House Wren (*Troglodytes aedon*) and Tree Swallow (*Tachycineta bicolor*) historical presence and cohabitation effects in the Beaverhill Natural Area

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Abstract

The Beaverhill Natural Area provides good habitat for many migratory and year-round bird species. The nest boxes installed by the Beaverhill Bird Observatory provide accessible nesting spots for many cavity-nesting birds such as House Wrens (*Troglodytes aedon*) and Tree Swallows (*Tachycineta bicolor*). Since these species are both cavity nesters and occupy the same area, interspecific competition for nesting space is inevitable. We studied the use of the House Wren boxes by both Tree Swallows and House Wrens and the effects of interspecific competition on overall nesting success. The nest boxes were checked weekly and nest activity was recorded (i.e. nest building stage, species occupying the nest box, presence/temperature of eggs, and nestling age). Once all the nestlings fledged, we compiled our data and data from the past 6 years for analysis. Results from our chi-square goodness of fit test show that there were significantly more Tree Swallows than House Wrens occupying the nest boxes this year compared to previous years (X^2= 10.396, *df*=1, *p*= 0.012631). A negative correlation was also found between the proportion of Tree Swallow / House Wren and the overall nesting success of both species ($r(5)$= -0.37, *p*: 0.33411). Although there was a decrease in overall nesting success this year compared to other years, there is a weak correlation between interspecific competition and overall nesting success. It is important to study factors influencing nesting success in birds to understand trends in population declines and prevent negative effects of population declines.

Introduction

The relationship between different species is fascinating to observe and grants us insight into the pressures of cohabitation. One example of this is the overlapping niches of cavity-nesting birds and the battle for nesting territory. Over the spring and summer of 2022, we monitored four different grids of House Wren nest boxes and noticed a surprising amount of Tree Swallows taking residence in these boxes. House Wrens and Tree Swallows are both cavity nesters, and lay their eggs in small, confined spaces, such as holes created by woodpeckers or nesting boxes with small entrances left out by humans (Cornell Lab of Ornithology [Accessed 2022]).

We wondered how the increased number of Tree Swallows would affect the number of successful nests of both species through interspecific competition. House Wrens are a feisty, competitive species, which can create conflicts with other birds. A method that House Wrens use

to compete with other individuals is by building partial nests in nearby areas, discouraging other birds from inhabiting the area (Finch 1990). This is thought to decrease competition, and discourage predators by decreasing bird density in an area (Finch 1990). House Wrens also are known to destroy the nests of other birds to reduce competition before the House Wrens begin to nest (Belles-Isles and Picman 1986). With more Tree Swallows on site, the amount of nest-destroying behavior may increase, resulting in fewer successful nests. This competition could affect both parties negatively; House Wrens must use up time and energy to compete with other individuals and competing species lose nest space and the nests themselves.

In this study, we examined the effect of competition between Tree Swallows and House Wrens sharing territory by first determining whether the increased number of Tree Swallow nests is significant compared to historical years. We then determined how the pressures of increased interspecific competition affect the nest success rates for both species. When different species with a similar niche occupy the same area, the survival rate of individuals decreases because of the increased competition for resources (Neumann and Pinter-Wollman 2022). With a significant increase of Tree Swallow residence in the House Wren boxes, we predict the nesting success rates of both species will be lower than in previous years.

Methods

Study Site

The Beaverhill Bird Observatory installed 99 Nest boxes across 4 grids (A, B, C, and D). Grid A, C, and D have 25 nest boxes arranged in a 5x5 grid and Grid B has 24 boxes arranged in a 3x8 grid. Grids A and B are located west of the weir and grids C and D are located East of the weir (Appendix A). The nest boxes are placed at chest height on trees that are aligned roughly 30-35 meters apart. The placement of these grids in the Beaverhill Natural Area is significant since this area is an internationally recognized Important Bird and Biodiversity Area and is an important migratory site for many species of birds (About BBO… [accessed 2022]). The surrounding forests provide good nesting habitat for House Wrens, making it an ideal area to monitor House Wren nesting success (History… [accessed 2022]). House Wrens prefer areas where there is a mixture of forested or thick bush area, as well as open clearings (Cornell Lab of Ornithology [Accessed 2022]). The Beaverhill Natural Area provides both, as the nest boxes are

dispersed in a forested area that includes some clearings and is positioned near a large, open wetland.

Data Collection

House Wren nest box surveys were conducted in all four grids weekly from May 20 - August 9, 2022. The nest box checks were not conducted at a consistent time/day every week due to factors such as weather and scheduling. All the nest boxes were cleaned and in suitable condition for nesting before the arrival of House Wrens. For example, they were securely attached to their trees and had wire securing the nest box lid in place. Occasional maintenance on the nest boxes was conducted during surveying if necessary. During the nest checks, we recorded the nest building stage, the species occupying the nest box, and the presence of eggs with temperature checks (warm or cold, indicating if the eggs were being actively incubated or not) (Appendix B). Once hatchlings were present, we recorded the number of hatchlings and their approximate age using Brown's nestling age guide (Brown et al. 2013). Once the nestlings were over 7 days old, they were not checked for at least three weeks, to reduce the risk of early fledging. Once the nestlings fledged, the nests were marked as successful or unsuccessful. Nests were considered successful if the nest had been vacated and there were feces left in the nest box, and at least half of the young survived. Nests were considered unsuccessful if more than half of the nestlings did not survive, the parent died on top of the nest, or more than half of the eggs were broken/unhatched.

Data Analysis

The data collected was input into an Excel spreadsheet for analysis and completion of statistical tests. Data from the years 2015-2022 (excluding 2016, since no data was collected during that year) were compiled to compare the number of House Wren boxes occupied by Tree Swallows throughout the years. Before determining if competition with Tree Swallows decreased nest successes, we determined if the observed number of occupied Tree Swallow nests in the House Wren boxes was significant compared to previous years. To do this, we performed a Chi Goodness of Fit test. The number of House Wren and Tree Swallow occupied nests was counted from each historical year. Each year from 2015 to 2022 had the same sample size of 99 nest boxes. For this study, we defined occupied nests as nests that had eggs laid in them. There were partial nests built by each species, and some partial nests contained egg cups- this inferred that

they were real nests and not decoy nests (Sundstrom 2016). However, due to the possible ambiguous perspectives of past interns, only nests with eggs laid in them were counted as being occupied for all of the historical data. To conduct the Chi goodness of fit test, we averaged the occupied nest counts of historic years and used the result as the expected count. We used the data collected from this year as the real count.

Afterward, we ran a correlation analysis to determine if Tree Swallow usage of House Wren nest boxes affected the overall nest success of the two species. The X variable was the proportion of Tree Swallow/House Wren occupancy and the Y variable was the proportion of successful nests/unsuccessful nests. The success rates of Tree Swallow and House Wren nests were combined for this test, to include how both species overall were affected. We used the same data from 2015-2022 used in the first test. For this analysis, the null hypothesis predicts that the Tree Swallow occupancy of House Wren boxes and overall nesting success are independent.

Results

Breeding parameters

There were a total of 18 active House Wren nests and 21 active Tree Swallow nests in the House Wren grids this year. Out of the active nests, there were 1 unsuccessful House Wren nest and 6 unsuccessful Tree Swallow nests. The first eggs were recorded on May 29 and were from a Tree Swallow nest. The first House Wren egg was recorded on June 4th. The average House Wren clutch size was 8 and the average Tree Swallow clutch size was 6. The Tree Swallow eggs hatched between June 11-June 20 at around 6 nestlings and the House Wren eggs hatched between June 20-July 23 at an average of 6 nestlings (some House Wren eggs were laid in July).

Number of Tree Swallow nests

In our Chi-Square goodness of fit test, we found that the 2022 count of Tree Swallows occupying House Wren nest boxes was significantly larger compared to previous years (X^2= 10.396, df=1, p= 0.012631) (Figure 1, Table 1). This rejects the null hypothesis that the large number of Tree Swallows occupying House Wren boxes in 2022 was the result of sampling variance, and is likely to be caused by other influencing factors.

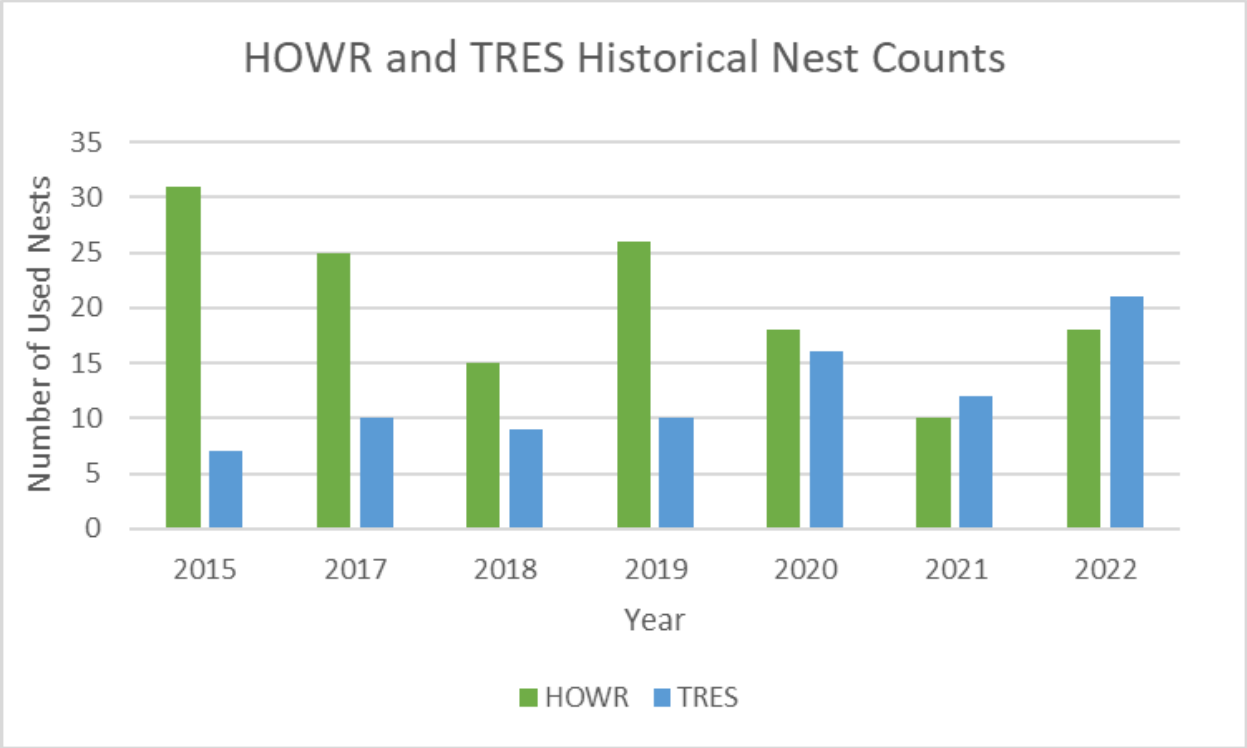

Figure 1. Historical active nest counts for Tree Swallows (TRES) and House Wrens (HOWR) in the House Wren nest boxes at the Beaverhill Bird Observatory.

Table 1. Count of Used House Wren and Tree Swallow Nests from 2015-2022, with Expected 2022 Count. Used nests are defined by containing eggs at some period. The expected 2022 count was calculated by averaging the counts of all previous years. 2016 is not listed because no data was collected in that year.

Year	House Wren Nests	Tree Swallow Nests
2015	31	7
2017	25	10
2018	15	9
2019	26	10
2020	18	16
2021	10	12
2022 expected	20.8333333	10.6666667
2022	18	21

Effect of competition

We found a weak negative correlation between the ratio of Tree Swallow/House Wren nest box usage and overall nest success ($r(5)= -0.37$, p: 0.334111). With a p-value higher than 0.05, we fail to reject the null hypothesis that the Tree Swallow occupancy of House Wren boxes and overall nesting success rate are independent.

Table 2. Excel output of a correlation analysis of the ratio of Tree Swallows (TRES)/House Wren (HOWR) and successful/unsuccessful nests. Data was collected from 2015-2022.

	TRES/HOWR	Successful/unsuccessful
TRES/HOWR	1	
Successful/unsuccessful	-0.36569642	1

Discussion

Number of Tree Swallows

The number of Tree Swallows occupying House Wren nests is higher than predicted. This is an unexpected trend, since Tree Swallows had a great decline in population between 1966 and 2017, losing almost half of their numbers (Cox et al. 2020). The cause of this decline is still speculated, but points mainly towards a decrease in insects, which is a major source of food for Tree Swallows (Cornell Lab of Ornithology [accessed 2022]). This decline in insect populations is also from the impacts of climate change (Cox et al. 2020). The increasing trend of Tree Swallow nests at the Beaverhill Bird Observatory seem to contradict this data. However, one sample of increased Tree Swallow numbers does not mean the whole population is increasing.

To help determine what was causing this interesting occurrence, we consulted with the Tree Swallow interns from summer 2022 on their findings. They stated that there were no unusual Tree Swallow numbers occurring this summer compared to past years, although 10 nest boxes located near wooded areas were occupied by House Wrens (August 2022 conversation between Tessa Frisky, Jonathan Kells, and Madison Pusch, unreferenced.) When compared to past data, it was found as a regular occurrence for a similar percentage of House Wrens to occupy the Tree Swallow grid. This eliminates the possible idea of the House Wrens invading

into the Tree Swallow boxes, which would force the Tree Swallows to seek nesting areas elsewhere, like the House Wren grid.

To truly determine the driving force of increased Tree Swallow occupancy in House Wren nest boxes in the Beaverhill Natural Area, it would require a large scope of knowledge around Tree Swallow and House Wren ecological behavior and preferences. More studies focusing on the population within and surrounding the area would have to occur.

Impact of Competition

The negative correlation between the ratio of Tree Swallow / House Wren and successful nests explains that as the proportion of Tree Swallows to House Wrens increases (higher number of Tree Swallows using House Wren boxes), the overall nesting success rate of both species decreases. Since the correlation value is close to zero, the relationship between Tree Swallow usage and nesting success rates is weak. This relationship means that the occupancy of Tree Swallows in House Wren Boxes may have some impact on the overall nesting success but we cannot confidently confirm a direct correlation between the two. The increase in Tree Swallow usage of House Wren boxes can lead to interspecific competition. In fact, interspecific competition is common between cavity-nesting birds such as House Wrens and Tree Swallows (Wiebe 2016). Since nesting cavities are often a limiting resource used by multiple species, interspecific competition can have negative impacts on competing species (Charter et al. 2016). Such negative impacts can include a decline in nesting success.

Although our results show that the interspecific competition between Tree Swallows and House Wrens influences nest success, the relationship between the two is not as strong as hypothesized. According to this year's observations and field guides, Tree Swallows migrate north early in the spring (Audubon field guide [accessed 2022]). This year we observed that Tree Swallows nested a week to two weeks earlier than the House Wrens. According to a past study conducted on Tree Swallows and Mountain Bluebirds, the individuals that arrived first were able to secure the best nesting spots, taking away nesting resources from the other species (Wiebe 2016). Therefore, by nesting earlier than the House Wrens, the Tree Swallows were able to secure spots, leaving fewer available nests for the House Wrens. This study shows the possible effects interspecific competition can have on nesting success, however, there are many other

factors such as predation, desertion, diseases, weather, and nest location that can affect nesting success (Best 1980). As a result, we cannot confidently conclude that interspecific competition is the main reason for the decrease in nest success.

Past studies have shown that nest competition has direct impacts on individuals however little is known about the effect nest competition has on House Wren populations (Charter et al. 2016). Although the House Wren's conservation status is of least concern, it is still important to understand the impact that high levels of interspecific competition has on House Wrens and other species (Audubon Field Guide [accessed 2022]). In fact, bird population declines can disrupt ecosystems leading to reduction in ecosystem services, declines in pollination, and the disruption of trophic cascades (Şekercioğlu ÇH et al. 2004). Therefore, by studying factors influencing nesting success we can help prevent population declines and protect ecosystems.

Conclusion

Our analysis of the effects of interspecific competition in the House Wren boxes at the Beaverhill Natural Area shows a strong increase in the residency of Tree Swallows compared to previous years. We hypothesized that this would result in strong interspecies competition, which would result in lowered nest success rates for both species. The correlation analysis demonstrated a weak negative correlation, meaning that the interspecific pressures did negatively affect nest successes, but not to a great extent. We understand that our data collected is in an uncontrolled setting, which makes it difficult to isolate the contributors to nest failure and success. As demonstrated by our results, the increase in Tree Swallow usage of the House Wren boxes could have caused an increase in interspecific competition, which could lead to a decrease in nesting success. Since there are other factors that influence nesting success, the correlation between interspecific competition and nest success was weak. Other factors such as predation, desertion, diseases, weather, and nest location can affect nesting success (Best 1980).

In order to better understand the effects of interspecific competition on nesting success, more controlled studies would have to be conducted. Furthermore, to investigate into the cause of the large community of Tree Swallows occupying the House Wren nests, studies focusing on disturbed vs undisturbed Tree Swallow habitats should be conducted to explore how cultivation and disturbance could be deterring the Tree Swallows away, and moving them into the Beaverhill Natural Area. Also, studies monitoring the movement of Tree Swallows would be

useful to evaluate if they are actively being pushed away from other territories. To further explore how Tree Swallow's presence affects nest success rates, the Beaverhill Bird Observatory could continue collecting yearly data, therefore increasing the sample size. With more future data, this study topic could continue by monitoring the trends of Tree Swallow occupancy, and the effects on nest success within the House Wren grids.

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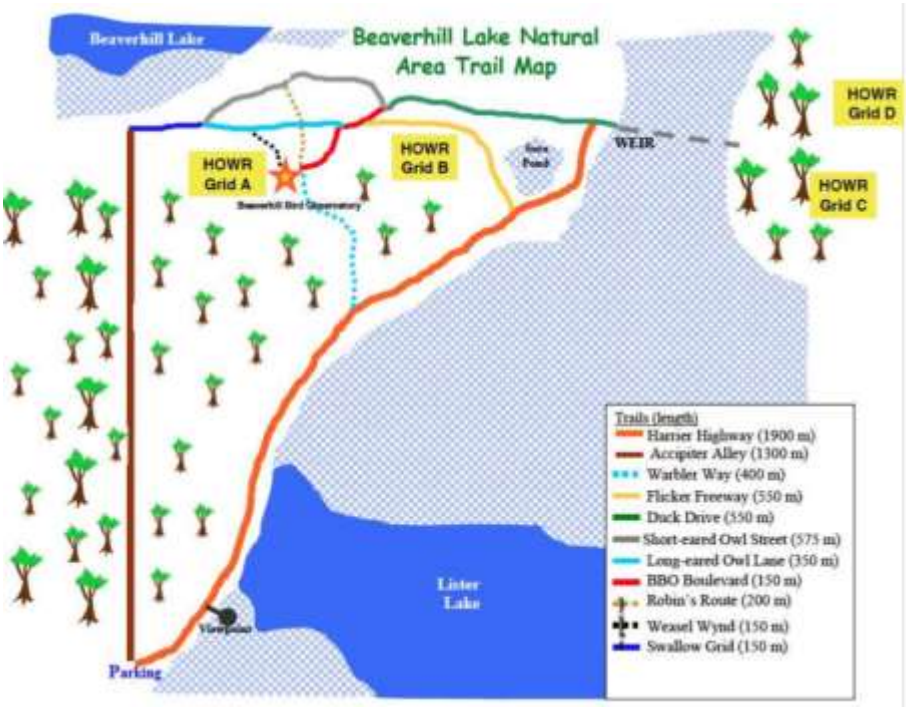
Appendix

Appendix A. Map of the BeaverHill Natural Area indicating the location of the 4 House Wren grids (Courtesy of the BBO House Wren internship manual).



Appendix B. Data sheet used during House Wren nest box checks.

Nestbox #	Spp.	Nesting State		Egg # + Temp. (W/C)	Adult (P/A)	Nestling #	Nestling Age	Comments
		Active (B<f, p, l >, E, N)	Inactive					

Works Cited

Beaverhill Bird Observatory. [date unknown]. Tofield (AB): About BBO; [accessed 2022 Jul 12]. http://beaverhillbirds.com/welcome/about-bbo/.

Beaverhill Bird Observatory. [date unknown]. Tofield (AB): History; [accessed 2022 Aug 9]. http://beaverhillbirds.com/welcome/history/.

Belles-Isles J-C, Picman J. 1986. House Wren nest destroying behaviour. The Condor. [accessed 2022 Aug 9];88:190–193. https://doi.org/10.2307/1368914.

Best LB, Stauffer DF. 1980. Factors affecting nesting success in riparian bird communities. The Condor. [accessed 2022 Aug 9];82(2):149–158. doi:10.2307/1367468.

Brown WP, Zuefle ME, Underwood TJ, Alexander AL, Alexander DA. 2013. House Wren nestling age can be determined accurately from a guide of digital images. North American Bird Bander. 38:150-159.

Charter M, Izhaki I, Ben Mocha Y, Kark S. 2016. Nest-site competition between invasive and native cavity nesting birds and its implication for conservation. Journal of Environmental Management. [accessed 2022 Aug 9];181:129–134. https://doi.org/:10.1016/j.jenvman.2016.06.021.

Corra, Joseph, and S Mažeika P Sullivan. 2021. Temperature and land use influence Tree Swallow individual health. Conservation Physiology. [accessed 2022 Aug]; 9(1): 1-11. https://doi.org/10.1093/conphys/coab084.

Cox AR, Robertson RJ, Rendell WB, Bonier F. 2020. Population decline in tree swallows (Tachycineta bicolor) linked to climate change and inclement weather on the breeding ground. Oecologia. [accessed 2022 Aug];192(3):713–722. https://doi:org/.10.1007/s00442-020-04618-8.

Finch DM. 1990. Effects of predation and competitor interference on nesting success of house wrens and tree swallows. The Condor. [accessed 2022 Aug 29];92(3):674–687. https://doi:org/10.2307/1368686.

House Wren | Audubon Field Guide. [accessed 2022 Aug 20]. https://www.audubon.org/field-guide/bird/house-wren.

House Wren Life History. [date unknown]. All about Birds, Cornell Lab of Ornithology; [accessed 2022 Jul 29]. *Www.allaboutbirds.org*, www.allaboutbirds.org/guide/House_Wren/lifehistory.

Neumann K, Pinter-Wollman N. 2022. The effect of resource availability on interspecific competition between a native and an invasive ant. Philosophical Transactions of the Royal Society B: Biological Sciences. [accessed 2022 Aug]; 377(1851). https://royalsocietypublishing.org/doi/full/10.1098/rstb.2021.0146.

Owen, Brenna. 2022 May 4. 2021 heat wave over B.CAlberta was among most extreme since 1960s: study." Global News. [accessed 2022 Aug 5]. globalnews.ca/news/8810459/bc-alberta-2021-heat-dome-research/.

Sundstrom, Bob. 2016 June. House Wrens and Dummy Nests. Bird Note. [accessed 2022 Aug 24]. www.birdnote.org/listen/shows/house-wrens-and-dummy-nests.

Şekercioğlu ÇH, Daily GC, Ehrlich PR. 2004. Ecosystem consequences of bird declines. Proceedings of the National Academy of Sciences. [accessed 2022 Aug 20]; 101(52):18042–18047. doi:10.1073/pnas.0408049101.

Tree Swallow | Audubon Field Guide; [accessed 2022 Aug 10]. https://www.audubon.org/field-guide/bird/tree-swallow.

Tree Swallow Life History. [date unknown]. All about Birds, Cornell Lab of Ornithology;[accessed 2022 Aug 24]. *Www.allaboutbirds.org*, www.allaboutbirds.org/guide/Tree_Swallow/lifehistory#food.

Wiebe KL. 2016. Interspecific competition for nests: Prior ownership trumps resource holding potential for Mountain Bluebird competing with Tree Swallow. The Auk. [accessed 2022 Aug 20];133(3):512–519. Https://doi.org/:10.1642/AUK-16-25.1.