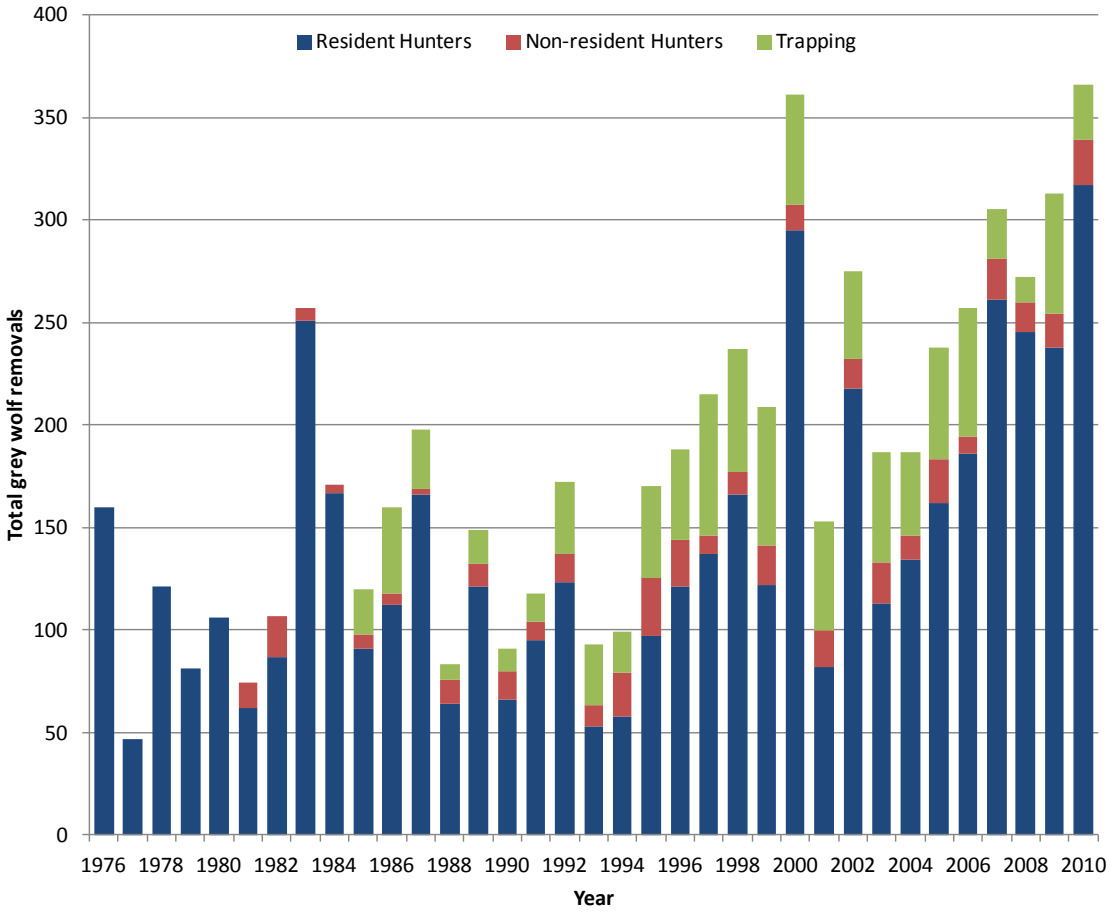

Figure A8. Reported harvest of wolves in Region 7b (Peace), 1976–2010. Non-resident harvest data were not available for 1976–1980. Trapping data were not available for 1976–1984.

Region 8 Okanagan

A hunting and trapping season for wolves in Region 8 was opened in 2012. Wolf hunting is allowed in all management units from 10 September to 15 June, with a bag limit of 3. Trapping is allowed from 15 October to 31 May. There is a compulsory reporting program in place.

Previously there was no hunting or trapping season and no harvest has been reported since 1993 (Figure A9). Wolf sightings have been increasing in recent years suggesting that the population is also increasing. Although there are now sightings throughout the region, the highest concentration has been in the northeast. There was very strong support from local stockmen, sportsmen, trappers, and guides to initiate a wolf hunting and trapping season.

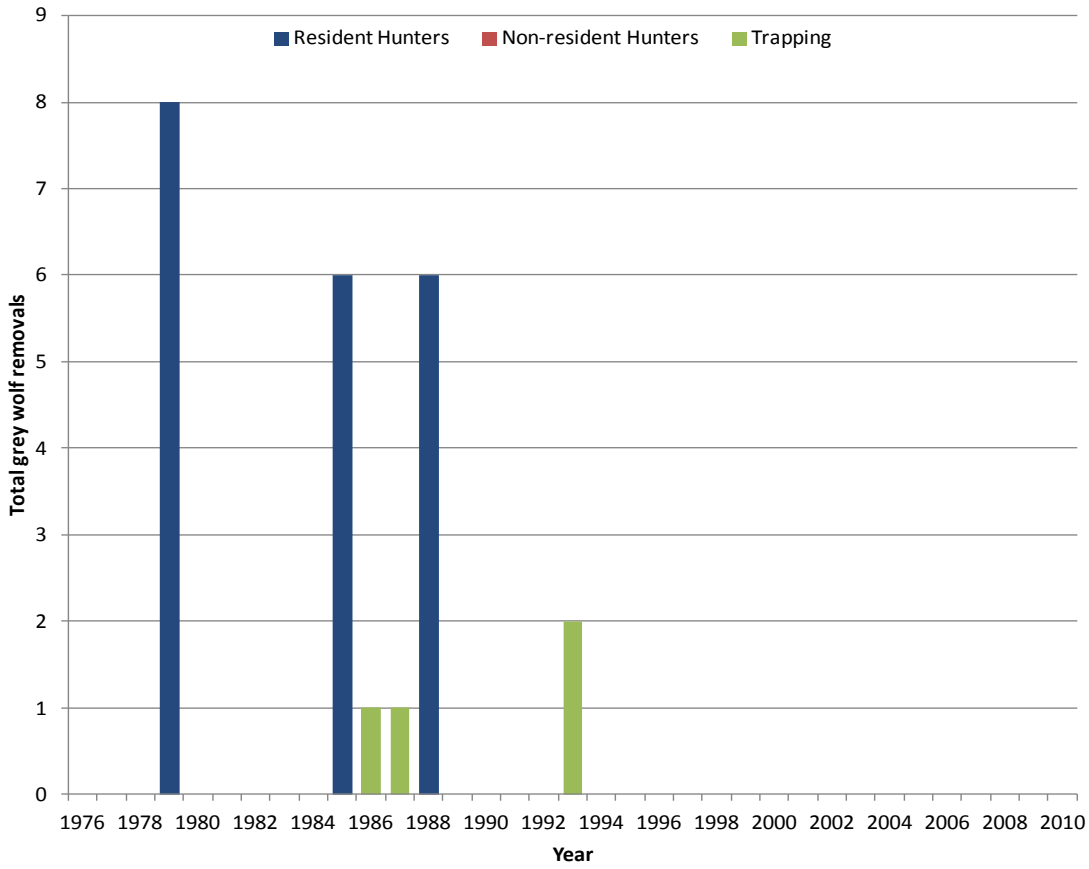

Figure A9. Reported harvest of wolves in Region 8 (Okanagan), 1976–2010. Non-resident harvest data were not available for 1976–1980. Trapping data were not available for 1976–1984.