

# A Comprehensive Evaluation of Contaminant Exposure and Reproduction in Delaware Bay Ospreys

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## Abstract

Despite serious water quality problems, contaminated sediments, and considerable pollutant loading and retention, Delaware Bay and River provide important habitat for wildlife. In 2002, we conducted a comprehensive evaluation of contaminant exposure and reproduction of ospreys breeding along 3 segments of a 200 km stretch of the Delaware Bay and River, and in a coastal reference area (Delaware Inland Bays). A sample egg was collected from each of 39 nests and analyzed for organochlorine pesticides, PCBs, and mercury; a subset of these eggs was analyzed for perfluorinated compounds and polybrominated diphenyl ethers. The fate of eggs remaining in each nest was monitored at weekly intervals through fledging. Concentrations of 10 organochlorine pesticides or metabolites (e.g., *p,p'*-DDE, dieldrin, heptachlor epoxide, chlordane), total PCBs, and several Ah receptor agonists (B-2, B-3, B-4, B-5) were greater ( $p < 0.05$ ) in eggs collected between the C&D Canal and Trenton compared to eggs collected from other sites. Concentrations of *p,p'*-DDE (0.785–2.84 µg/g wet wt) and total PCBs (5.50–14.5 µg/g wet wt) in eggs collected between the C&D Canal and Trenton were similar to levels recently found in the Chesapeake Bay regions of concern. The ratio of Aroclor 1254 to Aroclor 1260 was consistent among all sites, suggesting a common source of PCBs. In all study segments, at least 1 young was fledged from 66–75% of the nests. Average productivity at Delaware Inland Bays and southern Delaware Bay was 1.17 and 1.42 fledglings per active nest, which is marginally adequate to maintain the population. A logistic regression model found that organochlorine contaminant concentrations (*p,p'*-DDE, heptachlor epoxide, chlordane and metabolites, and total PCBs) were predictive of hatching success. These findings indicate environmental contaminants continue to be a significant stressor on osprey productivity in the northern Delaware Bay and River.

## Methods



## Introduction

### The Delaware River and Bay

- Valued habitat for fish and wildlife
- Internationally important bird habitat
- Important shipping channels/ports
- $\approx 300$  km long (our study area)
- Gradient from river to ocean
- Urban to rural gradient

### Why study ospreys in the DRB?

- Impaired water quality in the DRB
- Reproductive problems in past
- Shell thinning in waterbirds in early 1990's
- Existing data limited to 2 DB tributaries in NJ
- Number of nests unchanged in northern Bay
- Suspicion - contaminants affecting eagles?

### What did we study?

- Persistent Contaminants
  - Traditional OC pesticides, PCBs and Hg
  - PFOS, PBDE
- Reproduction
  - Nesting Activity
  - Hatching and Fledging Success
  - Productivity



## Results

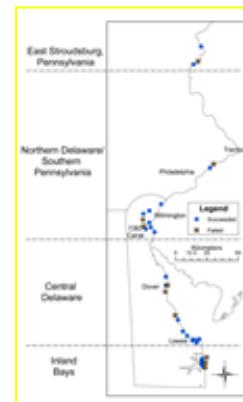
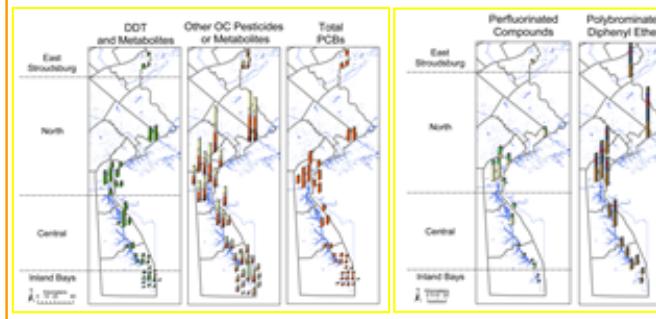
### Productivity of DRB ospreys

	Inland Bays	Central	North	East Stroudsburg
Nests Sampled	12	12	12	3
Eggs Incubated	26	28	27	6
Fate of Eggs				
Lost (Predated/Weather)	6	4	13	0
Failed to Hatch	0	2	2	1
Hatched (%)	20 (77%)	22 (79%)	12 (44%)	5 (83%)
Fate of Nestlings				
Lost (Predated/Out of Nest)	6	5	0	2
Fledged (%)	14 (70.0%)	17 (77%)	12 (100%)	3 (60%)
Successful Nests	9/12	9/12	9/12	2/3
Fledglings/Nest	1.17	1.42	1.00	1.00

### OC Pesticides and Hg

	<i>p,p'</i> -DDE	Dieldrin	Heptachlor epoxide	Chlordane metabolites	Mirex	HCB	Others	Hg	Total PCBs	Aroclor 1254:1260	TEQs	BDEs	Total BDE	Congener 47	PFOS	C9-C12 acids	C8, C10 sulfonate	0.47-14.5 µg/g	0.53-0.70	35-828 pg/g	71-820 ng/g	43-258 ng/g	NQ-221 ng/g	NQ-799 ng/g
	0.17-4.61 µg/g	0.002-0.084	0.001-0.036	ND-0.052	0.001-0.014	ND-0.014	ND to <0.01	0.02-0.27	0.47-14.5 µg/g	Aroclor 1254:1260	0.53-0.70	35-828 pg/g	71-820 ng/g	43-258 ng/g	NQ-221 ng/g	NQ-799 ng/g	0.17-4.61 µg/g	0.002-0.084	0.001-0.036	ND-0.052	0.001-0.014	ND-0.014	ND to <0.01	0.02-0.27

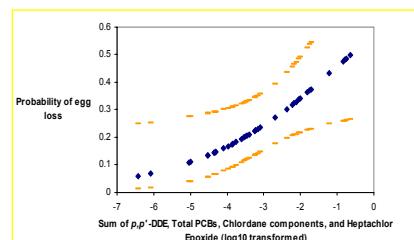
### PCBs, BDEs and PFOS



## Contaminants and Reproduction

- DDE, chlordane and metabolites, heptachlor epoxide, total PCBs and TEQs were correlated  
 $p < 0.0001 \quad r = 0.83-0.95$
- Principal components analysis  
DDE, chlordane/metabolites, heptachlor epoxide, and total PCBs = Component 1

Component 1 accounted for 91%  $\sigma^2$  in the PCA



## Conclusions

- p,p'*-DDE was 1.4x greater than we observed in the Chesapeake Bay osprey eggs
- 30% eggs had *p,p'*-DDE levels associated with  $\geq 10\%$  shell thinning
- PCBs + PFOS detected - hazard unknown
- Productivity: 2002 > 1989  
In range to maintain a stable population
- Contaminant exposure in DRB ospreys below threshold adversely affecting population
- POPs in osprey eggs mirror sediment and water quality pollutant endpoints, providing evidence that osprey is an excellent sentinel of "local" contamination



## What are the biggest threats to the osprey population?

- Dramatic increase in human population (>20% in last decade)
- Associated development
- Habitat loss
- Potential dredging of ship channels
- Emerging contaminant issues