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ENVIRONMENTALLY ACQUIRED LEAD IN THE LAUGHING GULL, *Larus atricilla*

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Abstract: Lead concentrations were measured in eggs, prefledglings and adult laughing gulls collected near Galveston, Texas. No lead was found in eggs. Prefledgling and adult birds had lead ranging from zero to 16 μg/g wet tissue. Liver had the greatest lead concentrations followed by brain, heart and skeletal muscle. There were no significant differences in lead concentrations between fledglings and adults or between males and females.

INTRODUCTION

Lead poisoning in waterfowl and upland game birds has been recognized for over 100 years.[9] Lead shot deposited by hunters in areas used by waterfowl contributes significantly to this problem and has stimulated numerous investigations.[1,2,3] Other sources of lead have been manifested in wildlife. Chupp and Dalke[4] concluded that lead in birds of the Coeur de 'Alene River Valley in Idaho resulted from wastes from the surrounding mines. Differences in lead concentrations in rural, suburban and urban pigeons have been attributed to differing environmental lead concentrations in Philadelphia[12] and Tokyo.[10]

Another ecosystem contaminated by lead is Galveston Bay, Texas. In 1969 an estimated 720 kg of lead were discharged daily into the Houston Ship Channel.[6] Aqueous lead concentrations in this area are quite variable. Mean values for the year ending in June, 1974 ranged from 60.8 parts per billion (ppb) at the head of the channel (Turning Basin) to 100 ppb at Morgan's Point where the Ship Channel enters Upper Galveston Bay.[6] The distribution of lead in the esturine ecosystem and its potential effect on the species in this ecosystem is important. The laughing gull (*Larus atricilla*) is a common carnivore-scavenger in this area. Because of this gull's position in the food chain, we felt this species would be a suitable indicator of environmental lead exposure and have examined the distribution of lead in this species.

MATERIALS AND METHODS

Ten laughing gull eggs, 10 prefledgling and six adult birds were collected from a breeding colony on South Deer Island in West Galveston Bay in June, 1974. Twenty additional adults were collected (with a shotgun) at three other localities within a 24 km radius on three occasions between October 1974 and March, 1975.

All eggs and birds were chilled upon collection and stored at —20 C until analyzed. Each bird was dissected and sexed. Samples of brain, liver, heart and skeletal muscle tissue were removed and weighed. Tissue samples were homogenized and prepared for lead analysis using the method of Murthy, *et al.*[8] Each egg was homogenized and treated as one tissue sample. Lead was determined in the homogenates by the atomic absorption methods of Keyworth, *et al.*[7] Results are expressed as μg lead/g wet tissue.

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The general linear model[11] was used to identify the significant sources of variation. The BMDO5V program from the University of California at Los Angeles[5] aided computations. The data were also analyzed according to collection time and locality, recognizing that these variables were confounded.

RESULTS

Means, ranges and standard deviations of the lead concentrations in four tissues of prefledglings and adults are given in Table 1. Less than one μg/gm (our useable lower limit of detection) was found in eggs. Generally, the tissues ranked from greatest to smallest in concentration of lead as follows: liver, brain, heart muscle and skeletal muscle. Concentrations in all tissues ranged from <1.0 to 10 μg/g in prefledglings and <1.0 to 16.0 μg/g in adults.

Concentrations of lead among tissues differed significantly ($p<.001$) and a significant interaction between sex and age ($p<.025$) occurred. No significant effect due to age, sex and the other interaction terms was observed. The analysis according to time and location of collection also revealed no significant associations.

TABLE 1. Lead concentrations (μg lead/g wet tissue) in four tissues of prefledgling and adult Laughing Gulls.

	TISSUE			
	Brain	Heart	Liver	Muscle
Prefledgling				
Males				
No. birds	3	3	3	2
Mean	2.07	1.00	4.20	<1.0
Range	<1.0-3.5	<1.0-3.5	<1.0-8.3	<1.0
Std. Dev.	1.8	1.7	4.20	0.00
Females				
No. birds	6	6	6	6
Mean	4.50	2.35	5.43	1.13
Range	1.6-9.1	<1.0-4.0	3.4-10.0	<1.0-1.6
Std. Dev.	2.5	1.4	2.6	1.0
Adult				
Males				
No. birds	11	11	11	11
Mean	2.11	3.86	5.04	1.74
Range	<1.0-8.5	<1.0-13.5	1.9-16.0	<1.0-6.5
Std. Dev.	2.7	4.7	3.9	1.9
Females				
No. birds	13	15	15	15
Mean	2.50	1.26	3.74	1.24
Range	<1.0-8.9	<1.0-5.5	<1.0-7.0	<1.0-3.5
Std. Dev.	2.9	1.9	2.3	1.2

DISCUSSION

Although gull eggs had no detectable lead, prefledglings had concentrations of lead as high as those of adult gulls. Thus the species is receiving significant lead before they begin foraging. Assuming that adults are exposed to lead at the same rate as the fledglings, the absence of greater concentrations of lead in the adults suggests that an equilibrium is reached by the time the birds have fledged.

Concentrations of lead observed in these gulls exceed, in some cases, the levels of intoxication reported for waterfowl and upland game. Reported toxic levels of lead include 3-6 ppm in geese,[1] 3-6 ppm in mallard ducks[2] and 5 ppm in black ducks.[1] No evidence of intoxication was found in the gulls, however. Apparently pigeons have not been intoxicated with concentrations of lead above those reported to be toxic to waterfowl and upland game.[11,13]

Due to the heavy introduction of lead into the Houston Ship Channel[6] and the gulls' significant dependence on marine fish, this species could be a good indicator of esturine level pollution. We cannot, however, rule out air-borne lead aerosols as a possible contributor at this time. Soft tissues were analyzed instead of feathers or bone because we wished to assess recent local exposure to lead. Laughing gulls banded in this region migrate at least as far as the southwest coast of Mexico and Venezuela, thus bone and feathers, which reflect lifetime accumulation of lead, were not employed.

The laughing gull was studied because it may serve as a biological space and time integrator of lead in esturine environments. In conclusion, the laughing gull does accumulate, and survive with, concentrations of lead reported to be toxic to other species. Studies over longer time periods and in unpolluted environments are necessary to establish further the suitability of the laughing gull as an indicator species for lead pollution.

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