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Nesting Success Of The Barn Owl (*Tyto Alba*) Using Nest Boxes In Southwest Missouri

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**NESTING SUCCESS OF THE BARN OWL (*TYTO ALBA*) USING NEST BOXES
IN SOUTHWEST MISSOURI**

A Masters Thesis

Presented to

The Graduate College of

Missouri State University

In Partial Fulfillment

Of the Requirements for the Degree

Master of Science, Biology

By

Robert Grant Dickerson

September 2017

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NESTING SUCCESS OF THE BARN OWL (*TYTO ALBA*) USING NEST BOXES IN SOUTHWEST MISSOURI

Biology

Missouri State University, May 2017

Master of Science

Robert Grant Dickerson

ABSTRACT

The Barn Owl (*Tyto alba*) is a medium-sized owl belonging to the family Tytonidae. They raise young within natural cavities and on hard surfaces including nest boxes. The nesting success of Barn Owls, using wooden nest boxes, was studied in southwestern Missouri in 2016. Data were collected on clutch and brood sizes, the numbers of young fledged, and the species and amount of prey found in their regurgitated pellets. Interaction between Barn Owls and Great Horned Owls (*Bubo virginianus*) was also observed and documented. Nest box occupancy was 30% which is lower than in other studies, however this study included a relatively low sample size. Eggs laid in the Barn Owl boxes were mostly successful, with only two hatchlings not surviving long enough to fledge. Prey types were similar across both species of owl. Non-occupied nest boxes may be a result of a low population in southwest Missouri, unsuitable habitat surrounding the nest box, or because of poor nest box placement.

KEYWORDS: barn owl, great horned owl, southwestern Missouri, nesting biology, nesting success, nest boxes, pellets

This abstract is approved as to form and content

Dr. Janice Greene
Chairperson, Advisory Committee
Missouri State University

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Approved:

Dr. Janice Greene

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INTRODUCTION

The Barn Owl (*Tyto alba*) is a cavity nester and is the only U.S. species belonging to the Family Tytonidae, one of the two families of owls. The species is easily identified by its heart-shaped facial disc and lack of a typical owl “hoot”. They instead use a series of hisses and shrieks. Most North American Barn Owls have brownish-red backs and pale white undersides. The female will have more speckled patterning on her belly while the male’s underside remains a dull white. They are a medium-sized owl, about 33-42 cm in length and weighing an average of 470 g (Ramsden 2015). They can be distinguished in flight from other owls by their squared-off tail as well as their feathered, dangling legs (Bruce 1999).

Habitat

Virtually any habitat where small mammals can be caught may be used as foraging habitat. Pastoral, mixed, and arable farmland including agricultural, equestrian, and horticultural land are routinely used by this species as home range habitat which is typically within 1,500 m of a nest site (Hegdal and Blaskiewicz 1984; Marti 1992; Taylor 1994). It is estimated, however, that mixed landscapes need to be between 1.4 and 2.0% of the total land area in order for it to be a suitable Barn Owl habitat (Askew 2006). Nest sites are often on farmland inside of barns, usually on top of stacks of hay, as well as in caves, tree hollows, and embankment burrows.

There has always been a close association of Barn Owls with humans, often roosting and nesting on farmsteads (Culvin 1985) and routinely utilizing human

dominated landscapes (Bunn et al., 1982). However, areas in which land is intensely grazed by livestock usually keeps the grass too short for many prey species, leaving few opportunities for Barn Owls to hunt successfully (Barn Owl Trust 2012).

Range

Barn Owls are the most widely distributed species of owl. Their range spans the width of the United States and continues south all the way throughout South America, as well as parts of Asia, Europe and Australia including remote places such as the Galapagos Islands (Figure 1). Missouri lies on the northern portion of their range (Figure 1). Northern habitation is limited mostly by a combination of cold temperatures and snowfall that makes finding food difficult and increases the amount of food needed (Marti, 1994).

Nesting

Barn Owls will not build nests in the traditional sense but instead will nest in natural cavities or man-made structures (Marti et al., 1979) often laying eggs directly on older owl pellets or hard surfaces. Barn Owls have been seen nesting and rearing young year round, with the peak being in spring and summer (Walk et al., 1999). They have a short life span, living on average less than two years (Stewart 1997), and a high reproductive output, averaging 4-7 eggs per clutch (Taylor 1994). Most Barn Owls begin nesting at one year of age and produce one brood per year (Bunn and Warburton 1977) while some often produce two and sometimes more broods per year (Lenton 1984). However, post-fledging survival in second clutches, towards the northern limit of their

range, is low because the fledglings have little time to perfect hunting skills before winter arrives (Marti 1994). Harsh winter weather limits the geographic distribution of the species. Long-term studies in climactically different parts of the species' range are needed to understand their overall reproductive pattern (Marti 1994).

Most owls are considered to be monogamous with both sexes providing crucial parental care. Barn Owls, however, have been observed using polygyny, where the females will nest in separate sites and occasionally even the same site (Marti 1990). Incubation takes place for four to five weeks, and eggs hatch every two to three days (Durant et al., 2004).

Nest site availability can be a limiting factor; populations have been shown to increase with the erection of nest boxes (Lewis 2009). Many nest boxes may go unoccupied; however, this may be due to being poorly targeted and poorly sited (Cayford 1992). Building and placing nest boxes in suitable areas of appropriate habitat can help prevent the negative effects of site loss (Barn Owl Trust 2012).

Status

While not globally threatened, Barn Owls are present in low numbers in certain areas as well as listed as a species of special concern (<http://www.state.nj.us>) or even endangered in certain states like Connecticut (<http://www.ct.gov>). Fall plowing, winter temperatures, nest site loss, and secondary poisoning from pesticides are all contributing factors to Barn Owl decline (Colvin 1985). The Missouri Department of Conservation has Barn Owls listed as “a species of concern, where populations are vulnerable” (Barn Owl | MDC Discover Nature). In 2015, 118 occurrences of Barn Owl nests were

documented in Missouri (R Rimer personal communication; Figure 2). Eighteen nests were observed in southwest Missouri according to nesting data that were provided by the Missouri Department of Conservation for the distribution of nests throughout southwest Missouri (Table 1). These nests spanned 7 counties and 4,465 square miles.

There have been little to no published studies pertaining to the reproductive success of the Barn Owl in southern Missouri; in fact one of the last papers to mention Missouri Barn Owls, specifically, was in 1884 (Sampson 1884). However, papers have been published on the reproductive behaviors of Barn Owls in other areas and on how Barn Owl boxes are a suitable method for studying these behaviors and managing Barn Owl populations (Marti et al., 1979). Nest boxes for Barn Owls can be used as a means to study nesting success in places where other nest sites are unavailable but prey are abundant.

This study was performed to ascertain information on the current population of Barn Owls in southwest Missouri.

Table 1. Nest sites monitored in southwest Missouri by the Missouri Department of Conservation.

County	Date Last Monitored	Activity Observed ¹
Barry	July 15, 2016	2 adults and 6 owlets
Barry	July 15, 2016	2 adults
Dade	June 2, 2015	2 adults and 7 owlets
Dade	June 2, 2015	1 adult and 1 egg
Greene	July 12, 2012	2 adults and 3 owlets
Greene	July 12, 2012	1 adult and 3 owlets
Jasper	June 2, 2015	1 adults
Lawrence	April 14, 2014	3 owlets
Lawrence	August 4, 2014	2 adults, 2 owlets
Lawrence	March 15, 2015	2 adults
Lawrence	June 2, 2015	2 adults, 7 owlets
Lawrence	June 2, 2015	1 adults
Lawrence	April 20, 2016	2 adults, 1 owlet
Lawrence	July 15, 2016	2 adults, 4 owlets
Lawrence	July 15, 2016	2 adults, 1 owlet
Lawrence	July 19, 2016	2 adults, 3 eggs, 3 owlets
Polk	October 29, 2015	2 adults, 2 owlet
Webster	January 6, 2015	1 owlet

¹: Most nests were only observed once.



Figure 1. Barn Owl distribution across Northern and Central America (www.birdsna.org).

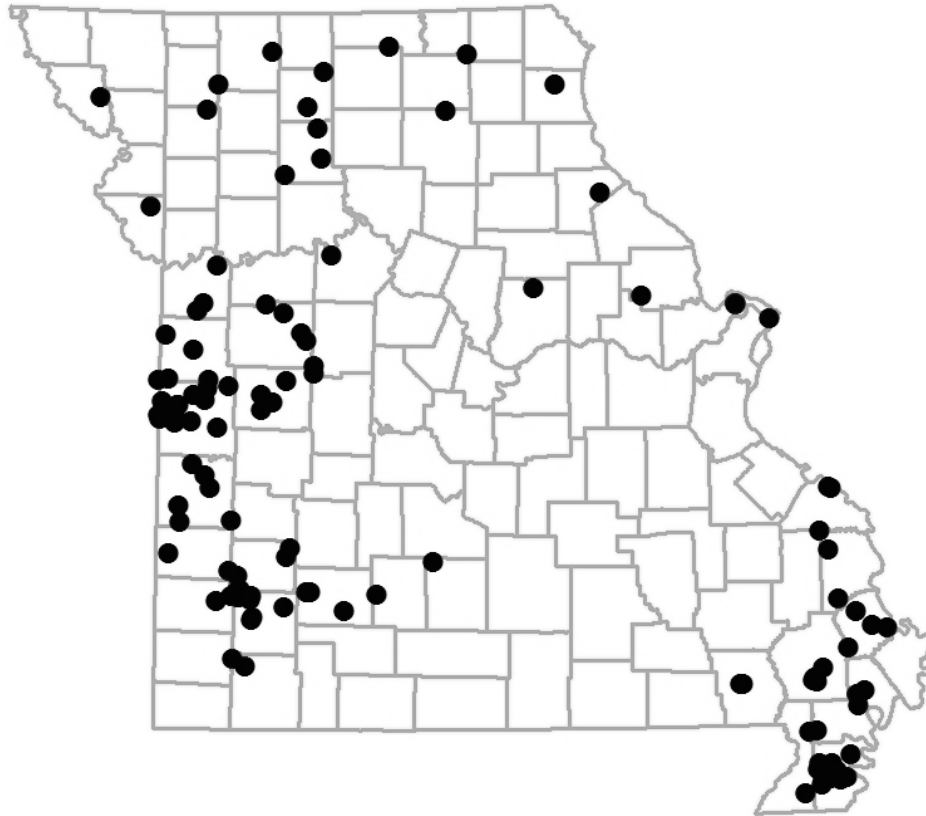


Figure 2. Barn Owl nest distribution in 2015 observed by the Missouri Department of Conservation (Missouri Dept. of Conservation Occurrence Data – Personal Communication).

METHODS

Study Sites

I conducted this study from February to September 2016. Boxes were placed on farmland and conservation land in the vicinity of Bois D'Arc, Missouri, a small rural town in the northwest part of Greene County, Missouri. Habitat surrounding the nest boxes included mowed and grazed farmland, wooded patches, as well as equestrian land. Permission was given by all private land owners as well as the Missouri Department of Conservation (MDC).

Nest boxes were built using Barn Owl box plans and were constructed by the Missouri Department of Conservation. Boxes measured 48 cm x 56 cm x 56 cm with an opening that measured 25 cm x 25 cm. Eight boxes were placed in Greene County, Missouri, in February 2016 (Figures 3-6). Five (boxes A-E) were placed in barns that were currently being used by private land owners, box (E) was placed in the second story of a haymow (the loft where hay is stored) that was only accessible to humans by a narrow stairwell and accessible to the Barn Owls by way of the haymow window. Box (F) was placed 10 feet up on a large wooden pole outside of an unused barn and a sheet of corrugated metal was attached to the roof to keep rain water from entering, and two (G-H) were placed in open-sided hay storage buildings. There are two boxes (I-J) previously established by MDC, one in an abandoned barn on government property (I), and one (J) which was located inside a two-story barn that was being used as storage for the land owner who was actively making repairs and improvements to it. All boxes were placed at a minimum of 10 feet above floor level.

Field Observations

Motion-activated game cameras (Stealth Cam G30 Triad Armed Trail Camera) were set facing the opening of the boxes and set to record 5 images whenever motion was detected. Once owls were seen on the recorded images, the camera settings were switched to record a 30-second video when triggered. Cameras were checked only once weekly so as to not disturb nesting owls and to determine occupancy. During each visit to the boxes, low batteries (AA) were replaced, and images and video were downloaded to a laptop hard drive.

Once occupancy was established, I performed weekly visual confirmations and took photographs inside the boxes to monitor clutch size and egg hatching dates, as well as owlet condition and fledging dates. Because this study was purely observational and did not involve handling of live animals, the project was considered by the Institutional Animal Care and Use Committee (IACUC) to be exempt of the need of prior approval.

Owls regurgitate the bones of their prey. These regurgitated pellets were collected throughout the barns, where available, to determine prey type and abundance. The skulls and dental structure within the pellets were identified through comparison with museum specimens. Broken skulls, within the pellets, that only contained the brain case were unidentifiable and thus not included in the data.



Figure 3. Locations for boxes A, D, G, I, and J.



Figure 4. Locations for boxes B and F.



Figure 5. Location for box C.



Figure 6. Location for boxes E and H.

RESULTS

Occupancy

Over the seven months of this study, three pairs of nesting owls were observed; two pairs of Barn Owls in boxes (J) and (E) respectively and one pair of Great Horned Owls (*Bubo virginianus*) in box (I). A Barred Owl (*Strix varia*) was also observed in box (J) before the barn owl started nesting in it, however no attempt to nest was made by the Barred Owl.

All three nesting pairs of owls attempted one clutch each (Table 2). The Great Horned Owl laid two eggs, and both successfully fledged. The Barn Owl in box (J) laid 5 eggs, and all 5 successfully fledged. The Barn Owl in box (E) laid 7 and fledged only 5. One egg failed to hatch, while one owlet looked to be extremely weak and much smaller than its siblings until during one visit it was no longer found in the nest box. This is assumed to be siblicide due to no carcass being found, and it was too young to fledge at that time.

Nesting Dates

The Barn Owl eggs took 34 days (box E) and 35 days (box J) to hatch (Table 3). After hatching, the owlets in box (E) took 51 days to fledge, and in box (J) they took 60 days to fledge. The Great Horned eggs in box (I) took 35 days to hatch and 44 days to fledge.

Great Horned Owl – Box (I)

The Great Horned Owl laid two eggs and both successfully fledged (Table 3) (Figure 7). The owlets were seen in their nest-barn for 7 days after first leaving their nest box but not again after that. They were never seen on the floor of the barn but always up in the barn's rafters and siding.

Barn Owl – Box (E)

Two adult Barn Owls were seen tending to the 7, and subsequently, 5 owlets throughout the nesting cycle in this box. The Barn Owlets were seen inside of the barn 14 days after leaving the box for the first time but weren't seen leaving the actual barn till 21 days after first leaving the nest box.

After first viewing the Barn Owls leaving the barn, subsequent weekly visits revealed they were still roosting in the barn. The final three weekly visits (June 30th, July 7th, and July 14th) revealed no sightings or recordings of any Barn Owl activity and was therefore assumed to be unoccupied.

Barn Owl – Box (J)

This box was placed by the Missouri Department of Conservation 9 years ago. It is the only box in this study that did not have a top on it, and it was evident that it had been used several times by previous Barn Owl pairs to rear young by the amount of broken down pellets, bones, feathers, and fecal matter inside the box, totaling at least $\frac{3}{4}$ of the boxes total volume.

The fledged Barn Owls were seen inside the barn for 14 days after first leaving the box and were seen leaving the barn after 7 days after first leaving the box. On August 22nd, no Barn Owls were seen inside the barn. The next two weekly visits revealed no Barn Owl occupancy or visitation.

Barn Owl/Great Horned Owl Interaction

On February 22, 29, March 1 and 3, a lone Barn Owl was seen sitting on top of the Great Horned Owl nest box. On March 6 and again on March 11, a pair of Barn Owls was seen mating on top of the Great Horned Owl nest box while the Great Horned Owl sat inside with its two eggs. On March 10, I recorded video of a barn owl holding a small mammal in its beak on top of the nest box while the Great Horned Owl was inside. Later on March 14 and 15, I observed a Barn Owl inside the nest box sitting on the Great Horned Owls eggs or on the chicks (it is unclear from the video if the eggs had hatched yet).

When I arrived on March 16, the chicks had hatched and appeared to be several days old, which leaves me to believe that the Barn Owl was inside of the box with the live Great Horned Owlets the day before. On March 15, the Barn Owl was able to fight the Great Horned Owl off the nest box and retain occupancy of it until the Barn Owl left later that evening. On March 20, a second Great Horned Owl, presumably the male, was seen standing on top of the nest box while another resided inside of it. The Barn Owl did not return for the duration of the nesting cycle.

Pellets

Pellets were collected between the three nest sites. In total, there were 8 prey species (Table 4) identified through skull and dental structure from the regurgitated pellets that were collected from 17 February 2016 to 15 June 2016. There were five species in the Cricetidae family, two in the Soricidae family, and one in the Muridae family. Prey species were counted as a percentage of total prey found in pellets at each species nest site (Table 5). Pellets were also collected from a fourth location, but that owl was never observed by me or any of the cameras, and so that data are not included in this report.

Table 2. Egg and fledgling success. 2016.

Species (box)	# of Eggs Laid	# of Eggs Hatched	# of Owlets Fledged
Great Horned Owl (I)	2	2	2
Barn Owl (E)	7	6	5
Barn Owl (J)	5	5	5

Table 3. Egg and fledgling dates. Dates defined by the day the first egg is laid, hatched, and fledged. 2016.

Species (Box)	Date Eggs Laid	Date Eggs Hatched	Date Fledged
Barn Owl (E)	April 1	May 4	June 23
Barn Owl (J)	May 4	June 7	August 5
Great Horned Owl (I)	February 10	March 15	April 27

Table 4. Types of prey found inside regurgitated owl pellets.

Family	Species	Common name
Cricetidae	<i>Reithrodontomys megalotis</i>	Western Harvest Mouse
	<i>Sigmodon hispidus</i>	Hispid Cotton Rat
	<i>Microtus ochrogaster</i>	Prairie Vole
	<i>Microtus pinetorum</i>	Woodland Vole
	<i>Synaptomys cooperi</i>	Southern Bog Lemming
Muridae	<i>Mus musculus</i>	House Mouse
Soricidae	<i>Blarina brevicauda</i>	Short-tailed Shrew
	<i>Cryptotis parva</i>	Least Shrew

Table 5. Number of each prey species found in pellets at each species' nest site(s).

Species	Barn Owl Nests	Great Horned Owl Nest
	(% of total)	(% of total)
<i>Reithrodontomys megalotis</i>	4 (6.1)	3 (4.1)
<i>Sigmodon hispidus</i>	4 (6.1)	6 (8.2)
<i>Microtus ochrogaster</i>	33 (50.7)	43 (58.9)
<i>Microtus pinetorum</i>	14 (21.5)	5 (6.8)
<i>Synaptomys cooperi</i>	3 (4.6)	11 (15.0)
<i>Mus musculus</i>	1 (1.5)	1 (1.3)
<i>Blarina brevicauda</i>	3 (4.6)	1 (1.3)
<i>Cryptotis parva</i>	3 (4.6)	3 (4.1)
Total	65	73



Figure 7: A young Great Horned Owl (~1 month old) in box (I).



Figure 8. Two Barn Owls mate on top of box (I) while a Great Horned Owl is inside.



Figure 9. A Barn Owl inside box (I) defends the box against a Great Horned Owl. During this picture there were two Great Horned Owl chicks in the box. Both chicks were unharmed.

DISCUSSION

The Barn Owl is on the Missouri Department of Conservation's Species of Concern list as being vulnerable in the state, however in southwest Missouri, Barn Owls will reproduce where habitat is suitable and nesting sites are available. This species has followed the decline of the modern farm and will continue to face hardship so long as nesting areas and prey become scarce. This study provides evidence that there is a reproducing population of Barn Owls in southwest Missouri but that suitable nesting locations are imperative when making management decisions.

Occupancy

Nest box occupancy in this study (30%) was lower than that of similar studies in other regions (50%-80%, Marti 1979). At two unoccupied boxes, the cameras picked up footage of feral cats on the rafters where the boxes were placed, and another picked up footage of a feral cat on the ground under the box. The presence of raccoons inside an empty nest box was also recorded. These factors may play a major role in the decision for a Barn Owl choosing a nest, as none of the boxes where these predators were seen were used.

Successful nests were in boxes that had been placed in a) locations with closed barn doors, denying access to barn owl predators, or b) high enough off the ground so that it was not accessible to non-avian animals. Human presence did not seem to factor into the decision to nest, as one of the Barn Owl nests was inside a barn that was being actively renovated. My weekly presence around the nests, including my observations of

the young, seemed to have no effect on nesting success since owls were successful in raising young despite my brief disturbances of them. No nest boxes were placed in empty grain silos, which have been shown to be an excellent location for nest boxes (R Fritzky personal communication) because of their seclusion and security.

Nesting Success

Eighty-three percent of the eggs laid successfully fledged, with only two owlet mortalities. This rate is lower than the percentage of young fledged in another study (92.5%, Marti 1978), however my sample size was also much lower (3 vs. 24 clutches). The owls in box (J) were seen leaving the barn altogether at a much younger age than the owls in box (E). This is possibly due to the increased human presence within the barn at box (J). The barn that held box (E) was visited by no humans other than myself for the duration of their nesting, and there were several places to seek shelter within the barn. Whereas, the barn that held box (J) was continuously being worked on and had little to no areas for shelter.

There was an unsuccessful attempt made by a Barn Owl to take over a Great Horned Owl nest. This interaction may be due to the low amount of suitable nesting sites in the area. Inhibition of Barn Owl activity in the presence of a Great Horned Owl has been documented in other studies (Rudolph 1978), however I observed consistent interactions between the two species, as well as a successful defense of a nest box by a Barn Owl that contained Great Horned Owl eggs. The interaction stopped after several weeks when a larger Great Horned Owl appeared at the nest site. This interaction may be that a young Great Horned Owl mother was incapable of defending her nest until the

male arrived. Footage of the Barn Owl roosting in the nest box with Great Horned Owl eggs however leaves more questions than answers.

Pellets

Pellets found at each nest site were compared to museum specimens and identified. The analysis based upon the number of skulls found indicated that the food both the barn owl and the great horned owl were consuming consisted of approximately 92.8% small rodents, and 7.2% shrews through spring and summer. Prey type is most likely a reflection of the relative abundances of the types found around each nest box (Jorgensen, et al., 1998). No birds were found in the owls' diet. During winter months, birds dominate the diet of barn owls as they are easier to locate than terrestrial mammals (Fritzell et al., 1984).

Summary

This study provided a look at the nesting success of a small population of Barn Owls in Southwest Missouri who utilized wooden nesting boxes to rear their young. A longer study and banding of owlets would have allowed for further observation of young dispersal, range size, survivorship, and further reproduction. More studies are needed to fully understand the nesting ecology of Barn Owls and the specific surrounding habitat requirements. Many factors are at play when a Barn Owl searches for a suitable nest, and they are constantly changing due to dynamic environmental effects. This report takes into account Element Occurrence Data from the Missouri Heritage Database. This report also takes into account the location of each nest box and factors that may have hindered its

occupancy. More information is needed in order to create a successful management plan for this species. Further awareness and education given to private land owners on the positive effects of this species could bolster its population here in Missouri and across the world.

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