Management Plan for the BALD EAGLE (*Haliaeetus leucocephalus*) in Ontario

Management plan prepared under the *Endangered Species Act, 2007*

September 2014

About the Ontario Management Plan Series

This series presents the collection of management plans that are written for the Province of Ontario and contain possible approaches to manage species of special concern in Ontario. The Province ensures the preparation of the management plans meet its commitments to manage species of special concern under the *Endangered Species Act,* 2007 (ESA, 2007) and the Accord for the Protection of Species at Risk in Canada.

What is a species of special concern?

A species is classified as special concern if it lives in the wild in Ontario, is not endangered or threatened, but may become threatened or endangered due to a combination of biological characteristics and identified threats.

What is a management plan?

Under the *ESA, 2007*, a management plan identifies actions that could be taken to ensure, at a minimum, that a species of special concern does not become threatened or endangered. The plan provides detailed information about the current species population and distribution, their habitat requirements and areas of vulnerability. The plan also identifies threats to the species and sets a clear goal, possible strategies, and prioritized activities needed to address the threats.

Management plans are required to be prepared for species of special concern within five years of the species being added to the Species at Risk in Ontario list as a special concern species.

What's next?

Nine months after the completion of a management plan a government response statement will be published which summarizes the actions that the Government of Ontario intends to take in response to the plan and the government priorities in taking those actions. The implementation of the management plan depends on the continued cooperation and actions of various sectors, government agencies, communities, conservation organisations, land owners, and individuals.

For more information

To learn more about species of special concern in Ontario, please visit the Ministry of Natural Resources Species at Risk webpage at: **www.ontario.ca/speciesatrisk**

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DECLARATION

The management plan for the Bald Eagle was developed in accordance with the requirements of the *Endangered Species Act, 2007* (ESA). This management plan has been prepared for the Government of Ontario, other responsible jurisdictions and for the many different constituencies that may be involved in managing the species.

The management plan does not necessarily represent the views of all of the individuals who contributed to its preparation, nor the official positions of the organizations with which the individuals are associated.

The goals, objectives and management approaches identified in the plan are based on the best available knowledge and are subject to revision as new information becomes available. Implementation of this plan is subject to appropriations, priorities and budgetary constraints of the participating jurisdictions and organizations.

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

RESPONSIBLE JURISDICTIONS

The primary responsibility for management of Bald Eagle populations and habitat in Ontario rests with the Ontario Ministry of Natural Resources and Forestry (OMNRF). Environment Canada – Canadian Wildlife Service, Ontario has responsibilities related to contaminant monitoring and the monitoring and management of nest sites in national wildlife areas. Parks Canada Agency has responsibility for Bald Eagles within national parks, national historic sites and canals in Ontario. The species is not listed under the federal *Species at Risk Act* and is not routinely monitored in any national park in Ontario.

EXECUTIVE SUMMARY

The Bald Eagle (*Haliaeetus leucocephalus*), a large diurnal bird of prey, is the only representative of the sea eagle group in North America. The adult is a widely recognized bird, with its large size and long wing span, and distinctive white head and tail contrasting with its dark body. It has a wide North American distribution, occurring in all continental states of the USA and all provinces and territories of Canada.

Beginning in the mid-20th century, many raptor species, including Bald Eagles, declined across North America as a result of the widespread use of the insecticide DDT. The southern Ontario population was almost extirpated, reduced to an estimated three to eight pairs in the 1970s, with virtually no successful reproduction. Populations were also reduced to a lesser extent in northern Ontario. The northwestern Ontario population, centered on Lake of the Woods, comprised the bulk of Ontario's Bald Eagles during the decline and remained relatively healthy though reduced in numbers. The Bald Eagle was one of the first species listed under Ontario's original *Endangered Species Act* in 1973.

The recovery of the Bald Eagle in Ontario began with the North American-wide prohibition on the use of DDT. While initial recovery was slow because of DDT persistence in the environment, populations gradually began to increase. Other recovery efforts in Ontario have included the release of Bald Eagle nestlings in southwestern Ontario, public education and stewardship programs, contaminant sampling, habitat protection measures through planning processes on both Crown and public lands, the placement of nest platforms and extensive monitoring efforts. Bald Eagles in the Great Lakes region recovered more slowly than inland populations because of the more contaminated fish populations. Northwestern Ontario populations recovered relatively rapidly. Northeastern Ontario populations, although much smaller than those in the northwest, also increased. Southern Ontario's Bald Eagle population recovery was slower and more gradual, and has continued since that time. The overwintering population of Bald Eagles in the province has increased rapidly since the 1980s.

Bald Eagles are both predators and scavengers, and while they feed primarily on fish, they will also feed on a wide range of water-oriented bird and mammal species. Pairs maintain a breeding territory, and typically arrive back on territory in late winter when lakes are still frozen. Territories usually contain productive, shallow waterbodies with abundant fish populations for forage. Bald Eagles typically nest in large supercanopy trees of a variety of species near water in forested landscapes. They tend to nest in areas with low levels of human disturbance, and may nest farther from the water when shorelines are heavily developed. However, some Bald Eagles appear to be coming more tolerant of human disturbance and may nest closer to human habitation. The young fledge at 10 to 11 weeks of age.

Southward migration in the fall generally occurs along major river drainage systems. Many Bald Eagles from the Great Lakes overwinter within the Great Lakes basin. The availability of food is the most important factor determining overwintering habitat, and Bald Eagles often congregate in areas of open water such as below dams and waterfalls.

While the Bald Eagle population in Ontario is clearly recovering, the species has some inherent vulnerabilities. As a top predator feeding primarily upon fish, the Bald Eagle is extremely sensitive to persistent chemical contaminants in aquatic systems that biomagnify through the food chain and concentrate in top predators. Levels of chemicals such as DDT and PCBs have dropped and now have less impact on Bald Eagle reproduction, but are still a concern in the Great Lakes. New and emerging persistent chemicals are also a concern. The Bald Eagle is a long-lived, slowly maturing species, and high adult survival is considered key to its long-term survival. Even slight shifts in adult survival can have major implications for population trends.

There is a well-established management program for the Bald Eagle in Ontario, with policy and planning guidance for forest management planning, municipal planning and renewable energy. Even with these programs and an increasing population and expanding range, the Bald Eagle still faces a number of threats in Ontario. These include chemical contaminants, heavy metal poisoning such as lead and mercury, incidental mortality from a variety of sources, diseases such as West Nile Virus and Avian Vacuolar Myelinopathy, localized habitat loss and climate change.

The management goal for this plan is to ensure that Ontario's Bald Eagle population continues to recover to achieve a stable or increasing population state at which natural events and human activities will not threaten its health and persistence. The following management objectives will help achieve this goal.

- Monitor Bald Eagle populations to ensure continued population recovery.
- Identify and protect Bald Eagle nesting habitat and important overwintering and stopover habitat on both public and private lands.
- Maintain continued high adult survival of Bald Eagles.

A number of management approaches are proposed to achieve these objectives. These include:

- an ongoing population monitoring program;
- continued protection of Bald Eagle habitat;
- research to evaluate recent habitat management policy direction;
- ongoing contaminant sampling and analysis;
- measures to reduce incidental mortality;
- an indigenous knowledge study; and
- communication products highlighting conservation successes and challenges of the Bald Eagle recovery program.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 SPECIES ASSESSMENT AND CLASSIFICATION

COMMON NAME: Bald Eagle

SCIENTIFIC NAME: *Haliaeetus leucocephalus*

SARO List Classification: Special Concern

SARO List History: Endangered (2004); Endangered (south of French and Mattawa Rivers) and Special Concern (north of French and Mattawa Rivers) (2006); Special Concern (2009).

COSEWIC Assessment History: Designated Not at Risk in 1984 (COSEWIC 2013).

SARA Schedule 1: Not listed

CONSERVATION STATUS RANKINGS (NatureServe 2013):

GRANK: G5 NRANK: N5B, N5N SRANK: S2N, S4B

The glossary provides definitions for the abbreviations above.

2.0 SPECIES INFORMATION

2.1 Species Description and Biology

Species Description

Members of the genus *Haliaeetus* are considered sea or fish eagles. The adult Bald Eagle is a large, diurnal bird of prey with a striking white head and tail contrasting with dark brown body plumage. The beak and eyes are yellow in adults. Juvenile Bald Eagles are generally brown, with little variation except for some limited white mottling in the underwing (Buehler 2000). Immatures gradually attain adult plumage over several years, with full adult plumage usually attained by 5.5 years (McCollough 1989). There is considerable variation in size, from 71 to 96 cm in total length, and a wingspan of 168 to 244 cm (Palmer et al. 1988, from Buehler 2000). Weight can vary from 2 to 6.3 kg (Johnsgard 1990, Buehler 2000). Males and females are similar in appearance, although as with most raptors, the females are larger than the males, averaging approximately 25 percent larger (Buehler 2000). The larger subspecies (*H. l. alascanus*) is found in the northern part of the range north of 40°N, including Canada (Buehler 2000). Wings are long and wide, with a short broad tail, with the broad wings supporting the Bald Eagle's typical flapping/soaring flight (Buehler 2000).

The Bald Eagle is one of the most studied avian species in North America. It has long been an important symbol in the human culture of the Americas (Miller 1957; Buehler 2000), and is known to have important spiritual and cultural value to many First Nation cultures (e.g. Johnston 1976). As a totemic symbol of the Anishnabeg, the eagle was considered to have traits of courage and foreknowledge (Johnston 1976). Eagle feathers in particular have special spiritual significance in some First Nation cultures (Sia 2013; OMAA 2012). Bald Eagles have only been found in Ontario's far north near Hudson and James Bay relatively recently and as such are less prominent in some First Nation cultures in this area (M. Sutherland, pers. comm. 2014).

Species Biology

Bald Eagles are long-lived, capable of surviving for more than 30 years in the wild (USGS 2014). They are fully mature and capable of breeding at 4 to 6 years, but often do not breed until older (Buehler 2000). Pairs are thought to mate for life unless one mate dies, and may overwinter together (Buehler 2000). Both adults defend a breeding territory. Territory establishment begins 1 to 3 months before egg laying, and average territory size (defended portion of the home range) ranges from 0.5 to 4 km^2 (Buehler 2000), although home ranges can be as large as 22 km^2 (Garrett et al. 1993). The critical courtship and nest building period prior to egg laying is considered to begin in mid-February in southern Ontario, and early March in northern Ontario (OMNR 2010a). Bald Eagles show a strong fidelity to nesting territories and typically use the same nest over successive years, although they may have 2 to 4 alternate (supernumerary) nests in the territory. Bald Eagles create large stick nests that are added to annually and may be used for decades (Szuba and Naylor 1998, Buehler 2000). Nests in Ontario measured from 0.8 to 3.0 m in diameter, averaging 1.5 to 1.9 m, and from 0.5 to 3.0 m deep, averaging 0.9 to1.2 m (Peck and James 1999). The average clutch size in Ontario is 2 eggs, ranging from 1 to 3, and eggs have been documented in Ontario nests from

February 20 to June 28 (Peck and James 1983; 1999). Average incubation period is 34 to 35 days, with one record of at least 36 days in Ontario, and could extend as long as 46 days (Harrison 1978, Johnsgard 1990, Peck and James 1999, Environment Canada 2001a). Renesting rarely occurs in the northern range if the nest fails (Buehler 2000). Young fledge at 8 to 14 weeks of age (Buehler 2000), but more typically 10 to 11 weeks (Harrison 1978). Up to 50 percent of fledging attempts may be initially unsuccessful, with the young falling to the ground and remaining there for several weeks before fledging (Buehler 2000). Young Bald Eagles in southern Ontario generally remain within an area of 30 km^2 in the natal territory for an average of 45 days after fledging (Laing 2006).

When fledglings leave natal territories, they travel independently of siblings and disperse along lakeshores and rivers and stopover near large waterbodies (Laing 2006). Immature Bald Eagles also migrate, often more nomadically. Adult Bald Eagles migrate in the fall when sufficient food is no longer available within the breeding territory (Buehler 2000). Bald Eagles rarely migrate in kettles or flocks, but may congregate during migration at communal feeding and roosting sites. Fall migration occurs at a slower pace than spring migration, with the location and timing of movement being influenced by the availability of food sources (Buehler 2000).

Bald Eagles from the Great Lakes region generally migrate south along major river drainage systems such as the Missouri and Mississippi rivers from August-January (Buehler 2000). Bald Eagles typically overwinter in temperate regions (Buehler 2000). A number of Bald Eagles over-wintering in Missouri originated from breeding areas in northwestern Ontario, or at least migrated through Ontario (Griffin et al. 1980). Some adults may not migrate, instead making more localized movements to winter food sources. A number of Bald Eagles now overwinter within Ontario, near areas with available food supply (Grier et al. 2003, Sandilands 2005).

Bald Eagle densities during the nonbreeding season vary widely, and appear to depend mainly on the availability of food resources (Johnsgard 1990). Several nestling Bald Eagles from southern Ontario were fitted with satellite transmitters between 2004 and 2009. In the ensuing years these birds tended to remain year-round in northeastern North America within an area bounded by southwestern Wisconsin and western Illinois to the west, James Bay to the north, the northern Tennessee and North Carolina borders to the south, extreme southwestern Labrador to the northeast, and New Brunswick to the east (Bird Studies Canada data)[1]. Once they reach sexual maturity, Bald Eagles raised within the Great Lakes Basin are generally sedentary, with few moving outside the basin (Ewins and Andress 1995).

Spring migration usually occurs over a shorter time period and in a more direct manner than in the fall, possibly because of the competitive advantage for nest sites and mates conferred by early arrival on a breeding territory (Buehler 2000). Only limited foraging occurs during the northward migration. Adults migrate back to breeding areas when lakes and rivers are still frozen and food resources are limited, typically from January to March; immatures tend to return later (Buehler 2000). March is known by members of Pikangikum First Nation as Meegeezogeezis (Ojibway), meaning the month when Bald Eagles return to the north (Davidson-Hunt et al. 2012).

[1] From http://birdmap.bsc-eoc.org/maps/eagles/viewer.jsp

Bald Eagles generally prefer fish in most regions but are also opportunistic foragers and scavengers (Buehler 2000). In northcentral Minnesota, fish make up 90 percent of the diet of breeding Bald Eagles (Dunstan and Harper 1975). Fishing is most often done by an aerial search followed by a sweeping glide along the water's surface with the feet capturing the fish (Fischer 1985). Introduced Pacific salmon (*Onchorhynchus* spp.) populations in major Great Lakes rivers such as the Nipigon River (e.g. Szuba and Naylor 1998) can be important food sources in the fall and winter, as they are for Bald Eagles in native salmon range (e.g. Elliott et al. 2011). The ideal source of forage fish for continued Bald Eagle recovery is described as populations of primarily warmwater fish in interior (i.e. non-Great Lakes) foraging areas (Bowerman et al. 1995). The traditional etiquette of Pikangikum First Nation members is to place unwanted fish and fish remains on the shore, ice or islands for Bald Eagles and other wildlife (Miller and Davidson-Hunt 2013).

Bald Eagles will also prey on birds, typically moderately-sized water-oriented birds such as ducks (Anatidae) and gulls (Laridae), as well as semi-aquatic mammals such as Muskrat (*Ondatra zibethicus*) and River Otter (*Lutra canadensis*) (Dunstan and Harper 1975, Johnsgard 1990, Ewins and Andress 1995). Bald Eagles in the Hudson Bay Lowlands have been observed to feed on Canada Geese (*Branta canadensis*) and Snow Geese (*Chen caerulescens*) (Sandilands 2005, K. Abraham pers. comm. 2006, M. Sutherland pers. comm. 2014, T. Armstrong pers. obs.).

Bald Eagles are also kleptoparasitic and will steal prey both from other Bald Eagles, several species of corvids (*Corvus* sp.), ducks, gulls and raptors such as Osprey (*Pandion haliaetus*) (Fischer 1985, Environment Canada 2001a). Ospreys are often the main recipient of Bald Eagle kleptoparasitism (Kimball 2009). Parasitic attacks on other species are much more successful than those on other Bald Eagles (53% vs 8%) (Fischer 1985). Kleptoparasitism was the primary means of foraging amongst a population of Bald Eagles overwintering on a salmon river in Washington (Stalmaster and Gessaman 1984).

In northern Ontario, urban waste disposal sites can be important Bald Eagle foraging areas, as they are elsewhere (e.g. Elliott et al. 2006). As an example, Bald Eagles are a regular occurrence at the Thunder Bay landfill site in northwestern Ontario, especially in winter, with over 200 sometimes being seen and a high of 240 being seen on December 19, 2013 (B. Ratcliff, pers. comm. 2014). In the Kawartha Lakes area, a greater proportion of immature Bald Eagles (39%) was observed feeding on garbage or offal as compared to adults (17%) (Ewins and Andress 1995).

Bald Eagles also feed upon carrion in the winter, and remains from hunted big game such as White-tailed Deer (*Ococoileus virginianus*) (Johnsgard 1990, Environment Canada 2001a, Martel 1992) and Moose (*Alces alces*) (T. Armstrong pers. obs.). White-tailed Deer carcasses from a variety of sources (e.g. predators, winter mortality and poaching) accounted for 47 percent of feeding observations of overwintering Bald Eagles in the lower Great Lakes (Ewins and Andress 1995). In Wyoming, wintering/migrating Bald Eagles primarily from northern Canada appeared to rely on hunting offal as a seasonal food source, returning to the area annually during the hunt and then moving on after the hunt was over (Bedrosian et al. 2012).

As well as being a top predator and a kleptoparasite, Bald Eagles can also affect other species through interspecific interactions and aggression. High Bald Eagle numbers can apparently influence the productivity of Great Blue Heron (*Ardea herodias*) colonies through the disturbance caused by the increased presence of Bald Eagles within heron colonies (Vennesland and Butler 2004). As well as affecting Osprey through stealing prey (Prevost 1979), Bald Eagles can also have a negative effect on Osprey nesting success in some situations (Ogden 1975), apparently related to the proximity of nesting sites (Jamieson and Seymour 1983). Bald Eagles have been known to take over Osprey nesting sites (Ewins et al. 1994). These influences on other species may potentially increase as Bald Eagle populations increase.

2.2 Population and Distribution

While primarily a North American species, the Bald Eagle also occurs in Siberia (Brownell and Oldham 1985). Breeding Bald Eagles are widely distributed across northern North America, including Alaska and much of Canada except for the southern prairies (Buehler 2000). Highest concentrations historically occurred along the Atlantic and Pacific coasts, particularly in British Columbia and Alaska and inland along major estuarine and river systems (Grier et al. 2003). British Columbia has the highest breeding season population of Bald Eagles in Canada (Johnsgard 1990). Densities decline in the north-central, far northeastern and northwestern parts of North America, even with apparently suitable habitat and food supplies, possibly because the ice-free period is too short (Grier et al. 2003). In the 1990s Bald Eagles were reported to breed in every Canadian province and every continental USA state except for Vermont and Rhode Island (Buehler 2000). Subsequent to that period breeding records have also been reported for the latter 2 states (Suckling and Hodges 2007). The highest numbers of breeding pairs in the USA outside of Alaska occur in two states, Minnesota and Wisconsin, adjacent to northwestern Ontario (Suckling and Hodges 2007).

All of Ontario is considered to have been within the historical range of the Bald Eagle, where it was considered a breeding season resident (Ridgeley et al. 2003). It was likely distributed primarily throughout the southern two-thirds of Ontario with concentrations around the Great Lakes, inland lakes and perhaps large northern rivers (Austen et al. 1994). Confirmed breeding locations for the Bald Eagle are currently widely distributed across Ontario (Figure 1), and breeding season distribution is essentially continuous across the province at the macro scale (Figure 2). Highest numbers occur along the Great Lakes shoreline, and the large lake and river systems of northwestern Ontario. In southern Ontario, nest sites are distributed primarily along Lakes Erie and Huron, with scattered inland sites across eastern and southern Ontario (Armstrong 2007). The north shore of Lake Ontario represents a major gap in Bald Eagle distribution, a gap that also apparently occurred historically (Armstrong 2007). Bald Eagles are broadly distributed across northern Ontario, with higher densities and more continuous distribution in northwestern Ontario (Jones 1995, Armstrong 2007). Although breeding season observations of adult Bald Eagles are common along the coastline and major rivers of the Hudson Bay Lowland, no formal nesting surveys have been conducted and there is only one documented breeding record for this region (K. Abraham pers. comm. 2013, D. Sutherland, pers. comm. 2013).

Approximately one-half (49%) of the Ontario shoreline of the Great Lakes is considered to have good potential as Bald Eagle nesting habitat (Bowerman et al. 2005). Bald Eagle habitat is more or less continuously distributed along the shorelines of Lakes Superior and Huron, with fewer and more fragmented areas of habitat along Lakes Erie and Ontario (Bowerman et al. 2005). Suitable shoreline habitat in Canada and the USA ranges from 76 percent on Lake Superior to 7 percent on Lake Erie (Bowerman et al. 2005).

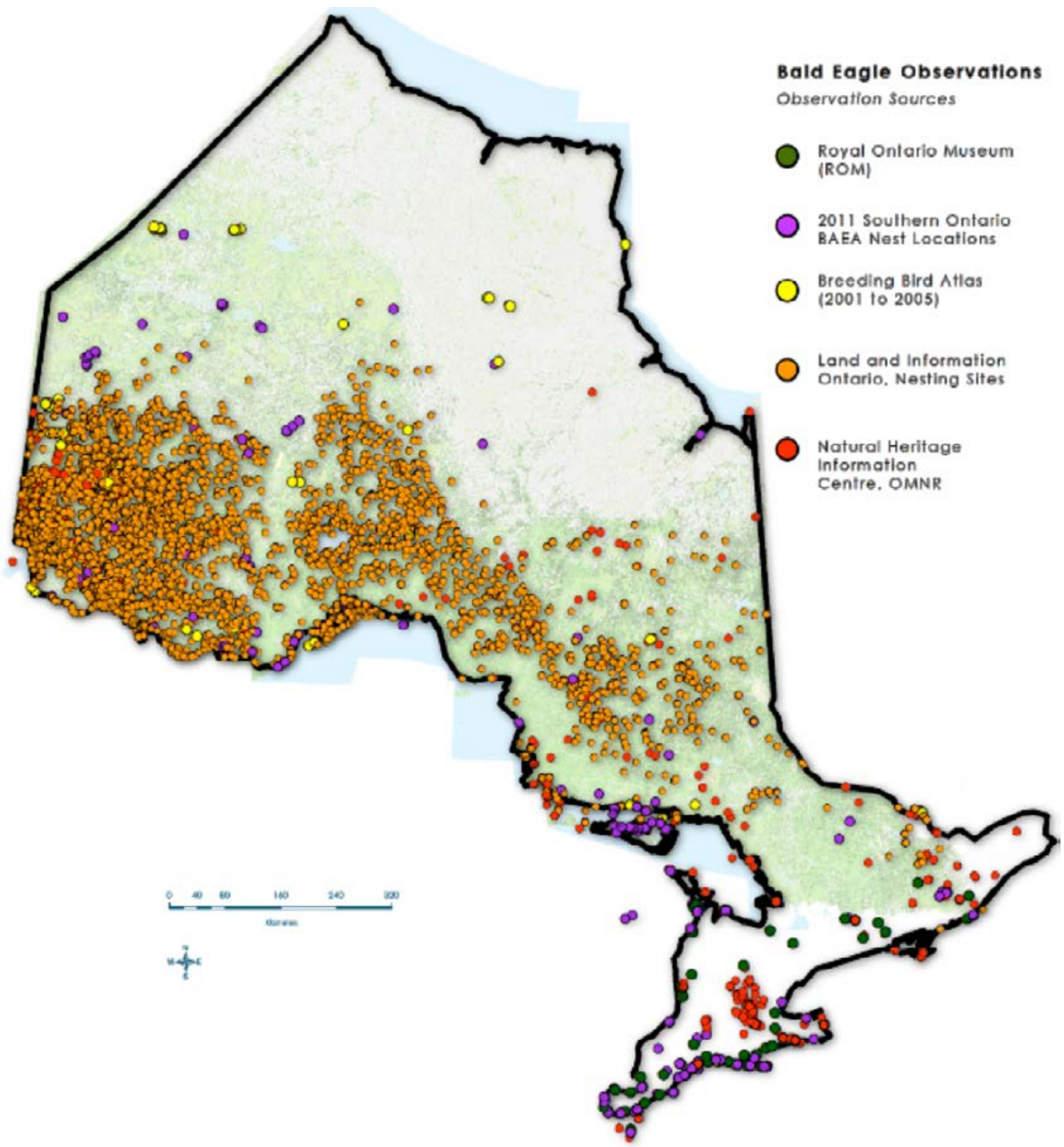

Figure 1. Current breeding (March-August) distribution of the Bald Eagle in Ontario based upon confirmed breeding records.[2]

[2] Data sources: Royal Ontario Museum Ontario Nest Records Scheme (2000+), Bird Studies Canada Project NestWatch records (2000+) and southern Ontario Bald Eagle Monitoring Program records (2011), confirmed breeding records from the Ontario Breeding Bird Atlas (2001–2005), Land and Information Ontario records (OMNRF), and Natural Heritage Information Centre (OMNRF) element occurrences.

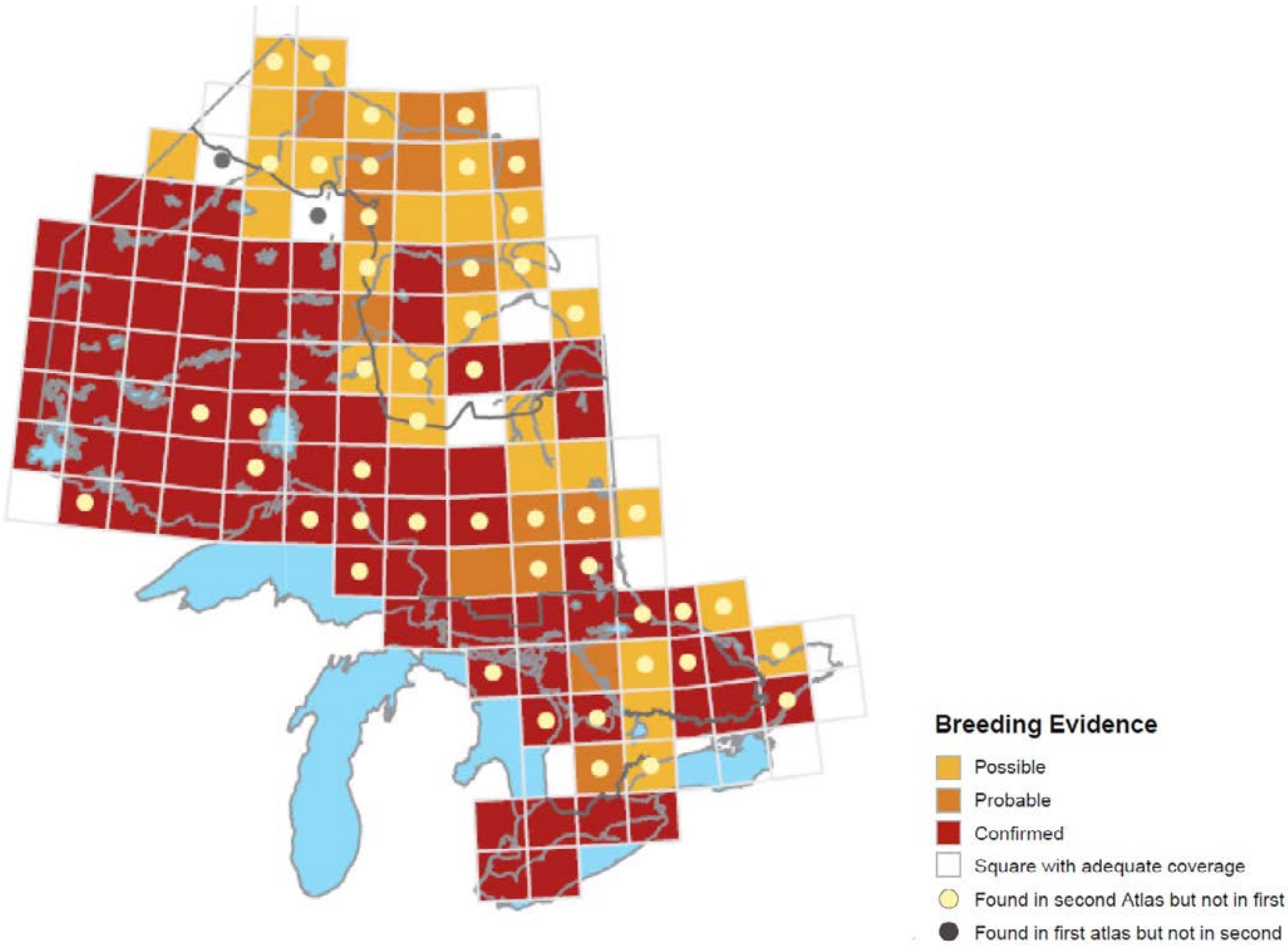

Figure 2. Breeding season distribution of the Bald Eagle in Ontario at the macro-scale (100 x 100 km blocks) based upon the Ontario Breeding Bird Atlas 2001–2005 (from Armstrong 2007).

North American Bald Eagle populations declined throughout the first half of the 20th century, although declines due to habitat loss and human persecution may have started as early as the 1500s (Environment Canada 2001a). Bald Eagles were killed because they were thought to be a threat to livestock and fish and game, and they were also harvested by some First Nations for ceremonial purposes (Buehler 2000). Financial bounties for the killing of Bald Eagles were in place in some parts of the western USA and Alaska through the first half of the 20th century (Van Name 1921; Buehler 2000), including Alberta in 1940 (Brownell and Oldham 1985). Human persecution is thought to have declined significantly since the 1970s, although this has not been quantified (Buehler 2000). Shooting deaths of Bald Eagles continued at least into the 1960s and early 1970s in Ontario (Brownell and Oldham 1985), and 7 percent (3 of 43) of dead and dying Bald Eagles collected from Ontario between 1991 and 2008 perished from gunshot wounds (Martin et al., in prep.).

The widespread use of organochlorine insecticides such as DDT during the mid-20th century was a primary factor in the further population decline of many birds of prey including the Bald Eagle (Grier 1982). DDE, a metabolite of DDT, appears to have been responsible for reproductive failures among birds of prey, including the Bald Eagle, resulting in significant population declines (Wiemeyer et al. 1984). Thinning of egg shells leading to reproductive failure and population collapse was one result of DDT contamination (Wiemeyer et al. 1993). Of particular interest from an Ontario context, a volunteer Ontario bander, Charles Broley, was instrumental in initially raising awareness about the declining status of the Bald Eagle across North America (Sprunt 1963; Environment Canada 2001a; USFWS 2009).[3] DDT use in Canada and the United States was prohibited in the early 1970s. DDT is a persistent chemical that remains in the environment for a long time. Recovery from this chemical was slow. Even a decade later persistent contamination was still leading to almost total reproductive failure among Bald Eagles in Ontario (Environment Canada 2001a). However, in northwestern Ontario Bald Eagle productivity increased rapidly over a 16 year period following the ban on DDT and showed a significant inverse relationship with DDE levels. This suggested that the recovery from organochlorine contamination was occurring more rapidly than originally anticipated (Grier 1982). DDT was not the only organochlorine affecting Bald Eagle populations. PCBs are persistent, toxic chemicals with a number of deleterious effects on birds, including reproductive (e.g., embryo mortality, decreased egg production, egg shell thinning), behavioural, pathological and immunological impacts (Friend and Franson 1999). PCBs likely also affected Bald Eagle productivity and subsequent recovery. There was a significant negative correlation between nest productivity and concentrations of both DDE and PCBs in nestling Bald Eagle (Bowerman et al. 2003). PCB levels varied across the province, for example being significantly higher in nestlings from the more highly contaminated Lake Erie area than in those from the relatively pristine Lake Nipigon (Donaldson et al. 1999).

There are no records of bounties being placed on Bald Eagles in Ontario, although there are anecdotal reports of human persecution. The widespread winter poisoning of Gray Wolves (*Canis lupus*) with strychnine in northern Ontario in the 1950s and 1960s resulted in the incidental death of a number of bird species, primarily Common Raven *(Corvus corax*), but also including Herring Gulls (*Larus argentatus*) and Bald Eagles (e.g. McKeown 1959, Pimlott et al. 1961, Shannon et al. 1963). While speculative, it is possible that this program may have had an additive impact on breeding Bald Eagle populations already depressed from the effects of DDT. This could be particularly so as the poisoning occurred in late winter (mid-February to late-April) (McKeown 1959, Shannon et al. 1963) when the migrant adults would have just arrived back on territory and food resources would have been limited. Scavenging Bald Eagles will displace Common Ravens at a carcass (Ewins and Andress 1995), and their ability to quickly find carcasses and then aggressively defend them from other scavengers makes them vulnerable to secondary poisoning (USFWS, no date). A study of Bald Eagle museum specimens collected from Ontario and four other North American jurisdictions from November to May between 1900 and 1980 revealed four records out of 21 specimens (19%) with a known cause of death which were poisoned incidentally by strychnine from canid control programs (Bortolotti 1984), adding some support to this possibility.

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3 "The plight of the Bald Eagle was brought to the attention of the people of the United States largely through the efforts of the late Charles L. Broley, a retired banker from Ontario. His hobby of banding young eagles in Florida and Ontario put him in a unique position to observe first hand their lessening numbers." (Sprunt 1963).

While there is historical information on some Ontario Bald Eagle populations, province-wide population information is not available. There were an estimated 200 nests in southern Ontario from the Ottawa River to Lake Erie at the beginning of the 20th century (Weekes 1975, Sandilands 2005). This declined to 100 pairs by the 1950s, and was further reduced to an estimated 10 pairs by the 1970s (Weekes 1974). Only 3 to 8 nests were active annually in all of southern Ontario throughout the 1970s, with an average productivity of 0.4 fledged young per nest (Brownell and Oldham 1985). This is less than the minimum of 0.7 fledged young per nest required to maintain a population (Sprunt et al. 1973) and the 1.0 fledged young per nest of a healthy population (Bowerman et al. 2003). By the 1980s, the Bald Eagle population outside of Lake Nipigon was essentially extirpated from almost the entire mainland Great Lakes Basin, being reduced to just eight active nests that failed to produce any young along the Great Lakes shoreline (Hunter and Baird 1995).

Southern Ontario populations subsequently increased as a result of DDT prohibition and other recovery efforts (Duncan 1990). The initial population recovery was slow, with only 20 to 25 pairs by the early 1990s (Austen et al. 1994), and impaired reproduction was still exhibited as a result of chemical contamination, particularly along the Great Lakes. The population of Bald Eagles nesting along the American side of the Great Lakes shoreline and rivers running into the Great Lakes still exhibited impaired reproduction in the 1990s and was considered a population sink, apparently as a result of PCBs and 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (dioxin) (Bowerman et al. 1995). There has been a noticeable improvement in Great Lakes contaminant levels in recent decades. Various studies demonstrate a significant decline in levels of DDT and PCBs in Bald Eagle samples from Lake Erie and the southern shore of Lake Superior, to the point where these chemicals no longer appear to be significantly affecting Bald Eagle productivity or population levels (Donaldson et al. 1999, Dykstra et al. 2005, Dykstra et al. 2010). The average annual decline in nestling blood plasma samples from Lake Superior Bald Eagles between 1989 and 2008 was 3 percent for DDE, 4.3 percent for PCBs and 2.4 percent for mercury (1991–2008) (Dykstra et al. 2010, Route et al. 2011). Between the 1980s and early 2000s, egg shell thickness of Bald Eagle eggs from the Great Lakes increased, and was at pre-1946 (pre-DDT) levels by 2000 (Best et al. 2010). In the 2000s the southern Ontario population continued to increase annually, and by 2011 there were 71 occupied territories and 41 successful nesting pairs, and at least 89 territories had been occupied at least once since recent monitoring began in 1980 (Figure 3) (Allair 2012). Bald Eagle nests in southern Ontario have continued to increase since that time (D. Sutherland, pers. comm. 2013). However in the mid-2000s, Bald Eagles had still "failed to return in large numbers to historic nesting locations along the shores of Lake Ontario" (St. Lawrence Bald Eagle Working Group 2006, pg. 1). These results suggest that southern Ontario's Bald Eagle nesting population may be close to the estimated population of 100 breeding pairs present in the 1950s, and 50 percent of the estimated historical population from the early 1900s (Weekes 1974).

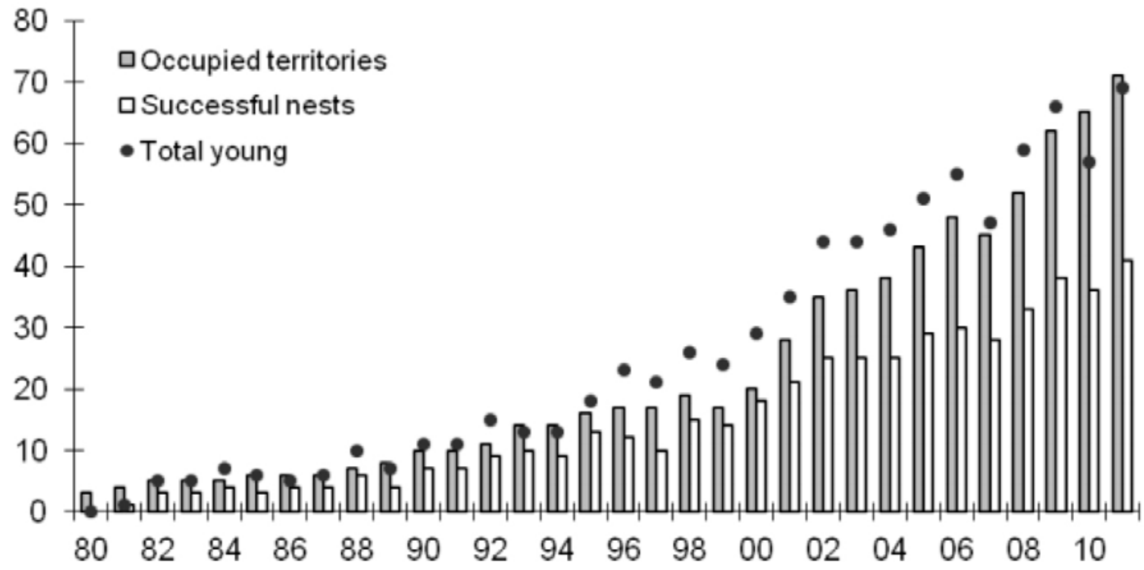

Figure 3. The number of successful Bald Eagle nests and occupied territories in southern Ontario and the number of eaglets produced from 1980–2011 (from Allair 2012).

The Bald Eagle population in northern Ontario remained more robust than southern Ontario during the population decline and was centred on a relatively stable Lake of the Woods population in northwestern Ontario, although there was still some decline. A nesting population was still present on Lake of the Woods in the mid-1960s (Mansell 1965). However even in northwestern Ontario there was a significant DDT-related decline in the proportion of potential territories that produced young (Grier 1974). As an example, a survey of Bald Eagles in the Lake Nipigon area in 1968 revealed that nest productivity was as low as on the Great Lakes, with average nest productivity of only 0.09 fledged young/active nest (Postupalsky 1968). The northwestern Ontario population also responded positively to the prohibition on the use of DDT and its declining presence in the environment, with a rapid increase in productivity following a decline in DDE levels (Grier 1982). In 1990 13 percent (57) of the known active nests in northern Ontario were in northeastern Ontario, while 87 percent (719) were in northwestern Ontario (Grier et al. 2003). The number of known active nests in northern Ontario increased by 78 percent between 1990 and 1998, with a higher rate of increase in the northeast (225%) than the northwest (66%) (Grier et al. 2003). This trend has likely continued since that time. The exception may be the Lake of the Woods population which apparently reached saturation levels and stabilized in the late 1980s (Grier et al. 1999). Bald Eagles also appear to have expanded northward, and have recently begun to nest along the Albany River over the past 20 to 25 years, an area where they were not historically known to nest (M. Sutherland, pers. comm. 2013).

Breeding Bird Atlas data in Ontario have shown a significant increase in the probability of observation from the early 1980s to the early 2000s in all atlas regions, and an almost fourfold increase province-wide (Armstrong 2007). Both breeding and overwintering populations of Bald Eagles have increased significantly across North America, based upon results of both Breeding Bird Surveys and Christmas Bird Counts (CBC) (Butcher et al. 2005). In Ontario the winter trend has been similarly positive, particularly in recent decades (Figure 4). The total number of Bald Eagles seen in all CBC counts across Ontario was relatively stable and less than 20 in all years except one between 1921 and 1986, after which the numbers began to increase exponentially (National Audubon Society 2014). The highest total number of overwintering Bald Eagles ever reported at all Ontario CBC sites, 1,082, occurred in 2013 when they were reported from 94 different count locations (National Audubon Society 2014). This trend likely reflects both the population increase and an increasing proportion of the population which overwinters within the province.

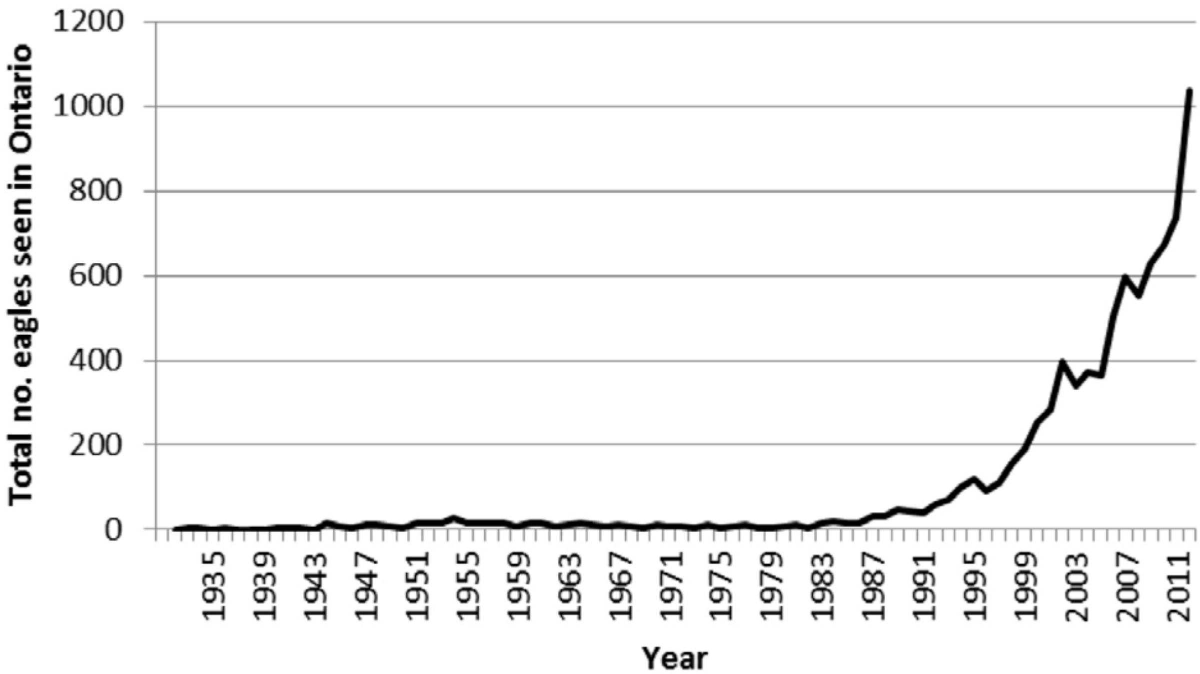

Figure 4. Trends in total number of Bald Eagles observed in Ontario during Christmas Bird Counts, 1931–2013 (National Audubon Society 2014).[4]

Several traditional overwintering areas have been identified in Ontario, including the Grand and Thames Rivers, the Thousand Islands Parkway and Wolf Island in the St. Lawrence River, the Trent-Severn Waterway, along Lake Erie at Rondeau, Long Point, Point Pelee and Nanticoke Generating Station, the Niagara River, Manitoulin Island, the warm water discharge area from the Bruce nuclear power plant, Terrace Bay and the Nipigon River (Timmerman and Halyk 2001; Grier et al. 2003; Sandilands 2005).

2.3 Habitat Requirements

In Ontario, typical Bald Eagle nesting habitat is described as mature forest with scattered supercanopy trees, and adjacent large productive waterbodies (Szuba and Naylor 1998). Bald

[4] While birds-seen-per-party-hour is often used as a standard measure for CBC results, total number is used here as this is a highly visible and sought-after bird and this value better indicates the relative size of the provincial overwintering population.

Eagles typically nest within 2 km of water with suitable foraging opportunities and often adjacent to large waterbodies, in forested areas of mature or old growth forest with some habitat edge (Buehler 2000). Northwestern Ontario nests are typically close to the water's edge, ranging from 6 to 200 m and averaging 23 to 65 m from the shoreline (Hackl 1994, Jones 1995). Nest trees in Minnesota averaged 160 m from water's edge (Grier and Guinn 2003), and 90 percent of Saskatchewan nests were within 200 m of the shoreline (Whitfield 1974). Ontario nests are more often near lakes than large rivers, often on peninsulas or islands (Peck and James 1983, Hackl 1994, Jones 1995).

Bald Eagle nesting density is related in part to prey availability which depends on the quality and area of foraging habitat, helping to explain the preference for larger bodies of water (Peterson 1986). Lakes greater than 1,000 ha with more than 11 km of shoreline appear to be more optimal for breeding territories (Whitfield et al. 1974, Peterson 1986). Oregon lakes had to be approximately 1,000 ha or larger to support more than one breeding territory (Frenzel 1983, cited in Johnsgard 1990). Lakes in northern Ontario containing Bald Eagle nests had significantly greater lake surface area, lake shoreline perimeter, lake island perimeter and shallow water area than lakes without nests (Jones 1995). Fish species diversity which is likely correlated with many of these variables was also greater in lakes with nests present (Jones 1995). Shallow water increases the likelihood that fish prey will be nearer the water surface where they are more vulnerable to predation (Buehler 2000). The availability of suitable prey is an important factor in Bald Eagle nest site selection and nest productivity. Open water areas in early spring and fish spawning areas in spring and early summer can be important Bald Eagle habitats (Naylor and Watt 2004). Bald Eagle presence on lakes in Wisconsin is positively correlated with pH and lake surface area, as well as the percentage of near-shore emergent vegetation, variables that are often associated with high fish abundance for Bald Eagle foraging (Newbry et al. 2005). While Bald Eagles typically prefer forested areas for nesting, in southern Ontario the Lake Erie area appears to be an exception due to the more limited forest cover (Sandilands 2005), a situation also observed in Minnesota (Guinn 2004).

Nest trees in northern Ontario are typically living (72–75% in northwestern Ontario), dominant (supercanopy), with a full crown and multiple accessible perches, in uneven-aged stands (Jones 1995). Nest trees are generally among the largest available trees in the area, with accessible broad crotches capable of supporting a nest, an unobstructed view and flight paths in all directions but especially towards the water (Johnsgard 1990, Buehler 2000, Sandilands 2005). Tree structure (e.g. size, limb features and visibility) appears to be more important than the specific species (Johnsgard 1990). Bald Eagles will nest in a variety of trees that can provide the required structural characteristics, although there are clear species preferences. In Ontario 26 different species have been recorded as being used as nest trees, with White Pine (37%) and various species of *Populus* (26%) being by far the most commonly used (Table 1). In Ontario coniferous trees (3 species) are used slightly more often than deciduous trees (10 species) as nest trees (Peck and James 1983). Northwestern Ontario nests are most often in White Pine (*Pinus strobus*) (64–74%) and Trembling Aspen (*Populous tremuloides*) (19–24%), with a smaller proportion of nests in White Birch (*Betula papyrifera*), Balsam Poplar (*Populus balsamifera*), Spruce (*Picea* sp.) and Jack Pine (*Pinus banksiana*) (Jones 1995). Red Pine (*Pinus resinosa*) is also used, although less frequently than White

Pine (Hackl 1994). In southern and southwestern Ontario, maples (*Acer* spp.), Eastern Cottonwood (*Populus deltoides*), White Pine, Sycamore (*Platanus occidentalis*) and Shagbark Hickory (*Carya ovata*) are used as nest trees (Hunter et al. 1997, Sandilands 2005, Hartig et al. 2010). Some cliff nesting also occurs adjacent to Lake Nipigon (T. Armstrong, pers. obs.) and there are at least two Ontario records of Bald Eagles nesting on the ground on islands – in Quetico Provincial Park (Martin 2005) and in the Slate Islands of Lake Superior (P. Dennis, pers. comm. 2013). Artificial nesting platforms are occasionally used by nesting Bald Eagles (Ewins et al. 1994, Hunter et al. 1997, Hartig et al. 2010). Bald Eagles will also on occasion use the nest of another species – amongst 1,133 provincial nest records there are records of Bald Eagles using nests previously occupied by Osprey (1), Great Blue Heron (2) and Common Raven (1)[5].

Nest trees are regularly blown down and the nests destroyed, highlighting the value of larger, firmer trees for longer-term nest retention (Jones 1995). Nest loss in some parts of northern Ontario may exceed 10 percent annually (Guinn 2004). Bald Eagles will often rebuild nests in the same vicinity and reoccupy the same site if other nest trees are available (USFWS 2007). In some cases, a Bald Eagle pair may not breed for a year after the loss of a nest tree (Kennedy and McTaggart-Cowan 1998). Territory abandonment has also been observed after nest tree loss following several years of nesting failure (Hartig et al. 2010).

Although there is considerable variation, nests are typically in areas with low human disturbance. Nests in areas with a high degree of shoreline development are typically further from the water than in areas with minimal development (Buehler 2000). More recently Grier and Guinn (2003) found that there was not a clear relationship between nest sites and human presence.

The availability of food is the primary determinant of Bald Eagle wintering habitat. Birds commonly congregate where food is available (Martel 1992). In northern areas open water may be the most important component of overwintering habitat (Steenhof 1978) because it allows access to fish and waterbirds. Overwintering Bald Eagles are generally associated with open water habitats, such as large river systems and coastal areas (Buehler 2000), while inland Bald Eagles concentrate around remaining patches of open water (Fischer 1985). Typical overwintering areas in southern Ontario are open water below dams or falls where injured fish, dead fish and waterfowl are available (Duncan 1990). Optimal winter habitat has open water for foraging, perching sites, suitable roosting areas for protection from the elements and low human disturbance (Buehler 2000). Buehler (2000) noted that overwintering Bald Eagles will tolerate higher levels of human disturbance in areas with higher food abundance.

5 Ontario Nest Records Scheme (Royal Ontario Museum) and Project NestWatch (Bird Studies Canada) data.

Table 1. Recorded nest tree species of Bald Eagles in Ontario as reported to the Ontario Nest Records Scheme (Royal Ontario Museum[6]) and Project NestWatch (Bird Studies Canada[7]).[8]

Tree Species	Number of nest records (%)
White Pine	194 (37.0)
Aspen/Poplar/Cottonwood (*Populus* spp.)	76 (13.4)
Trembling Aspen	33 (6.3)
Eastern Cottonwood	28 (5.3)
Pine (*Pinus* sp.)	26 (5.0)
American Elm (*Ulmus americana*)	21 (4.0)
Red Oak (*Quercus rubra*)	20 (3.8)
Red Pine	11 (2.1)
Silver Maple (*Acer saccharinum*)	11 2.1)
White Oak (*Quercus alba*)	10 (1,9)
Oak (*Quercus* sp.)	10 (1.9)
American Beech (*Fagus americana*)	9 (1,7)
Shagback Hickory	9 (1.7)
Sugar Maple (*Acer saccharum*)	7 (1.3)
Black Cherry (*Prunus serotina*)	7 (1.3)
White Birch	6 (1.1)
Balsam Poplar	6 ()1.1
Sycamore	5 (1.0)
White Ash (*Fraxinus americana*)	5 (1.0)
Black Spruce (*Picea mariana*)	5 (1.0)
Jack Pine	5 (1.0)
Basswood (*Tilia americana*)	4 (0.8)
Tulip Tree (*Liriodendron tulipifera*)	4 (0.8)
Maple (*Acer* sp.)	3 (0.6)
Spruce (*Picea* sp.)	2 (0.4)
Black Oak (*Quercus velutina*)	1 (0.2)
Pin Oak (*Quercus palustris*)	1 (0.2)
Green Ash (*Fraxinus pennsylvanica*)	1 (0.2)
White Spruce (*Picea glauca*)	1 (0.2)
Black Ash (*Fraxinus nigra*)	1 (0.2)
Ash (*Fraxinus* sp.)	1 (0.2)
Largetooth Aspen (*Populus grandidentata*)	1 (0.2)
Total	524

6 http://www.birdsontario.org/download/ONRSHandbook.pdf
7 http://www.birdscanada.org/volunteer/pnw/index.jsp?targetpg=index
8 From 1133 nest records between 1886 and 2013, summarizing only those where the species or genus of the nest tree was identified, including dead or dying trees. Does not include species for records where the forest type was specified but the nest tree species was not, nor dead trees where no species was indicated. Data provided by Bird Studies Canada and Royal Ontario Museum

Bald Eagles spend much of their daylight hours perching (Caton et al. 1992). Diurnal perch trees near foraging areas are an important and sometimes rare habitat attribute (Brownell and Oldham 1985; Jones 1995). These are typically tall accessible trees in the open or supercanopy trees in forested areas with good visibility of the surrounding area and easy access for landing and departing, adjacent to foraging areas, and in areas with low levels of human disturbance (Caton et al. 1992, Buehler 2000, MacKinnon et al. 2007). The availability of suitable shoreline perch trees can be a primary factor in the shoreline distribution of Bald Eagles (Garrett et al. 1993, Chandler et al. 1995), and perching sites near foraging areas may be a factor in nest site selection (Caton et al. 1992). Both deciduous and coniferous trees are used as perch trees, and tree characteristics such as stout branches and open structure appear to be more important than tree species (Garret et al. 1993). A review of several studies led to a recommendation that 20 to 40 suitable perch, roost and nest trees per hectare be retained in areas around Bald Eagle nesting habitat during forest management operations (Naylor and Watt 2004).

Roost sites during the nonbreeding season are another important habitat component which may have energetic benefits. Roosting areas are typically in areas with larger trees, less dense canopy and closer to forest edges (Chester et al. 1990). Winter roosting habitat may be further from water than nest sites (Buehler 2000), and typically consists of stands with old, large diameter trees and good crown accessibility (Naylor and Watt 2004). Winter roosts are generally less exposed than diurnal perch sites (Brownell and Oldham 1985). Most overwintering Bald Eagles in Washington selected coniferous trees over deciduous for roosting, even though their use necessitated higher energetic costs of travel because they were further away (Stalmaster and Gessaman 1984). Coniferous roosting habitat in winter provides energetic benefits, with net energy savings provided from higher temperatures and lower wind velocity (Stalmaster and Gessaman 1984).

2.4 Characteristics Contributing to Vulnerability of Species

Past Bald Eagle population declines were due primarily to human persecution and pesticide use, and when these factors were addressed the population responded favourably. The Bald Eagle's ecological position as a top predator consuming primarily aquatic prey places it in a position to be heavily influenced by any contaminants in the ecosystem. During the 1960s Bald Eagles had higher residues of organochlorine chemicals than Golden Eagles (*Aquila chrysaetos*), apparently due to their mainly fish-based diet (Brownell and Oldham 1985). Populations nesting along the Great Lakes appear especially sensitive to continued future chemical contamination because of their reliance on fish near industrial pollution sources, while interior nesting populations appear to be much less at risk (Bowerman et al. 1995, 2003). During the period of population decline in the 1960s, the Great Lakes breeding population had the lowest productivity of six populations studied by Sprunt at el. (1973). The southern Great Lakes population may even be a "sink" population, relying upon immigration from less contaminated inland populations (Hartig et al. 2007). The presence of a relatively uncontaminated prey base is essential for successful Bald Eagle reproduction (Bowerman et al. 2003). The declining trend in DDE levels in Lake Superior Bald Eagles is slowing, probably due to the retention of contaminants in this deep, cold oligotrophic lake (Route et al. 2011). The lingering presence of DDE in Lake Superior eagles may also be due to a more complex food chain with additional layers (Route et al. 2011). The Bald Eagle's reproductive sensitivity to organochlorine pesticides makes it a good indicator of environmental quality (Bowerman et al. 2005). Bald Eagles in relatively contaminated locations have also shown deformities such as abnormal bills (Fox 2001). For these reasons, and the fact that the Bald Eagle is one of the few wildlife species whose breeding population and productivity can be almost fully surveyed on the Great Lakes (Fox 2001), various jurisdictions have identified the Bald Eagle as an indicator of environmental quality, particularly in the Great Lakes (Environment Canada 2001a, Fox 2001, Bowerman et al. 2002, Bowerman et al. 2005, Laing and Badzinski 2005, Hartig et al 2007, Route et al. 2011, IJC Work Group 2013).

The Bald Eagle is a long-lived slow-maturing species. High adult survival is considered critical to the species' long-term survival, and even very slight shifts in adult survival rate can have major implications for the trajectory of the Bald Eagle population and its recovery (Grier 1991, J. Grier pers. comm. 2013). Adult Bald Eagle survival rates appear to be much more important to Bald Eagle populations than reproductive rates (Grier 1980). Thus any natural or human-caused factors that threaten to reduce adult survival rates are of particular concern.

3.0 THREATS

Natural ecosystems are continually evolving in response to a variety of forces and factors. But they are limited in their ability to adapt to rapid change, such as that introduced through human activities. Humans sometimes disrupt and degrade biodiversity through habitat loss, introduction of invasive species, population growth, pollution, unsustainable use and climate change. Our growing population combined with our rising levels of resource consumption can threaten biodiversity (OBC 2011). Recently, an assessment of pressures on Ontario's biodiversity showed that many threats are increasing (OBC 2010).

Jones (1995) summarized human-related threats to the Bald Eagle as illegal shooting, trapping, collisions and poisoning from lead shot, heavy metals, PCBs and DDT. Grier et al. (2003) identified recent threats to Ontario's Bald Eagle population as human expansion and development (if management guidelines were relaxed), the potential for personal take of eagles, and chemical contaminants and diseases such as avian vacuolar myelinopathy (AVM) and West Nile Virus (WNV). Current threats facing the Bald Eagle in Ontario are discussed in the following section.

Pollution:

Although levels have improved in recent decades, long-term environmental contamination persists and remains a concern for the Bald Eagle, particularly for those nesting near the Great Lakes (Bowerman et al. 1995, Environment Canada 2001a). PCBs, DDE and dieldrin all persist in Bald Eagle eggs from the Great Lakes, although levels declined substantially between the 1970s and 1989–1994 (Environment Canada 2001a). In the 1980s Bald Eagles nesting near the southern shore of Lake Superior had a lower nesting success rate than birds nesting in inland Wisconsin, and carcasses of nestlings from nests near Lake Superior had higher levels of DDE and PCBs than those from inland nests (Kozie and Anderson 1991). Herring Gulls as prey appear to be a major source of these contaminants (Kozie and Anderson 1991, Route et al. 2011). Residual chemical contaminants such as DDE remain a concern for Bald Eagles as they can be an added stressor in areas where food resources are limited, and sublethal effects may still be possible (Route et al. 2011).

New and emerging chemical contaminants are also a potential concern, such as the fire retardant polybrominated diphenyl ethers (PBDEs) and perfluorinated compounds (PFCs) (Route et al. 2011). PBDEs are as long-lasting as and bioaccumulate similarly to DDE and PCBs (Venier et al. 2010). While the effects of these chemicals have not been studied greatly, they do have known toxicological effects (Venier et al. 2010). Recent government and industry action is leading to reduced use of PBDEs in North America. PBDE levels in Bald Eagle nestlings from the south shore of Lake Superior increased from 2001 to 2006, and have begun to decline more recently (Route et al. 2011). With regard to PBDEs, Venier et al. (2010, pg. 1239) noted that "their presence in a species, which is still showing poor reproductive success and poor juvenile and adult survival rates, is a cause for concern", and emphasized the need for continued monitoring.

Elevated levels of heavy metals such as mercury and lead can also affect survivorship, and may affect the recovery of Bald Eagles in Ontario, particularly southwestern Ontario (Martin et al., in prep.). Mercury contamination has been a concern for Bald Eagles, although at current levels it has not been shown to have an effect on reproduction (Bowerman et al. 1995). Several Bald Eagles found dead in southern Ontario prior to 2004 had elevated levels of lead and mercury (Laing and Badzinski 2005). Of 43 dead and dying Bald Eagles collected between 1991 and 2008 in Ontario, 28 percent (12) died of lead and/or mercury poisoning: five of lead and/or mercury poisoning, three of lead poisoning and four of mercury poisoning (Martin et al. in prep.). In Ontario, 3 of 16 dead Bald Eagles collected between 2007 and 2012 died due to lead poisoning (Canadian Cooperative Wildlife Health Centre, unpubl. data[9]).

Lead poisoning from food sources is a threat that is growing in awareness as new studies become available. Prior to the prohibition on the use of lead shot for waterfowl hunting, Bald Eagle consumption of injured or dead waterfowl was likely a primary source of sometimes fatal lead poisoning (Wayland and Bollinger 1999, Scheuhammer and Norris 1996). Bald Eagles and other avian scavengers appear to be very vulnerable to lead poisoning from scavenging of hunter-killed big game carcasses (Hunt et al. 2006, Craighead and Bedrosian 2008), with lead poisoning linked closely with the fall big game hunting seasons (Stauber et al. 2010, Bedrosian et al. 2012). In one western USA study of hunter-killed deer, 100 percent of deer carcasses and 90 percent of deer remains contained lead fragments (Hunt et al. 2006). In Wyoming, 93 percent of the wintering Bald Eagles tested had been exposed to lead, and lead levels were significantly higher during the big game hunting season than before or after (Bedrosian et al. 2012). Twenty-five percent of the birds sampled in the same study during the hunting season had lead blood levels indicative of acute exposure (Bedrosian et al. 2012), while 48 percent of 22 Bald Eagles submitted for rehabilitation in the USA inland Pacific northwest region had toxic blood lead levels (Stauber et al. 2010). Lead levels in Bald Eagles in Minnesota did not change after the banning of lead shot for waterfowl hunting (The Raptor Centre 2014). Instead, most cases occurred in late fall and early winter, with a strong association with the rifle deer hunting season (Redig et al. 2009). In Iowa, which has a long White-tailed Deer hunting season and a large wintering Bald Eagle population, over 50 percent of the Bald Eagles admitted for wildlife rehabilitation had ingested lead (Neumann 2009). Poisoning from lead-contaminated big game offal could thus be a concern both for birds wintering in Ontario and those wintering elsewhere. Lead poisoning and its potential effects on adult survival are of particular concern for long-lived, slow-breeding species such as Bald Eagles (Fisher et al. 2006, Neumann 2009). In their study of lead poisoning of Bald Eagles, Stauber et al. (2010, pg. 286) concluded that “as long as hunting with lead-containing bullets is accepted and continues, the problem of lead poisoning will persist”. It appears that some lead contamination, at least in Lake Superior, is also a residual effect of past use of leaded gasoline and possibly some contaminated industrial or municipal waste (Route et al. 2011).

[9] Canadian Cooperative Wildlife Health Centre, National Data Base, Ontario/Nunavut Region

Secondary poisoning of Bald Eagles by sodium pentobarbital (a drug used to euthanize animals) has been implicated in Bald Eagle deaths in a number of North American jurisdictions (USFWS, no date), including 2 of 16 dead specimens (13%) collected in Ontario between 2007 and 2012 (Canadian Cooperative Wildlife Health Centre, unpubl. data[8]). The latter two birds were collected from northern Ontario, and most likely reflected Bald Eagles scavenging on carcasses of animals euthanized by a veterinarian (D. Campbell, pers. comm. 2014). This appears to be a rare event, probably brought about by improper disposal of euthanized remains or delayed maintenance of landfill sites (USFWS no date, D. Campbell, pers. comm. 2014). The USFWS (no date) identifies a number of mitigation measures to prevent secondary sodium pentobarbital poisoning.

Incidental Mortality:

Mortality from wind farms has been identified as a potential concern for a number of raptor species (de Lucas et al. 2008, Madders and Whitfield 2006). The mortality of a large number of Golden Eagles at the Altamont Pass Wind Resource Area in California was one of the more significant occurrences, although no Bald Eagle mortalities were documented at this site (Smallwood and Thelander 2008). The main threat to Bald Eagles is the direct mortality resulting from collisions with wind turbines, although disturbance effects on productivity or concentration areas and disturbance effects leading to the loss of nesting territories are also concerns (USFWS 2013a). Bald Eagles appear to be less susceptible to mortality from wind farms than some raptors. Between 1997 and 2012 a survey of 32 USA wind farms, excluding the Altamont Pass Wind Resource Area, revealed 85 eagle mortalities, of which six were Bald Eagles and the balance Golden Eagles (Pagel et al. 2013). There were also several other Bald Eagle wind-related mortalities in Canada that were not included in this study (J. Pagel, pers. comm. 2013). The authors cautioned that reduced vulnerability of Bald Eagles to wind facility collisions is only one of several possible explanations for this reduced frequency (Pagel et al. 2013). White-tailed Eagles *(Haliaeetus albicilla*) in Norway were vulnerable to turbine-related mortality when a wind farm was built close to a number of territories (Nygard et al. 2010). Prior to wind farm construction there were 13 territories in the vicinity of the wind farm and within 500 m of it, while less than a decade later this was reduced to five pairs, and the additional 10 percent mortality reduced cumulative survival through the first three years of life from 0.84 to 0.74 (Nygard et al. 2010). Based upon satellite telemetry data for juvenile White-tailed Eagles, an average of 24 percent of flights were within rotor height (Nygard et al. 2010), suggesting a high risk of collision. Birds also appeared to circle near the wind turbines, and it was speculated that this may be due to additional wind energy created by turbulence from the turbines (Nygard et al. 2010). Turbine-related mortality was greatest during the spring, perhaps reflecting increased territorial activity and good thermal conditions (Nygard et al. 2010).

No Bald Eagle mortalities have been reported in post-construction monitoring between 2006 and 2010 at monitored wind turbines in either Ontario or Canada (Environment Canada et al. 2012). However, in April 2009 a Bald Eagle that died from wounds consistent with a collision was found in close proximity to a wind turbine at a wind farm in Norfolk County, Ontario that had been in operation since 2006 (C. McCauley, pers. comm. 2014). A Bald Eagle nest recently constructed in the immediate vicinity of an approved wind energy turbine site in Haldimand County was removed in the winter of 2013 due to concerns that the returning birds would be vulnerable to wind turbine mortality (Government of Ontario 2013a).

Ontario has identified that avian mortality from a wind energy facility exceeding a threshold of 0.1 raptors per turbine per year (provincially tracked raptors) or two raptors per wind power project (fewer than 10 turbines) would be considered significant, and would require the implementation of a contingency plan (OMNR 2011). The USFWS has recognized that wind energy facilities constitute a form of potential mortality, and has developed a process to authorize the incidental "take" of Bald Eagles, applying local and regional thresholds (i.e. a maximum upper limit of the number of mortalities that can be allowed under permit annually) (USFWS 2013b). Local area[10] take rates are also specified, limiting the total local area take to 1 to 5 percent of the estimated total local Bald Eagle population (USFWS 2013a), with permits valid for up to 30 years (USFWS 2013b). At this time, for existing wind energy facilities there are no conservation measures that have been scientifically shown to reduce eagle disturbance and blade-strike mortality (USFWS 2013b).

Unsustainable Use:

While harvest of Bald Eagles for feathers is a concern in some parts of North America (Tombs 2014), there is no evidence that there is cause for concern in Ontario.

Trapping was an incidental source of mortality in the past (Bortolotti 1984, Brownell and Oldham 1985), extending at least into the 1970s. Occasional incidents of winter mortality of Bald Eagles from trapping did occur in northeastern Ontario in the 1980s (T. Armstrong, pers. obs.), and one of 43 dead or dying Bald Eagles collected in Ontario between 1991 and 2008 died from a snare (Martin et al., in prep.). It is probable that incidental trapping mortality in Ontario declined or ceased with the development and implementation of Canada-wide trapping methods and educational programs during the 1980s, which advised trappers using leg-hold traps for dry-land sets to conceal traps with evergreen boughs to reduce the likelihood of incidental eagle capture (C. Heydon, pers. comm. 2014). However there are no reporting mechanisms and the incidental capture of eagles (species unknown) is still occurring elsewhere in North America (Cole 2014).

Disease:

West Nile Virus spread rapidly after first being recorded in North America in 1999; some Bald Eagles tested positive for the virus and some mortalities were documented (Rappole and Hubalek 2003, Marra et al. 2004, Saito et al. 2007). Bald Eagle mortality from West Nile Virus appears to fluctuate from year to year, but appears to remain in the population at low levels with occasional mortality (P. Redig, pers. comm. 2014). As an example, 15 records of Bald Eagles (adults, juveniles, and hatching year) fatally infected with West Nile Virus were recorded at The Raptor Centre at the

[10] A population within a radius of 43 miles (69 km) of a wind energy facility, representing "the median distance to which the eagles disperse from the nest where they are hatched to the area where they settle to breed" (USFWS 2013).

University of Minnesota between 2004 and 2013 (P. Redig, unpubl. data). Unlike some other affected species such as American Crow (*Corvus brachyrhynchos*) and Great-horned Owl (*Bubo virginianus*), there does not appear to be any indication that the Bald Eagle is becoming more resistant to the virus (P. Redig, pers. comm.2014). However, in healthy, genetically diverse populations, there is likely sufficient resilience to result in localized impacts rather than broader population impacts (P. Redig, pers. comm. 2014). West Nile Virus has been recorded in Ontario Bald Eagles. One of 43 dead and dying specimens collected between 1991 and 2008 died from complications due to West Nile Virus (Martin et al., in prep.), and two of 16 dead Bald Eagles collected between 2007 and 2012 died due to the virus (Canadian Cooperative Wildlife Health Centre, unpubl. data[11]), collectively representing 7 percent of the known mortality from both samples. The recent high mortality of at least 40 Bald Eagles during the winter of 2013–14 in Utah (Prettyman 2014) suggests that West Nile Virus remains a significant disease concern for Bald Eagle populations, although this infection resulted from a unique circumstance whereby the virus was transmitted through scavenging on dead waterfowl rather than via mosquitoes.

In 2003 Avian Vacuolar Myelinopathy (AVM) was considered a new and emerging concern for Bald Eagles in Ontario (Grier et al. 2003). First discovered in Arkansas during the winter of 1994–95, AVM is a neurological disease that caused unusually high mortality in Bald Eagles and American Coots (*Fulica americana*) in two non-consecutive winters (Thomas et al. 1998). This was considered a concern for Ontario Bald Eagles because many northern birds from the northern USA and Canada overwinter in Arkansas (Thomas et al. 1998), and one of the first Bald Eagle mortalities from AVM confirmed in Arkansas was banded as a nestling in northwestern Ontario (Grier et al. 2003). Additional mortalities of Bald Eagles and other bird species have since been recorded in southern and southeastern USA from east Texas eastward (USGS 2002). The cause of the disease is not known, although it is believed to be a man-made or naturally occurring toxin (USGS 2002). While potentially affecting Ontario Bald Eagles when overwintering or migrating, AVM is unlikely to affect the species when resident within the province. AVM has never been diagnosed in Ontario, although the signs can be difficult to identify in samples of dead birds (D. Campbell, pers. comm. 2014). While identifying AVM as a concern, Grier et al. (2003) noted that little was known about this disease or how to mitigate it, and suggested continued awareness and monitoring.

Population Growth:

Expanding human populations and associated disturbance in areas of high value Bald Eagle habitat can impact the availability and suitability of habitat. Bald Eagle nests are typically further from the shoreline in areas with high levels of shoreline development and/or human activity relative to less developed areas (Buehler 2000). Bald Eagle response to disturbance is quite variable and appears to be affected by several factors, including the timing, type and duration of disturbance, distance to disturbance and degree of habituation (OMNR 2010a). There is no

[11] Canadian Cooperative Wildlife Health Centre, National Data Base, Ontario/Nunavut Region

clear relationship between the presence of roads and Bald Eagle nest productivity, although they appear to select nest sites further from roads (OMNR 2010a). Although Bald Eagles typically select nesting habitat in areas of low human disturbance (Peterson 1986), recent research has demonstrated that Bald Eagles may be more tolerant to human disturbance than originally thought. This is particularly so where Bald Eagles are habituated to human activity and have chosen to nest in close proximity to human habitation (Guinn 2013). Non-habituated Bald Eagles nesting in undisturbed areas appear to be less tolerant of human disturbance, and require greater protection. Once a nesting pair of Bald Eagles has successfully bred, they show increased nest site fidelity and may be more tolerant of human disturbance (Bricker and Hoar 2010). The USFWS (2012) has noted that "eagles are unlikely to be disturbed by routine use of roads, homes, or other facilities where such use was present before an eagle pair successfully nested in a given area". In southern Ontario where Bald Eagle habitat is fragmented and very limited, particularly near the Lake Erie shoreline, it appears that active management to restrict human activity near nests may help compensate for the limited habitat (Bowerman et al. 2005).

Habitat Loss:

Habitat loss is not generally seen as a major threat for Bald Eagles (Grier and Guinn 2003), and this is generally the case in Ontario with the possible exception of southern Ontario near Lake Erie (Bowerman et al. 2005, Sandilands 2005). However, habitat loss may be a concern in specific locations. Although habitat does not appear to be generally limiting for Bald Eagles, continued development of shorelines could limit future habitat and should remain a constant concern (Guinn 2004).

The *Fish and Wildlife Conservation Act*, 1997 (FWCA) provides for the protection of Bald Eagle nests and eggs (S. 7(1)). A recently enacted regulation (OR 171/13) made under the FWCA exempts a person from this protection while carrying out:

- a renewable energy project in accordance with a renewable energy approval under the *Environmental Protection Act*;
- forest operations in accordance with the applicable forest management plan approved under the *Crown Forest Sustainability Act*, 1994; or
- activities required to maintain an electricity transmission or distribution line within a transmission or distribution corridor, or to maintain a telecommunications line or a broadcast tower, if there is a risk to the function of the facility (Government of Ontario 2013b, 2014b).

With the first two exemptions, habitat protection and management provisions are addressed under parallel legislative requirements. While likely to occur rarely because there must be a risk to function, the third exemption for the maintenance of electrical or telecommunications transmission infrastructure represents a situation for which there is no parallel approval and public consultation process to protect nests or eggs, and no reporting mechanism for the removal of nests deemed to be a risk to the infrastructure. In Minnesota nesting does occur on some specific types of transmission towers that may offer several structural advantages over traditional nesting sites, and may become more common in future (Guinn 2004).

OMNRF guidance for wind energy and birds recognizes that Bald Eagle overwintering habitat ("Seasonal Concentration Areas") and Bald Eagle nesting, foraging and perching habitat ("Rare or Specialised Habitats for Wildlife") should be designated as Significant Wildlife Habitat under the Significant Wildlife Habitat Technical Guide (OMNR 2000), and a 120 m adjacent lands buffer is applied (OMNR 2011). This 120 m buffer is applied to the area identified as Significant Wildlife Habitat, such as 400 to 800 m surrounding a nest site. The efficacy of this buffer has not been tested scientifically, particularly for situations where the development is situated near a nesting pair that originally selected a more remote nesting site and is not habituated to human disturbance, and may or may not be sufficient.

As Bald Eagle populations continue to recover and expand, there are an increasing number of situations where habitat being used by breeding or overwintering Bald Eagles may be disturbed by urban developments. The potential conflict is reduced because Bald Eagles using such habitats presumably have some level of tolerance to human disturbance and perhaps even generational habituation (Guinn 2013), and habitat use is primarily focussed on shorelines and waterfronts that already receive considerable environmental protection. However, there are still situations where attention must be paid to the maintenance and protection of the habitat features important for continued Bald Eagle use including low human disturbance, using available planning tools such as the Significant Wildlife Habitat Technical Guide (OMNR 2000). Referencing the Lake Erie Bald Eagle recovery, the St. Lawrence Bald Eagle Working Group (2006, pg. 7) noted that "eagles may be developing a higher tolerance for human activity, but many breeding failures continue to be associated with human disturbance".

Climate Change:

While many effects of climate change cannot be accurately predicted, the Bald Eagle has shown itself to be a resilient species in the face of environmental change. It may be less vulnerable to climate change than some other species at risk with more specialized life history requirements and more restricted distribution (e.g. Brinker and Jones 2012). Warming temperatures and extended ice-free periods may favour Bald Eagle expansion further north into areas that have apparently suitable habitat and food conditions but currently have low eagle densities due to a limited ice-free period (Grier et al. 2003).

One of the areas where the Bald Eagle may be most vulnerable to climate change is in relation to changes to food supply, particularly aquatic species. A number of climate change impacts could affect fish communities, including their distribution, growth, survival and reproduction as a result of water temperature changes (Dove-Thompson et al. 2011). A projected northward expansion of warmwater fish species (Dove-Thompson et al. 2011, Chu and Fischer 2012) may have some positive impacts on Bald Eagle distribution and productivity, however, the effects from the anticipated drying and shrinkage of wetlands (Chu and Fischer 2012) would not likely be positive. Climate change may have impacts on other forage sources as well. For example, milder winters may reduce the amount of winter-killed wildlife available for forage.

Most of the mercury contamination in Bald Eagles is obtained from a diet of fish and is assumed to be methylmercury, the most toxic form (Route et al. 2011). Both weather and climate patterns affect mercury methylation, with highest levels of mercury apparently occurring during warm, wet springs, suggesting that climate changes leading to higher spring temperatures and higher precipitation may increase mercury levels in the future (Route et al. 2011).

Forest environmental conditions and tree species distribution and abundance are also expected to be dramatically altered with climate change (Colombo 2008). While Bald Eagles do have clear nest tree preferences, their flexibility in nest tree species selection and their ability to nest in both forested and more open habitats (Grier and Gunn 2003) will likely mitigate some of the potential impacts of broad changes in forest composition.

In one observed effect of climate change, Bald Eagles appear to be responding to milder winters by beginning to lay eggs earlier, although the trend is not yet conclusive (Garrison 2010). While not highlighting a specific threat to Bald Eagles, Garrison's (2010) study does highlight the value of long-term data sets to study trends in this species' response to climate change.

4.0 MANAGEMENT

4.1 Management Goal and Objectives

The goal of this management plan is to ensure that Ontario's Bald Eagle population continues to recover to achieve a stable or increasing population state at which natural events and human activities will not threaten its health and persistence. To achieve this goal several objectives have been identified that will require the support and cooperation of a number of interested organizations, landowners, institutions and government jurisdictions (Table 2).

Table 2. Management objectives for the Bald Eagle in Ontario

No.	Management Objective
1	Monitor Bald Eagle populations to ensure continued population recovery.
2	Identify and protect Bald Eagle nesting sites and important overwintering and stopover habitat on both public and private lands.
3	Maintain continued high adult survival of Bald Eagles.

4.2 Management Actions Completed or Underway

Considerable effort has been devoted to the recovery of the Bald Eagle, particularly in southern Ontario. The Bald Eagle was one of the first species to be listed under Ontario's earlier *Endangered Species Act* in 1973. In addition to the prohibition on the use of DDT in Canada (1969) and the USA (1972) (Brownell and Oldham 1985), recovery efforts in Ontario were focused on southern Ontario, and included the transfer and release of nestlings from Lake of the Woods, public education, tissue collection and analysis for contaminants, habitat protection through landowner stewardship, the placement of nest platforms and a coordinated monitoring program (Allair 2008, Austen et al. 1994, Environment Canada 2001b, Grier et al. 2003). Thirty-two eaglets were translocated from healthy populations in northwestern Ontario to two release sites on Lake Erie from 1983–1987; one of these released birds is known to have survived for at least 21 years (Allair 2008).

A Bald Eagle monitoring program took place in southern Ontario for many years as a partnership amongst Bird Studies Canada, OMNR, the Canadian Wildlife Service and the Canadian Cooperative Wildlife Health Centre at the University of Guelph. This program included active nest monitoring and volunteer nest reporting, blood and feather sampling and contaminant analysis, and a satellite telemetry program. The most recent summary report of this initiative was produced for 2011 (Allair 2012), and this program is no longer active (J. Allair, pers. comm. 2013). The satellite telemetry program has been completed but has not yet been analysed and reported on. Recent work in eastern Ontario has included an assessment of the potential habitat quality of eastern Lake Ontario and the St. Lawrence River and the identification of objectives and actions to support further Bald Eagle recovery in the area (St. Lawrence Bald Eagle Working Group 2006, 2008). A long-term monitoring program also took place in the Lake of the Woods area from 1966–1998 (Grier et al. 1999), and some monitoring has continued in recent years.

Bald Eagle samples have been collected and analysed for contaminant levels (Martin et al., in prep.) and a number of specimens found dead have been analysed for cause of death.

The Bald Eagle is designated as a special concern species in Ontario under the ESA, and is recognized as a specially Protected Raptor under the FWCA (Government of Ontario 2012). Forest management planning and land use planning have generally focussed on nesting habitat, although foraging and overwintering habitats in southern Ontario have also received some attention (e.g. Timmerman and Halyk 2001, Bricker and Hoar 2010, J. Boos pers. comm.2014). Habitat inventory guidelines are in place to survey for Bald Eagle nests to support resource management planning (Ranta 1997). Forest management guidelines for Bald Eagles were implemented for Crown forests throughout Ontario in the mid-1980s (James 1984, OMNR 1987), and have recently been revised (OMNR 2010a). These guidelines support the management and protection of Bald Eagle nests in areas where forest management activity is being undertaken, including the retention of supercanopy trees for nesting, Area of Concern (AOC) prescriptions for the management of primary, alternate and inactive nest sites, seasonal disturbance restrictions during the critical breeding period, and the provision of perch trees (OMNR 2010b). While guidelines could provide for the management of Bald Eagle habitat at broader landscape scales than just the nest, this aspect has not been routinely implemented (Naylor and Watt 2004). Recommended Area of Concern widths for Bald Eagle nests affected by forest management were recently reduced (from 400-800 m to 400 m), with harvesting allowed up to 101 m from the nest in some circumstances, based upon a science-based review of the effectiveness of guidelines for various stick-nesting birds (Naylor 2009).

As a special concern species, the Bald Eagle is considered a “species of conservation concern” under the Significant Wildlife Habitat Technical Guide (OMNR 2000, pg. 68), and habitat is designated as Significant Wildlife Habitat. This provincial policy designation provides for habitat consideration under a number of resource planning and management processes, including:

- the Provincial Policy Statement (OMMAH 2014);
- the Natural Heritage Reference Manual (OMNR 2010c) for municipal developments;
- the *Environmental Protection Act* for renewable energy developments (Government of Ontario 2014a);
- the provincial environmental assessment process; and
- the *Lakes and Rivers Improvement Act.*

OMNRF is in the processing of developing ecoregional criteria schedules for Significant Wildlife Habitat for all ecoregions across the province, with schedules completed for southern Ontario (ecoregions 5E, 6E, 7E) and work proceeding on more northern ecoregions. These criteria schedules provide ecoregional guidance to consider Bald Eagle nesting, perching and foraging habitats and seasonal concentration areas such as wintering habitat in development proposals within the broader context of the Significant Wildlife Habitat Technical Guide (OMNR 2000). A Significant Wildlife Habitat Mitigation Support Tool is being developed to replace the Decision Support Tool (OMNR 2001) and assist in identifying mitigation options for development proposals; Significant Wildlife Habitat for the Bald Eagle is incorporated in this mitigation support tool (OMNRF in prep., J. Boos pers. comm. 2014).

A number of existing regional brochures and fact sheets provide information on Bald Eagle recovery in Ontario, including a very detailed one for the Great Lakes Region (Environment Canada 2001a).

In addition to management actions which are completed or underway, there are a number of additional management approaches which are required to achieve the goal of the management plan (Table 3).

4.3 Management Plan Approaches for Action

Table 3. Management plan approaches for action for the Bald Eagle in Ontario.

Management Theme	Management Approach	Relative Priority	Threats or Knowledge Gaps Addressed	Relative Timeframe
1. Monitor Bald Eagle populations to ensure continued population recovery.				
Inventory and Monitoring	1.1 Develop an ongoing, two-stage Bald Eagle nesting survey that will provide for ongoing volunteer-based reporting annually, combined with more intensive periodic (e.g. five-year) surveys conducted on a sample area basis across the province.	Necessary	• Pollution • Climate change • Knowledge gap	Short-term, Ongoing
Inventory and Monitoring	1.2 Continue to process all Bald Eagle element occurrence and nesting records obtained by monitoring and habitat management programs into the Natural Heritage Information Centre and Land Information Ontario.	Necessary	• Knowledge gap	Ongoing
Research	1.3 Maintain a long-term nest monitoring data set to monitor trends & impacts of climate change on nesting phenology and other aspects of reproduction.	Necessary	• Climate change	Ongoing
Inventory and Monitoring	1.4 Initiate a volunteer-based monitoring program with partner organizations to monitor Bald Eagle winter numbers and trends, following established guidelines for the Midwinter Bald Eagle Survey.	Beneficial	• Climate change • Knowledge gap:	Long-term, Ongoing
Stewardship	1.5 Work with First Nations to conduct an assessment of existing indigenous knowledge of the natural history, ecology and conservation status of the Bald Eagle in Ontario.	Beneficial	• Knowledge gap	Long-term

Management Theme	Management Approach	Relative Priority	Threats or Knowledge Gaps Addressed	Relative Timeframe
2. Identify and protect Bald Eagle nesting habitat and important overwintering and stopover habitat on both public and private lands.				
Protection Management Stewardship	2.1 Continue to apply existing nest management guidance (e.g. forest management guidance, municipal planning guidance, wind power guidance) to ensure that active and alternative Bald Eagle nest sites are maintained, productivity remains high and a healthy population state is maintained.	Critical	• Habitat loss	Immediate, ongoing
Research	2.2 Initiate an effectiveness monitoring program to examine the effectiveness of the revised forest management planning guidance and wind energy guidance for the protection of Bald Eagle nests and the mitigation of disturbance effects on nesting Bald Eagles.	Necessary	• Habitat loss • Knowledge gap	Short-term
Protection Management Stewardship	2.3 Identify and document historical nesting habitat that has not yet been recolonized, particularly in southern Ontario adjacent to the lower Great Lakes (Erie, Ontario), and undertake measures to protect and manage these habitats through stewardship programs to maintain their suitability and accessibility for future occupancy.	Necessary	• Habitat loss • Knowledge gap	Medium-term
Protection Management Stewardship	2.4 Continue to identify and manage Bald Eagle nesting, overwintering and stopover habitat as Significant Wildlife Habitat for management, protection and mitigation during land use and resource management planning.	Necessary	• Habitat loss • Knowledge gap	Medium-term
Protection Management Stewardship	2.5 Complete the development of ecoregional criteria schedules for Significant Wildlife Habitat, with consideration of the status of Bald Eagles in each ecoregion. Identify Bald Eagle overwintering habitat as a criterion (e.g. seasonal concentration area) in the Significant Wildlife Habitat criterion schedule for southern Ontario ecoregions, and develop provincial guidance or best management practices for their identification, management and protection near or within urban centres.	Necessary	• Habitat loss	Medium-term
Inventory and Monitoring	2.6 Implement a reporting protocol to allow evaluation of the magnitude of control measures implemented under S.133.1(1)2 of the FWCA (Government of Ontario 2014b) pertaining to the removal of nests and eggs in order to maintain an electricity transmission, distribution line or broadcast tower where there is a risk to function.	Beneficial	• Incidental mortality • Knowledge gap	Medium-term

Management Theme	Management Approach	Relative Priority	Threats or Knowledge Gaps Addressed	Relative Timeframe
3. Maintain continued high adult survival of Bald Eagles.				
Protection	3.1 Continue the protection afforded to the Bald Eagle by the FWCA, and continue to enforce this protection to achieve no direct human killing of Bald Eagles.	Critical	• Incidental mortality	Immediate, ongoing
Inventory and Monitoring Research	3.2 Monitor disease and contaminant levels in Bald Eagle populations by developing and maintaining a collaborative tissue contaminant monitoring program and database with partners.	Necessary	• Pollution • Knowledge gap	Initiate in short-term, ongoing commit-ment
Protection	3.3 Continue to monitor wind energy facilities for incidental mortality of Bald Eagles.	Necessary	• Incidental mortality	Ongoing
Inventory and Monitoring	3.4 Implement a reporting protocol to allow evaluation of the magnitude of incidental Bald Eagle mortality from trapping.	Beneficial	• Incidental mortality • Knowledge gap	Medium-term
Management Education and Outreach	3.5 Develop with partners a series of educational messages and best management practices to reduce the potential for incidental Bald Eagle mortality, including the following. • Hunter education messages regarding the impacts of lead ammunition on birds of prey and voluntary measures that can be undertaken to reduce its impact. • Veterinary medicine messages to emphasize appropriate disposal measures for euthanized animals to reduce the risk of secondary poisoning. • Trapper education messages regarding measures to reduce the potential for incidental trapping of Bald Eagles.	Beneficial	• Incidental mortality	Medium-term

Supporting Narrative

The background and rationale for a number of the management approaches supporting objectives are addressed in the following section.

1. Monitor Bald Eagle populations to ensure continued population recovery.

Despite the Bald Eagle's improved population status in Ontario, it remains vulnerable, particularly near the Great Lakes, because of its reliance upon a fish diet and the tendency for chemical contaminants to biomagnify within Bald Eagles. Monitoring is important to ensure continued population health, particularly with ongoing concerns about the detrimental effects of heavy metals and other contaminants (Wheeler and Archer 2008. The UFSWS (2009) recognized the importance of maintaining a long-term Bald Eagle monitoring program after this species was delisted, recommending a combination of annual nest monitoring and aerial sampling of area sample plots at five-year intervals for at least 20 years. Such a program is also very consistent with the manner in which Peregrine Falcon (*Falco peregrinus*) surveys have been conducted in Canada (and Ontario) over the past several decades (Holroyd and Banasch 2012). There are some existing databases that can be maintained and improved to support continued monitoring efforts and provide valuable long-term data to monitor the effects of environmental and climatic change. A two-stage survey could use existing voluntary monitoring programs and datasets to continue the southern Ontario Bald Eagle Monitoring Program (e.g. Allair 2012) and the long-term Lake of the Woods monitoring program (e.g. Grier et al. 1999). The program should also establish a long-term low intensity monitoring program in a northeastern Ontario study area.

Part of the rationale for considering the Bald Eagle as a bioindicator species is that it is one of the few species that it is possible to survey and obtain close to a total count of breeding pairs and subsequent productivity (Bowerman et al. 1998). While the size of the breeding population in Ontario would preclude this provincially, intensive surveys on subsamples of the provincial range would be feasible. Surveying for Bald Eagle nests can be a time-consuming and expensive undertaking. A number of habitat models and approaches have been proposed to help streamline survey efforts by identifying key habitat features (Grier 1985; Jones 1995, Grubb et al. 2003, Bowerman et al. 2005). These models help identify and classify Bald Eagle habitat before survey initiation, thereby enhancing survey efficiency.

It is important to monitor winter population trends to determine population status and health, particularly as a large overwintering population is a relatively recent phenomenon in Ontario. The Mid-Winter Bald Eagle Survey conducted in the United States has an established methodology and provides valuable long-term data on population trends, distribution and habitat use (Steenhof et al. 2002, Steenhof et al. 2008), and has had occasional participation from Ontario. A local similar effort was recently undertaken in eastern Ontario for the Lake Ontario Basin (OMNR 2008). The survey requires annual monitoring of standard routes in the first two weeks of January, following standardized procedures (Steenhof et al. 2008). Given the popularity and usefulness of several citizen science wildlife monitoring projects in Ontario, including some in winter (e.g. Christmas Bird Count, Great Backyard Bird Count, Project FeederWatch), there may be interest and support for a similar wildlife monitoring project that would provide useful information on Bald Eagle winter population trends. Steenhof et al. (2002) noted that such a program could help monitor breeding and nonbreeding populations as they recover and no longer receive species at risk protections.

Long-term monitoring is essential if the effects of climate change are to be understood and addressed. Ontario is fortunate to have two long-term Bald Eagle datasets (southern Ontario, Lake of the Woods in northwestern Ontario) which can be built upon to support future climate change monitoring and research.

Despite the importance of the Bald Eagle to many First Nation cultures, there is no comprehensive study of indigenous knowledge related to the Bald Eagle in Ontario, and little published information in this regard. There is value in supporting documentation of First Nation knowledge of Bald Eagle natural history and the importance of the Bald Eagle to First Nations culture. This information has potential to support conservation measures, identify stewardship opportunities and increase public awareness.

2. Identify and protect Bald Eagle nesting habitat and important overwintering and stopover habitat on both public and private lands

Bowerman et al. (2005) identified three important challenges for managing Bald Eagle habitat in the Great Lakes region: (i) protecting the remaining shorelines from landscape-level changes that could reduce habitat suitability for Bald Eagles, (ii) initiating land management activities to improve and add to potential shoreline nesting habitat, and (iii) preserving habitat along the Lake Erie shoreline to maintain the current nesting population. Habitat with high potential to support Bald Eagles has been identified for eastern Lake Ontario and the St. Lawrence River, including some historical sites; the protection and management of these areas is considered essential to future recovery (St. Lawrence Bald Eagle Working Group 2006).

There is a well-established management program for the Bald Eagle in Ontario, with policy and planning guidance for forest management planning, municipal planning and renewable energy. Guidance documents include the Bald Eagle habitat management guidelines (OMNR 1987), more recent habitat management guidance in the Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales (OMNR 2010a, 2010b), wind power project guidance (OMNR 2011), and the Significant Wildlife Habitat Technical Guide to identify significant habitat for input to municipal and renewable energy planning (OMNR 2000). The most recent habitat management guidance in place for Bald Eagles has reduced the size of the AOC surrounding the nest to 200-400 m (OMNR 2010b). This direction has not been tested in Ontario, and the question of whether seasonal restrictions on forest management operations around occupied bird nests will result in reproductive output comparable to nests in undisturbed situations has been identified as a high priority within OMNRFs effectiveness monitoring program (OMNR 2010b). It is also important to determine if generational habituation will occur in future (Guinn 2013), which may lead to less restrictive habitat guidance in future. Similarly, the 120 m setback recommended for wind energy projects adjacent to significant Bald Eagle habitat (i.e. 120 m in addition to the 400-800 m AOC) (OMNR 2011) has not been empirically tested to determine its effectiveness to mitigate disturbance effects.

Bald Eagle winter roosting and feeding habitats are important habitat values that can be identified in Ontario as Significant Wildlife Habitat (i.e. seasonal concentration areas) for planning purposes (OMNR 2000). Considerable effort has been taken to manage Bald Eagle overwintering habitat within specific urban communities in southern Ontario (e.g. MacKinnon et al. 2007, Bricker and Hoar 2010). There is little general or broad direction on how to manage these habitat attributes. While the development of site-specific management guidance allows for the tailoring of recommendations specific to an individual site, broader habitat management approaches could be applied to a number of overwintering areas. As an example, Steenhof (1978) identified a number of recommendations to manage Bald Eagle overwinter habitat in earlier guidance developed for the USFWS.

While it is important to protect currently used Bald Eagle habitat, Bowerman et al. (2005) and the St. Lawrence Bald Eagle Working Group (2006, 2008) highlighted the importance of also identifying and protecting historic but currently unoccupied nesting habitat to allow for continued population recovery and recolonization. This is especially important in southern Ontario where habitat is limited and recovery is not yet complete. Bald Eagles in the Lake Erie region have returned to historical nesting trees that had been unoccupied for decades (St. Lawrence Bald Eagle Working Group 2006 and 2008).

A recently enacted regulation (OR 171/13) under the FWCA (Government of Ontario 2013b) provides for exemptions from the provision of the act that prohibits the destruction, taking or possession of nests of eggs of a bird (Government of Ontario 2012). One of these exempted activities, for the maintenance of an electricity transmission line, distribution line, or broadcast tower where there is a risk to function, has no corresponding regulatory approval. With no reporting mechanism in place, this means that there is no means to monitor and evaluate the degree or significance of any nest removal activities that may occur.

3. Maintain continued high adult survival of Bald Eagles.

Given the importance of high adult survival to continued Bald Eagle population health, it is important that measures be in place to mitigate any human-caused adult mortality. Protection measures for Bald Eagles in Ontario are already in place, and these should be maintained and enforced.

There are a number of pollution and disease threats which appear to be affecting Bald Eagles at low numbers in Ontario, and although populations are recovering the species remains sensitive to existing and emerging chemical contaminants, particularly in the Great Lakes. Much has been learned from the collection and tissue analysis of Bald Eagles that have died. An ongoing monitoring program is essential in order to detect any changes that might develop in levels of these threats or their impacts on Bald Eagles, and to respond quickly with mitigative action. Chemical contaminants were actively being monitored as part of the Southern Ontario Bald Eagle Monitoring Program, but this program is no longer active. A collaborative contaminant monitoring protocol should outline including collection procedures, responsibilities, and central database input and maintenance.

There are several forms of incidental mortality which may each have a minor impact on Bald Eagle populations, but which can be reduced through education and voluntary measures. Effective voluntary measures can be implemented to reduce the risk of lead contamination from hunter-killed game, secondary poisoning from pentobarbital, and some other threats.

There is limited awareness of the potential impacts of lead ammunition from big game hunting on birds of prey that scavenge carcasses and offal from hunter kills, and hunters could readily be made more aware of this threat and voluntary measures which they could undertake to lessen its impact. Four “very achievable steps” which could be implemented with moderate impact and no regulatory requirements have been proposed in one USA jurisdiction: (i) voluntary lead reduction by hunters, (ii) public education and information, (iii) research and diagnostics and (iv) surveillance and reporting (Wildlife Center of Virginia 2014). Non-lead ammunition provides a straightforward and easy solution to toxic lead exposure in wildlife from rifle ammunition, and many hunters will undertake this conversion voluntarily (Bedrosian et al. 2012). In the Wyoming study, 24 and 31 percent of hunters voluntarily switched to lead-free ammunition in the first and second year respectively, with hunter education and incentives (Bedrosian et al. 2012). Extensive public information and the early involvement of all relevant stakeholders in discussions and potential solutions are critical to the success of programs aimed at reducing lead poisoning in wildlife through the reduced use of lead ammunition (Krone et al. 2009).

The secondary poisoning of Bald Eagles by sodium pentobarbital is a rare form of incidental mortality that is completely preventable with appropriate veterinary practices related to carcass disposal methods.

Incidental trapping mortality is also a rare but unquantified form of incidental mortality, and existing trapper education messages are available that can be re-circulated and re-emphasized within the trapping community. It would be beneficial to have a better understanding of the level of incidental trapping mortality that currently occurs through some form of reporting.

5.0 GLOSSARY

Area of Concern (AOC): A forest management planning designation that delineates a geographic area associated with an identified natural resource feature value within which a natural resource management prescription will be identified to manage and conserve that value.

Bioaccumulate (Bioaccumulation): Process by which chemicals are taken up by exposure or consumption, and build up in an organism at a greater rate than that at which they are lost.

Biomagnify (Biomagnification): Process by which the concentration of chemicals in an organism at one trophic level is greater than those at the next lower trophic level of the food chain.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC): The committee established under section 14 of the Species at Risk Act that is responsible for assessing and classifying species at risk in Canada.

Committee on the Status of Species at Risk in Ontario (COSSARO): The committee established under section 3 of the *Endangered Species Act*, 2007 that is responsible for assessing and classifying species at risk in Ontario.

Conservation status rank: A rank assigned to a species or ecological community that primarily conveys the degree of rarity of the species or community at the global (G), national (N) or subnational (S) level. These ranks, termed G-rank, N-rank and S-rank, are not legal designations. A breeding status qualifier is used where species have distinct breeding and nonbreeding populations within the jurisdiction, and is denoted by the suffix B (referring to the breeding population) or N (referring to the nonbreeding population). The conservation status of a species or ecosystem is designated by a number from 1 to 5, preceded by the letter G, N or S reflecting the appropriate geographic scale of the assessment. The numbers mean the following:

1 = critically imperiled
2 = imperiled
3 = vulnerable
4 = apparently secure
5 = secure.

DDE: Dichloro-diphenyl-dichloroethylene. A breakdown product of DDT.

DDT: Dichloro-diphenyl-tricholorethane. An organochlorine pesticide developed and used in the mid- 20th century to control insects, which biomagnifies in fatty tissue and has harmful human and environmental effects.

Endangered Species Act, 2007 (ESA): The provincial legislation that provides protection to species at risk in Ontario.

Fish and Wildlife Conservation Act, 1997 (FWCA): The provincial legislation that regulates fishing, hunting and trapping in Ontario, as well as providing protection for wildlife species under provincial jurisdiction.

Fledge (Fledging): When a young bird leaves the nest and begins flying

Fledgling: A young bird that has recently left the nest and begun flying.

Kleptoparasite (kleptoparasitism): Animals that take food resources from other animals, of the same or a different species, rather than capturing food on their own.

Natal Territory: Territory in which a young bird was hatched and reared

Offal: The entrails and internal organs or viscera from a butchered or field-dressed animal.

Oligotrophic Lake: A deep, clear lake with high oxygen content, low productivity, low nutrient levels and little organic matter.

Organochlorine: A carbon-based compound containing chlorine, often a pesticide, that has significant negative human and environmental health impacts.

Overwintering: The process that occurs when a species spends the winter in a local area or jurisdiction rather than migrating away.

PBDEs: Polybrominated diphenyl ethers. A “group of chemicals that are used as flame retardants in a variety of polymer resins and plastics… They are harmful to the environment, build up in living organisms, and last a long time in the environment” (Environment Canada 2013, pp. 1-2).

PCBs: Polychlorinated biphenyls. A toxic and persistent industrial chlorinated hydrocarbon that was chemically inert and stable when heated, and which was used in a number of industrial and commercial applications such as electrical transformers and capacitors for insulating purposes, and in gas pipeline systems as a lubricant (Friend and Franson 1999).

Population Sink: A population where mortality exceeds local productivity and the population is not viable in the absence of continued immigration.

Productivity: Reproductive success of a population, usually expressed for birds as the average number of young that successfully fledged from active nests

Recruitment: The successful breeding of organisms leading to an addition of organisms to the population.

Sentinel Species (Indicator Species): A species whose presence, absence or general state of being can provide an indication of the quality of environmental health.

Species at Risk Act (SARA): The federal legislation that provides protection to species at risk in Canada. This act establishes Schedule 1 as the legal list of wildlife species at risk. Schedules 2 and 3 contain lists of species that at the time the Act came into force needed to be reassessed. After species on Schedule 2 and 3 are reassessed and found to be at risk, they undergo the SARA listing process to be included in Schedule 1.

Species at Risk in Ontario (SARO) List: The regulation made under section 7 of the *Endangered Species Act*, 2007 that provides the official status classification of species at risk in Ontario. This list was first published in 2004 as a policy and became a regulation in 2008.

Stopover Habitat: Areas that are temporarily used by migrating wildlife for shelter, rest or food while en route to their destination.

Supercanopy Trees: Trees that are higher than most trees in the forest, extending above the forest canopy and thus open and accessible.

Supernumerary Nests: Additional nest sites within a territory beyond the one being actively used. While only one nest site is used in any one year, supernumerary or alternate nests may be used in other years.

Territory: An area defended by a pair of breeding Bald Eagles that contains an active nest site and is used for nesting. A territory typically contains suitable trees for nesting and suitable foraging habitat.

Translocation (Translocate): The intentional movement of organisms from one location to another with the intention of augmenting or re-establishing a population in a new location.

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6.2 Authorities Consulted

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