Letters

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Two Case Studies of Satellite Tracking Juvenile Barn Owl (*Tyto alba*) Dispersal

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Barn Owl (*Tyto alba*) declines have been recorded in the midwestern USA, causing widespread conservation concern for this species (Marti et al. 2020). As a result, the Barn Owl was included as a Species of Greatest Conservation Need in Kentucky's State Wildlife Action Plan (Kentucky Department of Fish and Wildlife Resources [KDFWR] 2005) and the KDFWR started a population monitoring program for the species in 2010. Alongside this effort, KDFWR banded nestling Barn Owls and the resulting band recoveries sparked interest in using satellite tracking technology to learn more about survival and dispersal movements. In this study, we used a 20-g, battery-operated Argos platform transmitter terminal (PTT) to monitor the movements of two juvenile Barn Owls during 2014 and 2015. To our knowledge, this is the first report of an attempt to use satellite transmitters on wild-hatched Barn Owls. Our goal was to investigate the utility of satellite tracking for use in conservation-based research on Barn Owls. Here we report on the effectiveness of this technology for monitoring Barn Owls, as well as the dispersal movements and survival of each individual.

We captured owls for this project at a nest box inside a barn in Calloway County, Kentucky (36°33.483′N, 88°17.850′W). Barn Owls typically fledge at 50–55 d of age (Marti et al. 2020), so to ensure a good fit of the harness we targeted our transmitter deployment for just before fledging (47–48 d of age). We captured the Barn Owls by hand at the nest box, while also blocking the box entrance to prevent premature fledging. We then took morphological measurements, attached a US Geological Survey (USGS) aluminum leg band and determined the sex of all nestlings based on plumage characteristics (Pyle 1997). We attached a 20-g, battery-powered Argos satellite transmitter with a 16.5-cm antenna (NorthStar Science and Technology, LLC., King George, VA, USA) to the largest female in the nest each year. We attached the transmitter via a backpack harness with Teflon straps, secured with copper tube closures as described in Steenhof et al. (2006). All marking and banding was permitted by the USGS Bird Banding Lab (federal permit #23400) and we obtained special permission to attach transmitters up to 4% body weight for this project.

On 17 July 2014, we attached a transmitter to a nestling female Barn Owl (BNOW #1, weight = 665 g). On 1 July 2015, we redeployed the same transmitter (refurbished) on another nestling female Barn Owl (BNOW #2, weight = 690 g) at the same site. During each transmitter deployment, we installed a solar-powered trail camera in the nest box. The camera (LTL Acorn©, Guangdong, China, LTL-5210A with multimedia messaging service) had the ability to text images using cellular data. We programmed the camera to take three pictures every 5 min. We reviewed these images for any unusual behavior that might suggest the bird did not tolerate the transmitter and harness; we did not observe any excessive preening or picking in these photos.

We programmed the PTT, in consultation with the manufacturer, to take continuous data for 8 hr (2200–0600 H EST) and then turn off for 40 hr, to maximize high quality locations and the length of time each individual was tracked given battery constraints. We downloaded and processed data every 4 d. Argos location estimates are categorized by location class (LC) quality scores (LC = 0, 1, 2, 3, A, B, Z; Table 1). All low quality fixes (LC = 0, A, B, Z) were excluded from mapping and analysis (Argos 2016). We performed spatial mapping in ArcMap 10.5.1 (Esri 2016).

To calculate statistics on dispersal movements, we separated locations into pre-dispersal and dispersal periods. We considered locations as dispersal beginning when the bird started to make continuous movements away from its natal territory, and remained more than 2 km from the natal site for more than 1 wk (Weston et al. 2013). We calculated minimum cumulative distance traveled from the last pre-dispersal point to the first point where the transmitter stopped moving. We estimated the rate of movement during dispersal (km/8-hr period) by constructing vectors with all locations within each 8-hr tracking period. We report mean and standard deviation for rates calculated across multiple tracking periods.

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Table 1. Argos locations, by location class, for juvenile Barn Owls satellite tracked from the same natal site in Kentucky, in 2014 and 2015. Location classes A, B, and 0 were excluded from our data analysis.

Argos Location Class	Estimated Accuracy	Number of Locations for Each Owl BNOW #1	BNOW #2	% Total Locations
3	<150 m	31	97	33.5%
2	150 m to 350 m	16	43	15.4%
1	350 m to 1000 m	8	34	11.0%
0	>1000m	4	19	6.0%
A	no estimate	11	25	9.4%
B	no estimate	37	57	24.6%

We assumed probable mortality or transmitter shedding when the PTT transmitted continuously from the same location for two 8-hr periods (56 hr elapsed), and the PTT's motion sensor stopped incrementing. We attempted to recover motionless transmitters and determine potential cause of mortality as soon as was logistically feasible.

We received locations for BNOW #1 between 17 July 2014 and 29 August 2014 and BNOW #2 between 1 July 2015 and 3 October 2015. There were two lapses in data collection where no high quality locations (LC = 1, 2, 3) were taken during an entire 8-hr period for BNOW #1. These occurred during the pre-dispersal period when the bird may have been taking cover in human-made structures while still dependent on its parents for food. There were no lapses in data collection for BNOW #2. The number of high quality locations (Table 1) received per 8-hr period from the PTT ranged from 1–6 (BNOW #1: 2.6 ± 1.7; BNOW #2: 3.6 ± 1.1).

BNOW #1 dispersed 28 d after fledging and BNOW #2 dispersed 13 d after fledging. We estimated the average rate of movement as 6.8 ± 11.5 km/8-hr period for BNOW #1 and 6.3 ± 12.3 km/8-hr period for BNOW #2. Estimated maximum rate of movement was 30.2 km/8-hr period, 6 d after dispersal began for BNOW #1, and 64.0 km/8-hr period, 1 d after dispersal began for BNOW #2. The minimum cumulative distance traveled was 182 km for BNOW #1 and 421 km for BNOW #2.

BNOW #1 was 139 km east of its natal site when it was found dead, near a roadside, in White House, Tennessee (Fig. 1). We were able to retrieve the carcass and submit it to the University of Kentucky Veterinary Diagnostic Lab for necropsy. The necropsy confirmed trauma (vehicle collision) was the cause of death. The transmitter and harness were in good condition upon recovery and did not show signs of excessive picking at the antenna or harness.

BNOW #2 was 23.5 km northeast of its natal site when the PTT suddenly became motionless near a roadside in Aurora, Kentucky (Fig. 1). We searched the area on several occasions for the transmitter, but could not locate it. Because BNOW #2 was active until the locations became abruptly motionless, we assume the owl may have died suddenly (e.g., vehicle collision) or shed the transmitter.

Our results are not widely conclusive, as they result from tracking only two individuals. However, our study is the first to use satellite tracking for wild-produced Barn Owls, and thus, our findings may inform future research. Most previous Barn Owl telemetry studies have relied on radio telemetry, using much lighter transmitters weighing 5–10 g (Rosenburg 1986, Chien and Ritchison 2011). We did not observe any obvious negative effects on the tracked individuals from the 20-g PTT. However, more study is needed to understand the effects of transmitters on Barn Owls because PTTs may affect survival in some raptor species (Steenhof et al. 2006).

Upon review of our data, we omitted 40% of the locations received due to low quality fixes (Table 1). While this is a considerable portion of the data, we think that the PTT provided sufficient data to track large-scale movements and characterize the dispersal of the individuals. Nonetheless, the life history of Barn Owls presents a challenge to the use of satellite telemetry to identify nesting or roosting areas. Many barns and silos have metal roofs that may interfere with obtaining satellite fix locations and ground-truthing may be necessary to determine the exact structure used by a tracked individual, even with good location accuracy.

Very few studies have focused on the dispersal of young Barn Owls. Stewart (1952) used band recovery records to describe the dispersal in Barn Owls in the USA. He found that 63% of northern (including Kentucky) Barn Owls that traveled more than 80 km from their natal site dispersed in a southward direction. Marti (1999) also used band recovery data in Utah and found that natal dispersal occurred in most compass directions, with landscape features affecting dispersal routes. Interestingly, one of the birds in our study traveled eastward and the other moved in many directions, visiting the same vicinity of its final location on three separate occasions. Early dispersal movements were unexpectedly abrupt for both of the individuals we tracked and we assume that neither individual had completed its dispersal during our study. Juvenile survival is low for this species, and vehicle collisions are a documented cause of mortality for Barn Owls, especially for dispersing young (Altwegg et al. 2003, Borda-de-Água et al. 2014). Future studies on juvenile dispersal will likely require the deployment of many PTTs in order to obtain complete natal dispersal information for a few individuals.

Expanding knowledge of survival and dispersal is necessary for understanding the population processes that restoration activities aim to enhance. Movement data improves our determination of the necessary scale for successful conservation implementation. Telemetry studies on Barn Owls are inherently challenging due to roosting habits and the low first-year survival of this species. After

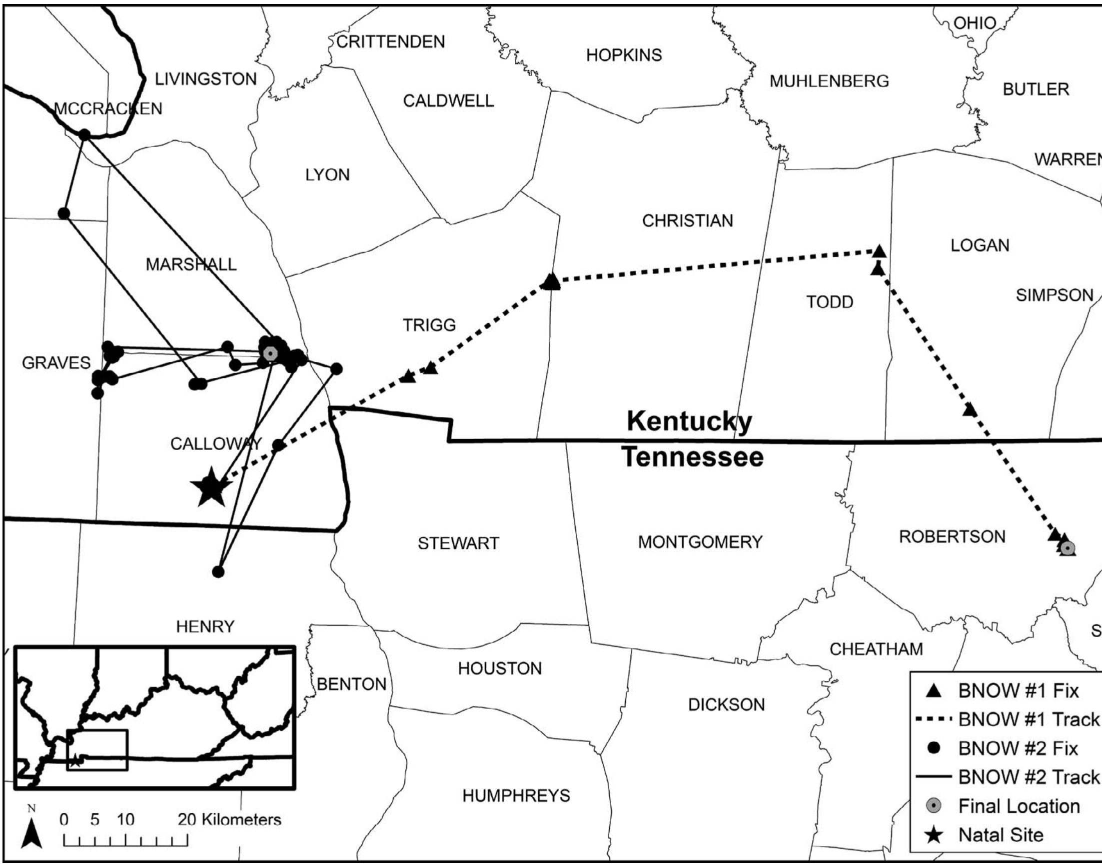

Figure 1. Dispersal movements of two juvenile Barn Owls, satellite tracked from the same natal site in Calloway County, Kentucky, in 2014 and 2015.

this pilot project, we opted to wait for technological advances to provide more options for tracking Barn Owls.

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