

U.S. FISH AND WILDLIFE SERVICE  
MAINE FIELD OFFICE  
SPECIAL PROJECT REPORT: FY06-MEFO-1-EC



**ENVIRONMENTAL  
CONTAMINANTS  
IN AN OSPREY EGG  
FROM  
UPPER RICHARDSON  
LAKE, MAINE**

January 2006

Mission Statement  
U.S. Fish and Wildlife Service

**"Our mission is working with others to conserve, protect, and enhance  
the nation's fish and wildlife and their habitats  
for the continuing benefit of the  
American people."**

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**Environmental Contaminants in an Osprey Egg  
from Upper Richardson Lake, Maine**

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## Executive Summary

On July 19, 2003 a non-viable, addled osprey (*Pandion haliaetus*) egg was collected from a nest at the northern end of Upper Richardson Lake in Richardsontown Township in western Maine. The egg was analyzed by the U.S. Fish and Wildlife Service for organochlorine compounds and trace elements.

Dioxins, furans, polychlorinated biphenyls (PCBs) and other organochlorine compounds were not detected at elevated concentrations in the osprey egg from Upper Richardson Lake. Only one dioxin congener (2,3,7,8 tetrachlorodibenzo-*p*-dioxin) was detected at a concentration of 1 part-per-trillion, fresh wet weight. Sixteen other dioxin and furan congeners were not detectable. Several dioxin-like PCBs occurred in the egg to produce a dioxin toxic equivalent (TCDD-TEQ) concentration of 29 parts-per-trillion. TCDD-TEQ concentration in the egg was well below a suggested reproductive effect level for osprey ( $\geq 136$  parts-per-trillion). Total PCB and p,p'-DDE concentrations were 1.15 and 0.35 parts-per-million, respectively. Both concentrations were below apparent toxic effect levels. Twenty-four other organochlorine compounds were non-detectable or in the low parts-per-billion range. Mercury was detected at 0.34 parts-per-million. The mercury level in the Upper Richardson Lake osprey egg was elevated compared to osprey egg studies in the mid-Atlantic region of the United States, but below suggested reproductive effect thresholds.

## **PREFACE**

This report provides documentation of environmental contaminants in a nonviable osprey egg collected from a nest at Upper Richardson Lake in western Maine. Analytical work was completed under USFWS Analytical Control Facility Catalog 5100004 and Purchase Orders 94420-03-Y289 (Organics) and 94420-03-Y290 (Trace Elements).

Questions, comments, and suggestions related to this report are encouraged. Written inquiries should refer to Report Number FY06-MEFO-1-EC and be directed to:

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This report complies with the peer review and certification provisions of the Information Quality Act (Public Law 106-554, Section 515).

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## 1. Background

On July 19, 2003 a non-viable, addled osprey (*Pandion haliaetus*) egg was collected from a nest located at the northern end of Upper Richardson Lake near Mill Brook (N 44° 54' 28.4" / W 070° 54' 24.9"; Figure 1). Upper Richardson Lake is located in Richardsontown Township and Township C, Oxford County, in western Maine. The lake has a surface area of approximately 4,200 acres (APC 2003), and supports several prey species for osprey including brown bullhead (*Ameiurus nebulosus*), white sucker (*Catostomus commersoni*), yellow perch (*Perca flavescens*), landlocked Atlantic salmon (*Salmo salar*), and brook trout (*Salvelinus fontinalis*). Compared to other lakes in Maine, osprey densities could be categorized as low on Upper Richardson Lake (C. Todd. 2005. Personal communication). The only other active osprey nest on the lake is located near Pine Island in the southern end of the basin (L. Savoy. 2005. Personal communication).

## 2. Methods

Egg metrics were recorded immediately after collection (e.g., total weight, length, breadth). Prior to processing, the egg was cleaned of surface debris using a paper towel soaked with deionized water. After the egg surface dried, the egg was scored at the equator with a stainless steel scalpel. Egg contents were extracted, placed in a chemical clean jar, and weighed. The sample was frozen and later shipped to analytical laboratories.

Egg contents were analyzed for polychlorinated dibenzo-*p*-dioxins, polychlorinated dibenzofurans, polychlorinated biphenyl congeners including the non-ortho and mono-ortho dioxin-like congeners, and other organochlorine compounds by the Geochemical and Environmental Research Group in College Station, Texas. Trace element determinations were made by the Mississippi State Chemical Laboratory. Percent lipid and percent moisture were also measured. Quality assurance and quality control (QA/QC) procedures at both laboratories included procedural blanks, duplicates, spike recoveries, and certified reference material. The USFWS Analytical Control Facility reviewed QA/QC results and accepted both data packages.

**Table 1.** Egg Metrics and percent lipids.

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|                        |                  |
|------------------------|------------------|
| Total Weight           | 47 grams         |
| Length                 | 58.1 millimeters |
| Mean Breadth           | 46.2 millimeters |
| Estimated Volume       | 63.5 milliliters |
| Weight of Egg Contents | 39 grams         |
| Percent Lipids         | 2.7%             |

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**Figure 1.** Upper Richardson Lake, Richardstontown Township



### 3. Analytical Results

Analytical results are presented in Table 2 (Dioxins, Furans, Dioxin-like PCB Congeners), Table 3 (Other Organochlorine Compounds), and Table 4 (Trace Elements). Concentrations are presented in pg/g (parts-per-trillion) for dioxins, furans, and PCB congeners, and in µg/g (parts-per-million) for other organochlorine compounds and trace elements. All results are presented on a fresh wet weight basis to account for moisture loss after egg laying (Stickel *et al.* 1973, Hoyt 1979). Dioxin toxic equivalent concentrations (TEQs) were calculated using toxic equivalency factors for birds described in Van den Berg *et al.* (1998).

### 4. Discussion

The length and breadth dimensions of the Upper Richardson Lake (URL) osprey egg were consistent with reported values (Poole *et al.* 2002). However, the URL osprey egg weighed only 47 grams. This amount is less than the mean egg mass and range of masses reported by Poole *et al.* (2002) and probably indicates a late or extraneous egg in the clutch (Poole 1989). A sulfur smell was evident during processing indicating the egg was added.

Contaminant concentrations in the URL osprey egg were compared to suggested no-effect levels described in several studies. Dioxin toxic equivalents in the URL osprey egg (29 pg/g) were well below the no-observable-adverse-effect level suggested in a Wisconsin osprey study ( $\geq 136$  pg/g, Woodford *et al.* 1998). Total PCBs concentrations between 8 and 25 µg/g have been associated with decreased hatching success in terns, cormorants, and eagles (Hoffman *et al.* 1996). The URL osprey egg contained 1.15 µg/g of Total PCBs. DDE in the URL osprey egg (0.35 µg/g) was well below the 4.2 µg/g threshold associated with eggshell thinning (Wiemeyer *et al.* 1988).

URL osprey egg contaminant residues were also compared to concentrations reported in two recent osprey studies from the mid-Atlantic region of the United States (Table 5).

Organochlorine compound concentrations in the URL osprey egg were less than levels found in Pennsylvania, Maryland, and Virginia (Toschik *et al.* 2005, Rattner *et al.* 2004). In contrast, the mercury (Hg) level in the URL osprey egg (0.34 µg/g) was higher than concentrations in osprey eggs from the mid-Atlantic studies (range: 0.04 - 0.06 µg/g; Toschik *et al.* 2005, Rattner *et al.* 2004). Elevated Hg exposure in fish-eating birds has been documented in Maine (USFWS unpublished data, Evers *et al.* 2003). An often used reproductive effect endpoint for Hg in bird eggs is 0.80 µg/g (Heinz 1979, Henny *et al.* 2002), while other investigators and ecological risk assessors use 0.50 µg/g as an ecological effect screening benchmark value (RAIS 2005).

Although the URL osprey egg Hg level was higher than osprey eggs from the mid-Atlantic region of the U.S., the concentration in the URL egg was below suggested reproductive effect threshold values.

**Table 2.** Dioxin toxic equivalents in osprey egg from Upper Richardson Lake, Maine

| Congeners                                | TEF               | pg/g<br>fresh wet weight | TEQ       |
|--|-------------------|--------------------------|-----------|
| <b>Dioxins</b>                           |                   |                          |           |
| 2,3,7,8-TetraCDD                         | 1                 | 1.1052                   | 1.1052    |
| 1,2,3,7,8-PentaCDD                       | 1                 | ND                       |           |
| 1,2,3,4,7,8-HexaCDD                      | 0.05              | ND                       |           |
| 1,2,3,6,7,8-HexaCDD                      | 0.01              | ND                       |           |
| 1,2,3,7,8,9-HexaCDD                      | 0.1               | ND                       |           |
| 1,2,3,4,6,7,8-HeptaCDD                   | 0.001 (less than) | ND                       |           |
| OctaCDD                                  | 0.0001            | ND                       |           |
| <b>Furans</b>                            |                   |                          |           |
| 2,3,7,8-TetraCDF                         | 1                 | ND                       |           |
| 1,2,3,7,8-PentaCDF                       | 0.1               | ND                       |           |
| 2,3,4,7,8-PentaCDF                       | 1                 | ND                       |           |
| 1,2,3,4,7,8-HexaCDF                      | 0.1               | ND                       |           |
| 1,2,3,6,7,8-HexaCDF                      | 0.1               | ND                       |           |
| 1,2,3,7,8,9-HexaCDF                      | 0.1               | ND                       |           |
| 2,3,4,6,7,8-HexaCDF                      | 0.1               | ND                       |           |
| 1,2,3,4,6,7,8-HpCDF                      | 0.01              | ND                       |           |
| 1,2,3,4,7,8,9-HpCDF                      | 0.01              | ND                       |           |
| OctaCDF                                  | 0.0001            | ND                       |           |
| <b>TEQ PCDD/F</b>                        |                   |                          | <b>1</b>  |
| <b>Non-ortho PCBs</b>                    |                   |                          |           |
| PCB# 77                                  | 0.05              | 263.22                   | 13.161    |
| PCB# 81                                  | 0.1               | ND                       |           |
| PCB# 126                                 | 0.1               | 119.925                  | 11.9925   |
| PCB# 169                                 | 0.001             | ND                       |           |
| <b>Mono-ortho PCBs</b>                   |                   |                          |           |
| PCB# 105                                 | 0.0001            | 11869.5                  | 1.18695   |
| PCB# 114                                 | 0.0001            | ND                       |           |
| PCB# 118                                 | 0.00001           | 51598.5                  | 0.515985  |
| PCB# 123 (coelute)                       | 0.00001           | 12238.5                  | 0.122385  |
| PCB# 156                                 | 0.0001            | 9409.5                   | 0.94095   |
| PCB# 157                                 | 0.0001            | NA                       |           |
| PCB# 167                                 | 0.00001           | 5596.5                   | 0.055965  |
| PCB# 189                                 | 0.00001           | 1248.45                  | 0.0124845 |
| <b>TEQ Total (PCDD/Fs + planar PCBs)</b> |                   |                          | <b>29</b> |

pg/g = parts-per-trillion

Dioxin toxic equivalency factors (TEFs) from Van den Berg *et al.* 1998

ND = Non-detectable

NA = Not available; data not provided in analytical package

TEQ = toxic equivalent concentration

PCDD/F = polychlorinated dibenzo-*p*-dioxins and dibenzofurans

**Table 3.** Organochlorine compounds in osprey egg from Upper Richardson Lake, Maine

| Compound                              | Concentration<br>(ug/g fresh wet weight) |
|---------------------------------------|--|
| <b>Polychlorinated Biphenyls</b>      |  |
| PCB-TOTAL                             | 1.1543                                   |
| <b>Hexachlorocyclohexanes</b>         |  |
| alpha BHC                             | ND                                       |
| beta BHC                              | ND                                       |
| gamma BHC (lindane)                   | ND                                       |
| delta BHC                             | ND                                       |
| <b>Chlordane Compounds</b>            |  |
| heptachlor                            | ND                                       |
| heptachlor epoxide                    | 0.0032                                   |
| oxychlordane                          | 0.0073                                   |
| alpha chlordane                       | ND                                       |
| gamma chlordane                       | ND                                       |
| cis-nonachlor                         | 0.0032                                   |
| trans-nonachlor                       | 0.0025                                   |
| <b>DDT Metabolites</b>                |  |
| o,p'-DDD                              | 0.0095                                   |
| o,p'-DDE                              | ND                                       |
| o,p'-DDT                              | 0.0030                                   |
| p,p'-DDD                              | 0.0168                                   |
| p,p'-DDE                              | 0.3531                                   |
| <u>p,p'-DDT</u>                       | <u>ND</u>                                |
| Total DDT                             | 0.3824                                   |
| <b>Other Organochlorine Compounds</b> |  |
| aldrin                                | ND                                       |
| dieldrin                              | 0.0043                                   |
| endrin                                | ND                                       |
| HCB (hexachlorobenzene)               | ND                                       |
| endosulfan II                         | ND                                       |
| mirex                                 | ND                                       |
| pentachloro-anisole                   | ND                                       |
| toxaphene                             | ND                                       |

ND = Non-detectable  
ug/g = parts-per-million

**Table 4.** Trace elements in osprey egg from Upper Richardson Lake, Maine

| Element | Concentration<br>ug/g fresh wet weight |
|---------|--|
| Al      | ND                                     |
| As      | ND                                     |
| B       | ND                                     |
| Ba      | 0.02                                   |
| Be      | ND                                     |
| Cd      | 0.01                                   |
| Cr      | 0.17                                   |
| Cu      | 0.61                                   |
| Fe      | 18.42                                  |
| Hg      | 0.34                                   |
| Mg      | 87.19                                  |
| Mn      | 0.22                                   |
| Mo      | ND                                     |
| Ni      | 0.06                                   |
| Pb      | ND                                     |
| Se      | 0.54                                   |
| Sr      | 0.27                                   |
| V       | ND                                     |
| Zn      | 8.17                                   |

ND = Non-detectable  
ug/g = parts-per-million

**Table 5.** Upper Richardson Lake osprey egg compared to osprey eggs from the mid-Atlantic region of the U.S.

|  | Upper Richardson<br>Lake - ME<br>n=1 | Delaware<br>River - PA <sup>1</sup><br>n=3 | South<br>River - MD <sup>2</sup><br>n=15 | Elizabeth<br>River - VA <sup>2</sup><br>n=15 |
|--|--------------------------------------|--|--|--|
| <b>Dioxin Toxic Equivalents (pg/g)</b>       |                                      |  |  |  |
| TCDD-TEQ Total                               | 29                                   | 97   | 160                                      | 57   |
| <b>Polychlorinated Biphenyls (ug/g)</b>      |                                      |  |  |  |
| PCB-Total                                    | 1.15                                 | 4.38                                       | 4.91                                     | 3.60   |
| <b>Chlordane Compounds (ug/g)</b>            |                                      |  |  |  |
| heptachlor epoxide                           | 0.0032                               | 0.0070                                     | 0.0120                                   | 0.0130                                       |
| oxychlordane                                 | 0.0073                               | 0.0100                                     | 0.0150                                   | 0.0140                                       |
| alpha chlordane                              | ND                                   | 0.0040                                     | 0.0050                                   | 0.0070                                       |
| cis-nonachlor                                | 0.0032                               | 0.0050                                     | 0.0160                                   | 0.0210                                       |
| trans-nonachlor                              | 0.0025                               | 0.0030                                     | 0.0070                                   | 0.0110                                       |
| <b>DDT Metabolites (ug/g)</b>                |                                      |  |  |  |
| o,p'-DDT                                     | 0.0030                               | 0.0090                                     |  |  |
| p,p'-DDD                                     | 0.0168                               | 0.0310                                     | 0.0400                                   | 0.1120                                       |
| p,p'-DDE                                     | 0.3531                               | 0.6560                                     | 0.4660                                   | 0.6600                                       |
| <b>Other Organochlorine Compounds (ug/g)</b> |                                      |  |  |  |
| dieldrin                                     | 0.0043                               | 0.0120                                     |  | 0.0160                                       |
| mirex  | ND                                   | 0.0040                                     | 0.0060                                   | 0.0050                                       |
| <b>Mercury (ug/g)</b>                        | 0.3400                               | 0.0400                                     | 0.0610                                   | 0.0400                                       |

All concentrations expressed as fresh wet weight

ND = Non-detectable

<sup>1</sup> Toschik *et al.* 2005 <sup>2</sup> Rattner *et al.* 2004

## 5. Summary

Dioxins, furans, PCBs, and other organochlorine compounds were not detected at elevated concentrations in the URL osprey egg. Only one dioxin congener (2,3,7,8 tetrachlorodibenzo-*p*-dioxin) was detected at a concentration of 1 pg/g, fresh wet weight. Sixteen other dioxin and furan congeners were not detectable. Several dioxin-like PCBs occurred in the URL egg to produce a dioxin toxic equivalent (TCDD-TEQ) concentration of 29 pg/g. TCDD-TEQ concentration in the URL egg was well below a suggested reproductive effect level for osprey ( $\geq$  136 pg/g; Woodford *et al.* 1998). Total PCB and p,p'-DDE concentrations were 1.15 and 0.35  $\mu$ g/g, respectively. Both concentrations were below apparent toxic effect levels (Hoffman *et al.* 1996, Wiemeyer *et al.* 1988). Twenty-four other organochlorine compounds were non-detectable or in the low ng/g range. Mercury was detected at 0.34  $\mu$ g/g. The Hg level in the URL egg was elevated compared to osprey egg studies in the mid-Atlantic region of the United States (Rattner *et al.* 2004, Toschik *et al.* 2005), but below suggested reproductive effect thresholds (Heinz 1979, Henny *et al.* 2002, RAIS 2005).

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