Mercury Exposure Profile for Sharp-tailed Sparrows Breeding in Coastal Maine Salt Marshes

(BRI 2002-11)

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Submitted to:
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INTRODUCTION

Sharp-tailed sparrows (*Ammodramus* spp.) inhabit wet meadows, marshes, and salt marshes of central and eastern North America. The taxonomy, distribution, and evolutionary history of this group has been debated for over a century. In 1995, based on morphological and genetic evidence, the American Ornithologists Union committee on classification and nomenclature voted to separate this single species with five known sub-species into two species: a northern species, *Ammodramus nelsoni*, with 3 sub-species (*A. n. nelsoni, A. n. alterus,* and *A. n subvirgatus*) and a southern species, *A. caudacutus* with two sub-species (*A. c. caudacutus and A. c. diverus*), limited to coastal wetlands. *A. n. subvirgatus* (hereafter Nelson's Sparrow) and *A. c. caudacutus* (hereafter Saltmarsh Sparrow) are sympatric in coastal Maine, New Hampshire, and the northeast shore of Massachusetts.

The biomagnification of mercury (Hg) in aquatic biota is well known (Watras and Huckabee 1994), however its expression in insectivorous birds is not well studied (see review in Thompson 1996). Terrestrial species have recently been selected to serve as potential bioindicators of contaminants including Tree Swallows (*Tachycineata bicolor*) for Hg exposure (Gerrard and St. Louis 2001) and organochlorines (Secord et al. 1999) and American Robins (*Turdus migratorius*) for lead (Johnson et al. 1999).

We believe sharp-tailed sparrows are an appropriate indicator of methylmercury availability in coastal marshes. Our two target species spend their entire life-cycle in salt marsh habitats of the Atlantic coast. Their small breeding territories afford an excellent opportunity to determine contaminant exposure for target marshes and even specific areas within a marsh. Because of increasing urbanization surrounding these habitats a better understanding of contaminant ecological impacts has been identified and is of national interest (Newman et al. 2002).

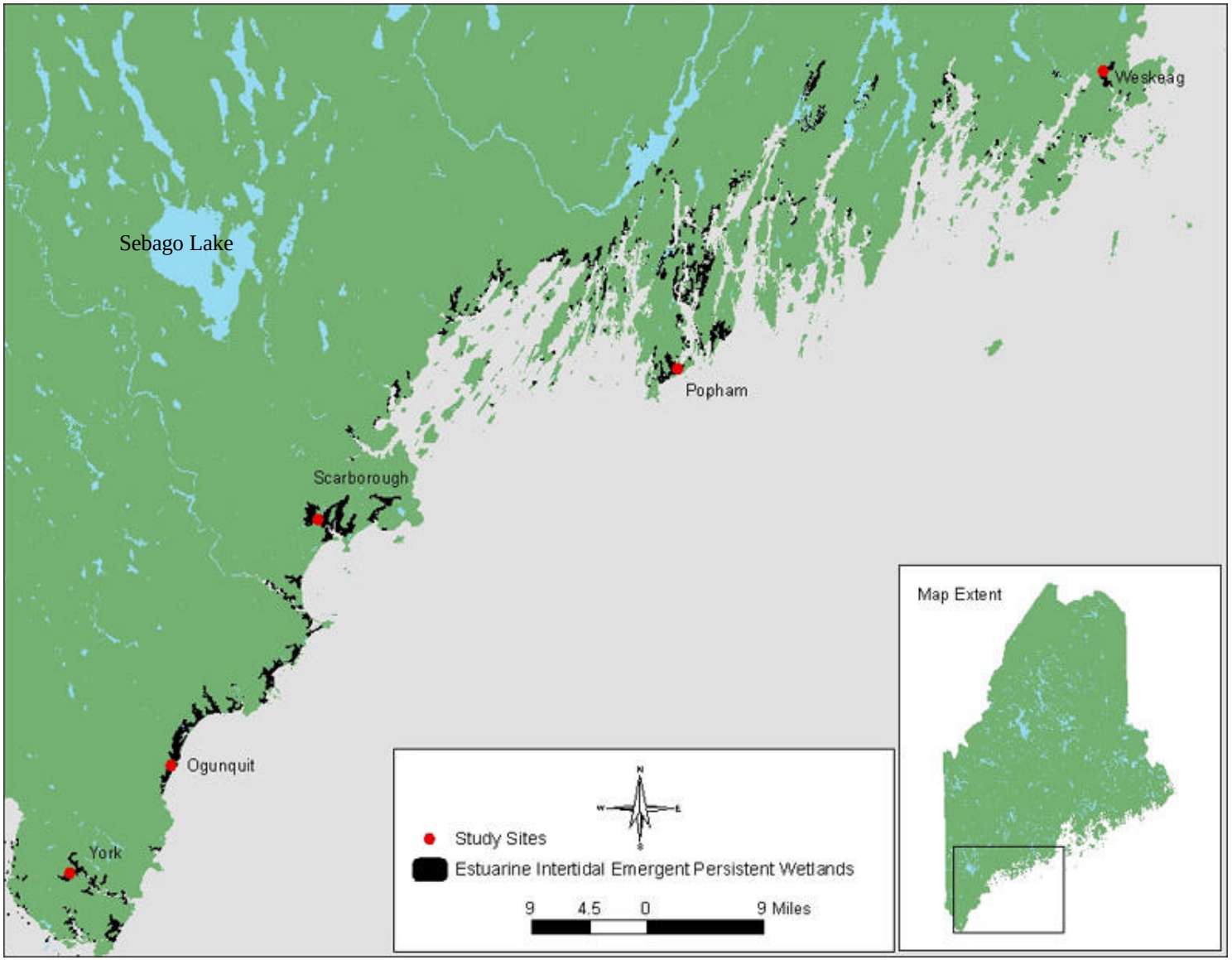
The objectives of this study were to 1) determine the extent of Hg exposure in two species of sharp-tailed sparrows in coastal Maine salt marshes, 2) compare blood Hg between Saltmarsh and Nelson's sparrows, and 3) determine if there were differences in Hg exposure among five Maine salt marshes.

STUDY AREA & METHODS

We sampled sharp-tailed sparrows from 5 marshes along the Maine coast during the breeding seasons (15 June-1 August 2001) of 2000 and 2001 (Figure 1). We used mist nets to capture sparrows and attached a U.S. Fish and Wildlife Service band and three color-bands to each individual. We used a wing cord ruler to measure unbended wing cord and dividers to measure tarsus length. We weighed all sparrows using a spring scale to the nearest 0.25 gm. We collected 30 µl – 50 µl of blood from the cutaneous ulnar vein for Hg contamination analysis using a micro-pipette. Micro-pipettes were stored in a test-tube and placed in a cooler immediately after collection. All samples were frozen on the day of collection and were maintained at $<25^{o}$ (F) until contamination analyses were conducted. Blood Hg levels are generally not compromised by body burden Hg levels during the breeding season (Evers et al. 1998).

We used independent *t* tests to determine differences in blood Hg levels between species and sex. If differences were significant between species or sex we then conducted further analyses separately. We used ANOVA with Tukey's post-hoc tests to determine if differences existed in blood Hg levels among the 5 sites. If there were differences among sites we then used ANOVA to determine if there were weight (g) or wing cord (mm) differences between high and low Hg level sites. All means are presented $\pm$ 1 SE.

Figure 1. Study sites with estuarine wetlands.



RESULTS

We captured and drew blood from 81 sharp-tailed sparrows (28 Nelson's and 54 Saltmarsh) in 5 marshes on the Maine coast (Table 1). Saltmarsh Sparrows (mean = 0.69 ± 0.03) had 41% greater blood Hg levels than Nelson's Sparrows (mean = 0.41 +/- 0.03) (t = 6.338, df = 79, P < 0.001, Figure 2). There was no difference in blood Hg levels between males and females for either species (Nelson's t = 1.69, df = 23, P = 0.171; Saltmarsh t = 0.848, df = 48, P = 0.401). We detected a difference in blood Hg levels among sites for both species (Nelson's F = 7.402, df = 4, P = 0.001; Saltmarsh F = 6.154, df = 4, P < 0.001, Figure 3 A and B). Popham beech and Ogunquit were highest in blood Hg for both species (Figure 3A and B). Sparrow weight and wing cord did not differ between high and low Hg level sites for either species (Nelson's weight F = 0.128, df = 1, P = 0.723, Nelson's wing cord F = 4.097, df =1, P = 0.053; Saltmarsh weight F = 1.219, df = 1, P = 0.275, Saltmarsh wing cord F = 1.542, df = 1, P = 0.220). There was a significant difference in weight between sparrow species.

Figure 2. Differences in blood Hg between Nelson's Sparrow and Saltmarsh Sparrow. Saltmarsh Sparrows had significantly more blood Hg than Nelson's Sparrow.

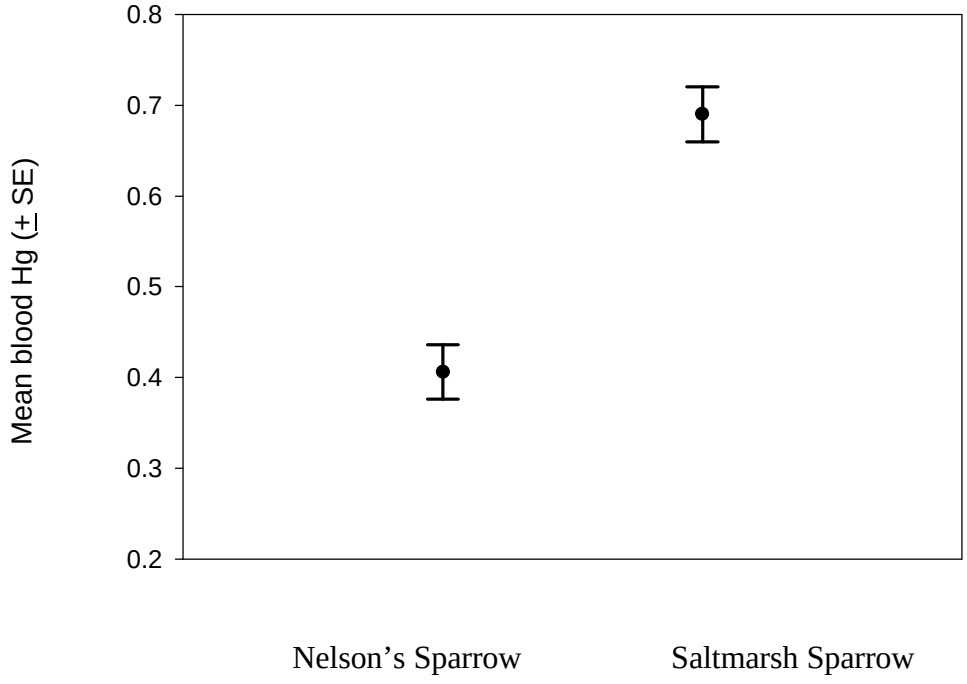


Figure 3. Differences in blood Hg between sites for A) Nelson's Sparrow and B) Saltmarsh Sparrow. Blood Hg levels were highest at Popham and Ogunquit for both species.

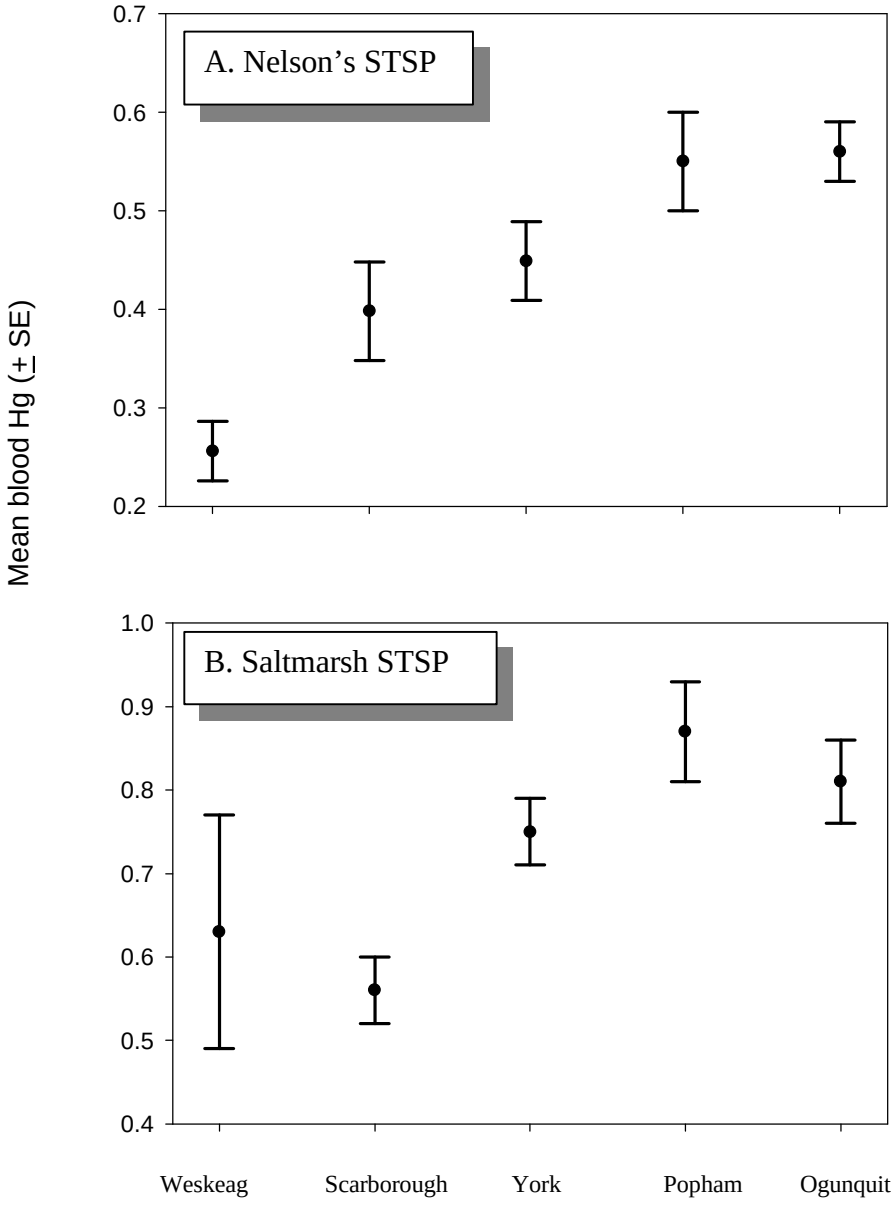


Table 1. Sampling locations, sample sizes and mean weight and wing cord for Saltmarsh and Nelson's Sharp-tailed Sparrows in coastal Maine (2000-2001).

		Saltmarsh Sharp-tailed Sparrow					Nelson's Sharp-tailed Sparrow				
Site	Lat / Long	Male	Female	Juvs	Mean Weight (g)	Mean Wing Cord (mm)	Males	Females	Juvs.	Mean Weight (g)	Mean Wing Cord (mm)
Weskeag	N 44 04.680 W 69 08.625	4	1	0	21.1 (0.6)	57.9 (2.2)	6	0	3	18.0 (0.8)	57.1 (1.1)
Popham	N 43 44.37 W 69 48.247	6	0	0	22.6 (0.5)	59.8 (0.8)	4	2	0	19.3 (0.7)	55.9 (1.6)
Scarborough	N 43 33.90 W 70 21.67	16	6	0	20.3 (1.6)	57.2 (1.3)	6	2	0	17.7 (1.7)	57.3 (2.1)
Ogunquit	N 43 17.02 W 70 34.92	7	4	0	20.3 (1.6)	57.6 (2.7)	3	0	0	18.3 (1.5)	56.8 (1.0)
York	N 43 09.64 W 70 44.01	6	1	3	19.2 (1.9)	56.9 (2.1)	2	0	0	18.4 (0.9)	57.0 (1.4)
TOTAL		39	12	3	20.7 +/- 1.3	57.9 +/- 1.1	21	4	3	18.3 +/- 0.6	56.8 +/- 0.5

DISCUSSION

We found nearly twice the Hg blood levels in Saltmarsh Sparrows than we did in Nelson's Sparrows at all five sites. This pattern was not predicted as both species spend their entire life-cycle in salt marsh habitat, presumably exposed to the same levels of contamination. Differential prey selection by sparrows could explain differences in the observed blood Hg levels. If Saltmarsh Sparrows, which are larger and have larger beaks, selected carnivorous prey while the smaller Neslon's Sparrows selected herbivorous prey, then we would expect to see higher levels of blood Hg in Saltmarsh Sparrows. Because these sparrows were recently split into two separate species (1995), little is known about dietary differences between them that may explain differences in blood Hg levels we found during this study.

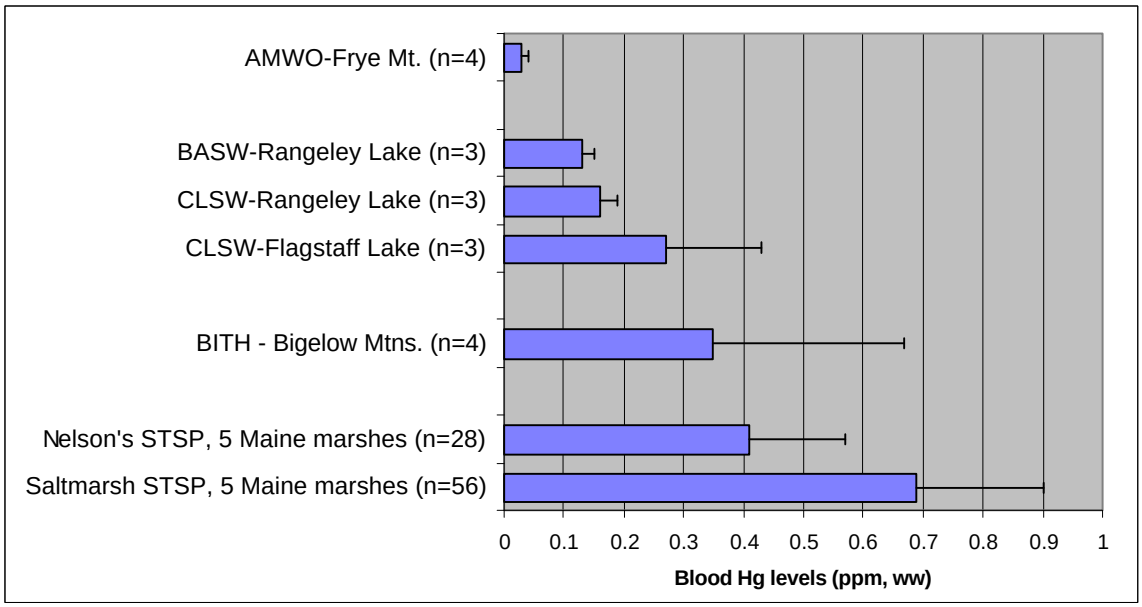
We also found differences among the five salt marshes we sampled; indicating that blood Hg levels in sharp-tailed sparrows may be used as an index to Hg contamination in the salt marshes. This finding was supported by the similar pattern in Hg levels within each species across the five sites. For both species, blood Hg levels were highest in Popham and Ogunquit, intermediate at York, and lowest in Scarborough and Weskeag. This consistency in blood Hg levels in the two species across the five sites indicates that theses sparrows may be potential indicators of salt marsh and estuarine Hg contamination.

Comparing our sparrow blood Hg levels with other related species is difficult. The handful of terrestrial bird Hg studies are not based on blood, rather their assessments use whole body analysis and/or organs (i.e., lethal sampling). However, our non-lethal sampling strategy for this project is comparable with other such collection efforts with insectivorous birds in Maine. BioDiversity Research Institute staff have sampled terrestrial birds including American Woodcock (*Scolopax minor*) (AMWO), Barn Swallow (*Hirundo rustica*) (BASW), Cliff Swallow (Petrochelidon pyrrhonota) (CLSW), and Bicknell's Thrush (Catharus bicknelli) (BITH) (Figure 4).

The sampling efforts with the swallows are particularly informative as a reference for Hg exposure. Swallows were sampled from two lakes that have thorough biotic Hg risk assessments based on fish and the Common Loon (*Gavia immer*) (Evers et al. 2002). Because swallow sample sizes are minimal statistical comparisons were not attempted. Barn and Cliff Swallows from Rangeley Lake, a low Hg risk system, had mean blood Hg levels considerably less than those found from both sharp-tailed sparrow species in each of the five marshes. Assuming a relationship exists between fish Hg levels and associated emerging insects, reference blood Hg levels for insectivorous birds are possibly less than 0.20 ppm (ww). Flagstaff Lake is well known for its elevated biotic Hg levels (Evers et al. 2002). Cliff Swallow blood Hg levels tended to be less on Flagstaff Lake than sharp-tailed sparrow blood Hg levels.

Further efforts with swallow species in areas with known biotic Hg assessments as well as at the sharp-tailed sparrow locations will provide further context for assessing hazards related to Hg levels in coastal Maine's salt marshes.

Figure 4. Blood Hg levels in selected insectivorous birds in New England



RECOMMENDATIONS

1. Determine Hg exposure for sharp-tailed sparrows in other Maine coastal marshes with large breeding populations;
2. Determine Hg exposure for Tree Swallows with breeding territories in coastal marshes with sharp-tailed sparrows at some locations for comparative purposes;
3. Determine Hg exposure for swallow species with breeding territories in areas with known biotic Hg levels;
4. Determine prey base of sharp-tailed sparrows and analyze prey items for Hg;
5. Measure levels of other contaminants including polychlorinated biphenyls in sharp-tailed sparrows.

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