The effects of neophobia on risk-taking behavior in *Tachycineta bicolor*: a behavioural study

Erin Campbell

Introduction

Tachycineta bicolor, commonly known as Tree Swallows, are migratory birds found across North America near water or wetlands. They nest in open areas, usually in tree hollows or man-made nest boxes, and adults care for young as a pair. They are primarily insectivores, feeding on the wing, but may also forage for small crustaceans, molluscs, or other non-insect food. Because of their migratory lifestyle and broad diet, *T. bicolor* is likely to come into contact with unfamiliar animals or objects, which may impact their ability to raise or feed young, mate, or otherwise thrive (Mettke-Hofmann, C., Winkler, H., Hamel, P. B., and Greenberg, R., 2013). As human influence extends further and further into habitats like the ones used by Tree Swallows, knowledge of anthropogenic affects on behaviour becomes an important tool for developing, implementing, and advising conservation efforts. Wetlands, in particular, are areas of high risk as human development continues to increase.

Recent research has indicated that aerial insectivore populations are currently on the decline in Canada, particularly Tree Swallows, due in part to increased agriculture and pesticide use (Robillard, A., Garant, D., and Belisle, M., 2013). Decline in key species such as *T. bicolor* will likely have far-ranging affects in both upper and lower trophic levels. This study examines how neophobia affects feeding rates and nest defense in adult Tree Swallow pairs, assessing the risk-taking behaviour of adults in the presence of a novel object near their nest. In addition, it was asked whether or not brood size affected risk-taking behaviour during nest defense, with the prediction that there would be a negative correlation between brood size and latency period to nest defense by the parents. This study continues work initiated by Golondrinas de las Americas, a research collective that monitors swallow behaviour and ecology across the Western hemisphere.

Methods

The Beaverhill Bird Observatory conducted observations in the Beaverhills area outside of Tofield, Alberta. Two locations containing networks of nest boxes were sampled; one location consisted of nest boxes built onto a fence in a farmer's field, located along Rowan's Road (53°22'01.09" N, 112° 33'46.01" W), and the other location, called the East Grid, was located approximately 1-2 kilometers from the road, in a meadow (53°22'59.84" N, 112°31'17.27" W). The nest boxes in this grid were built on individual posts. Observations were conducted between May 29 and June 29, 2013.

The Tree Swallow risk-taking study protocol was adapted from J. Rivers for the Golondrinas de las Americas project, and is as follows: Tests were conducted between 0700-1200 on day 6 or 7 (hatch day = day 0) of the nestling period. Nests were monitored from a position that ensured observation did not affect the behavior of the birds (either from a hide >25 m away, from a vehicle, or from a distance >100 m). Once adults left the nest without being flushed by the observer, the nest box was approached, and the observer's hand was placed on the top of the box momentarily. This served to control for the affect of human interference on bird behaviour during observations. The observer then returned to the chosen observation position and began a 30-minute nest watch, recording the latency of the first feed, and the total number of feeding visits during the 30-minute period. Then, after the adults were observed leaving the nest and the area, a yellow toy rubber duck was placed on top of the nest box, 1" from the front edge of the roof and centered over the hole, which served as the novel object.

The second part of the trial was then started, and the number of seconds elapsed from the time the object was placed on the nest to the time it took for the first adult to return to nest box area (defined as a sphere, centered on the box with a 4 m diameter) was recorded, in addition to the number of seconds elapsed from the

arrival time to the time the first adult fully entered nest box. It was not differentiated in the collected data whether the first parent who entered the sphere was also the same one who entered the nest box first. The number of physical contacts with the rubber duck made by adults prior to entering the nest was also recorded. If neither adult entered the nest within 30 minutes of the first arrival in the nest vicinity, the trial was terminated and the rubber duck removed. Similarly, once an adult entered the nest box, the trial was ended and the rubber duck removed. This project was undertaken as part of a student internship program, and the students, who acted as the observers, were not trained to take hatchling measurements, as dictated by the original protocol. Instead, the number of hatchlings per nest box was counted to assess brood size.

Results

In total, 20 pairs of Tree Swallows were included in the study. Feeding rate during the nest watch period was measured, with an average number of 5.867 feeds per nest box over a 30-minute period. During the neophobia trial, after the rubber duck was placed on the nest box, all feeding behaviour stopped. A paired T-test was performed on the data in order to compare the amount of time it took the adult to return to the next box sphere between the nest watch and neophobia trials ($t_{(19)}$=0.257, p=0.05) between the two variables. Another paired T-test was performed to compare the time it took for the adult bird to actually enter the nest box, in both nest watch and neophobia trials ($t_{(16)}$=0.0004, p=0.05). The sample size of this T-test was slightly smaller, since three adults did not enter their nest-boxes in the 30-minute period, and thus the trials were ended and not included in this analysis.

To test whether or not there was a correlation between brood size and risk-taking behaviour during the neophobia trials, Pearson's correlation coefficient *r* was used to compare the time it took the adult to return to the nest box sphere with brood size (defined as number of live hatchlings in the nest-box). In this case, r=0.246. In

addition, the time it took the adult to enter the nest box was also compared with brood size to determine Pearson's correlation coefficient, with r=0.341.

Discussion

The results of the T-test comparing the latency period to return to the nest box sphere during the nest watch and neophobia trials were found to be statistically insignificant, indicating that the presence alone of either the observer approaching the nest, or the presence of the rubber duck on top of the nest, did not greatly affect the latency period of their first return. However, the presence of the rubber duck on the nest in the neophobia trials did impact how long it took the adult to actually enter the nest box, and was significantly extended. During this time, after the adult had entered the sphere around the nest box, the adults, often as a pair, flew around the nest box in circles, swooping low at the rubber duck and making alarm calls. These behaviours are in keeping with the prior observations of Winkler, D. W. (1992), suggesting that the Tree Swallows perceived the rubber duck as a potential threat to their nest. However, while the Tree Swallows repeatedly dived towards the rubber duck, no individuals actually made contact with it. As previously mentioned, in three trials, the adults did not enter the nest within the 30-minute period, but they did enter the nest sphere and behave in the same way as the other trials.

The reactions of the Tree Swallows to the rubber duck are consistent with other studies that have tested for neophobia. As mentioned above, this may be partly due to the ecology of Tree Swallows. The study of Mettke-Hofmann *et al.*, while focused on the neophobic behaviour of blackbirds, yielded results that are indicative of higher neophobia rates among migrant species that are generalist feeders. Indeed, the data from our Tree Swallow study supports these results. Feeding rate dropped to zero in all trials after the rubber duck was placed on top of the nest-boxes and the Tree Swallows stopped foraging completely, instead focusing on the rubber duck. The abrupt ceasing of foraging and feeding behaviour in the presence of the rubber duck during neophobia trials was expected, but deserves further discussion. These data indicate that disturbances to the nest box area directly impact hatchlings. In scenarios where disturbance occurs on a longer term, the health of hatchlings

becomes immediately at risk. Although 17 of the 20 adult pairs eventually entered their nests in the presence of the rubber duck, out of concern for the well-being of both adults and hatchlings, this study did not measure the resumption of foraging and feeding behaviour. Nest abandonment and high levels of stress on the adults were of concern, however, it would be interesting to test the difference in parental nest defense behaviour when confronted with a stationary novel object, such as the rubber duck, and a dynamic object that exhibits behaviour of its own.

Greenberg, R. (1990) found similar results when testing for neophobia in feeding activity of two sparrow species. One, a colonizing habitat generalist, showed less neophobia while feeding, and the other, a wetland habitat specialist, showed higher rates of neophobia. Although Tree Swallows are generalists when it comes to food type, they require specific habitats, often located close to wetlands. Because of this, as in Greenberg's study, they may not be exposed to novel objects as often as a habitat generalist species that could make its nest in a multitude of locations. Thus, the behavioural plasticity of Tree Swallows during a period of neophobia may not be as developed as a species that commonly encounters unfamiliar objects.

It is interesting that nest defense was typically undertaken as a pair. Although it was not directly measured, males and females appeared to coordinate with each other to defend against the rubber duck, alternately diving at it. In many cases, one parent would position themselves on a nearby perch (in the form of a post or fence) and watch the nest, while the other parent dove and circled around the rubber duck. In addition, the sex of the adult who was the first to enter the nest box during neophobia trials was concretely identified in five of the trials. In every case, it was the female who entered the nest box first in the presence of the rubber duck, but in all cases the male was also present, perched nearby watching the nest. Difference in defense behaviour should also be of particular interest, as it appeared that the pairs worked in tandem to protect hatchlings. Occasionally, even neighbouring adult pairs helped to defend nest boxes, a phenomenon that has the potential to yield a wealth of information on the sociality of Tree Swallows. However, there was not enough

data to do any analyses on these phenomena, but this is an area that is strongly recommended for future research.

Pittet, F., Coignard, M., Houdelier, C., Richard-Yris, M-A., and Lumineau, S., (2013) suggest that, in precocial bird species, maternal experience with novelty may affect the offspring's ability to deal with neophobia, and thus the offspring's ability to provide adequate maternal care to their future offspring. Although Tree Swallows are an altricial species and co-parent, unlike the species of quail used in Pittet *et al.*, in which only the mother provides care, it would be of interest to determine whether this transmission of behavioural plasticity affects altricial species in a similar way. The impacts of growing human contact on Tree Swallows may have larger ramifications on their populations and breeding success if a link can be established between the expression and transmission of parental care.

The second part of our analyses tested the connection between defensive behaviour and brood size. These data yielded a very weak positive correlation between brood size and latency periods, which was not expected. Rather, it was expected that the correlation would be a negative one, with smaller latency periods accompanying nests with more hatchlings, due to the fact that the parents had invested more energy in the survival of the brood as a whole. Research on this area is also scant, and is likely due to a number of reasons, including the fact that most species of birds have optimal clutch sizes, and naturally do not show much variation in the number of eggs laid. However, survival rate is a different matter, and this is important to consider amidst growing anthropogenic concerns. The use of pesticides, growing human presence in suitable habitat areas, and habitat reduction are all factors that have the potential to affect the survival rate of young. However, the weak positive correlation found in our data may be tentatively explained as being a result of higher stakes for the parents with smaller brood sizes, investing more energy into protecting fewer individuals from potential threats, but this requires further scrutiny and more testing before this statement can be made with any confidence.

More research on the ecology of Tree Swallows is needed in order for researchers to assess the true behavioural plasticity of this dynamic species. Although there have been studies that have considered differences between the sexes in nest defense behaviour, this study observed the adult pairs working in tandem to protect hatchlings. These social dynamics are still little understood. In addition, habituation studies have the potential to test behavioural plasticity in a longer-term scenario, which may help to elucidate the bigger picture of anthropogenic affects on this species, and aerial insectivores in general.

References

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