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

Prepared by Ministry of Forests, Lands and Natural Resource Operations

November 2012

About the British Columbia Management Plan Series

This series presents the management plans that are prepared as advice to the Province of British Columbia. Management plans are prepared in accordance with the priorities and management actions assigned under the British Columbia Conservation Framework. The Province prepares management plans for species that may be at risk of becoming endangered or threatened due to sensitivity to human activities or natural events, or species where management is required to meet population targets for ecosystem management, human uses, or ecological services.

What is a management plan?

A management plan identifies a set of coordinated conservation activities and land use measures needed to ensure, at a minimum, that the target species does not become threatened or endangered or is being managed for use, ecosystem goals, or ecological services. A management plan summarizes the best available science-based information on biology and threats to inform the development of a management framework. Management plans set goals and objectives, and recommend approaches appropriate for species or ecosystem conservation.

What's next?

Direction set in the management plan provides valuable information on threats and direction on conservation measures that may be used by individuals, communities, land users, conservationists, academics, and governments interested in species and ecosystem conservation.

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Disclaimer

This management plan has been prepared by 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 prevent Grey Wolf populations in British Columbia from becoming endangered or threatened. 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 Ministry of Forests, Lands and Natural Resource Operations and 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 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.

RESPONSIBLE JURISDICTIONS

The British Columbia Ministry of Forests, Lands and Natural Resource Operations and the British Columbia Ministry of Environment are responsible for the management of Grey Wolves.

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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, agricultural interests, and human safety. This plan presents an analysis of historical and current management, an updated range map and population estimate, and a proposed approach for managing wolves for conservation while minimizing conflicts with humans in a consistent, transparent, and effective manner.

Persecution throughout the first half of the 20th century reduced the B.C. wolf population in the late 1950s, but it has since recovered and is expanding. Based on published density and range estimates, as well as ungulate biomass estimates, the current B.C. population is estimated to be approximately 8500 wolves. Although there is a positive bias in resident harvest statistics, the number of wolves being harvested has increased significantly in recent years.

The following factors limit and/or regulate the distribution and abundance of wolves in B.C.: abundance and distribution of ungulate biomass for 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 are thought to have a low impact on this species. The significance of these threats must be balanced against the fact that the wolf range is expanding, and that wolves have high reproductive rates and can disperse large distances. The hunting and trapping of wolves in B.C. currently has a standing non-detriment finding (see Appendix I).

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;
2. to provide for consumptive and non-consumptive use of wolves consistent with Ministry program plans;
3. to minimize the threat to public safety and private property caused by wolves; and
4. to control specific populations of wolves where predation is likely preventing the recovery of a species at risk (e.g., endangered populations of caribou).[1]

Provincial policy supports the use of predator control to address human safety, and to protect livestock and species at risk. Predator control to enhance ungulate populations for hunting is not supported by policy.

This document concludes with management recommendations and performance indicators to provide a way to define and measure progress toward achieving the management goal and objectives.

[1] 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 legal harvest (i.e., hunting and trapping).

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1 INTRODUCTION

The Grey Wolf (*Canis lupus*; hereafter wolf) is a highly adaptable, intelligent carnivore that inhabits most of British Columbia (B.C.) and is found in abundance in all Canadian provinces and territories except Newfoundland (from where it was extirpated). They are holarctic in distribution and occur throughout Asia, parts of Europe, and the Middle East (Sillero-Zubiri *et al.*, eds. 2004).

Wolves have a troubled history with western society, and systematic persecution has led to their extirpation in the regions of their historical range associated with the highest densities of people. Where the human population is small or where wolves have been protected by law, they are abundant, and in many places, increasing.

Wolves are common in wilderness areas of B.C. and have recolonized areas from which they were extirpated by decades of bounties and poisoning. The species attracts a highly polarized debate between those who see wolves as emblematic of B.C.'s wilderness heritage and those who see them as a threat to game species, agricultural interests, and human safety. Recently, researchers have highlighted the likely role of wolves in preventing the recovery of woodland caribou (*Rangifer tarandus caribou;* hereafter caribou) in B.C. (Mountain Caribou Science Team 2005; Wittmer *et al.* 2005).

Wolves are part of a complex predator–prey system that has challenged researchers and managers throughout the history of modern game management. 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).

Balancing the public interest where opinions are highly polarized is the challenge of managing wolves in B.C. This plan presents an analysis of historical and current management, an updated range map and population estimate, and a proposed approach for managing wolves for conservation while minimizing conflicts with humans in a consistent, transparent, and effective manner.

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: G4 (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 (2011) 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 is 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; H = possibly extirpated; 1 = critically imperiled; 2 = imperiled; 3 = special concern, vulnerable to extirpation or extinction; 4 = apparently secure; 5 = demonstrably widespread, abundant, and secure; NA = not applicable; NR = unranked; U = unrankable. 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).

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, and 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 persecution due to their depredation on livestock and fear of 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, with resulting areas becoming too small for populations with long-term viability.

Although the Grey Wolf still faces some threats, its relatively widespread range and stable population trend mean that the species, at the global level, does not meet, or nearly meet, any of the criteria for the threatened categories. Therefore, it is assessed as Least Concern. However, at the regional level, several wolf populations are seriously threatened. In North America, some of the reintroduced populations are still threatened; in Europe, the species is classified as Least Concern globally but several regional populations, such as the Western-Central Alps population, are classified as Endangered.

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 has a standing non-detriment finding (see Appendix I). Canada also has a non-detriment finding for legally harvested wolves (http://www.ec.gc.ca/cites/default.asp?lang=En&n=BB314F25-1).

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 pure white to a mixture of grey, brown, black and white to various shades of grey or black. 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, most of the United States (except Alaska and parts of Idaho, Montana, Minnesota, and Michigan), and from much of western Europe (Sillero-Zubiri *et al.*, eds. 2004).

3.2.2 Canadian

In Canada, provincial wolf populations are considered fully viable and occupy a large majority of their historical range except the island of Newfoundland, where they were extirpated by 1911 (Sillero-Zubiri *et al.*, eds. 2004).

3.2.3 British Columbian

Wolves are widespread and inhabits most of B.C. Wolves were considered extirpated in much of the Kootenay and part of the Thompson in the 1970s (B.C. Ministry of Environment 1979) but have now re-established as far south as northern Washington and Montana (Sime *et al.* 2009). 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 1000 km^2. On Vancouver Island, the density in Atkinson and Janz' (1994) study area in the Nimpkish Valley was estimated at 43 wolves per 1000 km^2; in the Adam River watershed, Scott and Shackleton (1980) estimated a density of 59 wolves/1000 km^2. Darimont and Paquet (2000) used a density of 30–35 wolves per 1000 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)* density information provided by Shackleton (1999), ecosection information by Demarchi (1996), and input from regional staff. High wolf density generally coincides with high moose density in the north and mule deer distribution on the coast. Low wolf density areas are 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.

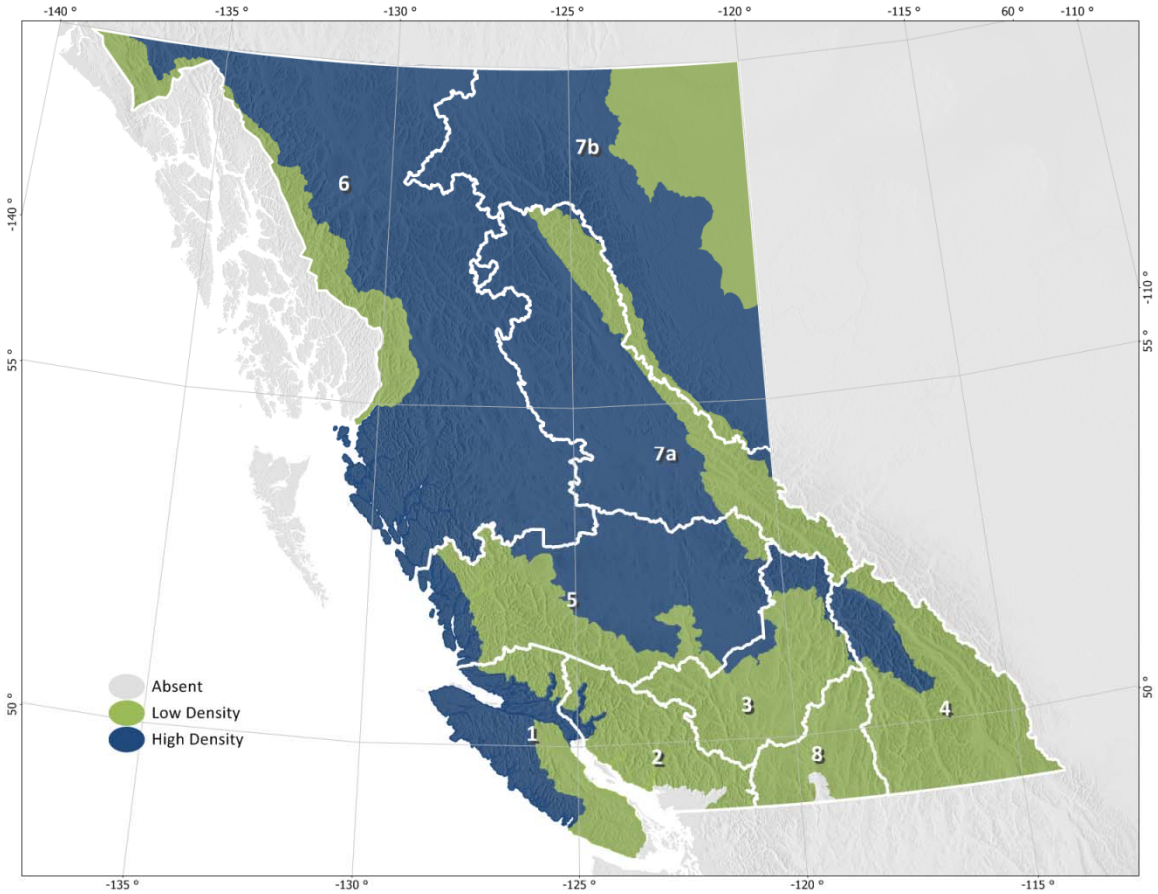

Figure 1. Estimated high- and low-density range of wolves in British Columbia.
Distributions are based on moose densities in the Interior and deer densities on the Coast, and adjusted based on regional input. Boundaries and numbers represent regions used for the harvest analysis.

To generate a wolf population estimate for B.C. from density extrapolations, a density of 5–15 wolves per 1000 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 1000 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).

A second wolf population estimate for B.C. was determined from ungulate prey biomass estimates. Fuller *et al.* (2003) regressed an index of winter ungulate density against wolf densities using data from 32 studies in North America and found a strong linear relationship (r^2 = 0.64). The Province has current (2011) ungulate population estimates and range distribution by species and region (http://www.env.gov.bc.ca/fw/wildlife/management-issues/index.html#ungulate_pop). These were also used to generate estimates of regional wolf populations (biomass index values were 8 for bison; 6 for moose; 3 for Roosevelt elk (*Cervus canadensis roosevelti*); 2 for caribou; and 1 for mountain sheep, mountain goat (*Oreamnos americanus*), mule deer, white-tailed deer (*Odocoileus virginianus*); and 0.75 for black-tailed deer (*Odocoileus hemionus columbianus*). Smaller, non-ungulate prey was not considered in the analysis.

The two independent wolf estimates were assessed and a combined estimate was developed to generate a provincial population estimate of approximately 6100 to 10 800 wolves (Table 1) or a best estimate of 8500. B.C.'s wolf population was previously estimated to be 6300 (2500–11 000) in 1979 (B.C. Ministry of Environment 1979) and 8100 in 1991 (Theberge 1991). Changes in estimates over time likely reflect changes in the precision and the method of estimation, rather than a trend in the provincial wolf population.

Table 1. Regional and provincial population estimate for wolves.

Region	Population range based on density estimates[a]	Population estimates based on prey biomass[a]	Combined estimate[a]	Combined estimate decision rule[b]
1 – Vancouver Island	150–480	320–380	230–430	1
2 – Lower Mainland	75–200	210–250	140–220[c]	1
3 – Thompson	150–400	500–650	330–550[d]	1
4 – Kootenay	200–500	850–1200	550–850	1
5 – Cariboo	430–1250	900–1100	650–1150	1
6 – Skeena	2300–4600	1550–2100	1900–3330	1
7a – Omineca	550–1550	1100–1500	800–1550	1
7b – Peace	800–2300	1950–2900	1400–2600	1

Region	Population range based on density estimates[a]	Population estimates based on prey biomass[a]	Combined estimate[a]	Combined estimate decision rule[b]
8 – Okanagan	50–150	350–460	50–150[e]	2
Total	**4700–11400**	**7700–10600**	**6100–10800**	

[a] Rounding rules for estimates: < 100, nearest 5; 100–499, nearest 10; 500–1999, nearest 50; ≥ 2000, nearest 100.
[b] (1) average of the density and biomass estimates used; (2) density estimate used as wolf distribution still expanding.
[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] Regional estimate based on reported observations is 75–100 , up from the previous estimate of 40 – 60 in 2007 (B. Harris, pers. comm. 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: 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).

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 the most 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 Roosevelt elk are most common in the south (Hatler *et al.* 2008).

Social Organization
Wolves live in packs typically composed of a breeding pair plus offspring 1–2 years old (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 except when there is a disruption to pack composition. 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 are migratory, wolves generally track the migrations and can establish separate territories in the different seasonal ranges of their prey (Mech and Boitani 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 size of the litter strongly depend on nutrition (Boertje and Stephenson 1982).

Mating occurs in late winter and litters (typically 4–7 pups) are born after a 63-day gestation period in April or May (Hatler *et al.* 2008). 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 old 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. They 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 responses in ungulate prey (Gasaway *et al.* 1992; Hayes *et al.* 2003). The effect of wolves on ecosystems extends 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, affecting the species richness and nesting abundance of neotropical migrant birds (Berger *et al.* 2001).

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.

These factors will continue to confound both theoretical research and field studies aimed at manipulating prey populations through the control of wolves. Although attempts may be successful, confidence in expected outcomes will necessarily be low.

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 biomass for prey** – this relationship has been demonstrated throughout the species range (Fuller *et al.* 2003).
2. **Human-caused mortality** – human-caused mortality 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) and mange and lice can affect haircoat quality, general health and kill juveniles and 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).

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

Threat #	Threat description	Impact[a]	Scope[b]	Severity[c]	Timing[d]
6	Human intrusions and disturbance	Negligible	Large	Negligible	High
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 three-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 this species is Low.[2] 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)
At current rates hunting and trapping mortality alone does not threaten wolf populations in B.C. Hunters rarely encounter this species and it is not considered desirable game. Trapping wolves is difficult and economic returns have been low for decades. Wolves can also sustain very high harvest rates (> 34% per year; e.g., Fuller *et al.* 2003). The average take in B.C. is thought to be well below this threshold (see Section 5.5). This includes animal control kills as a result of conflicts with livestock. The hunting and trapping of wolves in B.C. currently has a standing non-detriment finding (see Appendix I). Canada also has a non-detriment finding for the harvest of wolves (http://www.ec.gc.ca/cites/default.asp?lang=En&n=BB314F25-1).

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; invasive and other problematic species, which includes hybridization with dogs and diseases and parasites such as canine distemper, parvovirus, and ectoparasites). Agriculture (livestock farming and ranching) is considered only a past threat as not much new land 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).

It was determined that while other threats could possibly have some localized negative effects, such "threats" may overall be a benefit to the wolf. For example, although transportation and service corridors can cause direct mortality, the number of wolves killed by vehicles is low (2–10 over the last 10 years, average 5.6); even when corrected for unreported deaths, it is not likely to be more than 25 per year on highways (Ministry of Transportation, unpublished data). This is a very small proportion of the population; however, these same roads can be used as travel corridors by wolves allowing them to travel farther and faster. Log harvesting can result in dense second-growth forests that may impact the wolf prey system, although this is complex and difficult to predict. In other areas logging may be of benefit as forests are opened up, resulting in a higher prey base for wolves. Fires may be larger and hotter due to many years of fire suppression, which can result in forest ecosystems taking a long time to recover. However, generally fires may be a benefit by opening up habitat and increasing prey. It is also expected that climate warming will be a net benefit over the next 10 years with ranges of ungulates expanding, leading to higher ungulate prey populations in many areas (B.C. Ministry of

[2] 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.

Environment, unpublished data). Note that wolf populations that use salmon or beaver may not fare as well.

Only one threat (hunting and collecting terrestrial animals) with a low impact has been identified for this species. The significance of this threat must be balanced against a number of mitigating characteristics of wolf populations:

Wolf range is expanding – Wolves have dispersed into areas of B.C. where they were previously considered extirpated as recently as the late 1970s (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). Harvest data suggest that populations in B.C. are also increasing (see above). This is likely a function of an increasing prey base. Ranges of moose, white-tailed deer, and elk are expanding and leading to higher ungulate prey populations in many areas (B.C. Ministry of Environment, 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 reproductive rates – Litter sizes average 5 and survival can be high where prey is abundant. 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). As a result, wolves can sustain very high harvest rates (Fuller *et al.* 2003; Webb *et al.* 2009).

Wolves can disperse large distances – The ability of wolves to disperse for hundreds of kilometres makes it unlikely that populations will become fragmented and isolated in B.C. (Mech and Boitani 2003).

5 MANAGEMENT HISTORY

5.1 First Nations Use

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).

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).

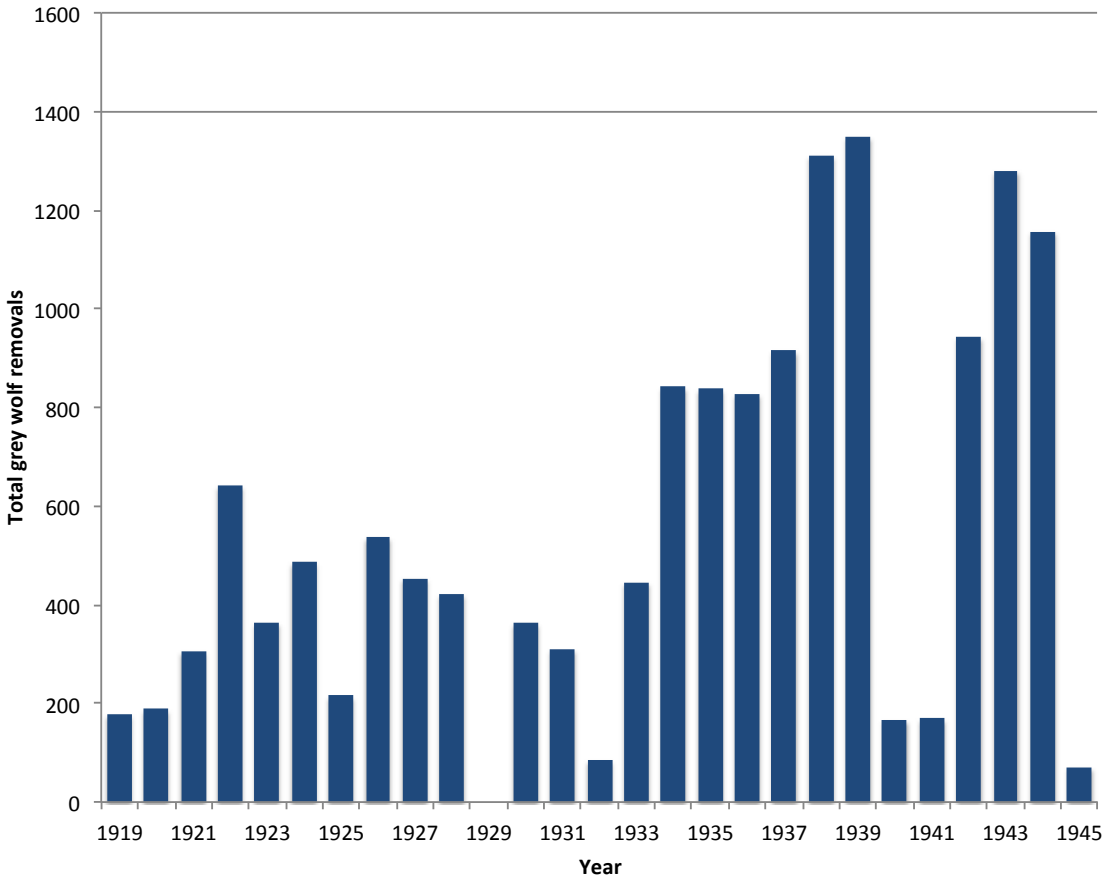

Figure 2. Available data on fur sales of wolf pelts, 1919–1945 (B.C. Ministry of Environment 1979).

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).

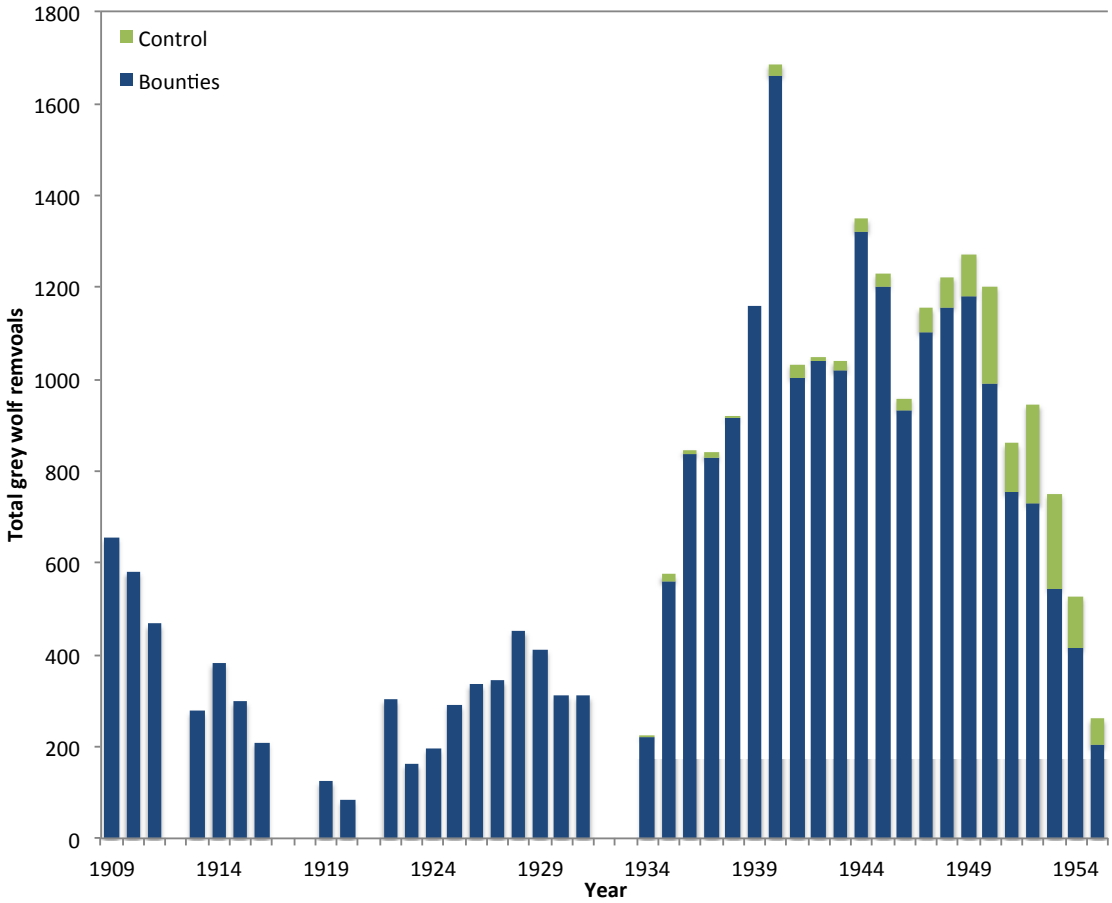

Figure 3. Available data on wolves removed under British Columbia's bounty and predator control programs. Bounties began before 1909 and ended in 1955. The bounty program was suspended during 1932–1933. Predator control continued after 1955 but data on removals are not available.

The Province began experimenting with poisoning in 1950. Baits laced with cyanide, strychnine, and Compound 1080 (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.

Predator control activities (bounties and government sanctioned wolf poisoning) resulted in a decline in the provincial wolf population that reached a minimum in the late 1950s. The population appeared to increase after bounties were removed in 1955 and when poisoning in wilderness areas ended in 1961 (B.C. Ministry of Environment 1979).

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 Province initiated an experimental wolf control program in the Nimpkish Valley on northern Vancouver Island in an attempt to increase 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 1998). Government-sanctioned wolf control activities ceased in the 1990s, although undocumented efforts to remove wolves through non-government incentives continued in the Peace region.

Recent harvest regulations have been liberal and are assumed to have not limited hunter harvest because relatively few hunters have an interest in hunting 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 has been 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 Ministry of Environment, and the 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 Ministry of Environment on how to manage mitigation of livestock predation in 2011 and onward, a commitment was made by the Conservation Officer Service to coordinate response for suspected predator attacks on livestock.

Management of Species at Risk

Attempting to control wolves to reduce predation risk on 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 has occurred through removals and sterilization of dominant pairs. Wolf densities have been reduced, however at this time, a correlation between reduced wolf densities and caribou recovery cannot be substantiated. An additional 2 to 4 years of wolf sterilizations and reductions is required in conjunction with caribou inventories to adequately assess the long term benefits of this program (R. Wright, pers. comm. 2011). The Province has also hired trappers to remove wolves from within, and adjacent to, caribou range in the Kootenay region. Although wolves have been removed, these removals have not yet resulted in an increase in targeted caribou herd populations (C. Ritchie, pers. comm. 2011). The rationale for the wolf removal is based on the hypothesis that increasing populations of moose (*Alces alces*) 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. This calculation is almost certainly overestimating the resident harvest. Regional staff believe that the true harvest figures might be half or less than what is estimated by the hunter survey calculations.

Harvest estimates can be affected by reporting biases; for example, successful hunters might be more likely to respond to the survey than unsuccessful hunters. This can occur for any game species, but the issue is more acute for wolves because only a very small proportion of hunters report successfully hunting wolves and, because there is no species license, that small harvest is extrapolated to a very large hunting population. As a result, a single wolf harvested can sometimes result in a harvest estimate of > 20 wolves in one management unit when extrapolated to the entire resident hunter population.

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 catch-per-unit effort statistics suspect but does not inflate harvest 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.

Harvest levels by trappers are inferred from provincial fur sales. Royalties are paid on all pelts sold in B.C., but not all pelts are likely to be sold because quality is variable and commercial values are generally low. Trapping effort and therefore harvest vary with the market value of pelts. No data on trapper effort are collected.

The Conservation Officer Service collects data on animal control removals. Some regions have compulsory reporting programs, where anyone harvesting a wolf for any reason must report the harvest to the relevant regional office. The reliability of compulsory reporting data is suspect because regional staff believe there are animals that are harvested but not reported.

5.5 Recent Harvest Trends

Wolf harvest has increased steadily in recent years (Figure 4). Resident hunting and trapping harvest both reached record levels in 2009. This period has likely corresponded with an increase in the wolf population, particularly in the Thompson and Kootenay regions and increased interest in harvesting wolves.

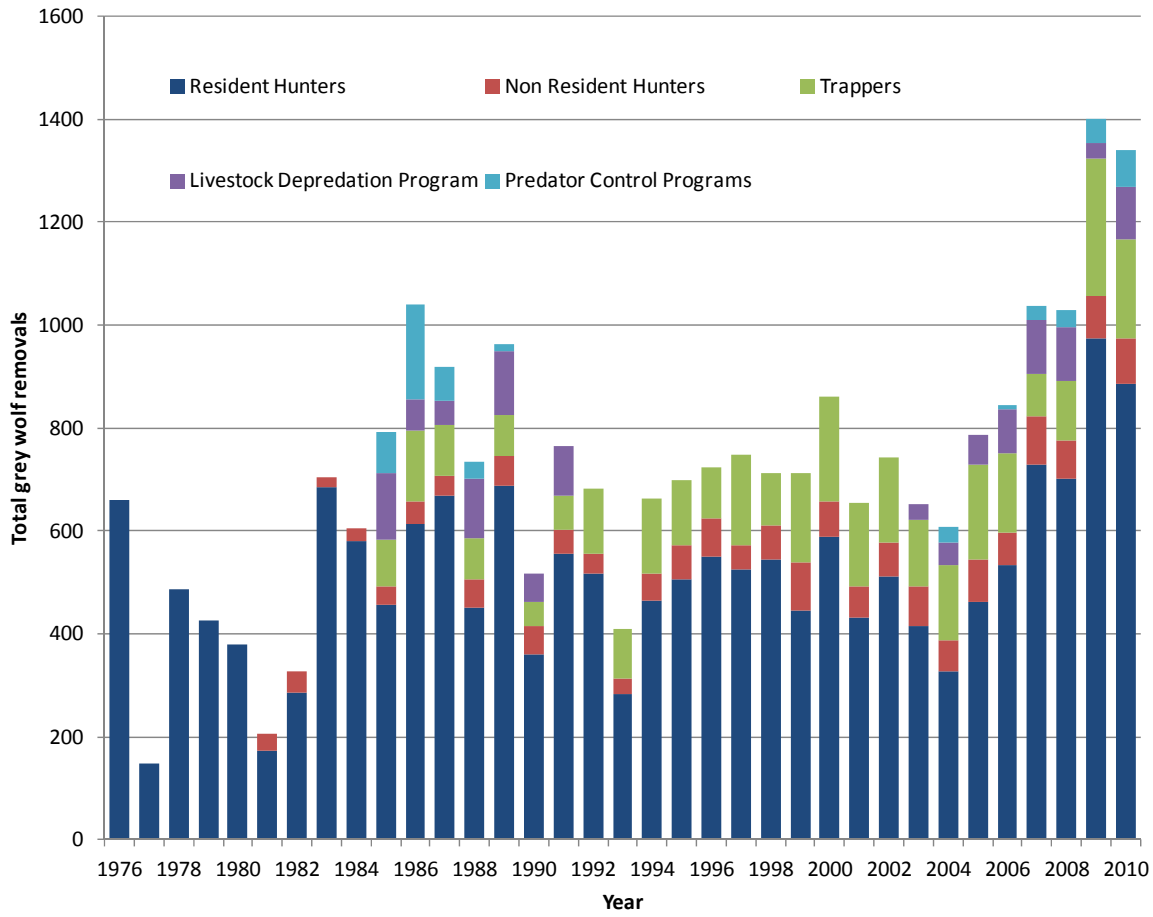

Figure 4. Total wolf removals in British Columbia during 1976–2010. Data for trapping, livestock depredation, and predator control programs were not available before 1985.

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;
2. to provide for consumptive and non-consumptive use of wolves consistent with Ministry program plans;

3. to minimize the threat to public safety and private property caused by wolves; and
4. to control specific populations of wolves where predation is likely preventing the recovery of a species at risk (e.g., endangered populations of caribou). [3]

7 CURRENT MANAGEMENT FRAMEWORK

Overall, wolf management in B.C. is becoming characterized by a two-zone management strategy. In areas where livestock depredation or species at risk are a concern, wolf management includes year-round open seasons and/or no bag limits, and in some cases targeted removal of individuals or packs. Elsewhere, wolf management is primarily concerned with providing hunting and trapping opportunities with controls on harvest through specified season lengths and bag limits. This two-zone management strategy concept is also embedded in the Wildlife Society technical review document, titled "Management of Large Mammalian Carnivores in North America" (Peek *et al.* 2012). Specifically, the author's 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."

The provincial wolf population estimated from wolf density extrapolations and ungulate prey biomass ranges from 6100 to 10 800 wolves (see Section 3.2.3). While this estimate is quite broad, it is considered to be adequate for most general wildlife management purposes. As noted by Boitani (2003), "While accurate estimates (of wolves) are necessary in scientific studies, the same accuracy is not always required for management and conservation planning. The order of magnitude of a population, or even its trend, is often sufficient to decide on conservation actions." This finding is partially because wolf populations are able to compensate for moderate-to-high levels of human-caused mortality, and because they are rarely actively sought by hunters and trappers. In most cases, the collection and analysis of harvest data is sufficient to ensure conservation of wolves is not compromised.

Note that for specific wildlife management programs involving intensive wolf removals, broad population estimates are not adequate. Rather, a well-designed, science-based analysis of predation pressure and rigorous inventory needs to be implemented (Peek *et al.* 2012).

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,[4] some of which include:

[3] 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 legal harvest (i.e., hunting and trapping).
[4] Big Game Harvest Management policy (4-7-01.07 March 2010).

- 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

Allowable harvests of wolves are determined using the same methods that are applied to manage other large carnivore species in B.C.; specifically, past harvest data and available data related to the status of populations. For harvest (trapping and hunting) data by region see Appendix 1.

Wolves are managed as a game species in B.C. and there are hunting and trapping seasons in all regions (Table 3). 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 (MU) where there are no bag limits (see Appendix 1 for details). Wolves are classified as Class 3 furbearers, which are not considered sensitive to harvest. Hunting is prohibited in national parks and some provincial parks.

Wolves are rarely encountered, are not considered a desirable game species for hunting, and often generate property and conservation concerns; therefore, regulations are frequently designed to encourage harvest. Seasons are long and there is no species license required for residents to hunt wolves. There is no age/sex restriction, as this type of restriction is infeasible for wolves: age or sex cannot be identified reliably in the field and the pack structure of populations renders management by sex and age ineffective. Limited entry hunting has not been considered for wolves; rather, seasons have been closed where conservation has been a concern.

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 1100m (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] 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	2	No bag limit in MUs within caribou range (7-2 to 7-9, 7-16 to 7-18, 7-23).
7b	Oct 15 – May 31	Aug 01 – Jun 15	3	No closed season below 1100m (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 regional biologists to inform regulatory reviews and adjustments. There are also compulsory reporting programs in Regions 1 and 4.

7.1.3 Resident / Non-Resident Allocation

In general, wolves are not a species in demand by either resident or non-resident hunters. As there appears to be no need to restrict current harvest levels for conservation reasons, wolves are not managed under the Province's current harvest allocation policy.

7.2 Damage Prevention and Control

The Province supports the control of wolves where they pose a significant risk to human safety or to property (note that direct threats to human safety are extremely rare). The Conservation Officer Service responds promptly to all high-risk, human-wildlife conflicts. The Wild Predator

Loss Prevention Pilot Project operated by the B.C. Agricultural Research and Development Corporation is winding down (2011) and the Conservation Officer Service has 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 the full suite of stakeholders that have an interest in this issue, including local livestock producers and producer groups, industry, the 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. The Conservation Officer Service promotes good livestock husbandry and other preventative practices, and encourages non-lethal control measures.

Wolf predation on livestock has become a growing concern, especially within the agricultural areas of the Cariboo and Peace regions. First Nations, guide outfitters, ranchers, hunters and local citizens have strongly requested more liberalized wolf hunting and trapping seasons to address these livestock predation concerns. In 2011, regulations were brought into effect to increase hunting and trapping opportunities within the most significantly impacted areas of the Cariboo, and similar regulations have been proposed for the Peace.

7.3 Management of Species at Risk

As a top predator, wolves have the potential to be a significant conservation threat to species at risk. Provincial policy supports the control of native wildlife where they are preventing the recovery of species at risk.

The broader scientific community generally accepts that predation by wolves is a direct limiting factor for caribou recovery across Canada. The role of wolf predation in preventing the recovery of caribou in B.C. and elsewhere has been a recent focus of research and management efforts. 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 *et al.* 2005, 2007). Predation is considered the greatest single threat to mountain caribou herds[5] and wolves are considered a major predator, particularly in northern portions of the range (Mountain Caribou Science Team 2005). Wolves may become more important predators in the south as their population continues to expand. Wolf inventory and radio-telemetry studies that were funded as part of the Mountain Caribou Recovery Implementation Program revealed there were approximately 260 wolves occupying the range of

[5]"Mountain caribou herds" refer to herds found in southern B.C. including portions of the Rocky Mountains' west slope and in the Columbia Mountains.

mountain caribou in 2008 (C. Ritchie, pers. comm. 2008). Peek *et al.* (2012) state "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."

The technical report "Recommendations for Predator-Prey Management to Benefit the Recovery of Mountain Caribou in British Columbia" (Wilson 2009) outlines a number of considerations for wolf management to benefit caribou recovery:

- Both predators and primary prey populations will need to be managed to reduce predation pressure in areas where predators are preventing caribou recovery.
- Without immediate action to reverse population declines by reducing predation losses, some mountain caribou herds could be extirpated before the benefits of other management actions are realized.
- Removal of all resident packs and/or individuals is a legitimate goal where even rare predation events would further jeopardize the viability of a caribou herd.
- Regulated hunting and trapping will not be sufficient to reduce wolves to target densities. Hired trappers can be more effective but many biologists doubt that recovery objectives can be met without resorting to shooting wolves from helicopters, which they consider to be the most effective and humane approach.
- In the long-term, caribou persistence will likely require reducing prey abundance within and adjacent to mountain caribou range, otherwise, predator reductions will need to be ongoing and intense.
- Analyses based on available data suggest that target densities of 50-300 moose/1000 km^2 would benefit mountain caribou recovery.
- Reducing moose to lower wolf densities to benefit mountain caribou has a strong theoretical basis, but to date experimental studies in B.C. have not provided empirical evidence to support this theory[6].

In the technical report "Estimating the short-term benefit of wolf reduction to mountain caribou herds", Wilson (2010) reached the following conclusions:

- The benefit of wolf reductions will be limited in most very small herds, but may reduce or halt population declines;
- The largest caribou herds are likely to benefit the most from wolf reductions and is most likely to result in a significant increase in the range-wide mountain caribou population; and,
- Aerial removal of wolves is more effective than trapping in all herd areas.

To date, B.C.'s existing 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 are ineffective and costly, and that an aerial wolf reduction

[6] Recent results from a moose reduction pilot project in the Parsnip watershed found no reduction in wolf numbers after moose were reduced by hunting (Heard *et al.* 2011). In a second moose reduction pilot project near Revelstoke, wolf numbers did decline when moose numbers were reduced but caribou numbers did not increase (Serrouya 2012).

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 and a rigorous inventory program implemented (Peek *et al.* 2012). The Mountain Caribou Recovery Implementation Program (http://www.env.gov.bc.ca/wld/speciesconservation/mc/index.html) provides numerous information sources that summarize the predator/prey planning component for mountain caribou recovery.

As mentioned previously, predator–prey systems are complex and poorly understood. Experience in other jurisdictions indicates that reducing wolves can benefit caribou 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).

Unsustainable predation rates on species at risk are usually a proximate indication of one or more ultimate causes (e.g., habitat alteration and loss in the case of caribou). As a result, intensive wolf reductions should be viewed as a short-term treatment rather than a long-term cure. To reduce wolves over the long term requires a reduction in the abundance of their primary ungulate prey.

The resilience of wolf populations means that efforts to reduce their numbers must be intense to be successful. But it also means that programs focused on specific species at risk pose little conservation risk to regional wolf populations.

7.4 No Reduction of Wolves to Enhance Ungulate Populations for Hunting

Provincial policy does not support predator control to reduce wolf populations for the purpose of enhancing ungulate populations for hunting. Hunting and trapping are generally not effective for reducing wolf populations over large areas. While in some ecological systems, reducing wolf numbers can increase ungulate populations, and also increase the harvest yield of ungulates (Peek *et al.* 2012), a high proportion of the wolf population (i.e., up to 80%) must be reduced over a large area for multiple years to be effective (National Research Council 1997, Hayes *et al.* 2003). In other ecological systems, wolf removals may not lead to an enhancement of ungulate numbers without additional reductions of other predator populations (e.g., bears or cougars). The impact of removing a large proportion of wolves from a system over a longer time period may also have considerable ecosystem/food-web related impacts that positively or negatively affect a number of other species (Berger *et al.* 2001).

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 related changes to the predator–prey system. These include:

- 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
- response of wolves and moose to wolf pack sterilization in the Ketchika (J. Elliott, unpublished data);
- in-progress study on mountain caribou demography in relation to changes and manipulations of predator–prey systems in the north Columbia Mountains (R. Serrouya, pers. comm. 2011);
- 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.

Estimating wolf populations continues to be a challenge because they are secretive, range over large areas, and live primarily in forested habitats.

These knowledge gaps are likely to persist for some time and management of wolves will necessarily be associated with considerable uncertainty. However, wolves have demonstrated remarkable resilience to efforts to reduce their populations, and the level of conservation risk to wolves under current knowledge gaps is likely low.

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 Increasing

Both anecdotal reports and harvest data indicate that wolf populations in Regions 3, 4, and 8 have been increasing for the last 10–15 years. This increase is likely a result of natural range expansion following control efforts in the 1950s and 1960s. Local wolf populations can rebound quickly from control efforts, but range expansion appears to be a longer-term phenomenon.

Wolf populations in Regions 5, 6, 7a, and 7b appear to be stable. Harvest has been variable but no longer-term trend has emerged. Harvest of wolves in Region 1 appears lower now than in the 1980s and 1990s. This might indicate a decline from the 1980s.

The overall B.C. wolf population has likely increased since earlier estimates in 1979 and 1991 although not substantially, because most of the increase has occurred in the south and densities there are still likely well below those in the north.

8.2 Wolf Harvest Is Increasing

Although the estimated harvest in some or all regions is likely higher than actual harvest, more wolves are being harvested (particularly in 2009) than at any time since records of resident harvest began in 1976.

Three factors could be leading to this increase:

1. more wolves – although the significant increase in some regional harvests in 2009 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 bag limits are not usually considered limiting because hunting is opportunistic; or
3. more motivated hunters –various incentives and informal campaigns in parts of the B.C. have promoted the hunting and trapping of wolves. These programs may be having some effect.

8.3 Harvest Trends Are Imprecise Indicators of Population Trends

With liberal hunting seasons and bag limits, hunter harvest of wolves is a function of opportunity and motivation. Hunters will harvest more wolves if wolves are encountered more often.

Because royalties are paid on all pelts sold, harvest numbers from trapping are more reliable than estimates derived from hunter survey data, but not all pelts are sold, due to low quality.

Harvest trends, anecdotal reports, and scattered research projects in aggregate provide only coarse indications of wolf abundance and distribution trends.

8.4 Pressure to Reduce Wolves to Protect Livestock and Species at Risk

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

Given the biology of the species and current wolf population size and trend, both the program to protect livestock and the program to recover species at risk can likely 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.

8.5 Wolf Populations Respond Primarily to Prey Abundance and Distribution

Wolf populations can withstand high rates of exploitation. 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 all of these reasons, hunting and trapping management is not considered a primary driver of wolf population size or distribution in B.C. Rather, wolf numbers are responding primarily to prey abundance and distribution.

9 FUTURE MANAGEMENT

9.1 Adjusting Regulations and Management Actions

Management decisions for wolves must address the overall management goal as well as the four management objectives (Section 6.2) that can be summarized as:

1. conservation,
2. consumptive and non-consumptive use,
3. damage prevention and control, and
4. management of species at risk (SAR).

Accommodating these management decisions requires 3 phases:

1. assessing wolf population and depredation trends,
2. determining population objectives, and
3. implementing regulatory change or a management action.

These dimensions and phases can be presented in a decision model (Figure 5), where management changes are based on a regional or sub-regional population objective that is based on an interpretation of several trend indicators.

The conservation and recreation indicators provide a *green*, *amber*, or *red* conservation flag for a wolf population in any given year. Based on depredation or species at risk information, a management objective is added (i.e., higher, stable, or lower population target). The management objective and conservation flag **combined** can be used to suggest changes to management regulations and actions. In this model, the options are:

1. more liberal;
2. no change for 3 years – indicators are sufficiently positive that regulations can be set for the next 3 years with little conservation concern;
3. monitor – data suggest a conservation concern that might warrant a regulation change within 3 years; and
4. less liberal.

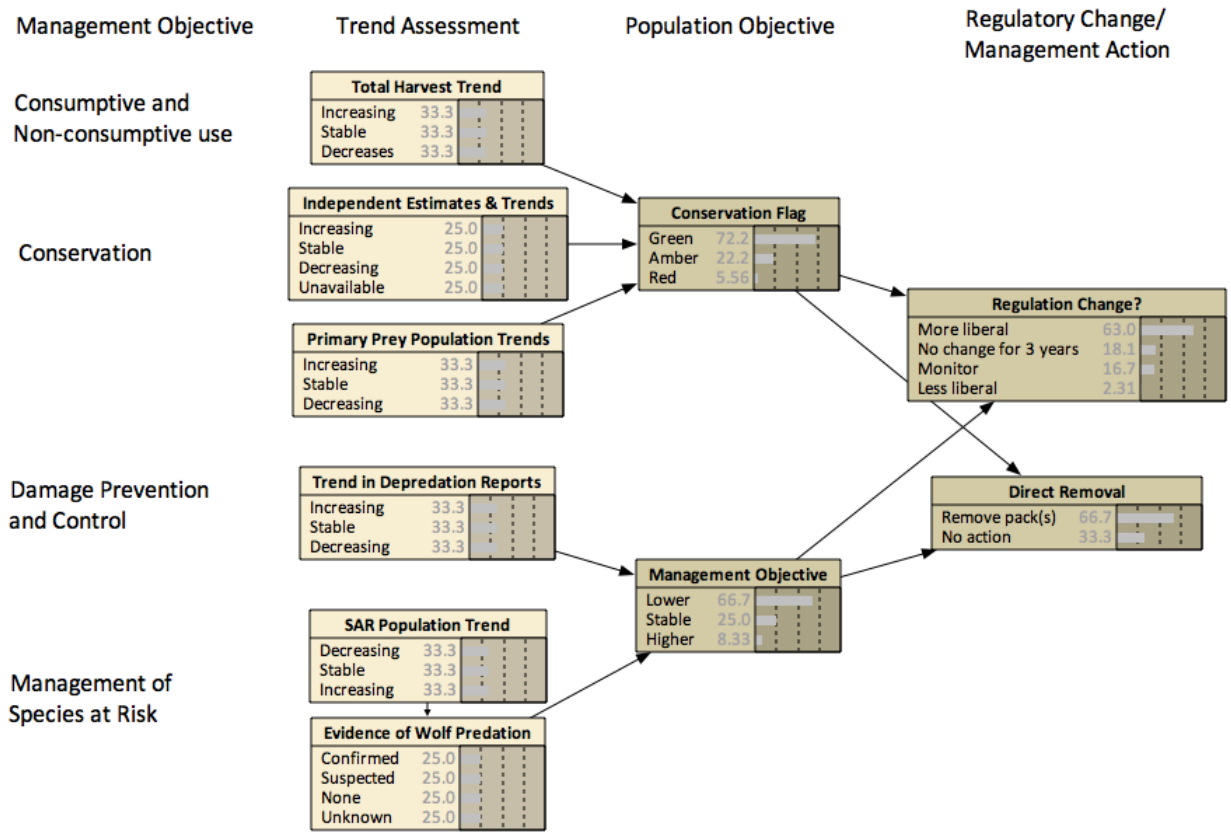

Figure 5. Decision model to address hunting regulation and pack removal decision for wolf management in British Columbia. Credit: Steve Wilson.

The model is presented as a Bayesian Belief Network (BBN). BBNs accept probabilistic inputs for different input "nodes" and calculate marginal probabilities for output nodes. This provides a number of advantages:

- Models are presented visually and are relatively easy to understand;
- Output is robust to incomplete information; and
- Uncertainty in inputs and/or in decision-making is presented explicitly.

Before being applied, the model should be reviewed with experts to ensure that all relevant variables have been captured, that the different states are both necessary and sufficient to resolve different management questions, and that the relationships among variables are consistent with expectations. The model can then be used to inform decision-making and to make regulation changes more transparent to stakeholders.

Wilson (2010) developed a detailed model to inform decisions regarding the removal of wolf packs to benefit mountain caribou herds. That model can be used to estimate the required intensity of control required to derive a desired response.

9.2 Summary of 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 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	• Simple to implement	• Requires permit outside hunting season	Moderate: Affects packs more than affects populations, but some demonstrated effectiveness for livestock depredation issues.	Removal of individuals can fragment packs and lead to high natality.
Direct removal of packs	• Eliminated threats in the short term	• Vacant territories are quickly re-occupied if conditions for wolves are	High: Demonstrated success in the short term.	Aerial shooting is the most effective and humane.

Management tools	Advantages	Disadvantages	Effectiveness	Comments
		otherwise good • Politically difficult to implement		
Harassment	• Non-lethal	• Labour-intensive and can be expensive	Low: Effects limited and temporary.	A variety of techniques have been developed for agricultural producers.
Reduction of ungulate prey	• Long-term solution	• Reduces hunting opportunities for other species • Uncertain outcomes and benefits not realized for many years • Required over a very large area because of wolf mobility	Moderate: Wolf populations are ultimately governed by abundance of ungulate prey	Effectiveness may be high, but more pilot studies are required.

9.3 Recommended Management Actions

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

1. Centralize warehousing of harvest, animal control, compulsory reporting, sightings, and other data to enable more effective and efficient analysis of regulation changes and management actions;
2. Suspend compulsory reporting programs where they are not generating reliable results;
3. Implement a low-cost species license for wolves to improve the accuracy and precision of hunter survey-based harvest estimates;
4. Reanalyze provincial wolf harvest statistics within 5 years to determine the effect of removing bag limits in certain management units on harvest levels and trends.
5. Investigate the use of the Bayesian Belief Network (Figure 5) to inform hunting regulation changes and pack removal decisions for wolf management in B.C.;
6. Share the rationale and expected outcomes of various management actions to reduce wolves with First Nations and stakeholders to improve transparency;
7. Clarify the responsibility for 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; and
8. Formally implement a two-zone management strategy in B.C. that balances wolf conservation with the need to address livestock depredation and recovery objectives for species at risk in specific areas while managing wolves elsewhere in the province primarily for conservation (i.e., hunting and trapping regulations only).

9. Produce a technical report describing the ungulate prey biomass method for estimating wolf densities to enable the assessment of sustainable human-caused wolf mortality rates in B.C.

10 MEASURING PROGRESS

The following performance indicators provide a way to define and measure progress toward achieving the management goal and objectives (see Section 6).

Conservation
Objective 1: To ensure a self-sustaining population throughout the species' range.

Performance measure: To avoid *red* conservation flags (see Figure 5, Decision model) for all regional populations.

The success of achieving a self-sustaining population throughout the species' range is best measured through interpretation of indicator data, verified by independent population estimates, where available.

Consumptive and Non-consumptive Use (Hunting/Trapping)
Objective 2: To provide for consumptive and non-consumptive use of wolves consistent with Ministry program plans.

Performance measure: Maintain liberal season lengths and bag limits of 2 or more, where conservation allows.

Damage Prevention and Control
Objective 3: To minimize the threat to public safety and private property caused by wolves.

Performance measures:

- Remove wolves or packs that pose a serious threat to human safety or property within 2 business days of credible reports.
- Enable the removal of wolves or packs that have killed livestock, where reasonable efforts have been taken to minimize conflicts by issuing permits (if required) to qualified individuals to remove wolves within 5 business days of request.
- Maintain liberal seasons within specific areas characterized by chronic wolf–agriculture conflicts by establishing open seasons in agricultural regions with chronic conflicts.[7]

[7] "Chronic" conflict areas are those where the frequency of verified kills of livestock by wolves exceeds the reasonable ability of landowners and the Conservation Officer Service to respond.

Management of Species at Risk

Objective 4: To control specific populations of wolves where predation is likely preventing the recovery of a species at risk (e.g., endangered populations of caribou).

Performance measure: No loss of individuals to wolf predation within target areas for critically endangered[8] populations of species at risk.

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APPENDIX 1. Harvest Regulations and Harvest Data by Region

This section presents harvest (trapping and hunting) data by region (see Figure 1 for region boundaries). 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. There is a compulsory reporting program in place. Trapping is allowed from 1 November to 30 June.

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).

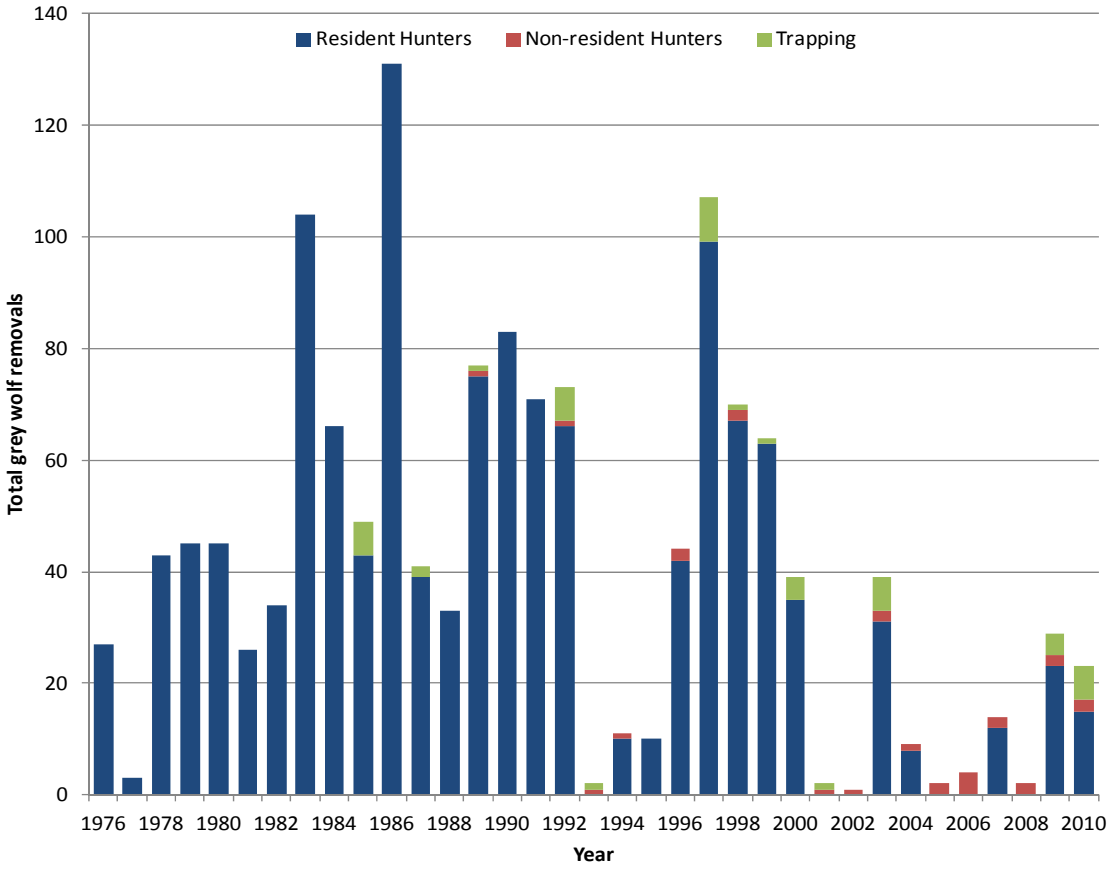

Figure A1. Harvest of wolves in Region 1 (Vancouver Island), 1976–2010. Non-resident harvest data were not available for 1976–1980. Trapping data were not available for 1976–1984.

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.

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, wolves are being harvested and regional staff believe the regional population is increasing (D. Reynolds, pers. comm. 2011), based on direct observation, increasing prey availability (e.g., reintroduction and expansion of Roosevelt elk populations), and anecdotal reports.

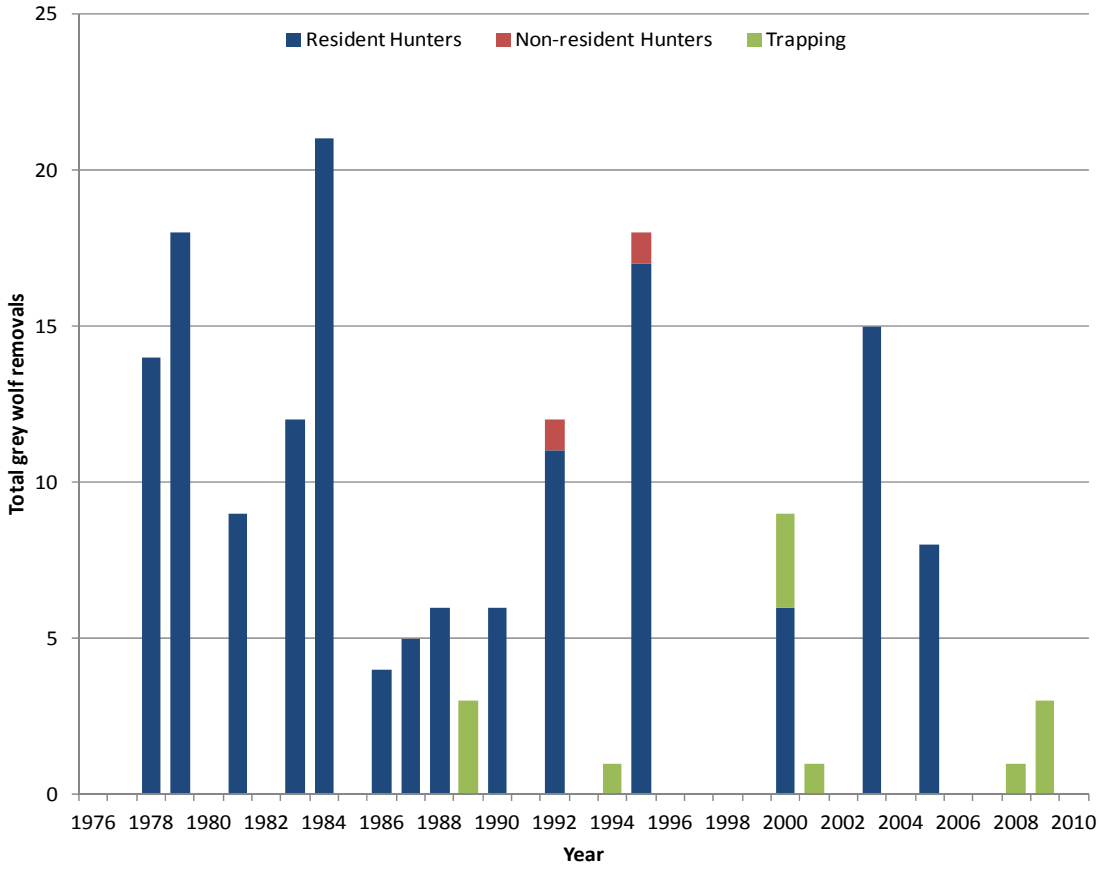

Figure A2. Harvest of wolves in Region 2 (Lower Mainland), 1976–2010. Non-resident harvest data were not available for 1976–1980. Trapping data were not available for 1976–1984.

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).

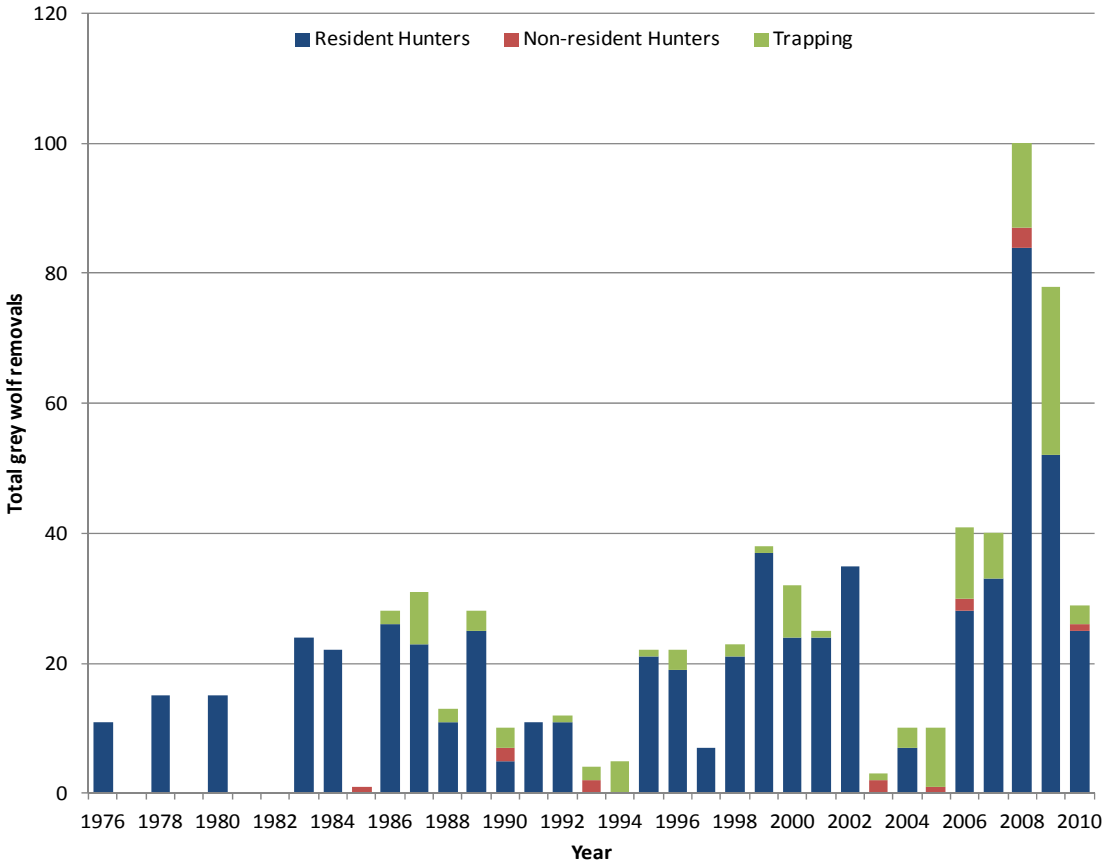

Figure A3. Harvest of wolves in Region 3 (Thompson), 1976–2010. Non-resident harvest data were not available for 1976–1980. Trapping data were not available for 1976–1984.

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.

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).

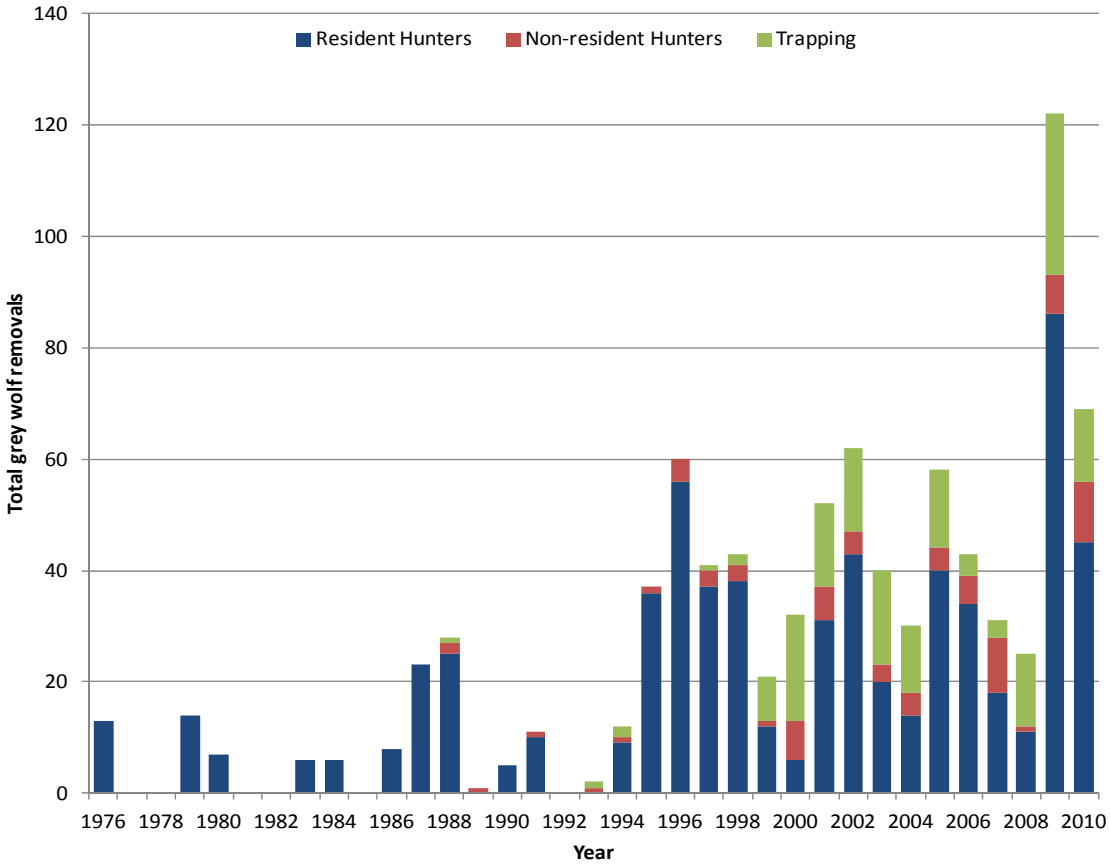

Figure A4. Harvest of wolves in Region 4 (Kootenay), 1976–2010. Non-resident harvest data were not available for 1976–1980. Trapping data were not available for 1976–1984.

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 Highlands 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 data indicate a substantial increase in both resident harvest and trapping (Figure A5).

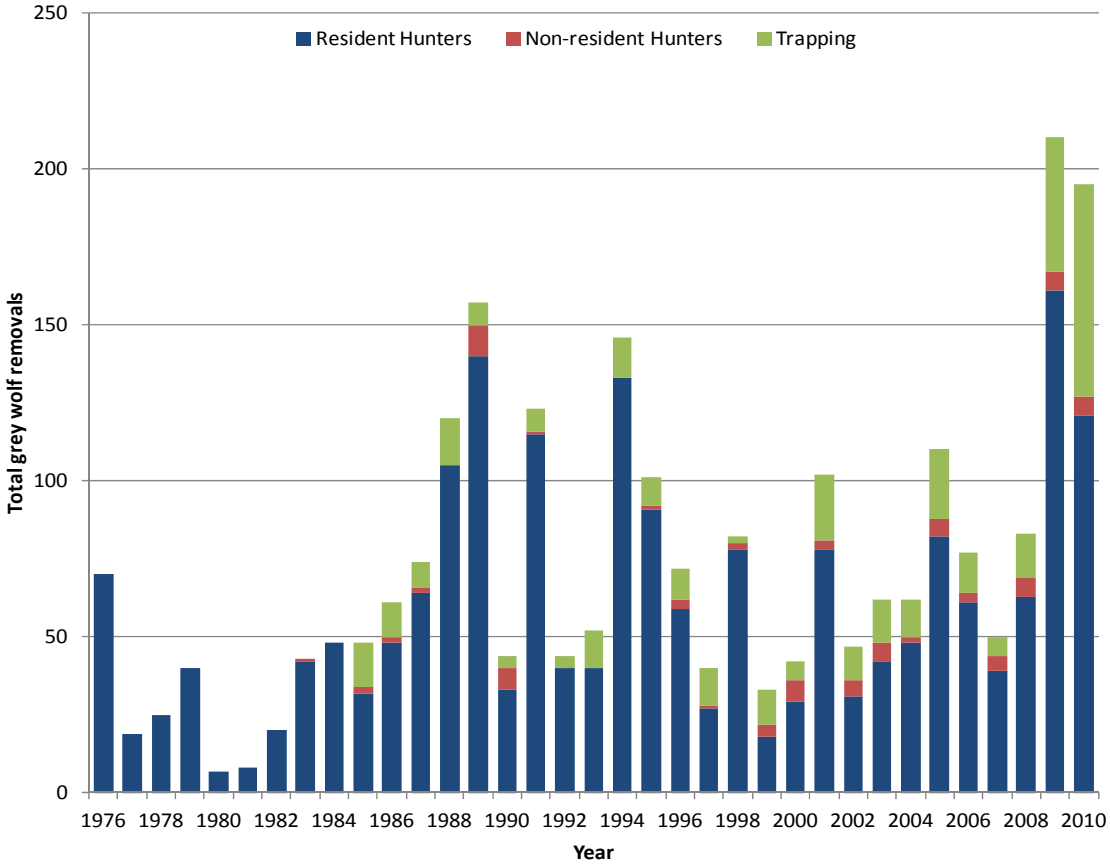

Figure A5. Harvest of wolves in Region 5 (Cariboo), 1976–2010. Non-resident harvest data were not available for 1976–1980. Trapping data were not available for 1976–1984.

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 (**Error! Reference source not found.**6). Harvest peaked in 2007 and has declined since. There is little information in the harvest data to infer a population change over the past 25 years.

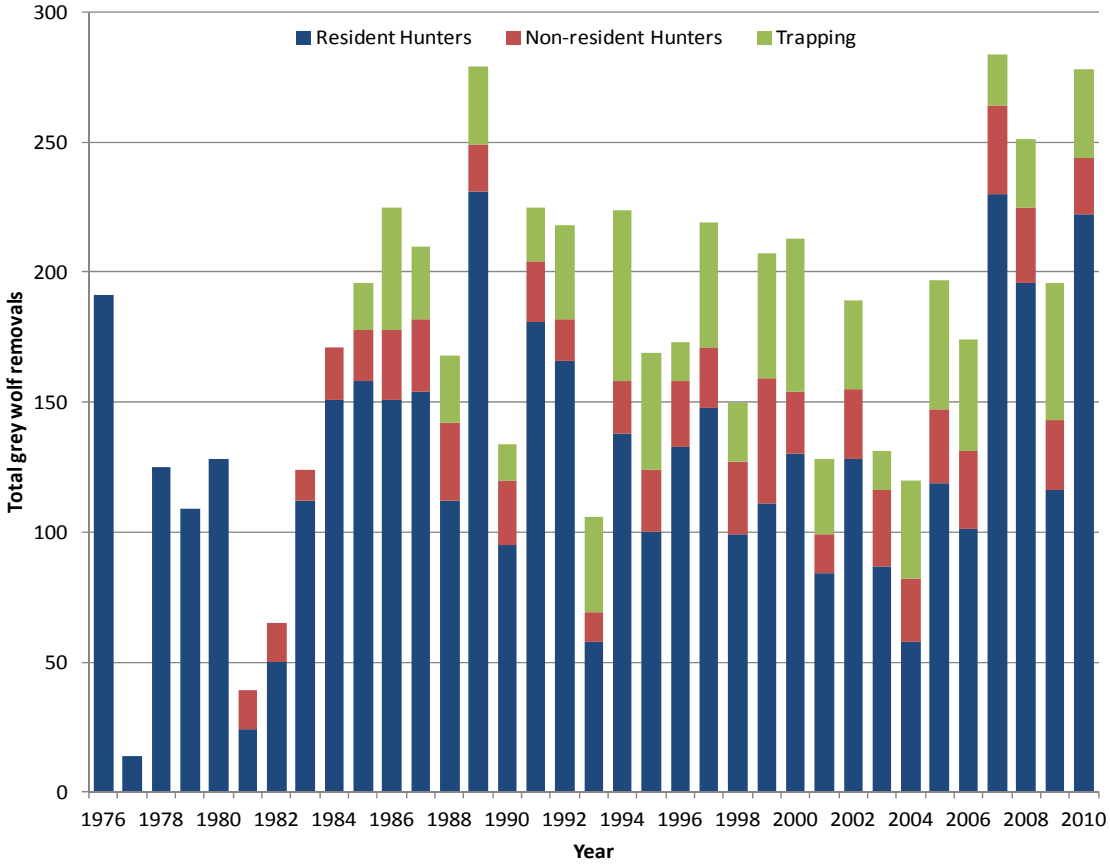

Figure A6. Harvest of wolves in Region 6 (Skeena), 1976-2010. Non-resident harvest data were not available for 1976-1980. Trapping data were not available for 1976-1984.

Region 7a Omineca

Nearly all of Region 7a is open to wolf hunting and the season extends from 1 August to 15 June. The bag limit is 2 except in management units in caribou range where 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.

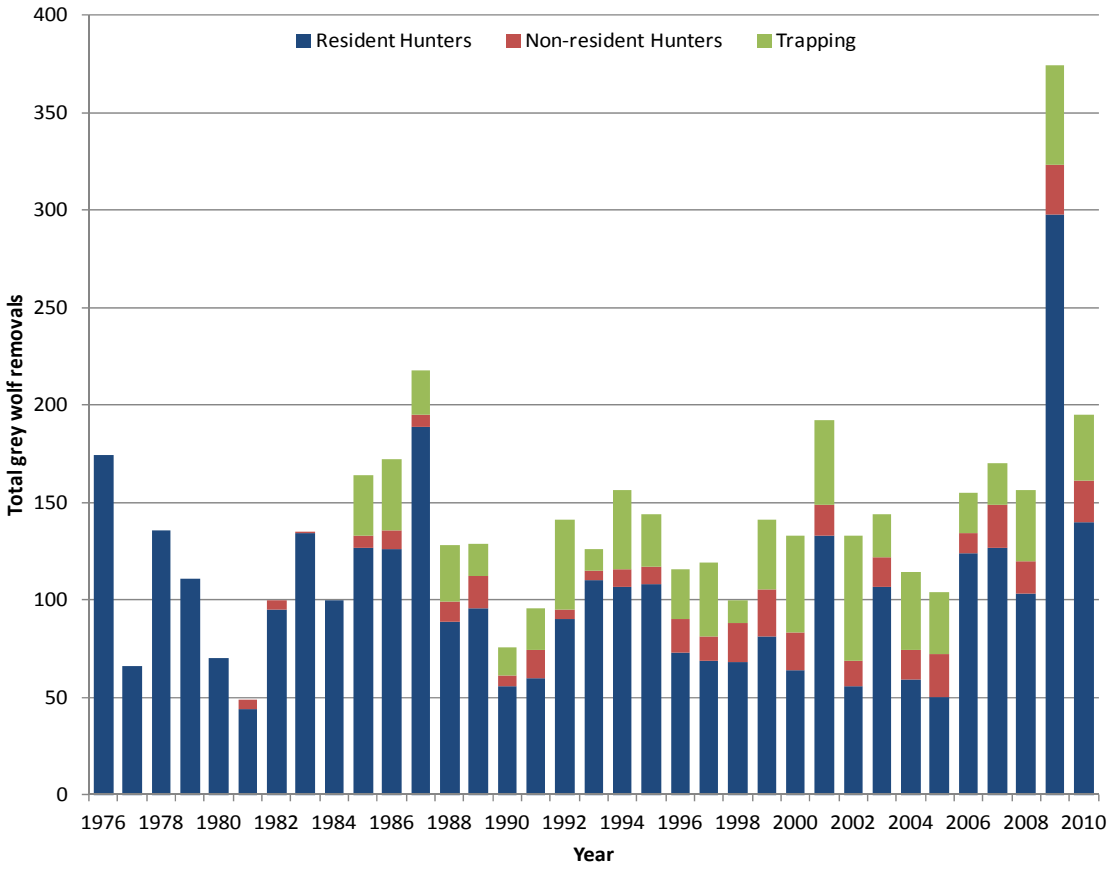

Figure A7. Harvest of wolves in Region 7a (Omineca), 1976–2010. Non-resident harvest data were not available for 1976–1980. Trapping data were not available for 1976–1984.

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.

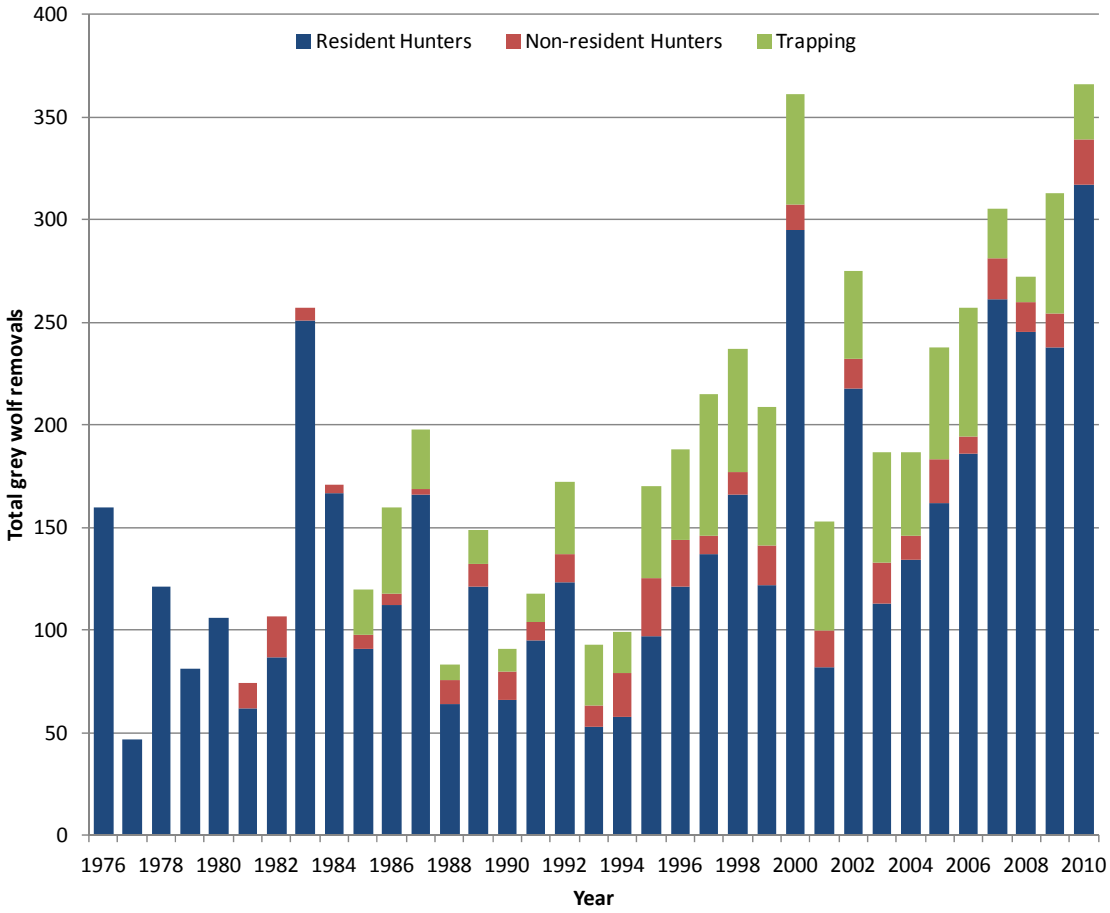

Figure A8. Harvest of wolves in Region 7b (Peace), 1976–2010. Non-resident harvest data were not available for 1976–1980. Trapping data were not available for 1976–1984.

Region 8 Okanagan

A hunting and trapping season for wolves in Region 8 was opened in 2012. 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.

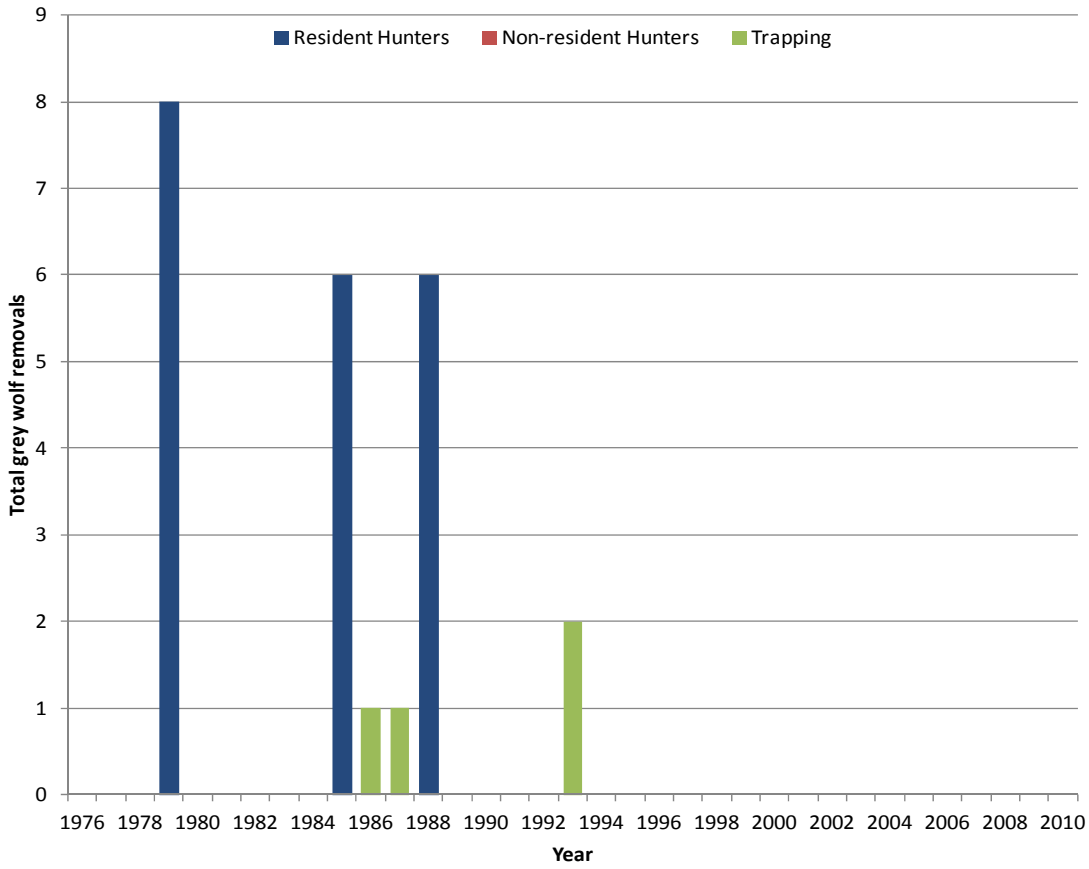

Figure A9. Harvest of wolves in Region 8 (Okanagan), 1976–2010. Non-resident harvest data were not available for 1976–1980. Trapping data were not available for 1976–1984.

APPENDIX 2. 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: This species is considered to be at low risk, the 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 increasing. There is high rescue potential from adjacent jurisdictions. This NDF is consistent with the NDF developed for Grey Wolf in Canada (http://www.ec.gc.ca/cites/default.asp?lang=En&n=BB314F25-1).

Threats analysis was conducted in 2011 and 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 or trade?	Small
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

Evaluation question	Estimate for Grey Wolf
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
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

Evaluation question	Estimate for Grey Wolf
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

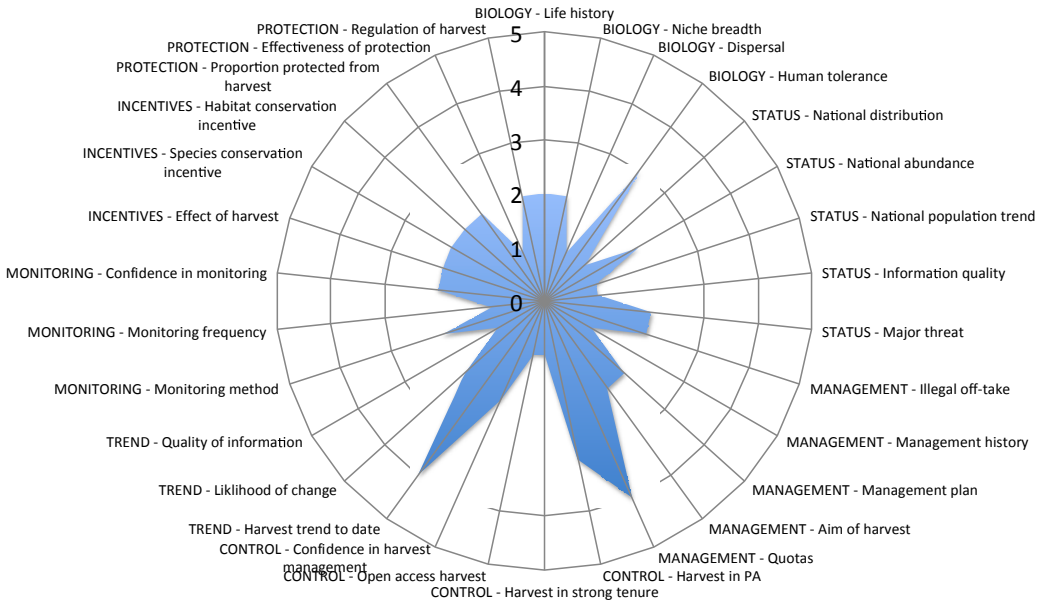

Figure A1. Radar plot of the factors affecting a CITES non-detriment finding assessment for Grey Wolf. Higher numbers represent areas that need to be considered in non-detriment findings.

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Province of British Columbia
October 6, 2011