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[10]**See attached report/memo**

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[12]**Final attached**

PREFACE

This report is final documentation of the 1992 environmental contaminants evaluation of Black-crowned Night Heron eggs from Barnstable County, MA and Richmond County, NY (PACF Catalog Number 5030018, Regional ID Number 5F01). Study design, implementation, data analysis, and reporting were completed by Environmental Contaminants personnel in the New England Field Offices, U.S. Fish and Wildlife Service, Department of the Interior, and Dr. Katherine Parsons of the Manomet Bird Observatory. Funding for the project was provided by the Division of Environmental Contaminants.

Questions, comments, and suggestions related to this report are encouraged. Written enquiries should be directed to:

U.S. Fish and Wildlife Service
New England Field Offices
22 Bridge Street
Concord, New Hampshire 03301

Because some of the data reported here are being reviewed for possible inclusion in a peer-reviewed journal, the Fish and Wildlife Service and Dr. Parsons request that no author cite any portions of this report without first contacting the authors.

The use of trade names in this report is solely for identification purposes and does not constitute an endorsement by the Fish and Wildlife Service or the Department of the Interior.

INTRODUCTION

Biologists from the Manomet Bird Observatory (MBO) have been conducting studies of colonial avian species along the north Atlantic coast since the early 1970s. In 1991, MBO biologists observed abdominal lesions on Black-crowned Night Heron (*Nycticorax nicticorax*) nestlings in 33% of the nests in the colony on Sampson's Island, Barnstable County, Massachusetts. In 1992, 50% of the studied nests contained diseased nestlings. The cause of these lesions is unknown. One hypothesis is that nest parasites may be responsible. There was no relationship, however, between dermestid beetle numbers and lesions (Parsons, unpublished data). A second hypothesis is that exposure to contaminants, such as organochlorines, has resulted in a reduced immunological response in nestlings. Adults from this colony feed in waters that may be potentially affected by hazardous materials released from Massachusetts Military Reservation (MMR) Superfund site. Materials found on the MMR include fly ash, bottom ash, waste solvents, waste fuels, herbicides, and transformer oil (EPA 1991).

Avian reproductive success has been compared between colonies in Cape Cod Bay and the colonies in the Newark Bay/Arthur Kill areas of New York and New Jersey. The percent of eggs hatched/nest of Black-crowned Night Herons, Herring Gulls (*Larus argentatus*), and Canada Geese (*Branta canadensis*) were significantly lower in the Newark Bay/Arther Kill colonies than those found in the Nantucket Sound/Cape Cod Bay colonies (Parsons 1990, Parsons 1991).

Our primary objective was to conduct a screening level survey to determine if organochlorines, as exist in eggs recovered from two selected colonies, could be correlated with either the nestling lesions as seen in the Cape Cod colony, or the decreased productivity of the Newark Bay colony. Our secondary objective was to assess the potential contaminant burden that could be expected in the Nantucket/Cape Cod Bay area as a potential restoration area for the endangered Roseate Tern (*Sterna dougallii*).

METHODS

Eight eggs were colleced from the Newark Bay colony (Isle of Meadows) on 26 May 1992. Ten eggs were collected from the Cape Cod Bay colony (Sampson's Island) on 11 June 1992. All eggs were refigerated until the contents could be removed. Egg volumn was measured using water displacement. Egg contents were stored in chemically-clean glass jars and frozen. Organochlorine residue analysis of egg contents was performed by Mississippi State Chemical Laboratory using methods described in Appendix 2. The results of contaminant residue analysis were corrected for moisture loss (Stickel et al. 1973). Geometric means, (expressed as ppm wet weight), were calculated for contaminants detected in at least 50% of the eggs from a particular colony. Contaminant concentrations at the two locations studies were compared using the Student's t-test.

RESULTS

The results of the organochlorine scan are shown in table 1. Eggs from the Newark Bay colony had significantly higher levels of p, p' - DDD, heptachlor epoxide, oxychlordane, and trans-nonachlor than eggs from the Cape Cod colony. PCB's, trans-nonachlor, oxychlordane, heptachlor epoxide, DDE, and DDD were detected in every egg from both colonies. Dieldrin and b - BHC were detected in at least 50% of the eggs from both colonies.

Table 1. Means (geometric), range (untransformed), and percent occurrence of organochlorine residues in Black-crowned Night Heron eggs collected from two colonies in 1992.

	Residue (ppm wet weight) and % occurrence						
Contaminant	Newark Bay	Range	%	Cape Cod Bay	Range	%	P
p, p'-DDE	3.12	0.77-13.4	100	1.64	0.49-12.7	100	ns
p, p'-DDD	0.11	0.03-0.65	100	0.03	0.01-0.16	100	0.0081
o, p'-DDD	0.03	0.01-0.12	100	-	nd-0.02	30	-
p, p'-DDT	0.04	nd-0.49	75	-	nd-0.21	20	-
Total DDT	3.36	0.85-13.7	100	1.70	0.53-13.1	100	ns
Dieldrin	0.02	nd-0.22	63	0.01	nd-0.07	90	ns
Heptachlor epoxide	0.04	0.02-0.11	100	0.01	0.01-0.02	100	0.0001
Oxychlordane	0.07	0.03-0.23	100	0.02	0.01-0.03	100	0.0016
Trans-nonachlor	0.09	0.04-0.41	100	0.04	0.03-0.05	100	0.0265
b - BHC	0.01	nd-0.03	75	0.01	nd-0.01	70	ns
Mirex	0.01	nd-0.03	75	-	nd-0.02	20	-
Total PCB's	8.48	2.0-33.9	100	4.58	1.9-9.3	100	ns

DISCUSSION

Piscivorous birds integrate both spatially and temporally the pollutant burdens within estuaries. Colonially-nesting species, such as black-crowned night herons and terns, exhibit strong colony-site fidelity year after year and can, thus, function as long-term indicators of estuarine quality.

Organochlorine chemicals have been implicated by many studies as having deleterious effects on growth and reproduction of fish and wildlife. The substance groups found at elevated levels in this study were DDE, DDT, and PCBs. DDE is a metabolite of DDT that has been correlated with eggshell thinning and reduced reproduction in many avian species. Henny *et al.* (1983) found a significant decrease in nesting success in black-crowned night herons in the Intermountain West when eggs contained greater than 8 ppm of DDE. This study also found a significant negative correlation between DDE concentrations and eggshell thickness. Fleming *et al.* (1984) also found a negative correlation between DDE concentrations and eggshell thickness in several heron species. Custer *et al.*'s (1983) data suggested that DDE concentrations in black-crowned night heron eggs exceeding 4.0 ppm may affect hatching success. Tremblay and Ellison (1980) found no apparent affect on black-crowned night heron reproduction in the St. Lawrence Estuary with a mean DDE

concentration in eggs of 2.2 ppm. The geometric means for DDE found in this study were 3.12 ppm (0.77- 13.4 ppm) for Newark Bay, and 1.64 ppm (0.49-12.7 ppm) for Cape Cod Bay. Although the means are below concentrations reported as having an affect on reproduction, the ranges of the data suggest that some individuals may be deleteriously affected by DDE.

Reports on the affect of PCBs on the reproduction of avian species is mixed. Blus *et al.* (1980) found a significant negative correlation between PCB residues and eggshell thickness in great blue herons (*Ardea herodias*). Other studies have not found this relationship (Vermeer and Reynolds 1970; Fleming *et al.* 1984). Hoffman *et al.* (1986) found a negative correlation between PCB concentrations in whole eggs and embryonic weight for eggs collected in San Francisco Bay. However, it was not clear whether the affect was persistent through hatching. The geometric mean for PCB concentrations in San Francisco Bay study was 4.1 ppm (0.8-52.0 ppm). This mean is similar to that found in this study at the Cape Cod colonies and notably less than the mean found at the Newark Bay colonies, although the ranges around the means in this study were much less extreme than in the San Francisco Bay study.

It can not be expected that the roseate tern will absorb the same contaminant burden or respond the same physiologically to contaminants as the black-crowned night heron. However, they are both piscivorous species, so if persistent contaminants are present in the food chain, both species would be expected to be affected. Studies on common terns (*Sterna hirundo*) have reported that eggshell thickness has not been found to be affected by DDE until concentrations exceed 4.0 ppm (Switzer *et al.* 1973; Fox 1976), which is similar to reports for black-crowned night herons. In colonies of common terns in the Great Lakes, deformities were not found in chicks when mean PCB levels in the eggs were 33.7 ppm. Deformities were reported when the mean PCB levels in the eggs were 55.9 ppm (Gilbertson *et al.* 1976).

CONCLUSIONS

A comparison of concentrations of DDE and PCBs found in this study to concentrations found to affect reproduction in previous studies suggest that DDE and PCBs may be impacting the reproductive success of both the Newark Bay and Cape Cod colonies. Since there was not a significant difference found in PCB and DDE levels between the two locations, this study does not provide an explanation for the significantly lower reproductive success in the Newark Bay colonies. Little literature appears to be available investigating the levels of contaminants that may induce immunological impairment in avian species. Therefore, it appears that additional studies addressing the concerns for these two populations are warranted. Further, the range of concentrations of DDE found in the black-crowned heron eggs in Cape Cod Bay suggest that DDE in the aquatic food chain may be high enough to affect the reproduction of the roseate tern. More studies should be conducted before a restoration of this species to Cape Cod Bay is undertaken.

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