The Effect of Anthropogenic Disturbance & Predator on Tree Swallows Fledgling Success

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Abstract

Wildlife is very important to the balance of natural ecosystem, however, while human expansion rises into wildlife habitat, the original balance is being broken, and wildlife populations will be impacted significantly. Therefore, the study results of wildlife population change are well accepted as a good indicator of the environmental changes that's caused by human influences. This three-month study on tree swallows (Tachycineta bicolor) was carried out on three grids in the Beaverhill Natural Area, located near Tofield, Alberta. A total of 162 nest boxes were surveyed with the objective of determining the major environmental factors that affect the reproductive success of tree swallows in nest boxes. A Chi Square test (Analysis of Variance) was performed to compare fledgling success among three grids. It was found that by comparing three grids with different level of exposure to the human disturbance, their nestling & fledgling successful rates differed by location. The box occupancy and success fledgling rate of the road grid was the lowest of the three grids, while its predation and abandonment rate was the highest of the three grids. It was also found that there was no significant different between other two grids, spiral and new grid, on their nesting and reproducing success. The results of this report supports the hypothesis that higher human disturbance negatively impact wildlife reproducing success.

Introduction

Established in 1984, the Beaverhill Bird Observatory (BBO) is a research and education station located approximately 8 km east of Tofield, Alberta. BBO is dedicated to the long term monitoring of bird populations, migratory routes, breeding success, and their survivorship (BBO, 2019). From the data collected, researchers can analyze the changes in bird populations and study how factors such as climate and/or other environmental changes can lead to changes in bird biology and behavior.

Tree swallows are a common sight nesting in nest boxes throughout Beaver County and elsewhere. These beautiful glossy blue/green and white birds are agile and dynamic flyers, catching the areal insects that they need to feed themselves and their young. Monitoring tree swallows during the breeding season has been occurring at the BBO since its inception (BBO, 2019). These swallows are considered secondary cavity nesters and will often use artificial nest boxes, which makes them easily accessible for research purposes (Custer, 2011). Furthermore, tree swallows are recognized for their ability to tolerate a significant amount of nest disturbance without abandoning their chicks (Steven, 1980). Due to these behavioral characteristics, tree swallows are widely used in avian surveys and biological research (Winkler, 1994). In this study we will examine the reproductive results of tree swallows in three grids found throughout the Beaverhill Natural Area and provide the potential factors that influence site selections.

Methods

Tree swallows were surveyed over a three-month period in the Beaverhill Natural Area, starting the 2nd week of May and ending early August. Nest box monitoring and data collection was performed by student interns. To ensure the data was comparable between the grids, the nest boxes were all the same shape & size, and installed at a similar height (1.5m) from the ground.

There were three grids that were monitored; spiral grid, new grid and road grid. The spiral grid was located in the northwest end of the grassland in the Beaverhill Natural Area, the new grid was in the northeast end of the grassland and the road grid was located mostly along Township Road 510, paralleling farmland.

Interns were required to visit the BBO site once a week to monitor and record the data that related to the tree swallow reproductive cycle. This included; number of total boxes monitored; number of occupied boxes; number of abandoned nest; number of predation; species present that include tree swallows (TRES), house wren (HOWR) and mountain bluebird (MOBL); nest activity (inactive or active- lined, partial or full nest); clutch size and temperature (warm or cold); presence of adults (absent, remained, present- remained in vicinity, or flushed from nest); nestling number; nestling age (aged 1-12+ days; nest success, and observations of the nest box. Box number, nestling number and nestling age were shared with the BBO biologists for banding purposes throughout the data collection period.

To compare significance, each set of data gathered from the three grids was inputted into Excel to calculate the total number of boxes occupation, nest abandon, predation, eggs, nestlings and successful fledgling. Then the percentage of successful fledgling was calculated based on the number of successful fledgling and the total egg number. Finally, the data was put through a Chi Square test to compare the differences of final fledgling success.

Results

New grid had the highest occupation rate at 96%, spiral grid had similarly close rate at 94%, and however, only 69% nest boxes were occupied on the road grid. Furthermore, among the nest boxes that had been occupied by tree swallows, new grid and spiral grid had a low nest failure rate of 2-4%, while the road grid had a very high failure rate of 35% (Table 1).

Out of the 47 spiral grid nest boxes, a total of 44 boxes were occupied, which included 37 TRES, 6 HOWR, and 1 MOBL. There were 2 boxes which had been attacked by predators after nesting (Table 1). During this breeding season, there were a total of 214 TRES eggs laid, with 195 hatched and 186 successful fledglings (Table 2).

Among the 50 new grid nest boxes, 47 occupied by TRES, 1 by HOWR and 2 unoccupied. Only one nest was abandoned after nesting and zero predation was recorded (Table1). A total of 309 TRES eggs were laid, with 267 hatched and 264 successful fledgling (Table 2).

Of the 65 road grid nest boxes, 44 were occupied by TRES, 1 by MOBL and 20 unoccupied. There were 17 predations as well as 6 abandoning recorded after nesting (Table 1). There were a total of 254 TRES eggs, with 187 hatched and 125 successful fledglings in this grid (Table 2).

When comparing the nest competition, the spiral grid has 15% nest occupied by species other than TRES (HOWR 13% & MOBL 2%), while the other two grids both has a very low competition of nest occupation rate (2%) by other bird species.

Table 1

	Spiral Grid 2019		New Grid 2019		Road Grid 2019	
Description	**Counted**	**% of Total**	**Counted**	**% of Total**	**Counted**	**% of Total**
Total Box Monitored	47	100%	50	100%	65	100%
Total Box Nested	44	94%	48	96%	45	69%
Total Box Nested TRES	37	79%	47	94%	44	68%
Total Box Nested HW	6	13%	1	2%	0	0%
Total Box Nested MOBL	1	2%	0	0%	1	2%
Total Unoccupied	3	6%	2	4%	20	31%
Total Predation & Other Factor Abandoned	2	4%	1	2%	23	35%

Table 2

	Spiral Grid 2019			New Grid 2019			Road Grid 2019		
Description	**Counted**	**Average**	**% of Total**	**Counted**	**Average**	**% of Total**	**Counted**	**Average**	**% of Total**
Total Box Nested TRES	37			47			44		
Total Eggs	214	5.78	100%	309	6.57	100%	254	5.77	100%
Total Nestling	195	5.27	91%	267	5.68	86%	187	4.25	74%
Total Fledgling	186	5.03	87%	264	5.62	85%	125	2.84	49%

The new grid had the highest mean clutch size 6.57 eggs, and the other two grids had very similar mean clutch size 5.77/5.78 eggs (Table 2).

The new grid also had the highest average fledgling success of 5.62 fledglings/box, while spiral grid had 5.03 fledglings/box and only 2.84 fledglings/box were recorded for the road grid (Table 2).

The Chi-Square test shows the variances among the three grids when using a p value of >0.05, while the Chi-Square value of Spiral/New is significantly lower than the table value 3.84 (Degree of Freedom=1 and Level of significance= 0.05), Spiral/Road and New/Road are statically significantly (Table 3). The fledgling success between the spiral grid and the new grid do not differ significantly (Chi-Square=0.0.0172529, p=0.8955). The fledgling success between the road grid and the other two grids are both significantly different (spiral V.S. road grid: Chi-Square=14.8281, p=0.0001178; new V.S. road grid: Chi-Square=14.8281, p=0.000077 Table. 3).

Table 3

Fledgling Success Chi-Square Test	Spiral V.S. New Grid	Spiral V.S. Road Grid	New V.S. Road Grid
Chi-Square	0.0172529	14.8281	16.1797
Significant at P<	0.05	0.05	0.05
P	0.8955	0.0001178	0.000077

Discussion

The data analysis of the successful nesting and reproduction of three grids revealed there was significant difference between the road grid and the other two grids - spiral and new grid.

While we know road grid is exposed to much more human disturbance due to road traffic and farm activities, to better understand the factors that caused the result we need take a closer look at the data analysis results.

From Table 1, we found the human disturbance effected nest occupancy rate. The unoccupied nest box rate of road grid was 31%, which is much higher than either spiral or new grid. This result indicates the environment around the road area is less favorable for tree swallow reproduction. Some negative factors around the road grid area that could affect the tree swallow reproduction are: a. the vehicle noise pollution; b. the vehicle exhaust pollution; c. the use of farm insecticide reduced the food abundance; d. the higher predation risk from farm mouse.

Also from Table 1, we found the road grid recorded a much higher predation rate (26%) than the other two grids (4% & 0%). We highly suspected this is also a major factor that caused a much higher abandoned nest rate in the road grid (9%) after tree swallow laid eggs. At the beginning of the breeding season, we found over ten nest boxes were occupied by deer mice when they were first cleaned, while none were found in the other two grids. This suggested the predation factor would influence abandonment/fail rates.

Given the fact that the predation and abandonment rates were higher in the road grid than the other two grids, this study suggests that several components of breeding that impact on the road grid tree swallows area are as follows: The road grid nest boxes were installed on the south edge of a farm and only about 10 meters away from the country road on its other side. As deer mice are one of the major predators for tree swallows, the predator density in farm area appears to be higher than the other two grids, which could lead to a higher predation rate. When analyze further, the difference in observed mouse predation rates is also probably due to the fact that road grid had nest boxes on wooden polls which mice can climb, while the other two grids had boxes installed on metal polls, often surrounded by metal siding to reduce predation.

While the level of tree swallow reproductive rate was effected by the factors listed above needs further analysis, the predation risk was evident and appears to be a major factor causing the low reproduction levels of tree swallows in the road grid.

Conclusion

The occupation rate, nestling rate and success fledgling rate of the road grid was significantly lower than the other two grids which were isolated from human disturbance. This result supported the hypothesis that human expansion will negatively impact wildlife reproductive success, and therefore will effect their population.

We recommend to continue studying the road grid and the environmental factors that influence it including; predator species, bird species, food availability, level of farm pesticide usage, and air condition test, which would allow a better understanding on how these factors can affect the reproductive success of tree swallows.

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