Northern House Wren (*Troglodytes aedon*) preference for reduced size nest box entrance holes when in competition for nesting sites with Tree Swallows (*Tachycineta bicolor*)

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Abstract

Since the establishment of the Northern House Wren long-term monitoring project in the Beaverhill Natural Area, there has been a steady decrease in the number of boxes occupied by Northern House Wrens each season. Using the experimental grid composed of nine boxes established in 2025, the relationship between hole size and thus competition has an effect on Northern House Wren nesting success rates. These portal protectors were installed on a majority of the boxes within the grid in order to limit access of competitor species such as Tree Swallow. While the results were promising, with much higher proportions of Northern House Wren nests being established in the grid than normal, there was ultimately not enough data to properly analyze the success of the portal protectors in promoting Northern House Wren nesting. As such, the Chi-squared test of independence resulted in a failure to reject the null hypothesis ($p = 0.69$). While the causes of the nesting decline in artificial boxes by Northern House Wren remain uncertain, a large number of nests being established by Northern House Wrens within the historical Tree Swallow monitoring area late in the season presents an interesting development in the preconceived notions of competition between the two species.

Introduction

This study is a continuation of the Northern House Wren (*Troglodytes aedon*) long-term monitoring project in the Beaverhill Natural Area (BNA). Although the project began in 2013, it was based on Micheal Quinn's thesis work on House Wren breeding biology in artificial nest boxes within the natural area from 1986-1988 (Quinn, 1989). The Beaverhill Natural Area is located ~10 kilometers east of Tofield, in the Aspen Parkland region of Alberta. The natural area consists largely of early successional aspen - balsam poplar forest that lines the former southern shoreline of Beaverhill Lake and current shoreline of Lister Lake. Beaverhill Lake is a major biodiversity hotspot, designated as a Key Biodiversity Area because of the lake's importance as a migratory stopover point and breeding area for a diversity of bird species (Key Biodiversity Areas, 2026).

The Northern House Wren is a small migratory songbird which breeds in much of the northern United States and southern Canada, in a variety of wooded habitats. The Northern House Wren is a cavity nesting bird, which uses both natural cavities created by woodpeckers and artificial nest boxes. They have also been known to occupy previously used nests of other species, such as Baltimore Orioles (Fletcher, 1944). Previous research has shown that nesting cavities with larger entrance holes are less desirable to Northern House Wrens than those with smaller entrance holes, indicating a preference for smaller holes (Will et al. 2016). This could be an evolutionary adaptation to interspecific competition with larger species, such as Tree Swallows (*Tachycineta bicolor*), for these same nesting sites or could be due to a lower chance of predation from larger nest predators who cannot fit in the holes. Alternatively, nest box occupancy decline by Northern House Wrens in the natural area could be due to other factors, such as habitat change. In Arizona, grazing by Elk has reduced understory vegetation, which resulted in a decline in nesting Northern House Wrens (Martin, 2014). Nest box placement could also be a factor, with the boxes being set up 13 years ago in the BNA, nest boxes on larger trees could impact the attractiveness of some sites. In an Ohio study, Northern House Wrens were shown to prefer nest boxes mounted on trees with smaller diameters (Dailey 2003).

Nest box occupancy by Northern House Wrens in the Beaverhill Natural Area has been in consistent decline since the project began. The reason why is unclear; however, one theory is increasing interspecific competition with Tree Swallows for nesting sites due to Tree Swallow population growth in the natural area. In 2013, Northern House Wren nest box occupancy in the A and B grids was 28% and 25% respectively, but in 2025 the same grids had 0 Northern House Wren nests. In contrast, Tree Swallow occupancy in 2025, is at 48% and 21% in each grid respectively (Butler, 2013; Flynn, 2025). This study focuses on the occupancy of boxes with reduced entrance sizes in the Northern House Wren and how that is impacted by interspecific competition with Tree Swallows in the BNA.

We predict that increasing numbers of Tree Swallows in the natural area, as well as their earlier nesting season, results in fewer available nesting sites for Northern House Wrens; however, since Tree Swallows are too large for nest boxes with entrance hole reducers, we predict that Northern House Wrens will more readily nest in those nest boxes due to reduced competition.

Methods and Study Site Description

This study was conducted on the Beaverhill Bird Observatory's five established artificial nest box grids, which are distributed across the Beaverhill Natural Area. Grids A, B, and E are on the West side of the Lister Lake weir, in the forest close to the observatory, while grids C and D are on the East side (Figure 1). All five grids were constructed with similar spacing between boxes and with similar forest cover to facilitate Northern House Wren nesting. Grids A, C, and D consist of 25 nest boxes each in a 5x5 orientation, while grid B consists of 24 nest boxes in a 3x8 orientation, and grid E contains 9 nest boxes in a 3x3 orientation. All grids, with the exception of grid E, are constructed away from the walking trails that run throughout the Natural Area. Grid E has a trail that runs through it, separating the C column from A and B. 92 boxes contained within the historical Tree Swallow monitoring Spiral grid (S) were included in analysis due to a large number of successful House Wren nests being established within the area this year.

The six grids, comprising 200 total pre-existing artificial nest boxes, were monitored during the study period of May 20 - July 28 (May 13 - August 12 for the Tree Swallow grid). During this time, each box was checked roughly once per week; however, once older hatchlings were observed in a box, monitoring was stopped to allow time for safe development of nestlings. During data collection, if activity was observed, the nest stage (partial, full, or lined) was recorded. In addition, once eggs were present, egg number and temperature were recorded, with interns gently touching unattended eggs to determine if they were warm or cold. Adult birds were not disturbed when sitting on eggs, and these nests were simply recorded as "present - remained". If nestlings were found in a box, they were aged using a nestling aging guide developed by Brown et al. (2013). After the age of 7 days and 10 days for Northern House Wrens and Tree Swallows, respectively, monitoring was stopped to allow for proper development of nestlings. Monitoring was later resumed after the nestlings were 25 days old and were assumed to have fledged. Overall nesting success was then determined by the presence or absence of fecal matter (successful) and/or dead nestlings (unsuccessful). During preliminary box maintenance and cleaning, a sweep of the study areas was also conducted to identify possible natural nesting cavities that could be used by Northern House Wrens upon their arrival later in the season.

The fifth grid of nest boxes, grid "E", was established in 2025 with the intention of using hole size restrictors on the box cavity to incentivize Northern House Wren nest construction or dissuade Tree Swallows from entering the boxes (Undheim, 2025). The boxes in this grid have identical construction to the boxes in the other grids, but boxes A1, A2, A3, B1, and B2 are fitted with 1-⅛" metal Portal Protectors. The other boxes in the grid remain unchanged, with the same 1-¼" cavities as the rest of the nest boxes in the study area (Undheim, 2025).

Using the data collected on nesting success, a Chi-square test of independence was used to evaluate nesting site preference between the different grids for both Northern House Wren and Tree Swallow.

Results

The first Northern House Wren eggs were recorded in grid C on June 4, and the latest were recorded on July 28 in grid S. The average clutch size for Northern House Wren was 5.42 eggs (n=19), with nests ranging from 1-8 eggs. The average brood size was 3.79 nestlings, ranging from 0-9 nestlings per box. Only 15 of the 19 Northern House Wren nests produced successful young. Tree Swallows appeared to be more successful in the grids, having their first eggs recorded between May 29 in grid S and July 6 in grid E. The average clutch size for Tree Swallows was 5.68 eggs (n=92), with clutches ranging from 1-9 eggs. The average brood size was 4.40 nestlings, ranging from 0-7 nestlings. Tree Swallows also had a similar nest success rate to Northern House Wrens at 73 of 92 nests being deemed successful.

The data collected this year was analyzed using a Chi-square test of independence. Grid D was omitted from analysis as it contained no successful nests of either species. There was no significant change in preference for either species between grids (Figure 2), and thus no change in box preference based on cavity size (X^2=3.07, df=5, p=0.69). As $p > 0.05$, we fail to reject the null hypothesis.

Discussion

The low sample size of successful Northern House Wren nests, as well as boxes with entrance size reducers makes it difficult to draw many conclusions about nest box entrance size preference in the Northern House Wren, therefore the results of this study are inconclusive. However, there were only two successful nests across the Northern House Wren grids, one of which was in a box with a portal protector in grid E. Meaning that out of 108 boxes, one of the two successful nests was located in one of the five boxes which had the entrance size reducers attached.

The only grids which had a higher observed than expected number of successful nests of Northern House Wren, were Grid E, and the Tree Swallow Spiral Grid (Grid S).

An addition of more reducers across the grids would likely make it easier to draw conclusions, as it would increase the number of them to compare with typical boxes, and if our hypothesis were correct, it would also increase the number of successful Northern House Wren nests. However, inconclusive results could also mean that another reason entirely could be behind the decline of Northern House Wren nest box occupancy.

High levels of rainfall in late June led to severe flooding in the Beaverhill Natural Area. Due to this, the Beaverhill Bird Observatory staff and interns could not continue regular operations, resulting in a period of 17 days between checks in three (A, B, E) of the Northern House Wren nest box grids, as well as a period of 27 days between checks for the other two grids (C, D) due to high levels of water at the weir. The flood is also likely to have significantly impacted the breeding success of birds in the natural area, disrupting nest building, ability to forage, and overall safety.

To try and identify the reason for declining Northern House Wren nest occupancy within the Northern House Wren grids, a closer look at habitat is warranted. This is because of differences in House

Wren nesting numbers within the Northern House Wren grids, located primarily in the deciduous forest, and the Tree Swallow Spiral Grid located in grassland with patches of willow. Only two Northern House Wren nests in the five Northern House Wren grids were successful, whereas there were 12 successful nests in the Tree Swallow Spiral Grid. Even the amount of dummy nests in boxes in the Spiral Grid was slightly proportionally higher at 13%, compared to 12% of boxes in all the Northern House Wren grids. It is worth noting that the 5 Northern House Wren grids and the Tree Swallow Spiral Grid contain a similar total of boxes with 108 and 92, respectively. It is possible that the decline in Northern House Wren nesting numbers within the Northern House Wren grids is due to the maturation of the forest where the grids are located. Compared to 1986 when the first Northern House Wren study at the BBO was conducted, and even 2013 when the Northern House Wren long term monitoring at the BBO began and the grids were reestablished, the forest surrounding the grids has matured greatly. Because of this, it is possible that the reason for higher nesting rates of Northern House Wren in the Spiral Grid is due to habitat differences, i.e. presence of willow stands. There is evidence that Northern House Wrens prefer nest boxes on trees with smaller diameters, as well as prefer nesting in areas with sparser vegetation, whereas the trees in the Northern House Wren grids have gotten larger. In the Tree Swallow Spiral Grid the vegetation is denser willow stands, making it more attractive for nesting Northern House Wrens (Dailey, 2003; Martin, 2014).

The fact that there were more Northern House Wren nests in the Tree Swallow Spiral Grid goes against our hypothesis that competition for nesting locations is a key factor in the decline of Northern House Wren nestbox occupancy in the Northern House Wren grids. This is because of a higher prominence of Tree Swallow nest box occupancy within the Spiral Grid, if our hypothesis is correct we should expect fewer Northern House Wren nests where there are more Tree Swallows. However, it is also possible that another factor outweighs the competition for nesting locations, and leads to higher densities of both species in the spiral grid. For example, food availability may be higher in the grassland-willows, and Northern House Wrens prefer nesting in high food availability environments regardless of competition for nesting sites.

At the end of the season, in grids A, B, and E, Northern House Wren nests were kept intact instead of being cleaned out like they have been in previous years. Both successful and dummy nests were kept. This decision was made to attempt to see if nest reuse will increase House Wren nest box occupancy or not. Possibly dummy nests help establish nesting locations for future breeding seasons. Another possible area of future research is into natural cavity nesting within the natural area, which could be an alternative explanation for declines in Northern House Wren nestbox occupancy.

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Figures

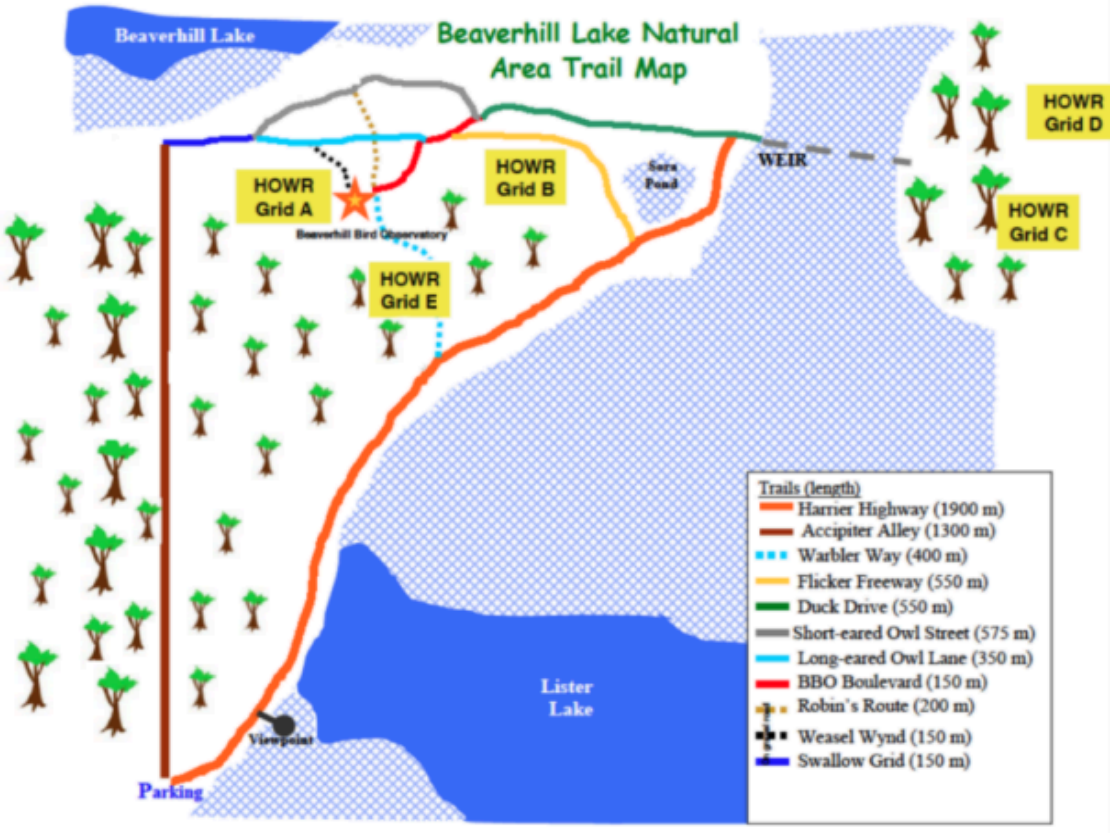

Figure 1. Map of the BBO depicting the locations of the five HOWR grids (internship manual)

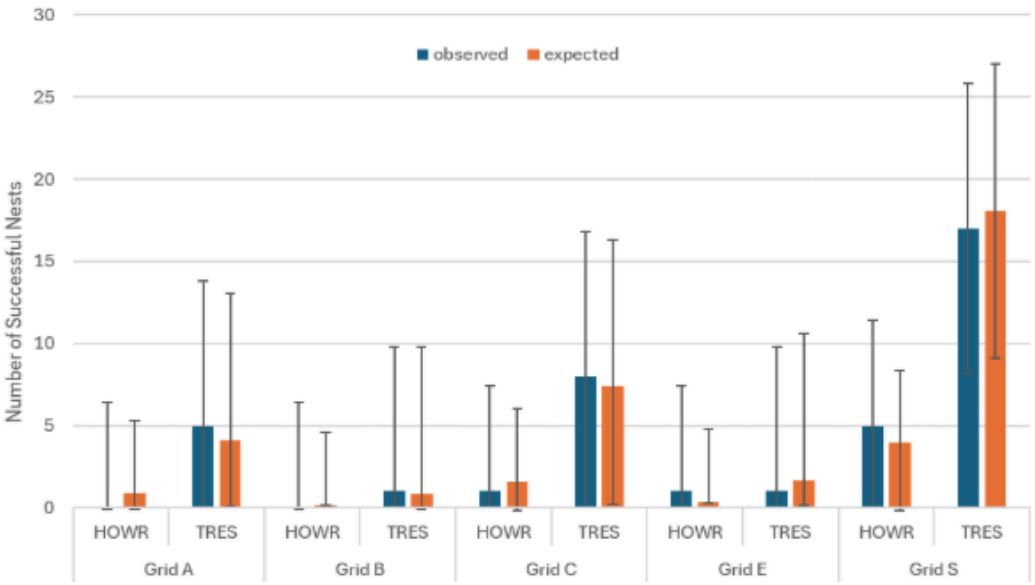

Figure 2. Rates of observed and expected nesting success by Northern House Wren and Tree Swallow, organized by grid. Error bars represent 95% confidence intervals.

References

Brown, W.P. et al. 2013. *House Wren Nestling Age can be Determined Accurately from a Guide of Digital Images*. North American Bird Bander, 38(4).

Butler, M. 2013. *Comparing the Nesting Density of House Wrens (Troglodytes aedon) in Artificial Environments with Natural Environments*. Beaverhill Bird Observatory. https://www.beaverhillbirds.com/media/1700/house-wren-meagan-butler.pdf

Cicon, E. 2025. *Internship Information Packet*. Beaverhill Bird Observatory

Dailey, TB. 2003. *Nest Box Use and Nesting Success of House Wrens (Troglodytes aedon) in a Midwestern Wetland Park 1*. The Ohio Journal of Science, 103(2), 25.

Fletcher, LB. 1944. *Unusual Nesting of House Wrens*. Bird Banding. 15(4):1. https://digitalcommons.usf.edu/bird_banding/vol15/iss4/9

Flynn, J. 2025. *The Effects of Interspecific Competition on the Northern House Wren*. Beaverhill Bird Observatory. https://www.beaverhillbirds.com/media/2600/house-wren-monitoring-19.pdf

Key Biodiversity Areas Partnership. 2026. *Key Biodiversity Areas factsheet: Beaverhill Lake*.

https://www.keybiodiversityareas.org/en/site/factsheet/11000/assessment

Martin, TE. 2015. *Consequences of habitat change and resource selection specialization for population limitation in cavity-nesting birds*. J Appl Ecol. 52: 475-485. https://doi.org/10.1111/1365-2664.12375

Undheim, L. 2025. *Impact of a selective experimental grid on Northern House Wren (Troglodytes aedon) and Tree Swallow (Tachycineta bicolor) nesting distributions within the Beaverhill Natural Area*. Beaverhill Bird Observatory. https://beaverhillbirds.com/media/2584/house-wren-monitoring-18.pdf

Quinn, MS. 1989. *Factors regulating the breeding population, reproductive success and mating system of House Wrens (Troglodytes aedon) at Beaverhill Lake, Alberta*. University of Alberta. https://doi.org/10.7939/R3G44HV9V

Will, DS, Dorset, EE, Thompson, CF, Sakaluk, SK and Bowers, EK. 2017. *Size of nest-cavity entrance influences male attractiveness and paternal provisioning in house wrens*. J Zool, 302: 1-7. https://doi.org/10.1111/jzo.12429