

## INDICATOR: BALD EAGLE REPRODUCTIVE SUCCESS

### Background

Bald eagles (*Haliaeetus leucocephalus*) are large fish-eating raptors, averaging 4.5-6.4 kg (10-14 lbs) for females and 3.6-4.1 kg (8-9 lbs) for males, with an approximate 2.1 meter (seven-foot) wingspan. They are classified and protected as provincially endangered in southern Ontario, state endangered in Ohio, and state threatened in Michigan. Recently (June 28, 2007) the bald eagle was removed from the federal list of threatened and endangered species in the U.S. The bald eagle continues to be federally protected in the U.S. under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. The species has been identified as an indicator of aquatic ecosystem health in the Lake Erie Lakewide Management Plan and is under review for indicator status by the State of the Lakes Ecosystem Conference (Environment Canada and the U.S. Environmental Protection Agency 2003).

Bald eagles were documented in the early 1900s as being “evenly distributed” throughout Michigan. The population then declined through the mid-1900s due to loss of nesting habitat and persecution by humans (shooting, poisoning, trapping and electrocution). In the 1950s, the decline of eagles in Michigan accelerated until they were on the brink of extinction in the 1970s. This trend was similar throughout the lower 48 states and southern Canada. This decrease was a result of several factors, most influential being the increasing widespread use of organochlorine compounds such as DDT and PCBs following World War II (Colborn 1991; Bowerman et al. 1995; Bowerman et al. 1998; Bowerman et al. 2003). Exposure to these contaminants in avian species can cause effects in early developmental stages, including embryonic mortality, egg shell thinning, wasting syndrome in hatchlings, and life-threatening deformities such as crossed bills and embryonic edema to the head and neck. Several of these effects are considered the Great Lakes embryo mortality, edema, and deformities syndrome (GLEMEDS) found in colonial fish-eating birds (Gilbertson et al. 1991). Post-fledging effects may manifest as sterility, altered behaviors such as impaired foraging abilities, and increased susceptibility to disease through immune system dysfunction. Death can also result from acute poisoning.

Reproductive impairments were greatly evident in the mid-1970s and early 1980s, when bald eagles nesting along the Lake Erie shoreline experienced near complete reproductive failure. The foundation for the recovery of the species in the U.S. and throughout North America was initiated in 1972 with the banning of DDT usage in the U.S. by the U.S. Environmental Protection Agency, and in 1973 with the passage of the Endangered Species Act and its implementation by the U.S. Fish and Wildlife Service. In 1973, the bald eagle was declared an endangered species in Ontario. With these protections and ensuing management, the bald eagle population along the Detroit River and Lake Erie shoreline has shown continual growth and improvement in reproductive performance.

### *Geographic Area of Coverage*

For the purpose of this indicator report, the geographic area of coverage includes the Detroit River corridor and the western basin of Lake Erie, extending on the north shore to Point Pelee, Ontario, on the south shore to Vermillion, Ohio, and including all islands within the western basin (Figure 1). The results of long-term reproductive monitoring are summarized below for all bald eagles nesting within 8 km (5 miles) of all shorelines and embayments within this geographic area. It does not include eagles nesting greater than 8 km (5 miles) from the shorelines, where exposure to Great Lakes contaminants occurs through their being situated along water courses that support spawning runs of Great Lakes fishes.

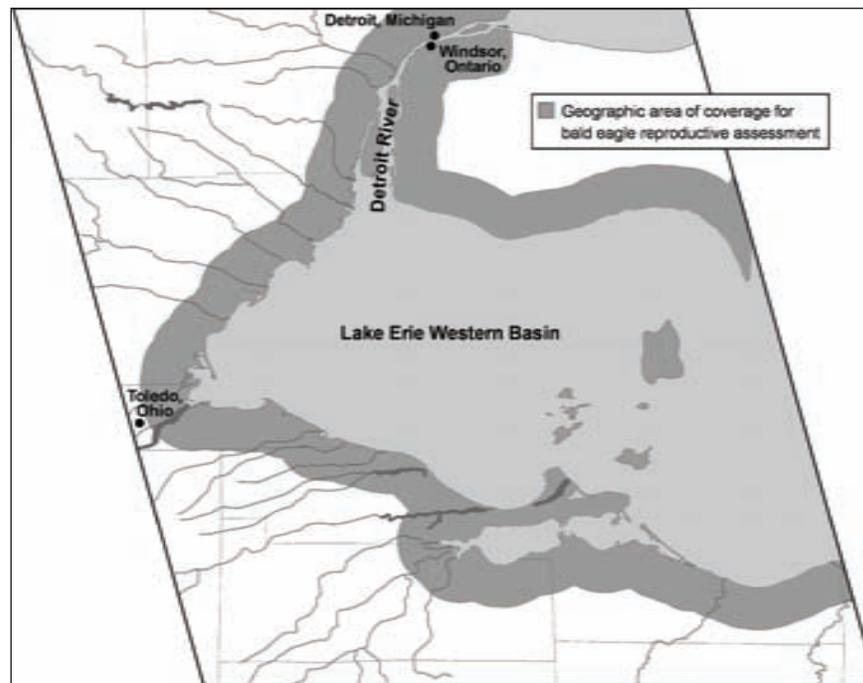


Figure 1. Geographic area of coverage for bald eagle reproductive assessment.

### *Nomenclature*

For the purpose of this report, a breeding area is the territory maintained by a pair of adult eagles during the breeding season, and contains one or more alternative nests. A breeding area is deemed occupied when behaviors and/or activities associated with reproduction are observed. These observations may include the presence of fresh lining in a nest, the construction of a new nest, the detection of eggs, incubation, or young, the observation of courtship flights or copulation, or the presence of two adults in close proximity to a nest. A breeding area is deemed inactive if no signs of reproductive efforts are noted, despite the presence of one or two adults in the general area. A successful breeding area is one that is known or suspected to have fledged one or more eaglets.

### **Status and Trends**

Bird Studies Canada (BSC), in partnership with the Ontario Ministry of Natural Resources and Canadian Wildlife Service, coordinates a research and monitoring program in southern Ontario which monitors the health of the southern Ontario bald eagle population. The status and productivity of every bald eagle nest on the north shores

of Lakes Erie, Ontario, and Huron are monitored annually using a network of volunteer nest monitors and landowners. While most nests are monitored from the ground, special aerial surveys occasionally have been conducted in Essex County to assess nests that are difficult to view from the ground. Presently, nests are accessed every five years to obtain blood and feather samples.

In Michigan, the Michigan Departments of Natural Resources and Environmental Quality and the U.S. Fish and Wildlife Service coordinate a monitoring program aimed at assessing the health of bald eagles. In Ohio, the Ohio Department of Natural Resources conducts annual reproductive assessments of bald eagles. Data are compiled from a combination of fixed-wing aircraft and helicopter surveys, and citizen reports.

The data collected by these monitoring programs show that the number of occupied breeding areas in southern Ontario, Ohio, and Michigan within 8 km (5 miles) of the Detroit River and western Lake Erie basin has increased over the last two decades (Figure 2). The increase has been most apparent in Ohio, where the number of occupied breeding areas has increased from zero in 1974 to 44 in 2006. Increases in occupation have also occurred in Michigan and Ontario, but to a lesser extent. The Sandusky Bay area in Ohio served as an eagle “refugia” in the lower Great Lakes during the 1970s, and thus helped fuel the later reoccupation and expansion of the shorelines in these other areas.

From 1961 to 1987 there were no bald eaglets produced in Michigan primarily due to the absence of breeding pairs (Figure 3). Since the mid-1980s, there has been a steady increase in the number of fledgling bald eaglets throughout the geographic area of coverage, with Ohio fledging over 60 young in 2006. The fledging of eaglets in Michigan and Ontario has also increased, but to a lesser extent than in Ohio, and appears to have leveled off.

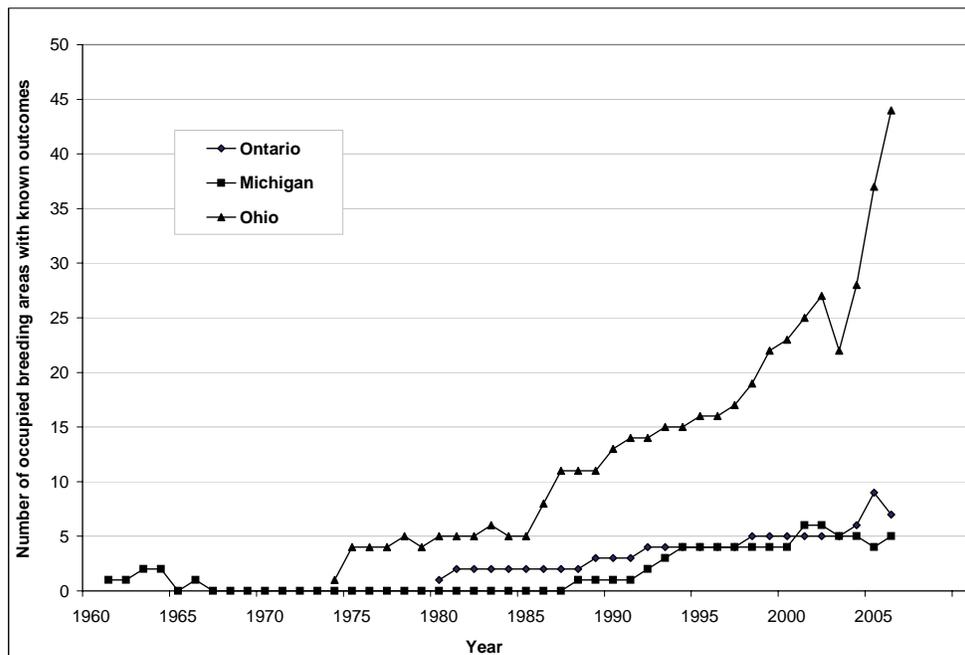


Figure 2. The number of occupied bald eagle breeding areas within 8 km (5 miles) of the Detroit River and western basin of Lake Erie, 1961-2006 (data collected by Bird Studies Canada, U.S. Fish and Wildlife Service, Michigan Departments of Natural Resources and Environmental Quality, and Ohio Department of Natural Resources; data compiled by D. Best, U.S. Fish and Wildlife Service).

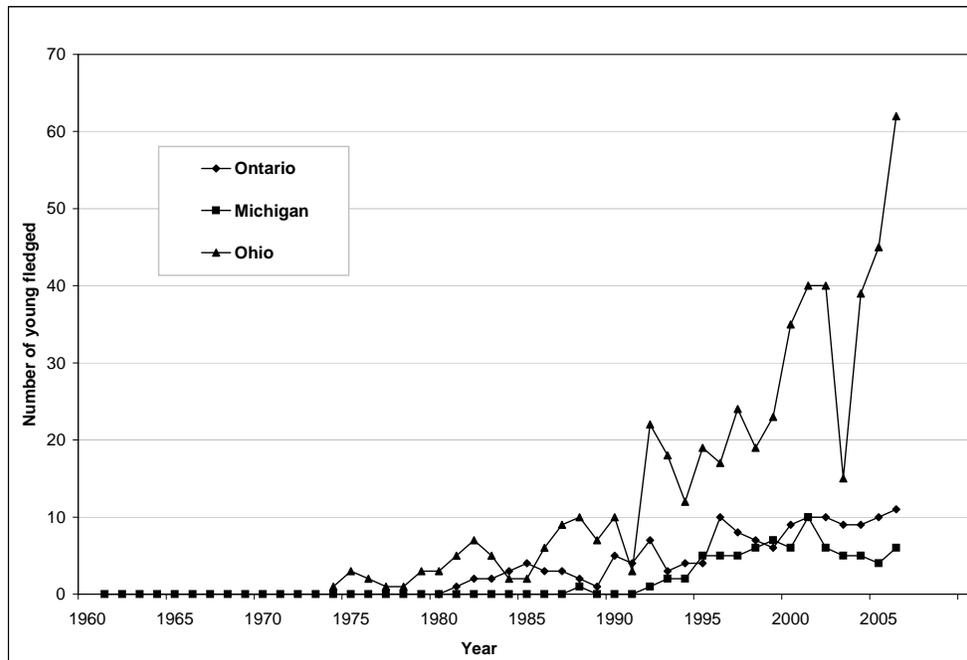


Figure 3. The number of eaglets fledged within 8 km (5 miles) of the Detroit River and western basin of Lake Erie, 1961-2006 (data collected by Bird Studies Canada, U.S. Fish and Wildlife Service, Michigan Departments of Natural Resources and Environmental Quality, and Ohio Department of Natural Resources; data compiled by D. Best, U.S. Fish and Wildlife Service).

In 2004, there were six occupied breeding areas in the geographic area of coverage in Ontario. This included four bald eagle nests found on the Canadian side of the Detroit River and an additional two nests along the north shore of the western basin of Lake Erie (i.e., Essex County). Two of these nests have been active since the early 1980s and two have been active since the early 1990s (Laing and Badzinski 2006). In 2005, the number of occupied breeding areas in the area of coverage rose to ten.

While these trends are suggestive of an improving situation, they can be misleading since they do not measure actual reproductive rates of performance. For a long-lived species like the bald eagle, repeated failures over time may not result in the abandonment of breeding areas. In addition, if the number of breeding areas over a period of time is growing faster than the number of eaglets fledged, then the rate of fledging young per nesting effort is actually declining. Therefore, true measures of reproductive performance need to be calculated from three monitoring outcomes: the number of occupied breeding areas, the number of eaglets fledged, and the number of successful breeding areas.

Within the geographic area of coverage, the number of eaglets fledged per occupied breeding area has increased over time (Figure 4) with Michigan lagging slightly behind Ontario and Ohio. For purposes of comparison, Sprunt et al. (1973) considered a rate of reproduction equal to 0.7 young fledged per occupied breeding area as representing a stable population. As a population exhibits increasing rates of reproduction above this level, the population will show expansion and improved health. The U.S. recovery goal for the northern states geographic area is 1.0 young fledged per occupied breeding area (Grier et al. 1983) and is generally considered to represent a healthy expanding population. Whereas eagles once reproduced poorly within the area of coverage, they now seem to be reproducing at healthy levels and promoting further expansion.

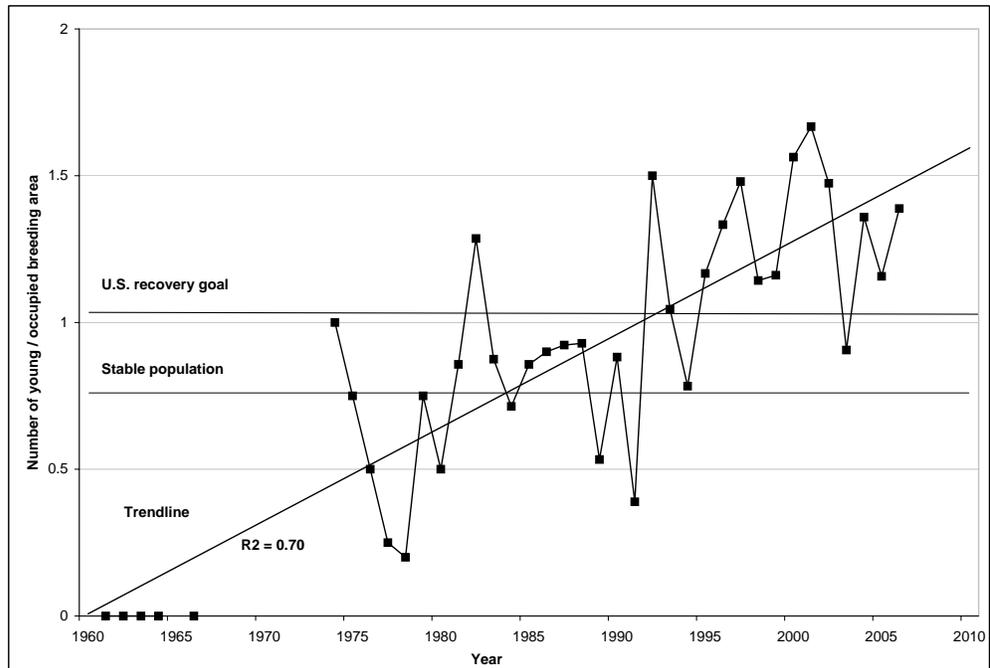


Figure 4. The number of eaglets fledged per occupied breeding area within 8 km (5 miles) of the Detroit River and western basin of Lake Erie, 1961-2006 (data collected by Bird Studies Canada, U.S. Fish and Wildlife Service, Michigan Departments of Natural Resources and Environmental Quality, and Ohio Department of Natural Resources; data compiled by D. Best, U.S. Fish and Wildlife Service).

Similar trends are exhibited by eagles within the geographic area of coverage in the number of eaglets fledged per successful breeding area, i.e., brood size (Figure 5) and in the success rate of occupied breeding areas (Figure 6). Sprunt et al. (1973) considered a success rate of 50% as representing a stable population.

Eagles within the area of coverage have exceeded this success rate for the past 12 years. All three measures of reproduction show considerable year-to-year variability, which may be attributable to differences in winter/spring weather, storm events, prey abundance and availability, human recreational activities, and other episodic factors.

The increase in the bald eagle reproductive parameters and the concurrent decline of organochlorine contaminants suggest the population is recovering in many parts of the lower Great Lakes (Bowerman et al. 2002). While the reoccupation of breeding habitat by bald eagles and the improved reproductive performance along the western basin of Lake Erie and the Detroit River corridor are positive signs, there are several factors which may confound the true situation. Since the mid-1980s, a large number of uncontaminated eaglets have been introduced to the Lake Erie watershed through hacking and fostering projects in both Ontario and Ohio. The apparent increase in nesting success in the period that followed may be associated more with the sexual maturation of this relatively clean, introduced cohort than with the eaglets locally reared and exposed to in-place contaminants.

Secondly, there are concerns about the viability and long-term stability of the bald eagle population along the Great Lakes shorelines. The large increase in the population of eagles across North America, and especially in inland areas adjacent to the Great Lakes,

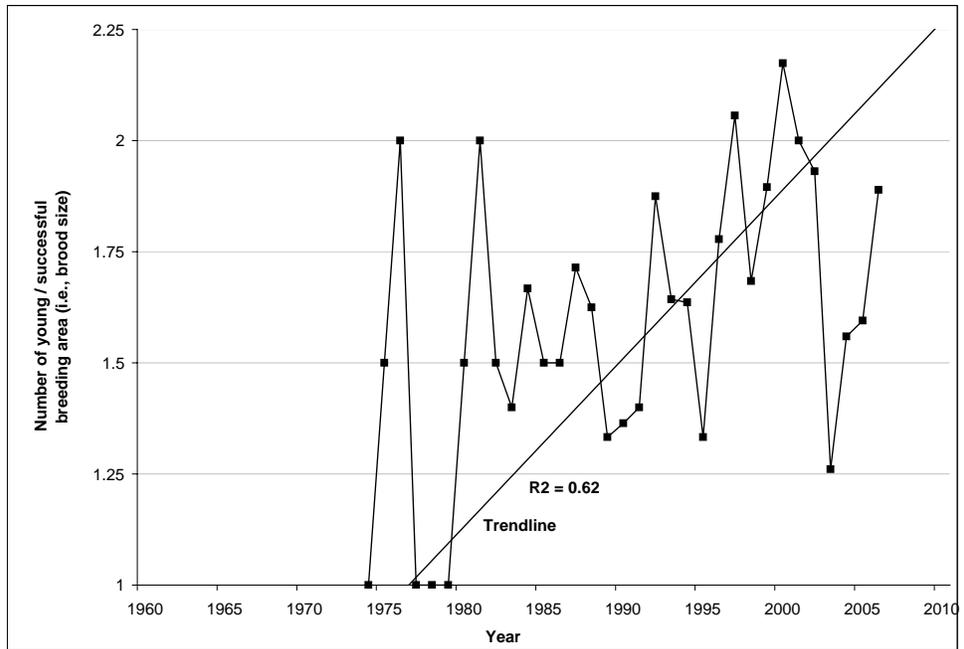


Figure 5. The number of eaglets fledged per successful breeding area, or brood size, within 8 km (5 miles) of the Detroit River and western basin of Lake Erie, 1961-2006 (data collected by Bird Studies Canada, U.S. Fish and Wildlife Service, Michigan Departments of Natural Resources and Environmental Quality, and Ohio Department of Natural Resources; data compiled by D. Best, U.S. Fish and Wildlife Service).

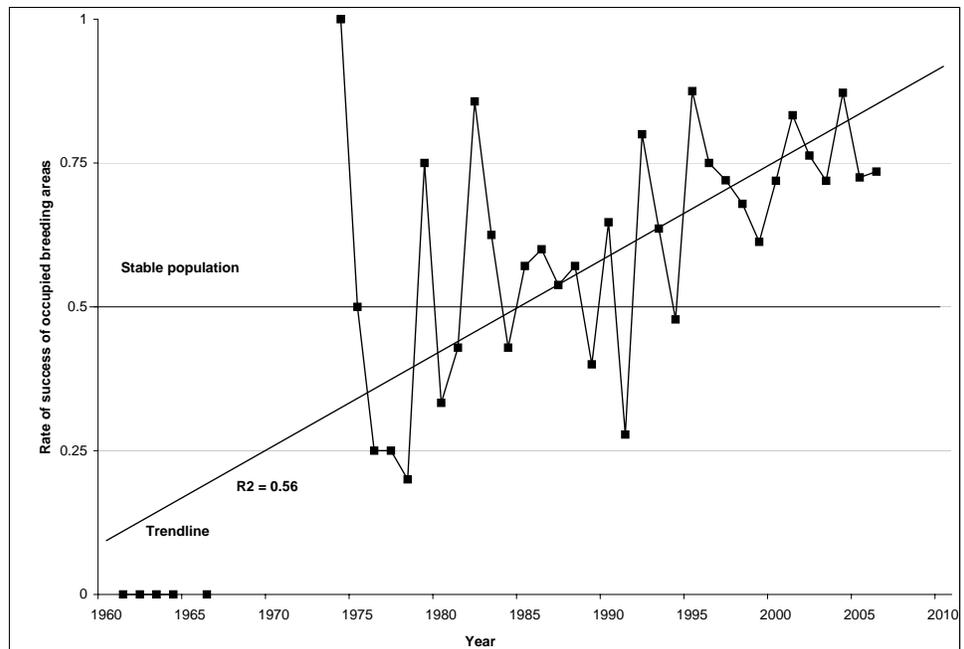


Figure 6. The rate of success of occupied breeding areas within 8 km (5 miles) of the Detroit River and western basin of Lake Erie, 1961-2006 (data collected by Bird Studies Canada, U.S. Fish and Wildlife Service, Michigan Departments of Natural Resources and Environmental Quality, and Ohio Department of Natural Resources; data compiled by D. Best, U.S. Fish and Wildlife Service).

has created a large pool of young eagles dispersing to find suitable and unclaimed nesting habitat. The possibility exists that the growth of the eagle population within the geographic area of coverage is dominated by immigration from clean, nearby inland areas. Observations of nest turnover rates, collected by volunteer nest monitors, suggest that bald eagles in southern Ontario have shortened life spans (Laing and Badzinski 2006). This is also suspected for the eagles located throughout the coastal areas of Ohio and Michigan (Grasman et al. 2000). Therefore, these shorelines may serve as a sink for excess eagles, rather than a source for expansion. In addition to these confounding factors, eagles continue to be vulnerable to human disturbance, in-place and new-generation contaminants, and ongoing habitat loss.

The potentially long life span of bald eagles and their upper trophic-level status within aquatic ecosystems make the species a good indicator of exposure to bioaccumulative contaminants. Grasman et al. (2000) suggest that reproductive impairments to bald eagles on Lake Erie continue to occur as a result of current exposure to organochlorine compounds within the aquatic ecosystem. The analysis of addled bald eagle eggs from Ontario and Ohio shows that criteria for adverse effects are consistently exceeded by total PCB and dieldrin concentrations, and often exceeded by *p,p'*-DDE concentrations. Roe (2004) found spatial differences in exposure to various organochlorine compounds in bald eaglet blood plasma, with lower concentrations detected in eaglets from Sandusky Bay than in eaglets from other areas along the Lake Erie shoreline of Ohio. Bald eaglets from Lake Erie exhibit rates of hard-tissue deformity, such as crossed bills, greatly above background levels in birds (Grasman et al. 2000). Future versions of this indicator report will present and discuss these and current exposure data in more detail relative to ecosystem health.

### **Management Next Steps**

Agencies and organizations with land management responsibilities should identify, enhance and protect bald eagle habitat where feasible within the Detroit River-Lake Erie basin. In addition, the placement of nesting platforms in suitable and secure habitat may provide stability over time to existing breeding pairs, as well as induce additional breeding pairs to establish within the river corridor. Efforts should be undertaken to identify and protect suitable nesting and foraging habitats.

Provincial, state and federal agencies should continue to place a priority on control of contaminants at the source and on the remediation of contaminated sediment “hot spots,” to ultimately ensure that contaminant levels in fish and other aquatic prey do not result in reproductive impairment of bald eagles. Further, bald eagles should continue to be protected through federal, state and provincial law enforcement efforts, in light of delisting of the species from endangered species protections as progress toward recovery continues. The species will also benefit from increased public outreach and awareness of the threats to the health of the species and the ecosystem.

### **Research/Monitoring Needs**

Grasman et al. (2000) identified the need to continue studies along Lake Erie on reproductive success, deformities, and contaminant concentrations in blood and addled eggs. Yearly monitoring of the bald eagle population for reproductive outcomes should continue throughout the Detroit River and western Lake Erie watersheds in Ontario,

Ohio, and Michigan. Eaglets should continue to be banded and have representative samples taken to monitor exposure to contaminants, so as to determine the health status of individual eagles and the ecosystems in which they reside. Contaminants of concern include organochlorine compounds and heavy metals, as well as emerging new-generation compounds. Furthermore, additional laboratory and field studies may be necessary to further clarify the role of environmental endocrine disruptors on reproduction in avian populations (Bowerman et al. 2000).

Grasman et al. (2000) identified the need for dispersal/recruitment studies along Lake Erie to address issues regarding the perceived high turnover rate of adult eagles, the survival and reproductive success of eagles exposed to developmental toxins, and the rates of immigration from inland to shoreline areas. In 2004, BSC in partnership with the Ontario Ministry of Natural Resources and Canadian Wildlife Service launched a new program called *Destination Eagle* to address the question of where juvenile eagles are becoming exposed to heavy metals. This was based on elevated levels of mercury and lead detected in tissues derived from necropsied eagles from southern Ontario. This program uses satellite telemetry to follow the movements of juvenile eagles for a five-year period. The goal is to identify areas where juvenile birds fledged from southern Ontario nests are spending the majority of their time, and perhaps becoming exposed to harmful contaminants. Between 2004 and 2006, a total of ten nestling bald eagles have been equipped with satellite telemetry. However, only three of these eaglets were fledged from within the geographic area of coverage. Preliminary results have shown that fledgling eaglets often wander great distances, but have used coastal marshes and embayments within the geographic area of coverage. This project aims to reveal important information on the movements of juvenile eagles and to increase public awareness of the importance of aquatic ecosystem health (Laing and Badzinski 2006).

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#### Links for More Information

Bird Studies Canada: <http://www.bsc-eoc.org/regional/ondesteagle.html>

U.S. Fish and Wildlife Service: [http://ecos.fws.gov/species\\_profile/servlet/gov.doi.species\\_profile.servlets.SpeciesProfile?spcode=B008](http://ecos.fws.gov/species_profile/servlet/gov.doi.species_profile.servlets.SpeciesProfile?spcode=B008)

Michigan Department of Natural Resources: <http://www.michigan.gov/dnr/0,1607,7-153-10319-32581~,00.html>

Ohio Department of Natural Resources: <http://www.dnr.state.oh.us/wildlife/Resources/Eagle/default.htm>

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