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MICHIGAN WILDLIFE CONTAMINANT TREND MONITORING

YEAR 2001 ANNUAL REPORT NESTLING BALD EAGLES

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SECTION 1.0

Executive Summary

- The bald eagle monitoring project is one component of Michigan's water quality monitoring program, which was summarized by the Michigan Department of Environmental Quality (MDEQ) in the January 1997 report entitled, "A Strategic Environmental Quality Monitoring Program for Michigan's Surface Waters" (Strategy). This document serves as the third annual report for the bald eagle element of the Strategy. The following are the goals of the bald eagle monitoring project:

  1.) Assess the current status and condition of individual waters of the state and determine whether standards are being met.

  2.) Determine temporal and spatial trends in the quality of Michigan's surface waters.

- The reproductive productivity (i.e., the total number of fledged young per occupied nest) for bald eagles in the state of Michigan in 2001 was 0.94. The productivity of eagles nesting within the state during 2001, was below the goal of 1.0 young per occupied nest set in the Northern States Bald Eagle Recovery Plan. Great Lakes (0.94), Inland (0.94), and anadromous (0.63) breeding areas were not significantly different. Lake Erie had the greatest watershed productivity (1.43), followed by Lake Michigan (1.07), inland lower peninsula (1.01), inland upper peninsula (0.87), Lake Huron (0.84), and Lake Superior (0.81).

- In 2001, 101 nestling bald eagle blood plasma samples were analyzed for organochlorine contaminants such as dichlorodiphenyltrichloroethane (DDT) and its metabolites, 20 polychlorinated biphenyl (PCB) congeners, chlordane, and dieldrin.

- Significant differences in total DDT concentrations were found between inland, Great Lakes, and anadromous breeding areas ($P<0.0001$); and also between inland lower peninsula and inland upper peninsula, Lake Erie, Lake Huron, Lake Michigan, and Lake Superior breeding areas ($P<0.0001$). Mean total DDT concentrations were ranked in the following order by location from highest to lowest: Anadromous > Great Lakes > inland breeding areas; and Lake Michigan > Lake Huron > Lake Superior > Lake Erie > inland lower peninsula > inland upper peninsula breeding areas. 4,4'-Dichlorodiphenyldichloroethylene (4,4'-DDE) was detected in 98% of the samples and was the most common DDT metabolite found in eaglet blood plasma. 4,4'-DDE concentrations measured in 2001, were lower than those measured in 1987-1992, with the exception of Lake Michigan, which was higher. Significant differences in total DDT concentrations were also found between the 2001 basin year watersheds ($P<0.0019$).

- Twenty PCB congeners were quantified and summed to determine total PCBs in nestling bald eagle blood plasma samples. Two congeners (138 and 153) contributed significantly to the total PCB concentrations. At least one of the targeted PCB congeners was detected in 76 of the 101 nestlings sampled. A significant difference in total PCB concentrations was found between inland, Great Lakes, and anadromous breeding areas ($P<0.0001$) and among the inland lower peninsula, inland upper peninsula, Lake Erie, Lake Huron, Lake Michigan, and Lake Superior breeding areas ($P<0.0001$). Mean concentrations of total PCBs were ranked in the following order by location: anadromous > Great Lakes > inland breeding areas; and Lake Erie > Lake Michigan > Lake Huron > Lake Superior > inland lower peninsula > inland upper peninsula breeding areas. Total PCB concentrations measured in 2001 were less than those measured in 1987-1992. Significant differences in total PCB concentrations were also found between the 2001 basin year watersheds ($P<0.0001$).

- Quantifiable concentrations of α-chlordane were measured in 29 blood plasma samples. Significant differences existed between Great Lakes and inland breeding areas ($P<0.0001$), and also between inland lower peninsula, inland upper peninsula, Lake Erie, Lake Huron, Lake Michigan, and Lake Superior breeding areas ($P<0.0001$). Mean α-chlordane concentrations were ranked in the following order by location: anadromous > Great Lakes > inland breeding areas; and Lake Erie > Lake Michigan > Lake Huron > Lake Superior > inland upper peninsula > inland lower peninsula breeding areas. Significant differences in α-chlordane concentrations were also found between the 2001 basin year watersheds ($P<0.0324$).

- Quantifiable concentrations of dieldrin were measured in 39 blood plasma samples. Significant differences occurred between Great Lakes, inland, and anadromous breeding areas ($P<0.0001$) and also inland lower peninsula, inland upper peninsula, Lake Erie, Lake Huron, Lake Michigan, and Lake Superior breeding areas ($P<0.0001$). Mean dieldrin concentrations were ranked in the following order by location: Great Lakes > anadromous > inland breeding areas; and Lake Michigan > Lake Superior > Lake Erie > Lake Huron > inland lower peninsula > inland upper peninsula breeding areas. Significant differences in dieldrin concentrations were also found between the 2001 basin year watersheds ($P<0.0001$).

- α-Hexachlorocyclohexane, γ-hexachlorocyclohexane, heptachlor, γ-chlordane, and toxaphene were not detected in any nestling bald eagle 2001 blood plasma samples. Hexachlorobenzene was quantified in only two samples from Lake Superior breeding areas and heptachlor epoxide was quantified in only four samples; three from Lake Superior breeding areas and one from a Lake Michigan breeding area.

SECTION 2.0

INTRODUCTION

In April 1999, the MDEQ, Water Division, began monitoring environmentally persistent and toxic contaminants in bald eagles. This study is part of the wildlife contaminant monitoring component of the MDEQ's Strategy (MDEQ 1997).

The November 1998 passage of the Clean Michigan Initiative-Clean Water Fund (CMI-CWF) bond proposal resulted in a substantial increase in annual funding for statewide surface water quality monitoring beginning in 2000. The CMI-CWF offers reliable funding for the monitoring of surface water quality over a period of approximately 15 years. This is important since one of the goals of the Strategy is to measure temporal and spatial trends in contaminant levels in Michigan's surface waters.

The bald eagle (*Haliaeetus leucocephalus*) was selected as a biosentinel species for monitoring contaminants in Michigan for the following reasons:

1. As a top-level predator, the bald eagle has a significant reliance on the aquatic food web and feeds primarily on fish and waterbirds. Specific dietary preferences of bald eagles include species of northern pike, suckers, bullheads, carp, catfish, bowfin, ducks, gulls, and deer (winter carrion and road-killed deer).

2. Past monitoring has shown that eagles accumulate organic and inorganic environmental contaminants and those contaminants may be quantified in blood, feather, and egg samples.

3. There is a viable population of bald eagles that provides sufficient sampling opportunities for a long-term monitoring program.

4. The large body size of nestling eagles allows monitoring to be conducted by blood sampling techniques and sufficient sample volumes are available to attain low quantification levels (QLs).

5. Mature bald eagles display great fidelity to their chosen nesting territory and often return to the same nest tree year after year. Although some eagles may move away from their nesting territories in the winter months, bald eagles generally reside within the state throughout the year. Therefore, contaminants found in nestling bald eagles will represent the uptake of available contaminants within a particular territory.

The primary objectives of this monitoring effort were to gather the third year of data in eaglets, evaluate temporal trends between these data and historical data available in the scientific literature, and evaluate spatial trends of contaminant concentrations among watersheds and among the Great Lakes basins. Because the methods for sample collection required nest visits and handling nestling eagles, other biological measures were obtained. Therefore, the secondary objectives of the project included determining reproductive success and collecting nestling morphological data. Both spatial and temporal trends of reproductive success were also assessed in this study.

In accordance with one of the key principles of the CMI-CWF, the bald eagle monitoring protocol was planned and conducted in partnership with outside organizations. In 1999, this partnership included Lake Superior State University and Clemson University, and since 2000, this partnership included Michigan State University and Clemson University.

This document serves as the third annual report for the bald eagle element of the Strategy. The first (MDEQ, 2002) and second (MDEQ, 2003) reports contained results of the samples collected in 1999 and 2000, respectively. This report contains the analytical results for organic contaminants that were measured in nestling bald eagle blood samples, and statistical temporal and spatial trend analyses of the data. Also included in this report are the data for reproductive success and nestling morphological measurements. Feather analyses for mercury concentrations have not been conducted at this time due to analytical difficulties. The feather mercury data for the 2001 report will be presented, as an addendum, in the fifth year report to the MDEQ.

Section 3.0

STUDY DESIGN AND METHODS

3.1 SITE SELECTION

The bald eagle monitoring project is designed to provide monitoring coverage of both the coastal Great Lakes and inland waters. Nesting eagles are found along the shorelines and on islands of each of the four Great Lakes surrounding Michigan. Further, the distribution of breeding eagles across much of Michigan provides monitoring coverage for many of the major river systems.

The establishment of breeding areas in southern Michigan is relatively recent, and the number of active breeding areas continues to increase as eagles either establish new breeding areas or re-occupy historical territories. For example, the breeding areas in Arenac, Barry, Ottawa, and Wayne counties were established in 1998 or 1999. One breeding area in Monroe County was established in 1988 and the other three breeding areas were first occupied in 1998 or 1999. The first breeding areas in Allegan and Saginaw Counties were established in 1993.

To facilitate the MDEQ's National Pollutant Discharge Elimination System permitting process, Michigan's watersheds, as delineated by eight-digit hydrologic unit codes (HUCs), are divided into five basin years for monitoring (Figure 1). Therefore, approximately 20% of Michigan's surface waters are assessed each year. The bald eagle sample collection schedule is consistent with the basin year delineation and complements the other monitoring activities conducted during each basin year. In addition to the basin year sampling, nests associated with the Great Lakes, the connecting channels, and 12 inland territories are sampled annually. Great Lakes and connecting channel nests are sampled annually because nesting success is highly uncertain for these sites. Twelve inland territories with consistently high productivity were selected to track annual trends in contaminant concentrations, assess variability in contaminant concentrations from one year to the next, and determine the frequency that nests need to be sampled to evaluate trends.

The following basin year watersheds were the focus of sampling in 2001 (Figure 2): Keweenaw Peninsula, Sturgeon, and Dead/Kelsey watersheds of the upper peninsula, and the Muskegon, East AuGres/Rifle, Cass, lower St. Joseph, upper Grand River, and Detroit watersheds of the lower peninsula. In addition to the basin year watersheds for 2001, nests associated with the Great Lakes and connecting channels were sampled. Great Lakes-associated nests are defined as those nests within 8.0 kilometers (km) of the shorelines of the Great Lakes and along tributaries where anadromous fish are accessible. Lastly, the 12 inland territories selected for annual sampling were located within the Ontonagon, Michigamme, Au Sable, and Thunder Bay River watersheds.

3.2 FIELD METHODS

The methods used to collect blood samples from nestling bald eagles are designed to avoid injury and undue stress to the birds. Sample collection and morphometric methods are adapted from Bortolotti (1984a, 1984b, 1984c), Henny and Meeker (1981), Henny *et al.* (1981), and Morizot *et al.* (1985). The methods are summarized below, but details of the procedures are published in a standard operating procedure (SOP) (Bowerman and Roe 2002).

Blood and feather samples are collected from five- to nine-week old nestling bald eagles from May 15 through July 4. The approximate age of nestling eagles is visually estimated from two aerial survey flights that are piloted by a Michigan Department of Natural Resource (MDNR) pilot or contracted private pilot. An observer on each flight makes notes of the nest tree and location, determines an aerial latitude and longitude for the nest, and notes the reproductive status of each nest (e.g., eggs, chicks, or adult brooding behavior). From the observer's notes, field crews are directed to the nests at the appropriate time for sampling. Field staff ground truth the latitude/longitude coordinates using Global Positioning System units.

Once at the nest, a trained crewmember climbs the nest tree and secures a nestling. The nestling is placed in a restraining bag, lowered to the ground, weighed by spring scale, and prepared for sampling. Morphological measurements of the culmen, hallux claw, and bill depth are derived by using calipers. The eighth primary feather and the footpad are measured by using a ruler. Procedures developed by Bortolotti (1984b) are used to determine the age and sex of the nestlings. Sex is determined by the relationship of hallux claw length, footpad length and bill depth. Once sex is determined, the length of the eighth primary feather is used to make a sex-specific estimation of age. Table 1 lists the primary measurements taken from the nestling bald eagles sampled and analyzed in 2001.

Sterile techniques are used to collect blood from the brachial vein of nestling bald eagles. Syringes fitted with 22 or 25 gauge x 1" needles are used for the veinipuncture. Up to 12 cc of blood are drawn from the brachial vein and are then transferred to heparinized vacuum tubes and placed on ice, in coolers, for transfer out of the field. Samples of whole blood are centrifuged within 48-hours of collection and the plasma is decanted and transferred to another vacuum tube and frozen at approximately –20° C for storage. Three to four feather samples also are collected from the nestling eagles. The vacutainers are sealed with tamper-proof chain-of-custody tape. After sampling is completed, the nestlings are banded with a Size 9, United States Fish and Wildlife Service (USFWS) rivet band and an appropriate color band. The nestling is then placed back in the restraining bag, raised, and released to the nest.

From the field, samples are transferred to prearranged collection points at various MDNR, United States Forest Service, or USFWS field stations. At the end of the sampling effort, all samples are collected and transferred to the USFWS East Lansing Field Office, entered into sample storage through a chain-of-custody tracking system, and stored frozen at approximately –20° C. Upon request to the USFWS chain-of-custody officer, samples are transferred to the Clemson Institute of Environmental Toxicology (CIET) for analysis. Upon receipt at the CIET, SOPs direct that samples be logged in, checked for sample integrity, and again stored frozen at approximately –20° C until prepared for instrumental analysis (CIET 1996, 1999).

3.3 Laboratory Methods

All plasma samples were received at the CIET laboratory under chain-of-custody by November 4, 2002. All extractions and analyses were conducted according to procedures detailed in CIET SOPs. Plasma samples were extracted in seven batches. Chicken plasma was used for laboratory control samples in all analytical batches. In addition to the eagle plasma samples, each analytical batch contained a reagent blank, a chicken plasma matrix blank, a chicken plasma matrix spike, and a chicken plasma matrix spike duplicate.

Organochlorine pesticide and PCB concentrations were quantified by capillary gas chromatography with an electron capture detector using the United States Environmental Protection Agency approved methods. All reported results were confirmed by dual column analysis. The QL for the organic compounds was 2 nanograms per gram (ng/g) (parts per billion) with the exception of toxaphene, which had a QL of 125 ng/g. Method validation studies were conducted on chicken plasma as a surrogate matrix to ensure that the data quality objectives of the Quality Assurance Project Plan (QAPP) (CIET 1996, 1999) were met. Average recoveries of 70% - 130% for matrix spikes were required under the QAPP (CIET 1996, 1999). Correlation coefficients (r^2) for calibration curves consisting of five concentrations of standards were at least > 0.99 for all target analytes in all batches. The average detector response for the instrumental calibration checks was within 20% of the initial calibration for each batch. The average Relative Percent Difference for the spiked analytes in the chicken plasma matrix spike and chicken plasma matrix spike duplicate were less than 30% for all batches.

3.4 STATISTICAL DESIGN

For the purposes of reporting and statistical analysis of the 2001 data, and in keeping with reporting conventions in the scientific literature, the data were broadly grouped by breeding area location. At the broadest level, Great Lakes and inland breeding areas were compared. The breeding areas located on anadromous rivers were examined separately from other Great Lakes breeding areas for organic contaminants to better assess the concentrations that may be affecting bald eagle productivity along the Great Lakes. The Great Lakes-associated nests were evaluated further by lake basin (Superior, Michigan, Huron, and Erie). Inland breeding areas were also evaluated further by peninsula (inland lower and upper peninsula nests). Lastly, breeding areas were also grouped by watershed (HUC).

To overcome the insufficient sample sizes that prohibited rigorous statistical analyses by watersheds in the Year 2000 Annual Report (MDEQ, 2003), samples from within the 2001 designated basin year watersheds that were collected during the 1999 (MDEQ, 2002), 2000 (MDEQ, 2003), and 2001 sampling efforts were combined. Combining the 1999-2001 sampling efforts for the 2001 basin year watersheds provided the sample sizes needed for statistical analyses. However, the lower St. Joseph, upper Grand River, and Detroit watersheds of the lower peninsula, could not be included in the statistical analyses because no samples were collected from these watersheds from 1999 to 2001. The 2000 basin year watershed data, using the results of the combined 1999, 2000, and 2001 sampling effort, are presented as an appendix to this report (Appendix I).

Statistical analyses at the broadest level, Great Lakes and inland breeding areas, were performed using nonparametric Wilcoxin Rank Sum tests. Statistical analyses of regional data were performed using nonparametric Kruskal-Wallis tests. Nonparametric statistics were employed as neither the assumptions of normality nor of linear regressions were met. All Wilcoxin Rank Sum and Kruskal-Wallis tests were performed using SAS Institute, Inc. (1999) statistical package. Nonparametric multiple comparisons were used to determine where significant differences occurred within regions (SAS Institute, Inc., 1999). A probability level = 95% (α = 0.05) was used to determine statistical significance.

SECTION 4.0

RESULTS AND DISCUSSION

4.1 REPRODUCTIVE SUCCESS

The reproductive productivity (i.e., the total number of fledged young per occupied nest) was calculated for bald eagles for all breeding areas in Michigan using the method of Postupalsky

(1974). The following four comparisons were made of productivity for the 2001 breeding season (Table 2): 1) Statewide total for all nests; 2) Great Lakes and inland nests; 3) Great Lakes, anadromous, and inland nests; and 4) Lakes Erie, Huron, Michigan, Superior, and inland upper and lower peninsulas. Breeding areas were classified as inland nests if they were >8.0 km from a Great Lakes shoreline and not situated along a river open to Great Lakes fish runs (i.e., anadromous). Great Lakes breeding areas were within 8.0 km of a Great Lakes shoreline and included those situated along anadromous rivers with the exception of Analysis 3.

The productivity for bald eagles for the state of Michigan in 2001, was 0.94 young per occupied nest. This is below the goal of 1.0 young per occupied nest set in the Northern States Bald Eagle Recovery Plan (Grier *et al.*, 1983).

Based on the year 2001 aerial and ground surveys, there were 376 occupied nests in the state of Michigan. Different subpopulation comparisons showed only slight differences in productivity among areas of the state (Table 2). Great Lakes (0.94), Inland (0.94), and anadromous (0.63) breeding areas were not significantly different (χ^2=3.339, P=0.1883). Breeding area productivities did not vary significantly by watershed locations (χ^2=4.712, P=0.4520). Lake Erie had the greatest watershed productivity (1.43), followed by Lake Michigan (1.07), inland lower peninsula (1.01), inland upper peninsula (0.87), Lake Huron (0.84), and Lake Superior (0.81).

Caution must be used when using statewide productivity from only one year to determine the health of the Michigan bald eagle population. A number of factors, including sample size and which nests are occupied annually, can greatly affect this determination. Individual breeding area productivities can be affected by weather, adult turnover rates, and other factors including longevity and patterns of occupancy. Furthermore, the 1.0 young per occupied nest is a recovery goal (Grier *et al.*, 1983) that was derived from an early modeling effort.

4.2 ORGANIC CONTAMINANTS IN NESTLING BALD EAGLE BLOOD SAMPLES

In 2001, 101 nestling bald eagle blood samples were analyzed for organochlorine contaminants. The target list of analytes included historical organochlorine pesticides such as chlordane, dieldrin, and DDT and its metabolic products, and 20 PCB congeners. The complete list of analytes and the parameter-specific Method Detection Levels (MDLs) and QLs are shown in Table 3. For statistical analysis, concentrations less than the MDL were reported as nondetects and were set at zero.

Of the 101 samples analyzed, 27 were from breeding areas in the 2001 basin year watersheds. Regionally, the analyzed samples were from 35 inland upper peninsula, 14 inland lower peninsula, 20 Lake Superior, 9 Lake Michigan, 19 Lake Huron, and 4 Lake Erie breeding areas.

The No Observable Adverse Effect Levels (NOAELs) in the blood of bald eagle nestlings for DDE and PCBs that are associated with a healthy bald eagle population (i.e., an average of one young per occupied nest) were determined using data from Bowerman et al., (2003). The NOAELs for DDE and PCBs in nestling blood are 11.4 and 36.4 ng/g, respectively.

4.3 DDT and Metabolites

Concentrations of 2,4'- and 4,4'-DDT and their metabolites, 2,4'- and 4,4'-DDE and 2,4'- and 4,4'-DDD, were measured in nestling bald eagle blood samples (Table 4). The most ubiquitous compound was 4,4'-DDE, which was quantified in 98 (97%) of the samples. Statewide, concentrations of 4,4'-DDE ranged from < 0.61 – 109.39 ng/g. 2,4'-DDE was quantified in

6 (6%) of the samples. Concentrations of 2,4'-DDE ranged from < 0.86 – 2.07 ng/g. 2,4'-DDD, 4,4'-DDD, 2,4'-DDT, and 4,4'-DDT were not detected in any of the 2001 bald eagle plasma samples.

Total DDT concentrations were calculated as the sum of 2,4'- and 4,4'- DDE, DDD, and DDT. Of the metabolites, 4,4'-DDE contributes the most to the total DDT concentrations (Table 4). Significant differences ($P<0.0001$) in total DDT concentrations were found between inland and Great Lakes breeding areas. Significant differences ($P<0.0001$) in total DDT concentrations were also found between inland, Great Lakes, and anadromous breeding areas. The Great Lakes and anadromous breeding areas were found to have significantly greater ($P<0.0001$) total DDT concentrations than inland Michigan breeding areas. Significant differences ($P<0.0001$) in total DDT concentrations were also found between inland lower and upper peninsulas, Lake Erie, Lake Huron, Lake Michigan, and Lake Superior breeding areas. Specifically, the concentration of total DDT in Lake Michigan was significantly greater than the concentrations of total DDT in the Lake Erie, Lake Superior, and inland lower and upper peninsulas breeding areas ($P<0.0118$). Lake Huron total DDT concentrations were significantly greater than the Lake Superior and the inland lower and upper peninsula breeding areas of Michigan ($P<0.0010$).

Mean total DDT concentrations were ranked in the following order by location from highest to lowest: Anadromous > Great Lakes > inland breeding areas; and Lake Michigan > Lake Huron > Lake Superior > Lake Erie > inland lower peninsula > inland upper peninsula breeding areas (Table 5, Figure 3).

At individual breeding areas, the greatest total DDT concentration (110.89 ng/g) was measured in a nestling from the Partridge Island breeding area, which is located on an island in Lake Superior in Marquette County (MQ-04d) (Table 4, Figure 4). This breeding area also had the highest total DDT concentration (256.51 ng/g) in 2000 (MDEQ 2003). Three other breeding areas had high total DDT concentrations, two from the Lake Michigan breeding area and one from the Lake Huron breeding area. Total DDT concentrations were quantified at 99.51 ng/g for Lake Michigan's Kregg Bay breeding area (DE-21c) and 91.59 ng/g for Lake Michigan's No-see-um Creek - North Lake breeding area (DE-16b), both in Delta County. A total DDT concentration of 80.39 ng/g was measured in Lake Huron's Gravel Island breeding area in Chippewa County (CP-26c).

Of the anadromous breeding areas, two breeding areas in Saginaw County, at Shiawassee Cutoff breeding area (SG-04b, 60.27 ng/g) and the Shiawassee National Wildlife Refuge breeding area (SG-02c, 53.49 ng/g) of the Saginaw River system, had the greatest total DDT concentrations. The nestling at Horseshoe Bend in Manistee County (MN-02b) had the third highest total DDT concentration (44.22 ng/g). This anadromous breeding area had the greatest total DDT concentration in 1999 (52.6 ng/g) and 2000 (39.51 ng/g).

The NOAEL for 4,4'- DDE in the blood of nestling bald eagles was determined to be 11.4 ng/g based on data presented in Bowerman et al., (2003). Of the 101 nestling plasma samples analyzed in 2001, 37 of the samples exceeded the NOAEL. It is therefore possible that once some of these nestlings reach breeding age they may not be able to reproduce at a level considered to support a healthy population due to elevated concentrations of 4,4'- DDE. The finding that some nestlings have concentrations of 4,4'-DDE in their blood above the NOAEL further stresses the importance of the long-term monitoring program to track fluctuations in annual bald eagle productivity within the state of Michigan.

The 2001 results were compared to results for samples collected using the same protocol during the period 1987-1992 (Bowerman *et al.*, 1993; Bowerman *et al.*, 2003). These comparisons (Table 6, Figure 5) show that 4,4'-DDE concentrations measured in 2001, were significantly less than those measured from 1987-1992 at the Lake Superior, and upper and lower peninsula breeding areas (P<0.0001). The year 2001 Lakes Huron and Erie breeding area's 4,4'-DDE concentrations were lower, but not statistically lower, than the concentrations measured from 1987-1992 (P=0.075). The exception to this trend was seen in Lake Michigan where the geometric mean 4,4'-DDE concentrations did not show a decline from 1987-1992 to 2001.

To allow a more rigorous statistical analyses, the 4,4'-DDE results from 1999-2001 were combined and then compared to results from 1987-1992 (Bowerman *et al.*, 1993; Bowerman *et al.*, 2003). These comparisons (Table 7) show that 4,4'-DDE concentrations measured from the period 1999-2001 were significantly less than those measured from 1987-1992 for the Lake Erie, Lake Huron, Lake Superior, and upper and lower peninsula breeding areas (P<0.0392). The exception to this trend was seen in Lake Michigan where the geometric mean 4,4'-DDE concentrations did not show a decline from 1987-1992 to 1999-2001.

Significant differences in total DDT concentrations were also found between the 2001 basin year watersheds (P<0.0019) (Table 8). The Cass watershed (HUC 04080205) total DDT concentration was significantly greater than the total DDT concentrations for the Muskegon and East AuGres/Rifle watersheds of the lower peninsula and the Sturgeon and Dead/Kelsey watersheds of the upper peninsula (P<0.0385). The Sturgeon watershed (HUC 04020104) had significantly lower total DDT concentrations than the Dead/Kelsey and Keweenaw Peninsula watersheds of the upper peninsula and the East AuGres/Rifle, Muskegon, and the Cass watersheds of the lower peninsula (P<0.0072).

4.4 PCBs

Twenty PCB congeners were quantified and summed to determine total PCBs in nestling bald eagle plasma samples (Table 9). The most ubiquitous congeners were PCB congeners 138 and 153, which were quantified in 71 (70%) samples each. Statewide, concentrations of congener 138 ranged from <0.65 – 45.74 ng/g and congener 153 ranged from <0.57 – 67.45 ng/g. The only other congener with greater than 50% quantification was congener 118 (56%). The statewide range for congener 118 was <0.58-34.94 ng/g. PCB congener 8 was not detected in any plasma sample analyzed in year 2001.

Statewide total PCB concentrations ranged from nondetect to 302.43 ng/g (Table 9). At least one of the targeted PCB congeners was detected in 76 (75%) of the 101 nestlings sampled. Of the 25 nestlings in which no PCB congeners were detected, 23 were found in inland upper peninsula breeding areas, and two were from Lake Superior breeding areas. PCB congeners were detected in nestlings from inland, Great Lakes, and anadromous breeding areas (Table 9). Total PCB concentrations were significantly different among the inland, Great Lakes, and anadromous breeding areas (P < 0.0001). The Great Lakes and anadromous breeding areas were found to have significantly greater (P<0.0001) PCB concentrations than inland breeding areas. Significant differences (P<0.0001) in total PCB concentrations were also found between inland lower and upper peninsulas, Lake Erie, Lake Huron, Lake Michigan, and Lake Superior breeding areas. PCB concentrations in Lakes Erie, Michigan, and Huron were significantly greater than Lake Superior and the upper and lower peninsulas of Michigan (P<0.0002). Lake Superior was significantly greater than the inland upper and lower peninsulas of Michigan (P<0.0179).

Mean total PCB concentrations were ranked in the following order by location from highest to lowest: anadromous > Great Lakes > inland breeding areas; and Lake Erie > Lake Michigan > Lake Huron > Lake Superior > inland lower peninsula > inland upper peninsula breeding areas (Table 10, Figure 6).

Concentrations of total PCBs were greatest in nestlings associated with anadromous breeding areas (Figure 6). The mean total PCB concentration in all anadromous nestlings (82.96 ng/g) was greater than concentrations in Great Lakes breeding areas (mean = 61.99 ng/g) (Table 10). Further, total PCBs in anadromous and Great Lakes' nestlings were greater than concentrations in inland nestlings (mean = 5.61 ng/g) (Table 10).

The greatest concentration of total PCBs (302.43 ng/g) was found in a Lake Michigan nestling from Delta County (DE-21c) (Table 9, Figure 7). An anadromous nestling, from the Lake Huron breeding area, had the 2nd highest concentration of total PCBs. The nestling was from the Shiawassee Cutoff breeding area in Saginaw County (SG-04b, 268.34 ng/g). Two other Lake Michigan breeding areas from Delta County, in the upper peninsula, also had high concentrations of total PCBs in 2001. The nestlings were from the Fishdam River mouth breeding area (DE-17d) with total PCB concentrations quantified at 73.39 ng/g and from the North Lake – No-see-um Creek breeding area (DE-16b) with total PCB concentrations quantified at 251.01 ng/g. These breeding areas are a part of the Green Bay National Resources Damage Assessment (NRDA) for PCB contamination.

The Saginaw River is also a NRDA site for PCB contamination, with remedial actions in progress. Despite the known sources of contamination, nestlings in the Saginaw River system had moderate to high total PCB concentrations. The breeding areas upriver of the remedial site include the Shiawassee State Game Area (SG-01e, 11.94 ng/g), Shiawassee National Wildlife Refuge (SG-02c, 136.98 and 189.92 ng/g), and the Shiawassee Cutoff breeding area (SG-04b, 268.34 ng/g). The breeding areas downriver to the remedial site include Santiago, which is the breeding area furthest down river (AR-03d, 25.47 ng/g), Big Charity Island, which is located in outer Saginaw Bay (AR-04b, 75.56 ng/g), Quanicassee (BY-02c, 60.17 ng/g), Dinsmoore (TU-01c, 51.66 and 72.72 ng/g), and Fish Point State Wildlife Area (TU-02d, 38.25 and 50.61 ng/g), which are all located adjacent to the remedial site in Saginaw Bay, south of the Saginaw River mouth.

The NOAEL for total PCBs in the blood of nestling bald eagles was determined to be 36.4 ng/g based on data presented in Bowerman et al., (2003). Of the 101 nestling plasma samples analyzed in 2001, 30 of the samples exceed the NOAEL. It is therefore possible that once some of these nestlings reach breeding age they may not be able to reproduce at a level considered to support a health population due to elevated concentrations of PCBs. The finding that some nestlings have concentrations of PCBs in their blood above the NOAEL further stresses the importance of the long-term monitoring program that is needed to track fluctuations in annual bald eagle productivity within the state of Michigan.

Data from the 2001 Michigan samples were compared to samples collected under the same protocol during the period 1987-1992 (Bowerman *et al.*, 1993; Bowerman *et al.*, 2003). These comparisons (Table 11, Figure 8) show that total PCB concentrations measured in 2001, were less than those measured in 1987-1992. However, the decrease in PCB concentrations was not statistically significant, at an alpha of 0.05, for Lakes Erie ($P=0.372$), Michigan ($P=0.051$), or Huron ($P=0.064$). Total PCB concentrations measured in 2001, were significantly lower ($P<0.0001$) than concentrations measured in 1987-1992 for Lake Superior, and the inland upper and lower peninsula breeding areas of Michigan.

To allow a more rigorous statistical analyses, the total PCB results from 1999-2001 were combined and then compared to results from the period 1987-1992 (Bowerman *et al.*, 1993; Bowerman *et al.*, 2003). These comparisons (Table 12), show that total PCB concentrations measured from the period 1999-2001, were significantly less than those measured from 1987-1992 at the Lake Huron, Lake Michigan, Lake Superior, and upper and lower peninsula breeding areas ($P<0.0036$). The exception to this trend was seen in Lake Erie where the geometric mean total PCB concentrations did not show a significant decline from 1987-1992 to 1999-2001 ($P<0.1302$).

The total PCB concentrations are listed by watershed in Table 13. Significant differences in total PCB concentrations were also found between the 2001 basin year watersheds ($P<0.0001$) (Table 14). The Cass watershed (HUC 04080205) total PCB was significantly greater than total PCB concentrations for the Muskegon and East AuGres/Rifle of the lower peninsula and the Sturgeon, Dead/Kelsey, and Keweenaw Peninsula watersheds of the upper peninsula ($P<0.0338$). The Muskegon watershed (HUC 04060102) had significantly lower total PCB concentrations than the Dead/Kelsey and Keweenaw Peninsula watersheds of the upper peninsula and the East AuGres/Rifle and the Cass watersheds of the lower peninsula ($P<0.0087$). The Sturgeon watershed (HUC 04020104) had significantly lower total PCB concentrations than the Dead/Kelsey and Keweenaw Peninsula watersheds of the upper peninsula and the Muskegon, East AuGres/Rifle, and the Cass watersheds of the lower peninsula ($P<0.0004$).

4.5 Other Organics

Concentrations of α-hexachlorocyclohexane (α-HCH), γ-hexachlorocyclohexane (γ-HCH), heptachlor, γ-chlordane, and toxaphene were not detected in any of the year 2001 samples. The QL for toxaphene is too high at 125 ng/g to characterize this contaminant in nestling bald eagle plasma samples. The analytical results for hexachlorobenzene, α-HCH, γ-HCH, heptachlor, heptachlor epoxide, α-chlordane, γ-chlordane, dieldrin, and toxaphene are shown in Table 15.

The only two samples collected in which hexachlorobenzene was quantified were from Lake Superior in the Von Zellens breeding area (BG04c, 0.54 ng/g) in Baraga County, and the Partridge Island breeding area (MQ-04d, 0.73 ng/g) in Marquette County. Heptachlor epoxide was quantified in four Great Lake samples, with three from the Lake Superior breeding area (AG-11f, 1.13 ng/g; BG-12a, 0.86 ng/g; MQ-04d, 1.72 ng/g), and one from the Lake Michigan breeding area (DE-21c, 1.44 ng/g).

Quantifiable concentrations of α-chlordane and dieldrin were more common. α-Chlordane was quantified in 29 samples, ranging from 0.80-8.73 ng/g, with 28 of those samples from Great Lakes breeding areas and 1 sample from the inland upper peninsula breeding area. The greatest concentration of α-chlordane (8.73 ng/g) measured in any region was found in a nestling from the Shiawassee Cutoff breeding area (SG-04b) in Saginaw County (Table 15). Statistical tests were conducted to discern any differences between breeding areas with regard to α-chlordane. Significant differences ($P<0.0001$) in α-chlordane concentrations were found between inland and Great Lakes breeding areas. A Kruskal-Wallace statistical test could not be conducted between the Great Lakes, inland, and anadromous breeding areas due to the large number of nondetect values for the inland breeding areas. Significant differences were also found between inland lower peninsula, inland upper peninsula, Lake Erie, Lake Huron, Lake Michigan, and Lake Superior breeding areas ($P<0.0001$). The Lake Erie breeding area was significantly greater than the other five breeding areas. The Lakes Michigan and Huron breeding areas were significantly greater than the inland upper and lower peninsula and Lake Superior breeding areas ($P<0.0199$). The Lake Superior breeding areas were significantly greater than the inland upper and lower peninsula breeding areas ($P<0.0341$).

Mean α-chlordane concentrations were ranked in the following order by location from highest to lowest: anadromous > Great Lakes > inland breeding areas; and Lake Erie > Lake Michigan > Lake Huron > Lake Superior > inland upper peninsula > inland lower peninsula breeding areas (Figure 9).

Significant differences in α-chlordane concentrations were also found between the 2001 basin year watersheds ($P<0.0324$). Five different groupings of the 2001 basin year watersheds, Keweenaw Peninsula, Sturgeon, and Dead/Kelsey watersheds of the upper peninsula, and the Muskegon, East AuGres/Rifle, Cass, lower St. Joseph, upper Grand River, and Detroit watersheds of the lower peninsula were significantly different. These data are presented in Table 16.

Similarly, quantifiable concentrations of dieldrin, ranging from 1.00 – 17.26 ng/g, were measured in 39 blood samples (Table 15). The greatest concentration of dieldrin was measured in Kregg Bay, a Lake Michigan breeding area in Delta County (DE-21c, 17.26 ng/g). Like α–chlordane, concentrations of dieldrin were greatest in nestlings located in Great Lakes breeding areas and least in inland breeding areas.

Statistical tests were completed to discern any differences between breeding areas with regard to dieldrin. Significant differences ($P<0.0001$) in dieldrin concentrations were found between inland and Great Lakes breeding areas. A Kruskal-Wallace statistical test indicated significant differences ($P<0.0001$) exist between Great Lakes, inland, and anadromous breeding areas. The Great Lakes breeding area was found to be significantly greater ($P<0.0015$) than the anadromous or inland breeding areas. Significant differences were also found between inland lower peninsula, inland upper peninsula, Lake Erie, Lake Huron, Lake Michigan, and Lake Superior breeding areas ($P<0.0001$). The Lakes Michigan, Superior, Erie, and Huron breeding areas had greater dieldrin concentrations than the inland upper and lower peninsula breeding areas ($P<0.0203$).

Mean dieldrin concentrations were ranked in the following order by location from highest to lowest: Great Lakes > anadromous > inland breeding areas; and Lake Michigan > Lake Superior > Lake Erie > Lake Huron > inland lower peninsula > inland upper peninsula breeding areas (Figure 10).

Significant differences in dieldrin concentrations were also found between the 2001 basin year watersheds ($P<0.0001$). Three different groupings of the 2001 basin year watersheds, Keweenaw Peninsula, Sturgeon, and Dead/Kelsey watersheds of the upper peninsula, and the Muskegon, East AuGres/Rifle, Cass, lower St. Joseph, upper Grand River, and Detroit watersheds of the lower peninsula were significantly different. These data are presented in Table 17.

SECTION 5.0

FUTURE STUDIES

Several potential areas of future study were identified following the first three years of this monitoring study:

- Determine if the variability is too high and the sample size too small to allow spatial and temporal trends to be assessed on a watershed basis.
- Determine if it is possible to locate key sources of mercury contamination in bald eagles by modeling air releases.
- Conduct further investigations to determine the source of PCBs found in hotspots such as the Huron Islands breeding area.
- Examine contaminant data to assess the partitioning of contaminants between various media and biota.
- Analyze archived eagle samples to enhance our ability to assess trends.
- Analyze some of the blood samples for new and emerging chemicals of concern (a subset of the samples collected in 2003 will be analyzed for polybrominated diphenyl ethers).

SECTION 6.0

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SECTION 7.0

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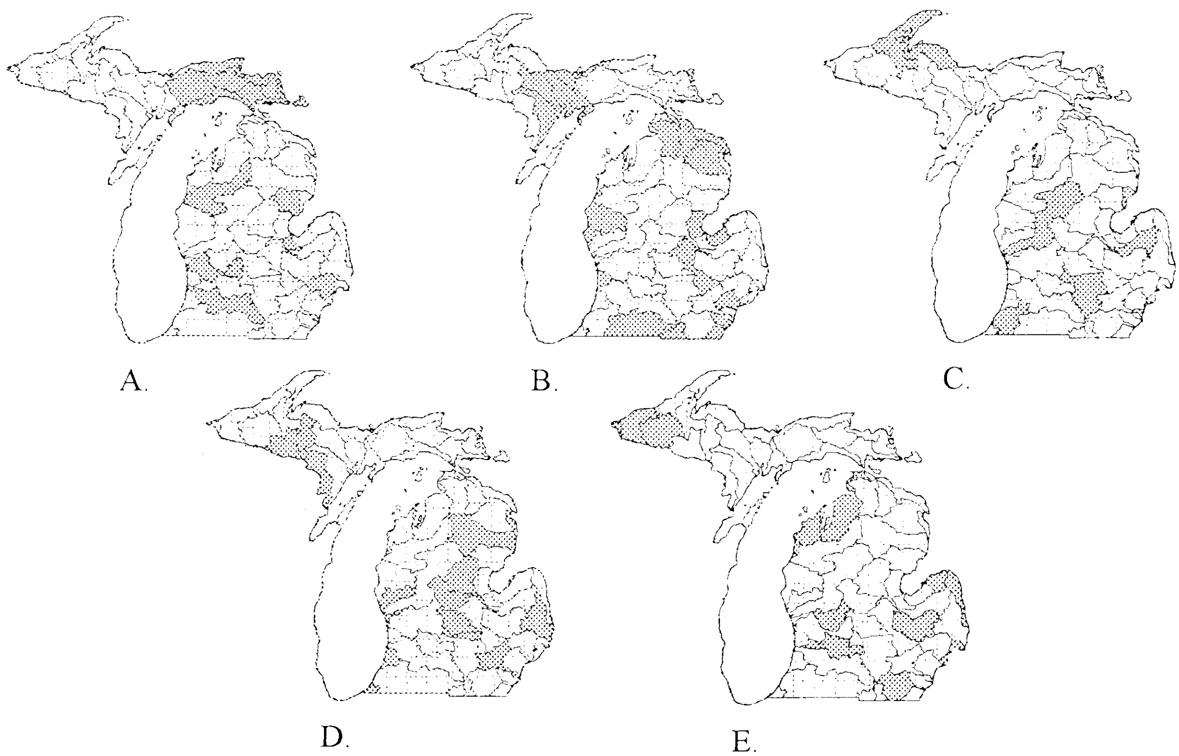

Figure 1. Michigan's watershed delineations and monitoring 'basin years'. A.) 1999 basin year watersheds (shaded), B.) 2000 basin year watersheds (shaded), C.) 2001 basin year watersheds (shaded), D.) 2002 basin year watersheds (shaded), and E.) 2003 basin year watersheds (shaded).

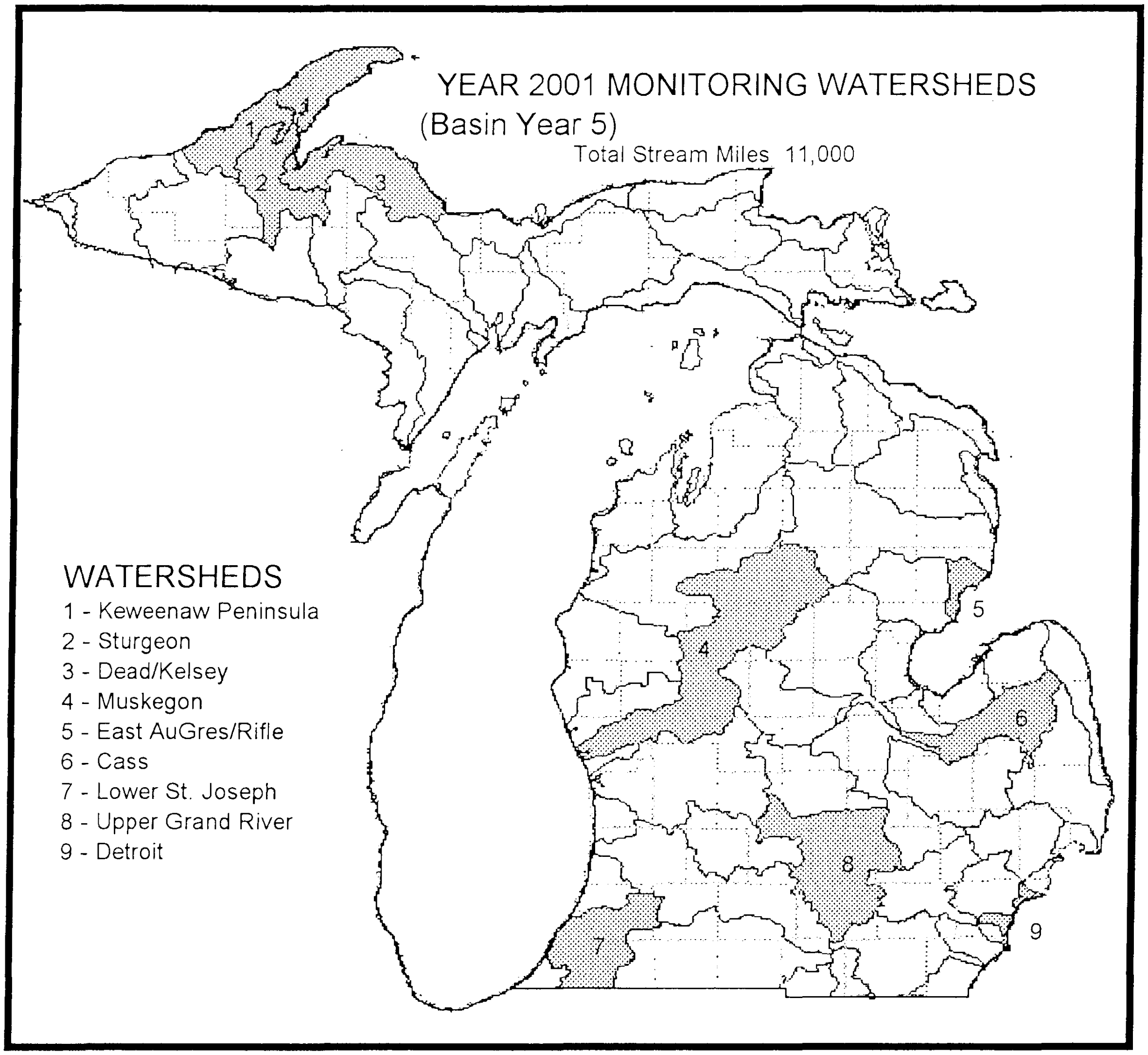

Figure 2. The 2001 basin year watersheds.

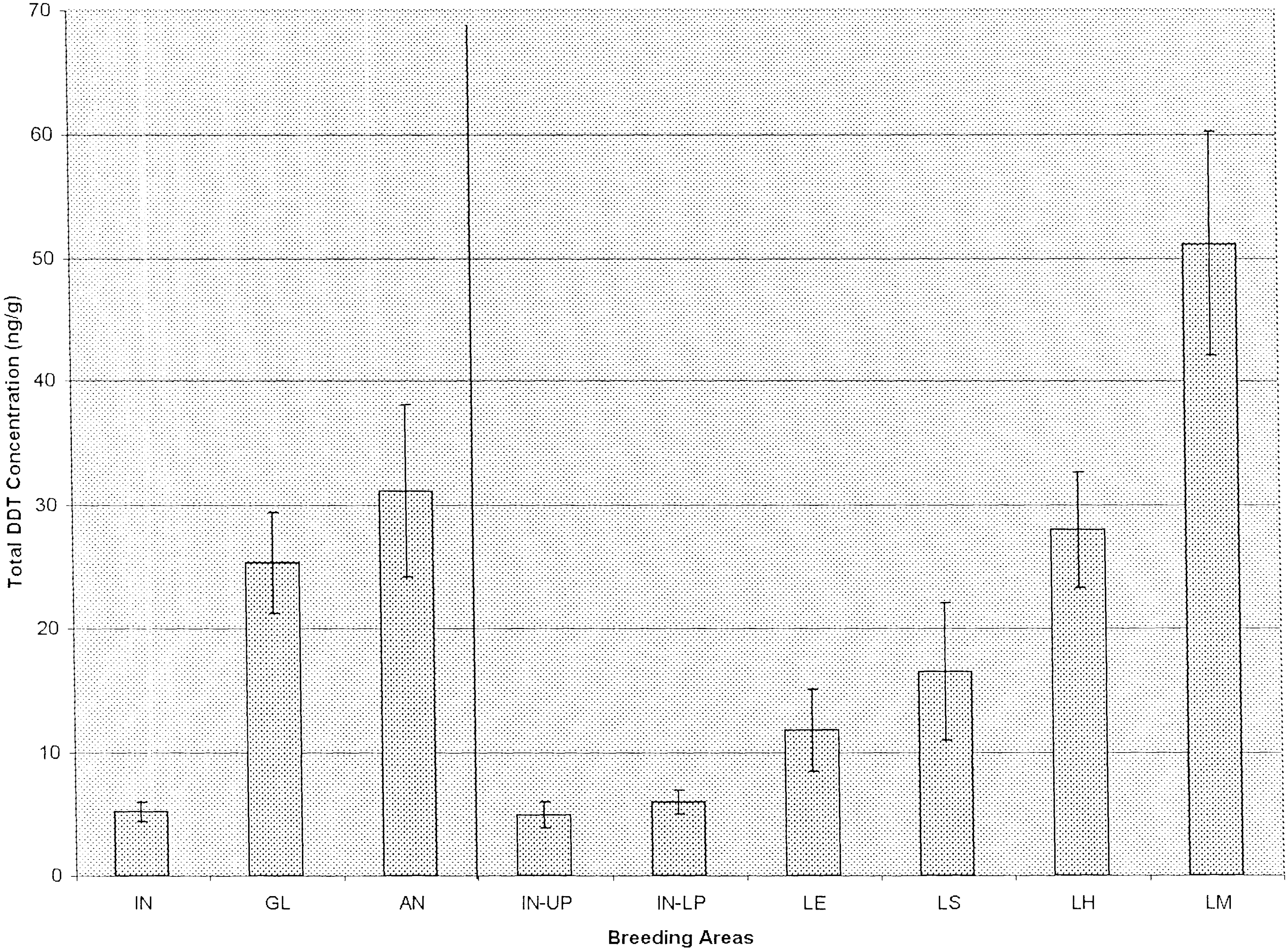

Figure 3. Mean Total DDT Concentrations (ng/g) in Nestling Bald Eagle Plasma in 2001.

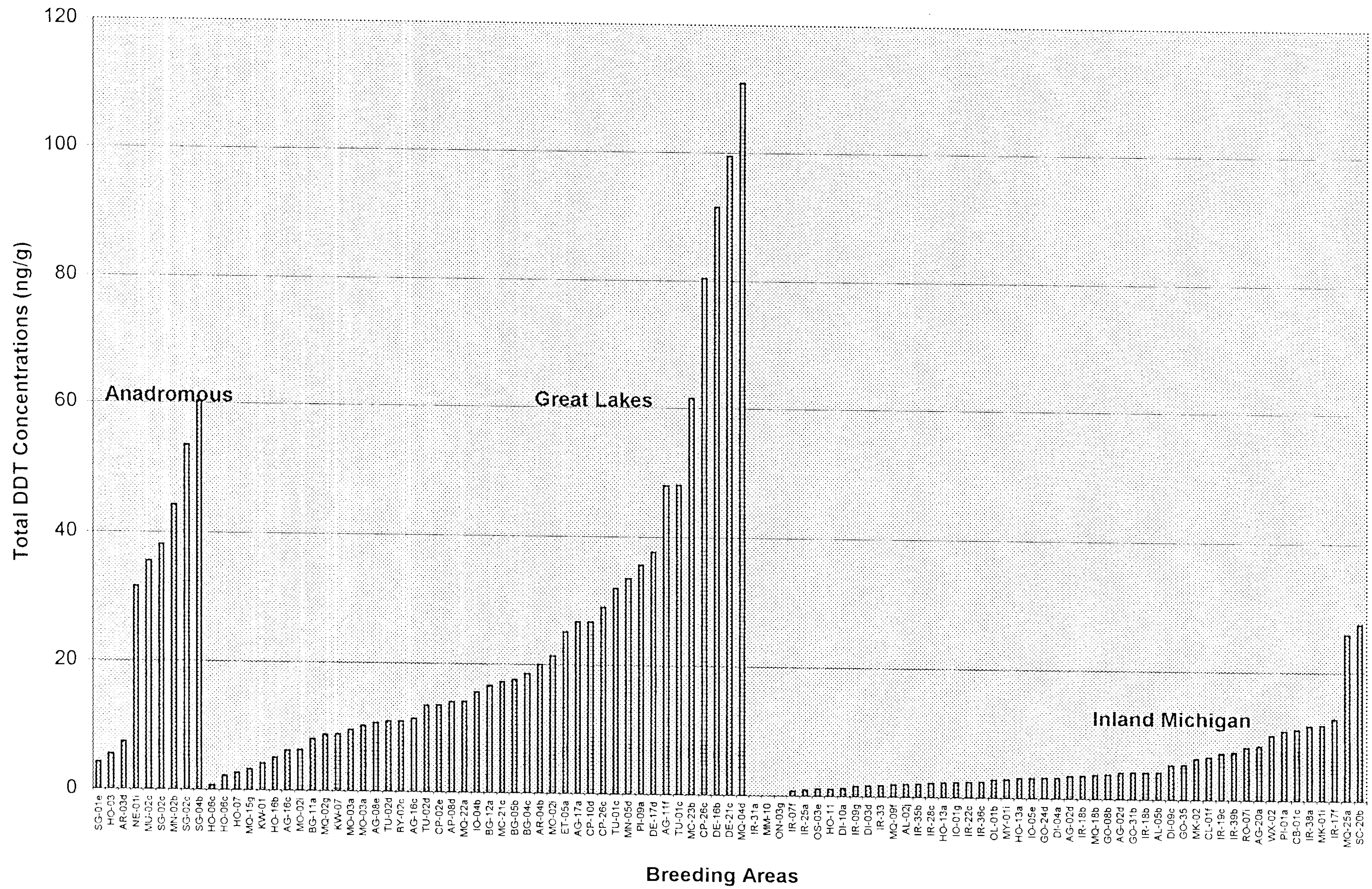

Figure 4. Concentrations of Total DDT (ng/g) in Nestling Bald Eagle Plasma from 2001.

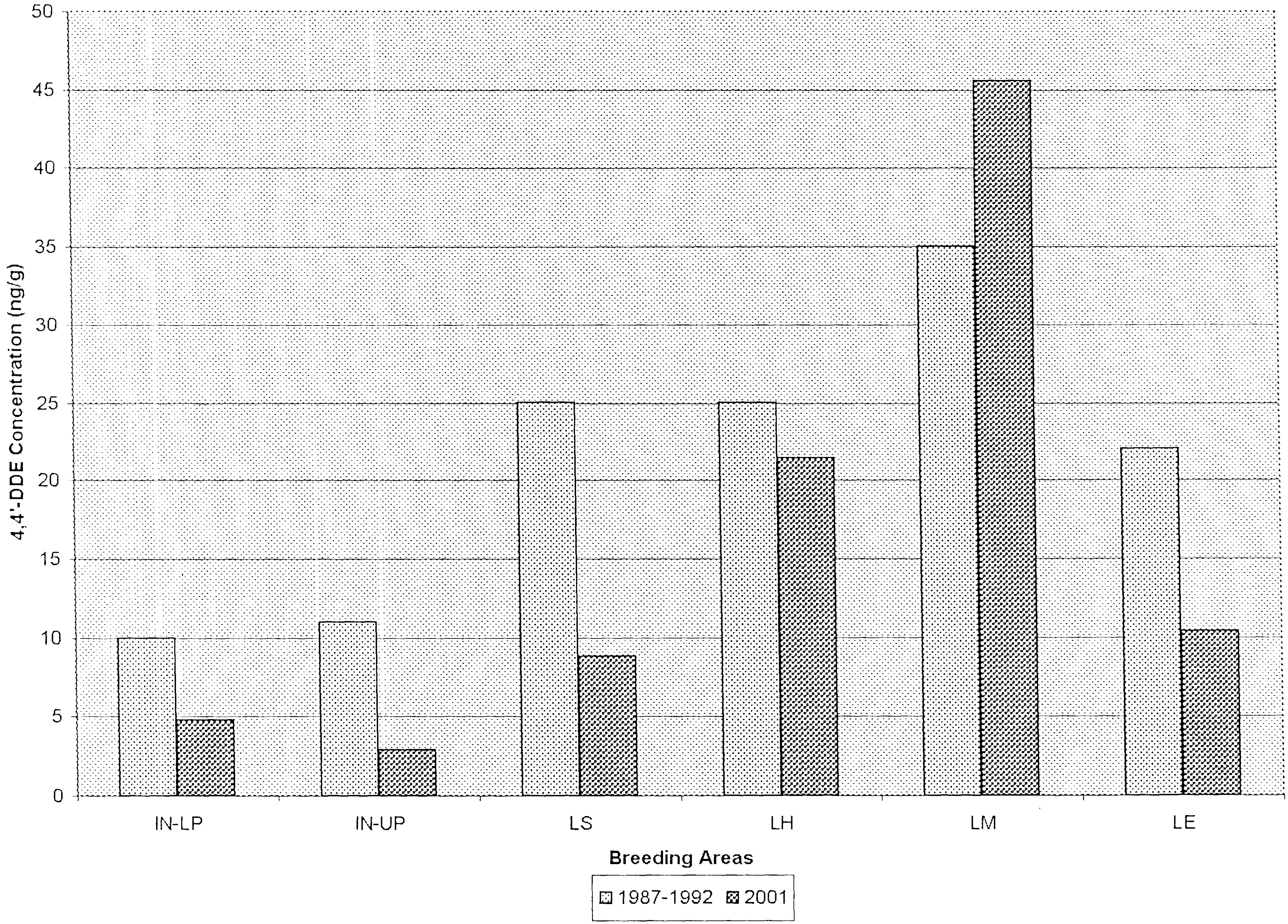

Figure 5. Geometric Mean of 4,4'-DDE (ng/g) in Nestling Bald Eagle Plasma for 1987-1992 and 2001.

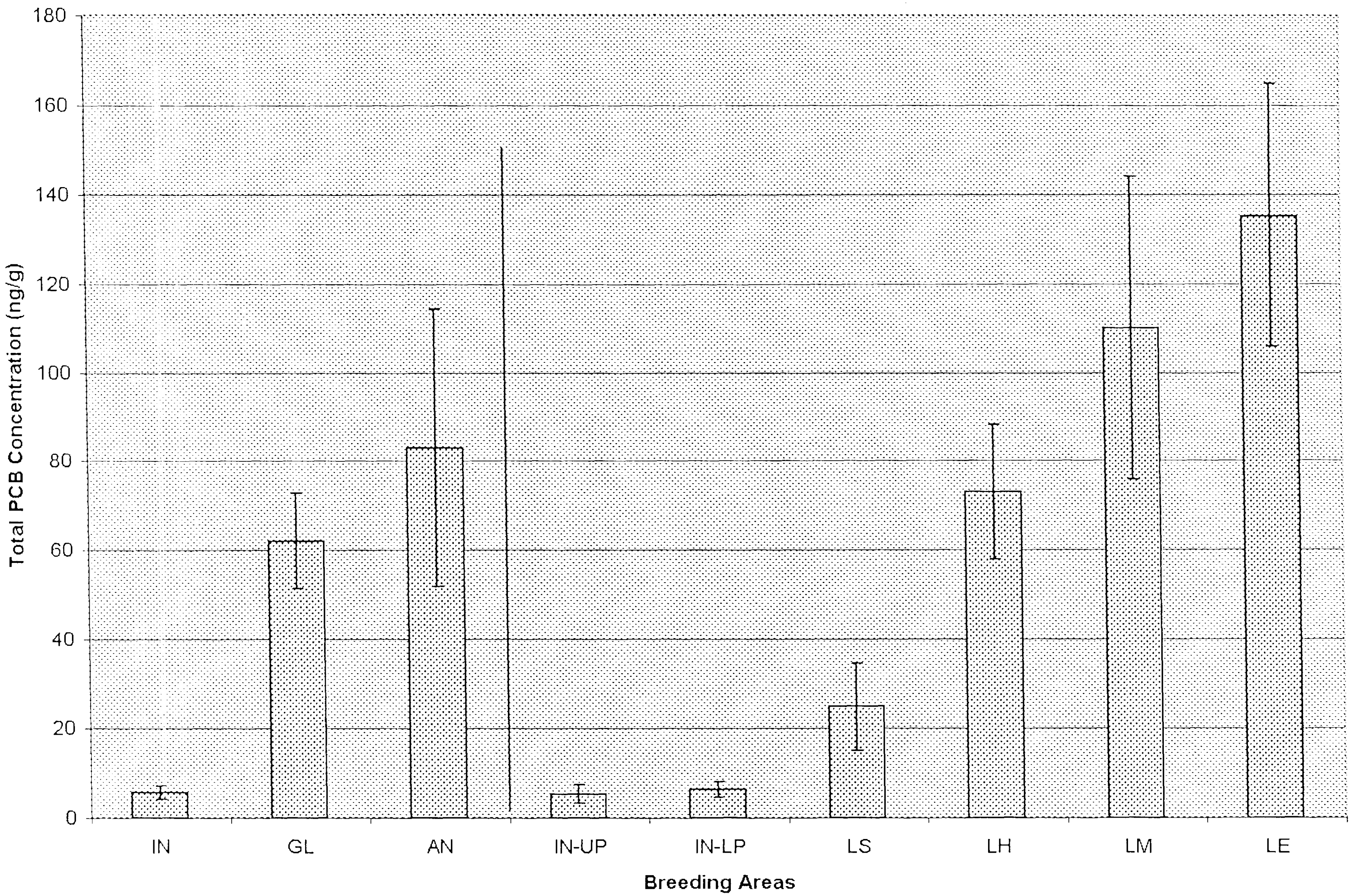

Figure 6. Mean Total PCB Concentrations (ng/g) in Nestling Bald Eagle Plasma in 2001.

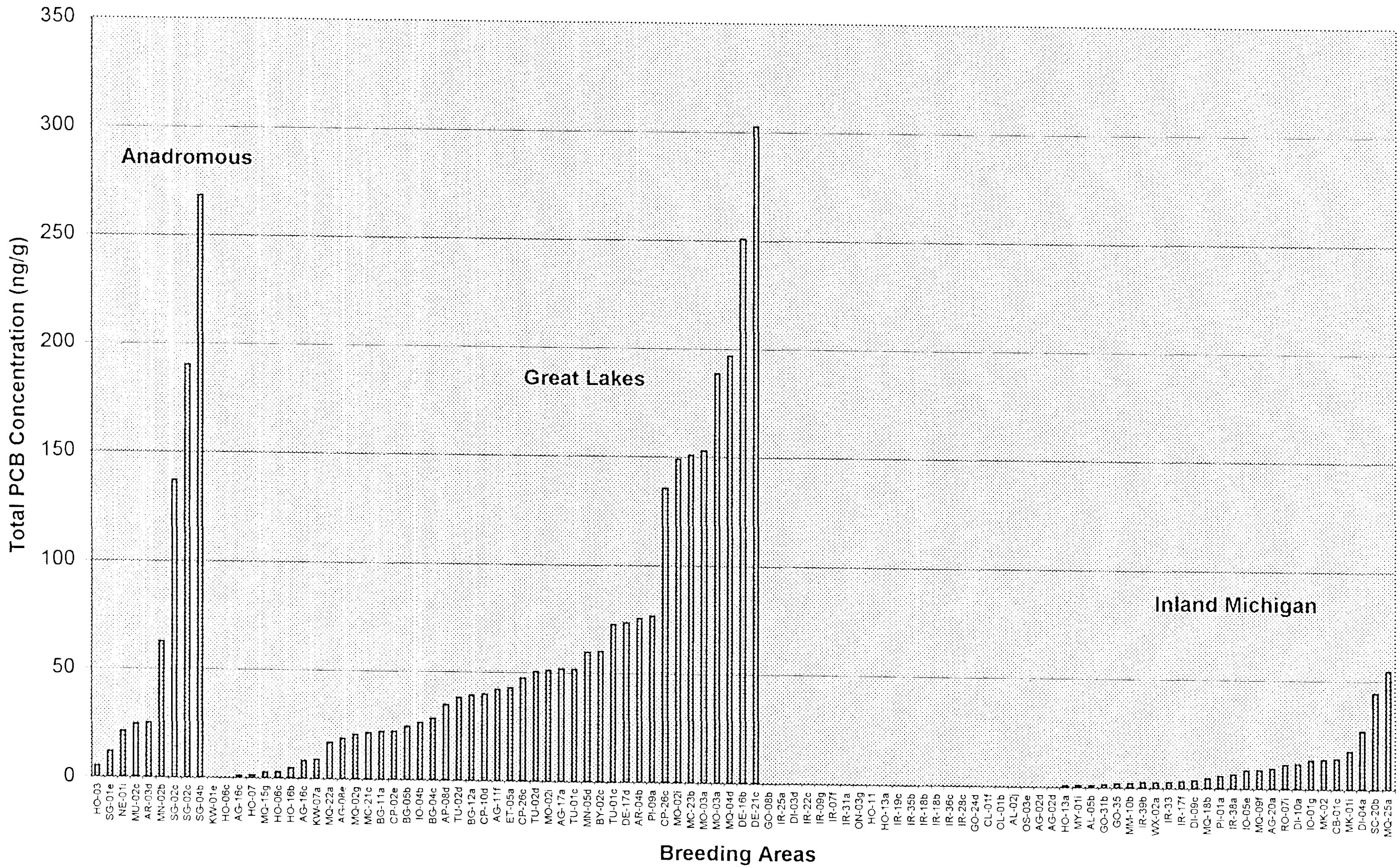

Figure 7. Concentrations of Total PCBs (ng/g) in Nestling Bald Eagle Plasma from 2001.

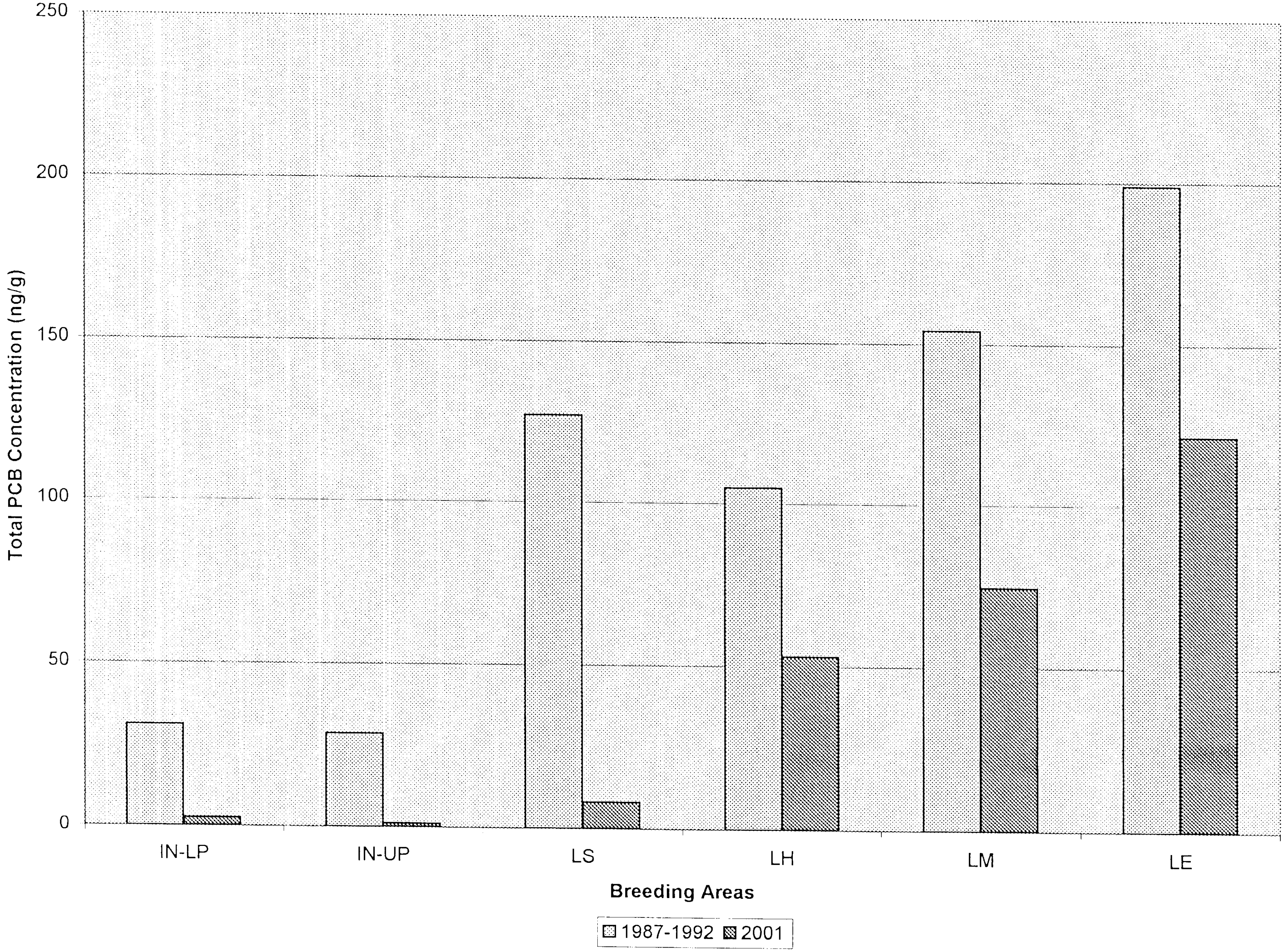

Figure 8. Geometric Mean Total PCBs (ng/g) in Nestling Bald Eagle Plasma for 1987-1992 and 2001.

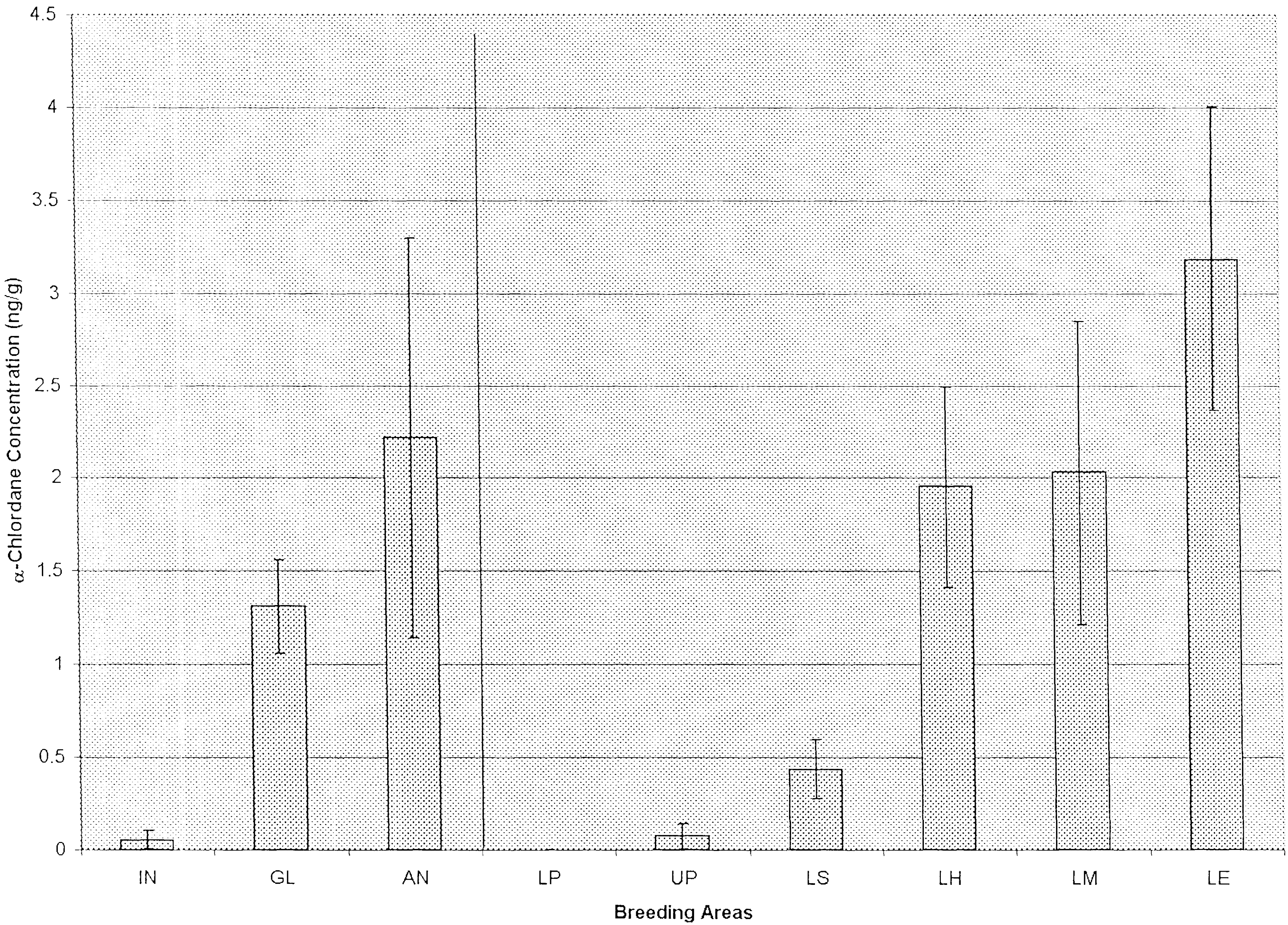

Figure 9. Mean a-Chlordane Concentrations (ng/g) in Nestling Bald Eagle Plasma from 2001.

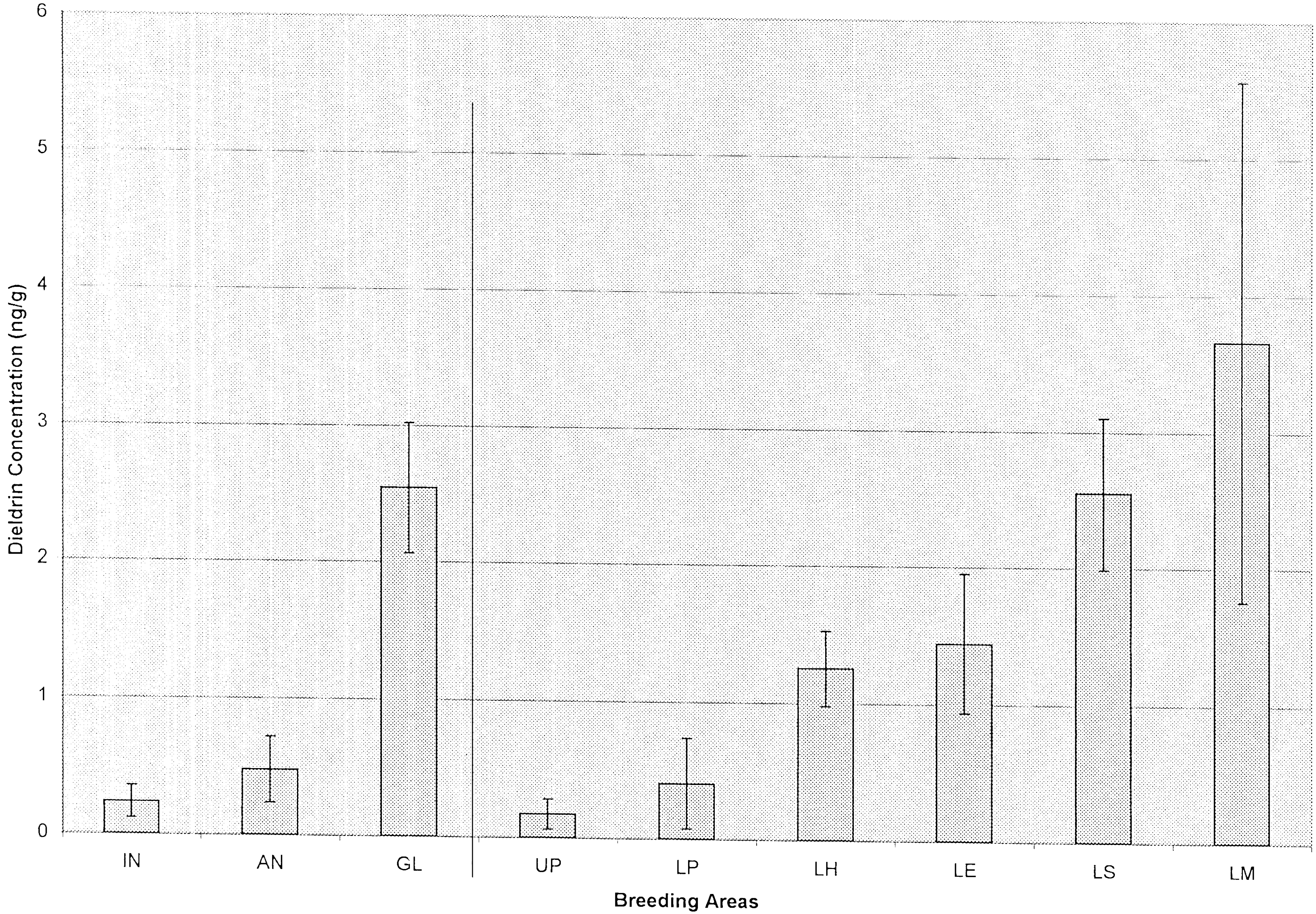

Figure 10. Mean Dieldrin Concentrations (ng/g) in Nestling Bald Eagle Plasma from 2001.

Table 1. Morphometric data for nestling bald eagles sampled and analyzed in 2001. Measurements are in millimeters (mm) unless otherwise stated.

Territory (A)	Breeding Area Location (B)	Territory Location ('C)	Blood Sample Number	Breeding Area Name	Date	Eaglet Sex Male/Female	Eighth Primary	Age (Days)	Footpad	Weight (kg)	Bill Depth	Culmen Length	Hallux	Tarsus	Middle Rectrix
AG-02d	UP	IN	BAEA-MI-C-2001-29	Baldy Lake	6/18/2001	M	240	52.8	130	3.6	30.2	45.7	34.9	*	155
AG-02d	UP	IN	BAEA-MI-C-2001-30	Baldy Lake	6/18/2001	M	202	47.5	127	3.2	30.7	44.5	*	*	*
AG-08e	LS	GL	BAEA-MI-D-2001-24	Autrain Lake	6/12/2001	M	171	37.4	130	3.7	27.4	41.5	34.5	*	*
AG-11f	LS	GL	BAEA-MI-C-2001-31	Laughing Whitefish Point	6/16/2001	F	252	55.9	140	4.6	33.1	45.0	38.9	*	*
AG-16c	LS	GL	BAEA-MI-A-2001-111	Beaver Basin	7/17/2001	M	263	56.0	127	4.1	30.5	45.0	34.0	18.3	119
AG-16c	LS	GL	BAEA-MI-A-2001-112	Beaver Basin	7/17/2001	F	243	55.0	138	4.7	31.8	47.2	37.3	19.8	90
AG-17a	LS	GL	BAEA-MI-A-2001-110	Grand Sable Lake	7/5/2001	F	165	44.0	136	4.3	33.3	46.5	36.6	19.6	54
AG-20a	UP	IN	BAEA-MI-D-2001-23	Hovey Lake	6/12/2001	M	135	38.1	137	4.3	29.8	45.5	33.0	*	*
AL-02j	LP	IN	BAEA-MI-C-2001-08	Bamfield Pond/Alcona Dam Pond	5/19/2001	F	220	51.4	145	4.2	32.5	46.3	38.3	*	*
AL-05b	LP	IN	BAEA-MI-D-2001-06	Sprinkler Lake	5/25/2001	M	*	54.2	125	3.9	30.9	43.3	35.0	*	*
AP-08d	LH	GL	BAEA-MI-D-2001-07	Devils Lake	5/25/2001	M	186	45.2	135	4.3	*	*	36.5	*	*
AR-03d	LH	AN	BAEA-MI-D-2001-10	Santiago	5/28/2001	F	170	44.4	146	4.6	31.3	44.5	36.9	*	*
AR-04b	LH	GL	BAEA-MI-D-2001-17	Big Chaity Island	5/31/2001	M	168	42.7	135	4.3	31.7	43.7	37.4	*	*
BG-04c	LS	GL	BAEA-MI-A-2001-53	Von Zellens	6/12/2001	unk	231	53.0	132	3.8	31.0	43.2	35.3	19.6	86
BG-05b	LS	GL	BAEA-MI-A-2001-51	Point Abbaye	6/12/2001	F	203	49.0	146	4.5	32.8	46.5	35.6	21.1	64
BG-11a	LS	GL	BAEA-MI-A-2001-49	Reeds Point	6/12/2001	unk	290	60.0	126	3.7	32.3	46.5	37.3	17.8	180
BG-12a	LS	GL	BAEA-MI-A-2001-40	Pequaming	6/9/2001	M	208	48.0	131	3.6	32.3	45.2	35.6	19.3	151
BY-02c	LH	GL	BAEA-MI-D-2001-12	Quanicassee	5/29/2001	F	255	56.3	140	4.9	34.5	50.1	38.5	*	*
CB-01c	LP	IN	BAEA-MI-C-2001-28	Upper Black River	6/6/2001	M	242	*	125	3.6	28.0	43.2	34.0	*	*
CL-01f	LP	IN	BAEA-MI-C-2001-04	Cranberry Lake	5/18/2001	M	177	44.0	132	3.4	31.4	44.0	32.7	*	*
CP-02e	LH	GL	BAEA-MI-C-2001-34	Sugar Isd-South	6/20/2001	F	215	50.7	146	4.5	32.3	48.9	38.0	*	*
CP-10d	LH	GL	BAEA-MI-C-2001-37	Burnt Isd	6/20/2001	F	111	36.1	140	*	30.5	43.0	*	*	*
CP-26c	LH	GL	BAEA-MI-A-2001-70	Gravel Island/Gravel Lake	6/19/2001	F	212	50.0	146	4.6	33.0	47.8	37.6	19.8	74
CP-26c	LH	GL	BAEA-MI-A-2001-71	Gravel Island/Gravel Lake	6/19/2001	F	201	47.0	132	3.7	29.5	41.7	32.0	17.8	61
DE-16b	LM	GL	BAEA-MI-A-2001-61	North Lake/No-See-Um-Creek	6/14/2001	unk	281	58.0	130	4.1	31.8	45.0	36.3	8.8	159
DE-17d	LM	GL	BAEA-MI-A-2001-83	Fishdam River Mouth	6/23/2001	M	304	62.0	128	4.3	32.3	47.5	37.1	17.5	183
DE-21c	LM	GL	BAEA-MI-A-2001-82	Kregg Bay	6/23/2001	M	221	50.0	133	3.9	30.0	44.5	34.5	17.3	101
DI-03d	UP	IN	BAEA-MI-A-2001-12	Weber Lake	5/25/2001	M	190	46.0	122	3.7	29.7	42.9	31.5	17.8	66
DI-04a	UP	IN	BAEA-MI-A-2001-16	Fumee Lake	6/1/2001	M	173	43.0	129	3.5	29.5	41.9	32.8	17.8	63
DI-09c	UP	IN	BAEAMI-A-2001-60	Gene Pond	6/14/2001	unk	201	49.0	140	4.1	33.5	47.5	35.8	21.3	68
DI-10a	UP	IN	BAEA-MI-A-2001-04	Sturgeon Falls Dam	5/26/2001	F	226	52.0	136	3.6	32.3	47.5	37.6	19.6	82
ET-05a	LM	GL	BAEA-MI-D-2001-18	Walloon Lake	6/3/2001	M	155	*	125	3.3	28.4	40.4	31.5	*	*
GO-08b	UP	IN	BAEA-MI-A-2001-06	Bass Lake	5/27/2001	M	165	42.0	129	3.5	29.7	42.2	33.8	18.3	49
GO-24d	UP	IN	BAEA-MI-A-2001-97	Deer Island/ Marsh Lake	6/26/2001	F	340	69.0	146	4.7	36.1	51.0	40.6	20.6	211
GO-31b	UP	IN	BAEA-MI-A-2001-21	Palmer Bay/ Big Lake	6/4/2001	F	261	57.0	145	5.0	34.3	48.3	38.6	20.8	108
GO-35	UP	IN	BAEA-MI-A-2001-25	Whitefish Lake	6/5/2001	F	215	51.0	138	3.7	31.8	45.5	36.1	20.6	90
HO-03	LS	AN	BAEA-MI-A-2001-35	Prickett Dam (North)	6/8/2001	F	322	66.0	137	5.0	33.8	48.0	38.9	21.3	183
HO-06c	LS	GL	BAEA-MI-A-2001-37	Sturgeon River	6/9/2001	M	139	39.0	127	3.2	29.0	38.9	31.5	18.3	77
HO-06c	LS	GL	BAEA-MI-A-2001-38	Sturgeon River	6/9/2001	M	196	47.0	130	3.6	31.0	43.4	33.3	17.8	138
HO-07	LS	GL	BAEA-MI-A-2001-48	Silver Creek/Princess Point	6/11/2001	M	224	51.0	126	3.7	30.5	43.4	34.5	18.3	169
HO-11	UP	IN	BAEA-MI-A-2001-36	Prickett Lake South	6/8/2001	M	196	47.0	128	3.6	30.5	41.9	33.5	18.0	139
HO-13a	UP	IN	BAEA-MI-A-2001-42	Otter Lake	6/10/2001	M	98	33.0	123	2.9	26.7	37.1	29.2	18.0	58

Table 1. Continued.

Territory (A)	Breeding Location (B)	Territory Location ('C)	Blood Sample Number	Breeding Area Name	Date	Eaglet Sex Male/Female	Eighth Primary	Age (Days)	Footpad	Weight (kg)	Bill Depth	Culmen Length	Hallux	Tarsus	Middle Rectrix
HO-13a	UP	IN	BAEA-MI-A-2001-43	Otter Lake	6/10/2001	M	164	42.0	127	3.3	29.2	41.1	33.5	18.3	117
HO-16b	LS	GL	BAEA-MI-A-2001-47	Portage Canal	6/11/2001	M	147	40.0	136	3.4	29.2	41.9	32.5	18.3	94
IO-01g	LP	IN	BAEA-MI-D-2001-08	Loud Dam East	5/26/2001	M	235	52.1	136	4.6	32.6	46.9	37.0	*	*
IO-04b	LH	GL	BAEA-MI-D-2001-05	Allen Lake	5/24/2001	unk	205	49.2	142	5.1	34.0	48.1	38.3	*	*
IO-05e	LP	IN	BAEA-MI-D-2001-09	Monument	5/26/2001	M	198	46.9	130	4.4	29.4	41.8	33.8	*	*
IR-07f	UP	IN	BAEA-MI-A-2001-19	Point Lake	6/3/2001	M	153	40.0	133	3.5	28.7	41.4	33.0	17.8	105
IR-09g	UP	IN	BAEA-MI-A-2001-18	Paint River/ Lower Hemlock Rapids	6/2/2001	F	173	45.0	146	4.3	33.5	45.7	35.8	21.3	49
IR-17f	UP	IN	BAEA-MI-A-2001-09	Michgamme Slough	5/28/2001	F	212	50.0	140	5.1	33.5	44.7	36.8	22.1	82
IR-18b	UP	IN	BAEA-MI-A-2001-87	Chicagon Lake	6/24/2001	F	216	51.0	143	4.6	32.8	46.2	36.3	20.1	76
IR-18b	UP	IN	BAEA-MI-A-2001-88	Chicagon Lake	6/24/2001	F	226	52.0	142	4.4	33.0	47.5	37.8	20.1	108
IR-19c	UP	IN	BAEA-MI-A-2001-76	Cooks Run/ Golden Lake	6/21/2001	M	258	55.0	123	3.4	31.5	45.5	34.5	17.8	118
IR-22c	UP	IN	BAEA-MI-A-2001-17	Michgamme River/ Camp 6	6/2/2001	F	177	45.0	145	4.1	33.8	47.8	36.6	19.8	62
IR-25a	UP	IN	BAEA-MI-A-2001-107	Shank Lake	6/30/2001	M	288	60.0	127	3.8	31.5	46.5	34.5	17.8	169
IR-28c	UP	IN	BAEA-MI-A-2001-90	Smokey Lake	6/25/2001	F	239	54.0	142	4.6	33.3	46.7	38.9	20.1	91
IR-31a	UP	IN	BAEA-MI-A-2001-20	Mallard Lake	6/3/2001	M	197	47.0	125	3.7	28.4	40.1	36.1	19.1	67
IR-33	UP	IN	BAEA-MI-A-2001-34	Buck/ Armstrong Lake	6/8/2001	F	246	55.0	142	4.8	35.0	50.8	39.6	21.3	106
IR-35b	UP	IN	BAEA-MI-A-2001-85	Peavy Pond Northeast	6/24/2001	M	287	59.0	124	3.9	31.8	45.2	36.3	18.3	146
IR-36c	UP	IN	BAEA-MI-A-2001-89	Little Spring Lake/Fence River	6/25/2001	F	341	69.0	135	5.1	34.5	49.5	40.1	19.8	224
IR-38a	UP	IN	BAEA-MI-A-2001-08	Mud/ Anderson Lake	5/28/2001	F	172	45.0	142	4.6	31.8	43.7	35.0	19.3	48
IR-39b	UP	IN	BAEA-MI-A-2001-07	Chicagon and Olson Creek	5/28/2001	M	248	54.0	131	3.7	33.3	47.0	35.6	18.5	97
KW-01e	LS	GL	BAEA-MI-A-2001-109	Gratiot Lake	7/1/2001	M	216	49.0	130	3.0	29.7	43.4	34.8	18.5	83
KW-07a	LS	GL	BAEA-MI-A-2001-108	Mud Lake/ Seven mile pond	7/1/2001	F	205	49.0	144	4.1	32.5	47.5	35.3	19.1	81
MC-21c	LH	GL	BAEA-MI-C-2001-33	Big St. Martins Island	6/19/2001	F	180	45.8	142	4.4	30.8	36.8	32.7	*	*
MC-23b	LM	GL	BAEA-MI-D-2001-21	Duel Lake	6/10/2001	F	134	39.4	149	3.7	30.1	40.0	34.7	*	*
MK-01i	LP	IN	BAEA-MI-C-2001-10	Missaukee Lakes	5/22/2001	F	241	54.3	147	4.5	34.3	49.4	37.7	*	*
MK-02	LP	IN	BAEA-MI-C-2001-11	Moddersville	5/22/2001	F	240	54.2	160	4.6	33.1	47.2	38.9	*	*
MM-10b	UP	IN	BAEA-MI-A-2001-13	Pemebonwon Falls	5/31/2001	M	160	41.0	130	3.0	29.0	40.9	32.3	17.8	45
MN-02b	LM	AN	BAEA-MI-B-2001-05	Horseshoe Bend	5/20/2001	M	196	47.0	131	3.5	29.3	43.0	34.6	*	73
MN-05d	LM	GL	BAEA-MI-B-2001-06	Manistee River State Game Area	5/20/2001	M	201	47.0	137	*	29.7	42.7	34.0	*	80
MO-02i	LE	GL	BAEA-MI-F-2001-06	Pt Moville/Laguna Beach	6/27/2001	F	188	*	141	4.0	32.9	45.6	34.6	*	*
MO-02i	LE	GL	BAEA-MI-F-2001-07	Pt Moville/Laguna Beach	6/27/2001	M	162	*	136	3.8	32.0	44.8	35.1	*	*
MO-03a	LE	GL	BAEA-MI-D-2001-01	Raisin River	5/22/2001	M	212	48.9	125	3.7	30.2	41.3	32.7	*	*
MO-03a	LE	GL	BAEA-MI-D-2001-02	Raisin River	5/22/2001	M	220	50.0	135	4.8	34.8	47.2	36.8	*	*
MQ-02g	LS	GL	BAEA-MI-A-2001-66	Salmon Trout	6/17/2001	M	221	50.0	132	3.7	31.0	44.5	35.3	18.3	86
MQ-04d	LS	GL	BAEA-MI-A-2001-65	Partridge Island	6/17/2001	F	250	56.0	138	4.0	33.3	49.3	38.9	20.3	191
MQ-09f	UP	IN	BAEA-MI-A-2001-44	Deer Lake	6/10/2001	F	228	53.0	143	5.0	34.0	47.8	37.8	21.6	165
MQ-15g	LS	GL	BAEA-MI-A-2001-69	Saux Head Lake	6/10/2001	M	228	51.0	132	3.9	31.2	44.2	34.3	18.5	168
MQ-18b	UP	IN	BAEA-MI-A-2001-62	Bony Falls Dam	6/18/2001	M	212	50.0	128	3.5	32.3	43.2	36.6	18.3	157
MQ-22a	LS	GL	BAEA-MI-A-2001-68	Harvey	6/14/2001	M	173	43.0	130	2.9	30.5	43.4	34.0	17.0	127
MQ-25a	UP	IN	BAEA-MI-A-2001-11	Marqarets Rapids/Ford River	5/30/2001	F	215	51.0	135	4.3	33.5	46.2	37.3	19.8	163
MU-02c	LM	AN	BAEA-MI-B-2001-01	Muskegon River State Game Area	5/1/2001	M	188	45.0	128	*	*	*	*	*	*

Table 1. Continued.

Territory (A)	Breeding Location (B)	Territory Location ('C)	Blood Sample Number	Breeding Area Name	Date	Eaglet Sex Male/Female	Eighth Primary	Age (Days)	Footpad	Weight (kg)	Bill Depth	Culmen Length	Hallux	Tarsus	Middle Rectrix
MY-01i	LP	IN	BAEA-MI-C-2001-26	Valetine Lake	6/5/2001	F	223	51.8	145	3.7	32.8	45.3	37.4	*	*
NE-01i	LM	AN	BAEA-MI-B-2001-04	Anderson Bayou	5/19/2001	F	218	51.0	149	4.9	33.6	48.3	37.1	*	*
OL-01b	LP	IN	BAEA-MI-C-2001-05	Evart	5/18/2001	F	154	42.2	139	3.7	30.9	44.3	35.0	*	*
ON-03g	UP	IN	BAEA-MI-A-2001-23	Interior	6/4/2001	F	257	57.0	135	4.6	35.6	48.8	37.8	19.8	111
OS-03e	LP	IN	BAEA-MI-C-2001-14	MiKinnley	5/25/2001	M	215	49.3	134	4.0	29.5	42.7	33.6	*	*
PI-01a	LP	IN	BAEA-MI-C-2001-25	Ella Lake	6/4/2001	F	257	56.6	143	4.1	30.0	44.5	37.5	*	*
PI-09a	LH	GL	BAEA-MI-C-2001-27	Lake Augusta	5/5/2001	M	135	*	127	3.2	25.9	38.5	29.2	*	*
RO-07i	LP	IN	BAEA-MI-C-2001-20	North Bay	5/30/2001	M	268	56.7	130	4.0	31.0	45.1	35.1	*	*
SC-20b	UP	IN	BAEA-MI-D-2001-27	Sceney D1-pool	6/14/2001	M	139	*	128	3.2	27.1	36.3	30.1	*	*
SG-01e	LH	AN	BAEA-MI-F-2001-04	Shiawassee SGA	5/23/2001	unk	297	*	138	5.1	34.3	51.3	42.1	*	*
SG-02c	LH	AN	BAEA-MI-F-2001-01	Shiawassee NWR	5/23/2001	unk	237	*	133	3.7	30.8	44.9	36.5	*	*
SG-02c	LH	AN	BAEA-MI-F-2001-02	Shiawassee NWR	5/23/2001	unk	267	*	131	3.7	30.6	45.6	36.2	*	*
SG-04b	LH	AN	BAEA-MI-F-2001-05	Shiawasse Cutoff	5/23/2001	unk	272	*	140	4.9	33.3	50.4	40.9	*	*
TU-01c	LH	GL	BAEA-MI-D-2001-15	Dinsmoore	5/30/2001	M	135	38.1	134	4.0	29.3	42.5	31.7	*	*
TU-01c	LH	GL	BAEA-MI-D-2001-16	Dinsmoore	5/30/2001	M	75	29.7	127	3.6	27.9	39.5	31.4	*	*
TU-02d	LH	GL	BAEA-MI-D-2001-13	Fish Pt.	5/29/2001	M	237	52.4	124	3.7	30.2	43.6	34.6	*	*
TU-02d	LH	GL	BAEA-MI-D-2001-14	Fish Pt.	5/29/2001	M	249	54.1	135	4.5	32.8	47.6	37.9	*	*
WX-02a	LP	IN	BAEA-MI-B-2001-10	Lake Mitchell	6/7/2001	M	236	52.0	135	3.6	30.5	44.6	35.2	*	*

[A] Territory ID is comprised of a two letter county code and a breeding area number assigned sequentially.

[B] UP = Inland Upper Peninsula, LP = Inland Lower Peninsula, LS = Lake Superior, LM = Lake Michigan, LH = Lake Huron, and LE = Lake Erie.

[C] IN = Inland, GL = Great Lakes, AN = Anadromous.

Table 2. The productivity of bald eagles in Michigan in 2001. Data are presented as 1. Statewide, 2. Great Lakes vs. Inland, 3. Great Lakes vs. Anadromous vs. Inland, and 4. Each of the Great Lakes vs. the Upper and Lower Peninsulas. Productivity values with the same letter are not significantly different.

Area for Comparison	Productivity (Young/Occupied Nest)
1. Statewide	0.94
2. Great Lakes	0.94 A
Inland	0.94 A
3. Great Lake	0.94 A
Anadromous	0.63 A
Inland	0.94 A
4. Lake Erie	1.43 A
Lake Huron	0.84 A
Lake Michigan	1.07 A
Lake Superior	0.81 A
Inland-Upper Peninsula	0.87 A
Inland-Lower Peninsula	1.01 A

Table 3. Organochlorine contaminant analytes measured in nestling bald eagle blood samples in 2001, with parameter-specific Method Detection Levels (MDLs) and Quantification Levels (QLs). Concentrations are in parts per billion.

Organochlorine Contaminant Analyte List	MDL	QL
Hexachlorobenzene	0.54	2.01
alpha-Hexachlorocyclohexane	1.94	2.01
gamma-Hexachlorocyclohexane (Lindane)	1.84	2.01
Heptachlor	1.74	2.00
Heptachlor Epoxide	0.77	2.00
alpha-Chlordane	0.75	2.01
gamma-Chlordane	0.55	2.01
Dieldrin	0.97	2.01
Toxaphene	---	125.0
2,4'-Dichlorodiphenyldichloroethylene (2,4'-DDE)	0.86	2.01
4,4'-DDE	0.61	2.01
2,4'-Dichlorodiphenyldichloroethane (2,4'-DDD)	1.55	2.01
4,4'-DDD	1.18	2.00
2,4'-Dichlorodiphenyltrichloroethane (2,4'-DDT)	1.57	2.01
4,4'-DDT	1.95	2.01
PCB Congener 8	1.94	1.98
PCB Congener 18	1.21	1.98
PCB Congener 28	1.23	1.99
PCB Congener 44	1.52	1.98
PCB Congener 52	0.64	1.98
PCB Congener 66	0.87	2.00
PCB Congener 101	0.38	2.00
PCB Congener 105	1.44	1.98
PCB Congener 110	1.91	2.01
PCB Congener 118	0.58	1.99
PCB Congener 128	0.75	1.99
PCB Congener 138	0.65	2.00
PCB Congener 153	0.57	1.99
PCB Congener 156	1.84	2.01
PCB Congener 170	1.28	1.98
PCB Congener 180	1.62	2.00
PCB Congener 187	1.12	1.98
PCB Congener 195	1.03	2.00
PCB Congener 206	1.19	1.98
PCB Congener 209	1.03	1.99

Table 4. Concentrations of DDE, DDD, DDT, and Total DDT (ng/g wet weight (ppb)) in nestling bald eagle plasma samples analyzed in 2001. Breeding areas were located in either inland lower peninsula (LP), inland upper peninsula (UP), Lake Huron (LH), Lake Michigan (LM), Lake Erie (LE), or Lake Superior (LS) watersheds. Territories were associated with either inland (IN), Great Lakes (GL), or anadromous (AN) waterbodies.

Territory	Breeding Area Location	Territory Location	Blood Sample Number	Breeding Area Name	2,4'-DDE	4,4'-DDE	2,4'-DDD	4,4'-DDD	2,4'-DDT	4,4'-DDT	DDE + DDD + DDT
AG-02d	UP	IN	BAEA-MI-C-2001-29	Baldy Lake	ND	4.18	ND	ND	ND	ND	4.18
AG-02d	UP	IN	BAEA-MI-C-2001-30	Baldy Lake	ND	3.54	ND	ND	ND	ND	3.54
AG-08e	LS	GL	BAEA-MI-D-2001-24	Autrain Lake	ND	10.55	ND	ND	ND	ND	10.55
AG-11f	LS	GL	BAEA-MI-C-2001-31	Laughing Whitefish Point	ND	47.96	ND	ND	ND	ND	47.96
AG-16c	LS	GL	BAEA-MI-A-2001-111	Beaver Basin	ND	11.32	ND	ND	ND	ND	11.32
AG-16c	LS	GL	BAEA-MI-A-2001-112	Beaver Basin	ND	6.22	ND	ND	ND	ND	6.22
AG-17a	LS	GL	BAEA-MI-A-2001-110	Grand Sable Lake	ND	26.64	ND	ND	ND	ND	26.64
AG-20a	UP	IN	BAEA-MI-D-2001-23	Hovey Lake	ND	8.48	ND	ND	ND	ND	8.48
AL-02j	LP	IN	BAEA-MI-C-2001-08	Bamfield Pond/Alcona Dam Pond	ND	1.99	ND	ND	ND	ND	1.99
AL-05b	LP	IN	BAEA-MI-D-2001-06	Sprinkler Lake	ND	4.28	ND	ND	ND	ND	4.28
AP-08d	LH	GL	BAEA-MI-D-2001-07	Devils Lake	ND	13.97	ND	ND	ND	ND	13.97
AR-03d	LH	AN	BAEA-MI-D-2001-10	Santiago	ND	7.35	ND	ND	ND	ND	7.35
AR-04b	LH	GL	BAEA-MI-D-2001-17	Big Charity Island	ND	20.00	ND	ND	ND	ND	20.00
BG-04c	LS	GL	BAEA-MI-A-2001-53	Von Zellens	ND	18.55	ND	ND	ND	ND	18.55
BG-05b	LS	GL	BAEA-MI-A-2001-51	Point Abbaye	ND	17.59	ND	ND	ND	ND	17.59
BG-11a	LS	GL	BAEA-MI-A-2001-49	Reeds Point	ND	7.99	ND	ND	ND	ND	7.99
BG-12a	LS	GL	BAEA-MI-A-2001-40	Pequaming	ND	16.57	ND	ND	ND	ND	16.57
BY-02c	LH	GL	BAEA-MI-D-2001-12	Quanicassee	ND	10.84	ND	ND	ND	ND	10.84
CB-01c	LP	IN	BAEA-MI-C-2001-28	Upper Black River	ND	11.01	ND	ND	ND	ND	11.01
CL-01f	LP	IN	BAEA-MI-C-2001-04	Cranberry Lake	ND	6.71	ND	ND	ND	ND	6.71
CP-02e	LH	GL	BAEA-MI-C-2001-34	Sugar Isd-South	ND	13.45	ND	ND	ND	ND	13.45
CP-10d	LH	GL	BAEA-MI-C-2001-37	Burnt Isd	ND	26.66	ND	ND	ND	ND	26.66
CP-26c	LH	GL	BAEA-MI-A-2001-70	Gravel Island/Gravel Lake	ND	28.99	ND	ND	ND	ND	28.99
CP-26c	LH	GL	BAEA-MI-A-2001-71	Gravel Island/Gravel Lake	2.07	78.32	ND	ND	ND	ND	80.39
DE-16b	LM	GL	BAEA-MI-A-2001-61	North Lake/No-See-Um-Creek	ND	91.59	ND	ND	ND	ND	91.59
DE-17d	LM	GL	BAEA-MI-A-2001-83	Fishdam River Mouth	ND	37.65	ND	ND	ND	ND	37.65
DE-21c	LM	GL	BAEA-MI-A-2001-82	Kregg Bay	ND	99.51	ND	ND	ND	ND	99.51
DI-03d	UP	IN	BAEA-MI-A-2001-12	Weber Lake	ND	1.71	ND	ND	ND	ND	1.71
DI-04a	UP	IN	BAEA-MI-A-2001-16	Fumee Lake	ND	3.25	ND	ND	ND	ND	3.25
DI-09c	UP	IN	BAEAMI-A-2001-60	Gene Pond	ND	5.38	ND	ND	ND	ND	5.38
DI-10a	UP	IN	BAEA-MI-A-2001-04	Sturgeon Falls Dam	ND	1.34	ND	ND	ND	ND	1.34
ET-05a	LM	GL	BAEA-MI-D-2001-18	Walloon Lake	ND	25.08	ND	ND	ND	ND	25.08
GO-08b	UP	IN	BAEA-MI-A-2001-06	Bass Lake	ND	3.87	ND	ND	ND	ND	3.87
GO-24d	UP	IN	BAEA-MI-A-2001-97	Deer Island/ Marsh Lake	ND	3.19	ND	ND	ND	ND	3.19
GO-31b	UP	IN	BAEA-MI-A-2001-21	Palmer Bay/ Big Lake	ND	4.23	ND	ND	ND	ND	4.23
GO-35	UP	IN	BAEA-MI-A-2001-25	Whitefish Lake	ND	5.43	ND	ND	ND	ND	5.43
HO-03	LS	AN	BAEA-MI-A-2001-35	Prickett Dam (North)	ND	5.51	ND	ND	ND	ND	5.51
HO-06c	LS	GL	BAEA-MI-A-2001-37	Sturgeon River	ND	2.24	ND	ND	ND	ND	2.24
HO-06c	LS	GL	BAEA-MI-A-2001-38	Sturgeon River	ND	0.72	ND	ND	ND	ND	0.72
HO-07	LS	GL	BAEA-MI-A-2001-48	Silver Creek/Princess Point	ND	2.70	ND	ND	ND	ND	2.70

Table 4. Continued.

Territory	Breeding Area Location	Territory Location	Blood Sample Number	Breeding Area Name	2,4'-DDE	4,4'-DDE	2,4'-DDD	4,4'-DDD	2,4'-DDT	4,4'-DDT	DDE + DDD + DDT (ng/g)
HO-11	UP	IN	BAEA-MI-A-2001-36	Prickett Lake South	ND	1.16	ND	ND	ND	ND	1.16
HO-13a	UP	IN	BAEA-MI-A-2001-42	Otter Lake	ND	3.12	ND	ND	ND	ND	3.12
HO-13a	UP	IN	BAEA-MI-A-2001-43	Otter Lake	ND	2.30	ND	ND	ND	ND	2.30
HO-16b	LS	GL	BAEA-MI-A-2001-47	Portage Canal	ND	5.10	ND	ND	ND	ND	5.10
IO-01g	LP	IN	BAEA-MI-D-2001-08	Loud Dam East	ND	2.42	ND	ND	ND	ND	2.42
IO-04b	LH	GL	BAEA-MI-D-2001-05	Allen Lake	ND	15.58	ND	ND	ND	ND	15.58
IO-05e	LP	IN	BAEA-MI-D-2001-09	Monument	ND	3.12	ND	ND	ND	ND	3.12
IR-07f	UP	IN	BAEA-MI-A-2001-19	Point Lake	ND	0.81	ND	ND	ND	ND	0.81
IR-09g	UP	IN	BAEA-MI-A-2001-18	Paint River/ Lower Hemlock Rapids	ND	1.62	ND	ND	ND	ND	1.62
IR-17f	UP	IN	BAEA-MI-A-2001-09	Michgamme Slough	ND	12.70	ND	ND	ND	ND	12.70
IR-18b	UP	IN	BAEA-MI-A-2001-87	Chicagon Lake	ND	3.64	ND	ND	ND	ND	3.64
IR-18b	UP	IN	BAEA-MI-A-2001-88	Chicagon Lake	ND	4.26	ND	ND	ND	ND	4.26
IR-19c	UP	IN	BAEA-MI-A-2001-76	Cooks Run/ Golden Lake	ND	7.26	ND	ND	ND	ND	7.26
IR-22c	UP	IN	BAEA-MI-A-2001-17	Michgamme River/ Camp 6	ND	2.44	ND	ND	ND	ND	2.44
IR-25a	UP	IN	BAEA-MI-A-2001-107	Shank Lake	ND	0.98	ND	ND	ND	ND	0.98
IR-28c	UP	IN	BAEA-MI-A-2001-90	Smokey Lake	ND	2.25	ND	ND	ND	ND	2.25
IR-31a	UP	IN	BAEA-MI-A-2001-20	Mallard Lake	ND	ND	ND	ND	ND	ND	ND
IR-33	UP	IN	BAEA-MI-A-2001-34	Buck/ Armstrong Lake	ND	1.76	ND	ND	ND	ND	1.76
IR-35b	UP	IN	BAEA-MI-A-2001-85	Peavy Pond Northeast	ND	2.11	ND	ND	ND	ND	2.11
IR-36c	UP	IN	BAEA-MI-A-2001-89	Little Spring Lake/Fence River	ND	2.56	ND	ND	ND	ND	2.56
IR-38a	UP	IN	BAEA-MI-A-2001-08	Mud/ Anderson Lake	ND	11.54	ND	ND	ND	ND	11.54
IR-39b	UP	IN	BAEA-MI-A-2001-07	Chicagon and Olson Creek	ND	7.46	ND	ND	ND	ND	7.46
KW-01e	LS	GL	BAEA-MI-A-2001-109	Gratiot Lake	ND	4.19	ND	ND	ND	ND	4.19
KW-07a	LS	GL	BAEA-MI-A-2001-108	Mud Lake/ Seven mile pond	ND	8.73	ND	ND	ND	ND	8.73
MC-21c	LH	GL	BAEA-MI-C-2001-33	Big St. Martins Island	ND	17.22	ND	ND	ND	ND	17.22
MC-23b	LM	GL	BAEA-MI-D-2001-21	Duel Lake	1.98	59.58	ND	ND	ND	ND	61.55
MK-01i	LP	IN	BAEA-MI-C-2001-10	Missaukee Lakes	ND	11.65	ND	ND	ND	ND	11.65
MK-02	LP	IN	BAEA-MI-C-2001-11	Moddersville	ND	6.47	ND	ND	ND	ND	6.47
MM-10b	UP	IN	BAEA-MI-A-2001-13	Pemebonwon Falls	ND	ND	ND	ND	ND	ND	ND
MN-02b	LM	AN	BAEA-MI-B-2001-05	Horseshoe Bend	ND	44.22	ND	ND	ND	ND	44.22
MN-05d	LM	GL	BAEA-MI-B-2001-06	Manistee River State Game Area	ND	33.50	ND	ND	ND	ND	33.50
MO-02i	LE	GL	BAEA-MI-F-2001-06	Pt Moville/Laguna Beach	2.02	19.25	ND	ND	ND	ND	21.27
MO-02i	LE	GL	BAEA-MI-F-2001-07	Pt Moville/Laguna Beach	ND	6.30	ND	ND	ND	ND	6.30
MO-03a	LE	GL	BAEA-MI-D-2001-01	Raisin River	ND	9.44	ND	ND	ND	ND	9.44
MO-03a	LE	GL	BAEA-MI-D-2001-02	Raisin River	ND	10.11	ND	ND	ND	ND	10.11
MQ-02g	LS	GL	BAEA-MI-A-2001-66	Salmon Trout	ND	8.71	ND	ND	ND	ND	8.71
MQ-04d	LS	GL	BAEA-MI-A-2001-65	Partridge Island	1.51	109.39	ND	ND	ND	ND	110.89
MQ-09f	UP	IN	BAEA-MI-A-2001-44	Deer Lake	ND	1.95	ND	ND	ND	ND	1.95
MQ-15g	LS	GL	BAEA-MI-A-2001-69	Saux Head Lake	ND	3.25	ND	ND	ND	ND	3.25
MQ-18b	UP	IN	BAEA-MI-A-2001-62	Bony Falls Dam	ND	3.80	ND	ND	ND	ND	3.80
MQ-22a	LS	GL	BAEA-MI-A-2001-68	Harvey	ND	14.09	ND	ND	ND	ND	14.09
MQ-25a	UP	IN	BAEA-MI-A-2001-11	Marqarets Rapids/Ford River	ND	25.86	ND	ND	ND	ND	25.86
MU-02c	LM	AN	BAEA-MI-B-2001-01	Muskegon River State Game Area	ND	35.52	ND	ND	ND	ND	35.52

Table 4. Continued.

Territory	Breeding Area Location	Territory Location	Blood Sample Number	Breeding Area Name	2,4'-DDE	4,4'-DDE	2,4'-DDD	4,4'-DDD	2,4'-DDT	4,4'-DDT	DDE + DDD + DDT (ng/g)
MY-01i	LP	IN	BAEA-MI-C-2001-26	Valetine Lake	ND	2.90	ND	ND	ND	ND	2.90
NE-01i	LM	AN	BAEA-MI-B-2001-04	Anderson Bayou	ND	31.55	ND	ND	ND	ND	31.55
OL-01b	LP	IN	BAEA-MI-C-2001-05	Evart	ND	2.85	ND	ND	ND	ND	2.85
ON-03g	UP	IN	BAEA-MI-A-2001-23	Interior	ND	ND	ND	ND	ND	ND	ND
OS-03e	LP	IN	BAEA-MI-C-2001-14	MiKinnley	ND	1.15	ND	ND	ND	ND	1.15
PI-01a	LP	IN	BAEA-MI-C-2001-25	Ella Lake	ND	10.79	ND	ND	ND	ND	10.79
PI-09a	LH	GL	BAEA-MI-C-2001-27	Lake Augusta	ND	35.56	ND	ND	ND	ND	35.56
RO-07i	LP	IN	BAEA-MI-C-2001-20	North Bay	ND	8.24	ND	ND	ND	ND	8.24
SC-20b	UP	IN	BAEA-MI-D-2001-27	Sceney D1-pool	1.08	26.34	ND	ND	ND	ND	27.41
SG-01e	LH	AN	BAEA-MI-F-2001-04	Shiawassee SGA	ND	4.25	ND	ND	ND	ND	4.25
SG-02c	LH	AN	BAEA-MI-F-2001-01	Shiawassee NWR	ND	38.07	ND	ND	ND	ND	38.07
SG-02c	LH	AN	BAEA-MI-F-2001-02	Shiawassee NWR	1.09	52.40	ND	ND	ND	ND	53.49
SG-04b	LH	AN	BAEA-MI-F-2001-05	Shiawassee Cutoff	ND	60.27	ND	ND	ND	ND	60.27
TU-01c	LH	GL	BAEA-MI-D-2001-15	Dinsmoore	ND	48.05	ND	ND	ND	ND	48.05
TU-01c	LH	GL	BAEA-MI-D-2001-16	Dinsmoore	ND	31.98	ND	ND	ND	ND	31.98
TU-02d	LH	GL	BAEA-MI-D-2001-13	Fish Pt.	ND	13.38	ND	ND	ND	ND	13.38
TU-02d	LH	GL	BAEA-MI-D-2001-14	Fish Pt.	ND	10.84	ND	ND	ND	ND	10.84
WX-02a	LP	IN	BAEA-MI-B-2001-10	Lake Mitchell	ND	10.05	ND	ND	ND	ND	10.05

Table 5. Mean, standard deviation, and median DDE, DDD, and DDT concentrations (ng/g wet weight (ppb)) in nestling bald eagle plasma analyzed in 2001. Statistical analysis of analytes within locations with no values or only 1 value above the QL were not conducted.

Territory Location	2,4'-DDE Mean ± St. Dev (Median)	4 4'-DDE Mean ± St. Dev. (Median)	2,4'-DDD Mean ± St. Dev. (Median)	4,4'-DDD Mean ± St. Dev. (Median)	2,4'-DDT Mean ± St. Dev. (Median)	4,4'-DDT Mean ± St. Dev. (Median)	Total DDTs Mean ± St. Dev. (Median)	n
All Inland Territories	0.02±0.15 (Less than MDL)	5.09±5.44 (3.25)	ND	ND	ND	ND	5.11±5.53 (3.25)	49
All Anadromous Territories	ND	31.02±20.87 (35.52)	ND	ND	ND	ND	31.14±21.01 (35.52)	9
All Great Lakes Territories	0.18±0.56 (Less than MDL)	25.10±26.36 (15.58)	ND	ND	ND	ND	25.28±26.63 (15.58)	43
Inland Lower Peninsula	ND	5.97±3.78 (5.37)	ND	ND	ND	ND	5.97±3.78 (5.37)	14
Inland Upper Peninsula	0.03±0.18 (Less than MDL)	4.88±5.97 (3.22)	ND	ND	ND	ND	4.91±6.08 (3.22)	35
Lake Erie	0.51±1.01 (Less than MDL)	11.27±5.57 (9.77)	ND	ND	ND	ND	11.78±6.54 (9.77)	4
Lake Huron	0.17±0.52 (Less than MDL)	27.75±20.11 (20.00)	ND	ND	ND	ND	27.91±20.48 (20.00)	19
Lake Michigan	0.22±0.66 (Less than MDL)	50.91±27.15 (37.65)	ND	ND	ND	ND	51.13±27.23 (37.65)	9
Lake Superior	0.08±0.34 (Less than MDL)	16.40±24.40 (8.72)	ND	ND	ND	ND	16.48±24.70 (8.72)	20

Table 6. Geometric mean, range, and frequency of detectable concentrations of 4,4'-DDE in plasma of 101 nestling bald eagles in Michigan in 2001 compared to 230 samples analyzed in 1987-1992 (Bowerman, 1993).

Location	Geometric Mean (ng/g)	Range (ng/g)	Frequency (%) of detection
Inland Lower Peninsula			
1987-1992	10	<5 - 193	86%
2001	4.75	1.15 - 11.65	100%
Inland Upper Peninsula			
1987-1992	11	<5 - 245	86.50%
2001	2.9	<0.61 - 26.34	91%
Lake Erie			
1987-1992	22	<5 - 429	100%
2001	10.37	6.30 - 19.25	100%
Lake Huron			
1987-1992	25	<5 - 78	92%
2001	21.44	4.25 - 78.32	100%
Lake Michigan			
1987-1992	35	<5 - 235	100%
2001	45.59	25.08 - 99.51	100%
Lake Superior			
1987-1992	25	<5 - 306	92%
2001	8.81	0.72 - 109.39	100%

Table 7. Geometric mean, range, and frequency of detectable concentrations of 4,4'-DDE in plasma of 316 nestling bald eagle samples in Michigan analyzed from 1999-2001 compared to 241 samples analyzed in Michigan from 1987-1992 (Bowerman, 1993).

Location	Geometric Mean (ng/g)	Range (ng/g)	Frequency (%) of detection
Inland Lower Peninsula			
1987-1992	10	<5 - 193	86%
1999-2001	4.70	<0.61 - 95.63	97%
Inland Upper Peninsula			
1987-1992	11	<5 - 245	86.50%
1999-2001	2.77	<0.61 - 82.56	83%
Lake Erie			
1987-1992	25	<5 - 429	100%
1999-2001	10.34	6.30 - 19.25	100%
Lake Huron			
1987-1992	25	<5 - 78	92%
1999-2001	16.16	1.97 - 78.32	100%
Lake Michigan			
1987-1992	35	<5 - 235	100%
1999-2001	38.22	8.06 - 211.85	100%
Lake Superior			
1987-1992	25	<5 - 306	92%
1999-2001	10.74	0.72 - 256.51	100%

Table 8. Means and standard deviations of Total DDT concentrations for samples collected from eaglets from the 2001 Basin Year Watersheds. Analyses includes 1999, 2000, and 2001 plasma samples from the 2001 Basin Year Watersheds. Means with same letters do not differ significantly. The lower St. Joseph, upper Grand River, and Detroit watersheds were not included due to lack of samples from these watersheds.

2001 Basin Year Watershed	Mean $\pm$ Std Dev. (ng/g) n	
Sturgeon	2.42 $\pm$ 1.48 9	A
Dead-Kelsey	8.57 $\pm$ 5.93 17	B
East AuGres-Rifle	10.11 $\pm$ 10.07 8	B
Muskegon	11.56 $\pm$ 10.56 19	B
Keweenaw Peninsula	19.96 $\pm$ 17.64 8	B, C
Cass	29.50 $\pm$ 20.27 4	C

Table 9. Concentrations of PCB congeners (ng/g wet weight (ppb)) in nestling bald eagle plasma analyzed in 2001.

Territory (A)	Breeding Area Location (B)	Territory Location (C')	PCB 8	PCB 18	PCB 28	PCB 44	PCB 52	PCB 66	PCB 101	PCB 105	PCB 110	PCB 118	PCB 128	PCB 138	PCB 153	PCB 156	PCB 170	PCB 180	PCB 187	PCB 195	PCB 206	PCB 209	Sum PCB Congeners
AG-02d	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AG-02d	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AG-08e	LS	GL	ND	ND	ND	ND	ND	ND	ND	ND	4.06	ND	1.80	4.29	5.41	ND	ND	2.09	1.25	ND	ND	ND	18.90
AG-11f	LS	GL	ND	ND	ND	ND	ND	1.65	0.54	ND	ND	4.92	2.76	9.80	12.59	ND	1.70	5.36	2.76	ND	ND	ND	42.07
AG-16c	LS	GL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.52	4.52	ND	ND	ND	ND	ND	ND	ND	8.04
AG-16c	LS	GL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.92	ND	ND	ND	ND	ND	ND	ND	0.92
AG-17a	LS	GL	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.37	1.79	9.66	18.75	ND	ND	11.78	5.30	ND	ND	ND	51.64
AG-20a	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.77	ND	2.85	4.61	ND	ND	ND	ND	ND	ND	ND	9.23
AL-02j	LP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AL-05b	LP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.00	ND	ND	ND	ND	ND	ND	ND	1.00
AP-08d	LH	GL	ND	ND	ND	ND	ND	ND	1.61	2.93	4.68	4.96	2.06	6.69	6.75	ND	ND	3.49	1.90	ND	ND	ND	35.06
AR-03d	LH	AN	ND	ND	ND	ND	ND	1.59	2.17	ND	4.80	4.32	0.75	3.94	4.37	ND	ND	1.84	1.70	ND	ND	ND	25.47
AR-04b	LH	GL	ND	ND	ND	ND	1.67	2.36	7.18	5.05	8.65	10.54	2.02	11.43	13.92	ND	1.88	6.88	3.97	ND	ND	ND	75.56
BG-04c	LS	GL	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.02	1.19	7.90	8.90	ND	ND	5.05	2.45	ND	ND	ND	28.50
BG-05b	LS	GL	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.96	1.07	6.20	8.18	ND	ND	4.79	1.50	ND	ND	ND	24.70
BG-11a	LS	GL	ND	ND	ND	ND	ND	ND	0.64	ND	ND	2.66	0.80	5.03	7.52	ND	ND	3.42	2.03	ND	ND	ND	22.09
BG-12a	LS	GL	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.81	2.95	8.00	12.30	ND	1.73	7.51	3.12	ND	ND	ND	39.42
BY-02c	LH	GL	ND	3.63	1.77	5.93	8.45	4.51	4.42	ND	7.47	5.93	1.28	5.96	5.92	ND	ND	2.63	2.26	ND	ND	ND	60.17
CB-01c	LP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.85	ND	2.56	5.61	ND	ND	2.82	1.36	ND	ND	ND	14.20
CL-01f	LP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CP-02e	LH	GL	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.48	ND	ND	10.36	ND	1.45	6.13	1.72	ND	ND	ND	22.13
CP-10d	LH	GL	ND	ND	ND	ND	ND	ND	1.13	2.04	4.25	5.80	ND	ND	13.35	ND	2.10	7.67	3.44	ND	ND	ND	39.79
CP-26c	LH	GL	ND	ND	ND	ND	ND	ND	1.50	1.58	2.35	4.45	ND	7.38	14.44	ND	2.16	8.98	4.49	ND	ND	ND	47.33
CP-26c	LH	GL	ND	ND	ND	ND	1.03	2.48	5.80	5.45	8.39	12.32	3.35	22.28	34.95	ND	7.12	21.72	10.66	ND	ND	ND	135.55
DE-16b	LM	GL	ND	ND	1.79	3.81	6.47	ND	15.46	12.02	22.35	34.40	5.78	35.81	53.16	ND	12.33	30.15	17.50	ND	ND	ND	251.01
DE-17d	LM	GL	ND	ND	ND	ND	ND	ND	6.06	ND	5.82	11.17	ND	11.14	20.21	ND	ND	11.84	7.16	ND	ND	ND	73.39
DE-21c	LM	GL	ND	ND	ND	ND	1.25	ND	12.51	14.15	22.48	34.94	10.77	45.74	67.45	2.92	21.57	43.06	25.61	ND	ND	ND	302.43
DI-03d	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DI-04a	UP	IN	ND	ND	ND	ND	ND	ND	1.85	ND	ND	1.26	ND	5.30	7.60	ND	1.80	7.44	2.13	ND	ND	ND	27.37
DI-09c	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.00	1.82	ND	ND	ND	ND	ND	ND	ND	3.82
DI-10a	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.14	ND	3.63	3.50	ND	ND	2.36	1.12	ND	ND	ND	11.75
ET-05a	LM	GL	ND	ND	ND	ND	ND	ND	1.61	ND	ND	4.07	1.90	8.95	12.67	ND	2.17	7.03	4.43	ND	ND	ND	42.84
GO-08b	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GO-24d	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GO-31b	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.37	ND	ND	ND	ND	ND	ND	ND	ND	1.37
GO-35	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.18	0.59	ND	ND	ND	ND	ND	ND	ND	1.77
HO-03	LS	AN	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.12	ND	2.06	1.91	ND	ND	ND	ND	ND	ND	ND	5.09
HO-06c	LS	GL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.34	1.40	ND	ND	ND	ND	ND	ND	ND	2.75
HO-06c	LS	GL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HO-07	LS	GL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.26	ND	ND	ND	ND	ND	ND	ND	ND	1.26
HO-11	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HO-13a	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.81	ND	ND	ND	ND	ND	ND	ND	ND	0.81
HO-13a	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 9. Continued.

Territory (A)	Breeding Area Location (B)	Territory Location (C')	PCB 8	PCB 18	PCB 28	PCB 44	PCB 52	PCB 66	PCB 101	PCB 105	PCB 110	PCB 118	PCB 128	PCB 138	PCB 153	PCB 156	PCB 170	PCB 180	PCB 187	PCB 195	PCB 206	PCB 209	Sum PCB Congeners
HO-16b	LS	GL	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.97	ND	2.53	1.27	ND	ND	ND	ND	ND	ND	ND	4.78
IO-01g	LP	IN	ND	ND	ND	ND	ND	ND	2.29	ND	ND	4.12	ND	2.48	4.74	ND	ND	ND	ND	ND	ND	ND	13.63
IO-04b	LH	GL	ND	ND	ND	ND	ND	ND	2.69	1.44	3.88	3.56	ND	5.20	6.63	ND	ND	3.08	ND	ND	ND	ND	26.48
IO-05e	LP	IN	ND	ND	ND	ND	ND	ND	1.22	ND	ND	2.20	ND	2.78	2.24	ND	ND	ND	ND	ND	ND	ND	8.44
IR-07f	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-09g	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-17f	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	2.28	ND	ND	0.97	ND	ND	ND	ND	ND	ND	ND	ND	3.24
IR-18b	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-18b	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-19c	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-22c	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-25a	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-28c	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-31a	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-33	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.56	1.20	ND	ND	ND	ND	ND	ND	ND	2.76
IR-35b	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-36c	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-38a	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.29	ND	2.42	2.92	ND	ND	ND	ND	ND	ND	ND	6.63
IR-39b	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.65	0.92	ND	ND	ND	ND	ND	ND	ND	2.57
KW-01e	LS	GL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
KW-07a	LS	GL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.96	5.99	ND	ND	ND	ND	ND	ND	ND	8.95
MC-21c	LH	GL	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.63	ND	ND	10.96	ND	ND	5.26	1.88	ND	ND	ND	21.74
MC-23b	LM	GL	ND	2.15	2.34	5.14	4.61	4.21	10.52	8.18	14.60	19.30	4.74	19.67	26.91	2.37	5.81	12.75	7.51	ND	ND	ND	150.80
MK-01i	LP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.10	ND	3.20	7.20	ND	ND	2.72	1.49	ND	ND	ND	17.71
MK-02	LP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.45	ND	3.63	4.07	ND	ND	1.63	ND	ND	ND	ND	13.77
MM-10b	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.01	1.06	ND	ND	ND	ND	ND	ND	ND	2.06
MN-02b	LM	AN	ND	ND	ND	ND	ND	ND	7.11	ND	5.50	8.77	ND	14.00	17.62	ND	ND	7.47	2.25	ND	ND	ND	62.72
MN-05d	LM	GL	ND	ND	ND	ND	ND	ND	3.97	3.25	6.22	6.04	1.99	10.76	14.11	ND	2.27	7.22	3.75	ND	ND	ND	59.59
MO-02i	LE	GL	ND	ND	1.23	5.88	5.02	7.51	9.49	1.64	15.67	8.02	2.59	23.93	24.23	ND	8.00	22.78	12.80	ND	ND	ND	148.79
MO-02i	LE	GL	ND	ND	ND	3.00	1.85	2.57	4.65	ND	6.51	2.78	ND	7.82	8.87	ND	1.73	7.77	3.49	ND	ND	ND	51.03
MO-03a	LE	GL	ND	6.40	3.96	19.20	19.30	14.91	9.85	2.11	17.45	8.22	1.60	12.26	14.98	ND	3.79	11.69	7.06	ND	ND	ND	152.78
MO-03a	LE	GL	ND	9.06	4.04	24.15	22.63	19.61	11.60	2.64	21.59	9.16	2.12	14.35	17.13	ND	5.92	15.47	8.76	ND	ND	ND	188.21
MQ-02g	LS	GL	ND	ND	ND	ND	ND	ND	ND	ND	4.95	ND	1.71	4.39	5.87	ND	ND	2.33	1.51	ND	ND	ND	20.76
MQ-04d	LS	GL	ND	ND	ND	ND	ND	5.52	2.82	6.33	5.64	17.57	7.45	35.08	55.33	3.49	9.60	30.07	14.22	2.11	1.42	ND	196.63
MQ-09f	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.94	2.98	ND	ND	2.62	ND	ND	ND	ND	8.53
MQ-15g	LS	GL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.27	1.21	ND	ND	ND	ND	ND	ND	ND	2.47
MQ-18b	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.20	ND	0.95	2.50	ND	ND	ND	ND	ND	ND	ND	4.65
MQ-22a	LS	GL	ND	ND	ND	ND	ND	ND	ND	ND	2.76	1.81	ND	3.73	6.10	ND	ND	2.70	ND	ND	ND	ND	17.10
MQ-25a	UP	IN	ND	ND	ND	ND	ND	1.39	5.52	1.69	5.34	7.20	1.32	9.86	13.34	ND	ND	6.83	2.08	ND	ND	ND	54.57
MU-02c	LM	AN	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.99	ND	10.70	9.62	ND	ND	3.36	ND	ND	ND	ND	24.66
MY-01i	LP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.92	ND	ND	ND	ND	ND	ND	ND	ND	0.92
NE-01i	LM	AN	ND	ND	ND	ND	ND	ND	2.38	ND	ND	2.90	ND	7.56	8.71	ND	ND	ND	ND	ND	ND	ND	21.55
OL-01b	LP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ON-03g	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 9. Continued.

Territory (A)	Breeding Area Location (B)	Territory Location (C')	PCB 8	PCB 18	PCB 28	PCB 44	PCB 52	PCB 66	PCB 101	PCB 105	PCB 110	PCB 118	PCB 128	PCB 138	PCB 153	PCB 156	PCB 170	PCB 180	PCB 187	PCB 195	PCB 206	PCB 209	Sum PCB Congeners
OS-03e	LP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PI-01a	LP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.28	ND	1.06	2.48	ND	ND	ND	ND	ND	ND	ND	5.82
PI-09a	LH	GL	ND	ND	ND	ND	1.40	2.28	7.39	3.01	7.58	9.91	2.34	12.68	15.47	ND	2.27	7.60	4.64	ND	ND	ND	76.55
RO-07i	LP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.57	ND	3.15	3.60	ND	ND	1.65	1.27	ND	ND	ND	11.23
SC-20b	UP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.38	ND	9.72	14.40	ND	2.31	8.12	3.66	ND	ND	ND	44.58
SG-01e	LH	AN	ND	ND	ND	ND	1.02	ND	2.38	ND	ND	2.91	ND	2.32	3.31	ND	ND	ND	ND	ND	ND	ND	11.94
SG-02c	LH	AN	ND	ND	2.78	4.36	6.06	3.45	12.71	5.38	11.91	16.71	3.93	23.81	22.01	ND	2.93	12.51	7.15	ND	ND	1.31	136.98
SG-02c	LH	AN	ND	ND	4.88	5.84	10.28	6.61	17.76	7.79	17.02	22.85	5.04	27.74	27.80	1.61	5.73	15.42	10.36	ND	1.19	2.01	189.92
SG-04b	LH	AN	ND	ND	3.01	5.59	8.15	6.51	22.84	13.18	26.17	33.83	7.20	40.02	41.86	3.52	9.26	26.36	15.45	1.99	2.00	1.41	268.34
TU-01c	LH	GL	ND	1.59	ND	3.04	4.16	6.71	5.45	ND	7.89	8.12	1.67	11.56	10.29	ND	2.42	6.31	3.52	ND	ND	ND	72.72
TU-01c	LH	GL	ND	ND	ND	2.00	2.89	2.11	1.69	2.61	6.63	7.95	1.50	8.90	8.02	ND	ND	4.44	2.95	ND	ND	ND	51.66
TU-02d	LH	GL	ND	ND	ND	2.19	1.85	4.90	4.52	ND	6.70	6.04	1.28	6.75	7.82	ND	1.71	3.95	2.89	ND	ND	ND	50.61
TU-02d	LH	GL	ND	ND	ND	ND	0.89	1.49	3.69	2.81	3.62	6.57	1.09	5.15	7.11	ND	ND	3.56	2.27	ND	ND	ND	38.25
WX-02a	LP	IN	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.75	ND	0.70	1.18	ND	ND	ND	ND	ND	ND	ND	2.63

(A) Territory ID is comprised of a two-letter county code and a breeding area number assigned sequentially.

(B) LP = Lower Peninsula, UP = Upper Peninsula, LE = Lake Erie, LH = Lake Huron, LM = Lake Michigan, LS = Lake Superior

(C') GL = Great Lakes, IN = Inland, AN = Anadromous

Table 10. Mean, standard deviation, and median PCB congener concentrations (ng/g wet weight (PPB)) in nestling bald eagle plasma analyzed in 2001. Statistical analysis of analytes within locations with no values or only 1 value above the MDL were not conducted.

Territory Location	n	8 Mean ± St. Dev. (Median)	18 Mean ± St. Dev. (Median)	28 Mean ± St. Dev. (Median)	44 Mean ± St. Dev. (Median)	52 Mean ± St. Dev. (Median)	66 Mean ± St. Dev. (Median)	101 Mean ± St. Dev. (Median)	105 Mean ± St. Dev. (Median)	110 Mean ± St. Dev. (Median)	118 Mean ± St. Dev. (Median)
All Inland Territories	49	ND	ND	ND	ND	ND	0.03±0.20 (Less than MDL)	0.22±0.89 (Less than MDL)	0.03±0.24 (Less than MDL)	0.16±0.82 (Less than MDL)	0.83±1.65 (Less than MDL)
All Anadromous Territories	9	ND	ND	1.18±1.87 (Less than MDL)	1.75±2.66 (Less than MDL)	2.83±4.15 (Less than MDL)	2.02±2.82 (Less than MDL)	7.48±8.37 (2.38)	2.93±4.82 (Less than MDL)	7.27±9.32 (4.80)	10.49±11.57 (4.32)
All Great Lakes Territories	43	ND	0.53 ± 1.77 (Less than MDL)	0.35±0.98 (Less than MDL)	1.73±4.78 (Less than MDL)	1.94±4.69 (Less than MDL)	1.93±4.01 (Less than MDL)	3.18±4.13 (1.50)	1.80±3.21 (Less than MDL)	5.17±6.48 (3.88)	6.34±7.81 (4.37)
Inland Lower Peninsula	14	ND	ND	ND	ND	ND	ND	0.25±0.67 (Less than MDL)	ND	ND	1.45±1.60 (1.16)
Inland Upper Peninsula	35	ND	ND	ND	ND	ND	0.04±0.23 (Less than MDL)	0.21±0.98 (Less than MDL)	0.05±0.28 (Less than MDL)	0.22±0.97 (Less than MDL)	0.58±1.63 (Less than MDL)
Lake Erie	4	ND	3.87±4.59 (3.20)	2.31±2.02 (2.59)	13.06±10.22 (12.54)	12.20±10.29 (12.16)	11.15±7.59 (11.21)	8.89±2.98 (9.67)	1.60±1.14 (1.88)	15.31±6.36 (16.56)	7.05±2.88 (8.12)
Lake Huron	19	ND	0.27±0.89 (Less than MDL)	0.65±1.41 (Less than MDL)	1.52±2.28 (Less than MDL)	2.52±3.30 (1.03)	2.37±2.44 (2.11)	5.52±6.09 (3.69)	2.80±3.42 (2.04)	6.95±6.26 (6.63)	9.10±7.87 (6.04)
Lake Michigan	9	ND	0.24±0.72 (Less than MDL)	0.46±0.92 (Less than MDL)	0.99±2.00 (Less than MDL)	1.37±2.45 (Less than MDL)	0.47±1.40 (Less than MDL)	6.62±5.27 (6.06)	4.18±5.76 (Less than MDL)	8.55±9.10 (5.82)	13.62±13.09 (8.77)
Lake Superior	20	ND	ND	ND	ND	ND	0.36±1.27 (Less than MDL)	0.20±0.64 (Less than MDL)	0.32±1.41 (Less than MDL)	0.87±1.85 (Less than MDL)	2.16±4.00 (0.49)

Table 10. Continued.

Territory Location	n	128 Mean ± St. Dev. (Median)	138 Mean ± St. Dev. (Median)	153 Mean ± St. Dev. (Median)	156 Mean ± St. Dev. (Median)	170 Mean ± St. Dev. (Median)	180 Mean ± St. Dev. (Median)	187 Mean ± St. Dev. (Median)	195 Mean ± St. Dev. (Median)	206 Mean ± St. Dev. (Median)	209 Mean ± St. Dev. (Median)	Sum PCB Congeners Mean ± St. Dev. (Median)
All Inland Territories	49	0.03±0.19 (Less than MDL)	1.40±2.20 (0.70)	1.83±3.20 (Less than MDL)	ND	0.08±0.41 (Less than MDL)	0.74±1.91 (Less than MDL)	0.27±0.73 (Less than MDL)	ND	ND	ND	5.61±10.91 (0.92)
All Anadromous Territories	9	1.88±2.77 (Less than MDL)	14.68±13.18 (10.70)	15.24±13.37 (9.62)	0.57±1.23 (Less than MDL)	1.99±3.38 (Less than MDL)	7.44±9.09 (3.36)	4.10±5.63 (1.70)	0.22±0.66 (Less than MDL)	0.35±0.73 (Less than MDL)	0.53±0.81 (Less than MDL)	82.96±94.02 25.47
All Great Lakes Territories	43	1.62±2.18 (1.28)	9.33±10.06 (6.75)	13.53±14.59 (8.90)	0.20±0.76 (Less than MDL)	2.27±4.18 (Less than MDL)	7.83±9.25 (5.26)	4.16±5.25 (2.76)	0.05±0.32 (Less than MDL)	0.03±0.22 (Less than MDL)	ND	61.99±70.09 (39.79)
Inland Lower Peninsula	14	ND	1.46±1.42 (0.99)	2.29±2.40 (1.71)	ND	ND	0.63±1.08 (Less than MDL)	0.29±0.58 (Less than MDL)	ND	ND	ND	6.38±6.57 (4.23)
Inland Upper Peninsula	35	0.04±0.22 (Less than MDL)	1.38±2.46 (Less than MDL)	1.64±3.49 (Less than MDL)	ND	0.12±0.49 (Less than MDL)	0.78±2.16 (Less than MDL)	0.26±0.79 (Less than MDL)	ND	ND	ND	5.31±12.29 (Less than MDL)
Lake Erie	4	1.58±1.13 (1.86)	14.59±6.79 (13.30)	16.30±6.34 (16.06)	ND	4.86±2.70 (4.85)	14.43±6.40 (13.58)	8.03±3.87 (7.91)	ND	ND	ND	135.20±58.85 (150.78)
Lake Huron	19	1.76±1.95 (1.28)	10.62±10.67 (6.75)	13.97±10.56 (10.36)	0.27±0.87 (Less than MDL)	2.05±2.65 (1.71)	7.78±6.83 (6.13)	4.28±3.98 (2.95)	0.10±0.46 (Less than MDL)	0.17±0.52 (Less than MDL)	0.25±0.60 (Less than MDL)	72.96±66.14 (50.61)
Lake Michigan	9	2.80±3.69 (1.90)	18.26±13.46 (11.14)	25.60±20.75 (17.62)	0.59±1.18 (Less than MDL)	4.91±7.45 (2.17)	13.65±13.95 (7.47)	7.58±8.60 (4.43)	ND	ND	ND	109.89±102.66 (62.72)
Lake Superior	20	1.08±1.79 (Less than MDL)	5.45±7.62 (3.63)	7.91±12.23 (5.64)	0.17±0.78 (Less than MDL)	0.65±2.17 (Less than MDL)	3.75±6.97 (1.04)	1.71±3.29 (Less than MDL)	0.11±0.47 (Less than MDL)	0.07±0.32 (Less than MDL)	ND	24.80±43.26 (13.02)

Table 11. Geometric mean, range, and frequency of detectable concentrations of Total PCBs (ng/g wet weight (ppb)) in plasma of 101 nestling bald eagle samples collected in Michigan in 2001, compared to 230 samples analyzed in 1987-1992 (Bowerman, 1993).

Location	Geometric Mean (ng/g)	Range (ng/g)	Frequency (%) of Detection
Inland Lower Peninsula			
1987-1992	31	<10 - 200	96%
2001	2.56	<0.38 - 17.71	71%
Inland Upper Peninsula			
1987-1992	28.5	<10 - 177	91%
2001	1.13	<0.38 - 54.57	74%
Lake Erie			
1987-1992	199	<5 - 928	100%
2001	121.55	51.03 - 188.21	100%
Lake Huron			
1987-1992	105	<5 - 928	100%
2001	53.17	11.94 - 268.34	100%
Lake Michigan			
1987-1992	154	<14 - 628	100%
2001	74.59	21.55 -302.43	100%
Lake Superior			
1987-1992	127	<12 - 640	100%
2001	8.26	<0.38 - 196.63	90%

Table 12. Geometric mean, range, and frequency of detectable concentrations of Total PCBs in plasma of 316 nestling bald eagle samples collected in Michigan from 1999-2001, compared to 241 samples analyzed in Michigan from 1987-1992 (Bowerman, 1993).

Location	Geometric Mean (ng/g)	Range (ng/g)	Frequency (%) of Detection
Inland Lower Peninsula			
1987-1992	31	<10 - 200	96%
1999-2001	2.81	<0.38 - 123.10	66%
Inland Upper Peninsula			
1987-1992	28.5	<10 - 177	91%
1999-2001	2.1	<0.38 - 189.32	56%
Lake Erie			
1987-1992	199	81 - 1325	100%
1999-2001	109.48	51.03 - 188.21	100%
Lake Huron			
1987-1992	105	5 - 928	100%
1999-2001	35.66	<0.38 - 268.34	98%
Lake Michigan			
1987-1992	154	14 - 628	100%
1999-2001	69.33	6.45 - 302.43	100%
Lake Superior			
1987-1992	127	12 - 640	100%
1999-2001	14	<0.38 - 368.14	96%

Table 13. Concentrations of Total PCBs, by watershed, in nestling bald eagle plasma samples collected in 2001.

HUC Watershed Name	Territory ID[A]	County	Breeding Area Location[B]	HUC[C]	Sample ID	Total PCB conc (ug/g)
AuGres-Rifle	AR-03d	Arenac	LH	04080101a	BAEA-MI-D-2001-10	25.47
AuSable	AL-02j	Alcona	LP	04070007	BAEA-MI-C-2001-08	ND
AuSable	AL-05b	Alcona	LP	04070007	BAEA-MI-D-2001-06	1.00
AuSable	IO-01g	losco	LP	04070007	BAEA-MI-D-2001-08	13.63
AuSable	IO-04b	losco	LH	04070007	BAEA-MI-D-2001-05	26.48
AuSable	IO-05e	losco	LP	04070007	BAEA-MI-D-2001-09	8.44
AuSable	OS-03e	Oscoda	LP	04070007	BAEA-MI-C-2001-14	ND
Black	CB-01c	Cheboygan	LP	04070005	BAEA-MI-C-2001-28	14.20
Black	MY-01i	Montmorency	LP	04070005	BAEA-MI-C-2001-26	0.92
Boardman-Charlevoix	ET-05a	Emmet	LM	04060105	BAEA-MI-D-2001-18	42.84
Brevoort-Millecoquins	MC-23b	Mackinac	LM	04060107	BAEA-MI-D-2001-21	150.80
Brule	IR-07f	Iron	UP	04030106	BAEA-MI-A-2001-19	ND
Brule	IR-09g	Iron	UP	04030106	BAEA-MI-A-2001-18	ND
Brule	IR-18b	Iron	UP	04030106	BAEA-MI-A-2001-87	ND
Brule	IR-18b	Iron	UP	04030106	BAEA-MI-A-2001-88	ND
Brule	IR-19c	Iron	UP	04030106	BAEA-MI-A-2001-76	ND
Brule	IR-25a	Iron	UP	04030106	BAEA-MI-A-2001-107	ND
Brule	IR-28c	Iron	UP	04030106	BAEA-MI-A-2001-90	ND
Brule	IR-31a	Iron	UP	04030106	BAEA-MI-A-2001-20	ND
Brule	IR-33	Iron	UP	04030106	BAEA-MI-A-2001-34	2.76
Brule	IR-38a	Iron	UP	04030106	BAEA-MI-A-2001-08	6.63
Brule	IR-39b	Iron	UP	04030106	BAEA-MI-A-2001-07	2.57
Cass	SG-02c	Saginaw	LH	04080205	BAEA-MI-F-2001-01	136.98
Cass	SG-02c	Saginaw	LH	04080205	BAEA-MI-F-2001-02	189.92
Cedar-Ford	DE-16b	Delta	LM	04030109	BAEA-MI-A-2001-61	251.01
Cedar-Ford	MM-10b	Menominee	UP	04030109	BAEA-MI-A-2001-13	2.06
Cedar-Ford	MQ-25a	Marquette	UP	04030109	BAEA-MI-A-2001-11	54.57
Chocolay	AG-08e	Alger	LS	04020201a	BAEA-MI-D-2001-24	18.90
Chocolay	AG-11f	Alger	LS	04020201a	BAEA-MI-C-2001-31	42.07
Chocolay	AG-16c	Alger	LS	04020201a	BAEA-MI-A-2001-111	8.04
Chocolay	AG-16c	Alger	LS	04020201a	BAEA-MI-A-2001-112	0.92
Chocolay	AG-17a	Alger	LS	04020201a	BAEA-MI-A-2001-110	51.64
Chocolay	MQ-22a	Marquette	LS	04020201a	BAEA-MI-A-2001-68	17.10
Dead-Kelsey	BG-04c	Baraga	LS	04020105	BAEA-MI-A-2001-53	28.50
Dead-Kelsey	BG-05b	Baraga	LS	04020105	BAEA-MI-A-2001-51	24.70
Dead-Kelsey	BG-11a	Baraga	LS	04020105	BAEA-MI-A-2001-49	22.09
Dead-Kelsey	BG-12a	Baraga	LS	04020105	BAEA-MI-A-2001-40	39.42
Dead-Kelsey	MQ-02g	Marquette	LS	04020105	BAEA-MI-A-2001-66	20.76
Dead-Kelsey	MQ-09f	Marquette	UP	04020105	BAEA-MI-A-2001-44	8.53
Dead-Kelsey	MQ-15g	Marquette	LS	04020105	BAEA-MI-A-2001-69	2.47
Devils Lake-Black	AP-08d	Alpena	LH	04070003b	BAEA-MI-D-2001-07	35.06
Escanaba	MQ-18b	Marquette	UP	04030110	BAEA-MI-A-2001-62	4.65
Fishdam-Sturgeon	DE-17d	Delta	LM	04030112	BAEA-MI-A-2001-83	73.39
Fishdam-Sturgeon	DE-21c	Delta	LM	04030112	BAEA-MI-A-2001-82	302.43
Keweenaw Peninsula	HO-07	Houghton	LS	04020103	BAEA-MI-A-2001-48	1.26
Keweenaw Peninsula	HO-16b	Houghton	LS	04020103	BAEA-MI-A-2001-47	4.78
Keweenaw Peninsula	KW-01e	Keweenaw	LS	04020103	BAEA-MI-A-2001-109	ND
Keweenaw Peninsula	KW-07a	Keweenaw	LS	04020103	BAEA-MI-A-2001-108	8.95
Lake Huron Islands	AR-04b	Arenac	LH	04080300	BAEA-MI-D-2001-17	75.56
Lake Huron Islands	MC-21c	Mackinac	LH	04080300	BAEA-MI-C-2001-33	21.74
Lake Superior Islands	MQ-04d	Marquette	LS	04020300	BAEA-MI-A-2001-65	196.63
Long Lake-Ocqueoc	PI-01a	Presque Isle	LP	04070003a	BAEA-MI-C-2001-25	5.82

Table 13. Continued.

HUC Watershed Name	Territory ID[A]	County	Breeding Area Location[B]	HUC[C]	Sample ID	Total PCB conc (ug/g)
Long Lake-Ocqueoc	PI-09a	Presque Isle	LH	04070003a	BAEA-MI-C-2001-27	76.55
Manistee	MN-02b	Manistee	LM	04060103	BAEA-MI-B-2001-05	62.72
Manistee	MN-05d	Manistee	LM	04060103	BAEA-MI-B-2001-06	59.59
Manistique	AG-02d	Alger	UP	04060106	BAEA-MI-C-2001-29	ND
Manistique	AG-02d	Alger	UP	04060106	BAEA-MI-C-2001-30	ND
Manistique	AG-20a	Alger	UP	04060106	BAEA-MI-D-2001-23	9.23
Manistique	SC-20b	Schoolcraft	UP	04060106	BAEA-MI-D-2001-27	44.58
Menominee	DI-04a	Dickinson	UP	04030108	BAEA-MI-A-2001-16	27.37
Menominee	DI-09c	Dickinson	UP	04030108	BAEAMI-A-2001-60	3.82
Menominee	DI-10a	Dickinson	UP	04030108	BAEA-MI-A-2001-04	11.75
Michigamme	DI-03d	Dickinson	UP	04030107	BAEA-MI-A-2001-12	ND
Michigamme	IR-17f	Iron	UP	04030107	BAEA-MI-A-2001-09	3.24
Michigamme	IR-22c	Iron	UP	04030107	BAEA-MI-A-2001-17	ND
Michigamme	IR-35b	Iron	UP	04030107	BAEA-MI-A-2001-85	ND
Michigamme	IR-36c	Iron	UP	04030107	BAEA-MI-A-2001-89	ND
Muskegon	MK-01i	Missaukee	LP	04060102	BAEA-MI-C-2001-10	17.71
Muskegon	MK-02	Missaukee	LP	04060102	BAEA-MI-C-2001-11	13.77
Muskegon	MU-02c	Muskegon	LM	04060102	BAEA-MI-B-2001-01	24.66
Muskegon	NE-01i	Newaygo	LM	04060102	BAEA-MI-B-2001-04	21.55
Muskegon	OL-01b	Oceola15	LP	04060102	BAEA-MI-C-2001-05	ND
Muskegon	RO-07i	Roscommon	LP	04060102	BAEA-MI-C-2001-20	11.23
Muskegon	WX-02a	Wexford	LP	04060102	BAEA-MI-B-2001-10	2.63
Ontonagon	GO-08b	Gogebic	UP	04020102	BAEA-MI-A-2001-06	ND
Ontonagon	GO-31b	Gogebic	UP	04020102	BAEA-MI-A-2001-21	1.37
Ontonagon	GO-35	Gogebic	UP	04020102	BAEA-MI-A-2001-25	1.77
Ontonagon	ON-03g	Ontonagon	UP	04020102	BAEA-MI-A-2001-23	ND
Ottawa-Stony	MO-02i	Monroe	LE	04100001	BAEA-MI-F-2001-06	148.79
Ottawa-Stony	MO-02i	Monroe	LE	04100001	BAEA-MI-F-2001-07	51.03
Pine	CL-01f	Clare	LP	04080202	BAEA-MI-C-2001-04	ND
Raisin	MO-03a	Monroe	LE	04100002	BAEA-MI-D-2001-01	152.78
Raisin	MO-03a	Monroe	LE	04100002	BAEA-MI-D-2001-02	188.21
Shiawassee	SG-01e	Saginaw	LH	04080203	BAEA-MI-F-2001-04	11.94
Shiawassee	SG-04b	Saginaw	LH	04080203	BAEA-MI-F-2001-05	268.34
St. Marys	CP-02e	Chippewa	LH	04070001	BAEA-MI-C-2001-34	22.13
St. Marys	CP-10d	Chippewa	LH	04070001	BAEA-MI-C-2001-37	39.79
St. Marys	CP-26c	Chippewa	LH	04070001	BAEA-MI-A-2001-70	47.33
St. Marys	CP-26c	Chippewa	LH	04070001	BAEA-MI-A-2001-71	135.55
Sturgeon	HO-03	Houghton	LS	04020104	BAEA-MI-A-2001-35	5.09
Sturgeon	HO-06c	Houghton	LS	04020104	BAEA-MI-A-2001-37	2.75
Sturgeon	HO-06c	Houghton	LS	04020104	BAEA-MI-A-2001-38	ND
Sturgeon	HO-11	Houghton	UP	04020104	BAEA-MI-A-2001-36	ND
Sturgeon	HO-13a	Houghton	UP	04020104	BAEA-MI-A-2001-42	0.81
Sturgeon	HO-13a	Houghton	UP	04020104	BAEA-MI-A-2001-43	ND
Upper Wisconsin	GO-24d	Gogebic	UP	07070001	BAEA-MI-A-2001-97	ND
Wiscoggin	BY-02c	Bay	LH	04080103a	BAEA-MI-D-2001-12	60.17
Wiscoggin	TU-01c	Tuscola	LH	04080103a	BAEA-MI-D-2001-15	72.72
Wiscoggin	TU-01c	Tuscola	LH	04080103a	BAEA-MI-D-2001-16	51.66
Wiscoggin	TU-02d	Tuscola	LH	04080103a	BAEA-MI-D-2001-13	50.61
Wiscoggin	TU-02d	Tuscola	LH	04080103a	BAEA-MI-D-2001-14	38.25

[A] Territory ID is comprised of a two letter county code and a breeding area number assigned sequentially.

[B] UP = Inland Upper Peninsula, LP = Inland Lower Peninsula, LS = Lake Superior, LM = Lake Michigan, LH = Lake Huron, and LE = Lake Erie.

[C] HUC = Hydrological Unit Code watershed delineation as defined by the U.S. Geological Survey (USGS).

Table 14. Means and standard deviations of Total PCB concentrations for samples collected from eaglets from the 2001 Basin Year Watersheds. Analyses included 1999, 2000, and 2001 plasma samples from the 2001 Basin Year Watersheds. Means with same letters within columns do not differ significantly. The lower St. Joseph, upper Grand River, and Detroit watersheds were not included due to lack of samples from these watersheds.

2001 Basin Year Watershed	Mean $\pm$ Std Dev. (ng/g) n	
Sturgeon	1.52 $\pm$ 1.95 9	A
Muskegon	9.19 $\pm$ 10.41 19	B
Dead-Kelsey	21.01 $\pm$ 10.98 17	C
East AuGres-Rifle	30.20 $\pm$ 34.52 8	C
Keweenaw Peninsula	39.08 $\pm$ 42.01 8	C
Cass	106.96 $\pm$ 70.30 4	D

Table 15. Concentrations of several organochlorine pesticides (ng/g weight (ppb)) in nestling bald eagle plasma analyzed in 2001. Breeding areas were located in the lower peninsula (LP), upper peninsula (UP), Lake Erie (LE), Lake Huron (LH), Lake Michigan (LM), or Lake Superior (LS) watersheds. Territories were associated with Inland (IN), Great Lakes (GL), or Anadromous (AN) water bodies.

Territory	Breeding Area Location	Territory Location	Blood Sample Number	Hexachloro-benzene	α-HCH	γ-HCH	Heptachlor	Heptachlor Epoxide	γ-Chlordane	α-Chlordane	Dieldrin	Toxaphene
AG-02d	UP	IN	BAEA-MI-C-2001-29	ND	ND	ND	ND	ND	ND	ND	ND	ND
AG-02d	UP	IN	BAEA-MI-C-2001-30	ND	ND	ND	ND	ND	ND	ND	ND	ND
AG-08e	LS	GL	BAEA-MI-D-2001-24	ND	ND	ND	ND	ND	ND	ND	3.14	ND
AG-11f	LS	GL	BAEA-MI-C-2001-31	ND	ND	ND	ND	1.13	ND	2.15	5.61	ND
AG-16c	LS	GL	BAEA-MI-A-2001-111	ND	ND	ND	ND	ND	ND	ND	ND	ND
AG-16c	LS	GL	BAEA-MI-A-2001-112	ND	ND	ND	ND	ND	ND	ND	ND	ND
AG-17a	LS	GL	BAEA-MI-A-2001-110	ND	ND	ND	ND	ND	ND	ND	1.84	ND
AG-20a	UP	IN	BAEA-MI-D-2001-23	ND	ND	ND	ND	ND	ND	ND	ND	ND
AL-02j	LP	IN	BAEA-MI-C-2001-08	ND	ND	ND	ND	ND	ND	ND	ND	ND
AL-05b	LP	IN	BAEA-MI-D-2001-06	ND	ND	ND	ND	ND	ND	ND	ND	ND
AP-08d	LH	GL	BAEA-MI-D-2001-07	ND	ND	ND	ND	ND	ND	0.80	1.16	ND
AR-03d	LH	AN	BAEA-MI-D-2001-10	ND	ND	ND	ND	ND	ND	1.46	ND	ND
AR-04b	LH	GL	BAEA-MI-D-2001-17	ND	ND	ND	ND	ND	ND	1.94	1.46	ND
BG-04c	LS	GL	BAEA-MI-A-2001-53	0.54	ND	ND	ND	ND	ND	1.36	4.99	ND
BG-05b	LS	GL	BAEA-MI-A-2001-51	ND	ND	ND	ND	ND	ND	1.14	3.93	ND
BG-11a	LS	GL	BAEA-MI-A-2001-49	ND	ND	ND	ND	ND	ND	ND	2.75	ND
BG-12a	LS	GL	BAEA-MI-A-2001-40	ND	ND	ND	ND	0.86	ND	1.30	5.09	ND
BY-02c	LH	GL	BAEA-MI-D-2001-12	ND	ND	ND	ND	ND	ND	2.12	ND	ND
CB-01c	LP	IN	BAEA-MI-C-2001-28	ND	ND	ND	ND	ND	ND	ND	ND	ND
CL-01f	LP	IN	BAEA-MI-C-2001-04	ND	ND	ND	ND	ND	ND	ND	ND	ND
CP-02e	LH	GL	BAEA-MI-C-2001-34	ND	ND	ND	ND	ND	ND	ND	ND	ND
CP-10d	LH	GL	BAEA-MI-C-2001-37	ND	ND	ND	ND	ND	ND	ND	3.38	ND
CP-26c	LH	GL	BAEA-MI-A-2001-70	ND	ND	ND	ND	ND	ND	ND	2.35	ND
CP-26c	LH	GL	BAEA-MI-A-2001-71	ND	ND	ND	ND	ND	ND	1.96	4.36	ND
DE-16b	LM	GL	BAEA-MI-A-2001-61	ND	ND	ND	ND	ND	ND	5.88	7.60	ND
DE-17d	LM	GL	BAEA-MI-A-2001-83	ND	ND	ND	ND	ND	ND	ND	ND	ND
DE-21c	LM	GL	BAEA-MI-A-2001-82	ND	ND	ND	ND	1.44	ND	5.12	17.26	ND
DI-03d	UP	IN	BAEA-MI-A-2001-12	ND	ND	ND	ND	ND	ND	ND	ND	ND
DI-04a	UP	IN	BAEA-MI-A-2001-16	ND	ND	ND	ND	ND	ND	ND	ND	ND
DI-09c	UP	IN	BAEAMI-A-2001-60	ND	ND	ND	ND	ND	ND	ND	ND	ND
DI-10a	UP	IN	BAEA-MI-A-2001-04	ND	ND	ND	ND	ND	ND	ND	ND	ND
ET-05a	LM	GL	BAEA-MI-D-2001-18	ND	ND	ND	ND	ND	ND	1.52	1.39	ND
GO-08b	UP	IN	BAEA-MI-A-2001-06	ND	ND	ND	ND	ND	ND	ND	ND	ND
GO-24d	UP	IN	BAEA-MI-A-2001-97	ND	ND	ND	ND	ND	ND	ND	ND	ND
GO-31b	UP	IN	BAEA-MI-A-2001-21	ND	ND	ND	ND	ND	ND	ND	ND	ND
GO-35	UP	IN	BAEA-MI-A-2001-25	ND	ND	ND	ND	ND	ND	ND	ND	ND
HO-03	LS	AN	BAEA-MI-A-2001-35	ND	ND	ND	ND	ND	ND	ND	ND	ND
HO-06c	LS	GL	BAEA-MI-A-2001-37	ND	ND	ND	ND	ND	ND	ND	ND	ND
HO-06c	LS	GL	BAEA-MI-A-2001-38	ND	ND	ND	ND	ND	ND	ND	ND	ND
HO-07	LS	GL	BAEA-MI-A-2001-48	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 15. Continued.

Territory	Breeding Area Location	Territory Location	Blood Sample Number	Hexachloro-benzene	α-HCH	γ-HCH	Heptachlor	Heptachlor Epoxide	γ-Chlordane	α-Chlordane	Dieldrin	Toxaphene
HO-11	UP	IN	BAEA-MI-A-2001-36	ND	ND	ND	ND	ND	ND	ND	ND	ND
HO-13a	UP	IN	BAEA-MI-A-2001-42	ND	ND	ND	ND	ND	ND	ND	ND	ND
HO-13a	UP	IN	BAEA-MI-A-2001-43	ND	ND	ND	ND	ND	ND	ND	ND	ND
HO-16b	LS	GL	BAEA-MI-A-2001-47	ND	ND	ND	ND	ND	ND	ND	1.52	ND
IO-01g	LP	IN	BAEA-MI-D-2001-08	ND	ND	ND	ND	ND	ND	ND	ND	ND
IO-04b	LH	GL	BAEA-MI-D-2001-05	ND	ND	ND	ND	ND	ND	0.99	ND	ND
IO-05e	LP	IN	BAEA-MI-D-2001-09	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-07f	UP	IN	BAEA-MI-A-2001-19	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-09g	UP	IN	BAEA-MI-A-2001-18	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-17f	UP	IN	BAEA-MI-A-2001-09	ND	ND	ND	ND	ND	ND	ND	3.45	ND
IR-18b	UP	IN	BAEA-MI-A-2001-87	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-18b	UP	IN	BAEA-MI-A-2001-88	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-19c	UP	IN	BAEA-MI-A-2001-76	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-22c	UP	IN	BAEA-MI-A-2001-17	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-25a	UP	IN	BAEA-MI-A-2001-107	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-28c	UP	IN	BAEA-MI-A-2001-90	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-31a	UP	IN	BAEA-MI-A-2001-20	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-33	UP	IN	BAEA-MI-A-2001-34	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-35b	UP	IN	BAEA-MI-A-2001-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-36c	UP	IN	BAEA-MI-A-2001-89	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR-38a	UP	IN	BAEA-MI-A-2001-08	ND	ND	ND	ND	ND	ND	ND	1.08	ND
IR-39b	UP	IN	BAEA-MI-A-2001-07	ND	ND	ND	ND	ND	ND	ND	ND	ND
KW-01e	LS	GL	BAEA-MI-A-2001-109	ND	ND	ND	ND	ND	ND	ND	ND	ND
KW-07a	LS	GL	BAEA-MI-A-2001-108	ND	ND	ND	ND	ND	ND	ND	2.07	ND
MC-21c	LH	GL	BAEA-MI-C-2001-33	ND	ND	ND	ND	ND	ND	ND	1.84	ND
MC-23b	LM	GL	BAEA-MI-D-2001-21	ND	ND	ND	ND	ND	ND	4.57	4.32	ND
MK-01i	LP	IN	BAEA-MI-C-2001-10	ND	ND	ND	ND	ND	ND	ND	ND	ND
MK-02	LP	IN	BAEA-MI-C-2001-11	ND	ND	ND	ND	ND	ND	ND	4.56	ND
MM-10b	UP	IN	BAEA-MI-A-2001-13	ND	ND	ND	ND	ND	ND	ND	ND	ND
MN-02b	LM	AN	BAEA-MI-B-2001-05	ND	ND	ND	ND	ND	ND	ND	ND	ND
MN-05d	LM	GL	BAEA-MI-B-2001-06	ND	ND	ND	ND	ND	ND	1.20	2.40	ND
MO-02i	LE	GL	BAEA-MI-F-2001-06	ND	ND	ND	ND	ND	ND	2.53	2.36	ND
MO-02i	LE	GL	BAEA-MI-F-2001-07	ND	ND	ND	ND	ND	ND	1.23	ND	ND
MO-03a	LE	GL	BAEA-MI-D-2001-01	ND	ND	ND	ND	ND	ND	4.10	1.59	ND
MO-03a	LE	GL	BAEA-MI-D-2001-02	ND	ND	ND	ND	ND	ND	4.89	1.83	ND
MQ-02g	LS	GL	BAEA-MI-A-2001-66	ND	ND	ND	ND	ND	ND	ND	4.54	ND
MQ-04d	LS	GL	BAEA-MI-A-2001-65	0.73	ND	ND	ND	1.72	ND	1.92	8.52	ND
MQ-09f	UP	IN	BAEA-MI-A-2001-44	ND	ND	ND	ND	ND	ND	ND	ND	ND
MQ-15g	LS	GL	BAEA-MI-A-2001-69	ND	ND	ND	ND	ND	ND	ND	1.85	ND
MQ-18b	UP	IN	BAEA-MI-A-2001-62	ND	ND	ND	ND	ND	ND	ND	ND	ND
MQ-22a	LS	GL	BAEA-MI-A-2001-68	ND	ND	ND	ND	ND	ND	0.82	5.05	ND
MQ-25a	UP	IN	BAEA-MI-A-2001-11	ND	ND	ND	ND	ND	ND	2.59	1.56	ND

Table 15. Continued.

Territory	Breeding Area Location	Territory Location	Blood Sample Number	Hexachloro-benzene	α-HCH	γ-HCH	Heptachlor	Heptachlor Epoxide	γ-Chlordane	α-Chlordane	Dieldrin	Toxaphene
MU-02c	LM	AN	BAEA-MI-B-2001-01	ND	ND	ND	ND	ND	ND	ND	ND	ND
MY-01i	LP	IN	BAEA-MI-C-2001-26	ND	ND	ND	ND	ND	ND	ND	ND	ND
NE-01i	LM	AN	BAEA-MI-B-2001-04	ND	ND	ND	ND	ND	ND	ND	ND	ND
OL-01b	LP	IN	BAEA-MI-C-2001-05	ND	ND	ND	ND	ND	ND	ND	ND	ND
ON-03g	UP	IN	BAEA-MI-A-2001-23	ND	ND	ND	ND	ND	ND	ND	ND	ND
OS-03e	LP	IN	BAEA-MI-C-2001-14	ND	ND	ND	ND	ND	ND	ND	ND	ND
PI-01a	LP	IN	BAEA-MI-C-2001-25	ND	ND	ND	ND	ND	ND	ND	1.13	ND
PI-09a	LH	GL	BAEA-MI-C-2001-27	ND	ND	ND	ND	ND	ND	3.26	1.63	ND
RO-07i	LP	IN	BAEA-MI-C-2001-20	ND	ND	ND	ND	ND	ND	ND	ND	ND
SC-20b	UP	IN	BAEA-MI-D-2001-27	ND	ND	ND	ND	ND	ND	ND	ND	ND
SG-01e	LH	AN	BAEA-MI-F-2001-04	ND	ND	ND	ND	ND	ND	ND	ND	ND
SG-02c	LH	AN	BAEA-MI-F-2001-01	ND	ND	ND	ND	ND	ND	3.86	1.28	ND
SG-02c	LH	AN	BAEA-MI-F-2001-02	ND	ND	ND	ND	ND	ND	5.91	1.49	ND
SG-04b	LH	AN	BAEA-MI-F-2001-05	ND	ND	ND	ND	ND	ND	8.73	1.55	ND
TU-01c	LH	GL	BAEA-MI-D-2001-15	ND	ND	ND	ND	ND	ND	2.58	1.03	ND
TU-01c	LH	GL	BAEA-MI-D-2001-16	ND	ND	ND	ND	ND	ND	0.89	1.33	ND
TU-02d	LH	GL	BAEA-MI-D-2001-13	ND	ND	ND	ND	ND	ND	2.11	ND	ND
TU-02d	LH	GL	BAEA-MI-D-2001-14	ND	ND	ND	ND	ND	ND	ND	1.00	ND
WX-02a	LP	IN	BAEA-MI-B-2001-10	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 16. Means and standard deviations of α-chlordane concentrations in the 2001 Basin Year Watersheds. Analyses includes 1999, 2000, and 2001 plasma samples from the 2001 Basin Year Watersheds. The lower St. Joseph, upper Grand River, and Detroit watersheds were not included due to lack of samples from these watersheds.

2001 Basin Year Watershed	Mean ± Std Dev. (ng/g) n
Sturgeon	<0.75 9
Muskegon	0.21 ± 0.43 19
East AuGres-Rifle	0.61 ± 0.93 8
Dead-Kelsey	0.71 ± 0.85 17
Keweenaw Peninsula	0.94 ± 1.27 8
Cass	2.69 ± 2.70 4

Table 17. Means and standard deviations of Dieldrin concentrations in the 2001 Basin Year Watersheds. Analyses includes 1999, 2000, and 2001 plasma samples from the 2001 Basin Year Watersheds. The lower St. Joseph, upper Grand River, and Detroit watersheds were not included due to lack of samples from these watersheds.

2001 Basin Year Watershed	Mean ± Std Dev. (ng/g) n
Sturgeon	<0.97 9
Muskegon	0.24 ± 1.05 18
East AuGres-Rifle	0.51 ± 1.09 8
Cass	0.94 ± 0.66 4
Keweenaw Peninsula	2.71 ± 2.70 8
Dead-Kelsey	3.05 ± 1.95 17

Appendix I. 2000 Basin Year Watershed Data Analyses

The following basin year watersheds were the focus of sampling in 2000: Cedar-Ford, Escanaba, Tacoosh-Whitefish, West Betsy-Chocolay, and Fishdam-Sturgeon of the upper peninsula, and the Cheboygan, Black, Lone L.-Ocqueoc, Thunder Bay, Northern Pere Marquette, Kawkawlin, West Pigeon-Wiscoggin, Macatawa (Black-Macatawa), Shiawassee, Rouge, upper St. Joseph, St. Joseph, Tiffin, and Ottawa-Stony watersheds of the lower peninsula.

Since insufficient sample sizes prohibited rigorous statistical analyses by watersheds in the Year 2000 Annual Report (MDEQ, 2003), results of samples collected in 1999 (MDEQ, 2002), 2000 (MDEQ, 2003), and 2001 from the 2000 designated basin year watersheds were combined. Combining the 1999 through 2001 year sampling efforts for the 2000 basin year watersheds provided more appropriate sample sizes needed for statistical analyses. However, the Macatawa (Black-Macatawa), Rouge, upper St. Joseph, St. Joseph, and Tiffin watersheds of the lower peninsula could not be included in the statistical analyses because no samples were collected from these watersheds from 1999 to 2001.

Statistical analyses of regional data were performed using nonparametric Kruskal-Wallis tests. Nonparametric statistics were employed as neither the assumption of normality nor of linear regressions were met. Nonparametric multiple comparisons were used to determine where significant differences occurred within regions. All Kruskal-Wallis tests were conducted using the SAS Institute, Inc. (1999) statistical package. A probability level = 95% (α = 0.05) was used to determine statistical significance.

Significant differences in total DDT concentrations were found between the 2000 basin year watersheds (P<0.0001). No logical conclusions could be made from the comparisons. These data are presented in Table 1.

Significant differences in total PCB concentrations were also found between the 2000 basin year watersheds (P<0.0001)(Table 2). The Kawkawlin watershed mean total PCB was not significantly different from the other watersheds in the lower peninsula and upper peninsula (P<0.0556). The Fishdam-Sturgeon watershed of the upper peninsula had significantly greater mean total PCB concentrations than the West Betsy-Chocolay and Escanaba watersheds from the upper peninsula and the Cheboygan, Thunder Bay, Black, Northern Pere Marquette, Lone L.-Ocqueoc, and West Pigeon-Wiscoggin watersheds from the lower peninsula (P<0.0471). The Tacoosh-Whitefish watershed from the upper peninsula had significantly greater mean total PCB concentrations than the West Betsy-Chocolay and Escanaba watersheds from the upper peninsula and the Cheboygan, Thunder Bay, Black, Northern Pere Marquette, and Lone L.-Ocqueoc watersheds in the lower peninsula (P<0.0185). The Shiawassee watershed of the lower peninsula had significantly greater mean total PCB concentrations than the West Betsy-Chocolay watershed of the upper peninsula and the Cheboygan, Thunder Bay, Black, and Northern Pere Marquette watersheds in the lower peninsula (P< 0.0238). These data are presented in Table 2.

Significant differences in mean α-chlordane concentrations were also found between the 2000 basin year watersheds (P<0.0001). No logical conclusions could be made from the comparisons due to the high variability and small sample size. These data are presented in Table 3.

Significant differences in mean dieldrin concentrations were also found between the 2000 basin year watersheds (P<0.0014). No logical conclusions can be made from the comparisons due to the high variability and small sample size. These data are presented in Table 4.

Table 1. Mean and standard deviations of Total DDT concentrations in the 2000 Basin Year Watersheds. Analyses includes 1999, 2000, and 2001 plasma samples collected from the 2000 Basin Year Watersheds. The Macatawa (Black-Macatawa), Rouge, upper St. Joseph, St. Joseph, and Tiffin watersheds were not included due to lack of samples from these watersheds.

2000 Basin Year Watershed	Mean ± Std Dev. (ng/g) n
Thunder Bay	2.25 ± 1.89 10
Cheboygan	4.88 ± 1.44 2
Kawkawlin	11.64 1
Ottawa-Stony	12.60 ± 7.76 3
Northern Pere Marquette	15.80 ± 16.78 5
Black	17.30 ± 26.73 8
West Betsy-Chocolay	17.40 ± 17.01 15
Lone Lake-Ocqueoc	21.28 ± 9.48 6
West Pigeon-Wiscoggin	22.36 ± 14.89 6
Escanaba	27.22 ± 30.67 7
Shiawassee	32.26 ± 39.61 2
Cedar-Ford	64.45 ± 57.11 10
Fishdam-Sturgeon	71.93 ± 36.25 7
Tacoosh-Whitefish	86.99 ± 82.66 2

Table 2. Mean and standard deviations of Total PCB concentrations in the 2000 Basin Year Watersheds. Analyses includes 1999, 2000, and 2001 plasma samples collected from the 2000 Basin Year Watersheds. Means with same letter within a column do not differ significantly. The Macatawa (Black Macetawa), Rouge, upper St. Joseph, St. Joseph, and Tiffin watersheds were not included due to lack of samples from these watersheds.

2000 Basin Year Watershed	Mean ± Std Dev. (ng/g) n	
Cheboygan	0 2	A
Thunder Bay	1.54 ± 2.15 10	A
Black	16.46 ± 27.28 8	A
West Betsy-Chocolay	16.96 ± 18.51 15	A
Northern Pere Marquette	26.49 ± 26.93 5	A
Kawkawlin	38.14 1	A, B, C, D
Lone Lake-Ocqueoc	39.21 ± 31.60 6	A, B
Escanaba	40.63 ± 43.51 7	A, B
West Pigeon-Wiscoggin	54.82 ± 11.42 6	A, B, C
Ottawa-Stony	89.65 ± 52.01 3	A, B, C, D
Cedar-Ford	129.90 ± 73.21 10	A, B, C, D
Shiawassee	140.14 ± 181.30 2	B, C, D
Tacoosh-Whitefish	148.99 ± 116.43 2	C, D
Fishdam-Sturgeon	160.89 ± 109.67 7	D

Table 3. Mean and standard deviations of α-chlordane concentrations in the 2000 Basin Year Watersheds. Analyses includes 1999, 2000, and 2001 plasma samples collected from the 2000 Basin Year Watersheds. The Macatawa (Black-Macatawa), Rouge, upper St. Joseph, St. Joseph, and Tiffin watersheds were not included due to lack of samples from these watersheds.

2000 Basin Year Watershed	Mean $\pm$ Std Dev. (ng/g) n
Black	0 8
Cheboygan	0 2
Kawkawlin	0 1
Thunder Bay	0 10
Escanaba	0.55 $\pm$ 0.73 7
West Betsy-Chocolay	0.64 $\pm$ 0.68 15
Northern Pere Marquette	0.64 $\pm$ 0.92 5
Lone Lake-Ocqueoc	0.97 $\pm$ 1.52 6
West Pigeon-Wiscoggin	1.28 $\pm$ 1.14 6
Ottawa-Stony	1.53 $\pm$ 0.89 3
Fishdam-Sturgeon	2.58 $\pm$ 2.14 7
Tacoosh-Whitefish	3.41 $\pm$ 0.33 2
Cedar-Ford	3.89 $\pm$ 2.37 10
Shiawassee	4.37 $\pm$ 6.17 2

Table 4. Mean and standard deviations of Dieldrin concentrations in the 2000 Basin Year Watersheds. Analyses includes 1999, 2000, and 2001 plasma samples from the 2000 Basin Year Watersheds. The Macatawa (Black-Macatawa), Rouge, upper St. Joseph, St. Joseph, and Tiffin watersheds were not included due to lack of samples from these watersheds.

2000 Basin Year Watershed	Mean ± Std Dev. (ng/g) n
Cheboygan	0 2
Kawkawlin	0 1
Thunder Bay	0 10
Escanaba	0.40 ± 0.73 7
Black	0.78 ± 1.49 8
Shiawassee	0.78 ± 1.10 2
Northern Pere Marquette	0.87 ± 0.84 5
West Pigeon-Wiscoggin	0.96 ± 0.89 6
Lone Lake-Ocqueoc	1.49 ± 0.42 6
Ottawa-Stony	1.87 ± 1.68 3
Cedar-Ford	2.39 ± 3.47 10
West Betsy-Chocolay	3.99 ± 2.74 15
Tacoosh-Whitefish	4.20 ± 5.94 2
Fishdam-Sturgeon	6.73 ± 6.12 7