The effects of nest box location on Tree Swallow (*Tachycineta bicolor*) productivity and nest success at Beaverhill Bird Observatory, Alberta

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ABSTRACT

Tachycineta bicolor (T. bicolor), better known as the Tree Swallow, is an avian species commonly studied due to its high tolerance of human interaction, tendency to flock in large numbers, and return to same nesting location year after year. Over a three month period spanning from May to July, two designated *T. bicolor* nest box grids within the Beaverhill Bird Observatory were monitored to track various parameters regarding productivity and nest success. Both grids were located 9 miles east of Tofield, Alberta near Beaverhill lake; the spiral grid boxes were situated near shrubs and shaded forested area, where the field grid boxes were situated in a grassed area lacking shade. This report will discuss differences found between nesting grids through the measurement of various parameters such as average and range of clutch size, brood size at hatch, brood size at seven days, date of first egg, and overall nest success. Using Microsoft Excel 2016, two single factor ANOVA tests were conducted to highlight significant differences among grids. Upon analysis, there was no significant difference in clutch size between grids. However, a statistically significant difference was found between grids regarding brood size at seven days; where the spiral grid produced a higher number of healthy fledglings. Furthermore, the spiral grid had a significantly higher nest success percentage than the field grid. Findings from this report conclude that further research should be conducted to examine the effect of habitat on *T. bicolor* productivity and nest success.

INTRODUCTION

A stunning, iridescent bird with a distinct call roams Canadian fields during the summer season to find a mate and reproduce. In July and August it migrates, spending the winter in southern United States (US) and Mexico (Cornell University, 2015). The Tree Swallow (*Tachycineta bicolor)* is easy to recognize by its dark head and wings, and white underside. Adult males display a greenish-blue iridescent coloring along their wings and head; while females show a duller colored brown tint, while juveniles have a dark tan color (Cornell University, 2015). A female of this species will build a nest within natural cavities and/or in man-made nest boxes (Stutchbury and Cohen, 2011). Females use grass and other natural materials to build a cup-shaped nest, while males supply feathers to line it, as seen in Figure 1 (Cornell University, 2015). The *T. bicolor* diet consists of a variety of insects caught while in flight, and have been known to eat berries such as bayberry and waxmyrtle (Salmon Creek Tree Swallow Project, 2017). This species is highly social, migrates in large flocks and prefers nesting in close proximity of one another (Cornell University, 2015). *T. bicolor* is an active beautiful traveler of North America and is highly researched by humans due to a high tolerance of human interaction, tendency to flock in large numbers, and return to same nesting location year after year.

The Beaverhill Bird Observatory (BBO), situated within the Beaverhill Natural Area, is one such place where *T. bicolor*, are monitored (BBO, 2017). BBO serves as a sanctuary for countless species that make this area their home, as well as a research facility that tracks migratory patterns and other parameters regarding avian species' productivity. In addition to serving as a sanctuary and research facility, BBO promotes education and conservation of avian species and the habitat they which they reside. Through educational initiatives, BBO has provided two interns with the opportunity to monitor and collect *T. bicolor* nest box data and subsequently compile this report. Data for this report were collected and analyzed in order to compare differences in *T. color* productivity and nest success between two separate nest box grids through measured parameters including clutch size and brood size at seven days. The two grids differed in surrounding vegetation: the spiral grid boxes were in close proximity to shrubs and trees, where the field grid boxes were located in a grassy area. Due to differences in grid location, it is hypothesized that differences in *T. bicolor* productivity and nest success will be observed.

METHODS

Data collection for this report spanned a three month period, which began on May 25, 2017 up until July 28, 2017. Data were collected south of Beaverhill Lake at the Beaverhill Bird Observatory, in a natural area located nine kilometers east of Tofield, Alberta. The two nest box grids: the spiral grid and field grid, within Beaverhill Bird Observatory were checked once per week by their respective interns. Both grids were monitored throughout the entire nesting season (May-July) of *T. bicolor*, and continued after first clutches had fledged to monitor possibility of second clutches. The wooden nest boxes stood erect by metal posts at a height approximately one to two meters high. The field grids boxes were located in an open field; tall grasses surrounded the boxes with very little shrubs and shade present. The field grid location contrasted with the spiral grid location, which had boxes surrounded by trees and shrubs. Boxes in the spiral grid consisted of a top fastened lid, while the field grid boxes had a side fastened door. Lids and doors of the boxes were fastened by metal wires to ensure the boxes would not open throughout the season. The direction that the boxes faced varied between east, south and west.

Initially, data were recorded based on presence and completeness of nest; where “B” signified a nest in progress without eggs or young, “p” for partially built, “f” for a full nest with a cup formed, “l” for lined with grass or feathers without the presence of eggs or young. Further into the nesting season, “E” was used to denote the presence of eggs, where number and temperature (“w” for warm, “c” for cold) of the eggs were also recorded. Upon hatching, “N” was used to denote nestling, where nestling number and age were also recorded. Nestling age was determined using the aging guide found on the Tree Swallow Projects website (Gates, 2017). Recording nestling age allowed for a banding date to be set at 11-12 days old, before the chicks fledged the nest. At this age, *T. bicolor* chicks’ bodies are an ideal size for bands to placed comfortably around their legs.

Another parameter recorded was the presence of an adult *T. bicolor* in or around the nest box; where “A” stood for absent, “P” for present, “P-flushed” for flushing the bird out of the nest box, “P-remained” for adult remaining on eggs during check, and “P-in vicinity” for adult flying near box, if necessary. For example, the parameters for the nest box seen in Figure 1 below would include P-remained (i.e., *T. bicolor* staying in the box during check), E (i.e., eggs in nest), and 4W (i.e., four warm eggs). The “comments” section in the data chart allowed for any other notable information to be documented; such as presence of a deceased bird, nest box maintenance (e.g., chain wire, loose screws, etc), aggressive dive bombing adult, insects or mice in the nest, and approximate banding dates for nestlings.

Figure 1. An active nest box within the spiral grid at Beaverhill Bird Observatory, occupied by a female *T. bicolor* protecting her eggs.

Following three months of field data collection, the raw data was input into Microsoft Excel 2016, and was analyzed using a single factor analysis of variance (ANOVA) in order to compare parameters between the field and spiral grid, such as clutch size and nesting success.

RESULTS

The two nest box grids, spiral and field, were checked each week on the same day throughout the nesting season. The spiral grid consisted of 48 nest boxes. Out of the 48 nest boxes in the spiral grid, there were a total of 47 clutches. Second clutches were observed in boxes T3, T6, and T25, as the first clutches were unsuccessful, possibly due to predation, while the second resulted in healthy fledglings. The spiral grid had an average clutch size of 6.09, an average brood size of

5.32 at hatch, and 5.32 at seven days, with a nest success of 87% (brood size at seven days divided by clutch size, multiplied by 100). With regards to brood size at hatch and brood size at seven days, we assumed that all chicks in a brood hatched on the same day. Therefore, if one egg hatched a day late we included this chick in the brood size at hatch data. The average first egg date in the spiral grid was observed to be on May 24, 2017, ranging from May 21 to May 31, 2017. The average hatch date for the spiral grid occurred on June 14, 2017, ranging from June 6 to July 12, 2017.

The field grid consisted of 42 nest boxes. Out of the 42 nest boxes, there were a total of 39 clutches. Only one second clutch was observed in box T62, the first clutch being unsuccessful, and the second resulting in healthy fledglings. Clutches observed in boxes T54, T57, and T78 never hatched. Box T84 had a clutch of nine eggs but never resulted in any fledglings, possibly due to predation. The field grid had an average clutch size of 6.21, an average brood size of 4.06 at hatch, and 4.06 at seven days, with a nest success of 65% (brood size at seven days divided by the clutch size, multiplied by 100). The average first egg date in the field grid was observed to be on May 26, 2017, ranging from May 19 to May 31, 2017. The average hatch date for the field grid occurred on June 17, 2017, ranging from June 4 to July 23, 2017.

Not only were Tree Swallows nesting within the spiral grid and the field grid, but House Wrens (*Troglodytes aedon*) began to move into the boxes during the season. They took up more boxes as the weeks went on, preferring the spiral grid more over the field grid. At week eight, a total of 14 boxes were occupied by *T. bicolor* within the spiral grid and 29 boxes occupied within the field grid. During the same week, there were seven boxes occupied by *T. aedon* within the spiral grid and four boxes occupied within the field grid. Lastly, there were 27 inactive nest boxes within the spiral grid and nine inactive within the field grid.

Table 1. Nest box breakdown by species (*T. bicolor* and *T. aedon*) for week eight (30/06/17).

	Spiral grid (number of boxes)	Field grid (number of boxes)
T. bicolor	14	27
T. aedon	7	4
Inactive (vacant)	27	9

As single factor ANOVA was run on Microsoft Excel 2016 to compare clutch sizes between the field and spiral grids for the 2017 nesting season, as seen in Table 2.

Table 2. Single factor ANOVA analyzing clutch size between the spiral and field grids.

Summary				
Groups	*Count*	*Sum*	*Average*	*Variance*
Spiral grid clutch size	47	286	6.085106383	2.470860315
Field grid clutch size	39	242	6.205128205	1.325236167

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.307032568	1	0.307032568	0.157242799	0.692713388	3.954568408
Within Groups	164.0185488	84	1.952601772			
Total	164.3255814	85				

When comparing clutch sizes between grids, the F calculated value (0.157) is less than the F critical value (3.95), with a P-value (0.69) greater than 0.05. Considering these two factors, we conclude that there is no significant difference between grid clutch sizes.

A single factor ANOVA was also run on the data to compare brood size at seven days between the two grids as seen in Table 3 below.

Table 3. Single factor ANOVA analyzing brood size at seven days between the spiral and field grids.

Summary				
Groups	*Count*	*Sum*	*Average*	*Variance*
Spiral grid brood size	34	175	5.147058824	2.371657754
Field grid brood size	32	135	4.21875	3.595766129

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	14.20593806	1	14.20593806	4.791880438	0.032248704	3.990923772
Within Groups	189.7334559	64	2.964585248			
Total	203.9393939	65				

When comparing brood sizes at seven days between grids, the F calculated value (4.79) is greater than the F critical value (3.99), along with a P-value (0.03) less than 0.05. Considering these two factors, we conclude that there is a significant difference between grid brood sizes at seven days.

DISCUSSION

The data analysis comparing clutch sizes showed no statistically significant difference between grids; therefore, *T. bicolor* productivity in terms of clutch size was found to be relatively the same among both grids. However, when a ANOVA was conducted on brood size at seven days, a statistically significant difference was found between grids. When looking at average brood size at seven days, the spiral grid had a greater number of successful fledglings (5.15) than the field grid (4.22). Possible reasons for a greater nest success in the spiral grid include differences in surrounding vegetation, food abundance, shade from the sun, and predators. Since *T. bicolor* are aerial insectivores, it is possible that the spiral grid boasted a higher insect abundance, resulting in more efficient food capture, shorter travel time back to the nest to feed the fledglings, and subsequently increased nest success (Jones, Harris, & Siefferman, 2014). It is highlighted in Twinning et. al (2016) that not only food quantity, but quality has an effect on *T. bicolor* reproductive output and overall fitness. Therefore, it is possible that the spiral grid provided more insects with higher amounts of omega-3 long-chain polyunsaturated fatty acids which support aerial insectivore performance. This could also be why *T. aedon* used more nest boxes in the spiral grid, as they prefer a grid habitat with greater insect abundance and surrounding vegetation.

It was also observed that the spiral grid had a higher amount of *T. aedon* nests near the end of the season, while the field grid had more *T. bicolor* fledglings occupying the nest boxes (Table 1). Furthermore, *T. bicolor* nestlings in the spiral grid tended to fledge earlier than in the field grid. Since there were more *T. bicolor* nestlings occupying boxes in the field grid later in the season, *T. aedon* females may have preferred to nest in the spiral grid since there were less *T. bicolor* in the area and subsequently less interspecific competition.

When examining overall nest success (clutch size divided by brood size at seven days), the spiral grid boasted a much higher percentage (87%) than the field grid (65%). The spiral grid had more nestlings survive than the field grid; where the clutch sizes between grids were relatively similar, but the field grid had a smaller amount of fledglings present at seven days. It is possible that parent *T. bicolor* had a more challenging time accessing adequate food supply for the nestlings in the field grid. It also may be possible that the lack of surrounding vegetation in the field grid resulted in chick mortality during extreme weather conditions. Since cold temperatures have a significant effect on *T. bicolor* brood survival, it is possible that the field grid was more susceptible to cold snaps due to lack of surrounding vegetation and wind block from trees (Winkler, Luo, & Rakhimberdiev, 2013). Future research could examine internal nest box temperatures to look for possible effects of vegetation coverage on grid success.

CONCLUSION

Upon completion of this report, it is apparent that there are significant differences in nest success between the spiral and field grids through the measured parameter of brood size at seven days. However, *T. bicolor* productivity was found to be relatively similar between the two grids when looking at the ANOVA results of clutch size. Differences in grid nest success may have been a result of differences in surrounding vegetation and insects; where *T. bicolor* possibly had more efficient acquisition of food in the spiral grid, subsequently resulting in more successful fledglings. Further research should be conducted on this topic, such as differences in grid insect type and density. It may also be interesting to look into types of surrounding vegetation that support increased *T. bicolor* productivity and nest success. Research on T. bicolor habitat preference will allow future nest box grids to be placed in locations that support optimal T. bicolor productivity and success.

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REFERENCES

Beaverhill Bird Observatory. (2017). About BBO. Retrieved from http://www.beaverhillbirds.com/welcome/about-bbo/

Gates, C. (2017). Nestling Growth. Retrieved from http://www.treeswallowprojects.com/basics.html

Jones, J. A., Harris, M. R., & Esiefferman, L. (2014). Physical habitat quality and interspecific competition interact to influence territory settlement and reproductive success in a cavity nesting bird. Frontiers in Ecology and Evolution, 2. doi 10.3389/fevo.2014.00071

Powell, H. (2015). Tree swallow. Retreived from https://www.allaboutbirds.org/guide/Tree_Swallow/id

Robertson, R. J., B. J. Stutchbury, & R. R. Cohen. Tree Swallow (*Tachycineta bicolor*). *In* The Birds of North America, No. 11 (A. Poole, P. Stettenheim, and F. Gill, eds.). The Birds of North America Online, Ithaca, New York.

Twining, C. W., Brenna, J. T., Lawrence, P., Shipley, J. R., Tollefson, T. N., & Winkler, D. W. (2016). Omega-3 long-chain polyunsaturated fatty acids support aerial insectivore performance more than food quantity. *Proceedings of the National Academy of Sciences of the United States of America*, *113*(39), 10920–10925. doi 10.1073/pnas.1603998113

Winkler, D. D., Luo, M., & Rakhimberdiev, E. (2013). Temperature effects on food supply and chick mortality in tree swallows (Tachycineta bicolor). Oecologia, 173(1), 129-138. doi 10.1007/s00442-013-2605-z