Examining Carry-Over Effects in Resident and Migratory Sparrows Using Feather Corticosterone

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ABSTRACT

Many factors influence a bird's likelihood of survival, including access to food, quality of habitat, and protection from depredation. This study is aimed to assess winter survival rates in relation to corticosterone, a hormone that regulates stress responses. For many birds, both winter and molt (annual replacement of feathers) can be stressful seasons with potentially high mortality rates. An acute or chronic stress response during molt might have a carry-over effect onto winter survival rates, known as a seasonal interaction. We examined overwinter survival rates in populations of migratory White-throated Sparrows (*Zonotrichia albicollis*) and resident Song Sparrows (*Melospiza melodia*) in an urban wetland. We related survival rates to corticosterone levels during molt. These results will allow us to determine if survival rates vary among individuals in accordance with corticosterone hormone levels, providing further insight on potential carry-over effects from molting to winter seasons. In both species, survival rates varied with time, and there was not a direct relationship between CORT during molt and overwinter survival.

Figure 1. A color banded resident Song Sparrow (A) and a migratory White-throated Sparrow (B). Captured in mist nets from the Olentangy River Wetland Research Park during Autumn 2016.

INTRODUCTION

Overwinter survival can limit bird populations, so determining drivers of survival is crucial to wildlife conservation. Migratory and resident birds have different requirements for energy and potential stress, and stressors in one season can carry-over to effect survival in subsequent seasons, known as seasonal interactions.

- **Question:** Does stress during molt carry over to affect overwinter survival, indicating a seasonal interaction? [2]
- **Prediction 1:** Higher CORT levels during feather molt will be negatively related to survival.[5]
- **Prediction 2:** Due to the time constraint and stress of migrating, migratory White-throated Sparrows will have higher CORT levels than resident Song Sparrows (Fig 1).

STUDY AREA

This study was conducted at the Olentangy River Wetland Research Facility, comprised of three wetlands and a bottomland hardwood forest (Fig 2).

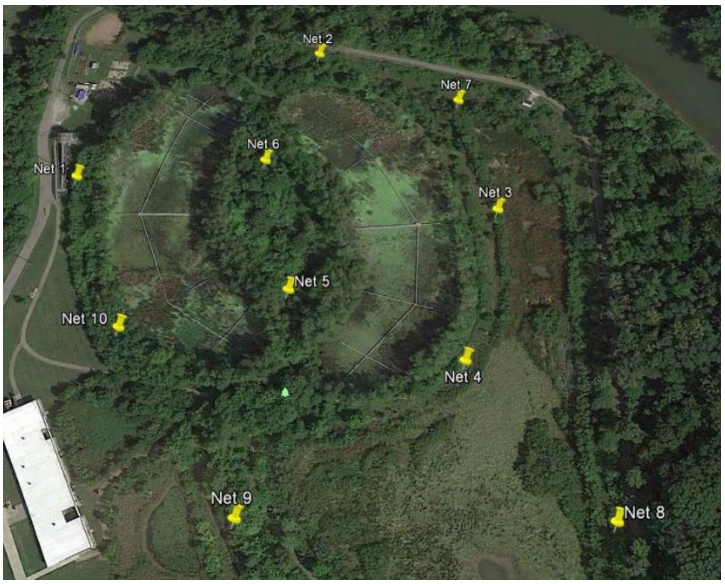

Figure 2. Map of the Olentangy River Wetland Research Facility (40.020434, -83.017981). Each pin represents a net location where sparrows were caught in mist nets and banded.

METHODS

Mist nets were set up in 10 locations to capture sparrows for banding and feather collection. Tail feathers were collected from Song Sparrows (n=23) and White-throated Sparrows (n=33), and were given a unique color band combination to allow for re-sighting (Fig 1). CORT was extracted from feathers using methanol, and concentrations were determined using Enzyme Immunoassay (EIA).[1] Cormack-Jolly-Seber models were generated in Program MARK to estimate both survival and re-sighting probability. Akaike's Information Criterion (AIC) was used for model comparison, and a strong outlier in WTSP data was omitted.

RESULTS

Cormack-Jolly Seber models of survival (CJS) indicated that survival for both species varied with sampling periods (Tables 1,2). CORT was not directly related to survival in SOSP (β=0.09, LCI = -0.08, UCI = 0.626) or WTSP (β=0.20, LCI = -0.26, UCI = 0.67). SOSP survival averaged across the sampling period was 0.90 and re-sighting probability was 0.31. WTSP survival averaged across the sampling period was 0.89 and re-sighting probability was 0.38.

Table 1. AIC Table for SOSP. The best model assumes that survival rates (phi) vary with time, re-sighting probabilities (p) are held constant, and that CORT has a considerable effect.

Model	Num. Par	AICc	Delta AICc	AICc Weights
{phi(t)p(.)+CORT}	5	128.5418	0	0.81413
{phi(.)p(.)}	2	132.4442	3.9024	0.11569
{phi(.)p(.)+CORT}	3	134.706	6.1642	0.03734
{phi(.)p(t)+CORT}	10	135.2834	6.7416	0.02798
{phi(.)p(t)}	11	139.2172	10.6754	0.00391
{phi(t)p(t)+CORT}	13	142.1065	13.5647	0.00092
{phi(t)p(.)}	11	149.2863	20.7445	0.00003
{phi(t)p(t)}	20	186.5683	58.0265	0

Table 2. AIC Table for WTSP. The best model assumes that survival rates (phi) vary with time, re-sighting probabilities (p) vary with time, and that CORT has a considerable effect.

Model	Num. Par	AICc	Delta AICc	AICc Weights
{phi(t)p(t)+CORT}	13	183.5262	0	0.92846
{phi(.)p(t)+CORT}	10	189.1272	5.601	0.05643
{phi(.)p(t)}	11	192.2486	8.7224	0.01185
{phi(t)p(.)+CORT}	4	194.8393	11.3131	0.00324
{phi(t)p(t)}	19	206.5105	22.9843	0.00001
{phi(t)p(.)}	11	214.0871	30.5609	0
{phi(.)p(.)}	2	219.8651	36.3389	0
{phi(.)p(.)+CORT}	3	222.0317	38.5055	0

Resident Song Sparrows had significantly greater CORT levels during molt than migratory White-throated Sparrows ($t=6.37$, $df=54$, $p<0.001$; Fig 3).

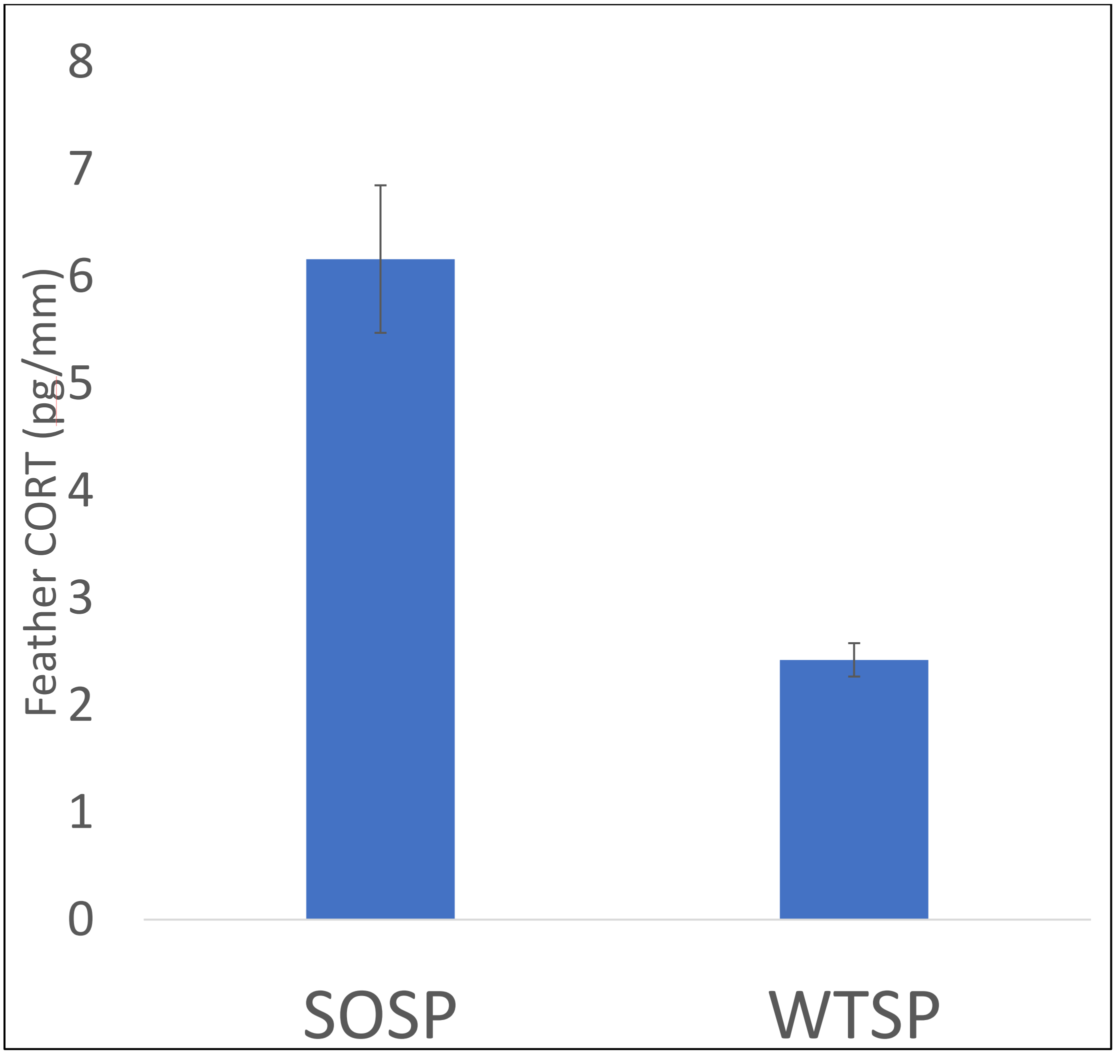

Figure 3. Feather CORT values for both sparrow species with standard error. Collected from sparrows captured in mist nets from the Olentangy River Wetland Research Facility during Autumn 2016.

DISCUSSION

CORT is contributing to help the model fit better, and showing a slight positive trend in relation to survival although not statistically significant, potentially due to small sample size. Higher levels of CORT can be beneficial in stimulating hunger and prompting the bird to forage more, which points to the possibility that higher CORT may be adaptive as opposed to detrimental.[3] Lastly, re-sighting probability increased with time in WTSP, as the skills of the observers increased.

FUTURE OBJECTIVES

It may be beneficial to sample during molting period to develop a stronger relationship between CORT during molt and its carry-over effect on survival. In addition, new variables such as body condition or blood samples could be incorporated to better explain survival. Ultimately, it is important to explain what is affecting survival rates and better understand how seasons interact to influence population dynamics.

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