SHORT COMMUNICATIONS

J. Raptor Res. 35(1):58–61

WINTER ROOSTING BEHAVIOR OF AMERICAN KESTRELS

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KEY WORDS: *American Kestrel;* Falco sparverius; *nest boxes; roosting behavior; sex differences; winter behavior.*

During the nonbreeding season, a protected nightly roost site can be critical to maintaining a positive energy balance and reducing predation risk (Walsberg 1986, Atkinson 1993). American Kestrels (*Falco sparverius*) winter across much of North America (Root 1988); however, little is known about their roosting behavior, especially in the portion of their range where climatic conditions may be stressful (Bird 1988). Mills (1975) suggested that the presence of a suitable roost may be a critical part of a nonbreeding territory. Kestrels readily adopt nest boxes for breeding and frequently use breeding habitats during the nonbreeding season (Balgooyen 1976, Bird 1988).

How frequently kestrels use nest boxes as winter roosts is currently unknown, although Eastern Screech Owls (*Otus asio*) will frequently use them as winter roosts (Duguay et al. 1997) as will European Starlings (*Sturnus vulgaris*, Kessel 1951). Toland and Elder (1987) reported that their nest boxes in Missouri (38°98'N, 92°30'W) were used as roosts by American Kestrels during one winter during a 3-yr study. Bortolotti and Wiebe (1993) reported migrating kestrels roosting in spruce trees (*Picea* spp.) in Saskatchewan (52°07'N, 106°38'W) and Doody (1994) reported wintering female kestrels using predominately man-made structures in Louisiana (30°22'N, 91°11'W); apparently, no nest boxes were available at either site.

At my study site in southeastern Pennsylvania, winter conditions can be harsh (mean winter temperature = 5.3°C, wind speed = 4.4 m/sec, min temp = −8°C, National Climatic Data Center 1994–95 nndc.noaa.gov). As a result, a protected winter roost site might be an important component of a kestrel territory. The main objective of this study was to determine the importance of nest boxes as winter roosting sites. Given that males and females differ in the ability to occupy high quality sites during winter (Ardia and Bildstein 1997), as do permanent and winter residents (Smallwood 1988), I sought to compare roosting behavior between males and females and between year-round residents and winter residents.

METHODS

Study Site. I conducted this study between November 1994 and February 1995 in Berks and Lehigh counties, southeastern Pennsylvania (40°55'N, 75°75'W). November was considered the start of winter because wintering kestrels have established areas of use by this time (Ardia 1997). The study area (approximately 800 km²) is a patchwork of rolling hills and farmlands, which consists primarily of open agricultural land (pasture and fields of corn [*Zea mays*], soybean [*Glycine max*], and alfalfa [*Medicago sativa*]) separated by small woodlots and orchards. Between 70–100 pr of kestrels nest in the area each year in nest boxes (Rohrbaugh and Yahner 1997). Nest boxes at the site are cleaned and repaired in March prior to the breeding season and wood shavings are placed in the boxes. The orientation of the nest boxes varies (Rohrbaugh and Yahner 1997).

Nest Box Use. As a part of another study, I determined all occupied kestrel wintering territories along 153 km of survey route (Ardia 1997). From 59 occupied territories, I selected 20 territories at random (10 male and 10 female) and within each of these 20 territories, I chose a nest box randomly from those available (16 territories contained only one nest box, range = 1–3, $\bar{x}$ = 1.3).

Between 12 December 1994 and 27 January 1995, I visited each box twice between 2000–2400 H to determine whether it was occupied. I also conducted two 60-min observations at each nest box: for 30 min prior to sunrise until 30 min following sunrise, and for 30 min before sunset until 30 min following sunset. Each observation was conducted from a car at a distance of about 100 m using 8× binoculars. For all observations, daylight was sufficient to observe the box opening and any movement that might have occurred.

Roosting Behavior. I conducted 25 focal observations of 13 male and 12 female kestrels going to roost. For these observations, I chose kestrels randomly from all territory holders. Each kestrel was located 30 min prior to sunset and observed until it went to roost; observations were conducted with 8× binoculars from a car at a distance of about 100 m. The time of roost selection and the type of roost were recorded for each observation. I measured roost-site height (m) using a clinometer and

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Table 1. Roost sites used by 13 male and 12 female American Kestrels wintering in southeastern Pennsylvania in 1994–95.

	TREE BRANCHES N (%)	TREE CAVITY N (%)	EAVE N (%)	BUILDING N (%)
All observations	6 (24%)	2 (8%)	11 (44%)	6 (24%)
Male	3 (23%)	2 (15%)	6 (47%)	2 (15%)
Female	3 (25%)	0 (0%)	5 (42%)	4 (33%)

the distance flown to the roost from the last pre-roost perch to the roost with either a Ranging 50–1000 m rangefinder (for distances >50 m) or a measuring tape (for distances <50 m). I revisited each roost site during daylight hours to verify roost type.

I placed roost sites into four classes: tree branches, natural cavity, eave (a human-made structure where kestrels were not inside a structure but were protected from the elements) and building (a human-made structure such as a barn or silo where kestrels physically entered the structure). All kestrels classified as year-round residents were color-banded birds observed on winter territories before 15 September. Any bird that arrived after 15 September and was not previously color-banded was classified as a winter resident.

RESULTS

Nest Box Use. I encountered no American Kestrels using nest boxes either during nest box observations or during visits to boxes. A majority of nest boxes were empty (65%); boxes were used by eastern gray squirrels (*Sciurus carolinensis*; 20%), mice (*Peromyscus* spp.; 10%), and an Eastern Screech Owl (5%).

Roosting Behavior. Wintering kestrels used human structures, tree branches, and tree cavities as roosts (Table 1). Kestrels roosted in maples (*Acer* spp.; $N = 4$), eastern white pines (*Pinus strobus*; $N = 1$), and oaks (*Quercus* spp.; $N = 3$). A majority of roost sites were human-made (68%). There was no difference between natural and human-made roosts in roost height, time before sunset that kestrels entered the roost, nor in the distance that kestrels moved from their last perch to the roost (Table 2).

I detected no difference between male and female kestrels in roost-site types ($\chi^2 = 2.72$, df = 3, $P = 0.43$), nor in roost height, time to roost, and distance traveled from their last perch to roost (Table 2). I also detected no difference between year-round residents and winter residents in roost-site types ($\chi^2 = 2.78$, df = 3, $P = 0.41$), roost height, time to roost, and distance traveled from last perch to roost (Table 2). There was no interaction between sex and residency status for roost height, time to roost, and distance traveled from last perch to roost ($Fs_{1,21} < 2.56$, $Ps > 0.12$).

Table 2. Characteristics of roost sites ($\bar{x} \pm$ SD) used by American Kestrels wintering in southeastern Pennsylvania.

	HEIGHT OF ROOST SITE (m)	TIME TO ROOST (MIN BEFORE SUNSET)	DISTANCE TRAVELED FROM LAST PERCH TO ROOST SITE (m)
All observations ($N = 25$)	5.7 ± 2.4	3.4 ± 1.3	34.4 ± 20.5
Natural roost sites ($N = 8$)	6.4 ± 1.5	3.3 ± 1.5	40.7 ± 27.6
Human-made roost sites ($N = 17$)	5.4 ± 2.7	3.5 ± 1.3	31.5 ± 16.3
t-value	$F_{1,21} = 0.99$, $P = 0.32$	$F_{1,21} = 0.25$, $P = 0.62$	$F_{1,21} = 1.08$, $P = 0.31$
Male kestrels ($N = 13$)	5.0 ± 1.4	3.6 ± 1.0	37.7 ± 27.2
Female kestrels ($N = 12$)	6.4 ± 3.1	3.3 ± 1.5	30.9 ± 9.2
	$F_{1,21} = 2.34$, $P = 0.14$	$F_{1,21} = 0.45$, $P = 0.51$	$F_{1,21} = 0.70$, $P = 0.42$
Year-round residents ($N = 11$)	6.2 ± 3.1	3.3 ± 1.3	31.5 ± 16.7
Winter residents ($N = 14$)	5.1 ± 1.08	3.6 ± 1.31	37.6 ± 24.3
	$F_{1,21} = 1.13$, $P = 0.3$	$F_{1,21} = 0.18$, $P = 0.67$	$F_{1,21} = 0.42$, $P = 0.52$

DISCUSSION

Patterns of kestrel roost use at my southeastern Pennsylvania site were similar to those reported for a similar latitude (Mills 1975) and a more southerly site (Doody 1994). My results suggested that wintering kestrels at my study site may not use nest boxes as roost sites even though they are available. There is year-to-year variation in whether kestrels use nest boxes as winter roosts (Carpenter pers. comm.), and in some areas, nest boxes are never used as winter roosts (Bortolotti pers. comm.). Given that my data are limited to a few observations in one season, it is premature to conclude that kestrels never use nest boxes at my study site; however, my results suggest that other roost sites may be more important to kestrels than nest boxes.

Because the winter energetics of kestrels are strongly influenced by convective heat loss (Hayes and Gessaman 1980, Ardia 1997), the lack of use of nest boxes is somewhat surprising if the use of boxes has thermal benefits. Therefore, that nest boxes are not used suggested that nest boxes may provide no better thermal benefit than either natural or human-made roosts, or, more likely, that benefits of nest boxes are outweighed by potential costs. A possible cost of nest boxes may be increased risk of predation (Orell 1989); one cause of mortality in breeding kestrels is predation on females incubating or brooding at night (Kellner and Ritchison 1988, C.J. and S. Robertson, D. Ardia unpubl. data). In winter, without the need to enter nest boxes to breed, females may avoid exposure to predation. Also, nest boxes may increase exposure to ectoparasites (Merila and Allander 1995), although winter weather conditions are often harsh enough to reduce ectoparasite activity.

In my site and others, kestrels have readily adopted human-made roosts and use these sites over natural locations, both of which were readily available. I observed no differences between males and females nor between year-round and winter residents, suggesting that if tradeoffs exist in roost site selection, they may be similar for all kestrels. Further observations on winter roosting behavior, especially the role of nest boxes, is needed across the range of the American Kestrel.

RESUMEN.—Las perchas nocturnas pueden ser críticas para reducir la pérdida de energía y los riesgos de depredación de las aves rapaces. Estudie el comportamiento de *Falco sparverius* en las perchas de invierno en Pennsylvania, para evaluar si utilizaron las cajas de anidación como perchas nocturnas. No encontré evidencia que los cernícalos utilizaron las cajas. Sin embargo, al observar los individuos desplazarse a las perchas ($N = 25$), encontré que ambos machos y hembras tendían a utilizar estructuras humanas (68% utilizaron cocheras y aleros como sitios de descanso en lugar de árboles y cavidades de árboles). No encontré diferencias entre machos y hembras en la altura de las perchas, hora antes del atardecer para utilizar las perchas, o en la distancia de la última percha antes de utilizar la percha nocturna. Tampoco encontré diferencias entre los residentes anuales y los de invierno en estas variables. Aunque los datos son limitados fue sorprendente encontrar que los cernícalos no utilizaron las cajas de anidación como perchas nocturnas. El posible incremento de los riesgos de depredación y la exposición a ectoparásitos pueden sobrepasar a los beneficios "termales" que proveen las cajas de anidación.

[Traducción de César Márquez]

ACKNOWLEDGMENTS

I thank my late wife Melinda Ardia for intellectual inspiration and field assistance throughout the study. I am grateful to K. Bildstein for advice and technical support. Additional field support was provided by B. and S. Robertson. I thank the staff of Hawk Mountain Sanctuary Association for their assistance and generous use of their facilities. G. Bortolotti, T. Carpenter, B.J. Christman, S.M. Murphy, D. Varland, and an anonymous reviewer provided helpful comments on the manuscript. I was supported by the Hawk Mountain-Zeiss Raptor Research Award and a Paul A. Stewart Award from the Wilson Ornithological Society. This is Hawk Mountain Sanctuary contribution number 42.

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Received 13 May 2000; accepted 20 October 2000