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Management Plan for Cougars in Alberta

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Preface

This plan represents the department's goals, objectives and management strategies for the management of cougars in Alberta. It will periodically be reviewed and updated as necessary. Implementation will be subject to priorities established during the budgeting process. This plan includes historical information up to the spring of 2012.

Note: for the purposes of this publication, information is presented in a format that corresponds to fiscal years. Data for the year 2010, for example, corresponds to April 1, 2010 to March 31, 2011

Table of Contents

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Management Plan for Cougars in Alberta
Executive Summary

Historical Populations and Management

Cougar populations in Alberta have undergone significant numerical decline and range contraction as a result of prey declines and direct persecution that accompanied human settlement. Cougars probably reached their lowest numbers in the early 1900s, and may have been relegated primarily to remote mountainous areas at that time. Cougar populations likely increased throughout the early part of the 20th century; however, they were subject to bounty payments from 1937 to 1964, which may have limited population growth. From the time they were first declared big game animals and managed with regulated hunting seasons in 1971, cougar populations have increased in number and expanded in distribution. A quota system was implemented in 1990 to ensure that hunting harvests were sustainable even as interest in cougar hunting increased. Cougar management was adjusted throughout the 1990s and 2000s to reflect a growing population, with several new hunting areas added as cougars continued to expand their range.

Current Status

Approximately 2,050 cougars are estimated to exist in Alberta. Populations are highest in the mountains, foothills, and southern boreal forest, gradually declining from south to north. Cougars are well established in much of the Parkland region and in the Cypress Hills, and appear to make use of major river drainages in the Prairies region. An abundant cougar population in Alberta is reflective of plentiful ungulate herds, and climate change coupled with human-caused landscape modification should only improve conservation prospects for the species.

Management Goals, Objectives and Strategies for the Future

Cougars are appreciated for their intrinsic value and as a trophy game animal, yet they can cause conflicts with people through predation on pets and livestock, and can create public safety concerns. Cougar management in Alberta will reflect a need to balance cougar conservation with strong public sentiment that opposes the presence of cougars in rural residential and agricultural landscapes. Management objectives and strategies will include:

- Ensuring that cougar populations are protected from significant decline and that viable populations are maintained.
- Maximizing the benefits to Albertans through optimum allocation of the cougar resource amongst recreational, commercial, and other users.

- Maximizing the recreational benefits and enjoyment to Albertans from the cougar resource through the provision of a variety of recreational opportunities, including viewing and hunting.
- Providing a commercial benefit to Albertans from the cougar resource through tourism and non-resident hunting.
- Minimizing property damage and risks to human safety caused by cougars by ensuring that cougar predation on livestock and pets is reduced as much as possible, continuing the Wildlife Predator Compensation Program, and removing or relocating offending individuals.
- Promoting and encouraging scientific and educational activity to enhance knowledge of cougars.

1.0 Introduction

The cougar (Puma concolor) is one of North America's most charismatic wildlife species. Albertans have generally demonstrated an increasing tolerance for the continued sustainable management of the species, yet public opinion surveys still indicate an almost irrational fear towards this large cat (Knopff 2011). Recent research in Alberta and elsewhere has shown that cougars are extremely capable of living in close proximity to human activity, perhaps more so than any other large carnivore in North America (Sweanor et al. 2008, Orlando et al. 2008, Knopff 2011). This has created new challenges for both the wildlife managers who are responsible for cougar management and for rural residents that now share their backyard with cougars.

Alberta's first Cougar Management Plan (Alberta Forestry, Lands and Wildlife 1992) was based on a comprehensive research project in Sheep River and was used to guide cougar management in the province for two decades. This management plan provided recreational opportunities and mechanisms to deal with cougar-human conflict and achieved the objective of a slowly expanding and increasing cougar population. Over the term of that plan, knowledge of cougar ecology, population dynamics and response to hunting increased, with research conducted across North America including a seminal study on cougar predation habitats completed in west-central Alberta. At the same time, wildlife managers have adaptively modified management objectives and strategies from the 1992 plan through changes in the hunting regulation to address an increasing interest in cougar hunting, an increasing cougar population, and increasing conflicts with humans. By the late 2000s, it became clear that substantial changes to the province's Cougar Management Plan were needed in order to reflect the new reality of an abundant, widely distributed cougar population that was interacting with residents on a more regular basis.

Extensive consultations with stakeholders, public opinion surveys, and discussion with other jurisdictions have all contributed to the development of this revised Cougar Management Plan for Alberta. This plan reviews the biology of cougars, as well as their history and management in Alberta. It also summarizes the current status and use of the species in the province. Finally, it outlines goals, objectives and management strategies for the future conservation and use of cougars in Alberta.

2.0. Background

2.1 Biology

2.1.1 Habitat

Cougars are habitat generalists, making them among the most adaptable and wide ranging mammals in the world. Their range extends from northern Alberta and British Columbia to the southern tip of South America. In between, cougars thrive in a wide range of ecosystems including deserts, equatorial jungles, boreal forests, mountains, and swamps. Large expanses of open habitats without substantial forest cover or topographic structure (e.g., prairies) are rarely used by cougars, nor are places where human populations are extremely dense (e.g., cities). Even where physical habitat characteristics are appropriate for cougars, sufficient prey must be available to support a cougar population. Prey availability, coupled with human tolerance, are therefore key components of cougar habitat.

2.1.1.1 Home range characteristics

Beier (2009) identifies a set of three landscape level characteristics that meet cougar home range requirements:

1. adequate availability of prey;
2. ample vegetative cover or topographic ruggedness for hunting, security during feeding and kitten rearing; and
3. limited anthropogenic disturbance and persecution.

In Alberta, these characteristics are met in many mountainous and forested natural regions and sub-regions. Although cougars avoid large expanses of open habitat in agricultural or prairie landscapes, they can take advantage of islands of forested habitat to establish home ranges, such as the Cypress Hills in southeastern Alberta and southwestern Saskatchewan. In fact, cougars in the Cypress Hills occur at some of the highest densities recorded in North America, probably because of high prey density that occurs in an 'island' of available habitat (Bacon et al. 2009). The fact that cougars tend to avoid open habitats led Van Dyke et al. (1986) to suggest that cougars will not establish home ranges that overlap recent logging activity. However, data from GPS collared cougars in west-central Alberta disputes this claim and several cougars had home ranges encompassing not only recently logged areas but also on-going logging activity. Oil and gas development and associated linear features (e.g., roads, pipelines, and seismic lines) also can be successfully

incorporated into cougar home ranges (Knopff 2011). In some cases, cougars may benefit from forest openings created by industrial development and agriculture because it increases the amount of edge habitat within the home range. Cougars use edge habitat for hunting (Laundre and Hernandez 2003), exhibit strong selection for this habitat type (Knopff 2011), and sufficient edge habitat may be an important requirement for home range establishment (Laundre and Loxterman 2007).

Cougars can incorporate areas of high human activity such as farms, ranches and small rural communities into their home range (Knopff 2011). Even residential developments at the edge of urban areas can be incorporated into cougar home ranges if they maintain sufficient natural landscape features and attract prey animals such as deer (Knopff 2011, Kertson et al. 2011). However, there appears to be a threshold of human use beyond which cougars do not incorporate anthropogenic landscapes into their home ranges. For example, cougars tend to select home ranges that abut rather than encompass major roads (e.g. high volume divided highways) and high density urban development (Dixon and Beier 2002, Arundel et al. 2007, Orlando et al. 2008, Kertson et al. 2011). Forays into urban areas are rare and tend to occur along natural areas such as forested ravines or river valleys (Beier 1995). Similarly, although cougar home ranges do occur in agricultural landscapes, home ranges may be more likely to abut rather than encompass large areas of high density agriculture where forest cover is limited.

Cougar home range size is highly variable, and depends on a number of ecological factors including prey availability and landscape features within the home range (Logan and Sweanor 2001, Grigione et al. 2002, Laundre and Loxterman 2007). Home ranges are larger when habitat is of lower quality or prey less abundant; prey catchability may be more important than prey abundance, and cougar home ranges may be larger where prey is abundant but less available in appropriate hunting habitat (Laundre and Loxterman 2007). Male cougars also have much larger home ranges than females. In Alberta, annual adult female cougar home ranges have been reported between 62 km^2 and 412 km^2 and annual adult male home ranges between 221 km^2 and 1,311 km^2 (Ross and Jalkotzy 1992, Knopff 2010). Annual areas used by young cougars in the process of establishing a home range can be much larger, and an area of 3,502 km^2 was used by one sub-adult male in west central Alberta over the course of 212 days (Knopff 2010).

Cougars in Alberta establish home ranges in a variety of habitats ranging from backcountry areas in the Rocky Mountains to rural agricultural landscapes adjacent to urban centers (Knopff 2011). Recently, cougars appear to have been expanding their range north into the boreal forest and establishing home ranges there (Anderson et al. 2009, Knopff et al. 2013). Cougars do not establish home ranges in the open prairies and agricultural developments outside of linear riparian habitats in the southeast of the province, and home ranges do not overlap major urban centers.

2.1.1.2 Habitat use within home ranges

In forested environments, the habitat feature most consistently selected by cougars is the edge of forests and open areas, which may provide optimal hunting opportunities (Logan and Irwin 1985, Laing 1988, Dickson and Beier 2002, Holmes and Laundré 2006, Laundre and Loxterman 2007, Knopff 2011). Although open areas are required for creating the edges selected by cougars, open habitats tend to be avoided (Logan and Irwin 1985, Williams et al. 1995, Dickson and Beier 2002, Knopff 2011). Similarly, large expanses of contiguous forest without edge habitat are avoided by cougars (Knopff 2011). Cougars do use non-treed habitats where other landscape features facilitate stalking prey. For example, in mountainous terrain, cougars use rock outcrops and other variations in topography to conceal themselves as they approach prey (Logan and Irwin 1985, Logan and Sweanor 2001).

Other features that tend to be selected by cougars include riparian zones (Dickson and Beier 2002), shrub habitat (Logan and Irwin 1985, Dickson and Beier 2002, Knopff 2011), and areas of topographic ruggedness such as draws, canyons, rock outcrops (Logan and Irwin 1985, Laing 1988, Arundel et al. 2007). Cougars select almost impenetrable vegetation for kitten den sites (Beier et al. 1995). Features generally avoided by cougars include grasslands (Dickson and Beier 2002) and agricultural/pastureland (Laing 1988). Overall, cougars tend to avoid anthropogenic features including roads, buildings, well-sites, and pipelines (Van Dyke et al. 1986, Orlando et al. 2008, Kertson et al. 2011, Knopff 2011).

Variation in selection occurs between study areas and within study areas between individual cougars. For example, instead of seeking higher topographic ruggedness, cougars in one southern California study selected flatter terrain (Dickson and Beier 2002). In west-central Alberta, cougars exhibited substantial individual variation in habitat selection patterns, such that some cougars avoided habitats that others selected (Knopff 2011). Variation in selection patterns demonstrates the flexibility in cougar habitat use and their ability to adapt to changing conditions. Flexible habitat use appears to be a key reason that cougars are able to adapt to anthropogenic landscape change and establish home ranges in rural landscapes and in urban-wildland interfaces.

One way cougars adapt to human use of the landscape is to alter habitat selection temporally (Ruth 1991, Orlando et al. 2008, Sweanor et al. 2008, Knopff 2011). Cougars avoid areas of human activity or development during the day but will use these same areas more frequently at night. For example, in Clearwater County, Alberta, cougars used forest patches and river valleys far from human activity during the day, but increased their use of edges of agricultural fields and reduced their avoidance of buildings and roads at night when people are less active (Knopff 2011).

Another way cougars adapt to anthropogenic landscape change is to alter their fundamental response to those features. For instance, cougars in remote areas may strongly avoid anthropogenic

features such as roads and well sites, whereas cougars living with more of these features within their home ranges may adapt to them and avoid them less. In the Clearwater County, cougars avoided most anthropogenic landscape features in wilderness areas but cougars in more developed areas appeared to habituate to some anthropogenic landscape features such as pipelines, seismic lines, well sites, and buildings (Knopff 2011). Cougars increased their avoidance of roads in more developed areas, possibly because of increased traffic volumes (Knopff 2011). Data on habitat selection obtained from cougars in remote areas, therefore, may not predict cougar space use well in more developed landscapes.

2.1.2 Population dynamics

Extensive research has been conducted on cougar population dynamics in western North America, especially for hunted populations. Data specific to Alberta are available primarily from a long-term study at Sheep River during the 1980s, which provides the best provincial data on cougar population dynamics. These data have been supplemented with information from more recent studies, particularly the Central East Slopes Cougar Study conducted between 2005 and 2008 in Clearwater County.

2.1.2.1 Reproduction

Although adult cougars are generally solitary animals, reproduction is achieved using short-term mating associations within a polygamous mating system. Female cougars are not territorial and substantial home range overlap is common in most places where cougars have been studied, including in Alberta (Logan and Sweanor 2009, Bacon 2010, Knopff 2010). Male cougars are territorial and their territories are normally several times larger than female home ranges in the same area, providing potential reproductive opportunities with multiple females. Males actively defend territories and their access to females, with fights between males often resulting in severe injury or death (Logan and Sweanor 2001, Lotz 2005, Logan and Sweanor 2009). Nevertheless, adult male territories do overlap (Logan and Sweanor 2009, Knopff 2010), sometimes by as much as 50 to 70 per cent (Logan and Sweanor 2001). Therefore, in addition to being polygamous, cougar mating systems also can be promiscuous (i.e., both sexes can breed with multiple individuals of the opposite sex), and female cougars sometimes mate with several males during a single estrous cycle (Logan and Sweanor 2001).

Female cougars produce their first litters anywhere from 22 to 40 months of age (Logan and Sweanor 2001). In Alberta, six known-age females had their first litters at an average age of 30 months (Ross and Jalkotzy 1992). Females are capable of coming into estrous repeatedly if they are unable to find a mate or if they lose a litter. Consequently, cougars can breed and produce young at any time of the year, although studies in western North America show that births tend to peak during July to September and are at their lowest during January to February (Cougar Management

Guidelines Working Group 2005). When the late stages of gestation and kitten birth occur during spring and summer, female cougars can take advantage of the increase in vulnerable young ungulate prey (Knopff et al. 2010a). In Alberta and other northern jurisdictions, extreme winter weather may also reduce survival of newborn kittens. Average gestation for cougars is 92 days (Anderson 1983; Logan and Sweanor 2001) and litters normally consist of two to three kittens (Ross and Jalkotzy 1992, Murphy 1998, Logan and Sweanor 2001). Litter size may vary as a function of environmental conditions such as prey availability (Stoner et al. 2006, Quigley and Hornocker 2009).

Female cougars give birth to kittens at nursery sites, which typically consist of heavy cover, including deadfall, rocks, tree wells, and sometimes even small caves (Beier et al. 1995). Kittens are born spotted with their eyes and ears closed. They remain at the nursery site for the first six to eight weeks of life as they gain their sight and hearing and begin to move around, although mothers may move kittens if the site is disturbed. During the nursery phase, a mother cougar must leave her kittens alone when she is hunting, sometimes travelling substantial distances from the nursery site. After about eight weeks, kittens begin traveling to kills with their mothers; however, mothers continue to spend substantial time apart from the kittens while hunting (Laundre and Hernandez 2008). Kittens remain with their mothers until they are one to two years old. By this time, young males can be substantially larger than their mothers, and family groups are sometimes confused for mating associations or even a "pack" of adult cougars travelling together. As a result of kitten dependence over such long periods, cougars exhibit long inter-birth intervals (e.g., 17 to 24 months; Ross and Jalkotzy 1992, Lindzey et al. 1994, Logan and Sweanor 2001).

Despite long inter-birth intervals, cougars are capable of relatively rapid population growth compared to some other large carnivores (e.g., grizzly bears or wolverines). Several aspects of female cougar ecology provide potential for a relatively high natural rate of increase:

1) Females reach sexual maturity and produce large litters at a young age;

2) All adult females in the population can reproduce;

3) If a litter is lost, females can quickly become pregnant again; and

4) A lack of female territoriality permits cougars to congregate where prey are abundant (Pierce et al. 2000a; Logan and Sweanor 2001).

The cougar population at Sheep River, for example, grew by as much as 55 per cent (2.7 cougars per 100km^2 to 4.2 cougars per 100km^2) during 1984 to 1989, a result driven primarily by local recruitment of adult females (Ross and Jalkotzy 1992). Importantly, cougar population growth appears to be limited by prey availability (Pierce et al. 2000a; Logan and Sweanor 2001), not a territorial land tenure system as originally postulated by Seidensticker et al. (1973).

Adult male cougars do not participate in kitten rearing. Indeed, adult males sometimes kill kittens when they encounter them, a behaviour that may be part of the male cougar reproductive

strategy. Killing kittens sired by unrelated males can increase the reproductive success of the infanticidal male by providing an opportunity to breed with the female sooner, and this behaviour may be relatively common in heavily hunted populations (Ross and Jalkotzy 1992, Logan and Sweanor 2001, Cooley et al. 2009). This contradicts the hypothesis that hunting male cougars increases kitten survival, which is a belief that was held by many cougar outfitters in Alberta in the late 1990s (Ross and Stevens 1999).

2.1.2.2 Mortality and Survival

Primary causes of mortality in cougar populations vary depending on whether cougars are hunted or not. Where they are hunted, most adult cougars are killed by hunters (Anderson and Lindzey 2005, Lambert et al. 2006, Stoner et al. 2006, Cooley et al. 2009, Robinson and DeSimone 2011). Where cougars are not hunted, adults tend to be killed by other cougars (Hemker et al. 1984, Logan and Sweanor 2001), by vehicles, and through removal by management agencies due to conflict (Beier and Barrett 1993).

Causes of kitten mortality have been less well studied. In populations where kittens were monitored, most deaths are a result of natural causes such as starvation or infanticide by males (Logan and Sweanor 2001, Cooley et al. 2009). In most North American states and provinces, including Alberta, hunters are not permitted to shoot spotted kittens or females cougars travelling with spotted kittens. Consequently, no direct kitten mortality due to hunting is expected in these jurisdictions. However, hunting can contribute to kitten mortality indirectly in one of two ways. First, where hunting creates high male turnover, greater numbers of kittens may die from infanticide attributed to the subsequent movement of unrelated males into the area (Ross and Jalkotzy 1992, Logan and Sweanor 2001, Cooley et al. 2009). Second, because mothers spend substantial time away from their kittens (Laundre and Hernandez 2008), hunters may inadvertently kill females that have dependent kittens because the female is traveling alone (i.e., does not appear to have kittens). Recent research in Montana indicates that in hunted populations, starvation of orphaned kittens may be more common than death by infanticide (Robinson and DeSimone 2011). The extent to which dependent kittens are orphaned by hunters is unknown, but may be substantial in some areas. In a heavily hunted management unit in Utah, at least 11 kittens from five litters were orphaned when their mothers were killed due to hunting or depredation control (Stoner et al. 2006). In west-central Alberta, two of seven adult females killed by humans (one hunter harvest; one accidental snaring) had dependent kittens. On the other hand, no kitten orphaning was documented during a large-scale study of cougar survival and mortality in a heavily hunted area in Washington (Cooley et al. 2009).

Cougars are hunted in Alberta and hunting is the primary source of adult cougar mortality on provincial lands. During 1981 to 1989, the Sheep River Cougar Study documented 27 mortalities of

marked cougars. Of these, 63 per cent were killed by licensed hunters (Ross and Jalkotzy 1992; Table 1). Similarly, during 2005 to 2010, the Central East Slopes Cougar Study documented 22 representative mortalities of marked animals in the Clearwater County, of which 68 per cent were killed by licensed hunters (Knopff 2010; Table 1). Accidental trapping was also an important mortality source in the Central East Slopes Cougar Study (Table 2.1), and number of cougars snared by trappers targeting wolves in Alberta has been increasing since 1997 (Knopff et al. 2010b).

Table 2.1. Mortality of radio-collared cougars in two Alberta research projects

	Sheep River Study (1981-1989)		Central East Slopes Cougar Study (2005 – 2010)	
Mortality Cause	Number	Percent	Number	Percent
Legal Harvest	17	63	15	68
Illegal Kill	1	4	1	5
Accidental	0	0	4	18
Trapping				
Male Cougar	3	11	0[a]	0
Natural Accident	1	4	1	5
Disease	2	7		0
Problem	0	0	1	5
Animal/Landowner				
Kill				
Unknown	3	11	0	0
Total	27		22	

[a] Although no collared cougars were killed by other cougars, collared adult male cougars killed 2 un-collared cougars during the study

In Alberta's protected areas (e.g., National and Provincial Parks), natural sources of mortality may dominate, but most adult cougars in Alberta probably die as a direct result of human activities (e.g., 67 per cent in Sheep River and 95 per cent in the Clearwater County). Although human caused

mortality, especially hunting, is likely the primary source of cougar mortality in many jurisdictions, including Alberta, the effect of human-caused mortality on local or regional cougar populations depends on the extent to which mortality is compensatory or additive, annual survival rates for individual cougars, and whether or not source-sink dynamics are operating at large spatial scales.

Compensatory mortality occurs when reductions in population size result in density-dependent increases in birth rates, survival, or immigration that "compensate" for lost individuals. Compensatory mortality is central to sustainable harvest of wildlife populations because it provides increased opportunity to harvest a population without causing long-term decline (Caughley and Sinclair 1994, Boyce et al. 1999, Czetwertynski et al. 2007). Quigley and Hornocker (2009) suggest that human-caused cougar mortality is often compensated for in cougar populations by reductions in natural mortality. This view is consistent with a number of studies that found low rates of natural mortality in hunted cougar populations (Ross and Jalkotzy 1992, Anderson and Lindzey 2005, Lambert et al. 2006, Knopff et al. 2010b), in contrast with higher rates of natural mortality found in unhunted populations (Hemker et al. 1984, Beier and Barrett 1993, Logan and Sweanor 2001). On the other hand, some recent studies have found that hunting mortality was not compensated for by reduced natural mortality, increased reproduction, or higher kitten survival, suggesting that hunting mortality is largely additive (Cooley et al. 2009, Robinson and DeSimone 2011). However, in both of these cases, population growth rates were influenced by high rates of immigration (Robinson et al. 2008, Cooley et al. 2009, Robinson and DeSimone 2011), indicating that immigration may provide an alternative means via which populations can compensate for high rates of mortality.

Cougar populations appear to be capable of accommodating substantial harvest. A non-hunted cougar population in Utah recovered from a 27 per cent experimental reduction in resident adults in just nine months (Lindzey et al. 1992). Logan and Sweanor (2001) experimentally reduced a cougar population in New Mexico to less than half of the original number of adults and the population subsequently grew rapidly, recovering over a two year period. Similarly, Anderson and Lindzey (2005) found that after a 66 per cent population reduction due to heavy hunting in Wyoming (i.e., 43 per cent of the population removed annually for two years), the population recovered within three years when hunting pressure was reduced to 18 per cent annual removal. In one Washington study, an attempt to reduce a cougar population through liberal hunter harvest was unsuccessful, despite removing more than 24 per cent of cougars annually through hunting (Robinson et al. 2008). However, sustained annual harvest of greater than 40 per cent of adult cougars over four years for a heavily hunted population in Utah caused rapid population decline and reduced age structure over a large area, resulting in slow recovery when hunting pressure dropped below 30 per cent annual harvest (Stoner et al. 2006).

In Alberta, annual cougar survival was high at Sheep River during a period of light harvest in the 1980s, and the population grew rapidly (Ross and Jalkotzy 1992). During 2005 to 2008 in Clearwater

County, heavy hunter harvest and incidental snaring by trappers resulted in estimated annual survival for independent females of 70 per cent (95 per cent CI 53 to 87 per cent), annual survival for independent males of 60 per cent (95 per cent CI 38 to 84 per cent), and annual population level survival of 67 per cent (95 per cent CI 53 to 81 per cent), which may have put the local population at risk of decline (Knopff et al. 2010b). Available evidence suggests that cougar population may decline when total annual adult cougar survival is sustained below 60 to 70 per cent and when female survival is sustained below 75 to 80 per cent (Anderson and Lindzey 2005, Lambert et al. 2006, Stoner et al. 2006). However, variation in the ability of cougar populations to sustain harvest will depend on the spatial scale over which heavy harvest occurs and the dynamics of adjacent populations which may supply immigrants in a source-sink population framework (Robinson et al. 2008).

2.1.2.3 Dispersal and source-sink dynamics

Cougars have excellent dispersal capabilities. Male cougars almost always disperse, whereas some females choose to stay close to their natal area, setting up home ranges that partially overlap with that of their mother (Ross and Jalkotzy 1992, Logan and Sweanor 2001); however, many females disperse away from their natal area (Logan and Sweanor 2009). Female cougar dispersal probably occurs in a density dependent fashion, such that female dispersal rates are higher when local populations are abundant relative to available habitat and prey (Logan and Sweanor 2009). When resources are scarce because of high cougar density, the advantages conferred on females that stay close to related females may decline, leading some young females to seek habitats away from kin but with less competition (Logan and Sweanor 2009). Although males typically disperse further than females, both sexes are capable of extremely wide ranging dispersal events. Straight line dispersal distances as far as 1,067 km and 357 km have been recorded for males and females, respectively (Thompson and Jenks 2005, Stoner et al. 2008). Cougars are known to disperse through a variety of landscapes, many of which contain poor quality habitats that would be avoided by cougars under other circumstances (e.g., dispersal across prairies, through areas with heavy human populations, and over major freeways (Sweanor et al. 2000, Thompson and Jenks 2005, Stoner et al. 2008).

Good dispersal abilities mean that cougar populations are well connected at broad regional scales. Genetic evidence indicates that cougars in North America may exist as mega-populations, with little differentiation across vast areas (Anderson et al. 2004, Biek et al. 2006). This indicates that immigration and emigration over broad geographic regions may be especially important factors in cougar population dynamics. Areas with low mortality rates and cougar densities close to carrying capacity are likely to generate emigrants (sources), whereas areas with high mortality and cougar densities below carrying capacity are likely to attract immigrants (sinks). These source-sink dynamics can create stability in local cougar populations, even where local survival and reproductive rates

suggest that a closed population should either be increasing (stability achieved through emigration; Cooley et al. 2009) or declining (stability achieved through immigration; Robinson et al. 2008, Cooley et al. 2009).

Therefore, to achieve cougar population reduction, increased mortality may need to occur at very large spatial scales (e.g. Stoner et al. 2006); otherwise immigration may offset high rates of local mortality (Robinson et al. 2008). In cases where cougar populations have been reduced experimentally through translocation or hunting, immigration from nearby source populations plays an important role in recovery and stability (Lindzey et al. 1992, Logan and Sweanor 2001, Anderson and Lindzey 2005, Stoner et al. 2006, Robinson and DeSimone 2011). However, immigration may not replenish female cougars as quickly as males. Several studies show that local recruitment of females is essential for population growth and recovery (Lindzey et al. 1992, Ross and Jalkotzy 1992, Logan and Sweanor 2001, Anderson and Lindzey 2005). Even where populations remain numerically stable, shifts to younger overall age structure is likely in sink populations (Anderson and Lindzey 2005, Robinson et al. 2008, Robinson and DeSimone 2011).

2.1.3 Cougar-prey relationships

Like all felids, cougars are obligatory carnivores and must kill other animals to survive. Prey availability is a critical component of cougar home range placement, habitat selection, and population size. By killing other animals, cougars can affect dynamics of prey populations. When cougars prey on livestock or humans, they create conflict with people. Hence, understanding cougar predation is central to understanding all aspects of cougar biology, ecology and management.

2.1.3.1 Hunting behavior and food habits

Cougars hunt on the ground (not from trees) and rarely sit and wait for prey (Knopff 2010). Instead, cougars are stalking predators that move through the landscape using acute hearing and excellent vision to search for prey; once potential prey is encountered cougars use stealth to approach it until they are close enough to launch an attack (Seidensticker et al. 1973, Murphy and Ruth 2009, Knopff 2010). Cougars grasp prey with their powerful forearms and retractable claws and deliver a killing bite, generally on the throat immediately below the jaw. Smaller animals are sometimes killed by a bite to the back of the head or neck.

After making a kill, cougars drag their prey to a cache site. Animal carcasses are typically cached in dense cover, often under the low boughs of a coniferous tree. Cougars generally pluck or shear hair from their prey before consuming meat. After finishing a meal the cougar will bury the carcass with available debris including dirt, grass, sticks, leaves, and snow. Cougars typically remain in the immediate vicinity of the kill until they have consumed all edible material (including bones of young ungulates or small prey), which can take days or weeks for larger prey (Anderson and Lindzey 2003,

Knopff et al. 2009). Ungulate stomach contents (rumen) are not consumed by cougars, and they will often bury it separately from the carcass.

In many places, cougars are most active and do most of their hunting at dusk, dawn, and overnight (Beier et al. 1995, Sweanor et al. 2008). However, in west-central Alberta, cougars were active and killed prey throughout the day, with peaks in the late afternoon and evening (Knopff 2010). When hunting, cougars tend to select habitats that offer sufficient cover for stalking. Cover can be either shrubs and trees or terrain broken by boulders and small cliffs. Edge habitats between forests and open areas are especially preferred, possibly because these habitats offer high prey density with sufficient stalking cover (Laundre and Loxterman 2007).

Cougars can subsist on a wide variety of prey (Iriarte et al. 1990), but in North America deer are almost always the primary prey of cougars, although elk also make up a substantial portion of cougar diet in some places (Hornocker 1970, Ackerman et al. 1986, Murphy 1998, Anderson and Lindzey 2003, Laundre 2008). Prey preferred by cougars is predicted to be about the size of a deer or small elk based on energetic constraints models (Carbone et al. 1999). Where predation by cougars has been studied in Alberta, deer always made up the largest component of cougar diet at the population level (Ross and Jalkotzy 1996, Knopff et al. 2010a, Bacon et al. 2011, J. Banfield unpublished data). In Sheep River, mule deer were the primary prey of the cougar population (Ross and Jalkotzy 1996), whereas in Clearwater County white-tailed deer dominated (Knopff et al. 2010a). In the Cypress Hills deer made up most of the biomass consumed by cougars, but mule deer and white-tailed deer were not distinguished (Bacon et al. 2011).

Although cougar populations in Alberta subsist primarily by killing deer, a wide variety of prey is incorporated into cougar diets. In west central Alberta, cougars killed and fed on a variety of wild prey including white-tailed deer, mule deer, moose, elk, bighorn sheep, mountain goats, feral horses, other cougars, wolves, coyotes, red foxes, lynx, black bears, marten, beavers, porcupines, snowshoe hares, red squirrels, hoary marmots, grouse, ducks, Canada geese, and ravens (Knopff et al. 2010a). Moreover, although cougars kill primarily deer at the population level, prey composition also varies by age-sex class. Adult females consume mostly deer, adult males tend to focus on larger prey such as moose, elk, or feral horses, and sub-adult cougars kill more non-ungulate prey such as beavers or porcupines (Ross and Jalkotzy 1996, Knopff et al. 2010a). Similar dietary segregation by sex for cougars where males focus on large prey and females on smaller prey is also found in other parts of North America (Murphy 1998, Anderson and Lindzey 2003, White et al. 2011).

In addition to hunting for live prey, cougars also will scavenge. Scavenging behaviour by cougars has been reported from several studies, including those conducted in Alberta. Studies of cougar food habits in the Clearwater County found that cougars, like most large carnivores, are inclined to scavenge when the opportunity arises (Knopff et al. 2010b). Knopff et al. (2010b) found that scavenging was a common foraging strategy employed by most cougars in the population; that

scavenging increased during winter when carrion availability was higher; that some cougars spent a substantial portion of their foraging time consuming carrion during winter; and that healthy adult cougars with demonstrated killing ability incorporated scavenging into their foraging strategy. In the Cypress Hills, Bacon and Boyce (2010) documented a case of at least six different cougars scavenging on the carcass of a large male elk in late winter. As noted above, killing large ungulates can be dangerous for cougars, and it is therefore not surprising that cougars would take advantage of opportunities to scavenge.

2.1.3.2 Kill rates

The effect cougars have on a population of their prey depends in part on kill rate, or the frequency with which cougars kill prey. There has been substantial variation in kill rate estimates for cougars in the literature, resulting in disagreement about how often cougars kill prey and the effects cougars have on ungulate populations. For example, adult females without kittens have been reported killing as few as 15 and as many as 53 ungulates per year (Anderson and Lindzey 2003, Laundre 2005). Small sample sizes for predation sequences monitored in the field and indirect methods for estimating cougar kill rates such as energetic models make it challenging to determine which estimates are most reliable. More recently, GPS telemetry techniques have made it easier to monitor large numbers of cougars over long durations, increasing the reliability of cougar kill rate estimation (Anderson and Lindzey 2003, Knopff et al. 2009). Knopff et al. (2010a) applied these techniques and estimated cougar kill rates in west-central Alberta from 85 season and demographic specific kill rates calculated over monitoring periods averaging 107 days and yielding 1,326 predation events. On average, cougars monitored in that study killed 42 ungulates per year, but this was highly variable among individuals and depended on a number of factors, especially cougar age, sex and reproductive status. Season also had an important influence on kill rates, highlighting the importance of year-round monitoring to calculate annual kill rates.

Although biomass of prey killed did not vary significantly by season, cougars killed 1.5 times as many ungulates during summer when they focused predation on smaller and more vulnerable juvenile prey. Cougar age-sex and reproductive class had a strong influence on cougar predation patterns and females with kittens greater than 6 months old killed most frequently, averaging 1.5 ungulates per week during summer and 1.1 ungulates per week during winter (Knopff et al. 2010a). Mature adult males killed less frequently than adult females at 0.7 ungulates per week during summer and 0.6 ungulates per week during winter, but this was primarily because of the much large size of prey killed; males killed more moose, elk and feral horses and annual biomass killed by adult males was higher than any other age-sex class (Knopff et al. 2010a). Sub-adults killed ungulates least often with kill rates as low as 0.3 ungulates per week during winter for sub-adult females (Knopff et al. 2010a).

Higher kill rates identified in the Alberta study indicate a greater potential for cougars to affect prey than has been reported in some previous studies (e.g., Laundre 2005). Data from west-central Alberta also reinforce the importance of considering season and cougar population structure when investigating cougar-ungulate dynamics (Knopff et al. 2010a). These findings may also have application for using cougar harvest to manage cougar predation on ungulates. In particular, Knopff et al. (2010a) suggest that if younger cougar populations and reduced fecundity are maintained through sport hunting, as occurred in Utah and Washington (Stoner et al. 2006, Robinson et al. 2008, Cooley et al. 2009), effects of cougars on ungulate prey may decline even if cougar population density is stable because sub-adults kill fewer prey than adults and females without kittens kill less often that females with kittens. However, Knopff et al. (2010a, pg 1146) also point out that: "Managers should be cautious when applying cougar harvest to enhance ungulate populations…because the benefit to ungulates will be situation dependent, population-level predator control may not always produce the desired outcome for ungulates, and side-effects are possible, such as increased conflict with humans when average cougar age is reduced".

2.1.3.3 Prey selection

In addition to kill rate, the effects cougars have on population of prey will depend on how many animals they kill from that population and which animals they kill. Cougars are selective predators, rarely killing prey in proportion to its availability (Murphy and Ruth 2009). In single prey systems, prey selection simply comes down to the type of individuals killed within the prey population. But cougars in North America, including those in Alberta, generally have more than one ungulate prey species available to them. In such systems, cougar prey selection takes two forms, 1) which species is selected and 2) which individuals from the population of that species are selected.

Species selection may depend on a variety of factors. In general, cougar selection for a given prey type tends to increase with the relative abundance of that prey type in the home range (Knopff 2010). However, prey abundance alone does not explain much of the variation in prey selection (Knopff 2010). The most important drivers of prey selection by cougars appear to be cougar age, sex, size, and for females the number of kittens and size of kittens (Ross and Jalkotzy 1996, Murphy 1998, Pierce 2000b, Knopff 2010). In west-central Alberta, younger cougars and females tended to select smaller prey (deer or sheep), but mature cougars, especially adult males, tended to consume more large prey, occasionally selecting strongly for those prey types (Knopff 2010). Sub-adult cougars tend to target small and midsized prey, including non-ungulate prey (Murphy 1998, Knopff et al. 2010a).

Cougar population structure therefore plays a defining role in the number of each prey type killed in multi-prey systems. Just as cougar harvest may be used to alter population level kill rates, different cougar harvest strategies may change the type of prey taken by a cougar population. For

example, reducing the proportion of mature males in a cougar population may benefit larger ungulates such as moose and elk in multi-prey systems, but may result in increased predation pressure on smaller ungulates like deer and bighorn sheep (Knopff et al. 2010a, White et al. 2011).

Within a prey population, the most vulnerable individuals (e.g., the young, sick, and old) tend to be selected by cougars. Some researchers have hypothesized that cougars kill prey as encountered, resulting in a higher potential to affect prey populations because prey killed will have higher average reproductive potential than occurs when predation is selective (e.g., Wilmers et al. 2003). However, empirical data consistently indicate selection of vulnerable prey by cougars. For example, cougar predation on large ungulate species such as elk and moose tends to focus on animals less than one year old, likely because large adults of these species are more difficult for cougars to kill and impose greater risk (Hornocker 1970, Turner et al. 1992, Ross and Jalkotzy 1996, Murphy 1998, Husseman et al. 2003; Knopff et al. 2010a). Even when cougar predation focuses on deer, young animals are often selected (Pierce et al. 2000b, Knopff et al. 2010a).

Additional evidence for cougars targeting vulnerable prey comes from west-central Alberta, where cougars shift their predation patterns seasonally to take advantage of the most vulnerable ungulate classes available. Cougars killed female ungulates more often in early spring when they are in the late stages of pregnancy, male ungulates more often just before and during the rut when they are least wary, and focused predation heavily on juvenile ungulates in spring when they are vulnerable due to small size and inexperience (Knopff et al. 2010a). Although body condition of prey may not drive selection by cougars in some cases (Pierce et al. 2000b, Husseman et al. 2003), cougars disproportionately killed deer infected by chronic wasting disease in one Colorado study (Krumm et al. 2010). A general pattern of selecting vulnerable prey is consistent with a strategy to minimize risks associated with predation by targeting less risky prey (Ross et al. 1995, Logan and Sweanor 2001).

Individual cougars may also specialize on a particular prey species (Knopff and Boyce 2007). Ross et al. (1997) found that one female cougar in the Sheep River study focused predation on bighorn sheep, killing nine per cent of the bighorn population and 26 per cent of the lambs in a single winter. Declines in bighorn populations at Ram Mountain have also been attributed to predation by specialist cougars (Festa-Bianchet et al. 2006). Knopff (2010) conducted a detailed study of individual specialization by 37 cougars in west-central Alberta and found that most cougars specialized, focusing on a single prey type for which they selected strongly. Most cougars in west-central Alberta specialized on deer, but others focused on elk, bighorn sheep, moose, and feral horses.

Cougar predation on bighorns at Ram Mountain ceased abruptly in 2003 and Festa-Bianchet et al. (2006) suggested that the reason for this was the death or emigration of an individual specialist. During 2005-2008, Knopff (2010) monitored nine cougars with ranges overlapping the Ram

Mountain bighorn sheep population. Of the 313 prey killed by those cougars only one was a bighorn sheep. The bighorn population at Ram Mountain was recovering despite a cougar density of between 2.71 and 3.49 per 100 km^2 in the vicinity, highlighting the potential importance of specialization by individual cougars for cougar-prey relationships (Knopff 2010).

2.1.3.5 Predation on livestock

Livestock and pets are occasionally killed by cougars, but generally make up a very small proportion of cougar diet. Some of the most comprehensive studies of cougar predatory behaviour in North America have been conducted in Alberta, and much of the work has taken place in parts of Alberta where cougars overlap with agricultural and ranching communities. During the Sheep River study, two dogs were found killed by collared cougars out of 368 kill sites investigated (Alberta Forestry, Lands and Wildlife 1992, Ross and Jalkotzy 1996). In west-central Alberta, including ranching communities around Caroline and Rocky Mountain House and recreational communities around Canmore and Banff, livestock and pets made up less than one per cent of the 1,500 predation events visited by field crews (Knopff et al. 2010a). Similarly, in the Cypress Hills, domestic animals accounted for only 0.4 per cent of 266 predation events (Bacon et al. 2011), despite a high density population of cougars living adjacent to and overlapping with ranching communities. Finally, in the Pincher Creek and Beaver Mines area where substantial overlap occurs between cougars and livestock, only one domestic cat was identified from 159 predation events (J. Banfield, University of Alberta; unpublished data).

2.2 Cougar-Human Conflict

2.2.1 Public views on cougars

Public perception of cougars is complex. Historically, pervasive anti-predator sentiment in North America resulted in bounties and poisoning programs that contributed to the extirpation of cougars from much of the eastern portion of their range (Kellert et al. 1996, Anderson et al. 2009). In recent times, public views of cougars in North America are become increasingly positive. Cougars are valued as a big game species (Treves 2009), a wilderness icon (Gill 2009), and for their ecological role as top predators (Logan and Sweanor 2001, Ripple and Beschta 2006, Knopff 2011).

Although cougars are increasingly viewed positively, substantial variation in public opinion remains. Factors affecting public attitudes towards large carnivores in North America, including cougars, have been associated with value for wildlife (Kellert et al. 1996, Mattson and Clark 2009), socioeconomic status (Naughton-Treves et al. 2003, Mattson and Clark 2009), and social associations (Williams et al. 2002, Naughton-Treves et al. 2003). Positive and conservation-orientated views about carnivores increase with both urbanization and education, whereas hunters, ranchers and older members of the community are generally less tolerant of cougars (Williams et al.

2002, Manfredo et al. 2003, Naughton-Treves et al. 2003, Knopff 2011). Lower tolerance for cougars tends to be associated with traditional views about cougars; for example, that cougars are a competitor for game, a threat to livestock, or an economic resource (Mattson and Clark 2009, Knopff 2011).

Surveys in both the western United States and Alberta show that people living in cougar-inhabited regions typically have positive views about cougars (Manfredo et. al. 1998, Riley and Decker 2002, Thornton 2007, Knopff 2011). Two separate surveys distributed in rural Alberta, one in Clearwater County the other southwest of Calgary, found that the majority of survey participants valued cougars highly (Thornton 2007, Knopff 2011). Respondents believed that cougars were important for maintaining healthy ecosystems and wanted to see them persist on the landscape (Knopff 2011). A willingness to coexist with cougars (i.e., tolerance) was strongly linked to the amount of value respondents place on cougars (Knopff 2011).

Although people generally value cougars and want to conserve them, they also fear cougars and the potential threat posed to pets, livestock and people (Riley 1998, Thornton 2007, Knopff 2011). When respondents of the Clearwater County survey were asked for comments about cougars near their homes, remarks about being “terrified”, “afraid to leave the home”, to “let children out”, were not uncommon (Knopff 2011). Respondents to surveys in Alberta and Montana have reported a greater fear of cougars than of automobile accidents (Riley 1998, Knopff 2011). The risk ascribed to cougars greatly exceeds true risk. In Alberta, only one human fatality has been recorded as a result of a cougar attack, whereas car accidents kill over 350 people annually (Alberta Transportation 2008). Fear of cougars means that people generally have a low tolerance for maintaining cougars close to their homes. Consequently, support for cougar conservation is great as long as the animals themselves and the threats they pose are distant (Manfredo et al. 1998, Riley and Decker 2002, Knopff 2011).

Public perception has been an important driver of cougar management in the western United States. Recently, increased complaints about cougars filed with management agencies have led several states to actively attempt to reduce cougar populations through increased hunting in an effort to lessen conflict (e.g., Oregon Department of Fish and Wildlife 2006, Robinson 2008). On the other hand, public ballots in Oregon and California (driven by the urban majority) have either made it illegal to hunt cougars with hounds, or halted cougar hunting altogether (Mattson and Clark 2009).

2.2.2 Root causes of conflicts

Conflict between people and cougars occurs where the two species share the same landscape. Since the 1960s, changing public opinion, refined cougar management practices, and increases in ungulate populations have resulted in growing and expanding cougar populations in many parts of

North America, including Alberta (Anderson et al. 2009, Knopff 2010, Larue et al. 2012). This, in combination with growing human populations and rural and exurban development, means that people increasingly share landscapes with cougars, providing greater opportunity for conflict both near rural residences and for people recreating in the backcountry (Torres et al. 1996, Logan and Sweanor 2001, Baron 2004).

Conflicts arise from encounters between cougars and livestock, pets, or people. The probability of an encounter and subsequent conflict increases if cougars are attracted to places that are frequently used by people. Many domestic animals are similar to the natural prey of cougars, and cougars may be attracted to these animals as prey. Cougars have been documented killing a wide variety of domesticated animals including: goats, sheep, cattle, horses, dogs, cats, turkeys, pigs, llamas, alpacas, and chickens (Cougar Management Guidelines 2005, Knopff 2010). Although domestic animals make up a tiny fraction of cougar diet in Alberta (Knopff et al. 2010a, Bacon et al. 2011, J. Banfield, University of Alberta, unpublished data), they are an ongoing concern for people who have lost or might lose their animals. Depredation events are more likely on properties abutting cougar habitat (Torres et al. 1996) and occur more frequently at night when cougars use habitat closer to rural properties (Knopff 2011). The likelihood of a depredation event can increase if domestic animals are left to roam free outside, particularly at night.

A more serious type of conflict can arise from encounters between people and cougars. Cougar attacks can be initiated by both humans and cougars. In instances when humans approach cougars, it is highly likely that the cougar will either walk away or remain in place without demonstrating a threatening response (e.g. vocalizations, confrontational stance, or deliberate approach). Cougars that are most likely to demonstrate a threatening response when approached are mothers protecting kittens, but cougars may also act defensively protecting themselves or a kill (Sweanor and Logan 2009). Cougars do not typically see humans as prey, but when an encounter is instigated by the cougar, it is likely that the cougar is willing to expand its prey image. Underweight and young, inexperienced cougars appear to be more likely to attack people (Beier 1991, Mattson 2007). Vulnerable people (e.g. solitary, small-bodied) are more at risk of being attacked by a cougar. While Beier (1991) found that children under 16 years were more likely to be attacked than adults, in recent years more adults have been killed than children, perhaps because adults are more often alone (Torres 2005). In addition, rapid movements (e.g. running, skiing, biking, etc.) may elicit a predatory response by a cougar (Beier 1991, Fitzhugh et al. 2003, Torres 2005).

The probability that an encounter between a cougar and a person will escalate to an attack is low; although capable of killing humans, cougar rarely do so. There have been three to four attacks per year on people in North America since the beginning of the 1990's (Mattson 2007) and very few of these attacks are fatal. There have been 20 fatal cougar attacks between 1980 and 2011 (Beier 1991, Fitzhugh et. al. 2003, Sweanor and Logan 2009, Lewis 2012). As to be expected with increasing

cougar populations and more overlap between cougars and humans, however, the regularity of cougar attacks has increased, with half of fatal attacks occurring in the past 20 years (Sweanor and Logan 2009). As noted above, only one human fatality due to a cougar attack has been recorded in Alberta.

2.2.3 Methods to reduce conflict and increase tolerance

Reducing human-cougar conflict will hinge on the success of reducing opportunities for cougars and humans to interact. Because cougars and humans are increasingly occupying the same space, conflict management will rely on a cougar-conscious use of the landscape. Outdoor recreationists (hikers, trail runners, mountain bikers, cross-country skiers, etc.) should follow the following safety guidelines (Torres 2005):

1. Travel in groups and ensure that children are kept within eyesight.
2. Make noise.
3. Children playing outdoors in cougar habitat should be closely supervised and play areas should be located away from stalking habitat (forest edges, shrubs).
4. Keep pets under control, preferably on a leash.
5. Minimize activity at dusk and dawn.

Although minimizing activity at dusk and dawn may be advisable (Sweanor et al. 2008), cougars are active at all times of the day (Knopff 2010). Data from west-central Alberta indicate that early mornings in winter and the middle of the day in summer may present the lowest risk of encountering a cougar (i.e., least activity by cougars), there is still a risk of encountering cougars and cougars may be actively hunting, even in the middle of the day (Knopff 2010).

For people who live in places where cougars are also present, attractant management can be an important conflict reduction tool. Primary attractants include both wild and domestic animals. The following steps minimize the possibility of human-cougar conflict near rural residences:

1. Avoid attracting deer, elk or other potential prey of cougars to a residence (e.g., deliberate feeding, saltlicks, landscaping with high quality forage plants).
2. Minimize places where cougars could potentially hide near the home (close off decks, minimize dense shrub/tree cover)
3. Pets and hobby-farm animals should be kept in secure enclosures (i.e. indoors, covered kennels or barns), especially overnight.

Additionally, people who live or recreate in cougar country should know how to act if they encounter a cougar in order to reduce the likelihood that an encounter will escalate into an attack. These steps include:

1. Do not run.
2. Reduce your appearance of vulnerability (e.g. hold a coat overhead; wave your arms; maintain eye contact).
3. Throw sticks and rocks.
4. Carry bear spray and use it.

If the encounter escalates to an attack people should always fight back. There are several instances of humans successfully fending off a cougar by fighting back (Lewis 2012).

Education is an important tool to help maintain an informed and proactive public and may help reduce conflict and increase tolerance. This is especially true if education can increase the overall value individuals have for cougars, provide an opportunity to dispel common myths about cougars, or address inappropriate perceptions of risk. Informative signs at recreational facilities, pamphlets, and community and school presentations about safely living and recreating in cougar habitat can be useful for conflict-reduction (Sweanor and Logan 2009). Special education effort may be needed for newer residents of rural Alberta who have moved from the city to rural residential properties and may not know about the potential to encounter cougars.

Providing a variety of different education programs may increase opportunity to connect with a broad range of people and better increase tolerance. Programs that provide the opportunity to be directly exposed to animals and the chance to learn about their ecological importance can promote positive wildlife values (van den Born et al. 2001, Louv 2008). For example, in Washington State, the experiential educational program Project C.A.T. (cougars and teaching) provided opportunities for students to have hands-on experience with cougars by accompanying researchers on cougar captures and on visits to cougar kill sites (Griswold et al. 2008).

Following conflict events, media will often focus coverage on cougars, something that can strengthen public fear of cougars and decrease tolerance (Mattson and Clark 2009). Thus, applying proactive approaches to reducing conflict (as described above) are key way to increase tolerance. In the event that conflict occurs however, swift and appropriate management action to deal with the problem cougar may be essential to assuage public concerns (Cougar Management Guidelines Working Group 2005). Potential management actions for problem cougars include aversive conditioning, and translocating or killing individuals.

In cases where cougars are involved in a low risk conflict situation for the first time, aversive conditioning such as chasing with dogs or using slingshots and cracker shells may be appropriate (Cougar Management Guidelines Working Group 2005). However, the outcomes of aversive conditioning on cougars have not been well studied and the efficacy of this approach remains uncertain. Where public tolerance for cougars is low (e.g., close to urban settings; Knopff 2011) people may be less accepting of aversive conditioning.

Translocating problem cougars is often the public's preferred response to conflict events such as pet depredations and sightings (Manfredo et al. 1998, Thornton 2007). However, while translocation may be an effective tool for sub-adult cougars without established home ranges (Ross and Jalkotzy 1995, Ruth et al. 1998), for most cougars it is ineffective. Adult cougars with long established home ranges may try and return to their original home range (Ruth et al. 1998, Logan and Sweanor 2001), and Ruth et al. (1998) recommend moving cougars a distance of greater than 480km in order to preclude their return. In addition, translocated adult cougars have an increased likelihood of mortality (Ruth et al. 1998, Cougar Management Guidelines Working Group 2005). If translocation is attempted, the cougar should be moved to an area with ample prey and a moderate cougar density to maximize likelihood of successful home range establishment.

For high risk conflict events (e.g. cougar displays overly familiar behaviour towards people on multiple occasions or attacks a person) destroying the cougar is the most appropriate action (Cougar Management Guidelines 2005). In other cases, such as sightings or livestock depredations destroying the cougar may or may not be the best course of action. The primary benefit of such removals may be to assure local people that the animal has been eliminated, especially in the case of sightings.

If an individual cougar is involved in killing a domestic animal and is likely to re-offend, removal may be advantageous. However, cougars do not always reoffend. For example, in a case of llama depredation near Caroline, Alberta, the adult female cougar responsible was not translocated or killed because she had two eight week old kittens with her. Instead, she was GPS collared and closely monitored. She did not kill another domestic animal at any of the 78 predation events visited by field crews over the following year, despite maintaining a home range overlapping many rural residences and ranching operations (K. Knopff and A. Knopff, University of Alberta, unpublished data). Moreover, where cougar population densities in surrounding areas can act as sources, individuals that are removed are likely to be replaced rapidly through immigration (Robinson et al. 2008), and younger cougars that replace the individuals removed may be more likely to be involved in conflicts (Lambert et al. 2006). For the same reason, heavy hunter harvest at small spatial scales (e.g., less than 1,000km^2) may not be an effective tool for curbing human-cougar conflict (Lambert et al. 2006, Robinson et al. 2008).

2.3 Historic and Current Status in Alberta

2.3.1 Numbers and Distribution

Estimates of historic cougar distribution and population levels are based primarily on conjecture, coupled with limited written records from early explorers. Prior to European settlement, the distribution of cougars in Alberta likely included all areas along the foothills and mountains from the

49th parallel to Grande Prairie, and areas within the South Saskatchewan River drainage to the east (Preble 1908, Young 1946). During the early 1900s, sightings were recorded in the Cypress Hills and other locations east of the mountains and foothills (Soper 1964). In a publication on mammals of Jasper National Park, Soper (1970) mentioned a northward extension of the cougar's range in Alberta during the first half of the 20th century. Based on the lack of mention cougars received in several park reports, he felt that they may have been scarce or absent toward the north of the national park before that time. Whether this was true toward the east as well is not known. However, native ungulates, which constituted the primary prey populations, were greatly reduced by European settlement and cultivation, market hunting, and severe winter weather at the turn of the century (Cowan 1952, Dwyer 1969, Flook 1962, Stelfox 1964, Stelfox and Taber 1969). Consequently, cougars were probably also scarce during this period. As ungulate numbers rebounded during the first half of the 20th century (Cowan 1950, 1952; Dwyer 1969, Lloyd 1927; Stelfox 1964), cougar numbers probably increased as well.

Between 1937, when a bounty was initiated for cougars on provincial lands, and 1964, when the bounty was removed, records of bountied cougars indicate that the largest number of cougars occurred in the mountains and foothills north of the Red Deer River. During this time period, relatively few were reported from south of the Bow River. In contrast, by the 1980s the majority of hunter-killed cougars were harvested south of the Bow River, with relatively few killed in the north. Whether these mortality patterns reflect the actual relative abundance of cougars during these time periods is unknown, however anecdotal reports from houndsmen did indicate that cougar numbers were relatively low north of the Bow River in the 1980s (Alberta Forestry Lands and Wildlife 1992).

In the early 1990s, cougars were estimated to occupy approximately 72,000 km^2 of provincial lands located primarily in the foothills and mountains of southwestern Alberta (Alberta Forestry Lands and Wildlife 1992). At that time a provincial cougar population estimate was developed based on an intensive radio telemetry project near Sheep River, combined with consultations with regional wildlife biologists and houndsmen across cougar range. Cougar densities were estimated to be highest south of the Bow River, declining rapidly to the north. The provincial population was estimated at 685 cougars, including 640 outside of the national parks. While public sightings of cougars have been reported from across the province, mortality locations provide a much more robust data source with which to evaluate cougar distribution. By this measure, cougar distribution has expanded to the north and east during the past two decades (Knopff et al. 2013). They are now well established in the Cypress Hills (Bacon et al. 2010) and in the Peace Country near Grande Prairie and Valleyview (Knopff et al. 2013). A radio telemetry based estimate of cougar density near Nordegg suggests that cougar density is now approximately three times higher in that area than was estimated in the early 1990s (Knopff 2010). Overall, it appears that the Alberta cougar population

has expanded in distribution and increased in size over the past two decades, likely due to conservative harvest management and relatively abundant prey populations.

Although habitat-based methods to estimate cougar population size have been advocated (Cougar Management Guidelines 2005), this approach is not feasible in Alberta where populations are expanding, densities of deer in forested areas are poorly known, cougar habitat is primarily contiguous, and management by humans may limit cougar density below carrying capacity. Therefore, the current cougar population size was estimated using extrapolations of estimated cougar density from historic and recent radio telemetry projects (Alberta Forestry Land and Wildlife 1992; Knopff 2010), coupled with expert opinion of researchers, regional wildlife biologists, and houndsmen (Figure 2.1).

A total of 1,781 cougars were estimated to inhabit the 32 Cougar Management Areas (CMAs) in the province, with an additional 170 in protected areas (National Parks, Provincial Parks, and Wilderness Areas), and a conservative estimate of 100 on provincial lands outside of the CMAs. This resulted in a total provincial population estimate of 2,051 cougars. This estimate is extremely crude and confidence intervals cannot be calculated, particularly north of Highway 16 where no cougar research has been conducted. Nonetheless, this estimate does reflect the weight of evidence indicating an increasing population over the past two decades, as well as regional patterns in cougar density as indicated by field staff and hunters.

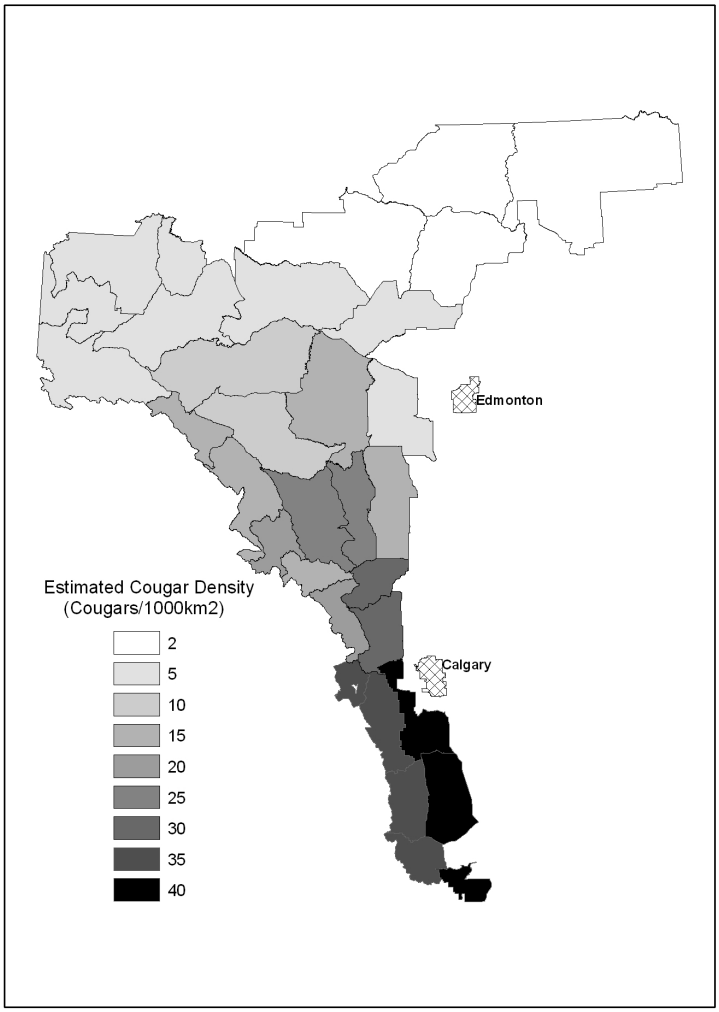

Figure 2.1. Estimated density of cougars within cougar management areas in Alberta.

2.3.2 Hunting

2.3.2.1 Hunting regulations

Hunting regulations for cougars have varied through time, reflecting changes in both cougar population levels as well as public attitudes towards large carnivores. Throughout much of the early 20th century, cougars were considered a pest species that predated on livestock and competed with humans for wild game. Cougars were first recognized as a valuable big game animal in 1969, when harvest restrictions were implemented in the form of a limited season length. Hunting regulations

continued to become more conservative until 1990, when a quota management system was implemented (Ross et al. 1996). At that time, CMAs and corresponding quotas were established to distribute cougar harvest pressure more evenly across cougar range. Increasing populations and range expansion led to minor regulation adjustments throughout the 1990s and early 2000s.

When first established, each CMA had both a total quota and a female sub-quota. All human-caused cougar mortalities were applied towards the quota, and the season closed in each individual CMA whenever the quota was reached. In cases where the number of human-caused mortalities exceeded the quota in a CMA, the overharvest was applied to the next years' quota. This system created situations where some CMAs did not open for hunting at all in certain years, typically because the quota filled with non-hunting mortalities. Beginning in 2004, separate male and female quotas were established, non-hunting mortalities were no longer applied towards the quota, and over-quota harvests were no longer applied to the next years' quota. This created a more stable season structure for hunters, who could be guaranteed that seasons would open in each CMA every year. However, this also required a reduction in quotas to account for estimated non-hunting mortality (Figure 2.2), and in some cases hunting quotas have also been reduced in response to high non-hunting mortality (e.g. accidental trapping) the previous year.

In response to increasing cougar populations and clustered harvest distributions, CMAs 1, 7, 9, and 11 were each split into two smaller CMAs in 1998 and 2000 in order better distribute the harvest in these areas. WMUs 216, 334 and 336 were added to the CMA system in 2003 because increased cougar populations in those units were capable of supporting a limited hunting season. In 2011, all CMA boundaries north of the Bow River were realigned, and six WMUs were added to reflect population increases and range expansion of cougars. In many cases, cougar harvests were being clustered in the more accessible portions of CMAs north of the Bow River, potentially resulting in overharvest in some locations, and underutilization in other areas. The new 2011 CMA boundaries were intended to achieve a more balanced spatial distribution of the harvest, as was originally intended when the quota system was first established.

Beginning in 2011, a fall season (November 1-30) for resident hunters was established in all 100 to 500 series WMUs outside of the CMAs, as well as in WMU 410. This season was created in response to increasing human-cougar conflicts in the Prairies, Parkland, and Boreal regions, as well as increases in human-caused cougar mortalities that indicated populations had expanded (Knopff et al. 2013). The use of dogs is prohibited in this season, and hunters may kill one cougar of either sex. No harvest quotas apply, but spotted kittens and females accompanied by spotted kittens are protected.

Table 2.2. History of management and hunting regulation changes for cougars in Alberta.

Year	Management Change
1937	Bounty instated
1964	Bounty lifted
1969	First cougar season declared. Season ran from September – March; dogs permitted only in January-March.
1971	Cougar designated as a big game animal. Bag limit set at one cougar/year. Fall (non dog) season corresponded to ungulate seasons. Winter season (dogs allowed) limited to December and January.
1978	Winter season limited to January in WMUs 300-312.
1981	Winter season reduced to month of January
1982	Kittens with spotted fur and females accompanied by kittens with spotted for protected.
1985	Fall hunting season abolished
1990	CMAs and quota system established. Total quota/female quota system. Winter season lengthened to 3 months in December-February.
1998	CMA 1 split into 2 separate CMAs. NR/NRA outfitter allocations continue to be valid across the original CMA.
2000	CMAs 7, 9, and 11 each split into 2 separate CMAs. NR/NRA outfitter allocations continue to be valid across the original CMA.
2003	WMU 216, 334, and 336 opened for cougar hunting.
2004	Quotas changes from Total/Female to Male/Female. Non-hunting mortalities no longer counted towards the quota.
2005	Cougars must be registered within one business day following the kill instead of 2 days.
2006	WMUs 353, 354, 355, 356, and 509 opened for cougar hunting.
2007	Landowners allowed to hunt cougars on their own land at any time of the year without the use of dogs. No licence required
2011	Landowners allowed to keep cougars hunted on their own land. CMA boundaries re-aligned. WMU 216 removed from CMA system; WMUs 351, 511, 512, 515, 516, and 517 added to CMA system. Fall hunting season (dogs prohibited) reinstated in some areas including most WMUs outside of the CMAs. Cost of resident cougar licence reduced to $20.31
2012	Hunting seasons in CMAs may be closed prior to the quota being reached if ESRD feels that conditions are such that the quota will be filled within the next business day.

2.3.2.2 Licence sales

Sales of cougar licences have generally increased since they were first introduced in 1971. Licence sales in 1971 and 1972 underestimated the actual number of cougar hunters, as cougars could also be hunted under the authority of an elk licence in those years. Licence sales fluctuated between 100 to 180 licences from 1976-1996, but then increased rapidly over the next 10 years, to a high of 367 in 2008. Licence sales remained relatively constant from 2007 to 2010, but then increased to 744 in 2011 due to the addition of the fall season and a reduction in licence cost. The number of licences sold to non-resident hunters has ranged from four to 29, comprising an average of 7.8 per cent (range 3.2 per cent to 16.7 per cent) of total licences sold. Non-resident licence sales have increased since 1998 when number of outfitter allocations was increased from 17 to 24, and also due to increases in the number of non-residents hunting under the authority of a hunter host.

2.3.2.3 Season Length

Since the quota system was established in 1990, the winter hunting season has occurred during the months of December-February. Seasons closed in each CMA when the quota filled, creating substantial variation in average season length across CMAs. From 2004-2010, seasons in the 15 CMAs in place during those years averaged 72 days (range 35 to 90 days) in length, but within certain CMAs, closed in as few as two days in some years. This slightly longer than the average season length of 60 days from 1999 to 2003, in part because some CMAs did not open for hunting at all during those years because quotas were filled with non-hunting mortalities before the hunting season opened.

2.3.2.4 Harvest

From 1973 to 1989, the average annual harvest by hunters was 32 cougars (range 21 to 47). Harvest levels doubled during 1990 to 1999, with an average of 69 cougars killed each year (range 40 to 111). From 2000 to 2011, harvest again increased, to an average of 106 cougars per year (range 79 to 127). Increases in annual harvest of cougars by hunters are likely due to a combination of increased interest by hunters and corresponding licence sales, increasing cougar populations, increased levels of motorized access, and an increase in hunting quotas through time. However, since the implementation of the quota management system in 1990, the size of the provincial cougar harvest has been constrained by quotas within each CMA.

Residents are responsible for the majority of the cougar harvest every year, but the proportion harvested by non-residents has increased through time. From 1973 to 1989, non-residents and non-resident aliens harvested an average of 4 cougars/year, representing 7.5 per cent of the harvest. The number of cougar harvested by non-residents increased to an average of 10.5 per year from 1990 to 1999, representing 15.3 per cent of the harvest during this time period. From 2000 to 2011,

harvests by non-residents increased to an average of 20.7 per year, representing 18.1 per cent of the harvest. This increase is due in part to an increase in the number of outfitter allocations from 17 to 24 in 1998. Hosted non-resident hunters have also killed an increasing proportion of harvested cougars over the past several years, with less than one person per year hunting under this authority in the 1990s increasing to an average of five per year in the 2000s.

Hunter success averaged 34 per cent from 2000 to 2010, with non-residents exhibiting a higher success rate (69 per cent) than residents (30 per cent). Overall hunter success has declined slightly since the 1990s, when 40 per cent of hunters who purchased a cougar licence harvested a cougar. This change is likely due to rapid increases in licence sales that have outpaced increases in quotas. Hunter success rates declined substantially in 2011 to 17 per cent, due to a significant increase in cougar licence sales that followed a reduction in licence cost and creation of the fall season.

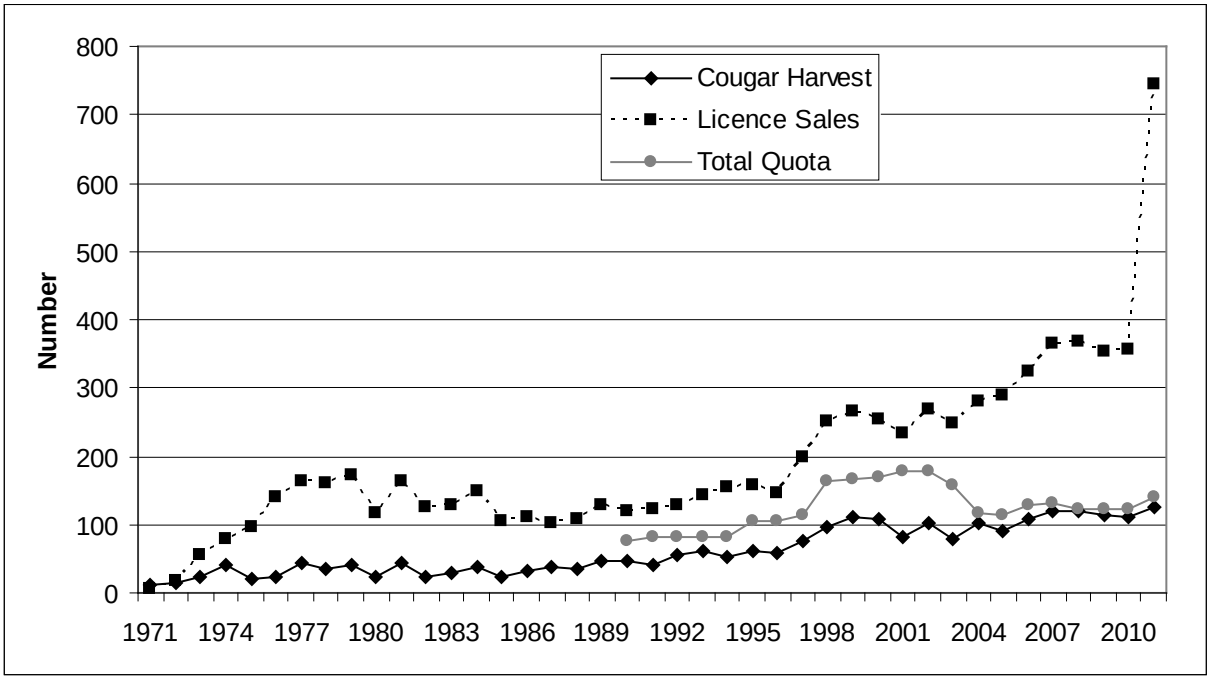

Figure 2.2. Cougar hunting licence sales, total hunting harvest, and hunting quotas in Alberta from 1971-2011.

Harvest Distribution

The distribution of the annual cougar harvest has undergone a substantial shift since the implementation of the quota system in 1990. Prior to the quota system, harvest distribution was dictated by relative densities of cougars in WMUs open to cougar hunting, the distribution of cougar hunting guides, snow conditions, and vehicular accessibility (Alberta Forestry Land and Wildlife

1992). Prior to 1990, the majority of the cougar harvest came from WMUs south of the Bow River, due to a higher number of cougar hunting guides in this region, high levels of motorized access, and relatively abundant cougar populations. This pattern has changed dramatically over the past two decades. The proportion of the harvest that has occurred north of the Bow River has increased steadily from 32 per cent in 1990, to a high of 80 per cent during the 2006 hunting season (Knopff et al. 2013). This change is due to increases in hunting quotas in the north in response to increasing populations, coupled with increased numbers of cougar hunting guides in northern areas.

In addition to regional changes in the distribution of cougar harvests, spatial patterning has occurred within CMAs, particularly in those north of the Bow River. Prior to 2011, larger CMAs north of the Bow River resulted in clustering of harvests within specific WMUs. At nearly 22,000 km2 in size, for example, CMA 10 was comprised of 12 WMUs, yet from 2007 to 2010, 13 of 24 (54 per cent) harvested cougars in this CMA were killed in WMU 438 near Hinton. During this same time period, six WMUs in CMA 10 saw no harvest at all. Similarly, in old CMA 8, 79 of 101 (78 per cent) cougars that were harvested from 2007 to 2010 were killed in three WMUs near Rocky Mountain House, despite the fact that they comprised only 42 per cent of the CMA. This clustering of harvest was likely influenced by cougar population density, amount of motorized access, snow conditions, and distribution of hunters and hunting guides. Low hunter interest or success in some areas may also be related to current regulations that prohibit carrying firearms on an OHV before noon. This restriction would make it difficult for hunters to effectively search for cougar tracks using an OHV. The requirement to register cougars within one business day may also prevent some hunters from taking advantage of hunting opportunities in very remote areas.

In WMUs comprised primarily of private land, harvest rates have been low and hunters have not taken full advantage of hunting opportunities. For example, since WMU 216 was opened for cougar hunting in 2003, until 2010, a total of only two cougars were harvested. During the same time period, five cougars (including three females) were killed in this WMU by other methods, and 112 cougars were killed within the four other WMUs that comprised CMA 7. In this case, it appears that hunters preferred to pursue cougars in WMUs where public land was more abundant. Similarly, in WMU 300, which since 1998 has been organized as its own CMA, the quota has been filled only three times in the past ten years despite a high estimated cougar density.

Spatial heterogeneity in harvest patterns within CMAs may create situations where cougars are locally overharvested in some areas and under-harvested in others. Realignment of CMA boundaries in 2011 was intended to redistribute harvest pressure more evenly across the landscape, and allow localized management in response to human-cougar conflicts or to help meet ungulate population objectives. Harvest rates will continue to be low in areas with low levels of motorized access, due to the difficulty of searching for tracks and transporting hunting dogs in these areas.

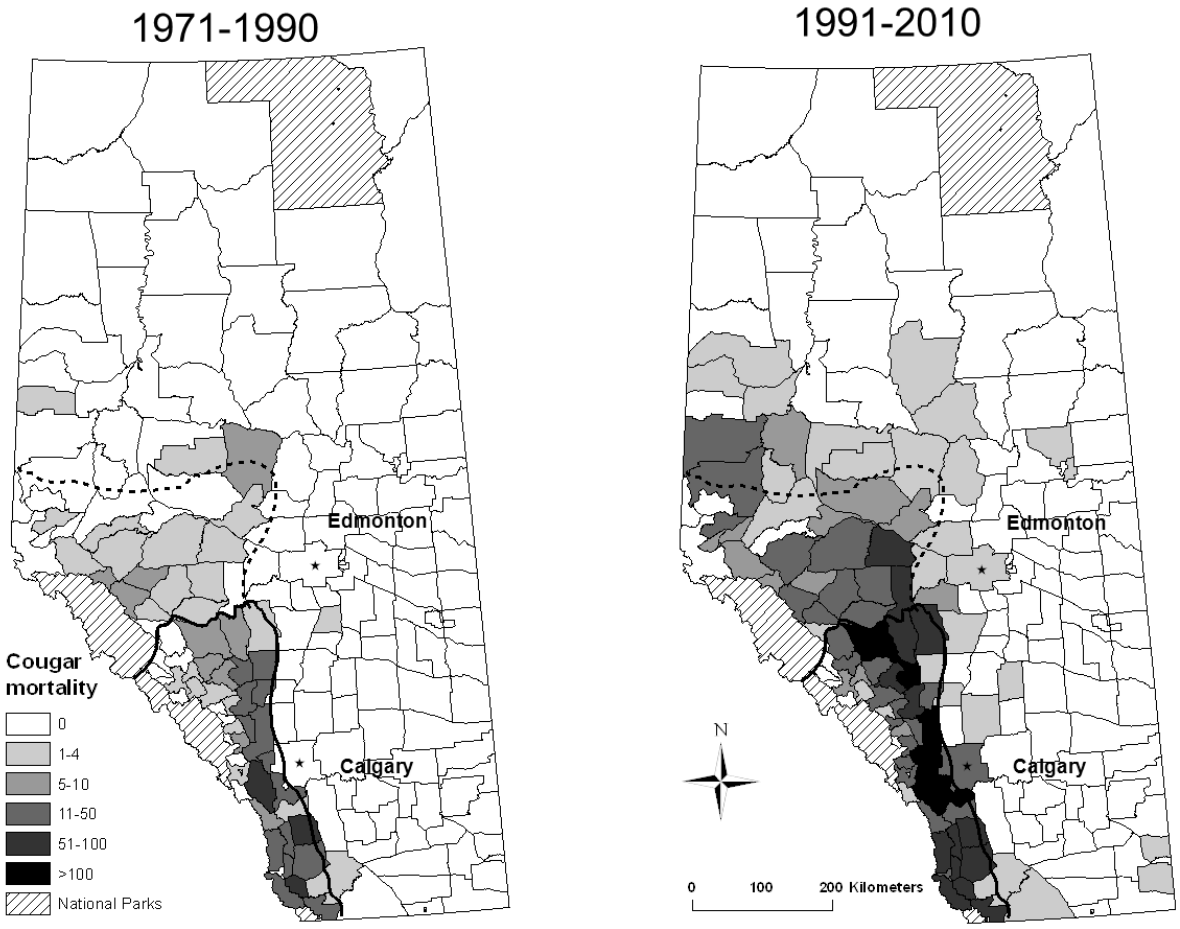

Figure 2.3. Number of cougar mortalities in wildlife management units in Alberta from 1971-1990 and 1991-2010. Also displayed are the outlines of core cougar range (solid line) and low-density cougar range (dashed line) for the distribution of cougars in 1998. Reproduced with permission from Wildlife Society Bulletin, 2013, DOI:10.1002/wsb.369.

Sex Ratio of the Harvest

The sex ratio of the annual cougar harvest varied substantially during the 1970s and 1980s, becoming much more consistent with the creation of the quota system in 1990. The percentage of females in the harvest declined substantially during this time, comprising 47 per cent of the harvest from 1971-1989 and only 31 per cent from 1990 to 2011.

The sex ratio of cougar harvests can be influenced by many factors, including season length, snow conditions, hunter preference for larger cougars, pressure from hunting guides, structure of the quota system, cougar population density, and competition between hunters. The percentage of

female cougars in the harvest is often been viewed as a measure of harvest sustainability, because harvest of adult females has a greater impact on the population than males. Male cougars should be the most vulnerable to harvest because they have large home ranges and travel at higher rates than female cougars, thereby crossing more roads and trails where tracks can be detected by hunters (Barnhurst 1986). Coupled with hunter selectivity for larger cougars and reluctance by some hunters to kill females in order to protect breeding capacity, this would tend to result in a harvest biased towards males. However, where hunting seasons are short or when snow conditions are poor, there may be fewer opportunities to tree cougars. In this case, many first time hunters would likely shoot a smaller cougar, which is more likely to be a female.

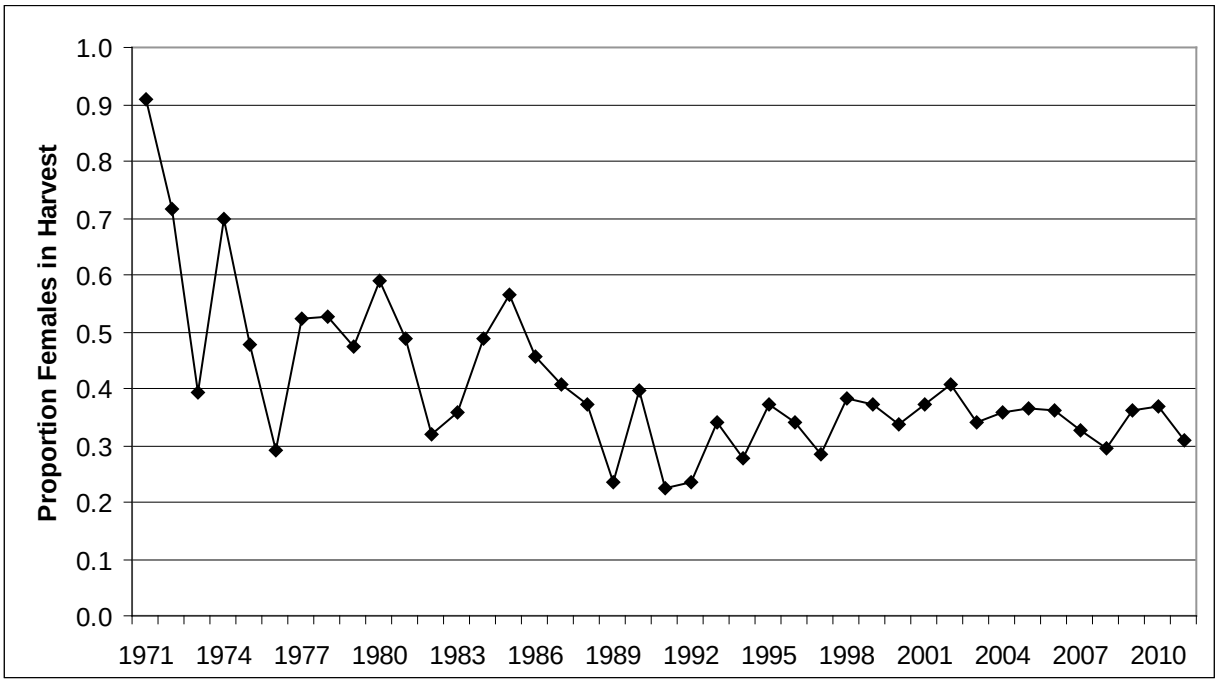

Figure 2.4. Proportion of female cougars in the harvest in Alberta from 1971-2011.

Prior to 2004, seasons in each CMA were closed when the female sub-quota (which was typically set at approximately half the total quota) was reached, which may have caused some hunters and guides to avoid killing females in order to extend the length of the season and maximize the number of cougars that could be killed. Similarly, the change to a system of separate male and female quotas in 2004 maintained a relatively low proportion of females in the harvest. In this case, hunters and guides have chosen not to fill the female quota in some CMAs in order to retain the ability to train their dogs for the entire three month season. In some remote CMAs, where the effort required to locate cougar tracks is high and the risk of losing dogs may be elevated, hunters and guides appear less willing to kill females, and female quotas in these areas often go unfilled.

2.3.3 Non Hunting Mortality

Human caused cougar mortalities other than hunting were a minor source of mortality in the 1970s, comprising two per cent of the total recorded mortality from 1971 to 1979. This increased to ten per cent of total mortality in the 1980s, 22 per cent in the 1990s, and 34 per cent in the 2000s. From 1999 (when detailed records of the specific causes of non-hunting mortalities were first recorded) to 2011, accidental trapping was the most significant source of non-hunting mortality, comprising 13 per cent of total mortalities recorded during this time period. Anecdotal reports indicate that the majority of cougars killed by accidental trappers are killed in snares set for wolves or coyotes, or in large conibears traps set for lynx or bobcat. Notably, the majority of accidental trapping mortalities occur on public land in the green zone, where recreational hunting opportunity is a priority for cougar management. Number of accidentally trapped cougars peaked in 2007, and was high enough, when added to other causes, to result in population sinks (Knopff et al. 2010). Unlike hunting, the majority of cougars captured by trappers are female (63 per cent), which may exacerbate effects on the population. In the Nordegg area, hunting quotas were reduced in response to high trapping mortality in 2007. The department has worked with the Alberta Trappers Association to educate trappers on methods to reduce accidental trapping of cougars since 2009.

Since landowner take was first authorized in 2007, this cause has been a significant source at 11 per cent of total recorded mortalities. It is anticipated that the 2011 regulation change allowing landowners to keep cougars that they kill on their own land may increase reporting rates, leading to an increase in recorded mortality by landowners. All landowner take occurs on private land, where hound hunting is less effective and options for managing cougars are more limited. Other sources of mortality, such as self defence, problem wildlife, and road kill, each typically comprise less than five per cent of total mortalities each year.

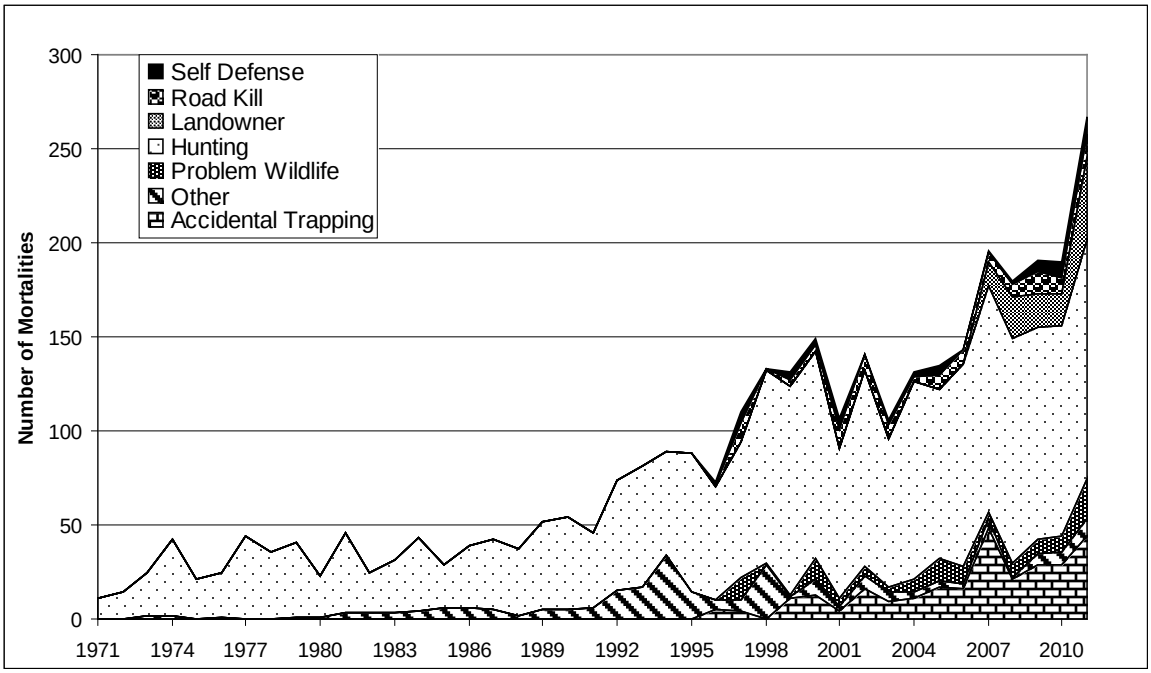

Figure 2.5. Number of cougar mortalities due to self defence, road kill, landowner hunting, licenced hunting, problem wildlife, accidental trapping, and other causes in Alberta from 1971-2011.

2.3.4 Cougar-Prey Relationships

Cougars are known to prey on all ungulate species in Alberta except bison and caribou. For the most part, cougar predation is not considered to be a primary limiting factor for ungulates in Alberta. Cougars are sympatric with several other large carnivore species (wolves, black bears, and coyotes) throughout most of their range, and with grizzly bears in many areas. Although cougars exhibit high kill rates (Knopff et al. 2010) and can exist at higher densities than wolves (Knopff 2010, Webb 2009), they have rarely been implicated in ungulate population declines. Cougar predation is focused primarily on smaller ungulate species such as deer, which have high reproductive rates, and on juveniles of larger ungulate species, which contribute less to population viability than do adults (Knopff et al. 2010).

Nonetheless, cougar predation may limit or even cause declines in some ungulate herds, particularly when populations are small or isolated. Cougar predation resulted in reduced survival rates of bighorn sheep on Ram Mountain near Nordegg, and at Sheep River southwest of Calgary, leading to population declines (Festa Bianchet et al. 2006). In these cases, cougar predation was not related to sheep density, and appeared to be caused by a small number of individual cougars that specialized on sheep. Population modeling indicated that stochastic predation events by specialist cougars could result in extirpation of some bighorn sheep herds, particularly those with less than

125 sheep. Similar instances of individual cougar specialization have been documented on moose and feral horses in Alberta, although in these cases the magnitude of the effect on the prey population was unknown (Ross and Jalkotzy 1996, Knopff 2010).

While cougar predation on caribou has not been documented in Alberta, no intensive research of cougar food habits has occurred where the distribution of caribou overlapped home ranges of monitored cougars. However, caribou and cougars may overlap substantially at the northern terminus of cougar range in Alberta, and cougars are expanding northwards (Knopff et al. 2013). In British Columbia, cougars are recognized as an important predator of caribou, and have likely caused population declines in some areas (Kinley and Apps 2001, Wilson 2009). While continued expansion of cougars into caribou range may increase the likelihood of negative population consequences for caribou, it remains uncertain whether cougars can persist at high densities across the northern tier of the province (Webb et al. 2012).

2.3.5 Cougar-Human Conflicts

Beginning in 1999, cougar sightings and cougar-human conflicts were recorded by the Department in the ENFOR database. Occurrences were recorded as one of several categories, including sightings, human conflict, property damage, livestock kill, and nuisance. These data have several limitations, including a lack of clear standardization for assigning occurrences to categories, and duplication of occurrences when several phone calls are received about the same cougar. Further, occurrences are more frequent in areas of higher human habitation and are not necessarily indicative of high cougar densities. The majority of occurrences are unverified, and an unknown percentage is likely related to species misidentification by the complainant. While inconsistencies in categorization prevent detailed analyses of trends in conflict type, the overall number of reported sightings and conflicts has increased through time (Figure 2.6). Relatively low numbers of reported occurrences in 1999 and 2000 may have been related to officer unfamiliarity with the ENFOR system during its first years of operation. Since 2001, the number of reporting sightings and conflicts has averaged 647 per year, requiring an average of 1528 hours per year of response time.

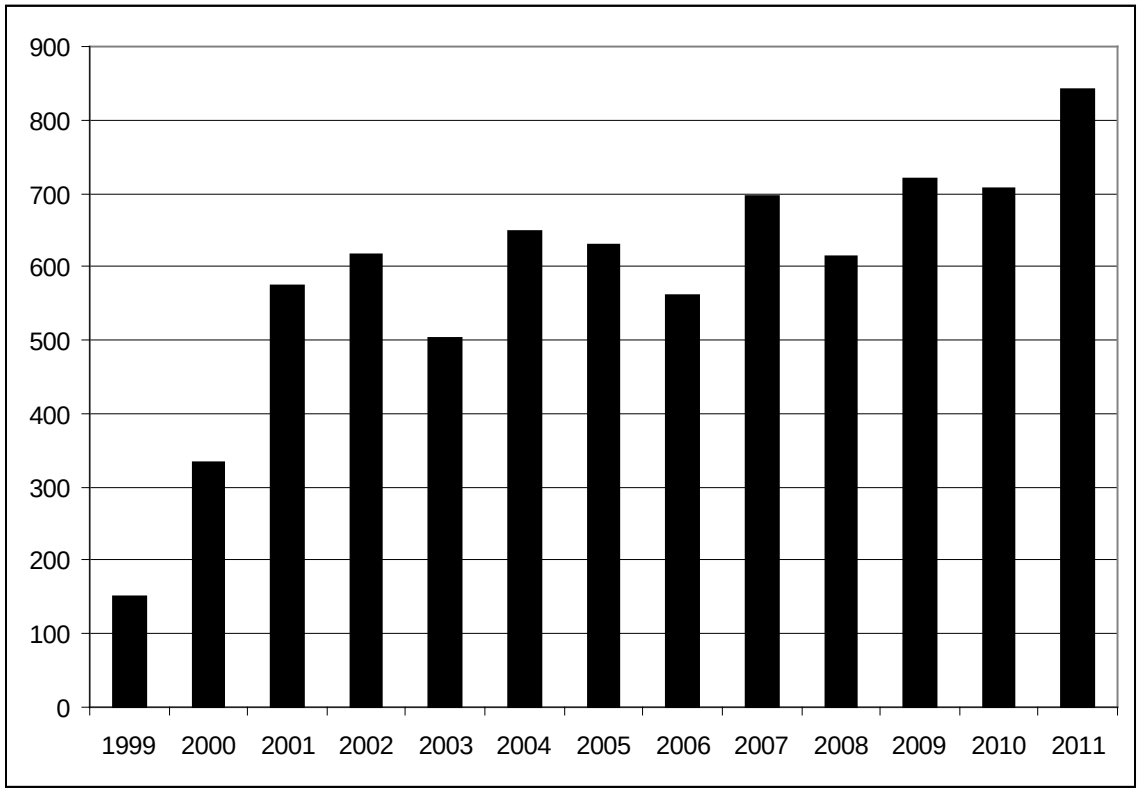

Figure 2.6. Number of cougar occurrences recorded in the ENFOR database in Alberta from 1999-2011.

Spatial locations where cougar sightings and conflicts occur are typically recorded at the level of the WMU, although a legal land description or GPS coordinates are sometimes included. Cougar occurrences have been recorded throughout the foothills and parkland regions and in many WMUs in the prairies, mountains, and boreal regions. High numbers of occurrences were recorded in WMUs surrounding major population centres that have high human populations, particularly Calgary, Edmonton, and Grande Prairie. Despite the presence of healthy cougar populations in many mountain WMUs, number of reported occurrences is low due to a relatively small human presence.

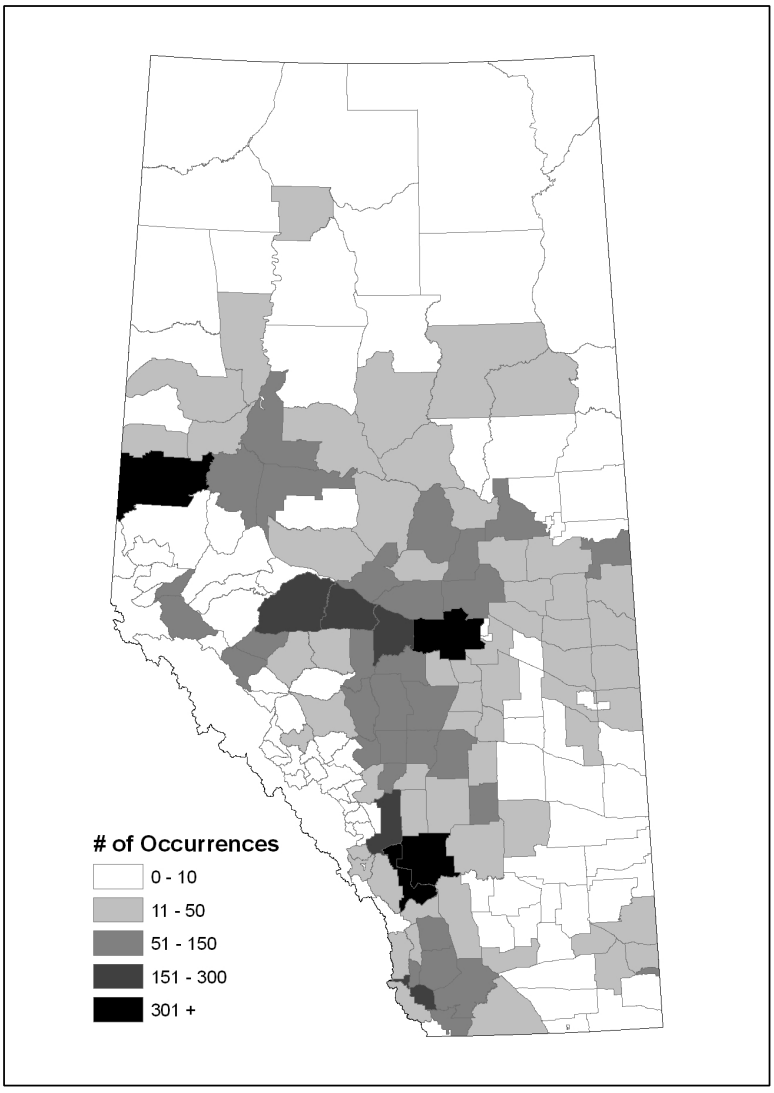

Figure 2.7. Number of cougar occurrences recorded in wildlife management units in Alberta from 1999-2011.

Response to cougar-human conflicts is currently directed by the *Cougar Response Guide*, which outlines the circumstances under which cougars of various age classes should be captured and relocated and/or euthanized. In general, cougars may be captured and relocated in situations where the investigating officer determines there is a potential public safety threat, or where a cougar has attacked pets or livestock. Cougars that make unprovoked contact with humans are euthanized. Since 2000, an average of eight cougars per year (range of three to 22) has been euthanized by the

department, and an average of three cougars per year (range of one to six) are captured and relocated each year. Most relocations occur in response to a cougar that has wandered into a populated area. Despite persistent public rumours to the contrary, all relocated cougars are released in remote areas within established cougar range. The department does not transplant cougars to establish new populations, or release them on private land near residences to control deer numbers. In some cases, Damage Control Licences may be issued by Fish and Wildlife Officers, authorizing private citizens to remove cougars using means specified in the licence, which can including trapping or the use of dogs.

2.3.6 Data Collection Guidelines

The Wildlife Regulation has required registration of all cougar mortalities since 1971. At the time of registration, the cause and date of mortality, location (WMU and/or Legal Land Description), sex, and estimated age are recorded. A copy of the registration form is retained at the District Office where the form is completed, and copies are sent to Wildlife Management Branch (WMB) headquarters, and to the District Office where the cougar died. In cases where the cougar was legally harvested by a hunter or landowner, they also retain a copy of the registration form. Registration data are entered by the WMB into the Compulsory Registration Database. When present, a premolar tooth is removed from each cougar and sent to Mattson's Lab in Milltown, Montana, for aging.

During the winter hunting season, a copy of the registration form from hunter-killed cougars is immediately faxed to WMB headquarters in order to allow close monitoring of harvest quotas. WMB staff enter this information in an excel file, which is used to track the number of male and female cougars killed in each CMA.

Due to the difficulty and expense of doing so, the department has not attempted to collect systematic data on cougar population trends, densities, or predatory behaviour. However, several university-led cougar research projects have been conducted in the province, typically with departmental involvement or input. These projects have greatly enhanced the department's ability to effectively manage cougars.

2.3.7 Economic Aspects

Unfortunately, no information exists on the economic contribution of cougars to the province of Alberta. Cougar hunting licence sales generate approximately $15,000 annually, and cougar hunting likely generates a significant amount of economic activity through the purchases of fuel, equipment, food, dog supplies, etc. Many cougar hunters hire guides to assist in their hunt, who typically charge $3,000 to $8,000 per hunter, depending on the hunt duration. Unlike most other big-game in

Alberta, guides are commonly hired by resident hunters that wish to pursue cougars, which create additional economic activity.

2.4 Summary and Management Challenges

A conservative harvest regime and abundant prey populations have allowed Alberta's cougar population to expand in distribution and increase in numbers over the past 20 years. The current provincial estimate is 2,050 cougars, distributed across most of the southern two-thirds of the province. Cougars are now common throughout much of the white zone, and appear very capable of exploiting habitat near human residences and other human activity. Cougar-human conflicts and safety concerns by the public have increased, and although the majority of rural Albertans appear to value cougars, most do not want cougars to be present near their residences.

Cougar hunting regulations have been slowly adjusted over time to reflect an increasing and expanding population. While most cougar harvest is still conducted under a strict quota system, quotas have increased in many areas, new WMUs have been added to the CMA system, a fall, non-hound season has been established outside of the CMAs, and the cost of a cougar licence has been reduced. The department has also increased the flexibility for landowners to manage cougars on their own land by allowing year-round hunting without the use of dogs.

In the future, important cougar management challenges will include balancing cougar conservation and management for trophy hunting with low public tolerance for cougars on private land.

3.0 Management Plan

3.1 Policy Framework

Wildlife resources in Alberta are administered according to policies outlines in The Fish and Wildlife Policy for Alberta (Alberta Energy and Natural Resources, Fish and Wildlife Division 1982). These policies, summarized in the following statements, provide general direction for establishing goals and objectives for cougar management in the province.

3.1.1 Resource Protection

"1)…The primary consideration of the Government is to ensure that wildlife populations are protected from severe decline and that viable populations are maintained…"

3.1.2 Resource Allocation

"2)(a) The wildlife resource, as a Crown resource, will be utilized in a manner which contributes the most benefit to the citizens of Alberta."

"2)(e) Wildlife will be allocated through a defined process whereby specific resources are deployed to specific uses in order to achieve stated public benefits."

"17) Wildlife must be allocated among different primary users in response to government policy. Until such time as supply and demand can be better rationalized, the following interim allocation guidelines will prevail in order of priority:

(b) Resident recreational use of game will have precedence over non-resident use. Wildlife stocks not fully allocated or utilized to higher priority uses may be allocated commercially to non-residents."

"18) The allocation of wildlife stocks to the different primary users does not imply that other uses cannot occur within areas where such uses are entitled."

3.1.3 Recreational and Educational Use

"8) A variety of wildlife recreational opportunities, in addition to hunting, will be available for the benefit and enjoyment of Albertans."

"9) The Government will promote the use of wildlife for the educational benefit of Albertans."

"21) A variety of hunting opportunities will be available for the recreational benefit and enjoyment of Albertans…"

3.1.4 Commercial Use

"22) The Division will encourage an environment that promotes the growth of the tourist industry…"

"22)(b)(ii) The Division will pursue this policy through:

(e) Managing wildlife to produce marketable use opportunities."

3.1.5 Protection of Private Property

"4) The Government, through the Division, will assist in preventing or controlling wildlife from damaging property and endangering human life."

"5) Responsibility for damage in any form caused by wildlife will be shared in relationship to what people can reasonably do for themselves and to the amount of any additional damage beyond that which would normally be expected to occur in an area."

3.2 Management Goals and Objectives

3.2.1 Resource Protection

Goal: To ensure that the cougar population is protected from any significant decline and viable, self-sustaining populations are maintained.

Objectives:

a) Maintain a viable population of at least 1,500 cougars on provincial lands in Alberta.

b) Allow a maximum human-caused mortality rate of not more than 20 per cent of the provincial cougar population.

3.2.2 Resource Allocation

Goal: To maximize the benefits to Albertans through optimum allocation of the cougar resource amongst recreational, commercial, and other users.

Objectives:

a) Provide Albertans and visitors to Alberta the opportunity to view, photograph and otherwise enjoy the cougar resource.

b) Provide the opportunity for recreational hunter to annually harvest a portion of the provincial cougar population.

3.2.3 Recreational Use

Goal: To maximize the recreational benefits and enjoyment to Albertans from the cougar resource through the provision of a variety of recreational opportunities.

Objectives:

a) Promote recreational non-consumptive uses such as observation and photography of cougars.

b) Provide opportunities for recreational hunting of cougar and a sustainable annual provincial harvest.

3.2.4 Commercial Use

Goal: To provide a commercial benefit to Albertans from the cougar resource

Objectives:

a) Provide opportunities for Albertans to benefit from the tourism value of cougars.

b) Allow the opportunity for non-resident hunters to hunt cougars.

3.2.5 Protection of Private Property

Goal: To minimize property damage and other hazards to humans caused by cougars.

Objectives:

a) Ensure that cougar predation on livestock and pets are reduced as much as possible by planned land management and agricultural development and by preventative livestock management.

b) Reduce economic loss as a result of cougar predation by continuing the Wildlife Predator Compensation Program.

c) Reduce the occurrence of chronic cougar problems on private lands by capture and translocation or euthanasia of offending individuals.

3.2.6 Science and Education

Goal: To promote and encourage scientific and educational activity to enhance knowledge of cougars.

Objectives:

a) Continue management-oriented research of Alberta's cougar populations and cougar-prey interactions.

b) Educate Albertans about cougars and their value in Alberta's natural environment.

c) Promote the cougar as an integral part of Alberta's ecological integrity.

3.3 Management Strategies

3.3.1 Resource Protection

Survival of the cougar in Alberta depends on successful management of prey populations, especially deer, elk, moose and bighorn sheep. Fundamental to the management of ungulates are habitat inventory, protection and enhancement. These strategies are detailed in the respective species management plans. Given their broad habitat requirements, habitat strategies for cougar are not recommended at this time.

3.3.2 Data Collection

The department will continue to require registration of all known cougar mortalities. The cause of death, sex, date of kill, location of kill, and approximate age of the cougar will be recorded in addition to information on the hunter, where applicable. Government staff will also continue to collect a premolar tooth from each registered cougar, regardless of cause of death.

In the future, the department will pursue several changes to the mortality registration process in order to improve the efficiency of data collection and entry. The current registration form will be modified to include additional categories for cause of mortality (accidental trapping, landowner, problem wildlife, etc.), and a tick box where staff can indicate when a tooth sample has been removed. The 'Approximate Age' section will be modified so that staff can select from 'Juvenile', 'Subadult', or 'Adult'. The 'location of kill' section will be expanded to allow finer resolution than township/range. The department will also move towards electronic submission of registration forms, such that electronic forms are filled out and submitted to the database by field staff at the time of registration. This will reduce data entry errors, allow enforcement of data collection standards, ensure that data are entered into the database in a timely fashion, and reduce the burden of recording and distributing hard-copy registration forms. Creation of a distinct electronic registration form for cougars would reduce the complexity of the form and allow collection of species-specific information.

Cougars will be added to the annual Game Harvest Survey in order to gather additional information on hunter effort, success rates, use of hounds, and participation in the fall vs. winter season. These data will be important as the department considers potential expansion of non-hound hunting seasons and the use of draws to manage cougar hunting pressure in popular areas.

The department will also improve the current system that is used for recording cougar sighting and conflicts. The ENFOR database was not designed for human-wildlife conflict data, has few enforced data standards, and cannot be used to easily distinguish sightings from conflicts. In

contrast, the Fish and Wildlife Management Information System (FWMIS) has been specifically designed to record information on wildlife sightings and conflicts, and includes data fields that allow distinction of conflict levels. Over time, the department will begin recording cougar conflict data in FWMIS. Pursuing this option will require the development of simple, easy to use electronic forms that load information directly into the database.

3.3.3 Resource Allocation and Recreational Use

Cougar hunting, which provides a quality recreational experience, will be continued in Alberta. The current one month fall hunting season (1 November – 30 November) and three month winter hunting season (1 December – last day in February) will be maintained. The prohibition against the use of dogs during the fall season will continue. The fall season may be extended to coincide with the opening of other big game seasons or to include an archery season if it is determined doing so will not result in an increase in harvest that would exceed objectives. The current restriction that prohibits cougar hunters from carrying firearms on OHVs before noon in some WMUs will be lifted during time periods and in locations where the only open big game season is for cougar.

3.3.3.1 Cougar Management Areas

Primary cougar range outside of national and provincial parks in Alberta will be divided into Cougar Management Areas (CMAs) for the purposes of allocating hunting pressure and harvest. In most cases CMAs will be larger than a single Wildlife Management Unit (WMU), reflecting the larger spatial scale of cougar population dynamics. CMAs will be established by combining WMUs that are similar in habitat type, levels of access, suspected cougar density, and amount of private land. CMA boundaries will be adjusted as required in response to changes in cougar distribution and density, and levels of cougar-human conflict.

3.3.3.2 Zone Management

The province will be divided into four ‘zones’ for the purposes of cougar management (Utah Cougar Advisory Group 2009, Wyoming Game and Fish 2006). These zones include 1) Protected; 2) Source; 3) Stable; 4) and Sink (Table 3.1). Protected zones, which include Provincial Parks, National Parks, and Wilderness Areas, will be managed with non-consumptive use as the priority and will not have hunting seasons.

In source zones, primary management objectives will be 1) to maintain a population buffer from potential population declines in stable zones and 2) to provide high-quality hunting opportunities for large, trophy sized male cougars. In most cases, source zones will be established in remote areas with low levels of motorized access, where the potential for conflicts with humans is low and there is limited interest in hunting cougars. In these areas, the opportunity for a limited harvest of female

cougars will be maintained to allow management flexibility to remove cougars that may be specializing on sensitive ungulates.

Stable zones will be managed to provide abundant hunting opportunities while ensuring stable population trajectories. The primary objective will be to maximize harvest for adult male cougars, which are highly valued by hunters. Stable zones will be established in areas with moderate to high levels of motorized access, and where there is limited opportunity for cougar-human conflict.

Sink zones will be managed to reduce or maintain cougar populations below carrying capacity, and to minimize property damage and risks to public safety. Sink zones will be established in areas with abundant year-round human residences and livestock. In some cases, sink zones will also be created where cougar predation is viewed as a significant mortality factor for vulnerable ungulate herds, such as caribou or isolated populations of bighorn sheep.

Table 3.1. Land use types, management objectives, and management targets for cougar management zones in Alberta.

Zone	• **Provincial Parks** • **National Parks** • **Wilderness Areas**	• **Buffer from population declines** • **'Natural' benchmark for research** • **Non-consumptive use and enjoyment**	• **No human caused cougar mortality**
Source	• Low levels of motorized access • Little or no year-round human residences	• Buffer from population declines • Source of male cougars for stable zones • Limited harvest of trophy sized adult male cougars • Ability to remove cougars of either sex that are specializing on important ungulate herds • Non-consumptive use and enjoyment	• Average age of harvested male cougars ≥ 5 years. • < 20% of harvest comprised of adult females
Stable	• Moderate or high levels of motorized access • Few or no year-round human residences	• Stable population • High quality hunting opportunities • Maximize harvest for adult male cougars	• Average age of harvested male cougars ≥3.5 years. • < 25% of harvest comprised of adult females
Sink	• Abundant year-round human residences • Areas with ungulate	• Reduce populations or maintain below prey-based carrying capacity	• In areas with established breeding populations, > 25% of

	herds vulnerable to cougar predation	• Minimize property damage and public safety risks	harvest comprised of adult females • Harvest may be primarily comprised of males in areas where breeding populations have not been established

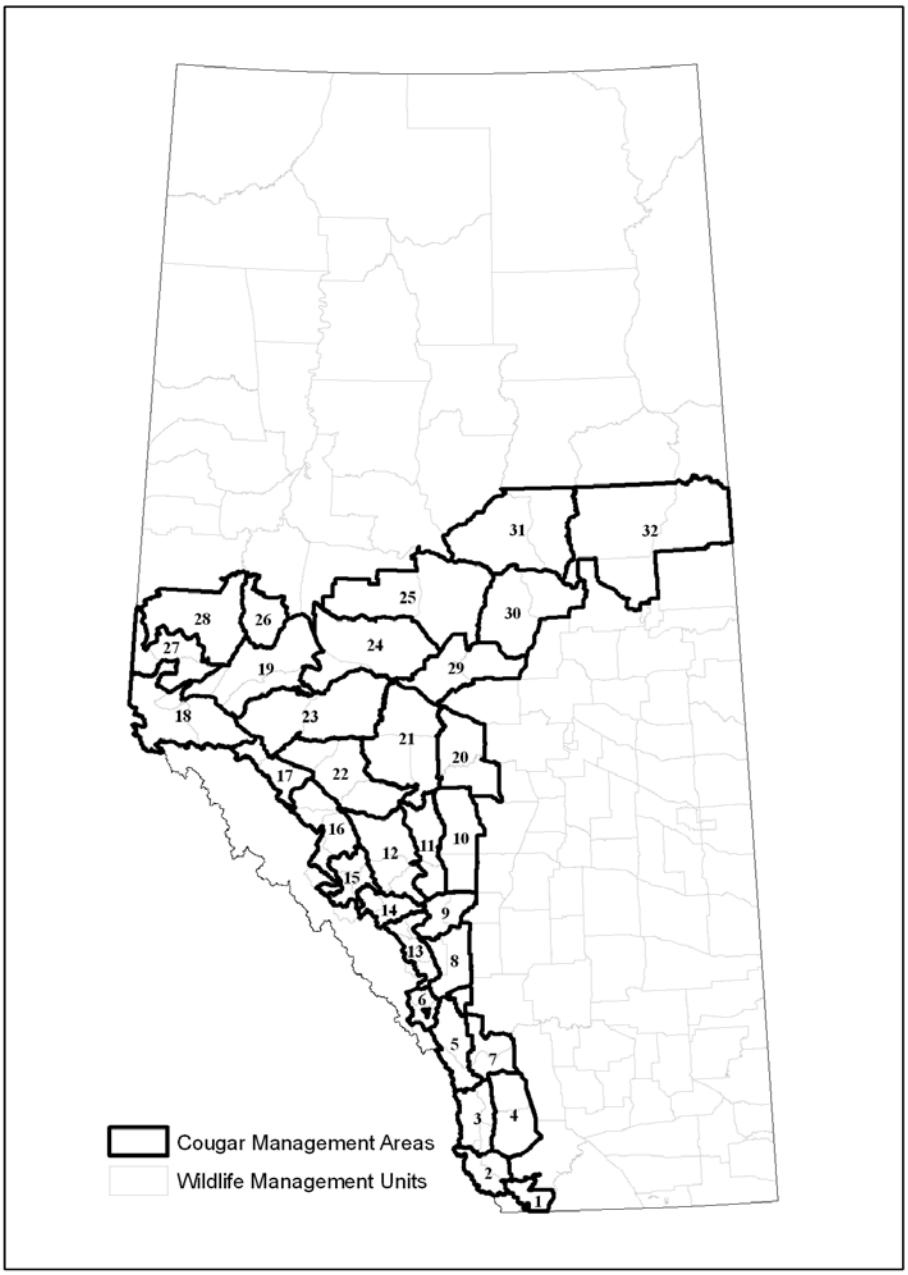

Figure 3.1. Cougar management areas and wildlife management unit boundaries in Alberta.

3.3.3.3 Quota Seasons

Where the use of dogs to hunt cougars is allowed, cougar populations will be protected from overharvest during the winter season with a quota harvest system. Currently, a separate quota for

male and female cougars is in place for each CMA. In the future, this will be changed to a total (either-sex) quota in order to provide equal opportunities for hunters to pursue cougars without the use of dogs, and to reduce misidentification of cougar sex and subsequent wastage. A total quota system will also allow more meaningful interpretation of the age and sex structure of the harvest when adjusting quotas (Anderson and Lindzey 2005). A female sub-quota will not be established, as strong selectivity by hunters for male cougars should result in a relatively low female harvest in most areas.

Resident hunters and non-residents hunting with a hunter-host will continue to be required to register harvested cougars within one business day following the kill. In the future, the department may consider relaxing this requirement in source zones, where it can be difficult for hunters to travel to a district office within the allotted time period.

When the pre-determined harvest quota is reached, hunting will close in the corresponding CMA. The department may also close the season in individual CMAs when conditions indicate that an over-quota harvest is likely. This will be employed in cases where the quotas has nearly been filled, snow conditions are good, and an upcoming weekend or holiday period would prevent timely reporting of harvested cougars. Hunters will be required to phone a 1-800 number or check the department's website each day to determine which areas are open for hunting. The current three month winter season (December 1 to February 28) will be maintained. In the future, the winter season may be expanded to include the month of March in order to give hunters additional opportunity to pursue cougars in areas where harvest quotas have not been filled.

Quotas will be established and adjusted using a system of adaptive management (Walters 1986) based on recent and current research on cougar population density, regular consultation with key stakeholders, and analysis of the age and sex distribution of harvested cougars. CMAs will be grouped into Data Analysis Units (DAUs) to facilitate meaningful analyses of cougar age data and allow adequate sample sizes for decision making (Table 3.2). A three year average of harvested cougar age will be calculated for each DAU, and quotas will be adjusted according to following guidelines.

Adaptive Management for Source Zone:

Target: <20% adult females in harvest and male age ≥ 5 years

Increase Quota

1. <17% adult females in harvest and male age ≥ 5 years, ↑ quota by 10%
2. <15% adult females in harvest and male age ≥ 5 years, ↑ quota by 20%

Reduce Quota

1. >20% adult females in harvest or male age <4.75 years, ↓ quota by 10%
2. >23% adult females in harvest or male age <4.5 years, ↓ quota by 20%

Adaptive Management for Stable Zone:

Target: <25% adult females in harvest and male age ≥ 3.5 years

Increase Quota

1. <22% adult females in harvest and male age ≥ 3.5 years, ↑ quota by 10%
2. <20% adult females in harvest and male age ≥ 3.5 years, ↑ quota by 20%

Reduce Quota

1. >25% adult females in harvest or male age <3.25 years, ↓ quota by 10%
2. >28% adult females in harvest or male age <3.0 years, ↓ quota by 20%

Adaptive Management for Sink Zone:

Target: >25% adult females in harvest

Increase Quota

1. <25% adult females in harvest, ↑ quota by 20%
2. <20% adult females in harvest, ↑ quota by 40%

Reduce Quota

Quotas reduced when CMA is transitioned to 'Stable'

Quotas will generally be established for a three year period in order to allow time for management changes to take effect, and to provide consistency in regulations for hunters. Deviations from the above guidelines, including more frequent changes to quotas, may occur in cases of significant non-hunting mortality or where scientific or strong anecdotal information suggests that management objectives are not being met. In addition, quotas may be temporarily increased for the hunting season following a severe winter that causes ungulate population declines (Webb et al. 2012). Both management targets and guidelines may be adjusted in the future as new scientific information becomes available on the use of indices to manage cougar populations.

Table 3.2. Cougar Management Areas, Zones, and Data Analysis Units in Alberta.

CMA	WMUs	Zone	Data Analysis Unit
1	300	Sink	1 (along with 108 and 110)
2	302, 400	Stable	2
3	303, 306, 308, 402	Stable	2
4	304, 305	Stable	3
5	404, 406	Stable	2
6	408, 410	Stable	2
7	310, 312	Stable	3
8	314, 316	Stable	4
9	318, 320	Stable	4
10	322, 332	Sink	5
11	324, 330	Stable	6
12	326, 328,429	Stable	6
13	412, 414, 416, 417, 418	Source	7
14	420, 422	Source	7
15	426, 428, 430	Source	7
16	432, 434, 436, 437	Source	7
17	438, 439	Stable	8
18	440, 442, 444	Source	9
19	352, 353, 441	Stable	10
20	334, 336	Sink	5
21	337, 338, 348	Stable	11
22	339, 340, 342	Stable	8
23	344, 346	Stable	11

24	347, 349	Stable	12
25	350, 351	Stable	12
26	354	Sink	13
27	505, 507	Stable	10
28	356	Sink	13
29	505, 507	Sink	5
30	509, 510	Stable	14
31	511, 516	Stable	14
32	512, 515, 517	Stable	14

3.3.3.4 Non Hound Seasons

In some areas and at specific times of the year, the use of hounds to pursue cougars is impractical or may result in conflicts with other hunters or landowners. In WMUs dominated by private land, hunters have been reluctant to take advantage of winter hound seasons, and harvest has been low. In certain mountainous areas with low levels of motorized access, harvest during winter seasons has been low or nonexistent. While the use of hounds for hunting cougars in these remote areas does not create conflicts, it may be possible to create additional recreational opportunities without exceeding harvest goals by allowing cougar hunting at other times of the year.

Where hounds are not allowed, hunter success is usually extremely low. Therefore, non-hound seasons will be established to overlap with fall ungulate seasons, when the number of hunters on the landscape is highest. This should increase participation in the cougar hunt, resulting in higher harvest rates and maximizing recreational opportunity.

Non-hound seasons will be maintained in the Prairies, Parkland, and some Boreal Regions, where most WMUs are comprised primarily of private land, or hunter interest during the winter season has been low. The current one-month season (November 1-30) will be maintained until 2014 in order to evaluate hunter interest and hunter success rates. In the future, this season may be lengthened if doing so is required in order to meet harvest goals in sink zones. Fall, non-hound seasons may be extended to foothills and mountainous regions if doing so will not elevate harvest to a level where it exceeds management objectives.

3.3.3.5 Alternative Season Structures

The major disadvantage of the quota harvest system is that in popular hunting areas, seasons can close very rapidly. For example, in 2011, the season was closed for both sexes within five days in two different CMAs. This creates a low-quality hunting experience, as hunters must rush to harvest a cougar before the season is closed. In these cases, hunters may not take the time to be as selective, increasing the number of females and young males in the harvest. The likelihood of over-quota harvests is also increased in these areas, due to the large number of hunters allowed under the general licence. In these popular hunting areas, a limited-entry draw season is an alternative approach to manage harvests. This season structure would allow hunters the full duration of the winter season to pursue cougars and also reduce competition, improving the quality of the hunting experience and allowing increased selectivity. A hybrid approach, which includes a draw for the first part of the season and a quota system for the latter portion of the season, has also been used successfully in some jurisdictions. The department will undergo consultation with stakeholders to determine if one of these approaches would be supported by the public.

3.3.4 Managing Commercial Use

Non-resident cougar hunting, through the use of allocations held by outfitters, will continue in Alberta. Currently, some allocations are valid in two CMAs, and the hunter can kill one cougar of either sex at any time in the three month winter season. In the future, the department may consider limiting each allocation to one CMA in order to ensure a desirable harvest distribution.

Currently, non-residents hunting under the authority of an outfitter-guide allocation must register their cougar within one business day following the kill. Since cougars harvested under an allocation do not count towards a quota, there is little justification for requiring this short timeline. Therefore, the department will consider altering this requirement to extend the time period within which these cougars must be registered.

The 1992 Cougar Management Plan indicated that non-resident hunting was to be limited to 10 per cent of the annual licensed removal. At that time, 17 NR/NRA cougar allocations existed, and the plan suggested that this number would be reduced when resident demand increased. However, the number of allocations was increased to 24 in 1998. Concurrently, resident licence sales increased from 112 in 1992 to 328 in 2010, indicating a substantial increase in demand from resident hunters. Over the last five years, harvest by non-residents and non-resident aliens (including hosted hunters) has represented 19 per cent of the total licenced harvest. Because resident demand for cougar hunting is high and increasing, cougar allocations will be included on the five year allocation review, with the long-term goal of reducing non-resident take to 10 per cent of licensed harvest within each DAU. It is anticipated that harvest by residents will increase through

time with expanding and increasing cougar populations, so reductions in outfitter allocations may not be necessary.

Currently, the majority of non-resident cougar allocations are distributed south of Highway 16, where demand by resident hunters is highest. In some CMAs, non-resident harvest comprises substantially more than 20 per cent of the harvest. As part of the five year allocation review process, the current spatial distribution of non-resident allocations should be reviewed and adjusted to ensure non-resident harvest does not exceed 20 per cent of the total harvest within any individual CMA. Exceptions to this guideline may be allowed in CMAs where resident demand is low, as evidence by quotas that regularly go unfilled.

3.3.5 Managing Cougar-Prey Relationships

Cougar management will include provisions to allow reduction of localized populations to protect declining or threatened ungulate populations. Where cougar predation is known or suspected to be a primary or significant contributor to declines in a threatened or isolated ungulate population (e.g. woodland caribou, bighorn sheep, and mountain goats), the department will consider establishing a sink zone in the corresponding CMA, utilizing a combination of fall and winter seasons to achieve harvest goals. Government-initiated culls will not be initiated for cougars, except in extreme cases in order to prevent the extirpation of an ungulate population, and where hunting alone is not effective. Where possible, management of this nature will be focused on individual cougars that are known predators of the affected ungulate species, typically determined through radio collars placed either on cougars, or on a sample of ungulates.

3.3.6 Managing Non-consumptive Use

Cougars are rarely observed in the wild because of their naturally low densities and elusive behaviour. It is unlikely that a program can be developed which could effectively enhance non-consumptive cougar viewing opportunities. Pursuit seasons, which allow cougars to be chased and treed (but not killed) outside of the regular hunting season, create additional recreational opportunities and allow houndsmen to train their dogs. Currently, five of 26 (19 per cent) jurisdictions in North America have separate pursuit seasons. Disadvantages of pursuit seasons include increased administrative and enforcement responsibilities and additional harassment and possible mortality of cougars. Young kittens may be captured and killed by hounds, ungulate kills made by cougars may be abandoned, and in the case of cougars residing in accessible areas, continued harassment may induce physiological trauma (Roberson 1984, Harlow et al. 1992). Pursuit seasons are not recommended for Alberta at the present time, but should non-consumptive demand for cougar viewing increase, special regional seasons could be considered. Currently, pursuit for non-hunting enjoyment and dog training can occur during the open hunting season.

3.3.7 Managing Non Hunting Mortality

Where possible, the department will endeavour to reduce levels of non-hunting cougar mortality, and to increase the proportion of cougar mortalities that occur through hunting. This will help to ensure that mortality rates are aligned with cougar management objectives, and prevent the unnecessary wastage of the cougar resource. Efforts to reduce non-hunting mortality will be focused on educational initiatives directed towards trappers, landowners, and hunters.

Beginning in 2009, the department has worked with the Alberta Trappers Association (ATA) to educate trappers on approaches to avoid accidental cougar captures. Outreach methods have included articles in the Alberta Trapper magazine, presentations at the ATA annual convention, and information in the annual Alberta Guide to Trapping Regulations. The department will continue to work with the Alberta Trappers Association to educate trappers on approaches to avoiding cougars. Improving data collection on the type of trapping set (e.g. snare, conibears, etc.) that cougars are caught in would help to target messaging towards trappers that are using traps most likely to catch cougars. The current policy of not allowing trappers to retain cougars that are captured accidentally will be maintained. Allowing trappers to keep cougars would create an incentive, likely causing some individuals to target cougars intentionally and increasing the number captured. This could require reductions in hunting quotas in some areas. Because trapping is non-selective, this would also lead to an unnecessary increase in the mortality of dependent kittens and females with dependent kittens, which would not be supported by the general public.

While harvest by landowners has also been significant these mortalities may be somewhat compensatory, as these cougars might be killed as problem wildlife or through illegal means if landowners were not legally authorized to do so. In addition, because this take occurs exclusively on private land, it may target cougars that are less vulnerable to hunting due to the difficulty of using hounds in those areas. Therefore, landowner harvest of cougars is unlikely to threaten populations in source and stable zones, and this provision may be important in maintaining and increasing public support for cougars on private land. The department will continue to monitor cougar harvest by landowners, as well as to educate residents in cougar range on methods to avoid conflicts.

Cougars killed as problem wildlife by agency staff and through Damage Control Licences average less than 10 per year, and are targeted at individual cougars that have depredated on pets or livestock, or have caused public safety concerns. These removals are not considered a threat to overall population viability, and are necessary to balance public tolerance with cougar conservation.

The number of cougars killed in self defence has increased in recent years. The majority of self defence kills occur during the fall big game hunting seasons, often by hunters that are using game calls to attract elk or moose. While the total number has remained small (reaching a high of nine in 2011), the department will continue to educate hunters on methods to avoid cougar encounters, and how to respond when cougars are seen. This information will be included in educational strategies that are part of the BearSmart program.

3.3.8 Protection of Private Property

The department will continue to respond to reports of cougars that have killed or threatened pets, livestock, or public safety. The Cougar Response Guide will be used to determine the appropriate response in the event that capture of the offending animal is necessary.

Landowners will continue to be allowed to hunt cougars on their own land without a licence on a year-round basis. The use of dogs will not be allowed under this authority. This will give rural residents flexibility to immediately remove cougars that are threatening pets or livestock or creating public safety concerns. Fish and Wildlife Officers may also issue Damage Control Licences to authorize landowners to utilize dogs or traps to remove cougars that have damaged property or are a threat to public safety.

3.3.9 Managing Scientific and Educational Use

The department will encourage, and where possible support, research on cougars in Alberta. In particular, information on cougar density and population dynamics north of Highway 16 is nonexistent. Research on cougars in this area should be a priority given recent range expansion and population increases in this area, potential interactions with caribou, and possible impacts of severe winters on cougar populations (Webb et al. 2012). Potential impacts of cougars on bighorn sheep populations also merits further research, especially in light of previous work that has indicated cougars can cause substantial declines in localized populations. In most cases, research will be conducted as collaborative efforts with universities, other government departments (e.g. Alberta Parks), and other research organizations.

The department will continue efforts to educate specific stakeholders, as well as the general public, about cougars and their management. A variety of media, including print brochures, the departmental website, and social media (such as YouTube) will be utilized. Specific initiatives directed towards trappers, hunters, and landowners will be enhanced where possible. Wherever possible, educational programs should proceed as collaborative efforts with other government departments (e.g. Alberta Parks) and organizations (e.g. Alberta Hunter Education Instructor's Association, Alberta Trappers Association).

4.0 Management Plan Application

4.1 Provincial Summary

The primary challenges for management of cougars in Alberta are to:

- Balance cougar conservation and hunting opportunity with low public tolerance for the species in rural landscapes.
- Ensure that cougar hunting is managed to provide maximum recreational opportunity, while also allowing the harvest of large, trophy males.
- Educate Albertans about cougar biology in order to promote public tolerance and reduce cougar-human conflicts.
- Manage cougar predation on sensitive ungulate herds.
- Encourage research on cougar population dynamics and food habits in northern Alberta.

4.2 Regional Perspectives

4.2.1 Mountains and Foothills

Cougar populations in the mountains and foothills are robust, and likely exist at or near prey-based carrying capacity. Cougars inhabiting public land in these regions pose little risk of conflict with people and public opinion surveys have indicated that most Albertans believe that cougars should be allowed to exist in these areas. Climate change, coupled with human-caused landscape modification, will likely ensure an abundant ungulate prey base for cougars. National and Provincial Parks and Wilderness Areas that are closed to cougar hunting, as well as regions with low levels of motorized access, will provide a buffer from potential population declines as well as a reservoir of male cougars for hunting. Recreational and commercial hunting will be a priority for cougar management in these regions, and using the age and sex-structure of cougar harvests to adjust hunting will ensure that this activity is sustainable. Non-hunting mortality, particularly accidental trapping, will continue to be a management concern. Educational programs directed at the trapping community can help trappers avoid catching cougars, reducing this unnecessary source of mortality.

4.2.2 Prairies and Parkland

Cougars are now well established in portions of the Prairies and Parkland regions, including the Cypress Hills where they exist at some of the highest densities ever recorded. Abundant deer populations, coupled with adequate cover in many WMUs, means that these areas can likely

support significant cougar populations. Cougar management in these regions will hinge upon public tolerance and the willingness of rural residents to coexist. Recent opinion surveys indicate that support for cougar conservation in these areas is low. Therefore, cougar management strategies will include educational initiatives to give people the knowledge to avoid and respond to cougar-human conflict, in hopes of raising tolerance over the long-term. In the meantime, rural residents will be given flexibility to remove cougars that they believe are a threat to pets, livestock, or public safety. Damage Control Licences may be issued to allow the use of dogs or traps to remove specific offending animals, and government staff will continue to capture and euthanize or kill cougars that have been involved in serious conflicts. Fall hunting seasons will continue in these regions in order to provide recreational opportunity and to manage the population below carrying capacity.

4.2.3 Boreal Forest

While cougars have recently expanded their range in the boreal forest, their long-term prospects in this part of the province are uncertain. The occurrence of severe winters that cause significant deer mortality may cause stochastic cougar population trends, leading to high levels of human conflict in some years. On the other hand, recent modelling efforts indicate that deer populations will continue to increase in the boreal forest and even with severe winters will be able to survive near agricultural areas. If this is the case, cougars will be a permanent fixture in the boreal forest, and may continue to expand their range. This will create new hunting opportunities, but will also lead to increased conflicts with people, and could contribute to elevated predation levels on woodland caribou. Research on cougar population dynamics and food habits in the boreal region should be encouraged, and will be important to inform management strategies in the future.

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