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THE USE OF NEST BOXES AS NIGHT ROOSTS DURING THE NONBREEDING SEASON BY EUROPEAN STARLINGS IN NEW JERSEY[1]

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The use of nest cavities as night roosts during the nonbreeding season in hole-nesting passerines is well-known (e.g., House Sparrow, *Passer domesticus,* Kendeigh 1961; European Starling, *Sturnus vulgaris,* Kessel 1957, Feare 1984; various *Parus* species, Thomas 1946, Kluyver 1957, 1966, Pitts 1976, Perrins 1979, Dhondt and Eyckerman 1980; Eastern Bluebird, *Sialia sialis,* Thomas 1946, Frazier and Nolan 1959, Zeleny 1976). Generally, two nonmutually exclusive hypotheses are considered as explanations for this behavior: (1) Birds may use cavities as night roosts during the nonbreeding season to keep warm (e.g., Kendeigh 1961, Zeleny 1968, Mertens 1977, O'Connor 1978). (2) Roosting in nest cavities at night during the nonbreeding season may be associated with nest-cavity selection during intense competition for a limited number of usable cavities (e.g., Kuerzi 1941, von Haartman 1957, Erskine 1964, Holroyd 1975, Dhondt and Eyckerman 1980, Nilsson 1984, Leffelaar and Robertson 1985, Robertson et al. 1986).

European Starlings compete for and use nest boxes as night roosts during the nonbreeding season (Kessel 1957, Ellis 1966, Feare 1984). In this paper, we describe our observations of starlings using nest boxes as night roosts during the nonbreeding season in New Jersey and suggest that this behavior may be primarily a manifestation of nest-site competition.

METHODS

We have studied the behavioral ecology of starlings that nest in boxes mounted on utility poles along the roadways of the Kilmer Campus of Rutgers University in Piscataway, Middlesex County, New Jersey, since 1978. The study site contained mowed lawns, old fields, and parking lots and has supported a population of starlings in nest boxes since 1975 (see Crossner 1977).

We censused nest boxes during the 1985–1986 and 1986–1987 nonbreeding seasons and 50 and 51 boxes were available as roosts, respectively. Beginning in November 1985 and October 1986, we visited boxes after dark. Each census began at least 1 hr after sunset because starlings retired to night roosts in boxes just before sunset (Kessel 1957, this study). The time between censuses ranged from 2 to 4 weeks. At each nest box we (1) recorded the contents of the nest box, (2) sexed and banded unbanded starlings with U.S. Fish and Wildlife Service aluminum bands and a unique combination of plastic color bands, (3) recorded the band number of previously banded birds, and (4) during the 1986–1987 nonbreeding season, placed vinyl patagial wing tags on 11 starlings. Captured starlings were immediately returned to the box after being handled. Starlings stayed in their boxes after being handled at least until we left the area.

During the breeding season (mid-April to mid-July), breeding females and males were usually captured and banded 6 to 7 days after their eggs hatched. Some additional adults were captured and banded if they were fortuitously discovered in nest boxes during censuses.

RESULTS

The use of nest boxes as night roosts during the nonbreeding season by starlings was rare during both the 1985–1986 and 1986–1987 nonbreeding seasons (Table 1). However, there were interesting patterns of box use.

Twenty six different boxes were used as night roosts. Of these, five different boxes were used as night roosts in both the 1985–1986 and 1986–1987 nonbreeding seasons. Ten boxes contained two starlings. Seven boxes each contained a male and female roosting together. Of these seven pairs, four pairs (57.1%) remained together and bred in the same box during the breeding season immediately following capture. Of these four pairs, only one pair had bred together during the breeding season prior to capture during a night census. We captured more females than males during night censuses (Table 1).

Two boxes contained two females. One pair of females that was captured in box I-14 on the night of 2 March 1986 bred communally in that box during the 1986 and 1987 breeding seasons (Stouffer et al. 1988). The other pair of females that roosted together was not seen again after being captured on 16 October 1986.

Box I-11A contained two males on 8 December 1985. One of these males was dead and its eyes were missing. Wounds about the head and face were common in the starlings that we have captured while they were fighting

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TABLE 1. The use of nest boxes as night roosts during the nonbreeding season by European Starlings in New Jersey.

			Total
Census season	1985–1986	1986–1987	—
Censuses	11	13	24
First census	17 Nov 1985	1 Oct 1986	—
Last census	13 Apr 1986	19 Mar 1987	—
Visits to boxes	530	557	1,087
Visits revealing starlings	25	10	35
Live starlings	31	14	45
Females	18	9	27
Males	13	5	18
Dead starlings	3	1	4
Females	0	0	0
Males	3	1	4

inside nest boxes during daytime censuses within the breeding season. The dead male was unbanded and therefore had no prior history of breeding in our boxes. The other male was banded as a nestling at box I-14 in 1984, did not breed in 1985 or 1986, but bred in I-11A during the 1987 breeding season. This male was the only starling banded as a nestling at our study site that was also captured roosting at night.

We found three other dead males (Table 1). No dead females were found. Each of these dead males was found alone. One, a former breeder in the box where he was found, had wounds about the head and face. The other two males had no apparent wounds. An autopsy of one of these males revealed a full stomach and ample body fat suggesting that the cause of its death was not starvation.

Most live starlings (36/45, 80%) captured roosting at night had bred at our study site at least once prior to capture. Twenty-two of 27 females (81.5%) and 14 of 18 males (77.8%) were prior residents. Thirty-three percent of all captured birds (10 females and five males) used their night roost boxes during the breeding season prior to capture. Three females and two males bred in boxes adjacent to the night-roost boxes during the season prior to capture.

Some birds of both sexes used their roosting box for breeding after being captured. Forty-four percent (20/45) of roosting starlings bred at the study site during the breeding season immediately after they were captured. Nineteen of these 20 (95%) birds used their roosting box for breeding during the breeding season after they were captured. Females (11/27, 40.7%) were as likely as males (8/18, 44.4%) to use their night-roosting box for breeding during the following breeding season ($\chi^2 = 0.06$, ns). Eight of the 14 (57.1%) starlings that roosted in male-female pairs retained their roostmate as their breeding partner during the subsequent breeding season.

Four starlings were each captured twice roosting alone in nest boxes at night. Two males were each captured roosting alone in the same nest boxes on two different nights during the same nonbreeding season. Two females were each captured roosting alone in the same nest boxes during two different nonbreeding seasons.

None of the 11 starlings that were wing-tagged during the 1986–1987 nonbreeding season returned to breed during the 1987 breeding season. In comparison, 20 of 34 starlings (58.8%) that were only banded returned to breed.

Our censuses were not frequent enough to capture all roosting birds, precluding a comparison between roosting and nonroosting birds of reproductive performance, mate fidelity, and nest fidelity. To determine whether night roosting in nest boxes was associated with cold weather we compared the night air temperature at the start of each census with the number of starlings we found during each census. There was no correlation between temperature and the number of starlings captured roosting inside nest boxes during the 1985–1986 (Spearman's rank correlation, $r_s = -0.538$, ns) and 1986–1987 ($r_s = -0.359$, ns) nonbreeding seasons. However, we captured the most starlings ($n = 8$) during the census taken on the coldest night (14 January 1986, −9.4°C).

DISCUSSION

In this study there was no correlation between air temperature and the number of starlings using nest boxes as roosts suggesting that air temperature alone was not an important factor in roost-site selection. That we captured the most birds on the coldest night even though there was no correlation between air temperature and the number of birds roosting at night suggests that there may be a threshold effect of temperature (Morrison, pers. comm.). Because we did not measure other potentially important weather factors (e.g., wind chill) we cannot reject the hypothesis that starlings used nest boxes as night roosts for the thermal benefits. However, we never found more than two starlings roosting together despite the thermal advantages of communal roosting.

The thermal benefits of roosting in a nest box at night may be secondary to the advantages that may be gained during the coming breeding season as a consequence of using a nest box as a night roost. Thus, night roosting during the nonbreeding season may be part of the protracted process of nest-site competition and selection in areas where starlings are nonmigratory (Kessel 1957, Feare 1984).

Starlings become active around nest sites during the

fall and early winter and frequently enter nest boxes at this time, sometimes placing new nesting material in them (Kessel 1957, Feare 1984, this study). Males and females sing and display at nest boxes (Kessel 1957, Ellis 1966) throughout the nonbreeding season, and the time spent around nest boxes increases as the breeding season approaches (Kessel 1957, Feare 1984). These observations suggest that starlings are competing over nest sites throughout the nonbreeding season.

The wounds on two of the dead males that we found inside boxes suggest that competition to roost in nest boxes at night can be intense in the nonbreeding season at our study site. Because these wounds were similar to those that we have found on the starlings we have discovered fighting inside nest boxes during the breeding season, we infer that these two dead starlings were killed while fighting with other starlings. No other species bred in our nest boxes or used our nest boxes for roosts so it is unlikely that these wounds resulted from fights with other species.

Ninety five percent of starlings we captured roosting bred in their roosting box during the breeding season following capture. Some of these starlings were captured roosting in boxes months before they began breeding. For example, female 66286 was captured roosting on 17 November 1985 in box I-14B. She laid her first egg in I-14B on 12 May 1986 indicating that nest-site selection sometimes occurs well before egg laying in the starling.

More females roosted in nest boxes than did males (Table 1). Females, especially first-year birds, tend to occupy the peripheral positions in communal winter roosts and tend to be in poorer condition than starlings at the center (Summers et al. 1987). Summers et al. (1987) suggested that these females were forced to the periphery of roosts as a consequence of competition with more dominant birds. Thus, roosting in a nest box at night may be a better alternative for such females.

Morrison and Caccamise (1985) found that the starlings in central New Jersey that used large communal roosts during the nonbreeding season showed greater fidelity to a diurnal activity center (DAC) than to a particular communal roost. They hypothesized that one advantage of fidelity to a DAC was an increased probability of obtaining a preferred nest hole for breeding (Caccamise and Morrison 1986). Fidelity to a familiar DAC may also help individual starlings obtain valuable information about the location of local food resources, protection from predators, and refuges from the weather on breeding grounds. Kessel (1957) and Feare (1984) both noted that starlings return from communal roosts to areas that contain nest sites during the day in the nonbreeding season.

We captured few birds in the local population roosting in nest boxes at night. There are three nonmutually exclusive explanations for this result. First, since food availability in the habitat surrounding the nest boxes is probably much lower in the nonbreeding season, starlings usually need to leave their DAC's each day to feed at supplemental food sources associated with communal roosts (Morrison and Caccamise 1985; Caccamise and Morrison 1986, 1988). Therefore, starlings may only use nest boxes as night roosts when there are adequate food sources at or near the nest site. Second, starlings may use nest boxes for night roosts if they are competing intensively for a nest hole during the day and do not want to leave it vacant at night. Fighting may occur at night when two birds show up at a box intending to use it as a night roost. Third, our census methods surely missed many other roosting starlings because we did not census boxes on the nights that they roosted. Kessel (1957) found that starlings alternated between roosting in boxes and communal roosts.

In summary, these observations suggest that the use of nest boxes as night roosts during the nonbreeding season may be part of the protracted processes of nest and mate selection in the starling. Starlings that roost in nest boxes at night might also receive the thermal benefits of being protected from the elements (Kendeigh 1961).

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LITERATURE CITED

CACCAMISE, D. F., AND D. W. MORRISON. 1986. Avian communal roosting: implications of diurnal activity centers. Am. Nat. 128:191–198.

CACCAMISE, D. F., AND D. W. MORRISON. 1988. Avian communal roosting: a test of the "patch-sitting" hypothesis. Condor 90:453–458.

CROSSNER, K. A. 1977. Natural selection and clutch size in the European Starling. Ecology 58:885–892.

DHONDT, A., AND E. EYCKERMAN. 1980. Competition and the regulation of numbers in Great and Blue tits. Ardea 68:121–132.

ELLIS, C. R. 1966. Agnostic behavior in the male starling. Wilson Bull. 78:208–224.

ERSKINE, A. J. 1964. Nest site competition between Bufflehead, Mountain Bluebird, and Tree Swallows. Can. Field-Nat. 78:202–203.

FEARE, C. J. 1984. The starling. Oxford Univ. Press, Oxford.

FRAZIER, A., AND V. NOLAN, JR. 1959. Communal roosting by the Eastern Bluebird in winter. Bird-Banding 30:219–226.

HAARTMAN, L., VON. 1957. Adaptation in hole-nesting birds. Evol. 11:294–347.

HOLROYD, G. L. 1975. Nest site availability as a factor limiting population size in swallows. Can. Field-Nat. 89:60–64.

KENDEIGH, S. C. 1961. Energy of birds conserved by roosting in cavities. Wilson Bull. 73:140–147.

KESSEL, B. 1957. A study of the breeding biology of the European Starling (*Sturnus vulgaris* L.) in North America. Am. Midl. Nat. 58:257–331.

KLUYVER, H. N. 1957. Roosting habits, sexual dominance and survival in the Great Tit. Cold Spring Harbor Symp. Quant. Biol. 22:281–285.

KLUYVER, H. N. 1966. Regulation of a bird population. Ostrich (Suppl.) 6:389–396.

KUERZI, R. G. 1941. Life history studies of the Tree Swallow. Proc. Linn. Soc. N.Y. 52-53:1–52.

LEFFELAAR, D., AND R. J. ROBERTSON. 1985. Nest usurpation and female competition for breeding opportunities by Tree Swallows. Wilson Bull. 97: 221–224.

MERTENS, J.A.L. 1977. Thermal conditions for successful breeding in Great Tits (*Parus major* L.). III. Thermal properties of nests and nest boxes and their implications for the range of temperature tolerance of Great Tit broods. Oecologia 28:31–56.

MORRISON, D. W., AND D. F. CACCAMISE. 1985. Ephemeral roosts and stable patches? A radiotelemetry study of communally roosting starlings. Auk 102:793–804.

NILSSON, S. G. 1984. The evolution of nest-site selection among hole-nesting birds: the importance of nest predators and competition. Ornis Scand. 15:167–175.

O'CONNOR, R. J. 1978. Nest box insulation and the timing of laying in Wytham Woods populations of Great Tits, *Parus major*. Ibis 120:534–537.

PERRINS, C. M. 1979. British tits. Collins, London.

PITTS, T. D. 1976. Fall and winter roosting habits of Carolina Chickadees. Wilson Bull. 88:603–610.

ROBERTSON, R. J., H. L. GIBBS, AND B. J. STUTCHBURY. 1986. Spitefulness, altruism, and the cost of aggression: evidence against superterritoriality in Tree Swallows. Condor 88:104–105.

STOUFFER, P. C., L. C. ROMAGNANO, M. P. LOMBARDO, A. S. HOFFENBERG, AND H. W. POWER. 1988. A case of communal nesting in the European Starling. Condor 90:241–245.

SUMMERS, R. W., G. E. WESTLAKE, AND C. J. FEARE. 1987. Differences in the ages, sexes and physical condition of starlings *Sturnus vulgaris* at the centre and periphery of roosts. Ibis 129:96–102.

THOMAS, R. H. 1946. A study of Eastern Bluebirds in Arkansas. Wilson Bull. 58:143–183.

ZELENY, L. 1968. Bluebird nesting box temperatures. Atl. Nat. 23:214–218.

ZELENY, L. 1976. The bluebird. Indiana Univ. Press, Bloomington, IN.

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NEWS AND NOTES

HAWK MOUNTAIN-ZEISS RAPTOR RESEARCH AWARD

The Hawk Mountain Sanctuary Association awarded its 1989 research grant to Suzanne M. Joy, a M.S. candidate at Colorado State University. Her project is entitled "Nest-site characteristics and foraging behavior of sharp-shinned hawks in mature aspen and conifer habitats."

The Hawk Mountain Sanctuary Association is now accepting applications for its 13th annual award to support student research on birds of prey. Support for this award is provided by Carl Zeiss Optical, Inc. Up to $2,000 in funds are available and will be awarded to one or two recipients. To apply, a student applicant should submit a brief description of his or her research program (five pages maximum), a *curriculum vitae*, a budget summary including other funding anticipated, and two letters of recommendation to Dr. James C. Bednarz, Hawk Mountain Sanctuary Association, Rte. 2, Kempton, PA 19529, USA. The deadline for applications is 15 November 1989. The Association's board of directors will make a final decision in February 1990. Only undergraduate and graduate students in degree-granting institutions are eligible to apply. The awards will be granted on the basis of the project's potential to improve understanding of raptor biology and its ultimate relevance to the conservation of raptor populations. The funds are no longer restricted to studies in North America and applications from anywhere in the world will be considered.

NORTH AMERICAN LOON FUND GRANTS

The North American Loon Fund (NALF) announces the availability of two grant programs for support of new or current research, management, or education projects that may yield useful information for Common Loon conservation in North America. The first of these programs, the Robert J. Lurtsema Research Award, consists of a $1,000 stipend available annually for a suitable research project focused on a member of the Family Gaviidae. Preference will be given to students and independent researchers with limited availability of other funding. The second program offers modest grants in support of research, management, or educational projects directly related to the conservation of Common Loons as a breeding species. Proposals in the range of $500.00 to $3,000.00 are most likely to be considered for funding. Further guidelines for prospective applicants are available upon request from the NALF Grants Committee. Deadline for submission of proposals is December 15, 1989. Funding awards will be announced by March 15th, 1990. Please submit guideline request to: North American Loon Fund Grants Committee, North American Loon Fund, RR 4, Box 240C, High St., Meredith, NH 032253.

AWARD FOR *THE CONDOR*

In a recent competition sponsored by the National Composition Association, *The Condor* was awarded first prize for excellence in typographic design, layout, clarity, and readability.