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MICHIGAN WILDLIFE CONTAMINANT TREND MONITORING

YEAR 2006 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 that 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 eighth 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.

- In 2006, 85 nestling bald eagle blood plasma samples were analyzed for organochlorine contaminants, dichlorodiphenyltrichloroethane (DDT) and its metabolites, hexachlorobenzene, *alpha*-hexachlorocyclohexane, *gamma*-hexachlorocyclohexane, heptachlor, heptachlor epoxide, *alpha*-chlordane, *gamma*-chlordane, dieldrin, toxaphene, and 20 polychlorinated biphenyl (PCB) congeners.

- No significant differences were found among Great Lakes (n=44), anadromous (n=7), and inland (n=34) breeding areas for total DDT (P=0.60) or 4,4'-DDE (P=0.52). No significant differences were found between Great Lakes and anadromous breeding areas pooled (n=51) and inland breeding areas for total DDT (P=0.22) or 4,4'-DDE (P=0.17). No significant differences were found among Lake Michigan, Lake Superior, Lake Huron, Lake Erie, inland Upper Peninsula, or inland Lower Peninsula for total DDT (P=0.18) or 4,4'-DDE (P=0.19). Geometric mean 4,4'-DDE concentrations were ranked in the following order by location from highest to lowest: Lake Huron (n=23) > inland Upper Peninsula (n=7) > Lake Superior (n=17) > inland Lower Peninsula (n=27) > Lake Michigan (n=10) > Lake Erie (n=1) breeding areas.

- Twenty PCB congeners were quantified and summed to determine total PCBs in nestling bald eagle blood plasma samples. Three congeners (153, 118, and 180) contributed significantly (i.e., consisting of ≥ 10% of the total PCBs) to the total PCB concentrations. At least one of the targeted PCB congeners was detected in 60 of the 85 nestlings sampled. No significant difference in total PCB concentrations was found among inland and Great Lakes and anadromous breeding areas pooled (P<0.35), and among the inland Lower Peninsula, inland Upper Peninsula, Lake Huron, Lake Michigan, Lake Erie, and Lake Superior breeding areas (P<0.78). Geometric mean PCB concentrations were ranked in the following order by location from highest to lowest: Lake Erie (n=1) > Lake Huron (n=23) > inland Upper Peninsula (n=7) > inland Lower Peninsula (n=27) > Lake Superior (n=17) > Lake Michigan (n=10) breeding areas.

- Quantifiable concentrations of *alpha*-chlordane were measured in seven blood plasma samples with three of the samples from Great Lakes breeding areas, three from inland breeding areas, and one from an anadromous breeding area. Because *alpha*-chlordane was detected in less than 50% of the samples, statistical analyses were not conducted.

- Quantifiable concentrations of dieldrin were measured in 34 blood plasma samples. Sixteen samples were from inland breeding areas, 14 were from Great Lakes breeding areas, and four were from anadromous breeding areas. Fourteen of the inland breeding area samples were from the Lower Peninsula and two were from the Upper Peninsula. Four of the Great Lakes samples (includes two anadromous breeding areas) were from Lake Michigan breeding areas, nine samples (includes two anadromous breeding areas) were from Lake Huron breeding areas, four were from Lake Superior breeding areas, and one was from a Lake Erie breeding area. Because dieldrin was detected in less than 50% of the samples statistical analyses were not conducted.

- Mercury data for 2006 is available in the Michigan Wildlife Contaminant Trend Monitoring report (MDEQ, 2009).

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 project 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's waters 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 project were to gather the eighth year of data on 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 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 project.

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 eighth annual report for the bald eagle element of the Strategy. The first (MDEQ, 2002), second (MDEQ, 2003), third (MDEQ, 2004a), fourth (MDEQ, 2004b), fifth (MDEQ, 2008a), sixth (MDEQ, 2008b), and seventh (DNRE, 2010) reports contained results of the samples collected in 1999, 2000, 2001, 2002, 2003, 2004, and 2005, 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. Feather analyses for mercury concentrations have been reported in five-year reports previously (MDEQ, 2009).

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. Currently, active bald eagle breeding areas are well distributed across the Upper Peninsula and northern Lower Peninsula of Michigan.

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 reoccupy 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. At the time of writing this report there were 790 breeding areas in the state of Michigan.

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.

The following basin year watersheds were the focus of sampling in 2006: Keweenaw Peninsula, Sturgeon, Dead-Kelsey, Lower St. Joseph, Upper Grand, Muskegon, East AuGres, Cass, and Detroit (Figure 2). In addition to the basin year watersheds for 2003, nests associated with the Great Lakes and connecting channels were sampled. Great Lakes-associated nests are defined as those nests within 8.0 kilometers of the shorelines of the Great Lakes and along tributaries where anadromous fish are accessible.

3.2 FIELD METHODS

The methods used to collect blood and breast feather 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 were collected from five- to nine-week old nestling bald eagles from May 15 through June 21, 2006. The approximate age of nestling eagles is visually estimated from two aerial survey flights that are piloted by either a Michigan Department of Natural Resources and Environment (DNRE) 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.

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^{o} C for storage. Three to four feather samples also are collected from the nestling eagles. Feathers are plucked from the breast and stored in small sealed envelopes. After sampling is completed, the nestlings are banded with a Size 9 United States Fish and Wildlife Service (USFWS) rivet 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 DNRE, 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^{o} 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^{o} 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 May 17, 2007. All extractions and analyses were conducted according to procedures detailed in CIET SOPs. Plasma samples were extracted in six 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 (CIET, 1996; CIET, 1999) were met. Average recoveries of 70-130% for matrix spikes were required under the Quality Assurance Project Plan

(CIET, 1996; CIET, 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 2006 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). Lastly, breeding areas were also grouped by watershed (HUC).

Contaminates were analyzed independently or grouped as follows. Total DDTs were analyzed as the sum of all DDT and DDT metabolites found. 4,4'-DDE was analyzed independently because of its pervasiveness in samples and history of causing ecological effects. Total PCBs were examined as the sum of the 16 PCB congeners found. Heptachlor epoxide, a-Chlordane, and Dieldrin were all analyzed independently.

Statistical analyses were performed using nonparametric rank converted ANOVA tests. Nonparametric pair-wise comparisons, least significant difference, were used to determine where significant differences occurred within regions. Nonparametric statistics were employed, as neither the assumptions of normality nor of linear regressions were met. All analyses were performed using SAS Institute, Inc. (1999) statistical package. A probability level = 95% (α = 0.05) was used to determine statistical significance. Differences in order (i.e., highest concentration to lowest concentration) between rank converted ANOVA and geometric mean results were observed and are the result of a combination of factors. The two factors include the assignment of the value of 0.0001 ng/g (see Section 4.2) to all non-detects and sample size, with the former having the greatest effect on the results. These two factors have also resulted is very large standard errors for some analysis, in these cases the latter is suspected to have had the greatest effect.

SECTION 4.0

RESULTS AND DISCUSSION

4.2 ORGANIC CONTAMINANTS IN NESTLING BALD EAGLE BLOOD SAMPLES

In 2006, 85 nestling bald eagle blood samples were analyzed for organochlorine contaminants. The target list of analytes included historical organochlorine pesticides such as chlordane, dieldrin, DDT (and its metabolic products), and 20 PCB congeners. The complete list of analytes and the parameter-specific Method Detection Levels and QLs are shown in Table 1. For statistical analysis, concentrations less than the QL were reported as one-half the QL (1.00 ng/g) and non-detects were set at 0.0001 ng/g.

Of the 85 samples analyzed, 30 were from breeding areas in the 2006 basin year watersheds. Regionally, the analyzed samples were from 7 inland Upper Peninsula, 27 inland Lower Peninsula, 17 Lake Superior, 10 Lake Michigan, 23 Lake Huron, and 1 Lake Erie breeding areas. The no-observable-adverse-effect levels (NOAELs) in 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.

4.21 DDT and Metabolites

Concentrations of 2,4'- and 4,4'-DDE and 2,4'- and 4,4'-DDD, and, 2,4'-DDT were measured in nestling bald eagle blood samples (Table 2). The most ubiquitous compound, 4,4'-DDE was detected in 57 (67%) samples and on average made up 96% of the total DDT quantified. Statewide, concentrations of 4,4'-DDE ranged from < 1.0-185.9 ng/g. Total DDT concentrations were calculated as the sum of 2,4'- and 4,4'-DDE, 2,4'- and 4,4'-DDD, and, 2,4'- and 4,4'-DDT.

No significant differences were found among Great Lakes (n=44), anadromous (n=7), and inland (n=34) breeding areas or between Great Lakes and anadromous breeding areas pooled (n=51) and inland breeding areas for total DDT or 4,4'-DDE. No significant differences were found among Lake Michigan, Lake Superior, Lake Huron, Lake Erie, inland Upper Peninsula, or inland Lower Peninsula for total DDT or 4,4'-DDE. Geometric mean 4,4'-DDE concentrations were ranked in the following order by location from highest to lowest: Lake Huron (n=23) > inland Upper Peninsula (n=7) > Lake Superior (n=17) > inland Lower Peninsula (n=27) > Lake Michigan (n=10) > Lake Erie (n=1) breeding areas. Geometric mean total DDT concentrations were ranked in the following order by location from highest to lowest: Lake Huron > inland Upper Peninsula > inland Lower Peninsula > Lake Superior > Lake Michigan > Lake Erie breeding areas (Figure 3).

No significant differences were found between Great Lakes watersheds for total DDT and 4,4'-DDE. Mean total DDT and 4,4'-DDE concentrations were ranked in the following order by Great Lakes watershed from highest to lowest: Lake Huron (n=32) > Lake Superior (n=22) > Lake Erie (n=1) > Lake Michigan (n=30) (Figure 4).

The greatest total DDT concentration (188.60 ng/g) in an individual breeding area was measured in a nestling from N. Pt.-Grass L.K. breeding area, which is located in the northeastern Lower Peninsula in Alpena County (AP-13; Table 2). 4,4'-DDE made up 99% of the total DDT found in that eaglet. In past reports an arbitrary "high total DDT" has been

considered to be ≥ 100 ng/g, two samples attained this threshold in this sampling season. The first is reported above. The second greatest total DDT concentration (145.50 ng/g) in an individual breeding area was measured in a nestling from E1 Pool (Seney) breeding area, which is located in the central in the Upper Peninsula in Schoolcraft County (MD-01) (Table 2). 4,4'-DDE made up 96% of the total DDT found in that eaglet.

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 85 nestling plasma samples analyzed in 2006, 38 (45%) exceeded the NOAEL. Of the eaglets exceeding the NOAEL, 24 (63%) were in Great Lakes breeding areas. 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.

4.22 PCBs

Twenty PCB congeners were quantified and summed to determine total PCBs in nestling bald eagle plasma samples (Table 3). Of these 20 congeners, PCBs 8, 18, 28, and 44 were not found in any eaglets. In four eaglets, congener 138 was the only congener found in each eaglet. Congeners 153 and 138 were the most ubiquitous congeners making up 24% and 21% of the PCBs detected in samples, respectively. Statewide, concentrations of congener 153 ranged from < 1.0-68.9 ng/g and congener 138 ranged from <1.0-59.9 ng/g.

Statewide total PCB concentrations ranged from non-detect to 274.5 ng/g (Table 3). At least one of the targeted PCB congeners was detected in 60 (71%) of the nestlings sampled. All but 6 of the nestlings in which no PCB congeners were detected were from inland breeding areas. PCB congeners were detected in nestlings from inland, Great Lakes, and anadromous breeding areas (Table 3).

Total PCB concentrations were calculated as the sum of all PCB congeners (Table 3). No significant differences were found for total PCB concentrations in Great Lakes (n=44), anadromous (n=7), and inland (n=34) breeding areas (Figure 5). No significant differences were found for total PCB concentrations for Great Lakes and anadromous breeding areas pooled (n=51) and inland breeding areas. No significant differences were found for total PCB concentrations in Lake Erie (n=1), Lake Huron (n=23), Lake Michigan (n=10), Lake Superior (n=17), inland Upper Peninsula (n=7), and inland Lower Peninsula breeding areas (n=27; Figure 5). The greatest total concentration of PCBs (274.5 ng/g) was found in a a nestling from N. Pt.-Grass L.K. breeding area, which is located in the northeastern Lower Peninsula in Alpena County (AP-13; Table 3). Geometric mean PCB concentrations were ranked in the following order by location from highest to lowest: Lake Erie > inland Lower Peninsula > Lake Huron > Lake Michigan > Lake Superior > inland Upper Peninsula breeding areas.

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 85 nestling plasma samples analyzed in 2006, 19 (22%) 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.

No significant differences were found between Great Lake watersheds for total PCB concentrations (Figure 6). Geometric mean total PCB concentrations were ranked in the following order by Great Lakes watershed from highest to lowest: Lake Erie (n=1) > Lake Huron (n=32) > Lake Michigan (n=30) > Lake Superior (n=22).

4.23 Other Organics

The other organic contaminants that were detected in 2006 nestling samples were ά-chlordane, and dieldrin (Table 4). Concentrations of ά-hexachlorocyclohexane, γ-hexachlorocyclohexane, hexachlorobenzene, heptachlor, heptachlor epoxide, γ-chlordane, and toxaphene were not detected in any of the year 2006 samples. However, because dieldrin and ά-chlordane were detected in only 40% and 8% of eaglets sampled, statistical analysis were not conducted.

Dieldrin was quantified in 34 samples ranging from 3.5-25.1 ng/g; half the samples were from Great Lakes breeding areas and the other half were from inland breeding areas. Regionally samples were from 3 Lake Superior, 12 Lake Huron, 2 Lake Michigan, 14 Lower Peninsula, and 3 Upper Peninsula breeding areas.

Alpha-chlordane was quantified in 7 samples ranging from 2.6-17.3 ng/g, 5 of the samples were from Great Lakes breeding areas and 2 were from inland breeding areas. All of the 7 Great Lakes samples were from Lake Huron breeding areas. The 2 inland samples were from the Lower Peninsula.

SECTION 5.0

FUTURE STUDIES

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

- 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 Lake Superior in northwest Marquette County.

- 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.

SECTION 6.0

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SECTION 7.0

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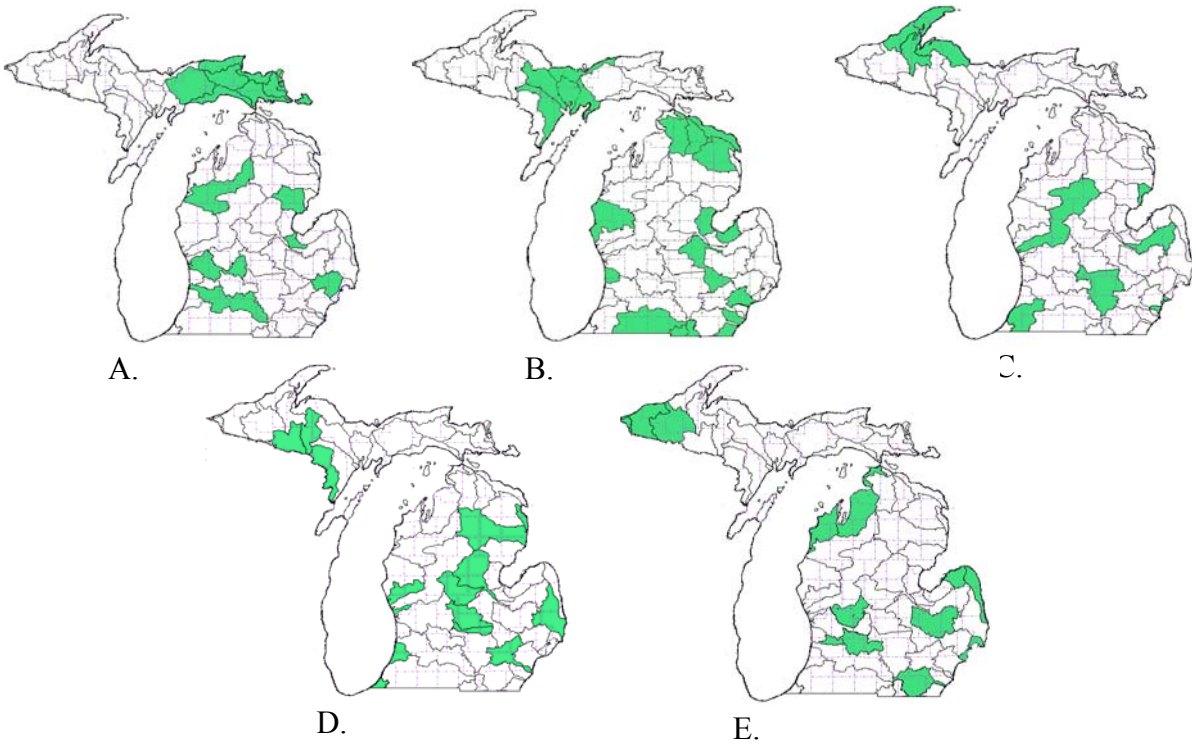

Figure 1. Michigan's watershed delineations and monitoring "basin years." A.) 1999, 2004 basin year watersheds (shaded); B.) 2000, 2005 basin year watersheds (shaded); C.) 2001, 2006 basin year watersheds (shaded); D.) 2002, 2007 basin year watersheds (shaded); and E.) 2003, 2008 basin year watersheds (shaded).

YEAR 2006 MONITORING WATERSHEDS
(Basin Year 8)

U.P. Watersheds
Ca – Carp River (Mackinac)
Ch – Charlotte & Upper St. Mary's (Chippewa)
Mi – Millecoquins (Mackinac: Lake Michigan Shoreline from Manistique to Lake Huron)
Msq – Manistique (Schoolcraft)
Mu – Munuscong and Lower St. Mary's (Chippewa)
Pe – Pendill's Creek (Chippewa)
Pi – Pine (Mackinac)
Ta – Tahquamenon (Chippewa)
2H – Two Hearted (Luce)
Wa – Waiska (Chippewa)

L.P. Watersheds
BS – Big Sable (Mason)
Cl – Clinton (Macomb)
Gr- Grand, Lower (Ottawa: Maple River to Lake Michigan)
Ka – Kalamazoo (Allegan)
Ma – Manistee (Manistee)
Ri – Rifle (Arenac)
Sa – Saginaw (Bay)

● Watersheds are identified by the name of the principal water body. The name in parentheses is the county where the most downstream segment of the principal water body is located.

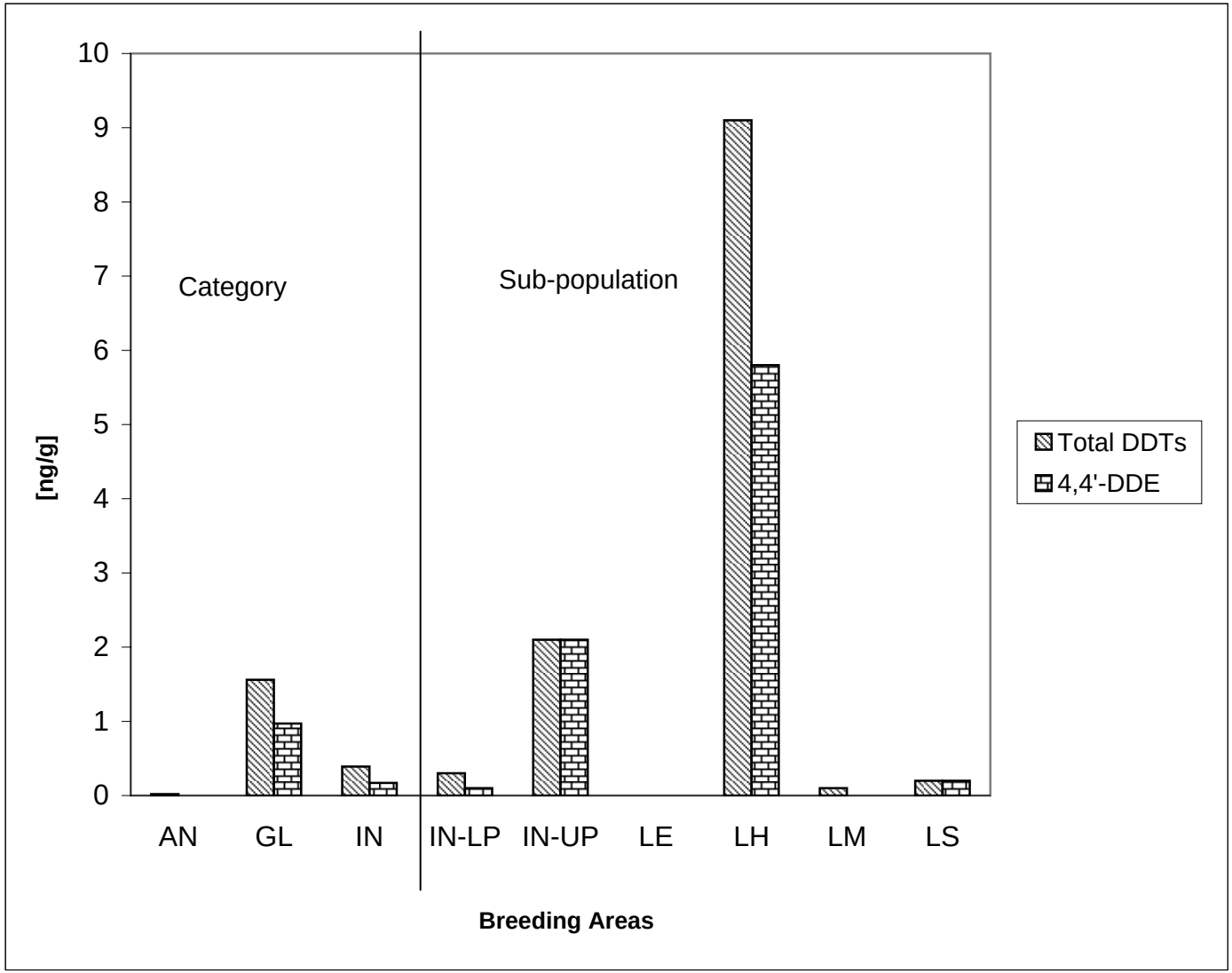

Figure 3: Geometric mean Total DDT and 4,4'-DDE concentrations (ng/g) in nestling bald eagles in 2006 by categories and subpopulations. Error bars have not been included because the number of non-detects makes

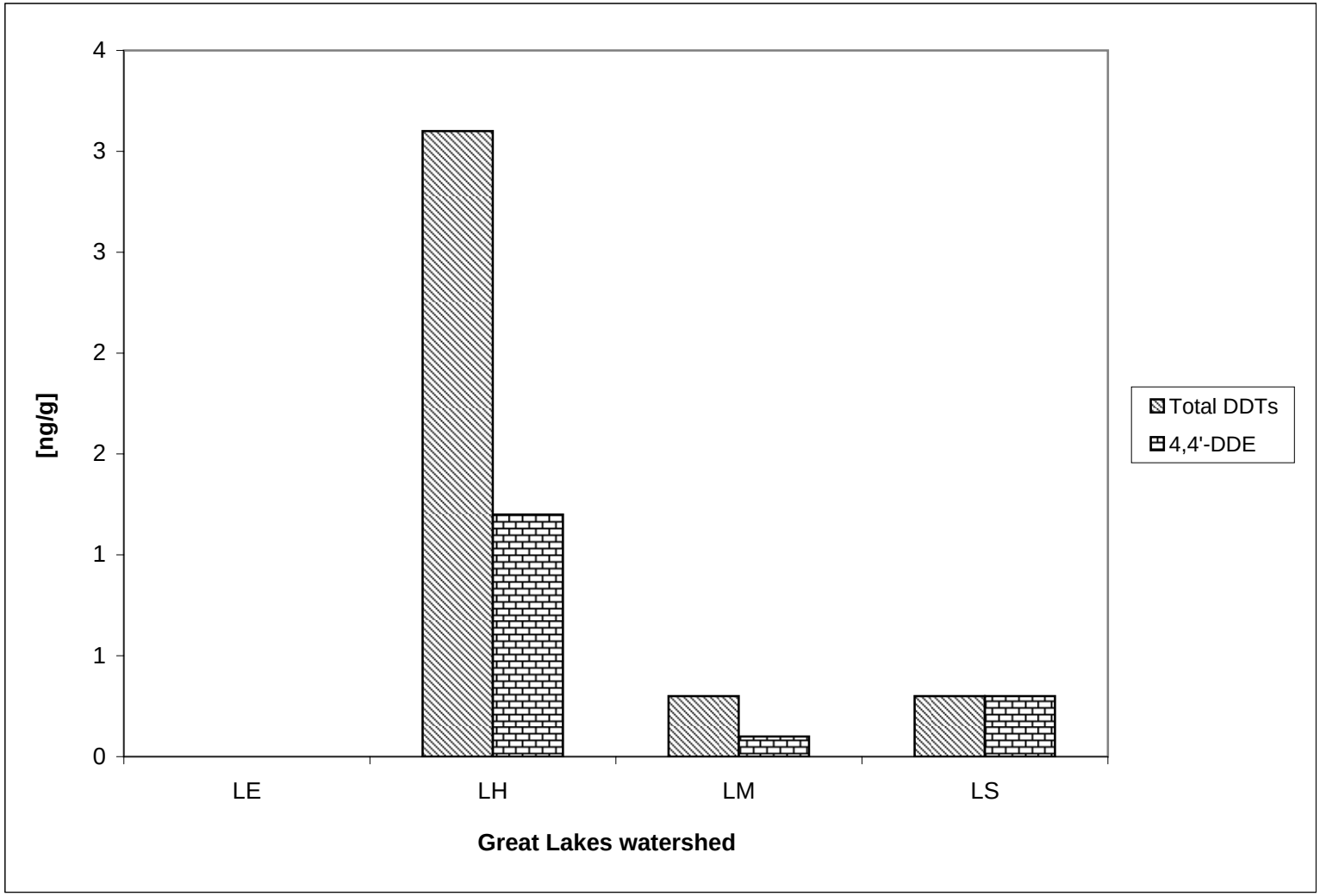

Figure 4: Geometric mean Total DDT and 4,4'-DDE concentrations (ng/g) in nestling bald eagles in 2006 by Great Lakes watersheds. Error bars have not been included because the number of non-detects makes them too large to display.

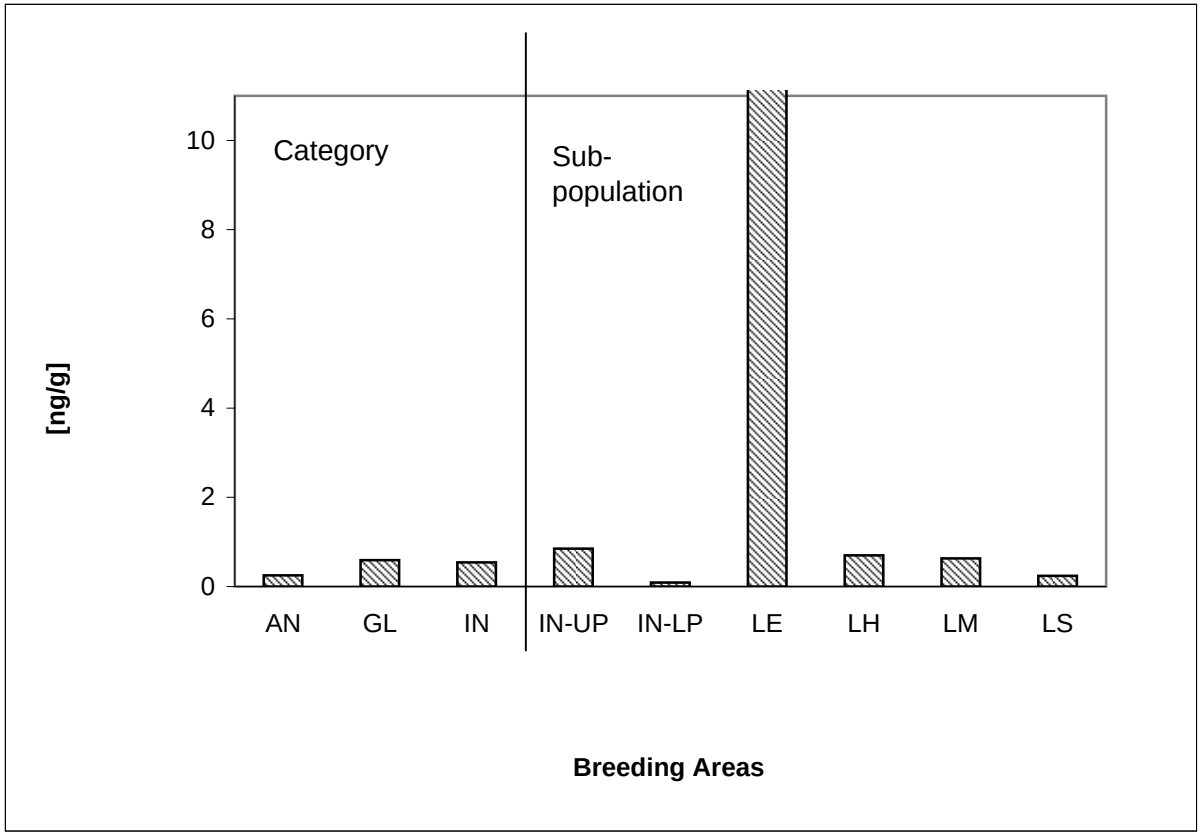

Figure 5: Geometric mean Total PCB concentrations (ng/g) in nestling bald eagles in 2006 by categories and subpopulations. The geometric mean for LE was 33.2 (n=1) because it was so much greater than the other results it has been truncated to better show other data points. Error bars have not been included because the number of non-detects makes them too large to display.

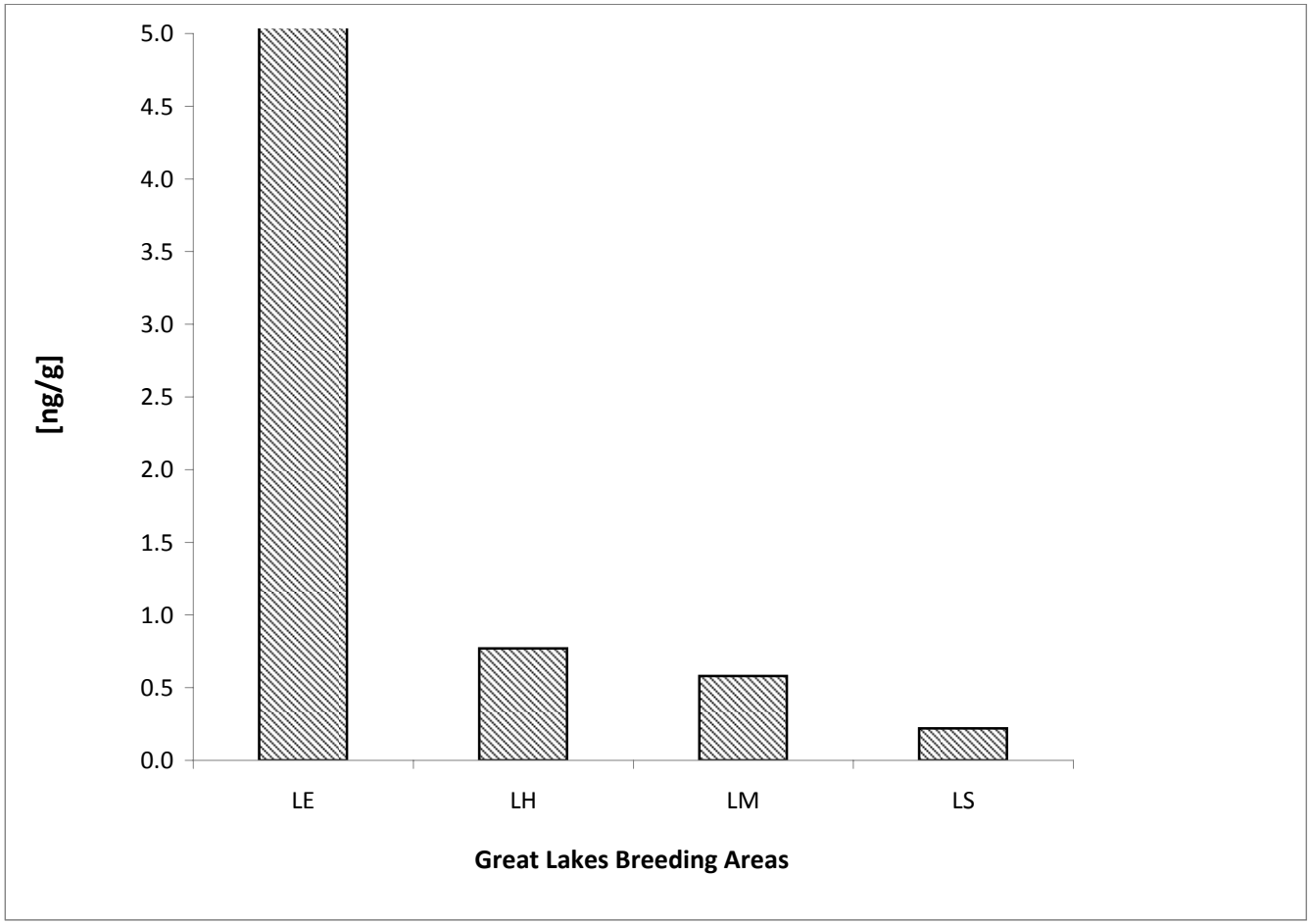

Figure 6: Geometric mean Total PCB concentrations (ng/g) in nestling bald eagles in 2006 by Great Lakes watersheds. The geometric mean for LE was 33.2 (n=1) because it was so much greater than the other results it has been truncated to better show other data points. Error bars have not been included because the number of non-detects makes them too large to display.

Table 1. Organochlorine contaminant analytes measured in nestling bald eagle blood samples in 2006, with parameter-specific Method Detection Levels (MDLs) and Quantification Levels (QLs).

Organochlorine Contaminant Analyte List	Method Detection Level (MDL)	Quantification Level (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 2. Concentrations of DDE, DDD, and Total DDT compounds (ng/g wet weight (ppb)) in nestling bald eagle plasma samples analyzed in 2004. Breeding areas were located in either inland lower peninsula (LP), inland upper peninsula (UP), Lake Huron (LH), Lake Michigan (LM), 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'-DDD	2,4'-DDE	2,4'-DDT	4,4'-DDD	4,4'-DDE	DDE+DDT+DDD
AG-11f	LH	AN	BAEA-MI-2006-A-48	Laughing Fish Pt.	ND	ND	ND	ND	23.9	23.9
AP-08e	LH	GL	BAEA-MI-2006-B-21	Devil's Lk.	ND	ND	ND	ND	34.5	34.5
AP-13a	LP	IN	BAEA-MI-2006-B-22	N. Pt.-Grass L.K.	ND	ND	ND	2.7	185.9	188.6
AP-13a	UP	IN	BAEA-MI-2006-B-23	N. Pt.-Grass L.K.	ND	ND	ND	ND	42.5	42.5
AP-13a	LP	IN	BAEA-MI-2006-B-24	N. Pt.-Grass L.K.	ND	ND	ND	1.0	36.2	37.2
AR-05a	LP	IN	BAEA-MI-2006-C-01	Pt AuGres	ND	ND	ND	ND	7.6	7.6
BG-02a	LP	IN	BAEA-MI-2006-A-43	King Lake	ND	ND	ND	ND	12.1	12.1
BG-02a	LH	GL	BAEA-MI-2006-A-44	King Lake	ND	ND	ND	ND	12.0	12.0
BG-04b	LS	GL	BAEA-MI-2006-A-031	VonZellen's Camp	ND	ND	ND	ND	6.4	6.4
BG-04b	LH	GL	BAEA-MI-2006-A-052	VonZellen's Camp	ND	ND	ND	ND	ND	ND
BG-11a	LM	AN	BAEA-MI-2006-A-053	Reed's Pt.	ND	ND	ND	ND	ND	ND
BG-11a	LH	GL	BAEA-MI-2006-A-055	Reed's Pt.	ND	ND	ND	ND	ND	ND
BG-12d	LH	AN	BAEA-MI-2006-A-47	Pequaming Pt.	ND	ND	3.3	ND	8.6	11.9
BG-14c	LM	AN	BAEA-MI-2006-A-45	Vermilac Lk	ND	ND	ND	ND	29.0	29.0
BG-14c	LM	AN	BAEA-MI-2006-A-46	Vermilac Lk	ND	1.0	ND	2.7	69.6	73.3
BG-18b	LS	GL	BAEA-MI-2006-A-056	Aura	ND	ND	ND	ND	ND	ND
BY-03d	LP	IN	BAEA-MI-2006-C-02	Nayanquing Pt	ND	ND	ND	ND	7.8	7.8
BY-03d	LP	IN	BAEA-MI-2006-C-03	Nayanquing Pt	ND	ND	ND	ND	18.2	18.2
BZ-09a	LP	IN	BAEA-MI-2006-B-16	Otter Lk-Sleeping Bear	ND	3.5	ND	ND	47.7	51.2
CL-05a	LH	GL	BAEA-MI-2006-A-007	Long Lake	ND	ND	ND	ND	7.4	7.4
CL-05a	LS	GL	BAEA-MI-2006-A-008	Long Lake	ND	ND	ND	ND	10.5	10.5
CP-22i	LP	IN	BAEA-MI-2006-A-33	Duck Bay-Sugar Isd	ND	ND	ND	ND	16.5	16.5
CP-22i	LH	GL	BAEA-MI-2006-A-34	Duck Bay-Sugar Isd	ND	ND	ND	ND	16.3	16.3
CP-30a	LS	GL	BAEA-MI-2006-A-38	Nebish Isd E	1.0	ND	ND	ND	43.4	44.4
CP-30a	LH	GL	BAEA-MI-2006-A-39	Nebish Isd E	ND	ND	ND	ND	27.5	27.5
CP-33a	LP	IN	BAEA-MI-2006-A-058	Sand Isd-Dunbar	ND	ND	1.0	ND	ND	1.0
CP-33a	LP	IN	BAEA-MI-2006-A-060	Sand Isd-Dunbar	ND	ND	ND	ND	ND	ND
CP-36a	LP	IN	BAEA-MI-2006-A-35	Back Bay	ND	ND	ND	ND	14.2	14.2
CP-36a	LS	GL	BAEA-MI-2006-A-36	Back Bay	ND	ND	ND	ND	ND	ND
CP-43a	LP	IN	BAEA-MI-2006-A-40	Lime Isd	ND	ND	ND	ND	8.8	8.8
CP-44a	LM	GL	BAEA-MI-2006-A-32	Squirrle Isd NE	1.0	ND	ND	1.0	34.4	36.4
CP-46a	LM	GL	BAEA-MI-2006-A-41	Rosedale	ND	ND	ND	ND	24.3	24.3
CP-46a	LP	IN	BAEA-MI-2006-A-42	Rosedale	ND	ND	ND	ND	27.2	27.2
CR-07b	UP	IN	BAEA-MI-2006-B-001	Bald Hill	ND	ND	ND	ND	ND	0.0
CR-07b	UP	IN	BAEA-MI-2006-B-002	Bald Hill	ND	ND	ND	ND	ND	0.0
CX-01c	LS	GL	BAEA-MI-2006-B-18	E. Jordan	ND	ND	ND	ND	7.8	7.8
CX-01c	LS	GL	BAEA-MI-2006-B-19	E. Jordan	ND	ND	ND	ND	17.4	17.4
ET-03a	LP	IN	BAEA-MI-2006-B-20	O'Neal Fldg.-Wilderness SP	ND	ND	ND	ND	7.0	7.0
GT-08a	UP	IN	BAEA-MI-2006-A-023	Cherry City Airport	ND	ND	ND	ND	6.5	6.5
GT-09a	LH	GL	BAEA-MI-2006-A-020	Old Mission Pt.	ND	1.0	ND	ND	15.1	16.1
HO-04c	LP	IN	BAEA-MI-2006-A-028	LaChance Bay	ND	ND	ND	ND	1.0	1.0
HO-05b	UP	IN	BAEA-MI-2006-A-026	Travers Island	ND	ND	ND	ND	39.5	39.5
HO-05b	LH	GL	BAEA-MI-2006-A-027	Travers Island	ND	1.0	ND	ND	75.4	76.4
HO-11c	LM	GL	BAEA-MI-2006-A-025	Prickett L.S.	ND	ND	ND	ND	3.7	3.7
IO-04c	LP	IN	BAEA-MI-2006-B-012	Allen Lake	ND	ND	2.2	ND	ND	2.2
IO-14a	LP	IN	BAEA-MI-2006-B-011	Monument E. 5-channels	ND	ND	1.0	ND	ND	1.0

Table 2. Continued.

Territory	Breeding Area Location	Territory Location	Blood Sample Number	Breeding Area Name	2,4'-DDD	2,4'-DDE	2,4'-DDT	4,4'-DDD	4,4'-DDE	DDE+DDT+DDD
LA-04a	LH	GL	BAEA-MI-2006-A-013	Neboshone	ND	ND	ND	ND	ND	ND
MD-01b	LP	IN	BAEA-MI-2006-B-009	Sanford Lake	ND	ND	1.0	ND	ND	1.0
MD-01b	LP	IN	BAEA-MI-2006-B-010	Sanford Lake	ND	ND	ND	ND	ND	ND
MN-04c	LS	GL	BAEA-MI-2006-B-17	Tippy Dam	ND	ND	ND	ND	17.4	17.4
MN-10a	LH	GL	BAEA-MI-2006-A-018	Little Manistee R.	ND	1.0	ND	ND	9.1	10.1
MN-10a	LS	GL	BAEA-MI-2006-A-019	Little Manistee R.	ND	ND	ND	ND	14.7	14.7
MQ-02g	LM	AN	BAEA-MI-2006-A-030	Conaway L-Salmon Trout R	ND	ND	ND	ND	3.7	3.7
MQ-08b	LH	AN	BAEA-MI-2006-A-024	Kawbagam	ND	ND	ND	ND	11.4	11.4
MQ-21b	LS	GL	BAEA-MI-2006-A-029	Huron Isds NWR W	ND	ND	ND	ND	32.9	32.9
MS-05b	LS	GL	BAEA-MI-2006-A-015	Walhalla E	1.0	ND	ND	ND	20.3	21.3
MS-07a	LS	GL	BAEA-MI-2006-A-014	Pere Marquette L.	ND	ND	ND	ND	12.3	12.3
MT-06a	LH	GL	BAEA-MI-2006-A-010	Jenson	ND	ND	ND	ND	4.6	4.6
MT-06a	LS	GL	BAEA-MI-2006-A-011	Jenson	ND	ND	ND	ND	ND	ND
MT-06a	LM	GL	BAEA-MI-2006-A-012	Jenson	ND	ND	ND	ND	ND	ND
MT-07a	LS	GL	BAEA-MI-2006-A-009	Stanwood	ND	ND	ND	ND	ND	ND
MU-03b	LS	GL	BAEA-MI-2006-A-017	Mona Lake	2.2	1.0	ND	14.7	33.4	51.3
OG-03c	LS	GL	BAEA-MI-2006-A-001	Hardwood Lake	ND	ND	ND	ND	7.7	7.7
OG-03c	LH	GL	BAEA-MI-2006-A-002	Hardwood Lake	ND	ND	ND	ND	6.9	6.9
OG-08a	LH	GL	BAEA-MI-2006-A-003	Devoe Lake	ND	ND	ND	2.4	17.4	19.9
OL-01b	LM	GL	BAEA-MI-2006-B-007	Evart	ND	ND	ND	ND	ND	ND
OL-01b	LM	GL	BAEA-MI-2006-B-008	Evart	ND	ND	ND	ND	ND	ND
OS-02n	LH	GL	BAEA-MI-2006-B-006	Mio Pond West	ND	ND	ND	ND	ND	ND
PI-03c	LE	GL	BAEA-MI-2006-B-25	False Presque Isle	ND	ND	ND	ND	15.0	15.0
RO-06d	LS	GL	BAEA-MI-2006-A-006	Bear Ck Fldg	ND	ND	ND	ND	5.0	5.0
RO-08c	LH	GL	BAEA-MI-2006-B-005	Wraco Lodge	ND	ND	2.2	ND	ND	2.2
RO-11c	LH	GL	BAEA-MI-2006-A-004	Woods/Twin Lake	ND	ND	ND	3.4	70.3	73.8
RO-11c	LH	GL	BAEA-MI-2006-A-005	Woods/Twin Lake	ND	ND	ND	ND	18.1	18.1
RO-13b	UP	IN	BAEA-MI-2006-B-003	Prudenville	ND	ND	ND	ND	ND	ND
RO-13b	LP	IN	BAEA-MI-2006-B-004	Prudenville	ND	ND	ND	ND	ND	ND
SC-06?	LH	GL	BAEA-MI-2006-A-49	E1 Pool (Seney)	ND	1.0	4.1	1.0	139.4	145.5
SC-12b	LP	IN	BAEA-MI-2006-A-057	Thunder Lk S	ND	ND	ND	ND	ND	ND
SG-06a	UP	IN	BAEA-MI-2006-C-05	Shiawassee Rookery	ND	ND	ND	1.0	11.2	12.2
TU-01c	LP	IN	BAEA-MI-2006-C-04	Dinsmoore	ND	ND	ND	ND	11.8	11.8
WA-03b	LP	IN	BAEA-MI-2006-C-06	Campeau Road	ND	ND	ND	ND	ND	ND
WX-02a	LH	GL	BAEA-MI-2006-B-13	Lake Mitchell	ND	1.0	ND	ND	6.3	7.3
WX-02a	LP	IN	BAEA-MI-2006-B-14	Lake Mitchell	ND	1.0	ND	ND	7.7	8.7
WX-04a	LP	IN	BAEA-MI-2006-B-15	Clam River	ND	2.5	ND	ND	ND	2.5
xx-xxa	LP	IN	BAEA-MI-2006-A-51	Passage Island	ND	ND	ND	ND	ND	ND
xx-xxe	LP	IN	BAEA-MI-2006-A-50	Malone Bay Wright Isd	ND	ND	ND	ND	ND	ND

Table 3. Concentrations of individual PCB congeners and Total PCBs (ng/g wet weight (ppb)) in nestling bald eagle plasma samples analyzed in 2006. Breeding areas were located in either inland lower peninsula (LP), inland upper peninsula (UP), Lake Huron (LH), Lake Michigan (LM), or Lake Superior (LS) watersheds. Territories were associated with either inland (IN), Great Lakes (GL), or anadromous (AN) waterbodies. PCB congeners 8, 18, 24, and 28 are not shown because they were not found in any samples.

Territory	Breeding Area Location	Territory Location	Blood Sample Number	Breeding Area Name	# 052	# 066	# 101	# 105	# 110	# 118	# 128	# 138	# 153	# 156	# 170	# 180	# 187	# 195	# 206	# 209	SUM PCBs
AG-11f	LH	AN	BAEA-MI-2006-A-48	Laughing Fish Pt.	ND	ND	ND	ND	ND	3.5	ND	12.9	18.2	ND	1.0	ND	5.3	ND	ND	ND	40.9
AP-08e	LH	GL	BAEA-MI-2006-B-21	Devil's Lk.	ND	ND	ND	ND	13.6	4.4	ND	5.2	4.2	ND	ND	3.2	ND	ND	ND	ND	30.6
AP-13a	LP	IN	BAEA-MI-2006-B-22	N. Pt.-Grass L.K.	4.7	22.4	28.9	12.4	25.1	26.8	8.6	41.6	37.2	4.5	12.0	29.4	17.1	1.0	2.7	ND	274.5
AP-13a	UP	IN	BAEA-MI-2006-B-23	N. Pt.-Grass L.K.	ND	6.9	9.4	3.8	15.2	8.2	2.2	12.3	11.0	ND	3.1	8.0	4.3	ND	ND	ND	84.4
AP-13a	LP	IN	BAEA-MI-2006-B-24	N. Pt.-Grass L.K.	ND	10.6	12.3	3.9	16.4	8.9	2.1	11.5	9.8	ND	2.4	6.5	3.7	ND	ND	ND	88.2
AR-05a	LP	IN	BAEA-MI-2006-C-01	Pt AuGres	ND	4.5	ND	ND	14.6	3.7	ND	3.8	2.6	ND	ND		ND	ND	ND	ND	29.1
BG-02a	LP	IN	BAEA-MI-2006-A-43	King Lake	ND	ND	ND	ND	ND	ND	ND	3.4	ND	ND	ND	ND	ND	ND	ND	ND	3.4
BG-02a	LH	GL	BAEA-MI-2006-A-44	King Lake	ND	ND	ND	ND	ND	ND	ND	3.8	ND	ND	ND	ND	ND	ND	ND	ND	3.8
BG-04b	LS	GL	BAEA-MI-2006-A-031	VonZellen's Camp	ND	ND	ND	2.7	ND	ND	ND	5.5	9.0	ND	ND	3.9	1.0	ND	ND	ND	22.0
BG-04b	LH	GL	BAEA-MI-2006-A-052	VonZellen's Camp	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BG-11a	LM	AN	BAEA-MI-2006-A-053	Reed's Pt.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BG-11a	LH	GL	BAEA-MI-2006-A-055	Reed's Pt.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BG-12d	LH	AN	BAEA-MI-2006-A-47	Pequaming Pt.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BG-14c	LM	AN	BAEA-MI-2006-A-45	Vermilac Lk	ND	ND	ND	2.1	9.1	8.2	ND	14.0	15.6	ND	1.0	ND	5.1	ND	ND	2.1	57.2
BG-14c	LM	AN	BAEA-MI-2006-A-46	Vermilac Lk	ND	6.3	4.3	4.7	11.1	17.9	6.4	34.2	37.1	ND	7.9	ND	15.4	ND	ND	1.0	146.3
BG-18b	LS	GL	BAEA-MI-2006-A-056	Aura	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BY-03d	LP	IN	BAEA-MI-2006-C-02	Nayanquing Pt	ND	5.0	ND	ND	14.2	3.9	ND	3.0	2.5	ND	ND	1.0	ND	ND	ND	ND	29.5
BY-03d	LP	IN	BAEA-MI-2006-C-03	Nayanquing Pt	ND	ND	ND	ND	13.6	4.6	ND	4.6	3.7	ND	1.0	2.9	1.0	ND	ND	ND	31.4
BZ-09a	LP	IN	BAEA-MI-2006-B-16	Otter Lk-Sleeping Bear	ND	8.2	5.8	2.5	19.1	8.9	2.9	17.2	16.4	ND	5.0	14.2	7.6	ND	3.8	ND	111.7
CL-05a	LH	GL	BAEA-MI-2006-A-007	Long Lake	ND	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND	ND	ND	ND	ND	ND	1.0
CL-05a	LS	GL	BAEA-MI-2006-A-008	Long Lake	ND	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND	ND	ND	ND	ND	ND	1.0
CP-22i	LP	IN	BAEA-MI-2006-A-33	Duck Bay-Sugar Isd	ND	ND	ND	ND	ND	2.7	ND	6.5	10.0	ND	ND	ND	ND	ND	ND	ND	19.1
CP-22i	LH	GL	BAEA-MI-2006-A-34	Duck Bay-Sugar Isd	ND	ND	ND	ND	ND	2.4	ND	6.4	9.1	ND	ND	ND	1.0	ND	ND	ND	18.8
CP-30a	LS	GL	BAEA-MI-2006-A-38	Nebish Isd E	ND	ND	ND	ND	7.0	7.9	ND	20.3	25.6	ND	4.9	ND	8.9	ND	ND	ND	74.6
CP-30a	LH	GL	BAEA-MI-2006-A-39	Nebish Isd E	ND	ND	ND	ND	7.0	5.7	ND	12.2	15.4	ND	1.0	ND	5.0	ND	ND	ND	46.3
CP-33a	LP	IN	BAEA-MI-2006-A-058	Sand Isd-Dunbar	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CP-33a	LP	IN	BAEA-MI-2006-A-060	Sand Isd-Dunbar	ND	ND	ND	ND	ND	15.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	15.3
CP-36a	LP	IN	BAEA-MI-2006-A-35	Back Bay	ND	ND	ND	ND	ND	ND	ND	5.3	7.3	ND	ND	ND	ND	ND	ND	ND	12.6
CP-36a	LS	GL	BAEA-MI-2006-A-36	Back Bay	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CP-43a	LP	IN	BAEA-MI-2006-A-40	Lime Isd	ND	ND	ND	ND	ND	ND	ND	3.2	ND	ND	ND	ND	ND	ND	ND	ND	3.2
CP-44a	LM	GL	BAEA-MI-2006-A-32	Squirrle Isd NE	ND	ND	ND	ND	7.5	5.6	ND	15.0	23.7	ND	ND	ND	6.6	ND	ND	ND	58.5
CP-46a	LM	GL	BAEA-MI-2006-A-41	Rosedale	ND	ND	ND	ND	ND	8.2	ND	14.2	20.1	ND	4.2	ND	7.0	ND	ND	ND	53.7
CP-46a	LP	IN	BAEA-MI-2006-A-42	Rosedale	ND	2.9	ND	ND	7.2	7.6	ND	17.5	23.8	ND	4.9	ND	8.5	ND	ND	1.0	73.3
CR-07b	UP	IN	BAEA-MI-2006-B-001	Bald Hill	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CR-07b	UP	IN	BAEA-MI-2006-B-002	Bald Hill	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CX-01c	LS	GL	BAEA-MI-2006-B-18	E. Jordan	ND	ND	ND	ND	11.3	1.0	ND	1.0	ND	ND	ND	ND	ND	ND	ND	ND	13.3
CX-01c	LS	GL	BAEA-MI-2006-B-19	E. Jordan	ND	ND	ND	ND	13.0	3.1	ND	4.4	4.0	ND	ND	2.8	ND	ND	ND	ND	27.3
ET-03a	LP	IN	BAEA-MI-2006-B-20	O'Neal Fldg.-Wilderness SP	ND	ND	ND	ND	14.0	1.0	ND	1.0	ND	ND	ND	ND	ND	ND	ND	ND	16.0
GT-08a	UP	IN	BAEA-MI-2006-A-023	Cherry City Airport	ND	ND	ND	2.5	ND	ND	ND	2.3	1.0	ND	ND	ND	ND	ND	ND	ND	5.8
GT-09a	LH	GL	BAEA-MI-2006-A-020	Old Mission Pt.	ND	ND	5.2	3.6	ND	2.4	1.0	7.9	8.1	ND	ND	2.7	2.4	ND	ND	ND	33.2
HO-04c	LP	IN	BAEA-MI-2006-A-028	LaChance Bay	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HO-05b	UP	IN	BAEA-MI-2006-A-026	Travers Island	ND	ND	ND	4.1	ND	3.2	1.0	12.3	17.2	ND	ND	7.7	4.3	ND	ND	ND	49.7

Table 3. Continued.

Territory	Breeding Area Location	Territory Location	Blood Sample Number	Breeding Area Name	# 052	# 066	# 101	# 105	# 110	# 118	# 128	# 138	# 153	# 156	# 170	# 180	# 187	# 195	# 206	# 209	SUM PCB
HO-05b	LH	GL	BAEA-MI-2006-A-027	Travers Island	ND	ND	ND	5.6	ND	7.7	3.7	22.6	31.6	ND	ND	13.8	8.0	ND	ND	ND	93.0
HO-11c	LM	GL	BAEA-MI-2006-A-025	Prickett L.S.	ND	ND	ND	2.7	ND	ND	ND	4.5	11.5	ND	ND	11.3	3.1	ND	ND	ND	33.2
IO-04c	LP	IN	BAEA-MI-2006-B-012	Allen Lake	ND	ND	ND	ND	ND	4.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.8
IO-14a	LP	IN	BAEA-MI-2006-B-011	Monument E. 5-channels	ND	ND	ND	ND	ND	2.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.4
LA-04a	LH	GL	BAEA-MI-2006-A-013	Neboshone	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MD-01b	LP	IN	BAEA-MI-2006-B-009	Sanford Lake	ND	ND	ND	ND	ND	3.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.3
MD-01b	LP	IN	BAEA-MI-2006-B-010	Sanford Lake	ND	ND	ND	ND	ND	4.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.8
MN-04c	LS	GL	BAEA-MI-2006-B-17	Tippy Dam	ND	ND	ND	ND	14.4	2.4	ND	4.2	3.5	ND	ND	ND	ND	ND	ND	ND	24.6
MN-10a	LH	GL	BAEA-MI-2006-A-018	Little Manistee R.	ND	ND	ND	2.7	ND	ND	ND	4.4	3.3	ND	ND	1.0	1.0	ND	ND	ND	12.4
MN-10a	LS	GL	BAEA-MI-2006-A-019	Little Manistee R.	ND	ND	ND	3.2	ND	1.0	ND	7.3	6.7	ND	ND	1.0	1.0	ND	ND	ND	20.2
MQ-02g	LM	AN	BAEA-MI-2006-A-030	Conaway L-Salmon Trout R	ND	ND	ND	ND	ND	ND	ND	3.0	3.8	ND	ND	ND	ND	ND	ND	ND	6.9
MQ-08b	LH	AN	BAEA-MI-2006-A-024	Kawbagam	ND	ND	ND	2.9	ND	ND	ND	5.7	7.2	ND	ND	2.6	ND	ND	ND	ND	18.4
MQ-21b	LS	GL	BAEA-MI-2006-A-029	Huron Isds NWR W	ND	ND	ND	4.5	ND	5.7	4.0	19.0	27.5	ND	ND	13.3	8.0	ND	ND	ND	81.9
MS-05b	LS	GL	BAEA-MI-2006-A-015	Walhalla E	ND	ND	ND	3.7	ND	2.4	1.0	10.7	9.2	ND	ND	3.0	2.5	ND	ND	ND	32.5
MS-07a	LS	GL	BAEA-MI-2006-A-014	Pere Marquette L.	ND	ND	ND	2.9	ND	1.0	ND	6.7	5.4	ND	ND	1.0	ND	ND	ND	ND	17.0
MT-06a	LH	GL	BAEA-MI-2006-A-010	Jenson	ND	ND	ND	ND	ND	ND	ND	ND	1.0	ND	ND	ND	ND	ND	ND	ND	1.0
MT-06a	LS	GL	BAEA-MI-2006-A-011	Jenson	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MT-06a	LM	GL	BAEA-MI-2006-A-012	Jenson	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MT-07a	LS	GL	BAEA-MI-2006-A-009	Stanwood	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MU-03b	LS	GL	BAEA-MI-2006-A-017	Mona Lake	ND	ND	ND	2.3	ND	ND	ND	2.1	ND	ND	ND	ND	ND	ND	ND	ND	4.4
OG-03c	LS	GL	BAEA-MI-2006-A-001	Hardwood Lake	ND	ND	ND	ND	ND	ND	ND	2.9	2.6	ND	ND	2.1	ND	ND	ND	ND	7.6
OG-03c	LH	GL	BAEA-MI-2006-A-002	Hardwood Lake	ND	ND	ND	ND	ND	2.8	ND	5.5	7.6	ND	ND	6.1	3.1	ND	ND	ND	25.1
OG-08a	LH	GL	BAEA-MI-2006-A-003	Devoe Lake	7.077	ND	7.658	3.4	ND	11.8	2.0	23.3	26.8	ND	6.3	17.3	11.9	ND	ND	ND	117.6
OL-01b	LM	GL	BAEA-MI-2006-B-007	Evart	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
OL-01b	LM	GL	BAEA-MI-2006-B-008	Evart	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
OS-02n	LH	GL	BAEA-MI-2006-B-006	Mio Pond West	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PI-03c	LE	GL	BAEA-MI-2006-B-25	False Presque Isle	ND	ND	ND	ND	13.0	3.1	ND	4.5	3.7	ND	ND	2.7	ND	ND	ND	ND	27.0
RO-06d	LS	GL	BAEA-MI-2006-A-006	Bear Ck Fldg	ND	ND	ND	ND	ND	ND	ND	ND	2.4	ND	ND	ND	ND	ND	ND	ND	2.4
RO-08c	LH	GL	BAEA-MI-2006-B-005	Wraco Lodge	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
RO-11c	LH	GL	BAEA-MI-2006-A-004	Woods/Twin Lake	2.345	9.141	9.572	7.0	ND	19.4	5.4	26.2	25.2	2.1	ND	12.4	9.4	ND	ND	ND	128.1
RO-11c	LH	GL	BAEA-MI-2006-A-005	Woods/Twin Lake	ND	2.544	1.000	2.0	ND	5.4	1.0	5.8	6.2	ND	ND	2.2	1.0	ND	ND	ND	27.2
RO-13b	UP	IN	BAEA-MI-2006-B-003	Prudenville	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
RO-13b	LP	IN	BAEA-MI-2006-B-004	Prudenville	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SC-06?	LH	GL	BAEA-MI-2006-A-49	E1 Pool (Seney)	ND	3.520	ND	5.2	9.5	20.4	1.0	59.9	68.9	ND	15.2	48.8	ND	ND	ND	1.0	233.5
SC-12b	LP	IN	BAEA-MI-2006-A-057	Thunder Lk S	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SG-06a	UP	IN	BAEA-MI-2006-C-05	Shiawassee Rookery	ND	5.423	ND	ND	14.2	3.8	ND	3.4	2.7	ND	ND	1.0	ND	ND	ND	ND	30.6
TU-01c	LP	IN	BAEA-MI-2006-C-04	Dinsmoore	ND	6.530	6.016	ND	6.3	6.0	ND	5.1	4.3	ND	1.0	2.9	1.0	ND	ND	ND	39.2
WA-03b	LP	IN	BAEA-MI-2006-C-06	Campeau Road	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WX-02a	LH	GL	BAEA-MI-2006-B-13	Lake Mitchell	ND	ND	ND	ND	ND	1.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.0
WX-02a	LP	IN	BAEA-MI-2006-B-14	Lake Mitchell	ND	ND	ND	ND	ND	1.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.0
WX-04a	LP	IN	BAEA-MI-2006-B-15	Clam River	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
xx-xxa	LP	IN	BAEA-MI-2006-A-51	Passage Island	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
xx-xxe	LP	IN	BAEA-MI-2006-A-50	Malone Bay Wright Isd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 4. Concentrations of individual organochlorine compounds (ng/g wet weight (ppb)) in nestling bald eagle plasma samples analyzed in 2006. Breeding areas were located in either inland lower peninsula (LP), inland upper peninsula (UP), Lake Huron (LH), Lake Michigan (LM), 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	a-Chlordane	Dieldrin
AG-11f	LH	AN	BAEA-MI-2006-A-48	Laughing Fish Pt.	ND	6.6
AP-08e	LH	GL	BAEA-MI-2006-B-21	Devil's Lk.	ND	13.6
AP-13a	LP	IN	BAEA-MI-2006-B-22	N. Pt.-Grass L.K.	17.3	25.1
AP-13a	UP	IN	BAEA-MI-2006-B-23	N. Pt.-Grass L.K.	5.9	15.2
AP-13a	LP	IN	BAEA-MI-2006-B-24	N. Pt.-Grass L.K.	7.1	16.4
AR-05a	LP	IN	BAEA-MI-2006-C-01	Pt AuGres	ND	14.6
BG-02a	LP	IN	BAEA-MI-2006-A-43	King Lake	ND	ND
BG-02a	LH	GL	BAEA-MI-2006-A-44	King Lake	ND	ND
BG-04b	LS	GL	BAEA-MI-2006-A-031	VonZellen's Camp	ND	ND
BG-04b	LH	GL	BAEA-MI-2006-A-052	VonZellen's Camp	ND	ND
BG-11a	LM	AN	BAEA-MI-2006-A-053	Reed's Pt.	ND	ND
BG-11a	LH	GL	BAEA-MI-2006-A-055	Reed's Pt.	ND	ND
BG-12d	LH	AN	BAEA-MI-2006-A-47	Pequaming Pt.	ND	6.4
BG-14c	LM	AN	BAEA-MI-2006-A-45	Vermilac Lk	ND	9.1
BG-14c	LM	AN	BAEA-MI-2006-A-46	Vermilac Lk	5.7	11.1
BG-18b	LS	GL	BAEA-MI-2006-A-056	Aura	ND	ND
BY-03d	LP	IN	BAEA-MI-2006-C-02	Nayanquing Pt	ND	14.2
BY-03d	LP	IN	BAEA-MI-2006-C-03	Nayanquing Pt	ND	13.6
BZ-09a	LP	IN	BAEA-MI-2006-B-16	Otter Lk-Sleeping Bear	ND	19.1
CL-05a	LH	GL	BAEA-MI-2006-A-007	Long Lake	ND	ND
CL-05a	LS	GL	BAEA-MI-2006-A-008	Long Lake	ND	ND
CP-22i	LP	IN	BAEA-MI-2006-A-33	Duck Bay-Sugar Isd	ND	6.8
CP-22i	LH	GL	BAEA-MI-2006-A-34	Duck Bay-Sugar Isd	ND	7.1
CP-30a	LS	GL	BAEA-MI-2006-A-38	Nebish Isd E	ND	7.0
CP-30a	LH	GL	BAEA-MI-2006-A-39	Nebish Isd E	ND	7.0
CP-33a	LP	IN	BAEA-MI-2006-A-058	Sand Isd-Dunbar	ND	ND
CP-33a	LP	IN	BAEA-MI-2006-A-060	Sand Isd-Dunbar	ND	ND
CP-36a	LP	IN	BAEA-MI-2006-A-35	Back Bay	ND	8.0
CP-36a	LS	GL	BAEA-MI-2006-A-36	Back Bay	ND	ND
CP-43a	LP	IN	BAEA-MI-2006-A-40	Lime Isd	ND	ND
CP-44a	LM	GL	BAEA-MI-2006-A-32	Squirrle Isd NE	ND	7.5
CP-46a	LM	GL	BAEA-MI-2006-A-41	Rosedale	ND	6.8
CP-46a	LP	IN	BAEA-MI-2006-A-42	Rosedale	ND	7.2
CR-07b	UP	IN	BAEA-MI-2006-B-001	Bald Hill	ND	ND
CR-07b	UP	IN	BAEA-MI-2006-B-002	Bald Hill	ND	ND
CX-01c	LS	GL	BAEA-MI-2006-B-18	E. Jordan	ND	11.3
CX-01c	LS	GL	BAEA-MI-2006-B-19	E. Jordan	ND	13.0
ET-03a	LP	IN	BAEA-MI-2006-B-20	O'Neal Fldg.-Wilderness SP	ND	14.0
GT-08a	UP	IN	BAEA-MI-2006-A-023	Cherry City Airport	ND	ND
GT-09a	LH	GL	BAEA-MI-2006-A-020	Old Mission Pt.	ND	ND
HO-04c	LP	IN	BAEA-MI-2006-A-028	LaChance Bay	ND	ND
HO-05b	UP	IN	BAEA-MI-2006-A-026	Travers Island	ND	ND

Table 4. Continued.

Territory	Breeding Area Location	Territory Location	Blood Sample Number	Breeding Area Name	a-Chlordane	Dieldrin
HO-05b	LH	GL	BAEA-MI-2006-A-027	Travers Island	ND	ND
HO-11c	LM	GL	BAEA-MI-2006-A-025	Prickett L.S.	ND	ND
IO-04c	LP	IN	BAEA-MI-2006-B-012	Allen Lake	ND	ND
IO-14a	LP	IN	BAEA-MI-2006-B-011	Monument E. 5-channels	ND	ND
LA-04a	LH	GL	BAEA-MI-2006-A-013	Neboshone	ND	ND
MD-01b	LP	IN	BAEA-MI-2006-B-009	Sanford Lake	ND	ND
MD-01b	LP	IN	BAEA-MI-2006-B-010	Sanford Lake	ND	ND
MN-04c	LS	GL	BAEA-MI-2006-B-17	Tippy Dam	ND	14.0
MN-10a	LH	GL	BAEA-MI-2006-A-018	Little Manistee R.	ND	ND
MN-10a	LS	GL	BAEA-MI-2006-A-019	Little Manistee R.	ND	ND
MQ-02g	LM	AN	BAEA-MI-2006-A-030	Conaway L-Salmon Trout R	ND	ND
MQ-08b	LH	AN	BAEA-MI-2006-A-024	Kawbagam	ND	ND
MQ-21b	LS	GL	BAEA-MI-2006-A-029	Huron Isds NWR W	ND	ND
MS-05b	LS	GL	BAEA-MI-2006-A-015	Walhalla E	ND	ND
MS-07a	LS	GL	BAEA-MI-2006-A-014	Pere Marquette L.	ND	ND
MT-06a	LH	GL	BAEA-MI-2006-A-010	Jenson	ND	ND
MT-06a	LS	GL	BAEA-MI-2006-A-011	Jenson	ND	ND
MT-06a	LM	GL	BAEA-MI-2006-A-012	Jenson	ND	ND
MT-07a	LS	GL	BAEA-MI-2006-A-009	Stanwood	ND	ND
MU-03b	LS	GL	BAEA-MI-2006-A-017	Mona Lake	ND	ND
OG-03c	LS	GL	BAEA-MI-2006-A-001	Hardwood Lake	ND	ND
OG-03c	LH	GL	BAEA-MI-2006-A-002	Hardwood Lake	ND	ND
OG-08a	LH	GL	BAEA-MI-2006-A-003	Devoe Lake	4.7	3.5
OL-01b	LM	GL	BAEA-MI-2006-B-007	Evart	ND	ND
OL-01b	LM	GL	BAEA-MI-2006-B-008	Evart	ND	ND
OS-02n	LH	GL	BAEA-MI-2006-B-006	Mio Pond West	ND	ND
PI-03c	LE	GL	BAEA-MI-2006-B-25	False Presque Isle	ND	13.0
RO-06d	LS	GL	BAEA-MI-2006-A-006	Bear Ck Fldg	ND	ND
RO-08c	LH	GL	BAEA-MI-2006-B-005	Wraco Lodge	ND	ND
RO-11c	LH	GL	BAEA-MI-2006-A-004	Woods/Twin Lake	7.7	6.0
RO-11c	LH	GL	BAEA-MI-2006-A-005	Woods/Twin Lake	2.6	ND
RO-13b	UP	IN	BAEA-MI-2006-B-003	Prudenville	ND	ND
RO-13b	LP	IN	BAEA-MI-2006-B-004	Prudenville	ND	ND
SC-06?	LH	GL	BAEA-MI-2006-A-49	E1 Pool (Seney)	ND	9.5
SC-12b	LP	IN	BAEA-MI-2006-A-057	Thunder Lk S	ND	ND
SG-06a	UP	IN	BAEA-MI-2006-C-05	Shiawassee Rookery	ND	14.2
TU-01c	LP	IN	BAEA-MI-2006-C-04	Dinsmoore	ND	6.3
WA-03b	LP	IN	BAEA-MI-2006-C-06	Campeau Road	ND	ND
WX-02a	LH	GL	BAEA-MI-2006-B-13	Lake Mitchell	ND	13.3
WX-02a	LP	IN	BAEA-MI-2006-B-14	Lake Mitchell	ND	11.1
WX-04a	LP	IN	BAEA-MI-2006-B-15	Clam River	ND	11.2
xx-xxa	LP	IN	BAEA-MI-2006-A-51	Passage Island	ND	ND
xx-xxe	LP	IN	BAEA-MI-2006-A-50	Malone Bay Wright Isd	ND	6.4