Habitat Characteristics Associated with Nest Site Selection and Reproductive Success of House Wrens (*Troglodytes aedon*)

A Senior Thesis

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Abstract:

Habitat characteristics influence the survival and reproduction of animal species. House Wrens (*Troglodytes aedon*) are an abundant species of songbird, are tolerant of humans, and nest readily in artificial nest boxes. We hypothesized that House Wrens would attempt more nests, raise more young, and feed their young more frequently in areas that contained more natural vegetation. Nesting boxes were placed in three habitats (100-123 boxes per year): a woodland area, a golf course, and a residential area. We quantified habitat characteristics within 15m of a nest box: % canopy cover, % shrub cover, % natural grass cover, % mowed grass cover, number of trees >10cm in diameter, and the presence or absence of blacktop, pine trees and other human structures. Between April and August 2010-2012, nesting success was monitored via checking the nest boxes at least twice a week for signs of reproductive behavior such as the formation of nests or the appearance of eggs. On the tenth day after hatching, the nestlings were banded with aluminum and colored leg bands to aid in estimates of survival. We observed that more nests were attempted in boxes without blacktop or pine trees, but with more tree trunks and human structures, such as fences. Given that a nest was successful, the number of nestlings banded increased with more vegetation, but decreased with the number of trees and with the presence of human structures. Feeding rates did not vary by habitat for four day observations. However, when the nestlings were 10 days old, the number of visits increased when more blacktop was present. Our first hypothesis was supported; house wrens attempted more nests and produced more nestlings in natural areas without blacktop and pine trees. Our second hypothesis was not supported; feeding rates for House Wrens did not vary with habitat

characteristics. This research supports the idea that human alteration of habitats may be detrimental to reproduction of songbirds. Particular care should be taken to maintain natural habitats if threatened or endangered birds are present.

Introduction:

Habitat characteristics increase or decrease the survival and reproduction of a species. By studying the natural habitat of organisms, habitats can be managed to favor the survival of a particular species. Organisms prefer to nest in habitats with “high intrinsic quality”. “High intrinsic quality” habitats are those habitats that offer plenty of food and water, shelter from predators, ample space, and any other properties that enhance the survival of a species (Muller *et al*. 1997). These “high intrinsic quality” habitats deteriorate as humans urbanize rural areas. Habitat destruction is one of the leading factors that cause populations of wild animals to decline (Veech 2006).

In order to successfully reproduce, birds must place their nests in habitats that offer both a food source and protection from predators. Habitat characteristics that may influence where a species places its nest include availability of shrubs, amount of ground cover, distance to human structures, and the number of trees surrounding the nest site. Chestnut-sided Warblers (*Steophaga pensylvanica*) and Field Sparrows (*Spizella pussila)* tend to nest in areas with ground cover, whereas the Grey-backed Thrush (*Turdus hortulorum*) tends to nest in areas that do not have a lot of ground cover (Schill and Yahner 2009, Zhou *et al.* 2011). Another habitat characteristic that also plays a role in determining nesting site is presence and abundance of shrubs. Southern Emu-Wrens (*Stipiturus malachurus*) and Grey-backed Thrush prefer to nest in areas that

contain ample amounts of shrub habitat (Maguire 2006, Zhou *et al.* 2011). Chestnut-sided Warblers prefer to nest in areas that do not contain shrubs (Schill and Yahner 2009). In addition, presence of human activity or structures may influence where a species places its nest. For example, the nests of Mariana Crows (*Corvus kubaryi*) are usually found 300m away from buildings (Ha *et al.* 2011).

Cavity-nesting species may benefit from reduced predation due to the placement of their nests within a solid cavity, but they select cavities adjacent to certain habitat characteristics. Mountain Bluebirds (*Sialia currucoides*), Eastern Bluebirds (*Sialia sialis*), Tree Swallows (*Tachycineta bicolor*), Carolina Chickadees (*Parus carolinensis*), and House Sparrows (*Passer domesticus*) prefer to nest near tall grassy areas (Munro and Rounds 1985, Pogue and Schnell 1994). Other bird species avoid grassy areas. Lewis's Woodpecker (*Melanerpes lewis)* and House Wrens (*Troglodytes aedon)* establish nests closer to trees (Newlon and Saab 2011, Parren 1991). These studies show that when multiple species are examined, different factors are important for different species, even if they have similar nest construction. This is why habitat preferences must be evaluated separately for each species.

One of the characteristics of a high quality habitat is high food abundance. High food abundance may result in higher feeding rates. Alaska Tree Swallows made more feeding visits than New York Tree Swallows, because there were more insects available in Alaska than in New York (Ardia 2007). So by evaluating the feeding rates of the same species in different habitats, researchers may indirectly measure habitat quality.

House Wrens are a good candidate species to study the effect of habitat characteristics on reproduction. They are an abundant species found in northwestern Ohio. They are tolerant of humans and use artificial nest boxes as cavities for nesting. Usually, in the absence of nesting boxes, House Wrens nest in tree cavities and they prefer to nest closer to the ground compared to higher up in the canopies (Johnson 1998). Because House Wrens nest close to the ground, it is easier for researchers to access their nests. House Wrens are also able to produce more than one brood of nestlings per breeding season allowing for adequate sample sizes (Johnson 1998).

The focus of this study was to find the impact of the habitat around a House Wren nest box on the nesting propensity and success. We erected nest boxes in various habitats with diverse vegetation to provide a range of habitats for wrens to nest. We predicted that nest boxes which have more shrubs, canopy cover, natural grass, and trees are more likely to be occupied and have higher reproductive success. We also predicted that feeding rates will be higher in areas that contain more natural vegetation.

Methods:

Study Sites:

Between 2010 -2012, 100-123 nest boxes per year were set up in three locations close to the Ohio State University - Lima Campus. One area was a wooded natural habitat on the OSU property (40-50 boxes per year; 40.743338ºN, 84.017129ºW); another area was a residential region which included a small part of the Proctor and Gamble industrial campus (37-43 boxes per year; 40.747248ºN, 84.039488ºW), and

finally, the last area was Hawthorne Hills Golf Course (40-50 boxes per year; 40.75551ºN, 84.026012ºW). The nest boxes located within the forest were placed at the edge of wooded areas adjacent to prairie grasses. Both the woods and prairie consisted of native species and non-native invasive species. There were only two boxes that were placed in the regenerating forest. The boxes in the residential region were placed next to tall trees and shrubs, and were often adjacent to man-made structures including fences, houses and railroads. Vegetation consisted of a mix of native and non-native (ornamental) species, and mowed grass. The boxes placed in the golf course were placed near native shrubs and trees. Boxes were 3-60 meters from greens, fairways, or the driving range. All boxes were placed 30m apart to prevent artificially high levels of territoriality (Muller *et al*. 1997).

Field Methods:

The nest boxes' dimensions were width 10.1cm, length 14.0cm, and depth 20.3cm. The hole was located 2.5 cm from the top of the box and was 2.9 cm in diameter. The small size of the hole prevented most other bird species from nesting in the boxes. On the front of the box, there was a white, sliding rectangular piece of wood which was used to trap adults.

All boxes were checked every 3-4 days from the end of April until the middle of August. After an accumulation of 4cm of sticks and the formation of a cup, the nest box was checked every day until the same number of eggs was present two days in a row. The hatch date for House Wren eggs is approximately twelve days after the wren has laid its final egg (Baltz and Thompson 1988). Beginning one day before the expected

hatch date, the nest box was checked every day until 50% of the nestlings had hatched (hatch day = 1). Afterwards, on every 3 day increments, the boxes were checked for survival of nestlings. When the nestlings were 6 days old, the adults were trapped in the box for banding (Drilling and Thompson 1984)**.** The adults were given a federal USGS aluminum leg band as well as a unique color combination of leg bands. This unique color combination allowed for individual identification of the wren. When the nestlings were 10 days old, the nestlings were banded using the USGS aluminum leg bands. The nestlings' mass, tarsus length, wing length, and tail length were recorded. Then, the nest was rechecked 7 days later to ensure that the nestlings had left.

Feeding Observation:

On days 4 and 10 after hatching, 30-minute feeding observations were carried out. Feeding observations were performed between sunrise and six hours after sunrise, because House Wrens were most active in the morning. The nests were monitored for 30 minutes from about 15-45 meters away using a spotting scope (20-40x80 Zeiss). Time of day and presence and identity (if possible) of adults were noted during the observation as well as the number of times the adults visited the box.

Statistical Analyses:

We determined whether differences in immediate habitat affected the reproductive success of House Wrens. Because a House Wren's territory was about 30m from one nest to another nest (Muller et al. 1997), a radius of 15m was applied around every nest box and the habitat characteristics within that area were noted. Habitat characteristics include percentage of canopy coverage, shrub, natural grass,

and mowed grass. In addition, we counted the number of tree trunks greater than 10cm and recorded if pine trees, blacktop, or human structures were present. We used the double-observer method, where independent counts or calculations were taken by two observers and averaged. To correct for correlations among variables, a principal component analysis was used to obtain a single principal score that represents variation in habitat. Variables included in the PCA included % canopy, % shrub, % natural grass, and % mowed grass. A generalized linear model fit was formed to compare how habitat affected nest site selection and nesting success. The explanatory variables were pine trees (yes/no), human structures (yes/no), blacktop (yes/no), number of tree trunks greater than 10cm, and a principal component score representing the amount of vegetation. The independent variables were the total number of nest attempts, the number of successful nests, and the total number of banded nestlings. The number of years a box was available, number of nest attempts, and number of successful nests, respectively, were used as an offset in the generalized linear model.

We tested for the effect of observer, day, start time and year on the number of visits of the adult to the nest box, and statistically significant variables were included in the final model. An analysis of variance test was run separately on the feeding data that was collected on day 4 and day 10. The dependent variables were a principal component score representing the amount of vegetation, number of tree trunks, and presence of pine trees, blacktop, or human structures. The independent variable was the number of visits.

Results:

The number of boxes occupied declined during the three years of the study (Table 1). Similarly nesting success also declined in subsequent years (Table 1). The average laying date over the three years was 7 June.

On average, nest boxes had equal proportions of canopy, shrubs, and grass. Nest boxes had 25.8 ± 20.1% canopy cover, 28.4 ±19.3% of shrub cover, 31.4 ± 26.8% of natural grass, and 28.4± 33.0% mowed grass cover. Blacktop was present at 31.5% of nest boxes, pine trees at 19.9% of nest boxes, and human structures at 45.5% of nest boxes. The average number of tree trunks was 6.13 ± 3.96.

A principal components analysis was used to obtain a single PC score that represents the amount of vegetation (eigenvectors: % canopy = 0.46, % shrub= 0.52, % natural grass = 0.45 and % mowed grass= -0.56). This PC score accounted for 68.4% of the variation in percent cover variables (eigenvalue = 2.74).

House Wrens had more nesting attempts near trees that are not pine trees, but number of offspring produced declined with more trees. Number of nesting attempts increased when no pines or blacktop were in the area, and where human structures and more tree trunks were present, but was not affected by amount of vegetation (Table 2). Number of successful nests increased when blacktop was present, but was not affected by the number of trunks, pine trees, human structures, or amount of vegetation (Table 2). Number of total nestlings banded increased when there were fewer trunks, more vegetation (PC1), and no human structures present in the area, but was not affected by the presence of pine trees or blacktop (Table 2).

The rate at which parents feed their offspring did not vary by habitat. Because observer (P = 0.08), date (P = 0.16), start time (P = 0.25), and year (P = 0.20) did not influence the number of adult visits to the nest when the nestlings were 4 days old (overall model $F_{9,153}$ = 1.58, P = 0.12), they were not included in the final model which examined the effects of habitat on visitation rate. When nestlings were four days old, the number of visits was not influenced by amount of vegetation (PC1 P=0.53), blacktop (P=0.81), number of tree trunks (P=0.53), presence of pine trees (P=0.93), or presence of human structures (P=0.84, overall $F_{5,159}$ = 0.52, P = 0.76). Because observer (P = 0.19) did not influence the number of adult visits to the nest when the nestlings were 10 days old, it was not included in the final model which examined the effects of habitat on visitation rate; however, date (P = 0.002), start time (P = 0.008), and year (P= 0.03) were significant and included in the final model (overall model $F_{9,120}$= 3.46, P = 0.0008). When nestlings were ten days old, the number of visits increased when blacktop was present (P= 0.02), but was not influenced by the amount of vegetation (PC1, P= 0.95), the number of tree trunks(P= 0.23), or the presence of pine trees (P= 0.90) or human structures (P= 0.45) after controlling for date (P = 0.01), start time (P=0.04), and year (P=0.02; overall $F_{9,120}$ = 3.74, P=0.0004) .

Discussion:

Our hypothesis was supported because House Wrens tend to attempt nesting in areas that have fewer human structures and more of a natural surrounding containing trees, shrubs, and natural grasses. Surprisingly, House Wrens tend to have more successful nests as blacktop became present. Taken together, this suggests that House

Wren reproduction is highest at an intermediate density of trees - high enough to initiate nesting, but low enough to increase the number of offspring produced.

Other research conducted on House Wrens is consistent with our results that House Wrens tend to nest closer to trees (Munro and Rounds 1985, Parren 1991, Wilner *et al.* 1983). However, the other studies did not quantify the different habitat characteristics around the nest box. Munro and Rounds (1985) classified the habitats according to forest, wooded pasture, shrub pasture, long grass, and fallow fields, and then measured the distance from the nest box to the nearest tree, as well as the distance from the nest box to the nearest road, and distance to the nearest occupied building. Parren (1991) also measured the distance to the nearest landscape feature, and measured 10 habitat variables, such as woody stems that are greater than 2cm in diameter. Despite these differences in methodology, similar conclusions can be made; namely, that House Wrens prefer nesting close to trees. Other cavity-nesting species such as Carolina Chickadees also tended to nest closer to trees (Pogue and Schnell 1994).

Some species of birds can benefit from human disturbance, while other species of birds are unable to tolerate human disturbance. The Mariana Crow tends to nest at distances greater than 300m from buildings or other human disturbances sites (Ha *et al.* 2011). Our results show that House Wrens are able to handle human disturbance; in fact there was a positive correlation between nest success and the presence of blacktop. Other studies have also shown that House Wrens can benefit from minimally disturbed habitat (Sawmiller and Augustine 2012). Another cavity-nesting species that benefits from human disturbances are House Sparrows because they tend to nest in

areas located near human habitation (Pogue and Schnell 1994, and Munro and Rounds 1985).

Our results found no relationship between the feeding rates and habitat. A previous study on House Wrens also found no correlation between feeding rates and habitat (Krohn and Augustine 2012). Another study on House Wrens found that feeding rates declined for birds in an urban setting compared to birds in a rural setting (Newhouse *et. al* 2008). Differences among these studies could be due to location, weather, or type and amount of human disturbance that affected the House Wrens.

Future studies should explore why blacktop has a positive correlation with number of successful nests. Blacktop could heat the box, which would help the nestlings survive hypothermia. Another possibility is that blacktop has a tendency to attract insects, particularly mayflies, which allow the House Wrens easier access to food (Kriska *et. al* 1998). The possible effects of the increased heat and insect attraction could be explored by placing black plastic underneath the nesting box.

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Table 1: Number and rates of House Wren nest boxes that were available, occupied, and successful in Lima, Ohio from 2010-2012.

Location: Lima, OH	2010	2011	2012
Number available	100	123	117
Percent occupied	83.0% (n = 83)	76.4% (n = 94)	67.5% (n = 79)
Percent successful	81.9% (n= 68)	37.2% (n = 35)	20.3% (n = 16)

Table 2: The effect of habitat characteristics [estimate ± standard deviation (P)] on the reproductive success of House Wrens in Lima, Ohio between 2010-2012.

Explanatory Variables	Number of Nest Attempts	Number of Successful Nests	Number of Nestlings Banded
Offset	# Years	# Nest Attempts	# Successful Nests
PC1 (Amount of Vegetation)	-0.08 ± 0.07 (0.25)	-0.16 ± 0.13 (0.21)	0.18 ± 0.052 (0.0004)
Presence of Blacktop (no)	0.18 ± 0.09 (0.046)	-0.44 ± 0.12 (0.0008)	-0.064 ± 0.052 (0.23)
Presence of pine trees (no)	0.81 ± 0.23 (0.0001)	-0.51 ± 0.33 (0.15)	-0.0016 ± 0.15 (0.99)
Presence of human structures (no)	-0.15 ± 0.07 (0.04)	-0.08 ± 0.12 (0.52)	0.091 ± 0.044 (0.034)
Number of trunks >10cm	0.04 ± 0.02 (0.03)	0.0075 ± 0.035 (0.83)	-0.024 ± 0.012 (0.046)
Overall Statistics			
Likelihood ratio χ^2	36.83	20.42	27.04
N	143	92	74
P-value	<0.0001	0.0010	<0.0001