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Claire Gentile

Christine M. Stracey

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HATCHING FAILURE IN A FLORIDA POPULATION OF HOUSE FINCHES (*Haemorhous mexicanus*)

Claire Gentile[1,2] and Christine M. Stracey[1,3,4,5]

[1]*Department of Biology, Westminster College, 1840 S 1300 E, Salt Lake City, Utah 84105*

[2]*Present Address: University of Washington School of Medicine, 4333 Brooklyn Ave. NE, Seattle, Washington 98105*

[3]*Department of Biology and Florida Museum of Natural History, University of Florida, Gainesville, Florida 32611-7800*

[4]*Present address: Department of Biology, Guilford College, Greensboro, North Carolina 27410*

[5]*Corresponding author email: straceycm@guilford.edu*

Abstract.—We analyzed data on hatching failure rates of an introduced population of House Finches (*Haemorhous mexicanus*) in Gainesville, Florida. We calculated overall hatching failure rates for 67 nests and also compared hatching failure rates of nests (n=53) located on lights under aluminum roofs to nests (n=14) at other locations. Average hatching failure for all nests was 0.201 +/- 0.045 SE. There was no significant difference in hatching failure between nests in lights (0.225 +/-0.053) and other locations (0.113 +/-0.074). Overall, this population has relatively high rates of hatching failure. Two hypotheses could explain such high rates of nest failure: a reduction in genetic diversity because of a founder effect and high nest site temperature. Future studies, therefore, should document both genetic diversity of this population and nest site temperatures.

The House Finch (*Haemorhous mexicanus*) is common throughout North America (Badyaev et al. 2012), and was introduced to the east coast in the 1930s by the release of a small number of captive birds on Long Island (Elliot and Arbib 1953). In 1945 and 1946, the number of individuals in the population was estimated to be 24 and 38, respectively (Elliot and Arbib 1953) and had expanded to Florida by the mid-1990s

(Badyaev et al. 2012). Introduced populations of birds with fewer than 150 individuals have increased rates of hatching failure (Briskie and Mackintosh 2004). During another study (Stracey and Robinson 2012), we observed what appeared to be high rates of hatching failure for House Finches in Gainesville, Alachua County, Florida.

In this study, we calculated/compared overall rates of hatching failure for House Finches in Gainesville, Alachua County, Florida. House Finches in Gainesville build their nests in extreme, varying environments (Stracey and Robinson 2012). Some nests are built in shrubs, parking garages, or on buildings where the temperature around the nest remains at typical, ambient levels. Other nests, however, are built on top of light structures beneath aluminum roofs, hereafter referred to as light nests (Fig. 1), which have the potential to reach high temperatures. We therefore also compared hatching failure rates from nests on lights to those in typical nest sites to test if there was an effect of nest site location on hatching failure.

Methods

We collected data on hatching failure rates of House Finches over a four-year period from 2004 to 2007. We located nests at ten study sites in Gainesville including the University of Florida campus, K-12 schools, residential neighborhoods, and parking lots (Stracey and Robinson 2012). For each nest, we defined the nest site as either “light” or “other.” Light nests were those built on top of lights under aluminum roofing (Fig. 1) and occurred at eight different locations. Other nest sites included shrubs, parking garage structures, and buildings at five different locations. The contents of nests were typically recorded every four days, with gaps ranging from three to fifteen days. For each nest, we recorded clutch size and number of unhatched eggs. We calculated hatching failure as the number of unhatched eggs divided by the clutch size and calculated overall rates of hatching failure for this population. We then compared hatching failure rates of light and other nests using a two-tailed Mann-Whitney test.

Results

We observed a total of 67 House Finch nests, with 53 nests categorized as “light” and 14 nests categorized as “other.” The average clutch size was 4.12 +/- 0.09 SE. The average hatching failure for all observed nests was 0.201 +/- 0.045 SE. The average hatching failure rate of “light” nests was 0.225 +/-0.053 SE, while the average for “other” nests was 0.113 +/- 0.074 SE. There was no significant difference in hatching failure between light and other nests ($U' = 336.35$, $n_1 = 53$, $n_2 = 14$, $P = 0.60$).

Discussion

The average hatching failure rate across multiple bird species is 10 percent, yet introduced populations of less than 150 founding

Figure 1. Example of a House Finch nest placed in a "light" nest site, situated between a light and the aluminum roof of a breezeway.

individuals show hatching failure rates that average 21.6 +/- 5.6 percent (Briskie and Mackintosh 2004). We documented an average hatching failure rate of 20.1 +/- 4.5 percent for this introduced population of House Finches. Reduced genetic diversity can increase hatching failure (Bensch et al. 1994, Kempenaers et al. 1996, Hansson 2004, Spottiswoode and Moller 2004, Mackintosh and Briskie 2005) and introduced populations of House Finches have lower allelic richness and heterozygosity relative to native populations, indicating decreased genetic diversity (Hawley et al. 2006). Our data are consistent with the hypothesis that reduced genetic diversity could be causing high rates of hatching failure in this population, but the data need to be compared to hatching failure rates of native populations of House Finches. A native House Finch population in Arizona had a hatching failure rate of 12.9%

(reported as mean hatching success = 87.1 +/- 19%; Stein et al. 2010), while an introduced population in New York had an average hatching failure rate of 36.9% (reported as mean hatching success = 63.1 +/- 7.1%; Hartup and Kollias 1999). While these data are suggestive that genetic diversity may play a role in hatching failure rates, data on levels of genetic diversity of this population are necessary to assess this hypothesis.

Another factor linked to increased rates of hatching failure is exposure to high ambient temperatures (Arnold et al. 1987, Veiga 1992, Arnold 1993, Serrano et al. 2005). For example, nests of Ash-throated Flycatchers (*Myiarchus cinerascens*) in metal fence posts in Arizona had significantly hotter nests (>41° C) than those nesting in bluebird boxes and only one pole nest successfully fledged young (Dunning and Bowers 1990). Presumably, our light nests, placed between a light and an aluminum roof, reached significantly higher temperatures than nests placed in other locations. Light nests had a hatching failure rate of 22.5 +/- 4.5 percent and other nest sites had a rate of 11.3 +/- 7.4 percent. We did not, however, find a significant effect of nest site on rate of hatching failure, which could be a result of our limited sample size for other nests (N = 14). There may also be an interaction between time of year and nest site location as temperatures early in the season are not likely to reach levels where they would negatively affect hatching rates. Unfortunately, because of our limited sample of nests from other sites, we are unable to look for an interaction between time of year and nest site. Alternatively, incubating females, which rarely leave the nest when temperatures exceed 27° C (Badyaev et al. 2012), may be able to regulate the nest microclimate sufficiently to avoid hatching failure. Cooper et al. (2006) found that Eastern Bluebird (*Sialia sialis*) nest boxes would reach temperatures as high as 46° C, but the nest pocket with eggs remained at 40.5° C. Without data on nest microclimate we are unable to further assess this hypothesis.

Whether incubation by female House Finches prevents lethal heating or nests never reach lethal temperatures, building nests in these light locations does not appear to have a significant immediate fitness cost to House Finches. Furthermore, these nests experienced very low levels of nest predation (Stracey and Robinson 2012) that likely outweigh any increase in hatching failure. To address the possible cost of increased temperature on nesting success, it is critical that future studies place data loggers at the nest site and inside the nest pocket to record actual temperatures.

In order to tease apart the effects of genetic diversity and temperature on hatching failure in this Florida population of House Finches, future studies should collect data on genetic diversity of the finches and employ data loggers to record nest temperature. In

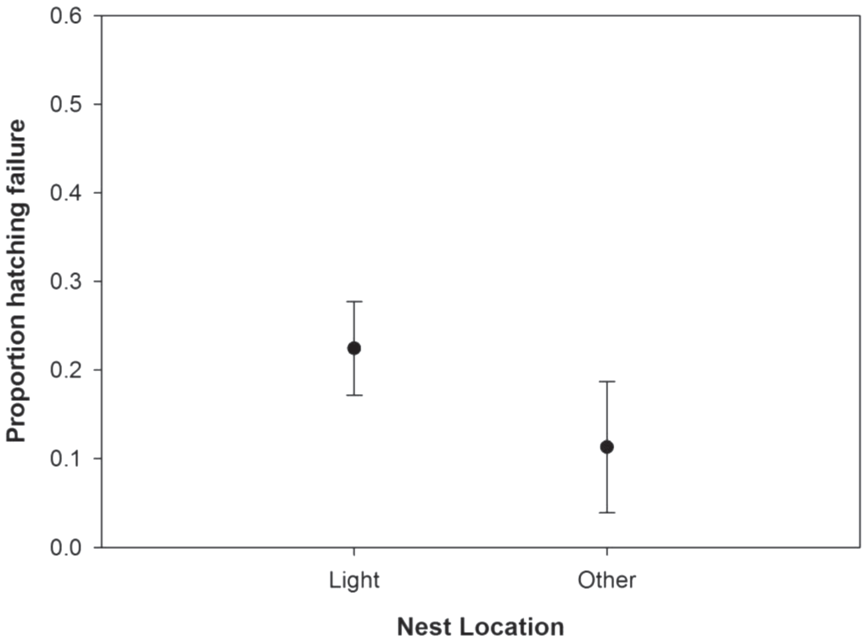

Figure 2. The average proportion of eggs that failed to hatch for nests built on top of lights under aluminum roofs (light nests; see Fig. 1) and nests located in shrubs, parking garage structures, buildings, etc. (other nests; $U' = 336.35$, $n_1 = 53$, $n_2 = 14$, $P = 0.60$).

addition, differences in humidity and eggshell structure may differ between native and non-native populations affecting rates of hatching failure (Stein and Badyaev 2011) and need to be taken into account in future studies. A larger sample of nests located in sites other than lights is also needed. Although this population in Florida appears to have a high hatching failure rate, these birds have still been able to thrive on the East coast and have expanded their range to cover the majority of the United States.

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