BACKGROUNDER
ON
WOLF CONSERVATION
IN ONTARIO

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1.0 INTRODUCTION

Wolves are an integral part of a functioning ecosystem. Society's impacts on these top predators and conservation programs are highly controversial. Wolves are seen as fascinating and unique members of Ontario's wildlife heritage and symbols of wilderness. Wolves are also seen as competitors with human interests in the areas of predation on other wildlife species and domestic livestock.

Governments in Ontario began dealing with wolves in 1793 when a bounty was enacted. The provincial bounty was revoked in 1972, and wolves were protected under the *Game and Fish Act*. The Act provided the authority to establish licences and set seasons, and to regulate harvest, export and trade in wolves.

Beyond revocation of the bounty, no additional conservation action was considered necessary over the following years. Consensus about wolf conservation, including protection, was elusive due to divergence of public opinion, incomplete scientific knowledge and lack of harvest information. In spite of this, wolves benefited from the management of their main prey species (i.e., ungulates and beaver) and their associated habitat.

In the mid 1990s, the Ministry of Natural Resources (OMNR) conducted a review of wolf status and policy in Ontario [28]. The objective of the review was to compile and present information on the gray wolf and the eastern coyote in Ontario, provide a point-in-time summary of knowledge on these species and recommend needed action. A number of the recommendations were implemented over the following years.

In 2001, OMNR implemented a strategy relating to the conservation of the wolves of Algonquin Provincial Park. In 2004, MNR permanently closed wolf and coyote hunting and trapping seasons in and around Algonquin Provincial Park. Over the years, OMNR has also been a partner and co-founder of important genetic work that is attempting to determine the status and distribution of the gray wolf, eastern wolf and the coyote across Ontario.

At this time, there is no evidence to suggest that either gray or eastern wolves are threatened or endangered on a regional or provincial basis in Ontario. Wolves and coyotes occur at relatively low densities compared to their main prey species (deer, moose, elk, caribou, beaver) and are generally secretive by nature. As a result, inventory methods are time-consuming, expensive and subject to a high degree of error. The information currently available in Ontario is not sufficiently sensitive to predict changes in the populations of canids except at the largest of scales. Therefore, there is the risk that conservation measures may not be appropriate or timely to respond to changes in local wolf populations.

In view of the apparent relative abundance of gray and eastern wolves in Ontario, compared to their world status, Ontario has an international responsibility to conserve this species carefully. Wolves can be considered a barometer of both biodiversity and a functioning ecosystem.

This background reviews the current knowledge, information and legislation dealing with wolves in Ontario, and provides background material for developing the *Proposed Strategy for Wolves in Ontario*.

2.0 HISTORIC AND PRESENT IMPORTANCE OF WOLVES

2.1. SOCIAL IMPORTANCE

Wolves were feared and persecuted by European settlers. Human encroachment into wolf habitat with subsequent wolf/human conflicts resulted in wolves being viewed as competitors for game species and a hindrance to agricultural development. In Ontario, provincial and local governments encouraged their eradication through the incentive of bounties. Public opinion about wolves has changed in the last decades due to information that reveals their ecological role and an increased appreciation for the intrinsic value of these predators.

More recently, there has been increasing public concern about the status of the gray and eastern wolves across North America. Ontario is no exception. This concern manifests itself in a range of viewpoints. One view expresses concern that wolf populations are in imminent danger from uncontrolled killing by humans and need immediate and complete protection to prevent their extinction. The other view is that increased numbers of wolves are or could result in unacceptable levels of predation on wildlife species and domestic livestock.

Opinion about the status of wolf populations in Ontario is based on limited information including the lack of comparative population surveys. However, it is undeniable that public interest in these species has heightened in recent years. Considering the rate and extent of change in land use and development, ultimately affecting prey availability both positively and negatively, there is reason to examine the status and develop a management program for the gray and eastern wolf populations in Ontario.

2.2. ECOLOGICAL IMPORTANCE

Wolves, as predators, are perceived to be an integral part of healthy ecosystems and do affect ecosystems through multiple interacting ecological processes which science does not fully understand. Wolves are a top predator of large mammals and affect these species directly, but their actions also influence other ecosystem components and processes in either less direct or less easily recognized ways. David Mech, one of the most recognized wolf researchers in the world, identifies the primary recognized direct ecosystem effects of wolves as (1) culling of inferior prey animals, (2) control or limitation of prey numbers, (3) stimulation of prey productivity, (4) increasing food for scavengers, and (5) predation on non-prey species [84]. Although there is a tendency of viewing these ecological effects as mainly positive, wolf researchers Mech and Boitani [93b] caution against doing so, as science does not really understand enough about the

many cascading effects of wolves on other elements of the ecosystem and concepts of positive and negative effects are human value judgments and differ among those who make them. Indirect effects of wolves which have also been recognized are the effect of wolves on reducing coyote numbers and the resulting effects from wolf predation on ungulate species (e.g., change in prey behaviour, increase in prey fitness and productivity, and effect on vegetation)

2.3. ECONOMIC IMPORTANCE

In addition to the less tangible intrinsic and social benefits, there are also economic benefits derived from wolves. About 600 Ontario wolf pelts are marketed annually through commercial fur auction houses and fur dealers.

In 2003/04, Ontario wolf pelts sold for an average of $64.74, based on sales at the two Ontario fur auction houses. Based on this average pelt price, about $57,000 in gross revenue was generated in wolf fur sales that year. The average price in the previous year, 2002/03, was $88.91. Variation in average pelt prices reflects the quality of the pelts and the market demand for wolf fur in a particular year. It is likely that pelts of smaller eastern wolves sell at prices lower than the average wolf pelt price and higher than those of large coyotes. The average price for a coyote pelt in 2003/04 was $25.88.

Average pelt sale figures do not reflect the full economic impact (direct, indirect and induced effects, and employment generated) of the harvest, preparation and sale of Ontario wolf fur by non-aboriginal and aboriginal trappers as this is not easily quantified.

The importance to the tourism industry and the economic impact of activities such as wolf eco-tourism and wolf hunting are also difficult to quantify. About 50 tourist outfitters advertise wolf hunts on the internet, but a much smaller number are known to provide wolf hunting opportunities to clients on a regular basis.

2.4. ABORIGINAL INTERESTS

The wolf Clan is one of the most prominent of the clans in all of Ontario's main Aboriginal groups, including the Anishinaabe (Algonquin, Ojibway, Odawa, Pottawatomi), the Cree, and the Iroquois. The wolf symbolizes love and care for family and community, loyalty and co-operation.

Most Ontario aboriginal communities retain Constitutional rights to harvest wolves for sustenance and ceremonial purposes. As wolf pelts are often used in the preparation of Aboriginal ceremonial dress, the actual number of wolves harvested by Aboriginal persons may be somewhat greater than the number reported as being harvested for sale. The recorded harvest by Ontario licensed treaty trappers in 2002/03 was 18 wolves.

3.0 WOLF BIOLOGY AND ECOLOGY

3.1. GENERAL DESCRIPTION

3.1.1. Taxonomic Status and Distribution of Ontario *Canis* Species

Wolves, also called Timber wolves, are the largest members of the family *Canidae*. Ontario is home to two wolf species, the gray wolf (*Canis lupus*) and the eastern wolf (*C. lycaon*). There is general agreement that the ancestral *Canis* originated in North America and that individuals migrated to Eurasia 1-2 million years ago where the gray wolf evolved. Later (about 300,000 years ago) the gray wolf returned to North America from Eurasia via the Bering land bridge.

Mitochondrial DNA suggests that the North American evolved eastern wolf diverged at about the same time into the smaller coyote (*C. latrans*), occupying the open land of the southwest, and the larger eastern wolf, occupying eastern forests and preying on white-tailed deer [168, 60]. The original, pre-1500s distribution of the eastern wolf was probably east of the Mississippi River and from the Gulf Coast north to the St. Lawrence and Great Lakes with a toehold in southern Ontario (Fig. 1).

The gray wolf was the most widely distributed Canid in North America at that time, ranging throughout most of Canada and areas of the States not occupied by eastern wolves. Following European colonization of North America, logging and land clearing for settlement and agriculture, and possibly the elimination of gray wolves, led to a northward expansion of white-tailed deer followed by eastern wolves up to and beyond the Pre-Cambrian shield country in central Ontario.

In the more settled eastern U.S. and southern Ontario, land clearing and the burgeoning human population led also to the decline of the eastern wolf, but at the same time facilitated the eastward expansion of the coyote. The first coyotes seem to have entered western Ontario at the beginning of the 20th century. DNA profiles of coyotes in Ontario today (also called “brush wolves” or “tweed wolves”) indicate they are actually hybrids of eastern wolves and coyotes [168]. They have now spread eastward into all of the New England states, and the Maritime Provinces including Newfoundland.

Although the exact ranges of gray and eastern wolves are still being defined in Ontario, gray wolves likely dominate the boreal forests and tundra regions of Ontario where deer are largely absent (Fig. 2). The southern distribution of eastern wolves seems to approximate the southerly limit of exposed Pre-Cambrian rock, which supports coniferous forests or a mix of conifers and hardwood [77]. Overall, wolves probably still occupy 85% of their historic (pre-colonization) distribution in Ontario. Genetic data suggest that the range of the eastern wolf in North America (and Ontario) is expanding while the range of the gray wolf in Ontario may be declining [60].

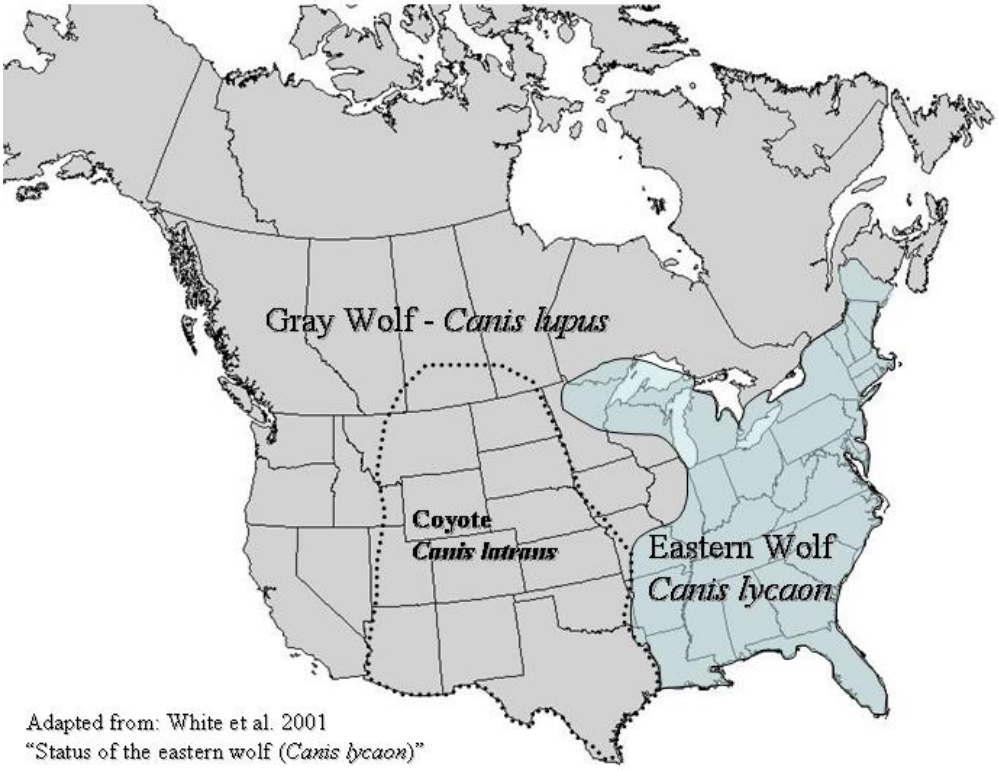


Figure 1. Historic distributions of North American Canids.

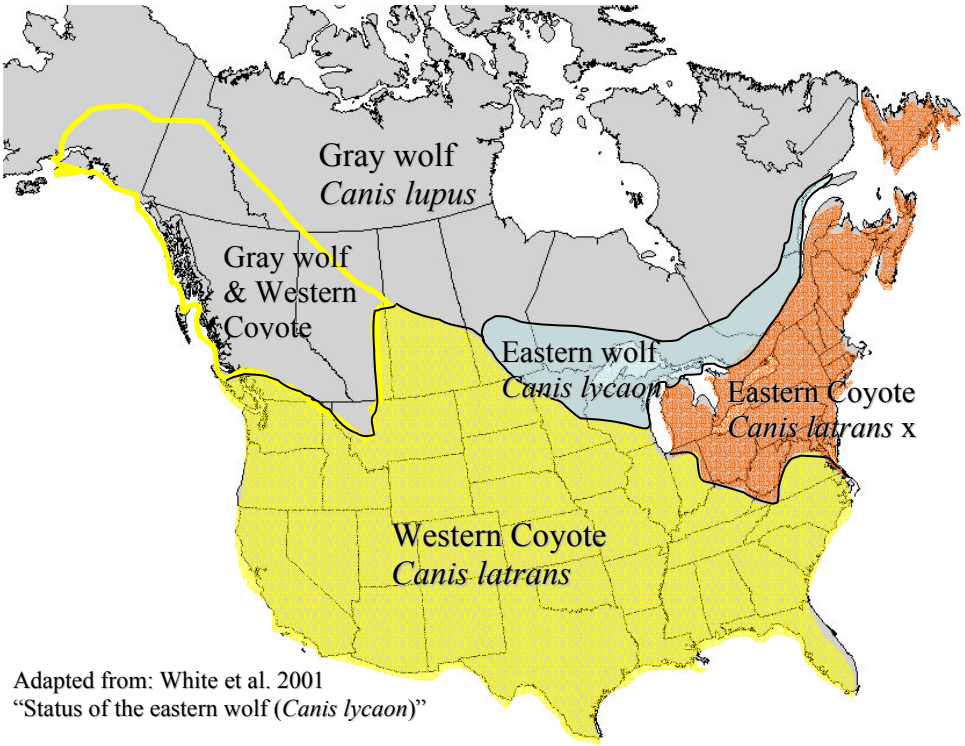


Figure 2. Present day distributions of North American Canids.

3.1.2. Physical Description

Wolves are typified by long legs, a narrow chest, and thick fur. The wolf's physical stature, long legs, blocky feet, and powerful muscles allow it to travel tirelessly at ~8 km/ hour for many hours each day in all types of climatic conditions [83, 110, 71]. Wolves are predators, equipped with necessary strength and senses to pursue prey. With few exceptions they are considered obligate predators of ungulates [84]. That is to say that they rarely exist anywhere without ungulate (hoofed) prey.

A grizzled coat is more common in the gray wolf but also seen in eastern wolves during winter. Pelage color can be highly variable for both gray and eastern wolves, but tends to be grayish or tawny with black frosting from the upper side of the neck and over the back. In summer the guard hair is very short and under fur almost absent from the ventral areas. In eastern wolves this sparse hair accentuates a darker, grizzled red appearance in summer. Whereas gray wolves can be entirely black in Eastern forested regions, and entirely white in Arctic regions, neither color phase has been documented for an eastern wolf. Like the red wolf (*C. rufus*), both eastern wolves and the closely related eastern coyote typically have reddish hair behind the ears. Both Ontario wolf species have a bushy tail that is generally straight and carried down.

Throughout most of their range eastern wolves tend to be 7-9 kg lighter than gray wolves. Depending on species and locality, the length of the body and the tail can range from 100-200cm. Male wolves are usually larger than females. Specifically, Pimlott et al. [129] reported that adult gray wolves from northern Ontario average 32 and 36 kg respectively for females and males. In contrast adult eastern wolves in Algonquin Park sampled during 1964-65 averaged 24.5 and 28 kg for females (n =33) and males (n =40) respectively. More recent data from Algonquin Park (B.R. Patterson et al., unpubl. *data*) suggests either no change or perhaps a slight increase in the weights of eastern wolves in Algonquin during the past 40 years (females = 25 kg (n = 32), males = 30 kg, n= 24). Consistent with the weight differences reported above, eastern wolves tend to have a more slender appearance and narrower muzzle than gray wolves.

Coyotes observed in the wild are sometimes confused with eastern wolves (*C. lycaon*). Confusion is heightened by the extensive occurrence of hybridization between eastern wolves and coyotes in Eastern Ontario [139, 168]. Common names for coyotes such as "brush wolf" or "prairie wolf" only add to that confusion.

Although often confused with eastern wolves, coyotes tend to be smaller and have more pointed ears and muzzles and proportionately smaller feet. A thorough description of the coyote can be found in Bekoff (1977) [19]. The size and weight of coyotes are commonly overestimated, perhaps because their long pelage masks a bone structure that is lighter than that of dogs [158]. Adult coyotes weigh 9–16 kg (20–35 pounds), with males usually about 2 kg (4 pounds) heavier than females [5, 20]. Coyotes in northeastern North America are slightly heavier (15–18 kg [33–40 pounds]), with some individuals weighing more than 20 kg [134a, 69, 139]. Total body length varies from 120 to 150 cm (48–60 inches), with tail lengths of about 40 cm (16 inches). The coyote skull is typically long,

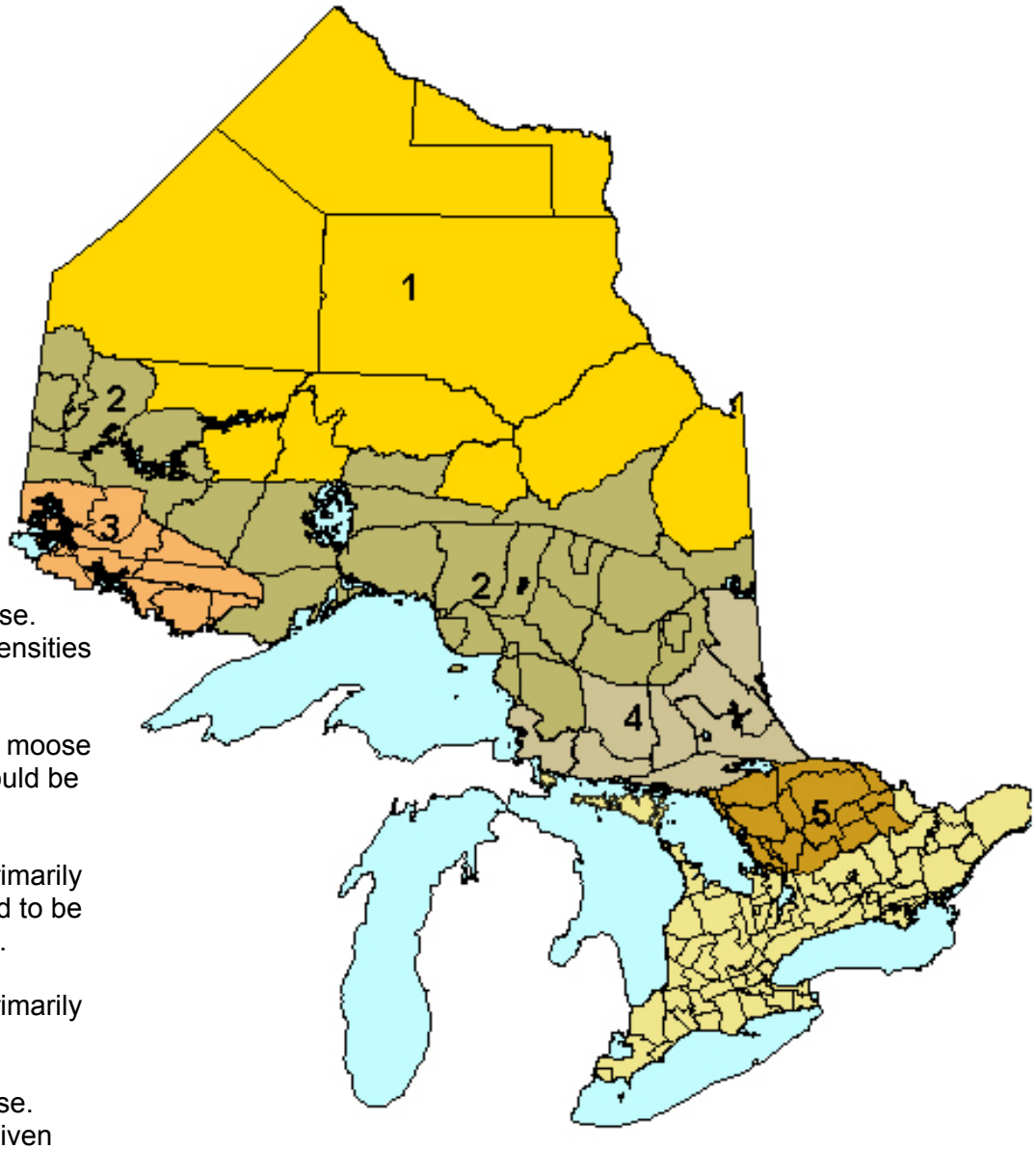
with a gently sloping forehead and prominent canine teeth. Pelage color of coyotes ranges from creamy to dark rufous, but the tawny-gray agouti pattern is the most common. Geographically, coyotes vary from a gray-black pelage in the Far North [155] to a fulvous or lighter pelage in southern or desert areas. In areas where hybridization with eastern wolves is common pelage coloration is very similar between the 2 species. Coyote coats become prime during late autumn [140, 112]. This long dense fur produces pelts that are sought for fur coats, fur trim, or other apparel. Identification of coyote–wolf hybrids can seldom be done on live specimens. Discriminate function analyses separating species based on skull measurements, or genetic analyses are usually required [79a, 138, 168, 60].

3.1.3. Provincial Population Size, Trend and Population Significance

Given the difficulty in precisely estimating wolf abundance, it is unclear precisely how many wolves there are (or have been historically) in Ontario. During the mid-1960s the number of wolves province-wide was estimated at between 10,000-15,000 [142]. During the 1970s deer numbers declined throughout their range in Ontario, and moose numbers similarly declined through much of the southern boreal forest, leading Kolenosky [77] to conclude that wolf numbers had probably declined drastically as well. Assumptions discussed by Kolenosky [77] lead to an estimate of ~4,500 wolves province wide in the early 1980s. However, based on a thorough review of the literature it seems unlikely that there were ever these few wolves in Ontario in recent (post colonization) times.

By grouping areas with similar prey species composition and abundance, topography, and climate, we have tentatively delineated 5 ecological zones within the present range occupied by wolves in Ontario (Fig. 3). We then reviewed the literature and documented reported wolf densities from other areas with similar prey densities and physiographic characteristics as each zone. By applying these density estimates to the area occupied by each zone we estimate the present number of wolves in Ontario at approximately 8,850 (Table 1). If this number is accurate then Ontario continues to have more wolves than any other state, province or territory in North America [23].

Given the difficulties in accurately estimating provincial wolf numbers discussed above, there is little quantitative data that speaks to recent trends in wolf abundance in Ontario. Figure 2 in Buss and de Almeida [28] suggests that in 1993 most MNR district/area offices in Ontario reported that wolves were either increasing or stable. Given that both deer and moose numbers have increased in many areas of the province in the last 10 years, and that wolf harvest trends over the last 5 years appear stable, it is likely that wolf numbers in most areas of the province have either been stable or increasing since 1993.



Zone 1 – Gray wolves that feed primarily on caribou and moose. Territories should be large (~1000/ km^2) and thus densities relatively low.

Zone 2 – Primarily gray wolves, probably feeding primarily on moose (with some use of caribou and deer). Densities should be slightly higher than found in zone 1.

Zone 3 – Wolves will likely be gray/eastern hybrids feeding primarily on deer, but also on moose. Densities are expected to be intermediate between those found in zones 4 and 5.

Zone 4 – Wolves will likely be gray/eastern hybrids feeding primarily on moose and deer.

Zone 5 – Eastern wolves feeding on deer but also some moose. Densities will be high relative to most other zones given relatively high prey abundance.

Figure 3. Proposed wolf ecological zones.

Table 1. Estimated wolf densities in the 5 proposed wolf ecological zones. Population estimates for each zone were calculated as the estimated density X area of each zone.

		Relevant density estimates from other study			Assumed	
Zone	Description	Location	Estimate (wolves/1000 km^2)	Reference	density for zone	Pop Estimate
1	Gray wolves that feed primarily on caribou and moose. Territories should be large (~1000/ km^2) and thus densities relatively low.	Denali Nat Park (Alaska)	6	101		
		Northwest Alaska	5	16		
					6	2,920
2	Primarily gray wolves, probably feeding primarily on moose (with some use of caribou and deer). Densities should be slightly higher than those found In zone 1.	Interior Alaska	9	53		
		Northeast Alberta	6	49		
		Southwestern Quebec	8	104 (LP area)		
		Pukaskwa Nat. Park	8	43		
					7.5	2,080
3	Wolves will likely be gray/eastern hybrids feeding primarily on deer, but also on moose. Densities are expected to be intermediate between those found in zones 2 and 5.	Northeast Minnesota	23-38	98,85, 88		
					25	1,180
4	Wolves will likely be gray/eastern hybrids feeding primarily on moose and deer. Densities may be similar, or slightly lower than zone 3.	Kenai Penn., AK	14	125		
		Southwest Quebec	14	104 (HP area)		
		Northwest Minnesota	17	45		
					15	1,050
5	Eastern wolves feeding on deer but also some moose. Densities will be high relative to most other zones given relatively high prey abundance.	Northcentral Minnesota	39	46		
		Algonquin Prov. Park	23-29	119		
		Voyageurs Park, MN	33	58		
		Southern Quebec	28	130		
					28	1,620
		Estimated Total Provincial Population				**8,850**

3.2. ECOLOGICAL ROLE/SIGNIFICANCE OF WOLVES

3.2.1. Prey Distribution and Status, and Selection by Wolves

Although wolves prey upon a variety of species, the survival of wolf populations necessitates the presence of a spatially abundant ungulate prey source [46, 84, 117, 121, 127].

In Ontario there are four ungulate species that wolves prey upon, moose (*Alces alces*), elk (*Cervus elaphus*), woodland caribou (*Rangifer tarandus caribou*) and white-tailed deer (*Odocoileus virginianus*). The relative importance of ungulate species in a wolf's diet, collectively depends on the distribution, density and availability of ungulates on the landscape, and the size and behaviour of the wolf species (*Canis lupus* or *Canis lycaon or some hybrid combination thereof*) present (Table 2). The only non-ungulate prey of seasonal dietary importance to wolves in Ontario is beaver (*Castor canadensis*).

Table 2. Distribution of wolf prey species across Ontario's wolf ecological zones.

Wolf Ecological Zones	Prey Species Distribution				
	Moose	**Woodland Caribou**	**Elk**	**White-tailed Deer**	**Beaver**
1	yes*	yes*	no	no	yes
2	yes*	yes	no	yes	yes
3	yes*	no	yes	yes*	yes
4	yes*	no	yes	yes*	yes
5	yes	no	yes	yes*	yes*

* Denotes primary prey species of wolves within wolf ecological zones.

Moose (*Alces alces*)

There are two subspecies of moose in Ontario. *Alces alces andersoni* occupies the western portion of the province from the Manitoba border to the Lake Nipigon area, while the range of *Alces alces americana* extends east to Quebec [18]. Moose range extends on a latitudinal gradient from south of Algonquin Provincial Park to the James and Hudson Bay coasts.

It is estimated that Ontario's moose population is approximately 114,000. Although moose numbers in parts of the province have declined, many areas have experienced a stable or upward trend in moose numbers since 1980 when the provincial population estimate was 80,000 animals [113a]. Aerial moose inventory data indicate the highest mean moose densities occur in northwestern Ontario in Zone 3 (> 0.37 moose/km^2),

and although some portions of wolf zones 2, 4 and 5 also have high densities, generally densities are more moderate (mean 0.20 – 0.25 moose/km^2) [82]. The lowest moose densities (mean 0.07 moose/km^2) are observed in wolf zone 1 [82].

Wolves across much of Ontario prey upon moose, but most wolf predation on moose is attributed to the larger gray wolf. The eastern wolf which preys to a greater degree upon white-tailed deer and beaver [41a, 160] is smaller than the gray wolf and subsequently a less efficient moose predator [42].

Elk (*Cervus elaphus*)

Historically, elk resided in Ontario until their extirpation by the early 1900s, a result of overharvesting and altered habitat stemming from human settlement [19b]. Several attempts at reintroductions occurred during the early to mid 1900s, with only two remnant herds surviving in the Burwash/French River area [19b]. Reintroductions occurring between 1998 and 2001 with animals from Elk Island National Park brought Ontario's elk population to around 450 animals [134b]. Elk are now located in four areas of the province namely, Lake of the Woods (LOW) in northwestern Ontario, the north shore of Lake Huron (LHNS), Bancroft/North Hastings (BNH) and the Nipissing/French River (NFR) area.

Since elk numbers in the reintroduction sites are low, relative to other edge dependant ungulates, wolves residing in those areas are likely sustained by other more abundant ungulate species [20b,36]. Elk at all reintroduction sites except for LHNS, are however suspected of having been preyed upon by wolves [134b].

Woodland Caribou (*Rangifer tarandus caribou*)

Ontario's woodland caribou are comprised of two ecotypes, forest-tundra and forest dwelling. The forest-tundra ecotype inhabits the most northwesterly portion of the province along the Hudson and James Bay coasts [1a, 62b]. Approximately 16,000 forest-tundra woodland caribou are estimated to be in the province [37], and they are not deemed to be at risk by the *Committee on the Status of Endangered Wildlife in Canada* (COSEWIC).

Forest-dwelling woodland caribou, reside south of the forest-tundra ecotype and primarily north of 50^o latitude [11]. Disjunct indigenous forest-dwelling woodland caribou populations occur as far south as the Lake Superior coast inhabiting the Slate Islands, Pic Island, and Pukaskwa National Park [38]. Michipicoten Island in Lake Superior has a population of forest-dwelling woodland caribou resulting from animals translocated in the 1980s [20a]. Woodland caribou occurring in the Lake Nipigon area and more easterly animals of the central highlands may provide a spatial link between the continuously distributed populations to the north and the more disjunct populations adjacent to the Lake Superior coast [38].

Ontario's forest-dwelling woodland caribou population has been estimated at 5000 animals [37]. Declining populations facilitated by human induced habitat loss and possibly increased predation associated with habitat modification has resulted in this ecotype being designated as "Threatened" by COSEWIC in 2002 [152]. This designation has increased provincial woodland caribou conservation efforts and Ontario is developing a provincial recovery strategy for this woodland caribou ecotype.

White-tailed Deer (*Odocoileus virginianus*)

White-tailed deer in Ontario have a broad spatial distribution with most animals residing in the Great Lakes – St. Lawrence forest region [154]. Although white-tailed deer populations in Ontario have fluctuated considerably, they have exhibited significant growth since the mid 1800's related to expansion of favourable habitat [120] and continue to expand both numerically and spatially. In 1980 there were an estimated 100,000 white-tailed deer in the province [114a], increasing to over 350,000 by 1996 [115a] and range expansion is continuing [116a]. Mild winters and an increase in suitable deer habitat are key factors that have allowed deer populations to reach high densities in many parts of the province.

The expansion of white-tailed deer in the province has implications for other ungulate species. White-tailed deer are the normal host for the meningeal worm (*Parelaphostrongylus tenuis*), a parasitic nematode that if transmitted to moose, woodland caribou or elk, can result in mortality of the ungulate [3, 4, 33]. The nematode is commonly found in white-tailed deer feces across Ontario where deer cohabit with moose [167].

Where wolf and white-tailed deer range overlap in the province, wolves are likely to prey to some degree upon deer (see Table 2). White-tailed deer are the primary prey species of the eastern wolf in and around Algonquin Provincial Park [42, 129,149,160] and likely elsewhere in that wolf ecological zone.

Beaver (*Castor canadensis*)

While wolves prey heavily upon ungulates throughout the year, wolf diet analysis has illustrated the importance of beaver to wolves in several geographic areas during snow-free months [2, 129, 130, 154b, 160]. High use of beaver as a food source may be a function of beaver proximity to wolf den and rendezvous sites, beaver/ungulate density and availability [49, 121, 130, 149, 160], or some combination of these and other factors.

Although harvest by the fur trade reduced beaver numbers significantly in the early 20th century, beavers are now both abundant and widely distributed throughout Ontario [18, 111b].

3.2.2. Wolf Habitat Requirements

Wolves are not generally restricted to specific habitat types, but rather their presence on the landscape is more often based on the habitat needs of their prey [31] and the degree of harvest by humans [23]. As such, landscape level habitat planning that operates under the premise of providing for the spatially explicit habitat needs of resident ungulate and beaver populations and considers road densities, should provide an adequate supply of quality wolf habitat. There is however, some evidence that a fine filter approach may be warranted around active wolf den and rendezvous sites [29, 111,165, 169].

Denning Habitat

Wolf breeding and the subsequent use of wolf den sites vary with latitude [17, 24, 47, 49, 68, 90, 92, 132]. Based on wolf denning activity observed in other geographic areas of similar latitudes [24, 45, 47, 49, 121,156], wolf denning throughout Ontario is expected to range from early April to early May.

With the wide spatial distribution of wolves in the province and the distribution and abundance of sites with frost-free soils at denning, it is expected that habitat characteristics of den sites will differ across wolf ecological zones. Eskers are common den sites of wolves in northerly tundra areas, possibly offering a suitable aspect facilitating excavation of frost-free soil [31, 164]. Wolves occupying more forested habitats locate den sites in a variety of site-specific habitats such as rock caves, hollow logs and stumps, beaver lodges or ground excavations on well-drained sandy knolls or hillsides [14, 29, 36,47, 74, 169], often near water [14, 74, 121]. Forest stand characteristics of wolf den sites range broadly from aspen dominated [31] to conifer rich [74, 111]. Ballard and Dau [14] report the use of both homogeneous conifer and hardwood stands, as well as mixed-wood stands by wolves for den sites in southcentral Alaska.

Although den sites may not be used each year by a wolf pack, frequent re-use of den sites is common [14, 31, 35, 36, 47, 68, 96, 121, 125]. A lack of alternative den sites [47, 96, 121], individual or pack familiarity with the area [62, 121], proximity to a seasonally clumped prey source [35, 149], or minimal interspecific [64, 66] and intraspecific harassment [35], may explain this fine-scale habitat selection behaviour. Den sites with an extensive number of tunnel entrances and large entrance diameters [14] or copious old prey bones and wolf scat [36, 68] may be indicative of traditional sites. Since research indicates wolf use of traditional den sites is common, and wolves are most vulnerable during this temporal period [29, 165], fine-scale habitat protection should be considered at these sites [169].

Rendezvous Sites

Once wolf pups are six to eight weeks old, the focal point of pack activity shifts as the pups are moved from the natal den to the initial and subsequent rendezvous sites [74, 84, 121]. Wolf pups remain at the rendezvous site while adult pack members hunt [78]. During

summer, wolf pups are moved to a series of rendezvous sites, occupying each site for a period of days to weeks, each site seeing less use than the natal den [121]. In the early fall, as pups attain sufficient size to facilitate hunting with the pack, rendezvous site use decreases [121, 157]. Like natal dens, rendezvous sites are often used repeatedly by a wolf pack, year-to-year [14, 121] but also during the year as wolves revisit summer rendezvous sites during the autumn and winter [39, 45, 62, 78, 121] possibly to reconnect with misplaced pack members [62].

Aside from often being located near or adjacent to water and having matted vegetation from considerable wolf use [74, 121, 129], rendezvous sites similar to wolf den sites are located in a variety of habitat types. In northern non-forested habitats, wolf kill sites have acted as rendezvous sites for pups, possibly allowing pups to become increasingly involved in pack hunting activities [59]. In forested areas, rendezvous sites range from open bogs, burns and clearcuts [74, 129, 147], open or semi-open canopied forest [14, 29, 39, 78, 129], and conifer dominated forest [74]. Some rendezvous sites in forested areas possess dens offering increased security for wolf pups [14, 121, 129], while this feature is absent at other sites [129].

Although some wolves have exhibited a high degree of tolerance to humans around rendezvous sites [151], wolves in more remote areas or where prone to human harvest, appear to have a low tolerance for human activity [47, 74]. Active rendezvous sites, similar to den sites are deemed as ecologically sensitive by some jurisdictions and are offered spatial and/or temporal protection [151, 169].

Habitat Fragmentation and Connectivity

Viable wolf populations require adequate prey abundance and favourable habitat characteristics across large spatial scales. Where prey and habitat conditions are compromised, spatial and numerical shifts in wolf populations occur [124, 117]. Areas in which human population and resource management activities are limited (i.e., protected and roadless areas) exhibit little pressure on wolf populations, but in areas where the opposing conditions occur increased wolf habitat fragmentation, human/wolf conflicts and wolf harvest are often realized [89].

With increased wolf habitat fragmentation come landscapes that are less conducive to wolf travel. Although natural habitat features such as large mountain ranges, plains [34, 57] or water bodies [32] fragment wolf habitat and reduce population connectivity and gene flow, human settlement and roads can magnify fragmentation and its effects [108].

Road density provides a relative means of measuring human-induced habitat fragmentation of an area, and identifying thresholds at which resident and colonizing wolf populations are negatively impacted. Increased wolf mortality and decreased wolf population persistence have been observed where road densities exceeded 0.45-0.73km/km^2 [72, 108, 150, 99]. Areas with extensive road networks provide an effective mechanism facilitating wolf [99, 89] and wolf prey [133] harvest. However, where wolves are afforded some degree of protection and prey remains abundant, they are able to inhabit areas with relatively high road densities and human activity [48, 91, 150].

The majority of Ontario's wolf range possesses road densities below thresholds identified as critical to wolf population persistence [28.] Large, contiguous areas remain across much of the northern part of the province and, although pressure to harvest natural resources from these areas is increasing [137], connectivity of wolf habitat remains high. Wolf range road density increases significantly toward the southern limit of Ontario. Some areas around Algonquin Provincial Park, Thunder Bay and Lake Nipissing have high road densities, and wolf populations in those areas may require more frequent monitoring to lessen isolation risk [28].

Wolf populations occupying disjunctive habitat require connectivity to populations in more contiguous wolf range to ensure their persistence [108]. Wolves dispersing from source populations are necessary to maintaining wolf populations in less favourable habitat as they offset increased mortality costs and maintain genetic variability [63, 89, 94, 126]. Wolf population dynamics increase in importance towards the southern limit of provincial wolf range, especially so if wolves are to geographically re-establish their range into other parts of the province (i.e., Frontenac Axis) or the northeastern United States [170].

3.2.3. Population Dynamics and Community Ecology

Population Structure and Density

The basic social unit of a wolf population is the mated pair. The natural extension of the mated wolf pair is the pack, which generally consists of a mated pair and its offspring from previous years [84, 86]. However, unrelated adults are sometimes also found in these "family" packs [102, 60]. Documented pack sizes range from 2-29 [93], and some packs contain offspring from as many as 4 subsequent litters [101]. Most packs move within exclusive home ranges called territories. Packs are generally hostile to strangers from neighboring packs. Each year a single litter averaging 4-7 pups is generally born, although multiple litters have been documented [156, 93], usually in heavily harvested or newly colonizing populations.

There is still much debate as to exactly why wolves live in packs, but it seems that the continued association of young wolves with their natal packs may simply be a way for young wolves to mature and learn hunting skills while still being subsidized by their parents. Although large packs are not required to successfully hunt large game [153], maintenance of large packs does appear to be facilitated by availability of large prey [93, 51]. Another benefit of pack living is that losses from ungulate carcasses to scavengers are minimized, i.e., losses to scavengers are inversely proportional to pack size [123, 163].

Characteristics of Wolf Pack Territories

By definition, a territory is a defended area [27]. Widespread and regular travel by wolves not only helps wolf packs secure prey, but also to defend and mark their territories.

Both scent marks [134c, 171] and howling [74, 61] appear to assist in demarcation of territories and help minimize actual encounters between neighboring wolf packs. Territory sizes tend to be inversely related to the biomass of vulnerable prey, and have been reported to range in size from 33 km^2 for a pack living in a deer yard in Minnesota [93], to 4,300 km^2 for a pack of 10 in Denali National Park, Alaska [101]. In a well-established population a territory mosaic develops such that the landscape is saturated by contiguous, but largely non-overlapping, territories. Overtop of this territory mosaic is a "layer" of solitary, non-breeding wolves that seem to wander freely (although they are sometimes killed when caught by resident packs) over the landscape looking for opportunities to join, or form, a pack. Although territoriality may sometimes breakdown when the major prey species is migratory [41, 165], this appears to be the exception rather than the rule; most territories are defended year-round [93].

Population Density

As discussed above, across North America wolf densities vary spatially and temporally due to changes in prey density and vulnerability [86, 145, 104,106, 126, 46, 50], and variation in levels of human harvest [45, 52, 81]. In Northeastern North America wolf densities vary from 3.3-4.5 /100 km^2 for wolves feeding primarily on deer in North-central Minnesota [46] to 1.0-1.5 /100 km^2 for wolves feeding primarily on moose in western Québec [104]. In recent years in Algonquin Provincial Park, Ontario, where wolves feed on a combination of deer, moose and beaver, wolf densities have ranged from 2.3-2.9 wolves/ 100 km^2 [119.] Although moose densities are high in Algonquin relative to most of Ontario, deer densities, particularly during winter, are relatively low [42], thus it is probably reasonable to assume that wolf densities across much of Ontario where moose and deer are sympatric would be similar to those observed in Algonquin in recent years. Above the Ontario tree line where wolves are probably largely dependent on caribou as prey, territory sizes are probably large, thus wolf densities could be <1/ 100 km^2. In summary, across Ontario it is likely that regional wolf population densities reflect the abundance and composition of the primary prey species, ranging from <1 wolf/ 100km^2 where wolves are reliant on a single (and relatively scarce) ungulate species (either deer or caribou depending on locality) to densities approaching 3/100km^2 where multiple ungulate species are present and deer are relatively abundant.

Reproduction

Female wolves may breed at 10 months of age in captivity, but there is only one record of a female breeding this young in the wild. This occurrence was documented within the introduced population in Yellowstone National Park where prey is particularly abundant [80]. Most wolves do not come into estrous until >22 months old [132, 67]. Whereas a female domestic dog may come into estrus twice a year and at any time during the year, the female wolf is strictly monestrous and highly photoperiodic [67]. Although a pack of wolves may contain several reproductively mature females [132], generally only one female reproduces. It seems that social aggression within the pack limits breeding to one female [118] and if social circumstances are altered, such as the death of a parent, subordinate offspring can successfully copulate.

Like the female, male wolves may rarely be physically capable of breeding at 10 months of age, but generally do not breed before 22 or 34 months of age [80]. Male wolves also demonstrate a photoperiodic reproductive cycle with breeding capability reaching its peak between December and March and being almost impossible from June through September [12, 80]. The breeding season in wolves seems to be progressively later with latitude [92], and in Ontario breeding probably peaks from mid to late February [74, 128, 47, 92]. In a study of captive wolves, estrus lasted about 9 days. As with most dogs, gestation lasts about 63 days, thus most pups are born during mid to late April.

Pups are born in dens which are generally excavated in well-drained sandy soils and are often associated with riparian areas. Although excavated dens are most common, use of beaver lodges, rock caves and hollow logs have been reported [128, 84, 47]. Litter sizes tend to average about 5-6 and may increase with ungulate biomass per wolf [157, 76, 22, 51].

Dispersal

Dispersal is defined as the movement of an individual animal from its place of birth to the place where it reproduces (or attempts to reproduce). Unless they assume breeding status in the pack, most wolves will eventually disperse from their natal pack [56]. Thus, a wolf pack can be viewed as a "dispersal pump" that converts prey animals into young wolves which are spewed out across the landscape each year [93]. Although generally thought of as a singular event, dispersal may sometimes be temporary, with individual members leaving and returning to their pack many times before dispersing permanently [56].

Wolves as young as 5 months old and as old as 5 yrs have been documented to disperse [93]. Wolves of both sexes disperse and there is no consistent sex-bias in rate, direction or distance of dispersal, although individual studies do report sex biases for particular dispersal characteristics. Gese and Mech [56] reported that between 1969 and 1989 annual dispersal rates in northeastern Minnesota varied between 4-35% for pups (< 12 months old), 47-83% for yearlings (12-24 months old), and 3-7% for adults (>2 years old). Wolf dispersal distances are highly variable, ranging from movement just outside the natal territory to long distance treks of up to 886 km [44]. Distance of dispersal seems to reflect the great variation in environmental conditions and motivation for dispersal. Younger animals tend to disperse further, perhaps because awareness of the "colonization potential" in immediate surrounding areas increases with age and experience [93].

Given the strong association with onset of dispersal and onset of sexual maturity, reproductive development (puberty) may be a primary trigger to dispersal. However, food availability also appears to have a strong influence, with dispersal rates generally increasing with food stress [105, 124, 65]. Although the dominant (breeding) wolves in a pack may sometimes overtly trigger the dispersal of subordinate animals, the incentive to disperse is likely more often mediated by the breeding pair denying subordinate pack members access to food [19, 93]. The youngest pups in a pack are generally fed first, with

older pups receiving progressively less access to food by their parents. When food is abundant there may be enough for all pack members, and dispersal rates will be low. Conversely, when food abundance is less than required for all pack members, the oldest pups in a pack are offered the least access to food by their parents and thus have incentive to disperse. Overall, dispersal is probably motivated by attempts to maximize both food input and breeding opportunities.

Mortality

Direct harvest by humans, intra-specific strife, disease and malnutrition comprise the primary causes of death for wolves in most areas.

Intra-specific Strife

On Isle Royale National Park, where there is no human killing of wolves, annual mortality due to starvation and intra-specific strife (mostly related to relatively low food availability) ranged from 0-57% from 1971-1995 [126]. Similarly, in Superior National Forest, Minnesota, annual wolf mortality rates ranged from 7-65% between 1968 and 1976, and 58% of that mortality was due to strife and starvation. In Algonquin Provincial Park both strife and starvation were uncommon when the population was partially harvested during 1987-1999 [148e] but natural mortality, dominated by intra-specific strife, starvation and disease, became considerably more common (20% of animals dying per year) following more complete protection of park wolves from human harvest (Patterson et al., unpubl. data) suggesting a compensatory relationship between human harvest and natural mortality.

Diseases and Parasites

Wolves are hosts to a variety of external and internal parasites. Although many of these can affect population densities, our discussion focuses on two that are of greater interest: rabies because of its implications to human health, and sarcoptic mange because it may be a cause of significant canid mortality.

Viral testing has been conducted on wolves during two studies in Ontario. Eastern wolves tested in Algonquin Provincial Park from 1989-1996 showed common exposure to PARVO (CPV-2) virus (38/46 or 82%) and infectious canine hepatitis virus (35/46 or 76%). The pattern of exposure of wolves in Algonquin to parvovirus in particular suggested widespread and early exposure, with 7 of 8 pups tested during the aforementioned period testing positive. In Minnesota, both percent population change and proportion of pups in the population were inversely related to the percentage of wolves seropositive to CPV-2 [94, 95]. Mech and Goyal [95] concluded that wolf populations in Minnesota were likely to decline when the prevalence of CPV-2 in adults consistently exceeds 76%. Similarly, Johnson et al. [73] reported that CPV-2 may have been responsible for significant wolf pup mortality in northwestern Montana and southeastern British Columbia. Although viral diseases may play a significant role in the demography

of wolves in southern Ontario, gray wolves tested in the Greater Pukaskwa Ecosystem study area from 1994-1996 showed infrequent exposure to CPV-2 virus and hepatitis, and no exposure to canine distemper [26]. The apparent lack of exposure of the Pukaskwa area wolves to these viruses may be explained by the isolation and low density population of wolves in this study area, the low density of other wild canids and raccoons, and the relative isolation from domestic dogs. Canine distemper requires direct contact with an actively infected animal for transmission. CPV-2 and hepatitis do not, and are resistant to the environment.

The red fox is the most prevalent wildlife carrier of the rabies virus in Ontario. From 1957 to 1993, 68% (23,970) of the more than 35,000 verified cases of rabies in wildlife were recorded in this species (Agriculture Canada, Animal Disease Research Institute, unpubl. data). Twenty-nine percent (10,285) of the cases during this period involved the striped skunk (*Mephitis mephitis*). Only 224 (0.6%) of the confirmed cases of rabies were attributed to wolves (167) and/or coyotes (57). Rabies has been confirmed as a mortality factor in wolves in Algonquin Provincial Park [148c]. Overall, however, it would appear that either few infected wolves or coyotes become known and are submitted for testing or, more probable, the incidence of the disease in these two species is very low.

An explanation for the apparent low incidence of rabies in wolves and coyotes may be found in the behavioral characteristics of these species. Gray wolves tend to compete with coyotes, and are known to kill them where they intrude into their territories [30]. Coyotes respond quickly to the extirpation of wolves by expanding their range into the vacant habitat [136]. While evidence suggesting that coyotes prey on foxes is lacking, the two species are not found in abundance in the same locations [136]. However, it appears that red foxes avoid coyote territories identified to them by coyote howling, scent or other forms of communication [158b]. This would result in a low frequency of wolf/fox and coyote/fox interaction, and thus may explain the low incidence of rabies in wolves and coyotes.

Mange is an irritation to the skin caused by a burrowing mite (*Sarcoptes scabiei*), the most significant ectoparasite of canids. Severe infestations result in loss of hair and secondary infection. Hair loss observed on live or dead canids is often the only common indication of such a condition, but confirmation of the disease is made by the discovery and identification of the causal mite. Mange has been observed sporadically in wolves, coyotes and foxes in Ontario. Hair loss in wolves has been reported periodically on the north shore of Lake Huron (Blind River, Sault Ste. Marie, Espanola) and recently, about 12-15% of yearling and adult wolves radio-collared in Algonquin Provincial Park have exhibited signs of mange.

Mange was relatively common among wolves and coyotes in southern Ontario in the early 1990s, and in the past 2 years seems to becoming common again with trappers reporting poor pelt quality in wolves in the Bancroft and Pembroke areas.

While there is insufficient information that mange is affecting the population dynamics of wolves in Ontario, it has been identified as a significant mortality factor elsewhere [170].

Other Mortality Factors

Wolves have been documented to also die of a large number of causes [51], including injuries inflicted by prey animals, falling off cliffs, avalanches, car and train collisions, drowning (summer and through ice in winter). However, except in areas where major highways are crossed frequently by wolves (e.g., Banff National Park), vehicle or train collisions and other types of accidents generally affect only a small proportion of most wolf populations [101, 15, 51].

3.2.4. Natural Regulation

The concept that wolves might regulate their own numbers has been entertained for at least 60 years [109, 143]. Indeed wolf populations are characterized by the factors necessary for intrinsic control: territoriality, intra-specific strife, variable but potentially high rates of dispersal, and reproductive inhibition in subordinate pack members. Although some earlier researchers believed that intrinsic control of wolf numbers occurred independent of prey availability [83, 84, 127, 128, 157], more recent research has made it clear that, except where limited by disease, wolf numbers ultimately depend upon the food supply [76, 46, 106, 51]. Food supply does not necessarily relate to the absolute densities of the main prey species of wolves, rather it is the biomass of "vulnerable" or available prey that is key. Despite the role of food supply in setting the upper density for a wolf population during a given year, the aforementioned mechanisms required for intrinsic control (territoriality, intra-specific strife, variable but potentially high rates of dispersal, and reproductive inhibition in subordinate pack members) do indeed act as the proximate factors "enforcing" the limit on density for a given wolf population. To summarize, changes in wolf numbers from year to year depend on how the combination of reproduction, mortality, immigration, and dispersal are affected by food availability.

3.3. HUMAN IMPACTS ON WOLF POPULATIONS

The *Fish and Wildlife Conservation Act* (FWCA) provides the regulatory tools to conserve wildlife, and hunting and trapping activities, in Ontario. The FWCA is enabling legislation that allows the government to licence hunters and trappers, set seasons, set quotas or harvest levels, restrict hunting or trapping in certain areas, allow people to protect their property, require reporting, collect royalties, control export and regulate trade.

Wolves are not intensively managed in Ontario. Wolves are generally managed using an open allocation approach with unlimited harvest by individual hunters and trappers.

The primary prey species of wolves in Ontario are moose, deer, caribou and beaver. Moose and deer are the primary ungulate species sought by hunters, and beaver is the most common furbearer trapped throughout Ontario's wolf range. Wolf/human competition for these resources is recognized, and wolf predation is a mortality factor considered in Ontario's game management.

Wolf/prey system dynamics are a challenge to study and understand. Research into understanding the complex interactions of species in such multi-prey (and multi-predator) systems has provided some insight into the impact that wolves have on their prey [52, 70, 95, 121, 124, 139], but significant knowledge gaps remain. The simplistic intuitive logic that reducing the number of wolves translates into greater prey abundance sometimes, but not always, holds [91]. Wolves can influence long-term prey densities, but the more noticeable short-term fluctuations are often the result of factors other than wolf predation (e.g. winter severity, predator and prey disease) [123].

When an ungulate or non-ungulate prey population declines, wildlife managers face the decision of whether to implement conservation measures in an attempt to increase numbers of the prey population to historical levels of abundance. Wild predators, such as wolves, are frequently perceived as the ultimate factor behind hunter harvest restrictions, possibly an assertion based on limited knowledge of the inherent complexity associated with wolf/prey relationships.

Some trappers target wolves when beaver populations are lower than expected or to augment them. The impact this has on the broader wolf population is dependent on the size of the trapline and the trapper's ability to catch wolves.

Understanding the impact of hunter harvest on wolf prey biomass (and ultimately wolf abundance) requires more research, given that wolf population productivity and density are closely linked to ungulate biomass [76]. Some research [25] indicates that wolves and hunters select for different ungulate prey characteristics, but the long-term impacts of such selection patterns on wolf populations need to be explored. Other research indicates that although hunters reduce wolf prey biomass, wolves may partially benefit by adopting an opportunistic foraging strategy in seeking out hunter-created carrion [135].

3.3.1. Human-caused Mortality

Hunting

Hunters harvest wolves and coyotes under a Licence to Hunt Small Game. The extent of interest in direct wolf hunting is not known. It is believed that much of the wolf harvest occurs incidental to big game hunting (i.e., during concurrent moose, deer and bear hunting seasons). Although hunting dogs are often used in the hunting of coyotes in southern Ontario, the extent of their use in wolf hunting is not known.

The full extent of harvest of wolves by hunters is also not known at this time. The most reliable harvest information is collected through mandatory reports from fur dealers and taxidermists indicating wolves received from hunters for sale or tanning from hunters. These reports indicate a small harvest of wolves and coyotes by hunters within wolf range (2000/01 – 151 animals, 22 identified as "wolves"; 2001/02 – 109 animals, 11 of these identified as "wolves", 2002/03 – 170 animals, 23 of these identified as "wolves"). Some of these coyotes may be eastern wolves, as it would be difficult for hunters to visually distinguish wolves from coyotes in the field particularly in central Ontario.

Wolf harvest data are also obtained from questions on wolf harvest included in the voluntary annual postcard surveys of moose and deer hunters, the periodic postcard surveys of bear hunters (2003), and the provincial mail surveys of moose hunters (2001) and small game hunters (2001 and 2003). These data suggest that 1,000-1,600 additional wolves/coyotes may be harvested annually by large and small game hunters. However, the level of confidence of this data is low due to the difficulty in hunters visually distinguishing wolves from coyotes in the field, low survey response rates, and possible duplication of harvest data submitted by the same hunter through various surveys.

The large discrepancy in harvest data from tanned and sold wolves and from hunter game surveys suggests that hunters are either harvesting these animals for personal use (e.g., self tanning) or are not using them at all.

Accordingly, there is an opportunity to enhance methodologies for collecting information on wolf harvest by hunters within wolf range to more accurately monitor the annual harvest of these animals and assess their sustainability.

About 50 tourist outfitters offer wolf hunts on the internet, only about a dozen are known to so on a regular basis.

Trapping

Harvest of wolves and coyotes by licensed trappers can be controlled through the application of harvest limits (quotas), should that prove necessary. Harvests of wolves by trappers averaged 337 animals (ranging from 285 to 1,248) annually during the period 1971-72 to 2002-03, while an average of 994 coyotes (ranging from 397 to 3,272) were trapped during the same period. Prior to 1999, licensed trappers were required to present pelts of all furbearing mammals for sealing by government staff prior to being sold. This has been replaced by annual mandatory harvest reporting.

Trapping methods that are permitted by regulation include a wide variety of trapping systems (body-gripping traps, including neck snares, and restraining foothold traps), although recent surveys of the methods used by Ontario trappers identify neck snares (92%) as the principal method for trapping wolves, with foothold restraining traps used primarily to trap coyotes (75.0%).

Commercially-manufactured trapping systems used to capture wolves and coyotes (as well as several other species of furbearing mammals) must be regulated by 2007 in accordance with the provisions of the *Agreement on International Humane Trapping Standards* (AIHTS), which sets out thresholds for time-to-death (for killing traps) and injury levels (for restraining trap systems). Several body-gripping and restraining trapping systems have been shown to meet the AIHTS standards, ensuring that licensed trappers will continue to have the means to harvest wolf and coyote populations. Trapping systems that are not commercially manufactured but are otherwise permitted by regulation (e.g., neck snares) are not included, and will continue to be used subject to the provisions of legislation and regulations.

Defense of Property and Public Safety

Members of the public can kill wolves in defense of personal property, such as livestock or domestic pets, or in response to public safety concerns. The number of wolves killed in this manner is unknown as there are no reporting requirements in place. Actual numbers are likely small as wolves generally do not occur in close proximity to people, and coyotes or hybrids frequent agricultural and developed areas.

3.3.2. Predation on Domestic Animals

In 2002/2003, OMAF reported paying $607,168 in compensation for 1,914 livestock predation claims attributed to wolves/coyotes under the *Livestock, Poultry and Honey Bee Protection Act*. The 1,914 claims represented a total loss of 3,752 individual animals, including several hundred chickens through several claims. Figure 1 illustrates the distribution of total compensation paid by County. The highest levels of compensation were paid in coyote-only range or in areas where both wolves and coyotes are present.

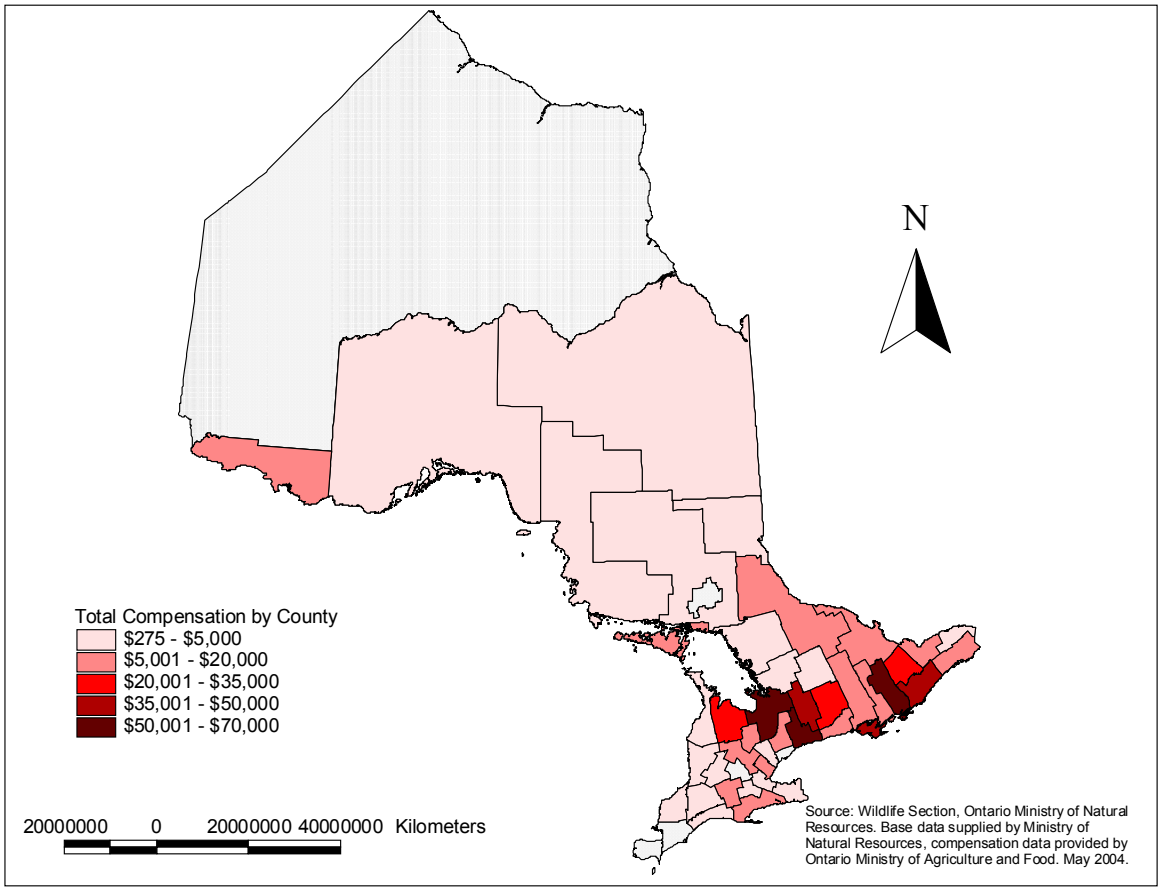


Figure 1. Total compensation paid by the Ontario Ministry of Agriculture and Food in 2002-2003 for livestock predation by wolves/coyotes.

High numbers of wild canids live in close proximity to farms. In spite of this, usually only a fraction of these may become implicated in the killing or injuring of livestock. When predation does begin to occur, the predators involved may significantly impact on a particular livestock production while adjacent farms may remain unaffected. Predation can also occur in areas and at times where natural foods seem to be plentiful.

The number of small pets, particularly cats, reportedly killed by "wild" canids in suburban and rural areas has increased in recent years. It is usually difficult to confirm the identity of the predators involved in these killings because these incidents are seldom witnessed, but they are likely caused by coyotes. OMNR staff do occasionally receive reports of domestic dogs being killed by wolves in more remote locations.

3.3.3. Predation on Wild Prey

Wildlife managers, scientists, academics and interested public have wrestled with the criteria and ethics surrounding the management of predators. Complete data on complicated predator/prey associations are often lacking, and numerous related environmental factors may cloud cause and effect analysis. Conflicting values and attitudes also make achievement of consensus on the need for predator management elusive.

Several authors have proposed a decision path to assist in determining when to initiate predator management [87, 55, 146, 161]. Most agree that the development of a clear management objective is the first step in the process. In the past, this objective was often described in terms of the desired size of prey population or the acceptable losses of prey to predators. More recently, changing attitudes have prompted managers to develop discrete management objectives for predator populations in addition to the objectives established for prey populations.

In Ontario from the mid-1970s to the mid-1980s predator control was practised in deer wintering yards. The objective was to reduce mortality of deer in the winter when they were most vulnerable to predators. Predator control was used to assist in rebuilding the Province's deer populations, along with improvement of habitat, reducing hunter harvest, limiting the harvest of antlerless deer, increasing enforcement to curb poaching and emergency feeding during severe winters. Predator control efforts diminished or ceased in the late 1980s after deer numbers increased. Predator management policies are contained within the *Moose Management Policy (WM.6.02.01)* [113a] and the draft *Recovery Strategy for Forest-Dwelling Woodland Caribou* (*Rangifer tarandus caribou*) in Ontario [116d]. Predator management activities for the purpose of wildlife management, based on the existing policies, have not been conducted in Ontario since the mid 1980s.

3.4. KNOWLEDGE GAPS

Despite the large number of both research and popular articles that have been written about wolves, many aspects of wolf biology remain to be thoroughly described. Most of these gaps exist because they deal with areas that are difficult to study directly [91, 51].

The following are knowledge gaps felt to be relevant to wolf conservation in Ontario, and are taken from a larger list detailed by Fuller et al. [51] who updated an earlier discussion of the topic by Mech [91b].

3.4.1. Dispersal and Immigration

Additional information on the movements of dispersing wolves, such as barriers to dispersal and dispersal corridors would be useful to predict when and where they will go.

3.4.2. Role of Disease

The effects of disease on the short- and long-term status of wolves need to be investigated.

3.4.3. Wolf-human Relationships

Continued assessment of human attitudes, beliefs, knowledge, and reactions to wolf status and harvest would contribute to successful wolf conservation. Additionally, better documentation of the lack of significant impacts of human developments on wolves is needed. Although human disturbance is often cited as being detrimental to wolves, this has typically not been convincingly documented [151, 21, 103].

3.4.4. Population Assessment

Standardized, accurate (and precise), and cost-effective methods of assessing wolf distribution and abundance need to be identified and implemented. Monitoring of wolf recovery, harvest impacts, or direct control, could be obtained from reliable population assessment techniques.

3.4.5. Effects of Wolves on Low Density Prey

Although much is known about the potential impacts of wolf predation on moose [107, 52, 106], the role that wolves play in limiting deer populations at relatively low densities is poorly understood [97].

3.4.6. Pup Survival

Keith [75] and Van Ballenberghe and Mech [157] emphasized the importance of studying the survival of wolf pups as a means of better understanding wolf population ecology. These researchers also stated that few data on pup ecology existed. A review of the contemporary literature indicates that the paucity of information on survival and cause-specific mortality of wolf pups still exists.

4.0 RESEARCH

4.1. ECOLOGICAL RESEARCH

Wolf research has a long history in Ontario. Dr. Doug Pimlott conducted the first major research study on wolves in the late 1950s and early 60s. The work culminated in the publication of *The Ecology of the Timber wolf in Algonquin Provincial Park* by Pimlott, J. Shannon and G. Kolenosky [129].

A number of other studies have been conducted since that time. John and Mary Theberge of the University of Waterloo, and several graduate students, conducted a radio-telemetry based investigation of the population dynamics, distribution, movements and predator/prey relationships of wolves in Algonquin Provincial Park from 1987-99. This study focused on wolf movements, pack territories, intensive field tracking for food habits investigation, and impacts of wolf predation on prey populations. Major results are summarized in *The wolves of Algonquin Park: A 12 year ecological study*, authored by the Theberges.

The Theberges quantified the timing and magnitude of wolf movements out of the southeast boundary of the park and revealed instances of high winter mortality of some park-origin wolves. Analyses suggested that human harvest might lead to the eventual extirpation of wolves from eastern Algonquin [162]. These analyses assumed the mortality rates documented for wolves in eastern Algonquin were similar throughout the park, and more importantly that the park contained a closed, biologically discreet population of wolves. Subsequent genetic work [60] has made it clear that wolves in Algonquin are part of a broader meta-population of eastern wolves that extends from southern Manitoba into southern Quebec. Similarly, recent telemetry-based research on wolves in western Algonquin indicates that most wolf packs in that area do not follow migratory deer out of the park during winter and thus would not be exposed to similar levels of human harvest as experienced by wolves in eastern Algonquin Provincial Park.

In 2001 OMNR enacted a 30-month ban on the harvesting of wolves in the 39 townships surrounding the park in an attempt to reduce human-caused mortality of this population. Subsequent monitoring by the OMNR (114 wolves radio-tagged between August 2002 and July 2004) indicated that although not necessary to prevent extirpation of wolves in the park, the harvest ban does reduce human impacts on wolves in Algonquin and is contributing to the maintenance of a naturally functioning wolf population. In May 31, 2004, the government announced that the harvest ban in the 39 townships surrounding the park would be extended indefinitely and that hunting and trapping of coyotes also would not be permitted, due to the difficulty in distinguishing them from wolves.

Environment Canada, under the direction of P. Paquet, conducted a study on the northeastern shore of Lake Superior to better understand predator/prey relationships and to learn more about the seasonal movements of gray wolves inhabiting Pukaskwa National Park and surrounding areas. The study indicated that wolves in the area exhibit low rates of growth owing to both food stress and human harvest [43]. Genetic

work suggests that the Pukaskwa area contains fairly pure gray wolves, with little hybridization with eastern wolves as seen in surrounding areas.

4.2. GENETIC RESEARCH

Since the 1990s a research team led by Dr. Brad White of the Natural Resources DNA and Forensics Profiling Centre (NRDPFC) at Trent University in Peterborough have been conducting genetic studies of wolves in Ontario. This work concludes that the eastern wolf (*C. lycaon*) is a distinct species of wolf very closely related to the red wolf (*C. rufus*), rather than a sub-species of gray wolf as originally thought.

The NRDPFC is presently collaborating with the OMNR on research efforts to delineate the present day range of eastern and gray wolves in Ontario, and to determine the conservation status of the eastern wolf and gray wolf in North America.

5.0 WOLF CONSERVATION APPROACHES

5.1. LEGISLATION AND POLICY AFFECTING WOLVES

5.1.1. International

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

Canada is a party to this international voluntary agreement among governments that aims to ensure that trade in animals and plants does not threaten their survival.

CITES is applied in Canada under the federal *Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act (WAPPRIITA)*, and is administered by the *Canadian Wildlife Service* with the cooperation of the provinces and territories. OMNR is one of the authorized issuers of CITES export permits in Ontario.

The level of trade control given to a species under the agreement is a function of the Appendix on which it is listed: Appendices I, II or III. Species that are not listed are examined periodically to determine whether *CITES* protection would benefit their conservation.

Many world populations of *Canis lupus* are currently listed in Appendix I, which includes species threatened with extinction, and their trade is restricted or not permitted. Appendix II includes (1) species not necessarily threatened with extinction but in which trade must be controlled in order to avoid utilization incompatible with their survival and (2) species that must be regulated in order that the trade of endangered species which they resemble can be brought under control.

The North American *Canis lupus* was listed on Appendix II of CITES in 1977, not because it is threatened, but rather to assist in the control of trade of endangered *Canis lupus* populations in other parts of the world. Under an Appendix II listing, the export from Canada of a live or dead wolf, or its parts and derivatives and any articles made from them, requires a *CITES Export Permit*.

Agreement on International Humane Trapping Standards (AIHTS)

The *Agreement on International Humane Trapping Standards* (AIHTS) was implemented in 1998 among Canada, the European Union (EU) and Russia. The United States is not a signatory to the agreement, but by a signed minute is bound to take actions toward establishing equivalent requirements for trapping systems used in that country. The AIHTS serves both as a trade agreement setting out the conditions under which pelts of wild furbearing mammals may continue to be imported into EU countries, and also setting out humane thresholds for application to commercially manufactured trapping systems.

Although negotiated at the federal level, this agreement requires action by provinces and territories as the legislative mandate rests with these authorities. The agreement applies to wolves and coyotes as well as a number of other species.

The AIHTS defines two major requirements regarding trapping systems: (1) phase-out of "conventional steel-jawed foothold restraining traps" used in the trapping of wolves and coyotes by October 2001 (this was accomplished throughout all Canadian provincial/territorial jurisdictions) and (2) certification by provinces and territories of commercial trapping devices shown to meet or exceed specific thresholds of 'humaneness' by October 2007.

5.1.2. National

Species at Risk

In 1996, Ontario signed the national *Accord for the Protection of Species at Risk in Canada.* The Accord commits Ontario and other signatories to take action to protect and recover threatened and endangered species and their habitats.

National protection and recovery of species at risk is provided under the federal *Species at Risk Act* 2003 (SARA), based on the assessment of species or populations by the national *Committee on the Status of Endangered Wildlife in Canada* (COSEWIC). Established in 1977, COSEWIC is a national body of experts which chooses candidate species, commissions national status reports, assesses and designates the status of species, and provides recommendations on the appropriate national designations to the federal government. The OMNR is represented on COSEWIC and provides input on national species designations.

The northern gray wolf was assessed by COSEWIC in 1999 as being "Not at Risk". It receives no protection under the federal *Species at Risk Act*. The eastern wolf was

designated as “Special Concern” in Schedule 1 of the Act in May 2001. A “Special Concern” designation indicates “a wildlife species or population that may become threatened or endangered because of a combination of biological characteristics and identified threats.”

COSEWIC gave the following rationale for the “Special Concern” designation of the eastern wolf: ‘*This wolf may be a separate species. Its exact range is not known, partly because it hybridized both with gray wolves and coyotes. Although there is no evidence of decline in either numbers or geographic range over the last 20 years, it may be threatened by hybridization with coyotes, which may be exacerbated by habitat changes and high levels of harvesting. In addition, it is difficult to identify this taxon without a molecular analysis*.’

Section 65 of SARA requires the competent [federal] minister to prepare a Management Plan that includes measures for the conservation of the species and its habitat, in cooperation with each province and territory in which the species is found, and with every aboriginal organization that will be directly affected by the Management Plan. The national Management Plan for the eastern wolf will be prepared by the federal government and Ontario will contribute to the development. The Management Plan must be completed within five years of designation. The eastern wolf was designated in 2001, therefore the Management Plan must be completed by 2006.

5.1.3. Provincial

Fish and Wildlife Conservation Act

Legislation

Wolves (*Canis lupus*), coyotes (*Canis latrans var.*) and hybrids of coyotes are classified as Furbearing Mammals under Schedule 1 of Ontario’s *Fish and Wildlife Conservation Act*, 1997, R.S.O. 1999, Chapter 41. The eastern wolf is treated under the Act as a subspecies of *C. lupus,* and will remain protected under the Act in this manner until the scientific community makes a final determination on the proposal that the eastern wolf is not a *C. lupus*. The Act currently affords it protection because (1) it is hybridized with *C. lupus* and *C, latrans*, two species protected under the Act, and (2) it is difficult to distinguish from these species in the wild (i.e., it is treated as a look-alike under the Act). Full recognition of the eastern wolf as a separate species under the Act would require an amendment to add it to the list of species under Schedule 1 (Furbearing Mammals).

The *Fish and Wildlife Conservation Act* is subject to the existing constitutional rights of aboriginal people.

Wolves, coyotes and their hybrids are hunted under a Licence to Hunt Small Game, and trapped or hunted under a *Trapper's Licence*. The open season for hunting and trapping wolves, coyotes or their hybrids is from October 1 to September 30 in any part of Ontario except in the townships of Clyde, Bruton and Eyre within Algonquin Provincial Park and the following townships surrounding the park: Alice, Airy. Ballantyne, Boulter,

Boyd, Burns, Butt, Chisholm, Calvin, Cameron, Clara , Clancy, Dickens, Dudley, Eyre, Fraser, Franklin, Finlayson, Harcourt, Hagarty, Herschel, Havelock, Head, Harburn, Livingstone, Lauder, Maria, McKay, McClintock, Murchison, McCraney, McClure, Papineau, Paxton, Petawawa, Richards, Rolph, Sabine, Sinclair, Wylie. With the exception of the area around Algonquin Provincial Park, the open season provides for year-round wolf hunting and trapping throughout most of their range in Ontario.

The *Licence to Hunt Small Game* is not valid from June 16 to August 31 in central and northern Ontario, an area that covers most wolf range, effectively providing a "closed season" for hunting during the summer months. The *Trapper's Licence* is valid from September 1 to August 31. A trapper may hunt or trap these species on an assigned trapline (on Crown land) or within a specific Private Land Trapping Unit with the permission of the landowner. Non-residents of Ontario are not allowed to hold a trapper's licence.

There is currently no bag limit or trapper quota on the number of wolves that may be harvested, although the Act provides authority for the Minister to make regulations prescribing such limits.

Wolves may be chased for purpose of field-training hunting dogs during closed hunting seasons under a *Licence to Chase Raccoon at Night and Fox, Coyote and Wolf During the Day*. The licence does not allow the possession of firearms during the chase and, therefore, does not allow killing of wolves. In May 2004, the chasing of wolves and coyotes in the townships in and surrounding Algonquin Park where hunting and trapping of these animals are not permitted was banned through a condition on the license issued.

The purchase or sale of live wolves is prohibited without the Minister's permission. A royalty is collected when a wolf pelt is tanned or a live wolf or a wolf pelt is exported from Ontario. Royalty rates are adjusted each year, and are based on 5.5% of the previous year's average selling price. The 2003/04 royalties are $4.90 per wolf and $1.60 per coyote. An *Export Licence for Furbearing Animals or their Pelts* is required to export a wolf or its pelt from Ontario.

It is prohibited to allow the pelt of a furbearing animal to be destroyed or spoiled except as prescribed by the regulations. The regulations permit a hunter or trapper to abandon or spoil a pelt if it is of no commercial value.

Wolf dens are protected from intentional damage by all but a licensed trapper or someone acting in defence of property.

Section 31 of the Act recognizes the right of a landowner to harass, capture or destroy a wolf or coyote that has damaged his/her property or, on reasonable ground, the landowner believes such an animal is about to cause damage or destruction. The Act also permits the landowner to hire an agent to resolve the problem if the landowner is unable to do so on his/her own.

Municipalities interested in compensating agents to assist landowners in the removal of wolves responsible for killing or damaging livestock must obtain authorization from the local ministry office, as the Act generally prohibits hunting or trapping for hire or gain or the inducing of a person to hunt or trap for gain. The ministry office authorizing the payments will establish the area and period of time for undertaking the control measures.

The Act restricts the keeping of scheduled species in captivity, except in specific circumstances. Wolves may be kept in captivity for rehabilitation, educational, scientific or other purposes under the following instruments:

- Wildlife Custodian Authorization (FW2002) allows custodians to hold wildlife temporarily to rehabilitate or care for sick, injured or immature wildlife until their successful return to the wild
- Licence to Keep Specially Protected and Game Wildlife in a Zoo (FW0004) allows zoos to hold scheduled animals in captivity but not to obtain animals from the wild
- Authorization to Keep Specially Protected and Game Wildlife in Captivity (FW2003), issued under section 40(2)c of the Act, is used only in special circumstances for educational, scientific or other purposes with conditions of authorization that are specific to the situation. The authorization covers the holding of wolves or wolf hybrids in personal collections.

Conditions under these legal instruments are currently under review and further conditions on standards of care for wildlife in captivity are under development.

Wildlife Policies

There are a number of policies dealing with wildlife conservation at the species level that reference wolves. They include *Control of Mammalian Predators* (WM.6.03.01, 1982) [113b], which outlines the circumstances under which predator management would be considered; and the *Moose Management Policy* (WM.6.02.01, 1980) [113a] which provides for consideration of area specific and time limited wolf control where they are significantly depressing moose populations. Management practices have evolved and these policies no longer reflect OMNR's current actions on predator control.

A *Recovery Strategy for Forest-Dwelling Woodland Caribou* (*Rangifer tarandus caribou*) in Ontario [116d] is currently under development. The draft strategy identifies the need to evaluate the role and situations where predator management might be considered as a potential tool for selective application in support of caribou recovery. This document is under review.

Crown Forest Management

Wolves are found throughout a wide range of forested areas and arctic tundra, therefore, most management of habitat used by wolves occurs through Ontario's Forest Management Planning process. The overall context for forest management in Ontario

is the 1994 *Policy Framework for Sustainable Forests* [114b] which includes the principle that forest practices must minimize adverse effects on soil, water, remaining vegetation, fish and wildlife habitat, and other values. The *Crown Forest Sustainability Act* (1994) provides for the regulation of forest planning, and is designed to allow for the management of all forest-based values while providing for the sustainability of Crown Forests.

The *Forest Management Planning Manual for Ontario's Crown Forests* [114d] and the *Forest Operations and Silvicultural Manual* [114c] are prepared in accordance with the *Crown Forest Sustainability Act*. The *Forest Management and Planning Manual* provides direction for all aspects of forest management planning for Crown lands in Ontario within the area of the undertaking as defined in the Environmental Assessment Board's *Reasons for Decision and Decision: Class Environmental Assessment by the Ministry of Natural Resources for Timber Management on Crown Lands in Ontario* [79b] as extended under the Ministry of the Environment's Declaration Order regarding OMNR's Class Environmental Assessment Approval for Forest Management on Crown Lands in Ontario (htpp://www.ene.gov.on.ca./envregistry/020001er.htm). The *Forest Operations and Silvicultural Manual* [114c] cites provincial guides and documents that must be considered during forest management planning and forest operations. Of fundamental significance to wolf habitat are guides addressing landscape pattern and prey species such as caribou, moose, deer and furbearers (i.e., beaver). OMNR policy directs that no species is to decline on a provincial scale due to forest management activities [8].

Species at Risk

The provincial status of species is assessed by the provincial *Committee on the Status of Species at Risk in Ontario* (COSSARO), a provincial group of experts with the mandate to evaluate and recommend a status for candidate species and re-evaluate current species at risk. COSSARO reviews status reports and assesses the level of risk for each species or population.

As with COSEWIC, COSSARO employs a uniform, scientifically-based, defensible approach to status evaluations. The committee evaluates species by considering factors such as population size, trends and distribution, habitat trends and known threats. Based on its evaluation, COSSARO recommends to OMNR the appropriate status category for each candidate species. Once designated by the OMNR, assessed species are maintained on the *Species at Risk in Ontario (SARO) List* (formerly called the *Vulnerable, Threatened, Endangered, Extirpated or Extinct Species* (VTEEE) *List*).

The gray wolf is currently designated provincially as 'Not at Risk'. On September 30, 2004, the eastern wolf was designated as ''Special Concern'. These designations are consistent with the national designation for these wolves. 'Special Concern' species have characteristics that make them sensitive to human activities or natural events

'Special Concern' species are not eligible to be listed in regulation under Ontario's *Endangered Species Act, R.S.O. 1980.*

Planning Act

Section 2.3.1 of the *Provincial Policy Statement* (1997) issued under the *Planning Act* (1990) states that: "development and site alteration will not be permitted in… significant wildlife habitat; … if it has been demonstrated that there will be negative impacts on the natural features or the ecological functions for which the area is identified." The *Significant Wildlife Habitat Technical Guide* [115c] advises that habitat for vulnerable [i.e., 'Special Concern'] species can be recognized as a category of significant wildlife habitat. Municipalities are required to "have regard to" the *Provincial Policy Statement*. The policy is currently undergoing a 5-year review.

Regulated Parks and Protected Areas

A major review of the parks and protected areas legislation was announced on September 9, 2004. This review includes legislation governing provincial parks, conservation reserves and wilderness areas. A discussion paper *It's in Our Nature – A Shared Vision for Parks and Protected Areas Legislation* [116b] has been prepared and input has been sought from the public, stakeholders and the aboriginal community.

The material presented below outlines the current legislation.

Provincial legislation relating directly to the protected area system includes the *Provincial Parks Act*, the *Public Lands Act*, and the *Wilderness Areas Act*. The *Provincial Parks Act* enables the establishment of provincial parks and guides their planning and management. The *Public Lands Act* enables the establishment of conservation reserves. The *Wilderness Areas Act* enables the establishment of wilderness areas. The *Provincial Parks Act* and the *Public Lands Act* provide the basis for the majority of the protected areas within Ontario's system. There are 10 independent wilderness areas (i.e., not contained within either provincial parks or conservation reserves) in existence, as well. Additional direction on the protected area system and permitted uses within new protected areas in central Ontario is found in *Ontario's Living Legacy Land Use Strategy* (OMNR 1999).

Provincial Parks Act

A set of policies that provides guidance on the planning and management of provincial parks, including direction on permitted uses was last revised in 1992 (*Ontario Provincial Parks: Planning and Management Policies: 1992 Update*, OMNR 1992). OMNR strategic direction is contained therein, and provides a conceptual framework for interpretation of the policies. The following excerpts from these policies provide guidance on activities that may relevant to wolf conservation within the provincial park component of the protected area system.

The goal of provincial parks is "*to provide a variety of outdoor recreation opportunities and to protect provincially significant natural, cultural and recreational environments in a system of Provincial Parks.*"

The provincial park system is comprised of several classes, the most protective of which are the Wilderness, Nature Reserve, and Natural Environment classes. Within individual parks, a zoning system is in use, to protect site-specific and landscape-scale features, and to control access and development. The Planning and Management Policies provide guidance for each class and each type of zone with regard to the compatibility of particular kinds of uses, relative to the heritage values contained therein.

Wilderness class parks, such as Polar Bear, Woodland Caribou, and Wabakimi Provincial Parks, generally are the largest parks in the system, and have the ability to support many landscape-scale ecological processes as well as many of the habitat requirements of wide-ranging mammals such as eastern and gray wolves, and woodland caribou.

Nature Reserves are established strictly to protect significant vegetation communities, flora, and fauna, with minimal human interference. They vary widely in size, but often are fairly small, especially in southern Ontario.

Natural Environment class parks also often are relatively large, and are intended to contain substantial diversity in earth and life science features. This class of park generally contains a wider diversity of recreational uses, but substantial areas tend to be zoned as Nature Reserve, Natural Environment, and in some cases, Wilderness zones. Algonquin, Lake Superior, and Sleeping Giant Provincial Parks are examples in this class.

The Planning and Management Policies provide direction on appropriate resource management activities, in the system as a whole, and for each class of park.

Conservation Reserves Act

Under Section 47 of the *Public Lands Act*, the prohibition or regulation of uses on public lands is authorized. The regulations under this section of the act consist largely of the boundaries of the existing Conservation Reserves. Furthermore, the regulations specify that:

- The lands described in the Schedules are designated as conservation reserves with the purpose of protecting natural heritage areas and natural features on public land and preserving traditional public land uses including wildlife viewing, hunting, fishing, walking, snowshoeing, cross country skiing and boating. O. Reg. 805/94, s. 1.
- Land within a conservation reserve shall not be used for mining, commercial forest harvest, hydro-electric power development, the extraction of aggregate and peat or other industrial uses. O. Reg. 805/94, s. 2.

"The goal of Conservation Reserves is to protect natural heritage values on public lands while permitting compatible land use activities." The *Conservation Reserves Policy* states that "wildlife population management … may need to be addressed separately for each Conservation Reserve, depending on the nature of the resources or features being

protected, and the nature of the management problem." Thus, the emphasis is on prior planning, with the ultimate focus being on protection of the natural heritage values of each conservation reserve. Uses other than those already excluded under O. Reg. 805/94 (see above) may be determined to be incompatible [or compatible] through preparation of a SCI [Statement of Conservation Interest], resource management plan [RMP], or by consideration of a "Test of Compatibility". The "test of compatibility" is outlined in the Procedure associated with the Conservation Reserves Policy (PL 3.03.05).

Wilderness Areas Act

The *Wilderness Areas Act* presently has 33 areas regulated under its authority. The Act states, among its provisions, that:

> "the Lieutenant Governor in Council may set apart any lands (whether or not covered with water) belonging to Her Majesty in Right of Ontario as a wilderness area for the preservation of the area as nearly as may be in its natural state in which research and educational activities may be carried on, for the protection of the flora and fauna, for the improvement of the area, having regard to its historical, aesthetic, scientific or recreational value, or for such other purposes as may be prescribed by the regulations made under this Act;
>
> Despite the *Fish and Wildlife Conservation Act, 1997* and the regulations under that Act, the Minister may take such measures as he or she considers proper for the protection in wilderness areas of fish, wildlife and invertebrates within the meaning of that Act;
>
> The Lieutenant Governor in Council may make regulations, (a) for the care, preservation, improvement, control and management of wilderness areas; (b) for prohibiting or regulating and controlling the use of lands in wilderness areas; (c) for prohibiting or regulating and controlling the admission of persons or domestic animals to wilderness areas and for issuing permits to persons to enter and travel in wilderness areas and prescribing the terms and conditions thereof and the fee therefor; (d) respecting any matter necessary or advisable to carry out effectively the intent and purpose of this Act."

Ontario's Living Legacy Land Use Strategy

The *Ontario's Living Legacy Land Use Strategy* [9] contains four objectives, two of which are directly relevant to wolf conservation. These are:

- completing Ontario's system of parks and protected areas;
- enhancing angling, hunting and other Crown land recreation opportunities.

The 378 new protected areas that were approved through the strategy, encompassing almost 2.4 million ha, have been, or are in the process of being, regulated under the *Provinical Parks Act* or the *Public Lands Act*, as described above. However, some differences in permitted uses within the new provincial parks have been authorized

through the strategy. Particularly significant in this regard is the direction with regard to commercial fur harvesting and hunting. In the case of commercial fur harvesting (which includes wolves), the strategy states that existing harvesting can continue indefinitely, except in new nature reserves, but that no new operations will be permitted. In the case of hunting, except for furbearing mammals (which include wolves), the activity will be permitted in all new parks and additions, except in nature reserve parks and zones. Hunting will also be permitted in additions to wilderness class parks. As before, these activities are permitted in conservation reserves, as long as they are compatible with the values for which the conservation reserve was established.

In conservation reserves, with regard to habitat management for wildlife, the strategy indicates that "specific management prescriptions will be identified in SCIs [Statements of Conservation Interest] and RMPs [Resource Management Plans]. No new habitat management will be permitted until an SCI or RMP is prepared. Existing habitat management practices will be reviewed to ensure that they are consistent with the protection of identified natural heritage values.

Livestock, Poultry and Honey Bee Protection Act

The *Livestock, Poultry and Honey Bee Protection Act*, administered by the Ontario Ministry of Agriculture and Food (OMAF), provides owners with compensation for livestock killed or injured by wolves. The Act defines "wolf" as any of the species *Canis lupus L.*, *Canis latrans Say*, or any cross breed of either.

Compensation for losses of livestock or poultry to predators has been available to producers since the elimination of the provincial bounty in Ontario in 1972, followed by implementation of the Wolf *Damage to Livestock Compensation Act* and the *Dog Tax and Livestock Compensation Act*. Claims were investigated by OMNR and compensation payments were made under the *Dog Tax and Livestock Compensation Act* by OMAF. The Wolf *Damage to Livestock Compensation Act* was repealed in 1974, and its provisions were incorporated in the revised *Dog Licensing and Livestock and Poultry Protection Act*, later renamed the *Livestock, Poultry and Honey Bee Protection Act*.

Evaluation of claims for livestock damage and compensation payments are facilitated through municipalities. Complaints of livestock injury or death are investigated by valuers hired by municipalities and appointed under the Act. The valuer attempts to identify the predator species from the various signs left and files a report describing the extent and amount of damage. Signs commonly looked for are the size and location of bite marks, feeding patterns, the extent of feeding, scats and the type of predator tracks. Evaluations that confirm predation are compensated by the municipality at current slaughter market-grade (meat) value up to a maximum amount. The municipality receives the reimbursement for claims attributed to wild predators from OMAF and absorbs the cost of claims attributed to domestic dogs.

Payment may be denied in whole or in part if the valuer finds evidence that the owner of the livestock did not take reasonable care to prevent the killing or injuring of livestock or poultry by wolves.

5.2. HABITAT MANAGEMENT

Wildlife habitat management within crown land forest management planning areas involves the application of the concept of coarse and fine filters. The coarse filter approach involves maintaining habitat conditions at the landscape and stand levels that are required by wildlife species using all successional stages of the forest. Some species have habitat requirements not met by the application of the coarse filter, and require additional fine filters that are directed to address their specific requirements (e.g., mineral licks, calving sites, aquatic feeding areas and winter cover). Landscape and wildlife habitat guides are the coarse and fine filters that together sustain wildlife habitat at the landscape, stand and site level. The application of all these guides should offer favourable habitat for wolves at all spatial scales.

There are no specific guidelines for the protection of wolf habitat, however suitable habitat for wolves is provided through application of the coarse and fine filter guides noted earlier, and particularly through the conservation or provision of habitat for prey species [13]. There are forest management guides for moose [7], white-tailed deer [159] and woodland caribou [131] habitat. These guides are considered during the preparation and implementation of forest management plans. Beaver is also an important prey species for wolves, and beaver habitat needs are described in the *Guidelines For Providing Furbearer Habitat in Timber Management* [6].

MNR is currently reviewing, revising and consolidating most of the current forest management guides, including the ones noted here. This consolidation will further strengthen the coarse and fine filter approach to wildlife habitat management, will provide specific direction to be implemented at the landscape, stand and site scales, and will help conserve the biodiversity of Ontario's forests.

Increased access provided through increased road densities can negatively impact wolf populations by facilitating wolf and prey harvest [28]. Each Forest Management Plan must have a Road Management Strategy, and this provides an opportunity to minimize the density of primary and secondary roads, and determine a schedule for road abandonment after use.

Some wildlife species require large areas of suitable habitat for their long-term survival. This seems to be particularly true for larger mammalian carnivores such as gray wolf, lynx, and fisher. A wolf population often consists of a minimum of 2 to 3 packs, thus their cumulative home range affects the amount of favourable habitat required for a wolf population [108].

6.0 EDUCATION

6.1. PUBLIC

Information and education can enhance knowledge and awareness of Ontario's wildlife heritage, and promote understanding and acceptance of the application of conservation programs.

Information specific to the conservation of Algonquin Park wolves is contained in the reports *The Wolves of Algonquin Provincial Park - a report by the Algonquin Wolf Advisory Group* [1b] and the *Wolves of Algonquin Park: Population, Habitat and Viability Assessment Final Report* [40]. Wolf ecology information is also contained in a number of publications developed with partners such as the Friends of Algonquin Provincial Park's *Mammals of Algonquin Provincial Park* [144] and the *Wild Furbearer Management and Conservation in North America* published jointly by OMNR and the Ontario Trappers Association [111b], and the *Ontario Hunter Education Manual* [116c].

A number of non-government publications by John and Mary Theberge are available on their research on the wolves of eastern Algonquin Provincial Park. These include *Wolves and Wolf Research in Algonquin Park* [148a], *Adventures with Algonquin Wolves* 1[48b], *Wolf Country* [148d] and, most recently, and *The Wolves of Algonquin Park: A 12 year Ecological Study* [148e].

A number of Provincial Parks use the wolf as a subject in their interpretive programs. The most consistent and notable interpretive programs are those of Algonquin Provincial Park. The park has offered the famous August "public wolf howls", smaller group howls and wolf evening programs since 1963. The public wolf howls are probably the single largest interpretive event in North America,.and the 3 August 2004 howls were attended by 6,544 participants (Rick Stronks, unpubl. data). To date, 126,575 people have participated in 92 public wolf howls since 1963 (Rick Stronks, unpubl. data). Wolf ecology is also featured in the park's world class visitor interpretive centre.

Ontario has been a participating member of *Project WILD* in Ontario since 1985, a program currently led by the Canadian Wildlife Federation. This program provides teachers with training in the use of an interdisciplinary, supplementary environmental and conservation education program designed for children from kindergarten to high school age. Numerous activities in this program deal with wildlife appreciation and predator/prey relationships.

Some non-government organizations have developed educational material on wolves and wolf ecology. Most notable of these is the program developed and promoted in public schools by Wolf Awareness Inc. in the United States. This organization also publishes a quarterly newsletter about wolves.

6.2. HUNTERS AND TRAPPERS

Ontario, like other jurisdictions, requires candidates to successfully complete a course in trapper and hunter education as a prerequisite to being issued a trapping licence to hunt or trap wolves or a small game licence to hunt wolves.

The trapper education curriculum includes information on species-specific trapping techniques. For wolves, this includes: information on site considerations, choice of bait or lure, snare size and placement. Ontario's hunter education curriculum includes instruction on the legal requirements for hunting, general wildlife management principles, firearm safety and wildlife identification.

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