Connectivity in urban areas as a driver of House Sparrow (*Passer domesticus*) declines

KEYWORDS: avian ecology, urban ecology, matrix connectivity

BACKGROUND & INTELLECTUAL MERIT: Metapopulation theory supports the idea that populations are more likely to persist over time if dispersal among populations is possible[1]. Understanding how populations are connected across the landscape is important in determining if a population will persist. Connectivity among patches, or suitable resource areas, in a landscape may determine metapopulation dynamics, and the probability of individuals dispersing among sub-populations[2]. The urban landscape consists of dynamic, disturbed habitat[3]. Species capable of living in urban areas (urban adapters) and species primarily, if not wholly, depending on human presence (urban exploiters) make up the large portion of urban birds[4,5]. Although it is known that fragmentation of natural lands leads to local and global extinctions of avian species[6], the effect of the urban matrix on urban exploiters is relatively unknown. Hereafter, urban matrix will be defined as the amount of built-up area with low vegetation density[3]. Matrix connectivity and resistance drives the decisions and the movement patterns of fauna within a landscape, [7,8] How and why matrix composition and connectivity affect movement patterns of fauna is inherently important, especially in dynamic areas influenced primarily by human disturbance.

The most ubiquitous, urban tolerant bird, the House Sparrow (*Passer domesticus*), can be found across the globe as both a native and nonnative urban exploiter[9]. It has experienced significant and surprising declines across its global range in urban and rural areas. The declines are of special concern in Europe and the United Kingdom (UK), but are relatively ignored in the U.S. [10,11]. Among the hypotheses proposed by House Sparrow researchers that has yet to be tested is the *urban matrix as a driver behind local population decline and extinction* (Helen Baker, pers. comm.)[10,12]. I seek a better understanding of how the urban matrix affects dispersal ability among colonies of a once successful, invasive urban exploiter in urban areas. Although the study of successful establishment by nonnative species is well studied, our knowledge of *why* once-successful, nonnative species decline is limited[13].

Is this species the canary in the urban coal mine?

Objectives: I will determine (1) if an urban exploiter is capable of re-homing (returning to capture site after translocation) within the urban matrix and (2) whether there is natural movement among colonies of an urban exploiter species. Hypotheses: 1) Connectivity of the urban matrix is a determinant of the ability of urban exploiters to re-home and 2) matrix connectivity affects the probability of immigration and emigration among colonies (sub-populations). Methods: I will (1) directly measure the ability of my focal species to move through the urban matrix to return to their capture site (home territory) and (2) determine the relationship between the emigration and immigration rates to the urban matrix among colonies. These studies will initially be conducted in the downtown, East, and Central districts of Seattle, WA. These districts represent varying degrees of connectivity in levels of high urbanization and currently contain House Sparrow colonies. I will use current satellite images to determine land use (habitat) of and potential patch connectivity (measuring inter-colony distance, contagion, land use using Geographic Information Systems) within my study area[14]. Prior to conducting translocations and individuals I will determine the location, foraging territories and demographics of House Sparrow colonies in my study area.

(1) Translocations/Matrix Permeability: In a minimum of 2 independent colonies (>3 km apart[9,10,15]) I will trap ≥10 House Sparrows initially (minimum sample size and number of colonies to be determined using power analysis after pilot). Individuals will be fitted with GPS

devices released (translocated) within a 2km radius[9] in either (1) another colony or (2) a suitable habitat without House Sparrows (if recoverability of GPS units is low I will utilize radio transmitters). Matrix resistance (time spent in translocation area, time to return home) will be analyzed using least-cost path analyses (to determine effect of habitat on movement) and will use AICc on a combination of generalized linear mixed models to analyze effects of connectivity and habitat on probability of returning to capture site[15].

(2) Measuring colonial mixture: Using intensive mark-recapture effort I will measure the amount of apparent dispersal among paired colonies of House Sparrows within my study area. Colonies to be observed will be determined using land-use and connectivity measures: at least 2 colonies <2km and at least 2 colonies ≥2 km apart (power analysis will determine minimum sample size). To compare the effect of inter-colony distance on migration rates I will individually mark each bird and aim to mark at least 80% of the apparent colony size during the non-breeding season. I will survey colony territories similarly and with equal effort at least once a week to locate possible dispersers/migrants through the following breeding season and the and winter. A removal model on counts conducted throughout the study will determine my detectability parameters. I will use generalized linear mixed models to determine the effects of connectivity, colony demographics and land use on probability of dispersal. *If funding permits I will use genetic analyses* to compare observed to actual rates of current and historical immigration and emigration among colonies. **Predictions:** If urban exploiter movement among colonies is limited by urban matrix connectivity I predict that: (1) the individuals translocated to an area where connectivity between the new colony and capture site is high will return home more quickly and with shorter paths (distance) than those translocated to areas with low connectivity and (2) colonies that are well-connected (high connectivity between sites) will have greater dispersal rates than less-connected colonies. **Alternative Hypotheses:** (1a) Age, sex and health will affect re-homing rate. I will use healthy, mature adults. (1b) Resource availability affects homing. While tracking the movement of individuals I will conduct time-budgets to test for differences in feeding rates among focal animals. (2) Individuals will disperse, but will not be seen at new colony. I will sample non-focal colonies at least once a month to detect dispersers.

BROADER IMPACTS: Trapping, banding and tracking birds requires dedication, teamwork and manpower, and therefore I will rely on recruiting and training undergraduate students. I will train undergraduate students from both the School of the Environment and from the Univ. of Washington's mentoring programs (see Personal Statement). I will go to inner-city classrooms to expose students to the natural resource education and to conduct basic bird identification and observation demonstrations. I will work with the Burke Museum of Natural History and Culture to create a small exhibit displaying the effects of humans on animals in cities, with an emphasis on ways to alleviate or mitigate our threats to birds. I will present my results internationally at *Urbio* and the *European Ornithologists Union* and in national ornithological and conservation conferences. I intend to submit chapter findings to ornithological and urban ecology journals.

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

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