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Nesting Success and Habitat Preference of the Barn Owl (*Tyto alba*) in Southwest Missouri

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**NESTING SUCCESS AND HABITAT PREFERENCE OF THE BARN OWL (*TYTO
ALBA*) IN SOUTHWEST MISSOURI**

A Master's Thesis

Presented to

The Graduate College of
Missouri State University

In Partial Fulfillment

Of the Requirements for the Degree
Master of Science, Biology

By

Samantha A. Meilink

December 2018

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NESTING SUCCESS AND HABITAT PREFERENCE OF THE BARN OWL (*TYTO ALBA*) IN SOUTHWEST MISSOURI

Biology

Missouri State University, December 2018

Master of Science

Samantha A. Meilink

ABSTRACT

The Barn Owl (*Tyto alba*) is a cavity-dwelling species and has been known to inhabit both natural and artificial cavities, such as nest boxes. The Barn Owl has a global distribution and can be found as far north as British Columbia and as far south as South America. They have a stable population in the United States; however, although generally stable in the United States, Missouri populations have experienced recent declines, prompting their listing as a species of special concern. In order to assist conservation efforts, land cover needs to be assessed to determine where it is best to place nest boxes. This study sought to assess nesting success and whether land cover influenced the presence or absence of Barn Owls. Nine nest boxes at 8 locations were set up in and around Bois d'Arc Conservation Area, Bois d'Arc, Missouri. The boxes were monitored from February to October 2017. Using ArcGIS and aerial images obtained from the National Agriculture Imagery Program (NAIP), I categorized the different land covers as: cropland, forest, grassland, hay, shrubland, water, urban, and barren. Though statistical analyses could not be performed due to small sample size, there were a few trends observed. Cropland was the dominant habitat category among all nest sites. Trends also suggests that Barn Owls prefer habitats with a range of 18.97-25.62% of forest, even when forest was available in a range of 9.81-49.52%. Of the 9 boxes, 4 hosted Barn Owl pairs. Clutch size varied from 5 to 8 eggs, but on average only 4 owlets fledged.

KEYWORDS: barn owl, barred owl, southwestern Missouri, nesting success, nesting biology, nest boxes, habitat preference

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In the interest of academic freedom and the principle of free speech, approval of this thesis indicates the format is acceptable and meets the academic criteria for the discipline as determined by the faculty that constitute the thesis committee. The content and views expressed in this thesis are those of the student-scholar and are not endorsed by Missouri State University, its Graduate College, or its employees.

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I dedicate this thesis to her.

TABLE OF CONTENTS

Introduction	Page 1
Methods	Page 4
Study Area	Page 4
Monitoring of the Nest Boxes	Page 4
Data Collection	Page 5
Habitat Analysis	Page 5
Results	Page 8
Nest box occupancy	Page 8
Nesting Success	Page 8
Barn Owl – Box (C)	Page 8
Barred Owl – Box (D)	Page 9
Barn Owl – Box (D)	Page 9
Box (E)	Page 10
Barn Owl – Box (F)	Page 10
Barn Owl – Box (G)	Page 10
Habitat Composition	Page 15
Discussion	Page 17
Nest box occupancy	Page 17
Nesting Success	Page 18
Habitat Preference	Page 19
Future Research	Page 20
Literature Cited	Page 22
Appendix	Page 26

LIST OF TABLES

Table 1. Egg and Fledgling Success in 2017	Page 11
Table 2. Egg and fledgling dates. Dates recorded are associated with when the first egg was laid, hatched, and fledged in 2017	Page 11
Table 3. Comparison of current study, Dickerson 2016, and Marti et al. 1979.	Page 19

LIST OF FIGURES

Figure 1. Locations of nest boxes A-I in or near Bois D’Arc Conservation Area	Page 6
Figure 2. Guide for ageing Barn Owl chicks obtained from BarnOwlTrust’s website (“Owlet identification and ageing”).	Page 7
Figure 3. Three Barred Owl chicks approximately 20 days old in Box D.	Page 12
Figure 4. Three Barn Owls at Box D. From the video, the female is brooding in the back left, the mated male in front of her, and the new individual is on the right.	Page 12
Figure 5. Video showed a Barn Owl and a Barred Owl fighting in Box E.	Page 13
Figure 6. Raccoon (A) observed inside the barn at Box G with a Barn Owl (B) positioned in front of it.	Page 14
Figure 7. Habitat composition surrounding nest boxes where Barn Owls were not present.	Page 16
Figure 8. Habitat composition surrounding nest boxes where Barn Owls were present.	Page 16

INTRODUCTION

The Barn Owl (*Tyto alba*) is the most widespread owl species and has a global distribution (Burton 1984). In the Western Hemisphere, they range from southern British Columbia, at their northern limits, to the southern tip of South America (Marti 1994). Populations of Barn Owls in America have been stable as a whole, earning the species a continental concern score of 8 out of 20, placing it in a lower concern group (Partners in Flight 2017); however, throughout much of its range in Europe, as well as on a local level in the United States, their populations have begun to decline in recent decades (Kasprzykowski and Goławski 2006, Martínez and Zuberogoitia 2004, Colvin 1985). According to Indiana, Michigan, Iowa, and Connecticut's Department of Natural Resources or Department of Energy and Environmental Protection, the Barn Owl is listed as endangered for their state ("Indiana Division of Fish and Wildlife"; "Michigan's Rare Animals"; "Iowa's Threatened and Endangered Species"; "Endangered, Threatened, and Special Concern Species in Connecticut"). The Barn Owl is also listed as threatened in Ohio and Illinois, according to their respective Department of Natural Resources ("Ohio's Listed Species"; "Checklist of Illinois Endangered and Threatened Animals and Plants"). In Missouri, New Jersey, Rhode Island, and Massachusetts, the Barn Owl is considered either vulnerable or a species of special concern ("NJ Endangered and Nongame Species Program Special Concern – Species Status Listing"; "Rhode Island Species of Greatest Conservation Need"; "List of Vertebrates: List of Endangered, Threatened, and Special Concern Vertebrate Species in Massachusetts"; "Barn Owl"). One reason to explain the population decline is the transition from traditional to intensive farming which causes a reduction of foraging habitats and nest sites (De Bruijn 1994, Taylor 1994, Roulin 2002). However, other

factors such as secondary poisoning from pesticides intended for prey items such as rodents which will bio-accumulate in predators and harsh winters may also contribute to the species' decline (Colvin 1985).

Barn Owls are capable of foraging in several types of habitat as long as prey are abundant. However, Barn Owls have a tendency to forage in open and cultivated farmland that contains linear structures such as woodland edges, hedges, banks and ditches (Andries et al. 1994, Martínez and Zuberogitia 2004, Kasprzykowski and Goławski 2006, Frey et al. 2011), and may also forage in dense grass fields and abandoned agricultural fields (Colvin 1980, 1984, 1985, Gubanyi et al. 1992). This is due to the high abundance of prey such as mice, shrews, and other small mammals that seek refuge in the tall grasses. Barn Owls will stay near these foraging areas while nesting.

Barn Owls are a cavity-dwelling species. They will use natural cavities, such as tree cavities, cliff sides, and burrows (Ottieni et al. 1972, Millsap and Millsap 1987, Gubanyi 1989). They have also been known to nest in human-made structures, such as duck blinds, barns, silos, and church steeples (Stotts 1968, Scott 1959, Soucy 1979, Colvin 1984, Parker and Castrale 1990). Barn Owls will readily use nest boxes primarily in man-made structures (Ottieni et al. 1972, Marti et al. 1979, Soucy 1980, Cook 1985, Marti and Wagner 1985). The availability of nest sites can limit the Barn Owl's population size (Lewis 2010); however, if the habitat is appropriate and prey are abundant, the erection of nest boxes may increase their population (Lewis 2010).

Barn Owls will begin nesting, in preparation of laying a clutch, between late winter and early spring, depending on the location. In the northeastern United States, the peak for egg laying occurs approximately mid-April (Colvin 1984). In tropical or subtropical areas, Barn Owls will

lay a second clutch in the late summer or fall. Some populations will also have double broods and replacement broods after a poor year. Barn Owls demonstrate an r-selected life history. Individuals reach sexual maturity at one year of age, and the average lifespan is 4 years. The average clutch size is 4-6 eggs, but as many as 18 eggs have been observed in a single clutch (Ottieni et al. 1972, Reese 1972, Smith et al. 1974). Eggs are laid 2 or 3 days apart and hatch asynchronously due to incubation beginning after the first egg is laid (Wallace 1948, Smith et al. 1974). Brooding is performed by the female with 21-24 day incubation times for individual eggs and 29-34 days for the whole clutch (Smith et al. 1974, Marshall et al. 1986). Chicks will reach adult weight and feathering in 63 to 70 days in the U.S. but will stay near the nest for another few weeks as they learn to fly and hunt (Pickwell 1948, Ottieni et al. 1972, Reese 1972, Smith et al. 1974).

The last published study mentioning Barn Owls in Missouri was in 1884 (Sampson 1884). Though a previous study was conducted in the same area in 2016, more research needs to be conducted in order to assist in conservation efforts. The erection of nest boxes has shown to help increase local populations, but habitat categories should be taken into account in order to better place nest boxes.

The objectives of this study were to (1) determine nesting success of Barn Owls in Southwest Missouri, (2) examine habitat preference of Barn Owls that inhabit nest boxes in barns or similar man-made structures, and (3) to see if there is any correlation between surrounding habitat and nesting success.

METHODS

Study Area

This study was conducted from February 3 to October 27, 2017. Nest boxes were previously erected on private farmland and property managed by the Missouri Department of Conservation (MDC; R. Dickerson, personal communication). All nest box locations were either near or in the MDC Bois D'Arc Conservation Area in the northwest part of Greene County, Missouri.

There were 8 locations and 9 owl boxes (Figure 1). One location contained two boxes (D, E) while the other 7 locations contained one nest box each. At the location, one box did not have a top (D) while the other did (E). Eight of the 9 boxes were placed in barns or similar structures with minimal human interference (B-I). One box was secured to a post approximately 3 meters off the ground outside of an unused barn with a sheet of corrugated metal on top to prevent rainwater from entering the box (A). Two of the eight locations (F, G) were owned by the Missouri Department of Conservation, and the remaining six locations were privately owned. These boxes have been in place for over a year, and Barn Owls have been known to inhabit two of the boxes (D, I) while a Great Horned Owl (*Bubo virginianus*) nested in another box (F; R. Dickerson, personal communication).

Monitoring of the Nest Boxes

Each nest box was monitored by a motion-activated game camera (Stealth Cam IR STC-G30 Game Camera). The cameras were placed to face the entrance to the box and were set to take a series of five pictures when the motion sensor was tripped. Once it was determined that

Barn Owls were present at a box, the camera was set to take a 20-30 second video when the motion sensor was tripped. Nest boxes and cameras were checked once weekly to reduce disturbance. During each visit, batteries were switched out if they were low, and images and videos were downloaded to an external hard drive.

Data Collection

Once occupancy was confirmed, weekly visual confirmation of the contents of the nest box was obtained. Photographs of the contents of the nest box were used to determine clutch size, dates associated with the first egg being laid and the first egg hatching, owlet condition, the number of owlets that fledged, and the dates of the last recorded activity of fledglings. A guide was used to assist in determining the age of fledglings of Barn Owls (Figure 2). This project was exempt from Institutional Animal Care and Use Committee (IACUC) approval, because it did not involve handling live animals and was purely observational.

Habitat Analysis

During the study, aerial images of Greene County were acquired from the National Agriculture Imagery Program (NAIP) for 2016. NAIP images from 2010 and 2014 were also used for comparison purposes if land covers were uncertain. These images were loaded into Esri's ArcMap 10.5.1. Each box location was established as a point and a 3 km² buffer was created around each point. This distance is associated with the average foraging distance of Barn Owls (Bond et al. 2004). Land cover was only analyzed within the buffer zone due to the importance of the area. Land cover was either described as forest, urban, grassland, cropland,

hay, water, barren, or shrubland. The area of all categories of land cover was determined for each buffer.



Figure 1. Locations of nest boxes A-I in or near Bois D'Arc Conservation Area.

A guide to ageing young Barn Owls

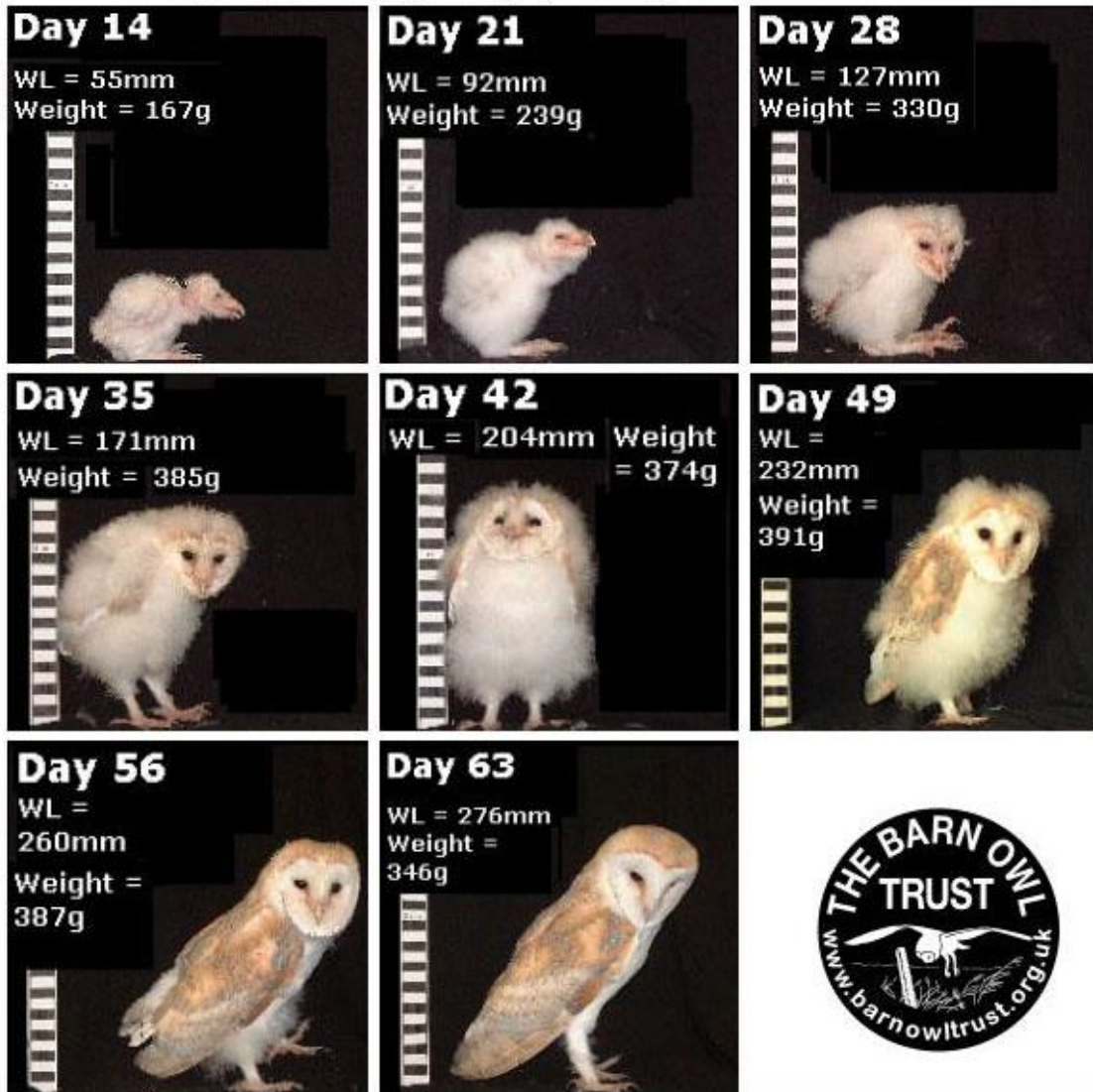


Figure 2. Guide for ageing Barn Owl chicks obtained from BarnOwlTrust's website ("Owlet identification and ageing").

RESULTS

Nest box occupancy

During the course of this nine-month study, five pairs of owls were observed nesting in the provided boxes. Barn Owl pairs were observed at four different boxes (C, D, F, G), and a Barred Owl (*Strix varia*) pair was also observed at Box D. Barn Owls were observed at another box (E); however, no nesting attempts were made. At two of the unused boxes (B, H), a domestic dog and Turkey Vulture (*Cathartes aura*) were observed, respectively, near the boxes.

Nesting Success

Each of the five pairs of Barn Owls only attempted one clutch each (Table 1). The Barred Owl laid 3 eggs and all successfully fledged (Figure 3). The Barn Owl that eventually nested in the same box as the Barred Owl (Box D) laid 5 eggs, and 4 successfully fledged. The Barn Owl in Box C laid 6 eggs, and 4 hatched and successfully fledged. The Barn Owl pair in Box F laid 7 eggs, and at least 4 of them fledged. The Barn Owl in Box G laid 8 eggs, and 4 of them fledged.

The Barn Owl eggs took an average of 36.75 days to hatch (Table 2). Once hatched, the owlets took an average of 54.5 days to fledge (Table 2). The Barred Owl eggs took approximately 33 days to hatch and 48 days to fledge (Table 2).

Barn Owl – Box (C). The Barn Owl eggs took 34 days to hatch and 57 days to fledge (Table 2). One egg went missing between May 5 and 12. The fifth egg never hatched, presumably because it was unfertilized. Four large chicks were seen June 16, and fledglings were seen flying around the barn on June 27. Three fledglings were last observed on July 14. Sixty-six percent of eggs laid successfully hatched and fledged.

Barred Owl – Box (D). The exact date of when the first egg was laid is unknown; however, the first egg hatched between March 25 and March 27. All three had hatched by March 31. Using this, it can be estimated that the first egg was laid sometime between February 20 and February 28. Fledglings began exploring the barn by April 30, and were not seen again after May 17.

Barn Owl – Box (D). The Barn Owl pair was first observed on May 22, only 5 days after the last Barred Owl was seen. An egg went missing from the nest on July 16; the egg was subsequently found broken on the floor of the barn. The first egg hatched on July 23; the next two eggs hatched by July 26. The fourth egg did not hatch until August 1. Incubation took approximately 35 days (Table 2), and it is believed that the missing egg from the nest was the fourth laid. A third individual appeared on July 10 and would make frequent visits to the box (Figure 3). It is presumed to be a hatch-year male based off its appearance and behavior. The molt limits on its legs still displayed a large amount of downy feathers. According to BarnOwlTrust’s aging guide (“Owlet identification and ageing”), the individual observed appeared to resemble a chick that is 56 days old (Figure 2). It occasionally brought along food and attempted to mate with the female. Some aggression was displayed between the new individual and the mated male. The new individual was last seen on August 7. All 4 fledglings were seen on September 23; however, one fledgling was seen as late as October 6. One fledgling was also found dead behind some equipment in the barn on October 20. The majority of the carcass was gone, leaving only the wings behind. It is possible that the youngest fledgling had been attacked by some predator. It took approximately 49 days for the owlets to fledge (Table 2). Eighty percent of the eggs laid successfully hatched and fledged.

Box (E). No owls nested in this box; however, a single Barn Owl was observed on April 4. The Barn Owl perched on top of nest box. On April 5, a Barn Owl was seen fighting with a Barred Owl inside the box (Figure 5). The video showed feathers flying, talons grasping one another, and loud screeching. After the fight, there were no other sightings of the Barn Owl.

Barn Owl – Box (F). The Barn Owl eggs took approximately 35 days to hatch and 57 days to fledge (Table 2). Five of the eggs had hatched by April 17, while 2 remained in the nest. It is presumed that the 2 remaining eggs were not fertilized and were still observed after the parents left the nest in September and on October 2. Five chicks were observed in the nest on April 28. At least 4 fledglings were observed on June 2, but a fifth fledgling could have been present. Confirmation was difficult to ascertain due to the shape of the nest box. No later sightings of the young were documented. Seventy-one percent of the eggs laid successfully hatched.

Barn Owl – Box (G). The Barn Owl pair was first observed March 20. By May 26, 5 eggs had hatched. The sixth egg hatched by June 2. The remaining 2 eggs did not hatch. Incubation took approximately 43. On May 23, a raccoon was observed inside the barn. A Barn Owl postured in front of it and began to hiss at the raccoon (Figure 6). The raccoon was not seen at a later date. One of the chicks went missing between June 2 and June 9. Another chick disappeared between June 9 and June 16, leaving only 4 chicks. Fledglings were last seen on July 21. No sightings were made after this. It took approximately 55 days for the owlets to fledge. Seventy-five percent of eggs laid successfully hatched; however, only 66.66% of those that hatched successfully fledged (Table 2).

Table 1. Egg and fledgling success in 2017.

Species (Box)	# of Eggs Laid	# of Eggs Hatched (% of eggs laid)	# of Owlets Fledged (% of hatched owls)
Barn Owl (C)	6	4 (66.67)	4 (100.00)
Barred Owl (D)	3	3 (100.00)	3 (100.00)
Barn Owl (D)	5	4 (80.00)	4 (100.00)
Barn Owl (F)	7	5 (71.43)	*4 (80.00)
Barn Owl (G)	8	6 (75.00)	4 (66.67)

*Fledgling numbers could not be accurately confirmed.

Table 2. Egg and fledgling dates. Dates recorded are for the first egg was laid, hatched, and fledged in 2017.

Species (Box)	Date Eggs Laid	Date Eggs Hatched	Date Owlets Fledged
Barn Owl (C)	April 14	May 18	July 14
Barred Owl (D)	*February 20	March 25	May 12
Barn Owl (D)	June 18	July 23	September 10
Barn Owl (F)	*March 2	April 6	June 2
Barn Owl (G)	April 5	May 18	July 12

*Dates are estimated within one week.



Figure 3. Three Barred Owls chicks approximately 20 days old in Box D.



Figure 4. Three Barn Owls at Box D. From the video, the female is brooding in the back left, the mated male in front of her, and the new individual is on the right.



Figure 5. Video showed a Barn Owl and a Barred Owl fighting in Box E.



Figure 6. Raccoon (A) observed inside the barn at Box G with a Barn Owl (B) positioned in front of it.

Habitat Composition

Habitat preferences could not be statistically determined due to the small sample size of this study, however some trends were observed. Box D and E were at the same location and subsequently share the same data.

At boxes where Barn Owls were not present, grassland ranged from 27.03% to 39.92% of the buffer zone (Figure 7; see Appendix). Amongst these sites where Barn Owls were not present, forest ranged from 7.82% to 9.81% as well as 42.68% to 49.52% of the buffer zone. Cropland at these sites ranged from 1.14% to 3.12% and 14.19% to 19.78%. At the sites where Barn Owls were not present, hay ranged from 5.50% to 9.62% and 37.17% to 39.28% of the buffer zone. Barren ranged from 0.00% to 1.25%, while water ranged from 0.11% to 0.26%. Amongst these sites where Barn Owls were not present, shrubland ranged from 1.01% to 7.26%. Urban ranged from 1.22% to 2.28%.

At boxes where Barn Owls were present, grassland ranged from 37.81% to 46.77% of the buffer zone (Figure 8; see Appendix). Amongst these sites where Barn Owls were present, forest ranged from 18.97% to 25.62% of the buffer zone. Cropland at these sites ranged from 9.39% to 19.93%. At the sites where Barn Owls were present, hay ranged from 2.90% to 8.92% and 12.49% to 28.93% of the buffer zone. Barren ranged from 0.00% to 0.22%, while water ranged from 0.25% to 0.54%. Amongst these sites where Barn Owls were present, shrubland ranged from 0.00% to 8.08%. Urban ranged from 1.16% to 2.39%.

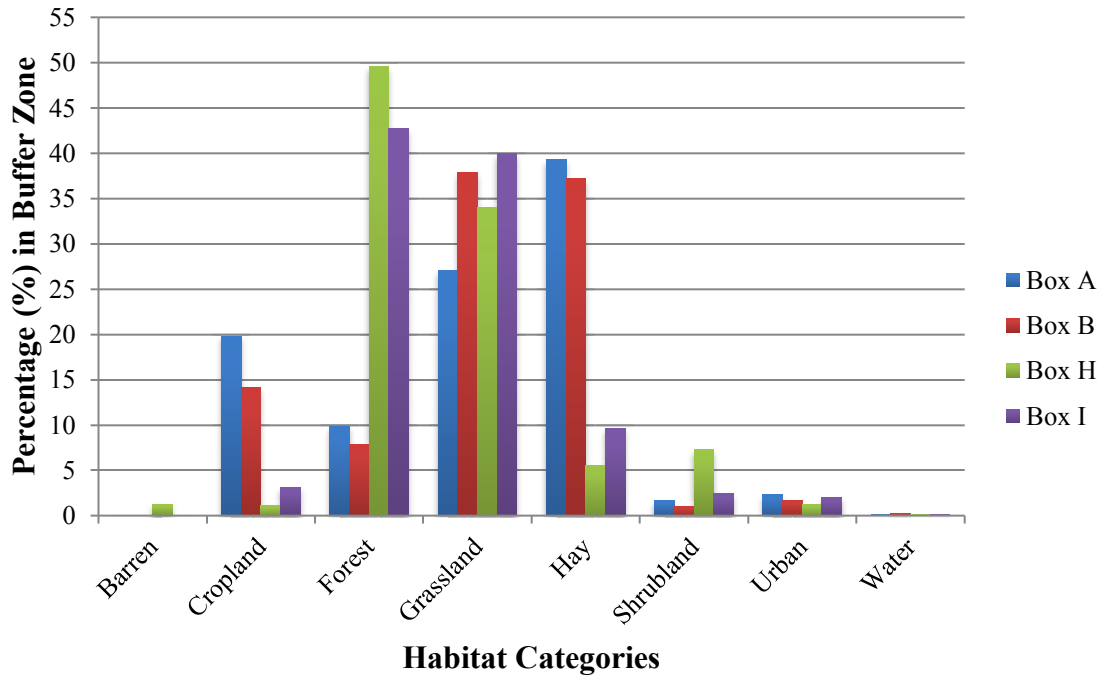


Figure 7. Habitat composition surrounding nest boxes where Barn Owls were not present.

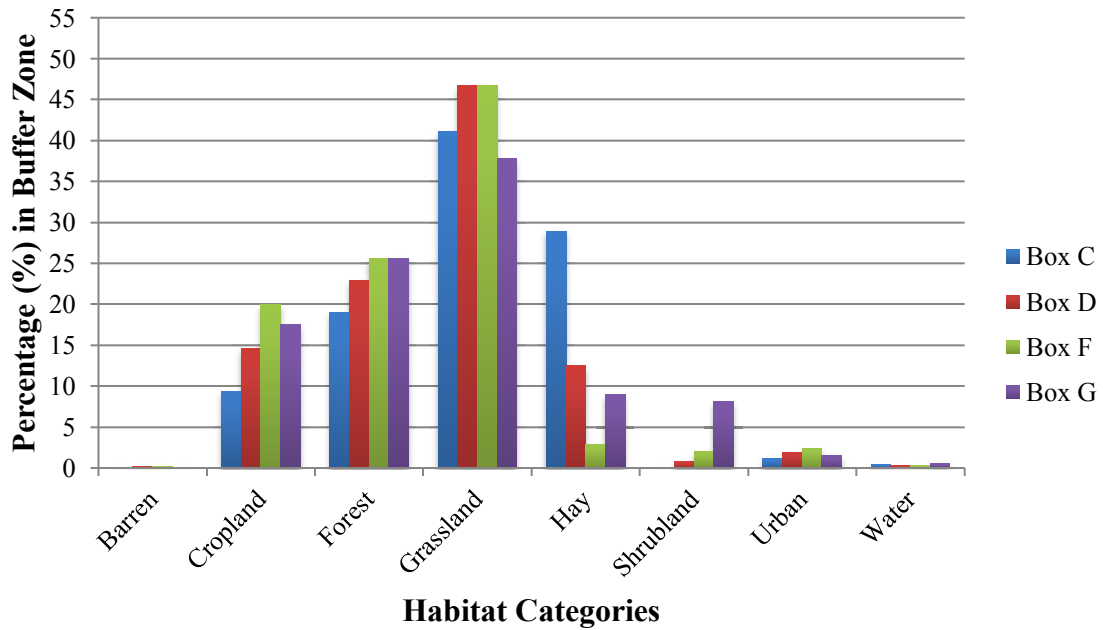


Figure 8. Habitat composition surrounding nest boxes where Barn Owls were present.

DISCUSSION

The Barn Owl is considered a species of conservation concern in Missouri, as well as a number of other states, even though nationally the species is considered to be of least concern. Nest site availability and habitat type may be a significant limiting factor on the abundance of Barn Owls in southwest Missouri. This study provides an initial analysis on the use of nest boxes with different surrounding habitats.

Nest box occupancy

Nest box occupancy was 44% in this study, an increase from the previous summer (Table 3; 30%; Dickerson, personal communication). Occupancy in this study was still considerably lower than that of other studies in other regions (Table 3; Marti et al. 1979). During the second year of their study, Marti et al. (1979) had 30 nest boxes available, and had a much greater occupancy (80%). The presence of potential predators or competitors, such as domestic dogs and vultures, at sites B and H, respectively, may influence the presence of Barn Owls; however, a raccoon was observed at an occupied box (G), where a Barn Owl remained. Barred Owls do not appear to deter Barn Owls from nesting. My weekly visits and presence of the landowners did not appear to influence Barn Owl presence in nest boxes probably because the owls were familiar or accustomed to some level of human activity and live routinely in buildings throughout their range.

Nesting Success

Seventy-three percent of eggs laid successfully hatched. In the previous summer, all eggs that were laid hatched (Dickerson, personal communication). Of those that did hatch in 2017, 84% of them successfully fledged with only 3 mortalities. This hatching and fledgling rate is lower than what was observed in the previous summer (Table 3; 85%; Dickerson, personal communication) and in other studies (Table 3; 92%; Marti et al. 1979).

In Box D, the new individual, that visited the box, appeared to be a hatch-year male that had not fully fledged yet. It is possible that he was either curious or exploring, or was looking for a mate. Presuming the individual was roughly 56 days old, it is possible that he came from either Box C or Box G based off hatching dates. However according to Marti (1999), natal dispersal of Barn Owls can range from 0 to 1267 km, with an average distance of 102.9 km, so it is possible that the hatch-year male could have come from outside the study area.

Even though clutch size ranged from 5 to 8 amongst the four Barn Owl clutches, only 4 chicks fledged from each pair. In 2016, 5 chicks fledged from each Barn Owl pair. The uniform amount of fledglings produced by each pair may be indicative of the fitness of the pair or the quality and abundance of prey available. A parallel study should be conducted to examine prey availability and population size to determine if prey abundance and availability influences the amount of eggs that hatch and subsequently fledge.

Table 3. Comparison of current study, Dickerson 2016, and Marti et al. 1979.

Factors	Meilink 2017	Dickerson 2016	Marti et al. 1979
# of Available Nest Boxes	9	10	30
Occupancy (%)	44	20	80
Total # of Eggs Laid	26	12	166*
Eggs Hatched (%)	73.1	100	80.7
Chicks Fledged (%)	84.2	83.3	92.5

*Exact number was not provided in study; number was calculated.

Habitat Preference

Box sites that had less than 18% and more than 26% of the buffer zone comprised of forest habitat did not have any Barn Owl pairs. According to Marti et al. (2005), Barn Owls are not found in dense forested areas. This may be due to the foraging strategies of Barn Owls who search for prey in cultivated farmland, abandoned agricultural fields, or dense grass fields (Marti et al. 1979, Colvin 1980, 1984, 1985, Gubanyi et al. 1992, Marti 2005) and possibly due to the difficulty of maneuvering through dense trees. This may also explain the predominance of grassland in each buffer zone (Marti et al. 1979). Another trend may suggest that more than 9% of cropland is preferable, but it would appear that cropland is a secondary choice after forest and grassland (Marti et al. 1979).

Another factor that may have influenced nest site preferences is the variance in the structure of the nest box site. The four sites, where Barn Owls were present, had structures that allowed the nest box to be higher off the ground, presumably to avoid most non-avian predators, and the barns were considerably closed off from outside elements, i.e., two to four complete

walls. One of the four locations where Barn Owls were present (Box C), the structure had two sides completely open, while the other three locations had four walls.

Another possible consideration could be the structure of the nest box itself. Eight of the 9 available nest boxes were similar in construction. These boxes (Box A-C, E-I) were completely sealed off except for a small opening on one side to allow for Barn Owls to enter and exit the box. The ninth box (Box D) was constructed differently. The box was roughly half the height of the other 8 boxes, and did not have a roof. At one location, these 2 different types of nest boxes were available. Barn Owl pairs nested at Box D in 2017 as well as in 2016 (Dickerson, personal communication). Barn Owls were spotted at Box E in 2017, but none attempted to nest in it. Many studies indicate that Barn Owls readily use and inhabit nest boxes (Ottieni et al. 1972, Marti et al. 1979, Soucy 1980, Cook 1985, Marti and Wagner 1985); however, there is little about preference between varying designs in nest boxes, since previous studies used only one design for their nest boxes. It is possible, if given a structure such as a barn that would protect the owls from the elements, then they would prefer a box with easier access and one that was not as confining.

Future Research

Even though this study had access to 2 years of data, a longer study would be more representative of the Barn Owl population in Southwest Missouri, and would provide a larger database on nesting success. In future studies, banding young Barn Owls would provide information on survivorship and possibly natal dispersal. Further studies with larger sample sizes are necessary to properly look at habitat preferences and to determine whether nesting locations in this study were due to habitat preferences or structural preferences. In future studies, offering

both open-top and closed-top nest boxes at every available location may determine which box is preferred and should be used in conservation efforts. This study might serve as a preliminary tool to gauge possible nest site locations to assist in the conservation and management of Barn Owls.

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APPENDIX

Box	Barren %	Cropland %	Forest %	Grassland %	Hay %	Shrubland %	Urban %	Water %
A	0.00	19.78	9.81	27.03	39.28	1.70	2.28	0.12
B	0.00	14.19	7.82	37.86	37.17	1.01	1.69	0.26
C*	0.00	9.39	18.97	41.14	28.93	0.00	1.16	0.42
D*	0.22	14.61	22.95	46.77	12.49	0.78	1.91	0.25
E	0.22	14.76	22.89	46.70	12.49	0.78	1.89	0.28
F*	0.22	19.93	25.59	46.71	2.90	1.98	2.39	0.27
G*	0.00	17.55	25.62	37.81	8.92	8.08	1.48	0.54
H	1.25	1.14	49.52	33.99	5.50	7.26	1.22	0.11
I	0.00	3.12	42.68	39.92	9.62	2.46	2.03	0.17