DO DIFFERENT CLUTCH SIZES OF THE TREE SWALLOW (*Tachycineta bicolor*)

HAVE VARYING FLEDGLING SUCCESS?

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August 25th, 2017

Abstract

Tachycineta bicolor (Tree Swallow) were surveyed over a three-month period starting the 2nd week of May 2017. Nest boxes contained within the 3 grids were monitored in a location 8 kilometres East of Tofield, Alberta, in the Beaverhill Natural Area. The 3 grids monitored by Tree Swallow interns were the spiral grid, the new grid, and the road grid. This study was proposed to examine the relationship between varying clutch sizes on fledgling success of Tree Swallows located in the new grid. The new grid contained 50 bird nest boxes which housed both Tree Swallow and House Wren species. A one-way ANOVA was used to compare the relationship between each clutch size and fledgling success in tree swallows (clutch sizes ranged from 3 to 8 eggs). It was determined that there was no significant difference between clutch size and fledgling success ($\alpha = 0.05$, $p = 0.18$). Further analysis using t-tests; however, showed that there was a significant difference between clutch sizes 6 and 8 (two tailed p-value= 0.0320). This suggested that larger clutch sizes (over 6 eggs) may have a higher fledgling success than average clutch sizes (4 to 6 eggs). Furthermore, a study by Steven (1980) suggested that larger clutch sizes may have a higher fledging success rate. A small sample size (n=1) in the new grid may have resulted in the non-significant difference in fledgling success at the new grid. It is necessary to continue the comparison of Tree Swallow survey data to determine all variables involved when analyzing the effect of clutch size on fledgling success.

Introduction

Clutch size in birds is often determined by the reproductive effort invested in young. Generally, birds that have a higher reproductive output will produce larger clutch sizes. The amount of investment birds put into reproductive effort; however, differs between species (Martin & Li, 1992). One such bird, the Tree Swallow, is known to have large clutch sizes and high reproductive outputs (Martin & Li, 1992). Many different factors may influence a species reproductive investment. One factor that controls bird populations is the trade-off between reproduction and survival. It has been hypothesized that birds invest less in young when survival rates are higher (Martin & Li, 1992). This trade-off between reproduction and survival serves to be one of the most important aspects of life-history in avian life.

Tree Swallows were chosen for this study because of their ability to breed continuously in the same colonies, handle high levels of disturbance without abandoning their nests, and breed in nest boxes (Steven, 1980). Additionally, Tree Swallows differ from other species of birds by their adaptability, which allows researchers to control their environments and study their breeding systems over long periods of time. The breeding grounds of the Tree Swallow species are extensive, ranging from Alaska to northern Mississippi and Alabama, USA (Ardia, 2005). Most female Tree Swallows will rear 1 brood per year and remain monogamous (Steven, 1980). Furthermore, the female is fully responsible for incubating all clutches produced (Steven, 1980). Young Tree Swallows are housed in nests made of grass and feather materials (NatureWorks, 2017). Nests are either found within natural or man-made cavities in the preferred grassland habitat (NatureWorks, 2017). The average female tree swallow will have clutch sizes ranging from 4 to 6 eggs (NatureWorks, 2017). Moreover, eggs hatch around 2 weeks after laying, with fledglings leaving the nest after about 3 weeks (NatureWorks, 2017). Tree Swallow diets consist mainly of insects such as beetles and dragonflies (NatureWorks, 2017). When resources are more limited; however, Tree Swallows may resort to eating berries (NatureWorks, 2017).

To determine if different clutch sizes in *T.bicolor* could influence fledgling success, data from the new grid were collected and analyzed. This information was used to test the hypothesis that larger clutch sizes will lead to increased fledgling success. To test this hypothesis, total clutch size was compared to fledgling success per nest box in the new grid. This paper will serve to outline observations made at Beaverhill Observatory over the summer of 2017 and their possible implications.

Methods

Data were gathered at Beaverhill Bird Observatory (BBO), approximately 8 km East of Tofield, AB, during the summer of 2017. Tree Swallow interns were assigned to either the spiral grid, the new grid, or the road grid. The new grid, as indicated by the black dot in *Figure 1.*, contained 50 bird boxes facing Northeast in rows of 10.

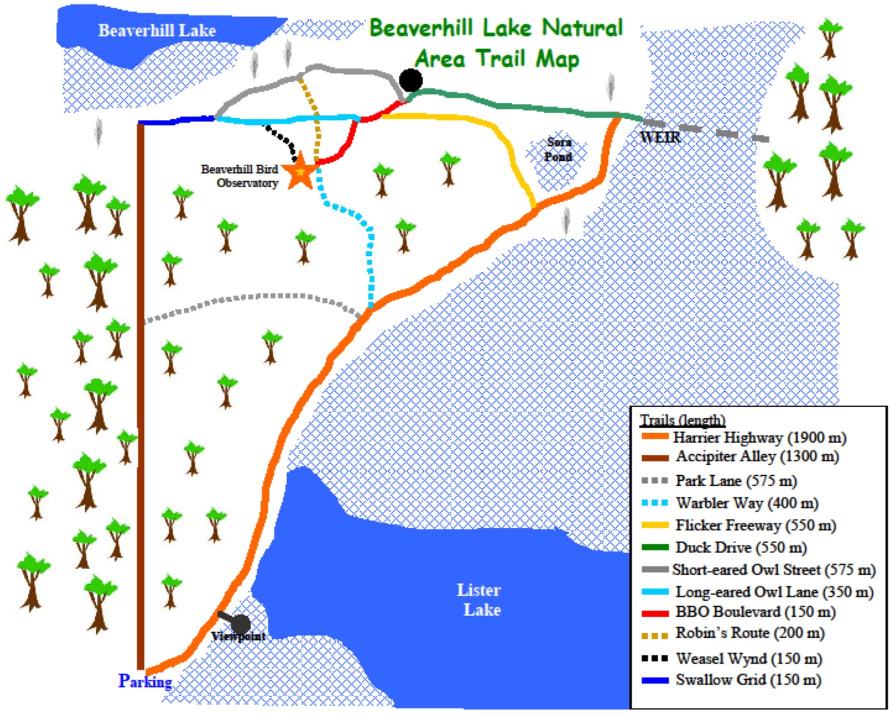

Figure 1. Beaverhill Lake Natural Area Trail Map. The black dot indicates approximately where the new grid is located. Image modified from Beaverhill Bird Observatory, Trail Map PDF. http://beaverhillbirds.com/docs/bbo_trailmap.pdf

Nest box data were recorded weekly starting the 2nd week of May, up until the last nestlings had fledged. Information recorded included: clutch size, nesting state, nestling age, parental presence/absence, temperature of eggs, number of eggs, and species present in the nest box. Nest boxes were attached to fence posts and were accessed by untwisting the wire from the sides of the box and removing the lid for examination.

Nesting state was determined to be either empty, partial, or full. An empty nesting state was determined by the absence of a nest or if only feathers was present.

Furthermore, a partial nesting state was determined by grass in the box, without a cup-shape. To assign a full nesting state, there must be grass, feathers, and a cup-shaped nest. Species occupying the nest boxes included Tree Swallows and House Wrens. Bird species were identified via nest material. Tree Swallows used feather and grass material; whereas, House Wrens used twig material to create their nests. Tree swallows were aged via their plumage (*Figure 2.*) and when chicks reached eleven days, they were banded. When all Tree Swallows had fledged, the nest boxes were cleaned out to provide space for new nests to be built the following year.

Data were analyzed using Microsoft Excel. The fledgling success was determined by calculating the ratio of successfully fledged young to clutch size for each nest box. Tree Swallow clutch sizes ranged from 3 to 10 eggs. Clutch size was measured by the maximum amount of eggs laid by 1 nest box. The data was compared using t-tests and one-way ANOVA. House Wren species were excluded from data analysis. Furthermore, nest box 34 was not included as it contained House Wren species.

Figure 2. Tree Swallow young about to reach fledging age (Zimmerman, 2016)

Results

There was no significant difference between the means of fledgling success for each clutch size (ANOVA; $\alpha = 0.05$, p-value= 0.181). Further analysis showed that there was a significant difference of fledgling success between clutch sizes 6 and 8 (t-test; $\alpha = 0.05$, two tailed p-value= 0.0320). There was no significant difference in fledgling success between clutch sizes 5 and 9 ($\alpha = 0.05$, two tailed p-value= 0.380). Furthermore, there was no significant difference in fledgling success between clutch sizes 4 and 5 ($\alpha = 0.05$, two tailed p-value= 0.710).

Discussion

Analysis of the one-way ANOVA showed that there was no significant difference between clutch size and fledging success; however, interpretations were still made. The findings of this study suggested that clutch sizes of 10 had the best fledging success rates; whereas, clutch sizes of 3 had the worst fledging success rates. This can be explained through the low frequency of Tree Swallow females supporting clutch sizes of 3 and 10 eggs (*Figure 3.*). The small sample sizes representing these populations may have resulted in non-typical results within this study. It may be inferred that clutch sizes outside the average range may have been less prevalent due to parental stress and low survivorship (Steven, 1980). It was also noted that there was declining trend with clutch sizes over 6, excluding clutch sizes of 10. Data showed that the majority of female Tree Swallows laid clutch sizes of 6 (*Figure 4.*). For the Tree Swallow species, clutch sizes of 6 are considered average (NatureWorks, 2017).

Previous studies have suggested that the largest clutch sizes fledge the most young (Steven, 1980). This supports data seen in *Figure 3.*, which notes that clutch sizes of ten (largest clutch size in population) successfully fledged the most young (80 percent, *Figure 3*.). Studies by Steven (1980) have also suggested that fledgling weights were significantly lower in larger brood sizes reared by young females, decreasing fledgling success and survivorship. This may explain why there was high variation of fledgling success per clutch size in the new grid. As well, food resource levels can play a limiting role on egg-laying females (Murphy, Armbrecth, Vlamis, & Pierce, 2000). This may explain why most clutch sizes over 6 had a decreased fledgling success and a limited sample size. Moreover, previous research suggests that larger clutch sizes are more subjective to starvation due to food limitation, which can decrease fledgling success (Murphy et al., 2000). As discussed previously, all individuals of a species must trade-off between survival and reproductive investment. Thus, Tree Swallows with low survival are hypothesized to lay more eggs per breeding attempt (Martin & Li, 1992). This trade-off may explain the variation seen between each clutch size, survival, and fledgling success. Overall, variation in reproductive investment, samples size, food resource levels, and brood weights were determined to be the best indicators as to why the data was non-significant and inconclusive.

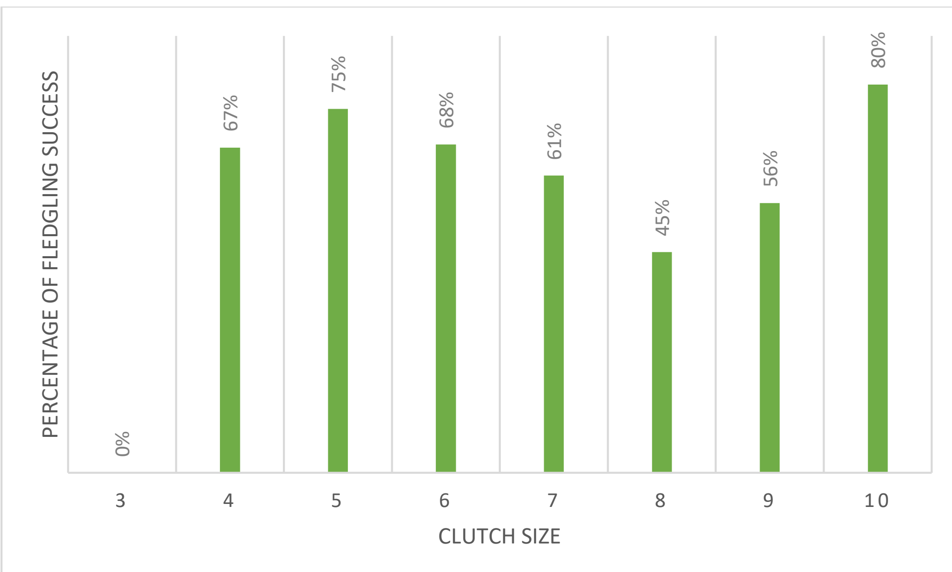

Figure 3. Percentage of tree swallows that successfully fledged for each clutch size.

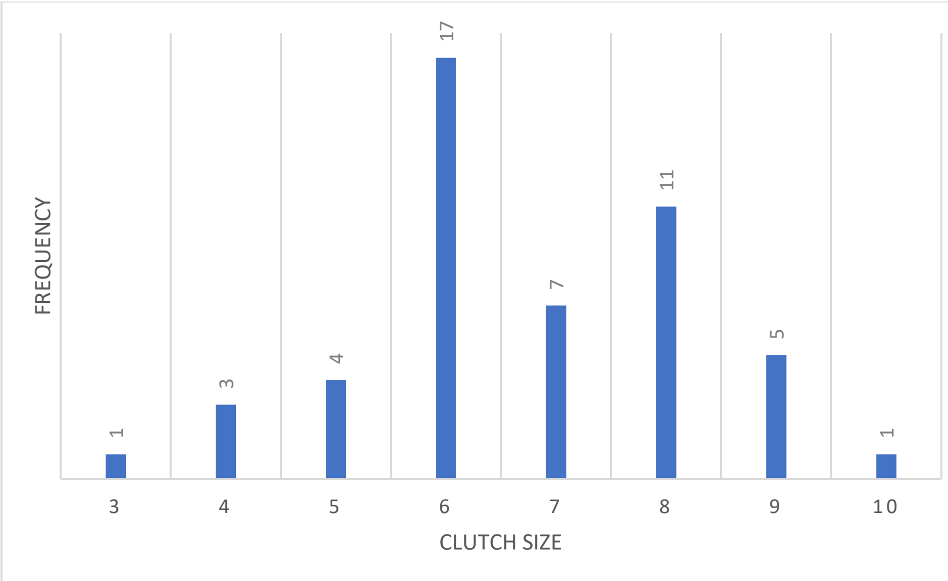

Figure 4. Frequency of each clutch size contained within the nest boxes.

Conclusion

Overall, the findings of this study suggested that clutch sizes of 10 eggs had the highest rate of fledged young. Furthermore, clutch sizes of 6 eggs were most prominent within the population. Clutch sizes of 3 and 10 eggs were the least prominent within the population. Average clutch sizes seemed to be preferred over both large and small clutch sizes, which may indicate a limitation within the environment. It was determined that the results of this study were non-significant through data analysis. To conclude, previous studies have suggested that larger clutch sizes produce more fledged young than small ones, but this has not been depicted within the new grid study as the results were non-significant (Steven, 1980).

Recommendations

To fully understand the impact of clutch size on fledgling success, all limitations on their environment must be understood. Therefore, future studies must focus on these confounding variables and their importance on Tree Swallow populations. It is recommended to study the influence of various spatial and environmental factors on the clutch size, brood size, and fledgling success of Tree Swallows in the new grid. Previous studies have suggested that changes in climate can cause birds to breed earlier, leading to increased clutch sizes (Hussell, 2003). Furthermore, future studies could compare variation in clutch sizes between dry and wet seasons. Overall, a larger sample size must be used to draw accurate conclusions about relationships between each clutch size and successfully fledged young in Tree Swallows.

Acknowledgements

I would like to thank members involved at the Beaverhill Bird Observatory for providing support and encouragement throughout the summer Internship. Furthermore, I would like to thank everyone at Beaverhill for the privilege and opportunity to be able to grow and learn in such a welcoming environment. This study was made possible through the bursary program SCiP (Serving Community Internship Program) and was carried out as part of an Internship program, provided through the Beaverhill Bird Observatory.

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