Dynamic Urbanization: Are Greening Cities Influencing House Sparrow Declines?

Background: Classic approaches to urban ecology have been addressed by Ramalho and Hobbs' "Dynamic Urban Ecology", with the idea that any effects of urbanization on environments and their inhabitats should be considered and compared across temporal gradients rather than comparing effects against only very recent changes to the urban environment.[1] Tree cover and impervious surfaces has been shown to be declining and increasing, respectively, in large U.S. cities, however, tree cover changes in smaller (than those in Nowak and Greenfield) cities have not been addressed in the literature.[2] The amount of tree cover in urban habitats has a direct impact on avian species diversity, and the changes in tree cover, or "urban greening", may be a primary factor influencing the ability of native birds to thrive in urban environments.[3,4] Newly urbanized systems tend to host nonnative species who are capable of adapting to rapid landscape changes and are better colonizers in this environment.[5,6] As some urban areas undergo greening over time, habitat suitability for some invasive species decreases.[7]

Many urban, nonnative birds in the US have declined over the past few decades while native commensals have increased as shown in Figure 1 (adapted from Breeding Bird Survey and Christmas Bird Count data). These trends may be attributed to multiple factors including, but not limited to: competition, predation, and food availability.[8,9] A familiar urban greening initiative, Tree City USA, is aimed towards recognizing cities that are committed to increasing and maintaining native arborous vegetation. Using towns that have attained and maintained this recognition may be beneficial in determining how effective urban forestry is at fostering native birds in urban areas, and creating hostile habitat for invasive, urban avifauna.

My proposed plan of research will test if urban greening is causing the decline of a once ubiquitous, synanthropic species, the House Sparrow (*Passer domesticus*). Confirmation of my predictions will suggest that this invasive species may no longer have the ability to persist in increasingly greening cities, possibly decreasing the demand for management efforts of this avian pest in urban settings. **Research Question:** Have cities delineated as Tree Cities actually increased their total tree cover? In cities where urban greening is increasing, are House Sparrows (HOSP) declining? **Hypotheses:** (1) Cities involved with Tree City USA have experienced higher rates of urban greening than cities of comparable size not in the program. (2) Urban greening in moderately sized cities is causing HOSP declines.

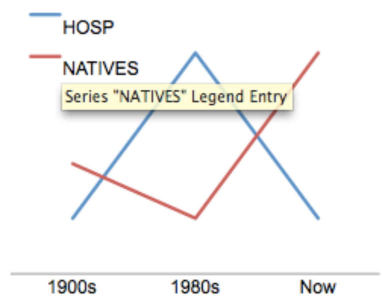

Figure 1 - Urban nonnative birds in the US have recently declined while native commensals have increased (Source: BBS and CBC data)

Methods: To address question (1) I will use a **paired design to compare the tree cover growth rate in cities** in similar geographic ranges, whose current populations are between 100,000 and 150,000 persons. At least 23 Tree Cities and 23 non-Tree Cities are needed to obtain power of 0.95, effect size=0.5 (for a 1-tailed, paired t-test) This study will determine whether the annual tree cover growth rate is larger in Tree Cities than non-Tree Cities. To determine the annual tree cover growth rate in these cities, I will use remote sensing technologies and/or Geographic Information Systems using methods similar to Goetz et al.[10] I will obtain aerial images of each city ranging from 1987-2012, place random, static (over time within cities), buffered points of equal size within each city, and calculate the total vegetation cover per buffer. *Predictions*: I predict annual tree cover growth rate to be higher in

Tree Cities than in non-Tree Cities. If my predictions are true, I will then determine whether there are HOSP declines associated with these growth rates.

To address question (2), I will use data obtained from the study above to determine whether there are relationships between tree cover growth rates, HOSP growth rates, and native, urban avifauna growth rates. Using a combination of BBS and CBC data, I will determine population growth rates of HOSPs in at least 25 random cities of those surveyed above (in the previous study, I will ensure I have calculated tree cover rates of cities that include the largest and lowest HOSP growth rates; this will ensure I have included the extreme ranges of the dependent variable). Using generalized linear modeling I will determine the relationship of tree cover growth rate and native bird growth rates to HOSP growth rates. *Predictions*: I predict HOSP declines will be highly correlated with **tree cover growth**. HOSP declines will be highly correlated with an **increase** in urban avian **natives** (competitors) **and predators**. **HOSP Decline Alternatives**: *Competition*: I will perform a field quasi-experiment using feeders in urban settings where HOSP colonies exist. All feeding stations will have two sides; one side will exclude all but HOSP (a mesh cover), the other will be open to all species. Feeders will be constantly maintained with ad libitum foods (appropriate for all species present during winter; determine by prior point-counts), and each feeding station will be pre-baited for at least 14 days, rotating exclusion and non-exclusion mesh to ensure habituation to and to reduce neophobia of the feeders. *Predictions:* HOSP feeding rates will decrease or cease when competitors are present in non-exclusion zones, and will decrease in exclusion zones when competitors are near. HOSP feeding rates will increase in both zones when no competitors are present. *Food Availability*: I will assume HOSP food availability is constant within each city, and changes at a constant rate with tree cover growth rates. *Predation*: I have created a novel way to detect avian predators through playback; I will perform tests to determine predator presence in urban areas of multiple Florida cities to determine if predator presence differs between cities of similar size.[11] *Socioeconomic Status, Urban Development Rates*: Evidence to support a link between HOSP abundance and socioeconomic status exists in the literature. To control for these factors I will assure that all cities analyzed in both studies have experienced similar rates of increase in urbanization since the mid-1980s.

Broader Impacts: While working with Neighborhood Nestwatch, I participated in a banding demonstration at Girls Place, an all-girls program that invites girls of all backgrounds, where I was reminded how little exposure some young children have to nature, and science in general. I am especially interested in fostering a relationship between this group and my urban bird research. I will alter my feeder experiments (see *Competition* above) to the Girls Place summer day camp program annually (June-Aug), creating a model that allows the girls to not only learn how to perform science, but to be involved in data collection weekly, if not daily, during their time at the camp. I will also attempt to lead one of their weekly field trips to a local hiking trail/birding hotspot, inviting members of the Alachua Co. Audubon to help guide the girls, provide binoculars, and enhance their understanding an appreciation of maintaining nature within and outside their city.

Statement of Originality: This Proposed Plan of Research represents my original ideas.

References: **[1]**Ramalho and Hobbs. 2011. *Trends in Ecol and Evol* 27(3),179-88. **[2]** Nowak and Greenfield. 2012. *Urban For and Urban Greening* 11(1), 21-30. **[3]** Beissinger and Osborne. 1982. *Condor* 84, 75-83. **[4]** Melles et al. 2003. *Consv Ecol*, 7(1), 5. **[5]** Alberti et al. 2008. *Urban Eco*, 143-58. **[6]** Machlis et al. 1997. *Soc and Nat Rsrcs*, 10(4), 347-67. **[7]** Savard et al. 2000. *Land and Urban Planning*, 48, 131-42. **[8]** Fahrig, L. 2003. *Ann Rev of Eco, Evol and Syst*, 34, 487-515. **[9]** Williamson and Fitter. 1996. *Bio Consv*, 78(1), 163-70. **[10]** Goetz et al. 2003. *Remote sensing of environment*. 88(1), 195-208. **[11]** Burnett and Sieving. 2014. *In review.*