CONTAMINANT CONCENTRATIONS

IN FLORIDA RAPTOR EGGS

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Title: Contaminant concentrations in Florida raptor eggs

Abstract: Inviable eggs from the nests of Florida bald eagles and ospreys were collected opportunisticly from 1987 through 1989. Egg contents were analyzed for organochlorine pesticide (OC), polychlorinated biphenyl (PCB) and heavy metal concentrations. The only organic contaminant found in all eggs was *p,p'*-DDE (range=0.27-4.9 μg/g wet weight). Both the lowest and highest levels were in bald eagle eggs. All bald eagle eggs but one contained above-detection limit levels of oxychlordane, heptachlor epoxide, *trans*-nonachlor, *p,p'*-DDD and PCBs. Polychlorinated biphenyl concentrations ranged from "not detected" to 34 μg/g in eagle eggs (the latter is the highest PCB concentration reported from Florida) and from 2.1 to 3.1 μg/g in osprey eggs. Mercury concentrations (range=0.12-0.60 μg/g wet weight) were less than those known to cause reproductive impairment; however, selenium concentrations (range=0.33-0.86 μg/g wet weight), with the exception of one eagle egg and one osprey egg, were within the range known to cause reproductive impairment.

Key Words: contaminants, heavy metals, mercury, selenium, arsenic, organochlorine pesticides, ospreys, bald eagles

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INTRODUCTION

Due to an increase in heavy metal concentrations and the persistence of organochlorine pesticides in the environment, successful reproduction of many wild bird populations in Florida may be seriously impaired. Species at the top of the food chain, especially those that feed primarily on fish, are particularly susceptible. The Vero Beach (Florida) Field Office of the U.S. Fish and Wildlife Service has acted as a "clearing house" for inviable raptor eggs collected from nests within the State since the mid 1980s.

Our goals in undertaking this project were, and are, to facilitate contaminant analysis and develop a centralized data base that may be utilized by wildlife managers and others involved in raptor management or contaminant research. This report is the first of a series addressing contaminants in Florida's raptors.

METHODS AND MATERIALS

From early 1986 through 1991, inviable eggs were collected from bald eagle (*Haliaeetus leucocephalus*) and osprey (*Pandion haliaetus*) nests in Florida. Eagle eggs were collected at various locations throughout the state including J.N. "Ding" Darling National Wildlife Refuge (NWR), Merritt Island NWR and from a nest in Monroe County. Both osprey eggs were collected from a nest on Kemp Channel in the Florida Keys within the boundaries of the Key Deer NWR. After collection, eggs were returned to the laboratory where contents were placed in chemically-cleaned glass jars, and frozen awaiting analysis.

The analytical methods for organochlorines, including preparation, Soxhlet extraction, and lipid removal were as described by Cromartie et al. (1975), with the following exceptions: glass extraction thimbles were used; only two fractions were used in the silica gel separation of the pesticides from the polychlorinated biphenyls (PCBs); and, 10% ethyl hexane was used to elute the pesticide fraction. The pesticides in each fraction were quantified with a gas-liquid chromatograph (GLC) equipped with a ^{63}Ni electron capture detector. The GLC column used was a 30m MEGABORE coated with a 1.0 micron film of 7% cyanopropyl/7% phenyl polysiloxane. Residues in 10 percent of the samples were confirmed by gas chromatography/mass spectrometry. The nominal lower limit of detection was 0.01 ppm for pesticides and 0.05 ppm for PCBs based on a 10 g aliquot wet weight (ww).

For mercury analysis, one gram aliquots were digested under reflux in sulfuric and nitric acids as described by Monk (1961). The determination was performed by cold vapor atomic absorption spectrophotometry using a Spectro Products mercury analyzer equipped with a Varian VGA-76 vapor generation accessory. The nominal lower limit of detection was 0.05 ppm ww.

Samples were analyzed for selenium and arsenic according to the method described by Krynitsky (1987). A 0.5 g fresh weight aliquot of tissue was used for digestion in 5 ml of nitric acid. Determination was by stabilized temperature platform graphite furnace atomic absorption spectroscopy using Zeeman effect background correction. The nominal detection limit was 0.1 ppm ww.

Table 1. Organochlorine pesticide concentrations in bald eagle eggs. Concentrations are expressed as ug/g (ppm) wet weight.

	Sample No.[a]				
Analyte	8901	8902	7978	7981	3676
HCB	ND	0.01			
oxychlordane	0.03	0.10	0.05	0.15	ND
heptachlor epoxide	0.02	0.09	0.03	0.10	ND
α-chlordane	0.01	0.19	ND	ND	ND
γ-chlordane	ND	0.11	0.02	0.05	ND
t-nonachlor	0.11	0.98	0.28	0.58	ND
PCB (total)	2.6	34.0	4.1	11.0	ND
p,p'-DDD	0.13	0.27	0.04	0.1	ND
o,p'-DDE	ND	0.04			
p,p'-DDE	1.3	4.4	3.4	4.9	0.27
o,p'-DDT	ND	0.08			
p,p'-DDT	ND	0.01	ND	ND	ND
mirex	0.02	0.44			
Lipid content (%)	4.78	4.90	0.32	ND	1.4

[a] Samples were collected at the following locations: 8901, Merritt Island NWR; 8902, J.N. "Ding" Darling NWR; 3676, Monroe County, FL. There is no record of the location where the remaining eggs were collected.

Table 2. Organochlorine pesticide and polychlorinated biphenyl concentrations in osprey eggs. Concentrations are expressed as μg/g (ppm) wet weight.

	Sample No.	
Analyte	7810	7812
oxychlordane	<0.012	0.034
cis-nonachlor	0.051	0.050
PCB (total)	2.1	3.1
p,p'-DDD	0.036	0.081
p,p'-DDE	0.53	0.93
Moisture (%)	81.68	78.6
Lipid (%)	3.3	5.86

RESULTS AND DISCUSSION

Organochlorine pesticide and PCB concentrations in bald eagle and osprey eggs are shown in Tables 1 and 2, respectively. Although eagle egg 8902 generally had the highest concentrations of those contaminants detected (Table 1), egg 7978 contained much higher contaminant levels relative to lipid content. PCBs were detected in four of the five eggs with concentrations ranging from <1.0 ppm to 34 ppm ww. Wiemeyer et al. (1984) reported concentrations up to 218 ppm ww; however, for eggs collected in Florida, the maximum concentration found was 28 ppm. As stated by Audet et al. (1992), the likely reason for greater PCB concentrations in eagle eggs than in osprey eggs is the eagle's higher position on the food chain.

Wiemeyer et al. (1984) also reported that mean PCB residues were significantly lower in eggs from successful nests than in unsuccessful ones (1.3 ppm vs. 7.2 ppm ww). Norheim and Kjos-Hanssen (1984) noted the PCB content in eggs was often positively correlated with DDE levels. Our results generally confirm this observation. Egg 3676, collected in Monroe County, contained only a single contaminant (*p,p'*-DDE) that was above detection limits (Table 1).

Heptachlor epoxide, γ-chlordane, endrin, dieldrin, *trans*-nonachlor and *p,p'*-DDT concentrations in osprey eggs were all below detection limits (<0.012 and <0.028 ppm ww in samples 7810 and 7812, respectively). When pesticide concentrations in osprey eggs were normalized to lipid content, they were very similar. PCB concentrations in osprey eggs (Table 2) were similar to those reported by Audet et al. (1992) in osprey eggs collected from

nests in Maryland, Virginia and Massachusetts (range=0.59 to 5.7); and, were less than those known to cause adverse reproductive effects (Wiemeyer et al. 1988).

As noted in Table 3, arsenic concentrations were below the limit of detection in all samples. Mercury concentrations were greater than those reported by Audet et al. (1992), but below those noted in eagle eggs collected by Wiemeyer and coworkers in 1979 (Wiemeyer et al. 1984), and much less than those noted in osprey eggs by Jenkins (1980). Mercury concentrations in all eggs were less than those linked to reproductive impairment (Eisler 1987, Wiemeyer et al. 1988).

Selenium concentrations in eagle and osprey eggs (Table 3) ranged from 0.33 to 0.86 ppm ww. With the exception of samples 7810 (osprey; 1.80 ppm dw) and 8902 (eagle; 1.94 ppm dw), dry weight concentrations of selenium in the remaining eggs were all greater than 2.0 ppm dw (range=2.01 to 3.02). Concentrations of selenium in eggs from nests in the San Joaquin Valley of California, where severe reproductive effects were noted, ranged between 2 and 110 ppm dry weight (dw). Thus, it is possible that selenium was at least a contributing factor in rendering these eggs inviable.

Table 3. Heavy metal concentrations in eggs of Florida raptors. Concentrations expressed as μg/g (ppm) wet weight.

		Analyte		
Sample	Moisture (%)	Arsenic	Mercury	Selenium
8901	79.4	-	0.12	0.40
8902	79.8	-	0.54	0.61
7978	71.94	<0.15	0.36	0.59
7981	65.78	<0.13	0.29	0.86
3676	81.68	-	0.60	0.53
7810	81.68	<0.096	0.16	0.33
7812	78.6	<0.096	0.16	0.43

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