ARTIFICIAL NEST BOX PLACEMENT AND ITS EFFECT ON TREE SWALLOW (*Tachycineta bicolor*) REPRODUCTIVE SUCCESS

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Introduction

The Beaverhill Bird Observatory (BBO) is located just east of Tofield, AB, in the Beaverhill Lake Natural Area. The BBO aims to improve the knowledge and appreciation of various avian species through research and public engagement. Monitoring songbird populations during breeding and migration seasons is a high priority and is accomplished by mist netting, bird banding and conducting censuses and point counts.
Since 19XX, the BBO has been monitoring tree swallow (*Tachycineta bicolor*) populations and dynamics by using a nest box program. This paper will outline some of the findings that were determined through observations made over the breeding season from May to August 2014.

Methods

There are four tree swallow grids set up around the Beaverhill Bird Observatory (BBO). For the purposes of this paper, two grids will be discussed, the road grid and the old grid. The road grid has 63 nest boxes set up on fence posts along Township Road 510, which is located outside of the natural area. These nest boxes are on the north side of the road and south-facing, with the exception of boxes 20 to 26, which are on the east side of Range Road 183 and are west-facing. The old grid has 50 nest boxes that are set up on posts in a tall grass field within the natural area. *[Direction boxes are facing].[Dimensions of nest boxes].* Each box was checked on a weekly basis starting at the beginning of May, until the last nestlings had fledged. The boxes were monitored for occupancy, number of eggs and number of nestlings. Notes were also kept regarding egg temperature, presence of adults and presence of other species. If an adult tree swallow was on the nest, it would be checked to see if it had been banded. Once the eggs had hatched, the nestlings were aged so that banding could take place at the appropriate time, which is approximately 10 to 12 days [citation]. In cases of inclement weather, nest box checks were postponed in order to minimize disturbance of the breeding pairs and their young. Once all of the nestlings had fledged, the nest boxes were completely emptied so that new nests could be built the following year.

Results

Using a two-tailed t-test, nest occupancy, clutch size, and hatchling success were compared across the two tree swallow grids. As outlined in Table 1, tree swallows occupied 77% of the 65 nest boxes on the road grid, with occupancy being defined as any development of a nest within a given nest box. As for the old grid, tree swallows occupied 92% of the 50 nest boxes, which demonstrates a significant difference in the occupancy of boxes between grids ($p < 0.05$).

In terms of average clutch size for each grid, two t-tests were completed based on different assumptions. The first t-test (Table 2) was completed specifically on the nest boxes that had eggs laid in them at some point during the breeding season. This ensures that the zeroes that represent

the nest boxes that never had any eggs in them do not skew the average clutch size per bird. Using this approach, there was no significant difference in clutch size between the road grid and the old grid ($p = 0.19$). The second t-test (Table 3), included the boxes that were either unoccupied, or did not have any eggs lain during the breeding season. This test determined the average number of eggs per box instead of looking at the reproductive strength of individual adult tree swallows. In this scenario, there was a significant difference between the two means ($p < 0.01$).

Hatchling success for each grid was determined based on the nest boxes containing eggs at some point during the breeding season. If a box was unoccupied or there was no clutch, the box was not included in the calculation. Table 4 demonstrates that there was no significant difference between grids with respect to hatchling success ($p = 0.28$).

In the road grid, mountain bluebird (*Sialia currocoides*) pairs occupied 3% of the available nest boxes, while house wren (*Troglodytes aedon*) pairs occupied 4% of the available nest boxes in the old grid.

Discussion

Of the measures analyzed in this study, the most substantial difference between the road and old grids was the level of occupancy of the nest boxes. Historically, tree swallows have been found to occupy nest boxes in open fields, maximizing their distance from wooded areas.[1] Although both grids are located in open areas, the old grid is more proximal to shrubs and trees. This suggests that nest box occupancy on the road grid may be influenced by other factors such as competition and predation.

Intraspecific and interspecific competition are both factors that influence nesting patterns of tree swallows. Male and female tree swallows are known to become territorial around nest sites, primarily early in the breeding season.[2] Male adults typically arrive to a breeding site first and will add a small amount of nesting material in a cavity in order to claim ownership. Females have been known to build more than one nest simultaneously, while only one will receive eggs.[2] These behaviors could influence patterns of occupancy depending on their rate of occurrence.

Interspecific competition is also an important component of nest occupancy. Although the occupancy of nest boxes in each grid by mountain bluebirds and house wrens was not substantial, it contributes to the competition between all breeding pairs for nesting sites and resources. On the road grid, deer mouse nests were prevalent, and quickly rebuilt after the nests were removed. Not only are deer mice competing for nest space, they were also predatory, with several adult tree swallows found dead and/or eaten in the nest box. It may also be possible that increased exposure on the road grid due to the surrounding pasture, cropland and road, may increase the effects of competition on tree swallows and their eggs and hatchlings.

The similarity in clutch size between the two grids suggests relative uniformity with respect to resource availability and the age structure of the tree swallow populations.[3] Conversely, there is a difference between grids with respect to hatchling success, which implies that there is a limiting factor on the road grid. A reasonable explanation for this difference is lower food availability on

the road grid, which could increase the search effort for food, making survival of adult tree swallows more difficult. Another explanation for decreased hatchling success is the level of predation on the road grid. Although both grids had evidence of predation within the nest boxes, the road grid seemed to have a higher frequency of deer mouse predation, which was demonstrated by the reoccurring nests throughout the season. Evidence of predation was observed in many forms, including broken or missing eggs, dead adults, eaten adults and abandoned nestlings. It should be noted that the possibility of death for adult tree swallows also greatly increases on the road due to the presence of vehicles. Abandoned eggs and nestlings were found in a number of nest boxes, which indicates that at least one adult was killed, likely through predation or being hit by a vehicle.

The notable differences between the two grids include the level of occupancy of the nest boxes and the hatchling success. Both competition and predation influence these outcomes, which elicits the need for more research in these areas. Descriptive recordings of predation on tree swallows could allow further analysis into the extent to which predation affects the reproductive success of tree swallows. Furthermore, if nest boxes are checked more frequently, the timing of incubation, nestling growth and fledging could be better understood in the Beaverhill Lake Natural Area and would provide insight into the effects of nest box placement.

Implications

Despite the difficulty in determining the contribution of artificial nest boxes in maintaining tree swallow populations, it can be assumed that the importance of these nest boxes will increase over time as the availability of natural tree cavities decreases with human development.[2] Implementing nest box programs or simply installing a few boxes at home can provide a nesting site for tree swallows during the critical breeding season.

For these programs to be successful, there are ways in which nest boxes can be placed and managed to increase their effectiveness. In addition to specific measurements, nest box placement is of critical importance. Tree swallows prefer open areas near water and a fair distance from shrubs and trees; these factors minimize competition with other avian species and provide resources for growing nestlings.[2] In comparing the two grids in this report, it can be advised that nest boxes either be placed facing away from an adjacent road, or at a reasonable distance from the road in order to reduce the deaths associated with vehicles.

Although widespread and abundant, tree swallows are dependent on specific conditions for nesting; therefore, proper management and conservation are still necessary for their long term survival. By making artificial nest sites available, it reduces the pressure on natural areas with limited resources, and reduces the competition between tree swallows and with other avian species.

1. Willner GR, Gates JE, Devlin WJ (1983) Nest box use by cavity-nesting birds. *American Midland Naturalist* 109:194-201.
2. Robertson RJ, Stutchbury, BJ, Cohen RR (1992) Tree swallow. *The Birds of North America* 11:1-28.
3. Robertson RJ, Rendell WB (1989) A comparison of the breeding ecology of a secondary cavity nesting bird, the tree swallow (*Tachycineta bicolor*), in nest boxes and natural cavities. *Canadian Journal of Zoology* 68(5):1046-1052.

Tables

Table 1. Proportion of occupied nest boxes for the road and old grids using a two-tailed t-test.

	Road Grid	Old Grid
Mean	0.77	0.92
p value	0.03	

Table 2. Results of a two-tailed t-test comparing clutch sizes in nest boxes that contained eggs during the breeding season on the road and old grids.

	Road Grid	Old Grid
Mean	5.73	6.11
p value	0.19	

Table 3. Results of a two-tailed t-test comparing clutch sizes in all nest boxes on the road and old grids, even if unoccupied.

	Road Grid	Old Grid
Mean	4.19	5.85
p value	<0.01	

Table 4. Results of a two-tailed t-test comparing hatchling success on the road and old grids.

	Road Grid	Old Grid
Mean	0.77	0.92
p value	0.03	