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Great Lakes Science Advisory Board. Ecological Committee. Biological Effects Subcommittee

David A. Best

Michael Gilbertson

Holly Hudson

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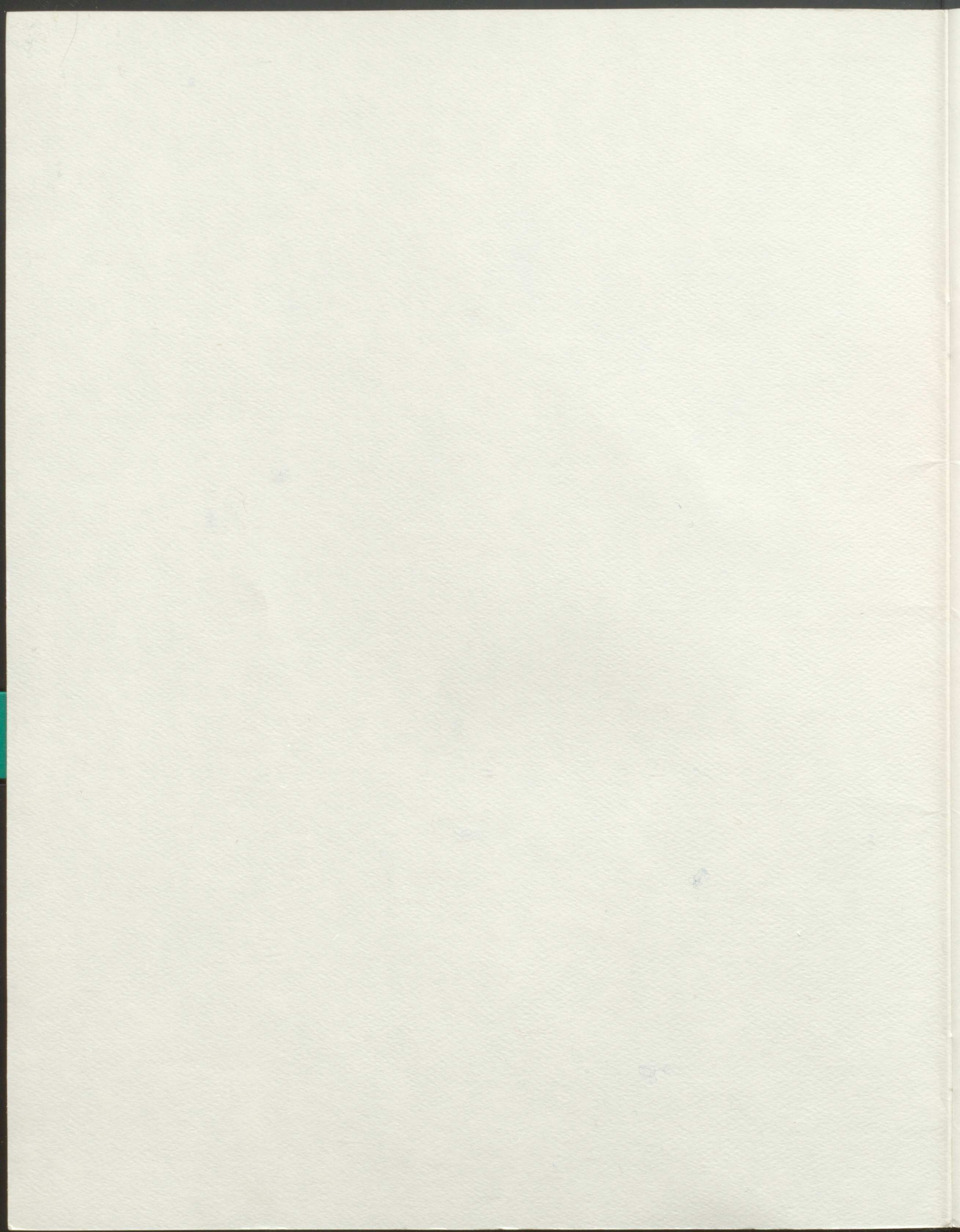
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Great Lakes Science Advisory Board's Ecological Committee

Report to the International Joint Commission

**Proceedings of the
Expert Consultation Meeting
on Bald Eagles**



**Proceedings of the
Expert Consultation Meeting
on Bald Eagles**

Edited by

**David A. Best
Michael Gilbertson
Holly Hudson**

February 12 and 13, 1990

**International Joint Commission
Great Lakes Regional Office
Windsor, Ontario**

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This report to the Chairpersons of the Science Advisory Board and the International Joint Commission was carried out as part of the activities of the Ecological Committee's Biological Effects Subcommittee. While the Commission supported this work, the specific conclusions and recommendations do not necessarily represent the views of the International Joint Commission, the Science Advisory Board or its committees.

Edited by

David A. Best
Michael Gilbertson
Holly Hudson

February 12 and 13, 1990

International Joint Commission
Great Lakes Regional Office
Windsor, Ontario

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International Joint Commission

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Two additional meetings have been held subsequent to the February workshop. These meetings discussed the standardization of research methods and reporting, and the development of appropriate legislation for all concerned agencies. Future research needs such as the development of habitat suitability indices (HSIs) that quantify the attributes of habitat for eagles were also discussed.

The future looks promising as bald eagle numbers continue to increase in the United States and Canada, but continued protection and management is needed to successfully maintain these recovering populations. A coordinated effort will help facilitate this goal.

In order to evaluate the effectiveness of the remedial programs on the Great Lakes, the participants of this meeting were asked to address the following questions. The results of which are listed in section 6.1.

QUESTION 1 Is sufficient information known about the status of the bald eagle population in the Great Lakes basin to make it a useful indicator?

QUESTION 2 Will designating the bald eagle as an endangered species justify the benefits of reestablishing survivors of the Great Lakes bald eagle population?

QUESTION 3 Is sufficient information known about the factors affecting the status of the Great Lakes bald eagle population to make it a suitable indicator of water quality improvement?

QUESTION 4 Are the various laws in the United States and Canada sufficiently enforced to reestablish the bald eagle in the Great Lakes basin?

QUESTION 5 Are existing techniques an effective way of reestablishing bald eagles in the Great Lakes basin?

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1.0 INTRODUCTION

The Biological Effects Subcommittee of the Science Advisory Board's Ecological Committee held a workshop February 12 and 13, 1990, to discuss the status of the bald eagle in the Great Lakes basin. The eagle has suffered past population declines due to habitat degradation by persistent toxic chemicals as well as habitat destruction by agriculture, logging and development.

The bald eagle has been proposed as an ecosystem indicator that would reflect the suitability of the Great Lakes to support a diversity of life. Because eagles integrate many habitat components, all of which must be suitable for sustained survival, the eagles reproductive success mirrors the health of the Great Lakes Basin Ecosystem.

Two additional meetings have been held subsequent to the February workshop. These meetings discussed the standardization of research methods and reporting, and the creation of an accessible database for all concerned agencies. Future research needs such as the creation of habitat suitability indices (HSIs) that quantify the attributes of habitat for eagles were also discussed.

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- QUESTION 1 Is sufficient information known about the status of the bald eagle in the Great Lakes basin to make it a useful indicator?
- QUESTION 2 Will delisting the bald eagle as an endangered species jeopardize funding for undertaking surveys of the Great Lakes bald eagle population?
- QUESTION 3 Is sufficient information known about the factors affecting the status of the Great Lakes bald eagle population to make it a reliable indicator of water quality improvement?
- QUESTION 4 Are the various laws in the United States and Canada sufficiently forceful to rehabilitate the bald eagle in the Great Lakes basin?
- QUESTION 5 Are hacking techniques an effective way of reestablishing bald eagles in the Great Lakes basin?
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- QUESTION 5: Are existing techniques an effective way of rehabilitating bald eagles in the Great Lakes basin?

2.0 PRESENT STATUS OF BALD EAGLES IN THE GREAT LAKES BASIN

2.1 PRODUCTIVITY, DIET AND ENVIRONMENTAL CONTAMINATION IN BALD EAGLES NESTING NEAR LAKE SUPERIOR

Karen Kozie

**formerly with Chippewa National Forest, Black Duck, Minnesota
presently with U.S. Fish and Wildlife Service, East Lansing, Michigan**

Bald eagles nesting along the Wisconsin shoreline of Lake Superior produced an average of 0.8 young-per-occupied-nest and had an average nest success of 57% during 1983-1988. Comparatively, eagles nesting in inland Wisconsin produced 1.3 young-per-occupied-nest and had 77% nest success for the same period.

High mortality rates occurred among Lake Superior nestlings in 1984 and 1985, 36% and 25%, respectively, compared to 4% inland. Contaminant levels in nestling eagle carcasses from nests near Lake Superior were higher than those collected inland, suggesting local contamination. Preliminary observations indicate there may also be a high turnover among breeding adults and that increased production among Lake Superior nests may be due to a younger breeding population, with low contaminant levels, dispersing from the inland population. Production rates alone may prove ineffective in determining population stability if survival rates are low.

Prey remains from nests near Lake Superior consisted of fish (50%), birds -- primarily herring gulls (48.4%) and mammals (1.2%), with Lake Superior eagles eating a higher percentage of birds than inland eagles (48% compared to 6%). DDE levels in fish were $X=0.07 \mu\text{g/g}$ and PCBs were $X=0.21 \mu\text{g/g}$ (wet weight). Herring gulls contained higher concentrations of DDE ($X=5.5 \mu\text{g/g}$) and PCBs ($X=16.95 \mu\text{g/g}$ wet weight), suggesting the consumption of herring gulls by Lake Superior eagles may be a causal factor in the lower productivity of this population.

2.2 POPULATION STATUS OF BALD EAGLES IN MINNESOTA

Jack J. Mooty

Minnesota Department of Natural Resources, Grand Rapids, Minnesota

The eagle population has staged a comeback in Minnesota from 115 occupied breeding territories in 1973 to 400 such areas in 1989. Productivity during this same time has averaged 1.2 young per occupied breeding area. Currently there are no known territories on the Lake Superior shoreline of Minnesota. Some of the eagles in Minnesota are year-round residents, able to survive the winter by locating near open-water areas near power plants, and along the Mississippi River in southeastern Minnesota.

Management plans are prepared for all known nesting areas in the state. Nest trees are buffered by three zones: the first, extending to 330 feet prohibits activity of any sort during the breeding season and no habitat changes are allowed; the second (to 660 feet) prohibits land use resulting in significant landscape changes such as clearcutting or construction, and the third (to 1,320 feet) allows clearcutting and construction from October 1 to February 15. Alternate nest trees and hazards to eagles are identified and included in the plan. Private landowners within the management zone are contacted and asked to cooperate in protecting nesting bald eagles. Minnesota provides five eaglets annually for translocation to other states.

2.3 BALD EAGLE REHABILITATION PROJECT: MINISTRY OF NATURAL RESOURCES, SOUTHWEST REGION

Pud Hunter

Ontario Ministry of Natural Resources, Aylmer, Ontario

Ontario's southwestern Bald Eagle Rehabilitation Project began in 1983 after nesting had decreased to a historic low in 1980 of two active nest sites with zero production; and, mid-winter bald eagle survey sightings in the Region's Aylmer district had declined to zero. Public support has a significant role in this project. Through the Ministry of Natural Resources (MNRs) Community Wildlife Involvement Program's partnership in resource management mandate, the public voluntarily participates in the project's components of monitoring, mitigation, enhancement, education, and research. Landowners with nests on their property are encouraged to create management plans to protect the eagles and allow them to proceed with normal activities. Local citizens and bird watchers record the activities and needs of the eagles. Research includes the banding and measuring of nestlings, the collection of prey remains and addled eggs from the nest and the retrieval of injured or dead eagle as found by the public sector. These samples are cooperatively analyzed by such agencies as the Royal Ontario Museum in Toronto, the Great Lakes Institute at the University of Windsor, eagle researchers from the United States and Ontario's Ministry of Agriculture and Food in Guelph. MNR also assisted the Canadian Wildlife Service between 1983-1987 with a hacking program. This program successfully released 28 eaglets over the five year period. By 1989, MNRs rehabilitation project has resulted in a fragile eagle repopulation in southwest Ontario as evidenced by an increase to eight active nest sites producing an average five young per year and an increase to 10 bald eagles observed in Aylmer district's mid-winter survey.

2.4 STATUS OF THE BALD EAGLE IN THE NATIONAL FOREST EASTERN REGION

Bob Radtke

retired, U.S. Forest Service, Milwaukee, Wisconsin

The Eastern Region of the National Forest system has shown considerable success toward the recovery of the bald eagle over the past 27 years. Numbers have increased from 64 occupied nests with an average 0.87 young fledged per-occupied-nest in 1964 to 295 nests with an average 1.1 young-per-occupied-nest in 1988.

Trends within individual forests differ with Hiawatha National Forest on the low end showing 11 occupied nests, 0.27 young-per-occupied-nest, and an 18% success rate. The Chequamegon and Nicolet Forests in Wisconsin, on the other hand are at near maximum production with 88 and 86% success rates and 1.3 and 1.48 young-per-occupied-nest respectively. Each forest, and the Eastern Region in turn have set recovery goals; so far the region has met 69% of its goal of 427 occupied nests. Chippewa National Forest has attained 90% of its recovery goal with 135 nests (recovery goal of 150).

Much of this attainment can be attributed to reduction in toxic chemicals as well as successful management plans. These plans provide boundary protection for individual nests and selection of suitable trees for future nests.

As a cautionary note, National Forests adjacent to the Great Lakes, i.e. Hiawatha National Forest, show low productivity as a likely result of toxic chemicals in the prey base.

2.5 BALD EAGLE RESEARCH: FLEDGLING HABITAT USE

Mark Shieldcastle

Ohio Department of Natural Resources, Oak Harbor, Ohio

Ohio bald eagle populations hit an all time low in 1979 with only four breeding pairs in the state. The Bald Eagle Restoration Program established in that same year, called for a recovery goal of 20 pairs. In 1989 the number of breeding pairs had risen to 12, a 60% attainment.

The program focuses on four components: education, rehabilitation, fostering, and artificial nest bases. Of these, fostering has had the greatest impact, with success rates of 100%. Many pairs not able to hatch eggs still make good parents.

With the stabilization of the population, attention is now being focused on use of habitat by fledglings. Where do eagles go once they leave the nest and before they reach maturity? The results of radio tracking and reported sightings of banded birds are disconcerting. No eagles were seen at rivers with marinas and heavy boating traffic despite these areas having excellent food sources. Juvenile birds are less able to adapt to disturbances and may become emaciated if not able to access feeding areas. Landsat photographs of wetlands are being overlaid with areas of fledgling and human use to identify areas of possible conflict. This data will aid management plans and legislation to protect critical habitat.

2.8 BALTIC SEA RESEARCH IN ESTONIA AND HANOVER
WIKER TRAVELING SOCIETY JOURNAL OF TRAVELERS
Mark Shindler

Ohio Department of Natural Resources, Oak Harbor, Ohio

During the past few years, a number of studies have been conducted in the Baltic Sea region. The purpose of these studies was to determine the distribution and abundance of various species of fish and other aquatic organisms. The results of these studies have shown that the Baltic Sea is a rich and diverse ecosystem. The fish and other aquatic organisms found in the Baltic Sea are similar to those found in other large bodies of water. The distribution and abundance of these organisms are influenced by a number of factors, including water temperature, salinity, and oxygen levels. The results of these studies have provided valuable information about the biology and ecology of the Baltic Sea. This information is being used to develop management plans for the Baltic Sea. The management plans will help to ensure that the Baltic Sea remains a healthy and productive ecosystem for many years to come.

2.9 THE STATE OF THE BALTIC SEA IN THE NATIONAL REPORT
WIKER TRAVELING SOCIETY

Mark Shindler

Ohio Department of Natural Resources, Oak Harbor, Ohio

The Baltic Sea is a large body of water that is shared by several countries. The sea is important for many reasons, including its role in international trade and its rich biodiversity. The state of the Baltic Sea is a topic that has received a great deal of attention in recent years. This report provides an overview of the current state of the Baltic Sea. The report discusses the physical characteristics of the sea, the distribution and abundance of its fish and other aquatic organisms, and the threats to the sea's health. The report also discusses the management plans that have been developed to protect the Baltic Sea. The management plans are designed to ensure that the Baltic Sea remains a healthy and productive ecosystem for many years to come.

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3.0 FACTORS AFFECTING POPULATIONS AND REHABILITATION PROGRAMS

3.1 CAUSES OF MORTALITY

J. Christian Franson
U.S. Fish and Wildlife Service, Madison, Wisconsin

Based on 131 bald eagle carcasses from the Great Lakes region examined at the National Wildlife Health Research Center from 1985-1989, the four leading causes of identified mortality were trauma (25.2%), poisoning (16.8%), gunshot (16%), and electrocution (12.2%). Of the 22 poisoning deaths, 15 (68.2%) were caused by lead, two by dieldrin, and one each by fenthion, famphur, strychnine, an unidentified organophosphorus compound, and an unidentified carbamate compound. Comparatively, data on 396 bald eagle carcasses collected from the Great Lakes region and examined from 1963-1984 showed that 11.4% of the mortality was due to poisoning. Of the poisoning deaths, 29 (64.4%) were caused by lead, 11 (24.4%) by dieldrin, three by endrin, and one each by DDE, strychnine, and PCB. Results of these data cannot be interpreted to represent actual proportional causes of mortality in bald eagles because of sample bias.

3.2 ORGANOCHLORINES AND MERCURY RESIDUES IN BALD EAGLE EGGS 1968-1984: TRENDS AND RELATIONSHIPS TO PRODUCTIVITY AND SHELL THICKNESS

Stanley M. Wiemeyer
U.S. Fish and Wildlife Service, Laurel, Maryland

Bald eagle eggs were analyzed for organochlorines and mercury and concentrations were evaluated to determine possible effects on eggshell thinning and reproduction. Most eggs had failed to hatch, thus biasing correlations with shell thickness.

For the years 1980-84, Maine eggs had the highest concentrations of DDE and PCBs; the Maine population was one of the slowest to recover. Contaminant concentrations have declined in eggs from several states including, Maine, Maryland, Virginia, and Wisconsin. DDE was most closely correlated with effects on eggshell thickness and young production; however, PCBs were highly intercorrelated with DDE making it difficult to separate the effects of the two toxicants. Concentrations of 1.3, 3.5, and 15 ppm DDE, fresh wet weight, were associated with 1.0, 0.70, and 0.25 young per occupied territory, respectively, for eggs collected in 1969-79. Production in sampled territories was lower than that in the overall populations. A level of 1.0 ppm DDE in eggs should have no adverse effect on reproduction. Dieldrin and PCB concentrations in eggs of ≤ 0.10 and 4.0 ppm, respectively, should be adequate to ensure normal reproduction. However, more information is needed on specific PCB congeners. Mercury concentrations in eggs were generally below those known to be associated with adverse effects on reproduction in other species. Dieldrin probably had a greater adverse impact on bald eagle survival than productivity.

3.3 MICHIGAN BALD EAGLE SUMMARY

Dave Best, U.S. Fish and Wildlife Service, East Lansing, Michigan
Bill Bowerman, Michigan State University, East Lansing, Michigan
Tom Weise, Michigan Department of Natural Resources, Lansing, Michigan

Eagle populations in Michigan increased from 88 breeding pairs in 1977 to 165 pairs in 1989. Comparatively, Great Lake populations grew from 10 to 41 pairs during the same period and now comprise roughly 25% of the state population. Michigan has already surpassed the Federal Recovery goal of 140 breeding pairs, but available occupied habitat exists for an additional 160, so a total of 300 nesting pairs is plausible. To support this, historic records show 400 pairs for the state.

Studies suggest that both Great Lakes eagles and inland eagles that feed on anadromous fish, have significantly lower reproductive rates than inland populations. This lower level of reproduction cannot be attributed to the level of experience in breeding pairs. Eagles nesting on Lake Michigan and Huron shores have nearly complete reproductive failure within five years of establishment. Thus, although the eagles are repopulating the shoreline regions, they rapidly lose the ability to reproduce. Reproductive failure has also occurred in some inland lakes where rough fish have been removed, theoretically to improve sport fishing. Removal of northern pike, bullheads and suckers, which are the primary prey of the inland bald eagle during the breeding season, has caused reproductive failure due to lack of available food.

Twenty-three addled eggs collected from 1985-1988 in Michigan and Ohio displayed higher levels of PCBs, DDE, and Dieldrin in shoreline versus inland populations and are inversely related to measures of productivity. PCB residues were 36.0 $\mu\text{g/g}$ (fresh weight) for shoreline populations versus 9.0 $\mu\text{g/g}$ for inland eggs; DDE levels were 13.0 $\mu\text{g/g}$ for lakeshore eggs compared to 3.2 $\mu\text{g/g}$ for inland samples and Dieldrin residues measured 0.90 $\mu\text{g/g}$ and 0.21 $\mu\text{g/g}$ for shoreline and inland eggs respectively. Residue levels of similar magnitude have been correlated to reproductive failure in previous studies. 2,3,7,8-TCDD dioxin equivalents in two eggs collected in 1986 (one from Lake Michigan, one from Lake Huron) were of a magnitude to be embryotoxic. Blood plasma levels of PCBs and DDE of Great Lakes nestlings collected in 1987 and 1988 were six times higher than levels in inland nestlings.

Although the Michigan eagle population in aggregate appears strong and exceeds recovery goals, the Great Lakes subpopulation is not faring as well. Reproductive failure, probably caused by a contaminated food supply, is indicative of this group. Current studies are being conducted to determine the linkage and extent of contaminated fish with reproductive failure. A proposal allowing fish ladder construction and dam removal to increase sports fishing opportunities in four river basins would expose healthy inland populations to Great Lakes fish. The percentage of eagle breeding areas subject to the influence of contamination from the Great Lakes would then increase from 25% to 42% of the state population. The results of these studies will help in understanding the link between Great Lakes fish and eagle reproductive success.

3.4 PERSISTENT TOXIC CHEMICALS

Sarah Shapiro-Hurley
Wisconsin Department of Natural Resources, Madison, Wisconsin

The Wisconsin Department of Natural Resources is developing an Environmental Contaminants Monitoring Program in wildlife. As part of that program, databases are being constructed showing incidences of contamination in various species throughout the years. Data on eagles show a high correlation between contaminated eggs and nesting in areas with fish and waterfowl consumption advisories. Reproductive success is documented under stipulations that the nest has been occupied three years prior to or since collection of eggs. This approach will try to eliminate the possibility of counting replacement pairs that use old, abandoned nest sites. Only two nest sites are located along Lake Michigan, these nests have failed four out of the five production years since establishment three years ago. Young pairs may be breeding here, which would account for the low productivity. Although occurrences of contaminants have been linked to lowered success and productivity, the Wisconsin DNR wants to investigate other possible limiting factors. Remedial Action Plans, and other recovery goal plans have given states authority to recover for damages if linkages can be shown. A database that demonstrates localized increases in toxic chemicals relative to poor success, or that shows chemical trends will be a valuable lobbying tool.

3.5 CONTROLLING TOXIC SUBSTANCES IN SURFACE WATERS: THE ROLE OF THE BALD EAGLE

Dave Zaber
National Wildlife Federation, Ann Arbor, Michigan

The National Wildlife Federation (NWF) and the Canadian Institute for Environmental Law and Policy (CIELAP) cooperatively run the binational Program for Zero Discharge. The Program's goal is to define strategies for achieving the Great Lakes Water Quality Agreement goals of "virtual elimination" and "zero discharge" for persistent toxic substances. As a part of this program, NWF's Great Lakes Natural Resource Center (GLNRC) is developing model water quality standards for the Great Lakes Basin.

Current water quality standards in the Great Lakes contain criteria to protect human health and aquatic life. Water quality criteria designed to protect terrestrial and avian wildlife are needed for the Great Lakes. One component of wildlife criteria is the designation of a suite of environmental indicator organisms. Because of the inherent limitations of monitoring every organism in an ecosystem, these environmental indicators act as surrogates by which we can gauge the "health" of the ecosystem. The bald eagle, because of its position at the top of the food web and its sensitivity to certain toxicants, is an excellent environmental indicator for contamination by certain persistent and bioaccumulative toxicants. The presence of a healthy, viable population of eagles nesting and feeding on the shores of the Great Lakes would, therefore, indicate significantly improved water quality.

To achieve the goal of zero discharge, it is essential that total mass loadings of persistent toxic substances to the lakes be regulated, not just the concentration of a toxicant in the vicinity of the discharge. Atmospheric and urban non-point sources of toxic substances must also be regulated. Regulatory reforms incorporating timetables for achieving given milestones (e.g. ecosystem indicator restoration) are critically needed. The continued poisoning of Great Lakes wildlife is a painful reminder that the cleanup of the Lakes is far from finished.

3.6 VETERINARY REHABILITATION OF BALD EAGLES

Mark Martell

The Raptor Center, University of Minnesota, St. Paul, Minnesota

The Raptor Center at the University of Minnesota receives injured birds from various states and rehabilitates them for release back to the wild. Bald eagles admitted to the center come primarily from Great Lake States. Trauma is the leading cause of injury for these birds (38%), followed by leg hold traps (28%), shooting (18%), disease (13%), and other causes (3%). Leg hold traps pose a difficult problem because injury is not always apparent at the time of discovery. Often tissue below the trap will take a few days before necrosis sets in. The center therefore recommends that trappers and conservation agents finding trapped eagles, send them to qualified rehabilitators who hold the bird for a minimum of seven to ten days before releasing.

Shooting injuries appear to follow duck-season openings, suggesting that many eagle shootings are accidental. All eagles brought to the clinic are routinely screened for lead poisoning. Blood lead levels of 0.2 ppm or above are considered elevated. Eagles with levels above 0.6 ppm demonstrate clinical signs of lead poisoning and are treated accordingly. Since 1980, 44 birds have shown elevated levels, 27 were treated and 14 recovered. Although most of these birds came into the center with other injuries, the high incidence of poisoning demonstrates the continued problem of lead in the environment. Release rates for the clinic averages 53% while 9% go to captive programs, and 38% are euthanized or die. The survival and reproductive success of released birds is being determined in a three-year study begun in 1988 using radio tracking devices. Although concrete data are not yet available, reports indicate one released bird has successfully mated and raised one young.

3.7 BALD EAGLE HACKING PROGRAM ON LAKE ERIE

Jeff Robinson

Canadian Wildlife Service, London, Ontario

Records from the early 1900s indicate 42 to 72 nesting eagle pairs inhabited the north shore of Lake Erie. Those numbers declined to three nesting pairs and zero production for 1980.

In 1983, the Canadian Wildlife Service and Ontario Ministry of Natural Resources began a five year hacking program to augment the population on the Canadian shore of Lake Erie. Long Point National Wildlife Area was chosen as the release site as historic and current bald eagle use indicated suitable breeding habitat was available. Young bald eagles were obtained from nests on Lake of the Woods at five to seven weeks of age. At this stage the young are independent in that they can regulate their body temperature and feed without constant parental care. Single young were selected from nests containing multiple young, which were determined during the annual aerial census. Different nests were accessed each year to maximize the genetic diversity of the introduced birds. The program at Long Point released 28 birds from 1983 to 1987 at a rate of approximately six per year. A companion program at a site on the Grand River near Lake Erie released two additional birds in both 1986 and 1987. These release programs effectively doubled the reproductive output of the Canadian subpopulation on Lake Erie. Of the 32 birds successfully transferred, two have been recovered dead in the Fall of their first year; one was shot on the north shore of the St. Lawrence River in Quebec, and the second was found dead of unknown causes on the shoreline of Lake Erie near Port Alma, Ontario. Successful nesting pairs on Lake Erie have increased to eight with average young production of one per nest. The program's success cannot be fully assessed until released birds successfully breed. As several color-marked bald eagles released at Long Point have been sighted in subsequent years, successful nesting should occur in the next several years.

3.8 DIOXIN EQUIVALENTS AS AN INTERPRETIVE TOOL

Tim Kubiak

U.S. Fish and Wildlife Service, East Lansing, Michigan

Environmental samples, especially wildlife collected in the Great Lakes region have shown and continue to show high concentrations of three families of halogenated, persistent toxic substances; the PCBs (polychlorinated biphenyls), PCDDs, (polychlorinated dibenzo- ρ -dioxins), and PCDFs (polychlorinated dibenzofurans). These three families of compounds share structural similarities and many individual "congeners" can take on a planar configuration. Generally, the compounds that are laterally substituted with chlorine atoms in the 2,3,7 and 8 positions (for the PCDDs and PCDFs) and the 3,3',4,4',5 and 5' positions (for the PCBs) are the most toxic. Further substitutions in the inner positions of all three families generally reduces their toxicity. It is now widely accepted that these compounds act via a cellular protein receptor, the Ah receptor. Most effects are mediated through this receptor. A suite of toxic and biologic effects are produced by these compounds that are qualitatively similar. Thus they have been generally characterized as producing toxicity through the same "mechanism of action." Each congener which shares these properties can be referred to as dioxin-like. The reference is made to dioxin because one dioxin congener, 2,3,7,8-tetrachlorodibenzo- ρ -dioxin (TCDD) is known to possess the greatest toxic potency of all the dioxin-like congeners and can be viewed as the prototype for this group of compounds.

The potency of individual congeners, within this group of compounds, to produce the similar suite of toxic and biologic effects varies by a factor of approximately one million. These effects have been well-studied in controlled laboratory conditions and include the ability to induce the enzymes aryl hydrocarbon hydroxylase (AHH) and ethoxyresorufin-*o*-deethylase (EROD), inhibition of weight gain, thymic atrophy, edema, reproductive impairment including teratogenic effects, immune system dysfunction and wasting syndrome. Effects vary among species because of sensitivity differences. Sufficient information exists on the relative potency of these compounds to produce the same effect so that potency ratios can be made of these compounds' potential to be toxic relative to all the others in the group. Since TCDD is recognized as the prototype compound, its relative potency is 1.00, while all the others have potencies less than TCDD. These relative potency relationships were necessarily identified to provide some means of data interpretation when environmental chemistry advances allowed for the analysis of individual congeners. Enzyme induction potency was originally used as the basis for determining the relative contribution of individual congeners in complex environmental mixtures of these contaminants. The relative potency factor of each congener was then multiplied by its individual concentration in an environmental sample to arrive at a "normalized" concentration in a common unit of measure, termed TCDD equivalent concentration in the sample for all PCDDs, PCDFs and PCBs. Other relative potency factors are now being described based on toxicity rather than enzyme induction potency. Remarkably, the relative potency factors are generally in quite good agreement, signifying that a good interpretive approach is being used. This is important to environmental toxicologists because past understanding of toxicity of these groups largely focused on total concentrations of individual families, such as the PCBs. Many early environmental studies failed to associate effects based on the total PCB concentrations, which did not focus on the 18 PCBs which were dioxin-like.

Work has been undertaken for many years to use an *in vitro* bioassay, the H-4-II E rat hepatoma cell bioassay, to help develop the above relationships. It was found that an environmental extract could be dosed to these cells and analyzed for total dioxin equivalents, much like the analytical chemistry approach. This extract bioassay has been shown to be a good semi-quantitative screening test to determine the degree of contamination by dioxin-like compounds and does associate well with toxic effects in the lab and environment.

Results of both analytical chemistry and H-4-II E extract bioassay have shown considerable dioxin-like toxicity to be present in Great Lakes wildlife, some where reproductive impairment and deformities have been found. The PCB congeners, 3,3',4,4',5-(IUPAC 126), 2,2',3',4,4'-(IUPAC105) and 3,3',4,4'-(IUPAC 77) are thought to contribute the most dioxin-like toxicity (equivalents), based on the relative potency factor approach. Actual 2,3,7,8-TCDD contributes a low percentage of the total equivalents, usually in the 5-10% range. Other dioxins and furans contribute even less equivalents than 2,3,7,8-TCDD.

Both approaches have been used to determine the amount of dioxin-like contamination in addled bald eagle eggs collected in 1986 from the Great Lakes (one from Boutlier on Bid Bay de Noc, Lake Michigan and one from near Alpena, on Thunder Bay, Lake Huron). They were analyzed for total PCBs using standard methods; total PCBs by congener specific analysis; TCDD equivalents from results of the congener specific PCB analysis; and TCDD equivalents by H-4-II E extract bioassay for total PCBs, with PCDDs and PCDFs removed prior to analysis. The results are shown below for each test and egg.

Table 1. PCBs in Addled Eggs of Bald Eagles Estimated by Four Methods

Egg Location	Total PCB		TCDD Equivalents Attributable to PCB	
	Standard Methods	Congener Specific Analysis	Congener Specific PCB Analysis	Enzyme Bioassay
Alpena	96 µg/g	98 µg/g	31 pg/g	1,065 pg/g
Boutlier	51 µg/g	83 µg/g	21 pg/g	560 pg/g

Total PCBs are some of the highest ever recorded in bald eagle eggs on the Great Lakes. The TCDD equivalents come almost exclusively from one PCB congener, IUPAC 126 (3,3',4,4',5-) from both sites. The extract bioassay results are consistently lower than the equivalents derived from analytical chemistry on the same samples, possibly suggesting some biological antagonism. All four analyses show significant contamination by PCBs. To place these data in perspective, 2-5 µg/g total PCBs is the lowest observable effect level in studies of bird reproduction, including laboratory chickens as well as Forster's terns and bald eagles on the Great Lakes. 1,000 pg/g injected into the eggs of white leghorn chickens completely inhibits hatching of chicks (100% egg mortality). A lowest observable effect level for white leghorn chicken embryos, injected with actual 2,3,7,8-TCDD is 6.5 pg/g in the egg contents, excluding the shell. If bald eagles were as sensitive as chickens, which the total data seem to indicate, PCBs are occurring at embryotoxic concentrations. We are now assessing the entire archived set of bald eagle eggs to determine what association PCB congeners (expressed as actual concentrations and as TCDD equivalents) and the rat hepatoma extract bioassay have with bald eagle reproductive success.

The use of dioxin-like toxicity is important for interpretation for another reason. There are studies which have shown environmental enrichment of the most toxic PCB congeners relative to concentrations in technical mixtures which have polluted the Great Lakes, such as Aroclor 1242 and 1254. Further work is necessary to determine how much enrichment is occurring at various trophic levels. This is critical since the major reproductive problem is associated with dioxin-like contamination and because PCBs are currently regulated by total concentration only.

4.0 FUTURE POLICY AND PROGRAMS

4.1 ONTARIO'S RECOVERY PLANS

Pud Hunter

Ontario Ministry of Natural Resources, Aylmer, Ontario

Southern Ontario Recovery Plan

The bald eagle, protected in Ontario under regulations of the Endangered Species Act, is doing well in the north but only 13 nesting pairs are known to the Ministry in the south (south of Lake Nipissing). A recovery plan highlighting four keys to recovery of the southern population is in preparation. The first key involves periodic censusing especially in the more remote parts of southern Ontario, monitoring by annual surveys to determine the state of the population and success of recovery efforts, and managing the eagle population by further improvements in reproduction (e.g. by hacking) and survival (e.g. by enforcement, application of the existing habitat management guidelines, and by public education). The second aspect of the plan calls for habitat protection, evaluation, and improvement. A habitat suitability index model will aid in the evaluation and ranking for rehabilitation of historic and potential nest sites. Some important variables used in the model are size of the water body and its ability to produce fish, availability of suitable nest trees, potential for human disturbance, and levels of toxic contaminants in local food. The plan also calls for improvements in public education and co-operation; Southwestern Region is a model in this regard with its stewardship initiatives and CWIP (Community Wildlife Involvement Program) projects. Finally, the plan calls for co-ordination of regional recovery efforts to facilitate efficiency and the exchange of information and expertise. The tentative objective of the plan is to double the number of active eagle nests in southern Ontario by the year 2004.

Ontario Recovery Plan

The Ontario Recovery Plan proposes four keys to the recovery of bald eagles in Ontario. The first part suggests that recovery populations of eagles should be censused, monitored, and managed. Current census' estimate breeding pairs at approximately 500-600 pairs for the province. Several areas have not been heavily monitored in the past, so this number may be on the low side. Additionally, northern populations of eagles appear stronger than southern populations, suggesting differential management may be needed. In the Southwestern Region, management plans for individual nests incorporate three buffer zones with varying activity allowed. Currently no territorial protection status exists, but nests are accorded a 640 acre protection zone. The second point in the Plan calls for habitat protection, evaluation, and improvement. Habitat Suitability Index (HSI) models are used to rank nesting sites for potential rehabilitation. Some index factors include the availability of nesting sites, size of water body next to nesting area, and the presence of toxic chemicals in the water. Third, there should be improved public education. Public education often equates to public support as witnessed by stewardship programs where public groups build eagle platforms and artificial nest bases for habitat rehabilitation. Lastly there needs to be coordination of recovery efforts across the various regions with each region setting its own recovery goals suitable for that area.

4.2 BALD EAGLE RECLASSIFICATION PLAN

Daniel James
U.S. Fish and Wildlife Service, Twin Cities, Minnesota

Since 1978, the bald eagle has been federally listed as endangered in 43 of the conterminous states and threatened in five. Five regional recovery plans were approved by the U.S. Fish and Wildlife Service. These plans identify strategies to effect the recovery of the bald eagle, including goals for reclassification to threatened status and for total delisting. Current population data indicate recovery goals have been reached in four of the five regions (the Southeast Region has met recovery goal numbers and production, but lacks in distributional requirements), thus the U.S. Fish and Wildlife Service is considering action to downlist the eagle to threatened status.

Opponents of downlisting/delisting fear the eagle will lose its protection under Federal Law and monetary support for research and education will diminish. The Endangered Species Act will continue to protect the eagle if it is downlisted to threatened status. Eagles could benefit through promulgation of special rules accorded to species with threatened status; thus habitat protection and other conservation measures could be strengthened. If the eagle was delisted, it would still be protected at the federal level under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. A 1988 amendment to the Endangered Species Act requires the U.S. Fish and Wildlife Service to monitor recovered species for a period not less than five years, thus the eagle would still have measures of protection following delisting. In addition, many states have laws protecting eagles and other endangered species.

4.3 AN INTERAGENCY INITIATIVE IN THE WESTERN LAKE SUPERIOR REGION

Bob Brander
Apostle Island National Lakeshore, Bayfield, Wisconsin

Anthropogenic toxics have been detected at alarming levels in the Lake Superior food-web, including the bald eagle. Funding needed to detect sources of the toxics is in short supply. The majority of funds available to study toxins in the Great Lakes ecosystem continue to go to the lower lakes, probable because they contain relatively larger loadings and because 98 percent of the ecosystem's human population live outside of the Lake Superior region. Agencies with missions in the Lake Superior region must pool their fiscal and intellectual resources. The Western Lake Superior Region Resource Management Cooperative held its first meeting in November, 1989. Comprised of six U.S. Federal Agencies, Michigan and Wisconsin Department of Natural Resources, and six academic institutions, the Cooperative has selected Lake Superior watershed quality, biodiversity, and resource supply and demand as the primary issues it will address during the 1990's. Canadian and Chippewa tribal participation has been invited. A Technical Committee within the Cooperative was formed to develop a proposal to study toxics in sediment, water and the food-chain in the Apostle Islands area. Within a couple of years, the Cooperative will be in a position to coordinate proposals for studies throughout the Lake Superior basin.

4.4 STANDARDIZATION OF METHODOLOGY

Dave Best
U.S. Fish and Wildlife Service, East Lansing, Michigan
with input from all participants

In the past few years various provincial, state and federal natural resource agencies have been cooperatively studying bald eagles of the Great Lakes. To facilitate this working relationship and promote effective interchange of research and management results, there is a need to standardize current and future methodologies.

In the absence of site-specific prey base studies to determine the frequency/volume of Great Lakes biota in the eagles' diet, a mutually agreeable and biologically meaningful measure of distance needs to be established as a working demarcation between coastal and inland breeding areas. With limited manpower, time, money and/or dwindling interest in provincial/state-wide aerial and ground surveys of breeding areas to assess productivity, there is a need to standardize survey protocols. Emphasis should be directed towards a more complete and thorough coverage of the Great Lakes shorelines, consistency across the basin in interpreting/determining occupation and breeding outcomes, establishing dates for aerial and ground surveys in order to collect meaningful reproductive data, and determining the minimum effort and survey frequency in inland areas scheduled for reduced surveys. Regarding contaminant investigations, there is a need to establish the types of tissues (including prey) to be taken or salvaged for immediate analysis or archiving, and the type and priority of chemical analyses to be performed for tissues from various regions of the basin. Results from past prey base studies from across the basin need to be summarized highlighting the differences between Great Lakes and inland breeding areas. Along much of the Great Lakes shoreline, a consistent habitat suitability assessment is required, particularly in historic breeding areas, to establish shoreline recovery goals and potential access restrictions. An ultimate result of this multiagency cooperative approach would be a binational Great Lakes recovery plan.

AN EVALUATION OF MICROBIOLOGY

Water Quality Assessment and Management with Input from all Participants

This report is based on the findings of a study conducted in 1975 to evaluate the current state of water quality in the Great Lakes region and to identify areas for improvement. The study was conducted by a committee of experts from various disciplines, including microbiology, hydrology, and environmental science. The committee's findings are summarized in this report.

The study found that water quality in the Great Lakes has declined significantly since the 1950s. This decline is primarily due to the discharge of pollutants from industrial and municipal sources. The pollutants include heavy metals, organic chemicals, and nutrients, which have led to the degradation of the aquatic ecosystem. In particular, the presence of toxic substances has caused the death of fish and other aquatic organisms, and the growth of harmful algal blooms.

The committee also found that the current regulatory framework is inadequate to address the problem. The existing water quality standards are outdated and do not reflect the latest scientific knowledge. Furthermore, the enforcement of these standards is inconsistent across the different Great Lakes. To improve water quality, the committee recommends that the following actions be taken:

- 1. Update the water quality standards to reflect the latest scientific knowledge.
- 2. Strengthen the enforcement of these standards.
- 3. Increase the funding for water quality monitoring and research.
- 4. Encourage the development of cleaner technologies to reduce the discharge of pollutants.
- 5. Promote public participation in water quality management.

The committee believes that these actions are essential to restore and maintain the high water quality of the Great Lakes. It is the responsibility of all those who use the Great Lakes to ensure that the water remains clean and healthy for future generations.

The Lake Superior Basin is a unique and valuable natural resource. It is the largest of the Great Lakes and is home to a diverse and thriving ecosystem. The basin's water is essential for the health and well-being of the people who live in the basin. It is also a source of recreation and tourism. The basin's water quality is therefore of great importance to all those who use it.

The basin's water quality has declined in recent years due to the discharge of pollutants from various sources. This decline has led to the degradation of the basin's ecosystem and has caused the death of fish and other aquatic organisms. The basin's water quality is therefore in a state of crisis and immediate action is needed to address the problem.

The basin's water quality can be improved by taking the following actions:

- 1. Reduce the discharge of pollutants from industrial and municipal sources.
- 2. Increase the funding for water quality monitoring and research.
- 3. Encourage the development of cleaner technologies to reduce the discharge of pollutants.
- 4. Promote public participation in water quality management.

The basin's water quality is a shared responsibility. It is the responsibility of all those who use the basin's water to ensure that the water remains clean and healthy for future generations. We must all work together to protect the basin's water and its ecosystem.

2

5.0 SUMMARY OF PROCEEDINGS

Ian C.T. Nisbet, Lincoln, Massachusetts

The status of the bald eagle in the Great Lakes basin is fairly well known. Population increases coupled with reproductive improvements have been occurring since the late 1970's. There has been a progressive expansion of the population from inland to Great Lakes shores during the 1980's. However, populations in these shoreline areas have persistent difficulties.

Reduction in the levels of environmental contaminants is generally agreed to be the reason for overall repopulation of the basin. This reduction can be related to decreasing adult mortality and improved breeding performance. Additionally, better protection and management, along with public support, has contributed to this rehabilitation. The general public that was rather indifferent to the eagle forty years ago is now very enthusiastic. Many are keen to have bald eagles nesting on their property. Another factor in the bald eagles' recovery, at least locally, appears to be the bird's ability to adapt to new habitats, sometimes in close proximity to human activities. Lastly, the hacking program is believed to have contributed to the reintroduction of the bald eagle in areas where it was once extirpated, or nearly extirpated.

There are several plausible reasons why lakeshore bald eagles are not performing well. First, breeding success is not as high along the lakes as inland. This outcome is likely due in part to persistent toxic chemicals. Presently, we have not been able to separate the significance of DDE and coplanar PCBs to reproduction. Across North America, DDE seems to have a greater correlation with decreased breeding performance. However, addled eggs from the Great Lakes show levels of coplanar PCBs high enough alone to account for reproductive failure. Additional research should help assess the role of these various chemicals.

Adult mortality may be an important element in reduced reproductive success and longevity for Great Lakes eagles. At present, we don't know the significance of lead or organochlorine poisoning throughout the basin. National Wildlife Health Laboratory data indicate dieldrin as a primary cause of death of 15 eagles within the last 17 years. Mortality in eagles may result from consumption of just one or two very "hot" prey items, thus making generalization of chemical importance difficult.

Another contributing factor may be the different prey base for inland and lakeshore birds. Coastal eagles consume a greater percentage of gulls and other waterbirds than inland populations. Because these avian species tend to occupy higher trophic levels than fish, they have the potential for greater bioaccumulation of contaminants. As a result, water quality objectives for the Great Lakes may have to be more stringent than those set for inland lakes where the eagles are more piscivorous.

There is some indication that the length of breeding area residency by a pair of eagles has an effect on reproductive outcome. Preliminary studies suggest that eagles occupying the shorelines of Lakes Michigan and Huron rapidly lose their ability to reproduce after three years of lakeshore occupation. This suggests that individual lakeshore breeding pairs need to be monitored for productivity over time and individual/pair turnover.

Lastly, we are uncertain of the effect on lakeshore eagles from human disturbances in the form of developmental/recreational activities. In Ohio, human activity appears to limit the dispersal of fledgling eaglets to a select few foraging areas. This suggests a need to define human activity parameters within habitat quality objectives.

The bald eagle would make a useful indicator species for bioaccumulative chemicals due to its top trophic level position. But it may not be the most sensitive to a broad

spectrum of environmental contaminants, or the most specific indicator of dioxin-like contaminants. The mink may be better suited for that role. A suite of indicator species from various ecosystem "niches" would prove most advantageous.

Using the eagle as an indicator species does have some disadvantages. First, certain shorelines presently have insufficient numbers of breeding pairs to make statistically meaningful conclusions. It will be interesting over the next twenty years to see whether and how rapidly eagles can resettle these shorelines. Eagles will serve as important habitat indicators in those areas.

Secondly, food habits vary among coastal birds due to location and prey availability, as well as individual quirks of diet. Localized breeding pairs may serve as indicators of habitat quality along distinct reaches of shoreline.

Another disadvantage remains the lack of knowledge about the specifics causing poor population performance. We recognize problems with reproduction, survivorship and prey contamination, yet specific causes and relationships are not well established. Presently, we may be unaware of all the factors that control breeding populations. We are not certain which chemicals are critical, individually or cumulatively, in determining overall breeding success. Even if this determination was possible, occurrences of impairment may vary depending on local sources of contamination.

In conclusion, eagles integrate many aspects of their environment. They rely on suitable nesting trees and a diverse, clean prey base. Population and breeding performance depend on several different components of habitat quality. With the bald eagle as an indicator species, an entire suite of physical habitat and water quality factors need to be present for success. As an integrator of these factors, the eagle can reflect whether the coastal environment of the Great Lakes as a whole is satisfactory. Therefore, the species serves as an effective indicator of overall habitat quality by integrating contaminant and habitat features. The future presence of bald eagles throughout the basin should reflect the ability of the Great Lakes to support all levels of consumers, including humans.

SECTION 6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Response to the Five Questions

QUESTION 1: Is sufficient information known about the status of the bald eagle in the Great Lakes basin to make it a useful indicator?

The data base on Great Lakes bald eagles has expanded sufficiently in the past few years to suggest that the species would serve as a good indicator of Great Lakes water quality. This is due to the eagles' dependence on a largely aquatic prey base. In spite of its adaptability to human activities and altered habitats, the species may further serve as an indicator of Great Lakes ecosystem health by integrating physical habitat suitability and water quality factors. In this expanded indicator role, habitat features including human disturbance, and water quality factors must be carefully assessed prior to attributing causal links to poor population performance.

QUESTION 2: Will delisting the bald eagle as an endangered species jeopardize funding for undertaking surveys of the Great Lakes bald eagle population?

Subsequent to the February workshop there have been reports of lost funding sources due to the U.S. proposal. The fear that the reclassification of the species would reduce its public visibility and funding priority, seems to be bearing out. Alternative and outside funding sources for research, management and educational needs should be pursued regardless of the outcome of the proposal.

QUESTION 3: Is sufficient information known about the factors affecting the status of the Great Lakes bald eagle population to make it a reliable indicator of water quality improvement?

In addition to the response to the first questions, research currently in progress should promote a better understanding of dispersal and survivorship in fledglings and subadults. Our knowledge of the bioeffects of the complex mixture of contaminants in the Great Lakes is improving with the development and use of new methodologies which focus on more sensitive biological endpoints. These include the H-4-II-E induction bioassay, congener specific PCB analysis, analysis of blood plasma and determinations of vitamin A and porphyrin levels. Our level of knowledge on the bald eagle in the Great Lakes basin is progressing toward a predictive capability as a reliable indicator species.

QUESTION 4: Are the various laws in the United States and Canada sufficiently forceful to rehabilitate the bald eagle in the Great Lakes basin?

On both sides of the border, laws and policies are currently in place to protect the eagle from direct exploitation, as well as protect and enhance water quality and habitat important to the bald eagle. No doubt there are aspects of the law that could be strengthened within individual political jurisdictions. However, the larger question remains as to how well the resulting regulatory framework is being interpreted and implemented by the responsible agencies for the benefit of the eagle. In particular, the jury is out in regards to the degree of control of toxics in the Great Lakes basin, specifically as it relates to the status and health of all upper trophic level species.

QUESTION 5: Are hacking techniques an effective way of re-establishing bald eagles in the Great Lakes basin?

Hacking techniques have shown varying degrees of success in New York and southwestern Ontario. Ultimate success is measured by the return of adults to the general area where they were hacked as eaglets, to establish breeding areas and successfully fledge young. This requires a minimum of 4-5 years for the eaglets to reach maturity and a means to mark and identify the hacked birds. Evaluating the efficacy of a program is hampered by our lack of knowledge on the dispersal patterns and survivorship of fledglings and subadults. There are no data to suggest that the hacking programs have failed outright. At a minimum, a well-planned program should augment the natural reestablishment of eagles to presently underutilized or unoccupied areas.

6.2 Great Lakes Recommendations

1. Further document the differences and delineate the boundaries between inland and Great Lakes bald eagle subpopulations, with regards to measures of productivity and mortality, contaminant burdens, prey base, juvenile dispersal patterns, ingress/egress between subpopulations, habitat suitability, human disturbance pressures, etc.
2. Standardize survey protocols to enable complete coverage of the Great Lakes shorelines and insure statistically comparable measures of productivity.
3. Model the Great Lakes food web for those toxic compounds which bioaccumulate in upper trophic levels.

3. Model the Great Lakes food web for those toxic compounds which bioaccumulate in upper trophic levels.
4. Support/incorporate in rules and regulations promulgated to control point and non-point source pollution to the Great lakes the concept of bioeffects from the accumulation of toxic compounds in upper trophic level species, including the bald eagle.
5. Establish management guidelines for Great Lakes breeding areas to ameliorate/mitigate for potential human disturbances from recreational and developmental uses of the shorelines.
6. Establish recovery goals specific to the Great Lakes subpopulation/shorelines which can be incorporated into state and provincial recovery plans.
7. Adopt the bald eagle as a ecosystem indicator of cumulative Great Lakes water quality and habitat suitability, which will ultimately yield a numerically stable, reproductively successful, self-sustaining subpopulation of long-lived individuals.

6.3 Other Recommendations

1. Coordinate color banding and radio telemetry efforts to facilitate cooperative observations and data exchange, and avoid past confusion from overlapping methodology.
2. Determine if the various banding techniques employed have an adverse influence on reproduction and other behaviors.
3. Quantify juvenile dispersal patterns and survival/mortality rates for juvenile and subadult eagles, in part to determine the adequacy of the levels of productivity cited as representing stable and healthy populations.
4. Standardize methods for contaminant investigations including the types and amounts of tissues to be sampled and the methods and detection limits of analyses to be performed, so as to facilitate data comparisons.
5. Examine the chronic effects of contaminants on aspects of eagle biology other than measures of productivity.
6. Identify suitable bald eagle populations within or outside the basin which may serve for comparative purposes as a control population to targeted subpopulations within the basin.
7. Continue to evaluate hacking, fostering and rehabilitation programs to assess overall survivorship and effectiveness at augmenting the natural repopulation of an area or region.
8. Increase the cooperation/participation among agencies, academia and others involved in regional or basinwide studies and monitoring efforts.
9. Continue to develop and refine habitat evaluation procedures to determine suitability of potential and historic breeding areas, for use in the setting of numerical goals in recovery plans.
10. Management/recovery plans should be routinely reviewed to insure the adequacy of the proposed measures, and updated when necessary to reflect new information and recent legislation/policy.
11. Encourage public participation by landowners of eagle habitat and other citizens in bald eagle education, protection, enhancement and recovery efforts.

12. Cooperate with the news media, when appropriate, in disseminating information on the status of the bald eagle, educational programs, enhancement/management efforts, protective measures, progress and obstacles to recovery, etc.
13. Investigate alternative funding sources to enhance investigative/monitoring efforts, or to mitigate for potential loss of funds from possible future downlisting or delisting of the species.

APPENDICES

- A. Report on the Status of Bald Eagles in the United States
- B. U.S. Recovery Plans and Conservation Plans by Region
- C. Recovery Goals and Objectives by State

3. The Department will, in cooperation with other agencies, develop and implement a program of public information, educational programs, and other measures to increase public awareness of the status of the bald eagle, and to encourage the public to report sightings of bald eagles.
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7. The Department will, in cooperation with other agencies, develop and implement a program of public information, educational programs, and other measures to increase public awareness of the status of the bald eagle, and to encourage the public to report sightings of bald eagles.

4.3 Other Recommendations

1. The Department should continue to monitor the status of bald eagles and other species of concern, and to report any changes in their status to the public.
2. The Department should continue to monitor the status of bald eagles and other species of concern, and to report any changes in their status to the public.
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11. The Department should continue to monitor the status of bald eagles and other species of concern, and to report any changes in their status to the public.

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APPENDICES

- A. Expert Consultation Meeting on Bald Eagles: List of Participants
- B. U.S. Recovery Plans and Current Status by Region
- C. Recovery Goals and Current 1989 Status by Jurisdiction

1. Develop and implement a comprehensive monitoring program to assess the status of the bald eagle, educational programs, and other management activities.

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5. Implement a comprehensive monitoring program to assess the status of the bald eagle, educational programs, and other management activities.

4.3 Other Recommendations

1. Coordinate with federal and state laboratory efforts to facilitate cooperative monitoring and data exchange and avoid past confusion and duplication.

2. Develop and implement a comprehensive monitoring program to assess the status of the bald eagle, educational programs, and other management activities.

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B. U.S. Recovery Plans and Current Status by Region

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- A. Expert Consultation Meeting on Gold Reserves: List of Participants
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- C. Recovery Goals and Current 1989 Status by Jurisdiction

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APPENDIX B. U.S. RECOVERY PLANS AND CURRENT STATUS BY REGION

REGION	RECOVERY GOAL	THREATENED GOAL	CURRENT STATUS
CHESAPEAKE BAY	None	175-250 territories 1.1 young-per-occupied-nest	190 territories 1.1 young-per-occupied-nest
NORTHERN STATES	1,200 territories In 16 states 1.0 young-per-occupied-nest	None	1,072 territories In 18 states 1.0 young-per-occupied-nest
PACIFIC STATES	800 territories 1/0 young-per-occupied-nest 65% success rate 38 zones met goals	Increased nesting pairs for 1985-1990 (goal met)	788 territories 1.0 young-per-occupied-nest 65% success rate 26 zones met goals
SOUTHEASTERN STATES	600 territories 9 states met goal 0.9 young-per-occupied-nest 50% success rate Met the above for 5 years	Recovery goals met for three years	583 territories 3 states met goal Productivity goals met
SOUTHWESTERN STATES	None	Expansion into river systems. Productivity 10-12 per year for a five-year period	19 territories in AZ 2 territories in NM 1981-85 productivity was 15.4 per year

APPENDIX B. U.S. RECOVERY PLANS AND CURRENT STATUS BY REGION

REGION	RECOVERY GOAL	INTERIM GOAL	CURRENT STATUS
CHESEBROUGH	None	15-20% reduction in young car accidents	10% reduction in young car accidents
NORTHWEST STATES	1,500 fatalities in 10 states; 10 young car accidents per county/year	None	1,100 fatalities in 10 states; 10 young car accidents per county/year
PACIFIC STATES	500 fatalities; 10 young car accidents per zone per year	Increase existing laws for 1985-1990 (goal met)	100 fatalities; 10 young car accidents per zone per year
SOUTHEASTERN STATES	500 fatalities; 9 states met goal; 0.9 young car accidents per 1000 vehicles per year	Recovery goal met for three years	500 fatalities; 9 states met goal; 0.9 young car accidents per 1000 vehicles per year
SOUTHWESTERN STATES	None	Expansion to 10 states; system procedure 10-12 per year for a three-year period	100 fatalities in 10 states; 10 young car accidents per 1000 vehicles per year

**APPENDIX C. RECOVERY GOALS AND CURRENT
1989 STATUS BY JURISDICTION**

STATE/ PROVINCE	RECOVERY GOAL NUMBER OF OCCUPIED BREEDING AREAS	CURRENT NUMBER OF OCCUPIED BREEDING AREAS	YOUNG PER OCCUPIED NEST	NUMBER OF OCCUPIED GREAT LAKES BREEDING AREAS	YOUNG PER OCCUPIED GREAT LAKES NEST
MINNESOTA	300	390	1.1	0	-
WISCONSIN	360	336	1.36		
MICHIGAN*	140	163	0.96	44	0.68
ILLINOIS	20	9	0.44	0	-
INDIANA	5	2	0.0	0	-
OHIO	20	12	0.75	11	0.64
PENNSYLVANIA	10	9	0.67	0	-
NEW YORK	50	10	1.11	0	-
ONTARIO					
North	Double	~500			
Southwest	Double	13		8	0.88

* Data from 1988