Am. Midl. Nat. (2021) 185:139–144

Notes and Discussion Piece

Lack of Foraging Site Fidelity Between Years by Common Nighthawks (Chordeiles minor)

Abstract.—Birds in the family Caprimulgidae generally exhibit high nest site fidelity, but it is not known if fidelity extends to foraging sites, especially for Common Nighthawks (*Chordeiles minor*), which are otherwise one of the most studied species. Common Nighthawks are ecologically distinct from other caprimulgids, being one of the few true aerial hawking species and among the longest distance migrants in the group. We predicted these birds would exhibit fidelity between years to a foraging site in British Columbia, Canada, where they forage in large numbers on a nightly basis and the same individuals return nightly. We banded individuals and, for a subset of birds, attached transmitters programmed to activate upon return to the foraging area the next year. We estimate we marked approximately 10% of the birds foraging at the site, but did not recapture a single marked bird despite capturing potentially 50% of birds foraging at that site over the two subsequent years. Furthermore, we did not detect any of the subset of birds with radiotransmitters, indicating they did not return to the foraging site in the year following initial capture. Our data suggest low fidelity between years to a foraging site, in contrast with the published records for nesting by this species and with the general expectations for the group.

Introduction

Nighthawks and nightjars (Caprimulgidae) are long-lived, migratory species. They are often habitat specialists; therefore, habitat may be limited for some species, and fidelity between years might be expected (Camacho, 2014). For example Red-necked Nightjars (*Caprimulgus ruficollis*) show both strong natal (Camacho, 2014) and breeding site fidelity (Camacho *et al.*, 2016). Furthermore, specific nest sites have been occupied for multiple years by individuals from several species of caprimulgids (Ganier, 1964; Jackson, 1985; Vilella, 1995; Wilkinson, 2009). In some of these instances, birds were not banded; therefore, it is unclear if it was the same individuals returning each year. However, long-term use of a specific nest site is suggestive of fidelity.

Common Nighthawks (*Chordeiles minor;* hereafter "nighthawks") are among the most wide-ranging and longest-distance migrants in the family (Brigham *et al.*, 2011), but there are few data about foraging site fidelity. During the breeding season, nighthawks typically defend a small (0.2–0.4 ha) nesting territory and occur at relatively low densities (Armstrong, 1965; Brigham *et al.*, 2011) often returning to the same nesting territory between years (EC Knight, unpub. data). In an example of extreme nest fidelity, one banded individual returned to the same nest on a rooftop over the course of 10 y (Dexter, 1961). In other anecdotal observations, the same natural nest sites were used in successive years by unmarked birds (Brigham, 1989). Ng *et al.* (2018) affixed GPS tags to 10 male nighthawks and recovered data from seven individuals, all of whom returned to within 1 km of the same breeding site in the boreal forest of Alberta.

Common Nighthawk fidelity to breeding sites is important for conservation efforts, but it is also important to consider their fidelity to foraging sites. In the same way that breeding season alone is insufficient for identifying threats to migratory species (Martin *et al.*, 2007), conservation planning must consider all resources required for breeding species (*eg.*, nesting and foraging areas). Individual foraging site fidelity is common in a diverse range of central-place foraging species (Wakefield *et al.*, 2015), but the degree to which nighthawks maintain fidelity to high-quality foraging locations is unknown. Contrary to colonial species typical of central-place foraging strategies, nighthawk breeding territories are dispersed across the landscape. As highly mobile aerial insectivores, nighthawks can potentially forage over a wide range, but certain high-quality foraging sites may consistently attract foraging individuals. Rather than individuals from a common breeding area maintaining fidelity to individual foraging areas (Wakefield *et al.*, 2015), individual nighthawks from dispersed breeding territories may maintain fidelity to a single high-quality foraging site.

Near Okanagan Falls in British Columbia, Canada, hundreds of nighthawks forage along a short stretch of river every night from early June until late August (Brigham, 1990; Fig. 1). All birds caught and radio-tagged at this site, returned on a nightly basis from roost sites up to 12 km away over the course of

FIG. 1.—Two of the authors tending a 12 m mist net set to catch Common Nighthawks (*Chordeiles minor*) over the Okanagan River in 2014. Seventeen birds and multiple caddisflies (Order Trichoptera) are visible in the photograph. Photo by Anne C. Brigham

a summer (Brigham, 1990). However, it is unknown whether individual nighthawks exhibit foraging site fidelity across years. In the current study, we were trying to track migratory movements of these birds and predicted individuals would show high between year fidelity given observations of repeated use of the same site by individuals over summer, evidence for breeding site fidelity, the suggestion of a relatively long life span (Brigham *et al.*, 2011), a relatively consistent number of birds foraging at this site over the past 30 y, and the generally consistent patterns of fidelity observed in a wide range of Caprimulgids (Holyoak, 2001).

METHODS

We studied nighthawks foraging over the Okanagan River, at sx̌ʷəx̌ʷnitkʷ Provincial Park (formerly Okanagan Falls Provincial Park) near the town of Okanagan Falls, British Columbia, Canada (49°20′26.59″N, 119°34′48.87″W). Nighthawks have been studied at this site for over 30 y (*e.g.*, Aldridge and Brigham, 1991; Brigham, 1989, 1990; Brigham and Barclay, 1995). A small section (approximately 300 m long and 50 m wide) of the Okanagan River attracts hundreds of nighthawks nightly to forage on caddisflies (Order Trichoptera) emerging from the river (Brigham, 1990). Based on telemetry data, nesting and roosting occurs throughout the valley and individuals commute up to 12 km to forage each night throughout the summer at this location (Aldridge and Brigham, 1991). Despite extensive searches throughout the valley over a period of several decades for similar foraging sites, we are not aware of any other sites in the area that are consistently used in the same way by nighthawks.

In the early breeding season of June 2014, as part of a larger project, we captured foraging nighthawks in mist nets set across the river at dusk. We marked captured birds in one of three ways. All birds were marked with leg bands issued by the Bird Banding Office of Environment and Climate Change Canada. With intent to document migration routes, we attached a geolocator-radiotransmitter combination package to a subset of birds (combined mass 1.34 or 1.68 g; geolocators models ML67A0 or ML6740; radio transmitters model CTxAg376, Lotek Wireless, Newmarket, ON, Canada). The transmitters were programmed to begin emitting signals 1 June 2015, and continue for approximately 2 wk until the battery died. We attached the geolocator-radio transmitter package with a backpack harness made from EPDM (ethylene propylene diene monomer) rubber cord and Teflon ribbon (Telonics Inc., Mesa, AZ). We ensured each harness was neither too tight nor too loose based on our experience with this and

other species. We assessed proper fit as being only one finger thickness between the harness and the bird's body, ensuring the harness did not restrict movement but at the same time being secured with no evidence of the package "bouncing". All birds carrying packages flew well when released. For a third subset of birds, in addition to the transmitter-geolocator, we surgically implanted a body temperature datalogger (1.15 g; WeeDrop, Alpha-Mach Inc., Ste-Julie, QC, Canada). We implanted the dataloggers using surgical techniques similar to previous studies on caprimulgids (Brigham *et al.*, 2000; Körtner *et al.*, 2001) and after surgery held birds overnight for observation. Given the smallest nighthawk weighed 72 g, in all cases the combined mass of the datalogger and/or geolocator-radio transmitter package was <3.7% of body mass. All research activities were approved by protocols from Animal Care and Use Committees at Texas Tech University and the University of Regina and conducted under permits issued by Environment Canada and British Columbia Ministry of the Environment.

We returned to the same site in early June in each of 2015 and 2016 to attempt to recover the packages. In 2015 we had two means of detecting marked birds. We could either capture a banded individual at the same study location or detect the transmitters programmed to begin when we arrived. In 2016 the only method available was to recapture birds at the foraging site because, by then, transmitters were nonfunctional.

In all 3 y, we visually estimated the total number of birds present on nights with the most activity. Counting birds was challenging because as aerial hawking insectivores, the birds flew erratically and they foraged in the highest densities as daylight faded. Four observers independently estimated the maximum number of foraging birds. We calculated the mean of these estimates and rounded to the nearest 10 nighthawks.

RESULTS

We banded 46 nighthawks in 2014 (32 males, 14 females). Of these banded individuals, 38 (25 males, 13 females) were also outfitted with a radio transmitter-geolocator package. Of these 38, half also had surgery to implant body temperature dataloggers (10 males, 9 females) and half carried external transmitter-geolocator packages only (15 males, 4 females). Our average estimates of the number of birds foraging at the site were similar in all 3 y, with a maximum of 380–400 nighthawks foraging over the river on the busiest nights.

In 2015, our first year to attempt to recapture birds, we netted on eight nights and captured 61 nighthawks. None was a recapture. The relatively low overall capture rate was due to high water levels that prevented us from setting nets affixed to poles in the river, but rather having to suspend a net from a rope across the river, which covered less area. We searched on a daily basis for 8 d to detect any birds with radio transmitters using a 3-element yagi antenna and a handheld receiver (R-1000; Communications Specialists, Orange, CA, U.S.A.), both at the capture site and systematically from roads and high points of land within 12 km of the study site area. Of the 38 birds carrying transmitters, we only detected one. We tracked the signal to a rocky patch on a hillside approximately 1.7 km from the capture site. The signal indicated it was buried under rocks and we could not recover it. We assume the bird had been killed by a predator in the summer of 2014 and over time the transmitter had become buried. In 2016, we were able to set nets between poles in the river, and over six nights captured 158 nighthawks, none of which was marked.

DISCUSSION

Our subjective impression of the total number of birds foraging at the site has not changed over the last 30 y (RM Brigham, pers. obs.). Excluding the individual likely killed by a predator, there were 45 marked birds theoretically available to be recaptured or detected in 2015, or recaptured in 2016, representing approximately 10% of the birds that foraged at the site if they returned. Over the 2 y following initial marking, we captured 219 nighthawks, none of which was marked. Some of our captures in 2015 and 2016 could have been the same individuals as we did not mark any in those years, but the conclusion remains that we captured a substantial number of foraging birds each year without recapturing any individuals marked in 2014 or detecting any by radio telemetry. From this we conclude nighthawks exhibit low foraging site fidelity between years at this location.

The interesting question stemming from our results is why the observed recapture rates are so low. We marked approximately 10% of the estimated nightly abundance and subsequently captured a large number of individuals at the same site (potentially 50% of the estimated number of individuals that foraged nightly). There are other plausible reasons besides a lack of site fidelity, although we think they are unlikely to be complete explanations. It is possible the transmitters and surgery negatively impacted birds we marked, reducing the chances of a bird returning to the site in subsequent years. However, we hypothesize it is unlikely our methods caused mortality. First, we detected one radio transmitter in 2015. The active transmitter indicates the equipment functioned as designed, and the lack of additional detections suggests the remaining birds left the valley to migrate south in fall. Furthermore, radio telemetry has previously been used to study nighthawks at the same site (Brigham, 1989) with transmitters weighing up to 5.4 g, representing 7.0% of body mass. These birds continued to fly, forage, and reproduce normally; suggesting this amount of mass did not adversely affect birds at least during a single summer. Given the combined mass of the most equipment we attached to birds in 2014 was only 3.7 g (plus the mass of the harness), we think it unlikely the mass of equipment negatively affected birds. Using a similar harness design, Ng *et al.* (2018) affixed 3.5 g GPS tags and recovered seven of 10 birds tagged. Likewise, Brlík *et al.* (2020) found geolocators affixed with harnesses to a variety of small birds rarely had a significant effect. Some of our birds underwent surgery, which may have had negative consequences; however, most (27 of 46, approximately 60%) of our marked birds did not have surgery and were also not detected. Similar surgeries have been conducted on other caprimulgids with no known ill effects. Natural mortality during migration or on the wintering grounds may explain our lack of recaptures; however, the available, albeit limited, evidence indicates nighthawks are relatively long-lived (Campbell *et al.*, 1990; Dexter, 1961) with records of individual birds living >10 y. Of 66 nighthawks that Ng *et al.* (2018) marked, two were killed on roads, two never left the breeding region and were likely depredated, and seven stopped moving or transmitting during migration. Therefore, potentially up to 17% of birds suffered mortality, if all seven migrating individuals died. This would mean eight (0.17 times 46) of our marked birds might have been expected to die, leaving 38 available for recapture, which is within the realm of our 10% of the population marked. Further, we affixed transmitters to 38 individuals. Assuming a 17% mortality rate would lead us to expect six birds to die of natural causes, leaving 32 birds available to track the following spring. Therefore, although it is plausible that a few marked individuals died, low foraging site fidelity seems to be a much more likely explanation for the absence of recaptures. Recapture attempts over 2 y may not be sufficient to evaluate recapture/survival rates, if young birds "float" before returning to natal breeding sites, as some avian species do (Penteriani *et al.*, 2011). One male tagged in 2018 in northern Alberta set up a breeding territory ~ 250 km northeast in the subsequent year, which combined with their high territory fidelity, suggests he was a floater in 2018 (EC Knight unpub. data). However, we know that all of our marked birds were at least second year birds. Because we marked no hatch year birds in our study, 'floating' as an explanation for our low recapture rate would require a very high proportion of the birds foraging over the river to be both very young and not returning to their natal areas, which seems highly improbable.

Our conclusion of low, between-year foraging site fidelity is further supported by examining past banding records at the same location. From 1986–1995 one of us (RMB) banded a total of 111 nighthawks at this site and only recaptured three in subsequent years even though all radio-tagged birds foraged at the same site nightly in the summer they were caught. Given the life expectancy of nighthawks and the relatively stable number of birds foraging there, this is also consistent with low foraging site fidelity between years. We argue this indicates there is a high turnover of individuals foraging at this site among years, resulting from extensive immigration. The large biomass of caddisflies that emerges from the river at this site represents an abundant and easily accessible prey resource and may attract birds from a wide range. If individual arrival dates vary among years, competition for breeding sites in this region may result in apparent immigration with the earliest arriving birds securing access to this foraging area. Given immigration is generally low in caprimulgids, whether our results can be attributed to low site fidelity or high immigration, the ecology of nighthawks at this foraging site appears unlike most caprimulgids. Continued research at our study site and nearby populations will provide valuable insight into patterns of habitat use in nighthawks. Studies tracking the foraging movements of individuals within and across seasons will be particularly informative, especially noting when/how

individuals forage at our study site compared to other potential foraging areas. More broadly, we need data from other nighthawk populations to determine if our results are typical for this species.

Acknowledgments.—We are grateful to A. Brigham, S. Bohn, E. Boyles, A. Sidler, and N. Lerminiaux for assistance in the field and to J. Christiansen and especially E. Knight for helpful comments on a previous version of the manuscript. We also thank C. Camacho and two anonymous reviewers for helpful feedback that improved the manuscript. Funding for this research was provided by the National Geographic Society, the Natural Sciences and Engineering Research Council of Canada, Texas Tech University, and Southern Illinois University.

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