Potential Factors Affecting Clutch Sizes of the Tree Swallow (*Tachycineta bicolor*) Based on Location of Artificial Nest Boxes

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Introduction:

The Tree Swallow (*Tachycineta bicolor)* is an aerial foraging insectivorous species found in North America during the breeding season (Robertson et al., 1992). The main food source of Tree Swallows is various flying insects, including caddisflies, dipteran flies, wasps and butterflies. Due to their food source, habitat selection for the bird species is primarily open areas, sometimes near water where aerial insects are produced in large numbers (Robertson et al., 1992).

Tree Swallows are secondary cavity nesting birds, meaning that they are not physically capable of excavating their own tree cavities, and occasionally must compete with other species, such as House Wrens (Quinn & Holroyd, 1989).

The nests built by Tree Swallows are made with dried grass, and formed into a cup shape by the females and are lined with various feathers (Robertson et al., 1992). Once the nest is complete, the female will lay eggs, about once a day, to a clutch size of four to seven eggs (Robertson et al., 1992). The eggs are then incubated for eleven to twenty days until the young hatch. The young that hatch stay in the nest, and are ready to fledge after about fifteen to twenty-five days.

Tree Swallows readily nest in nest boxes due to the limited availability of tree cavities (Finch, 1990). Some characteristics of the cavities have effects on reproductive rate (Rendell & Robertson, 1989), such as cavity volume and height (Robertson & Rendell, 1990). Additionally, Tree Swallow nest selection is negatively influenced by the distance to forest edge (Rendell & Robertson, 1990).

Methods:

This study was conducted in the vicinity of the Beaverhill Bird Observatory, about 8 km east of Tofield, Alberta. The observatory itself is within the Beaverhill Lake Natural Area, contained within the boundaries of the Beaverhill Lake Heritage Rangeland Natural Area. Three different grids of Tree Swallow nesting boxes were checked in the summer of 2015, starting at the end of May and finishing at the end of July. Two of the grids are within the Beaverhill Natural Area and the third one is along Township Road 510. The grid along the township road is referred to as the "road grid", the first natural area grid is the "spiral grid" or "old grid" and the second natural area grid is the "new grid" or "weir grid".

In each of the grids, there are varying numbers of boxes with different spacing between each box, usually about 10 meters. Each of the boxes are mounted on either a pole or fence post and the dimensions of each box were D=15.2cm x H=27.9cm x W=13.9 cm with a 3.8cm diameter hole in the front of the box as well as a number painted on the sides. On each of the nest box grids, the holes of the boxes were mostly south facing and have a lid held on by thin wire for accessibility to the inside of the box for observations.

Once a week during the study period, each of the grids were checked by the three interns assigned to the three grids. Each box was checked and notes were made about observations, including nest construction (designated as "complete nests" or "nest cup"), number of eggs, number of hatchlings as well as other observations, such as dead young or presence of a female in the nest. After the young swallows had fledged, old nest material in the empty nests was taken out in preparation for the next breeding season.

Statistical analysis was conducted on the data from the three grids to examine potential differences between the grids due to their habitat differences. Two tailed t-tests were conducted, which did not include any unoccupied nests or other species' nest.

Results:

The first t-test compared clutch size between the weir grid and the road grid (Table 1) and showed a significant difference between means (t calc: 2.50, t crit: 1.98, P: 0.0139).The next t-test compared number of fledglings between the same two grids and showed no significant difference between means (t calc: 0.897, t crit: 1.98, P: 0.37).

The second set of t tests compared clutch size and fledgling numbers between the road grid and the spiral grid (Table 1). With the test comparing clutch sizes, there was no significant difference between means (t calc: -0.22, t crit: 1.98, P: 0.82) and for number of fledglings there was also no significant difference between means (t calc: -0.64, t crit: 1.98, P: 0.52).

For the final t tests, the weir grid was compared to the spiral grid (Table 1). The comparison between clutch sizes showed a significant difference between means (t calc: 2.46, t crit: 1.98, P: 0.0155) and the comparison between fledgling counts showed no significance between means (t calc: 0.36, t crit: 1.98, P: 0.71).

Discussion:

From the results of the statistical analysis, it can be assumed that the weir grid likely had the most successful swallows in terms of clutch sizes.

When examining the differences between the weir grid and the spiral grid, a couple factors can be considered. Past studies have shown a negative correlation with distance to forest edge in nest selection by Tree Swallows, with nest boxes furthest from the forest edge being selected first by the swallows (Rendell & Robertson, 1990). Compared to the weir grid, the spiral grid was closer to the forest edge, which may limit Tree Swallow nesting due to various factors. Studies have related this forest edge effect, with House Wren interference of nesting swallows, as they have been found to do (Quinn & Holroyd, 1989), within 20m of forest edge and increased predation within 80m (Rendell & Robertson, 1990). Considering that the spiral grid has a closer proximity to forest edge and shrubs, as well as a higher House Wren presence (10% of occupied boxes) it is a likely scenario that those two factors contribute to putting pressure on Tree Swallow nesting, which in turn is reflected in mean difference.

With the road grid, limiting factors are not as obvious compared to the spiral grid. Effectively, there is no forest edge on the road grid, with the exception of short rows of Trembling Aspen (*Populus tremuloides)* only one tree in width. In terms of interspecific competition, the only other species found in the nest boxes during the Tree Swallow nesting period were Mountain Bluebirds, which were only found in three nest boxes of the 66 total on the grid. Mountain Bluebirds compete with other cavity nesting birds (Power & Lombardo, 1996) but do not appear to do so to the extent of House Wrens (Quinn & Holroyd, 1989).

Factors influencing the mean clutch size difference in the road grid may be predation or human disturbance. In terms of predation Tree Swallows have a few predators including various birds of prey, crows as well as small mammals such as mustelid species and mice. Of the predators of the Tree Swallows on or in the vicinity of the grid, mouse predation is the most likely, as signs of mouse activity in some boxes as well as one observation of mice in a nest box were recorded on one of the road grid checks. However, in order to conclusively determine that, more observations of mouse activity would need to be recorded.

Another likely scenario affecting the mean clutch size in the road grid is parasitism, since blow flies (*Protocalliphora spp.*) have been found to parasitize Tree Swallows, particularly in oil and gas extraction affected wetlands (Gentes et al., 2007) which may indicate that disturbance may cause more susceptibility to blow fly parasitism in Tree Swallow nests.

The final factor possibly affecting the road grid is human disturbance. Although the Township road is a fairly rural area, there is still some volume of vehicle traffic on the road. Two main potential pressures on nesting birds from traffic could be from vehicles scaring birds from the vicinity of their nests or from swallows colliding with traffic. Much like the other factors on the road grid potentially affecting Tree Swallow nesting, there would need to be further studies examining human disturbance due to vehicles.

Conclusion:

In conclusion, the various factors reflected in significant mean differences in clutch sizes appear to be more than a simple issue, but one with many different parameters to examine. Although differences between the three grids can be considered, more studies would need to be conducted to specifically examine factors causing significant differences in clutch sizes.

Future Work:

Concerning the spiral grid, potential future studies could involve looking into House Wren competition with the Tree Swallows for nest boxes as well as examining the forest and vegetation edge effects on nest selection.

The Road grid also has potential for future studies, as there are possible factors affecting the mean clutch size. Some ideas to examine would be the extent of competitive pressures from the Mountain Bluebird box usage on Tree Swallow nesting, examining the possibility of blow fly larvae as well as examining road traffic effects on Tree Swallow nesting.

Finally, examining the weir grid habitat and what parameters of the habitat make the mean clutch size larger would be a potential study topic.

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Appendix:

Table 1: Summary of mean values between Tree Swallow nest box grids

Grid Name	**Mean Clutch Size**	**Mean Fledgling Numbers**
Road	5.94	5.32
Weir	6.40	5.57
Spiral	5.98	5.46