Sublethal Effects of Pesticides on Wildlife

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Wading Birds Nest on Islands

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Wading Birds Forage in Surrounding Landscape

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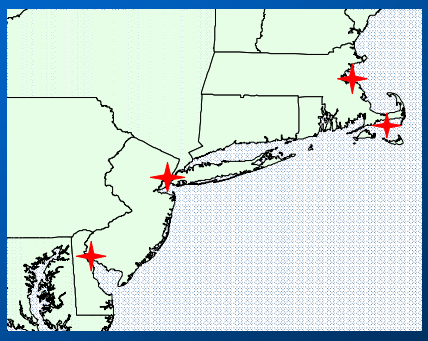
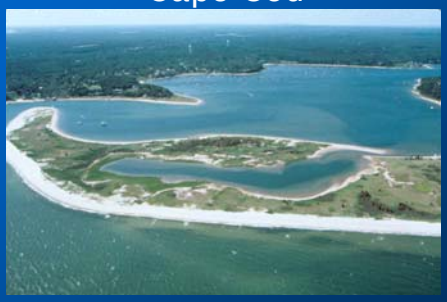
Reproductive Success Reflects Wetland Quality

Photo by D. C. Twichell

Study Region



Disease Symptoms on Cape Cod



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Detecting Disease Symptoms

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Discovery of Lesions

Photo by K. C. Parsons

- Conducted studies in six estuaries over 10 year period
- Performed thousands of nestling examinations

Percent of Nests with Lesions

	Boston	Cape Cod	New York	Del Bay
BC Night-Heron	1%	74%	16%	16%
Snowy Egret	0%	27%	0%	23%
Cattle Egret	-	-	0%	46%

Lesion Severity Score (out of 10)

	Boston	Cape Cod	New York	Del Bay
BC Night-Heron	0	**8**	0	1
Snowy Egret	0	2	0	1
Cattle Egret	-	-	0	**4**

Discovery of Lesions

- First seen on Black-crowns on Cape Cod in 1990
- Prevalent on Cattle Egrets in Del Bay
- Rarely seen in New York or Boston Harbor
- All species monitored affected except ibises

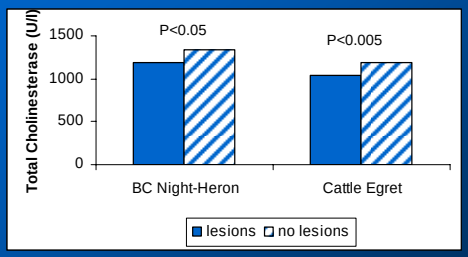
Neural Enzyme Deficiency

Photo by D. C. Twichell

Cholinesterase: A Fundamental Molecule

- Common to all animals
- Catalyzes nerve signal transmission
- Herons with lesions have low cholinesterase

Lesions and Low Cholinesterase



Causes of Lesions

Photo by D. C. Twichell

Possible Causes of Lesions

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- Disease
- Nest material
- Nest parasites

Lesions and Nest Characteristics

Photo by D. C. Twichell

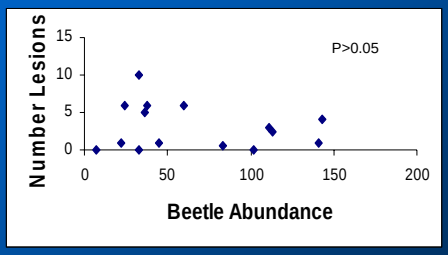
Beetle Larvae in Heron Nests

Photo courtesy of Colorado State U.

Nest Parasites

- Dermestid beetle larvae discovered in heron nests
- 0-300 larvae documented per nest
- All heron species; all estuaries
- Beetle abundance does not predict lesion occurrence or severity

Beetle Abundance and Lesions



Causes of Lesions

Photo by J. Wiese

- No relation to nest material
- No relation to immune status
- When nest parasites excluded—no lesions

Depressed Cholinesterase

Photo by M. Male

Causes of Depressed Cholinesterase

Photo by D. C. Twichell

- Disease
- Nutritional deficits
- Neurotoxins (mercury, ChE-inhibiting insecticides)

Photo by D. C. Twichell

Causal Factors

- Immune status does not predict cholinesterase variability
- Nutritional status unrelated to cholinesterase
- Mercury contamination does not explain low cholinesterase

Evidence of Insecticide Exposure

Photo by D. C. Twichell

Pesticide Residue Analysis

- Nestling regurgitations: dimethoate, parathion, methamidophos, chlorpyrifos, malathion,

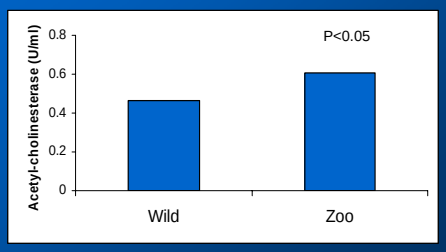
- Adult foot washes: phorate, naled

Photos by D. C. Twichell

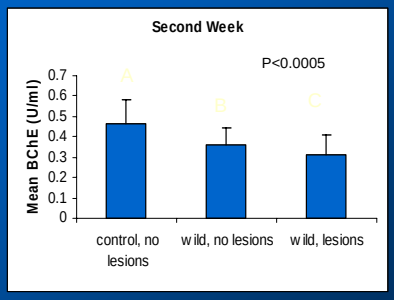
Reference Cholinesterase

Photo by J. E. Yacabucci

Cholinesterase in Captive and Wild Herons



Cholinesterase in Captive and Wild Nestlings



Evidence of Insecticide Exposure

- No evidence supporting other hypotheses
- Residue analyses show wild birds exposed to organophosphate insecticides
- ChE of wild adults and nestlings lower than captive populations
- Birds in farm habitats show greatest effects*
- Birds in agricultural estuaries show greater effects than urban estuaries*

*Parsons et al 2000 ETAC 19:1317-1323

Photo by D. C. Twichell

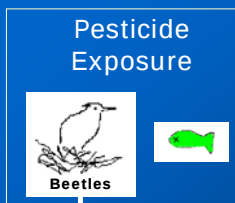


Photo by D. Carter

What are the impacts?

Photo by J. Fuller

Adverse Impacts of Low Cholinesterase

Photo by K. C. Parsons

- Poor thermoregulation
- Decreased food consumption
- Reduced predator-avoidance

(review in Grue et al. 1997)

Cholinesterase and Productivity

Photo by K. C. Parsons

Cholinesterase and Productivity

- Low nestling survival associated with low cholinesterase but not lesions
- Failure to fledge associated with low cholinesterase

What are the solutions?

Manomet Programs

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- Working with wildlife managers
- Farmer collaborations

WildNet—Wildlife and Contaminants Monitoring Network

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- Developing a continental database
- Providing training to wildlife professionals
- Ground-truthing ecotoxicological risk assessment

WildNet Partners

Working with Farmers

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Farm Habitats Project

- Collaborative applied research
- Developing Best Management Practices with farmers in orchards, row crop farms and cranberry farms
- Working with extension programs and NRCS to disseminate

Photo courtesy USFWS