

COMMUNAL ROOSTING BY THE EASTERN BLUEBIRD IN WINTER

ANITA FRAZIER AND VAL NOLAN, JR.

Although Bent (1949) notes that Eastern Bluebirds (*Sialia sialis*) may at times roost "several together," and Forbush (1929) is somewhat more explicit, the paucity of information on the bluebird's communal roosting suggests that the habit has been only rarely observed. Thus, the literature apparently contains no precise description of the behavior or physical condition of the birds nor any but general references to the bad weather which elicits this interesting response. This paper records observations by the senior author of roosting by a number of bluebirds in a nest box eight feet from the window of her house near Bloomington, Indiana, on five successive nights during extremely cold weather in February, 1958. After a brief review of some of the literature, the observations are analyzed with a view toward suggesting certain behavioral and physiological factors that may have been involved. In this connection the bluebird is compared with the Winter Wren (*Troglodytes troglodytes*), in which the habit has been more thoroughly studied.

LOCATION AND GENERAL BACKGROUND

The senior author's house stands at 990 feet above sea level, on the top of one of the highest hills in Monroe County, Indiana, in section 21, township 9 north, range 2 west. The nearest trees are a woods some 150 yards to the south, and there are extensive areas of mature woods no more than 300 yards distant in any direction.

The nest box in question is southeast of the house and therefore sheltered to some degree from cold winds, which are usually from the northwest. The box, 50 inches above the ground and on the west side of a bare pole ten inches in diameter, gets the last rays of the winter sun, which, indeed, shines into the one and one-half inch entrance hole. Inside dimensions are six inches in length and width and eight inches in height. The redwood boards are three-quarters of an inch thick, and the top is hinged to permit inspection of the contents of the structure. This box is one of six within one-quarter mile of the house. In February, 1958, it contained a few pieces of dry grass, but it had not been used for a nest since 1956. Other boxes had been occupied by nests in 1957, however, and throughout the fall of the latter year small flocks of bluebirds had engaged in their typical desultory exploring of all the boxes. Earlier in the winter, prior to the experience about to be related, as many as 22 bluebirds had been counted at one time on the wires and fence posts about the hilltop.

Until February the winter's weather was not especially rigorous. The first four days of that month were marked by snow on the ground, but this cover began to melt on Feb. 5, and disappeared in a few hours. It may be important that throughout the period of the communal roosting the sky was clear and the ground bare, and there were no known conditions rendering it difficult for bluebirds to find and gather whatever food supply the area afforded. Zero and near-zero night air temperatures began on Feb. 8-9; on the nights of 14-15 and 15-16,

the minimums rose to nearly 20° F. The behavior under discussion was not seen until it was noted by chance on the afternoon of Feb. 16, when it again turned very cold.

Weather data for the following chronological description were obtained from the station at the Bloomington airport, about five miles to the southeast of the hill. Times of sunrise, sunset and twilight for several dates (U. S. Naval Observatory, 1956) may be stated here to avoid repetition: Morning twilight began at 5:16 a.m. Central Standard Time on Feb. 9, 5:05 on Feb. 19, and 4:52 on Mar. 1. Sunrise was at 6:41 on Feb. 14, 6:34 on Feb. 19, and 6:28 on Feb. 24. Sunset was at 5:20 p.m. on Feb. 14, 5:26 on Feb. 19, and 5:32 on Feb. 24. Evening twilight ended at 6:46 on Feb. 9, 6:57 on Feb. 19, and 7:07 on Mar. 1.

THE OBSERVATIONS

February 16. Temperature 10° F. at 3 and 4 p.m., falling two degrees per hour until 6 p.m. and reaching a minimum of -2° before midnight. Between 3 and 6 p.m., surface winds were westerly and northwesterly at a fairly steady 15-16 knots, rising to gusts of a maximum of 22 knots.

At 4:30 p.m. a number of bluebirds were seen fluttering about the box, repeatedly entering it and leaving again and crowding each other as two sought entrance at once; on occasion as many as five were perched on its top. Also present was a male House Sparrow (*Passer domesticus*) which several times fluttered down past the opening as though trying unsuccessfully to go in; this bird was ignored by the others and soon left. Eventually 11 bluebirds went into the box, and one final member of the group perched on top, looked in, and departed. This last, or another, bird came back and again left without entering. After several such performances a twelfth bluebird went through the entrance at 5:00 p.m., and the evening's activity ended.

Vocalizations, if there were any, would have been inaudible through the window glass, and this is true of all subsequent observations. No count of the composition of the flock by sexes was made, nor, except as stated, was there an effort to differentiate between the behavior of the sexes. In recollection, it is the general impression that males and females were about evenly divided.

February 17. Temperature -5° F. (the minimum for the day) at 6 and 7 a.m., rising to -4° at 8 a.m. and to a high of 15° at mid-day, falling to 13° at 4 p.m., 9° at 5, and 8° at 6. Surface winds were westerly and northwesterly, at a rather steady 14-15 knots but with gusts of up to 23 knots.

No morning observations were made. At about 4:30 p.m. bluebirds began to arrive at the box, the thirteenth and last disappearing into it at 5:15. A male House Sparrow behaved as the one had done on the evening before.

On this and on all later evenings there was a marked reduction in the preliminary, possibly exploratory, going into and coming out of the box. Throughout the period birds would on occasion spend several minutes looking in before entering, but after the first night there was a certain directness and purposefulness in the general demeanor of all.

February 18. Temperature -3° F. (the minimum for the day) at

6 a.m., -2° at 7, 2° at 8, 22° at mid-day, 20° at 4 p.m., 19° at 5, and 16° at 6. Westerly and northwesterly winds in the late afternoon ranged between 11 and 18 knots, with gusts of as great as 25 knots.

At 6:45 a.m. no birds had yet emerged, so the box top was raised to permit an inspection. All 13 birds were present, filling the cavity to about three-quarters of its capacity; the entrance hole was blocked from the inside by the tail of one bird which pressed across it. The arrangement within the box was conspicuous and noteworthy: Each bluebird rested on its belly, its head pointed inward toward the center so that, viewed from above, the bills converged as at the hub of a wheel while the bodies radiated outward like spokes. The wheel is an inadequate figure in one respect, however, for the heads were also pointed downward, so that the long axis of each body was at about a 60° angle from the horizontal and the tails at a still greater angle. The birds thus formed a cone, apex down, and they were neatly arranged in two or perhaps three layers.

A moment or two after the box was opened, two birds fluttered out and flew somewhat erratically away. Another was then picked up from the cavity; its eyes were closed. Its feet had to be disengaged from the feathers of the back of the bird below it, but this is the only impression gained at the time concerning possible plumage adjustments to increase insulation (Moore, 1945). There was no response during several seconds of handling. It was then quickly replaced, the box was closed, and watch was resumed from inside the house.

At 7:25 six birds came out of the box and at 7:55 the remaining five. Three of the last group fluttered to the ground, remained there momentarily, then flew away. The others flew to fence posts or wires at various distances between the roost and the woods to the south, some resting on these perches for as long as two or three minutes before scattering toward the woods. The flight of all seemed to be labored and to lack buoyancy.

At mid-day the box was opened and found to contain a large quantity of droppings. Examination of other boxes near the house revealed a very few droppings in one. Fresh hay was placed inside the roost and bread crumbs and raisins strewn on its top and on the ground around it; the birds were never seen to touch this food.

At 4:35 in the afternoon, four bluebirds arrived together but departed after spending only a moment in the cavity. Five minutes later eight or nine appeared simultaneously, apparently from all directions, and these were shortly joined by several others. Seven members of this company went into the roost at 4:45 and five more at 4:55. Another four arrived at 5:20, but only two of this last group remained to roost. The House Sparrow did not appear.

February 19. Temperature 3° F. (the minimum for the day) at 6 and 7 a.m., 9° at 8 a.m., a maximum of 31° at midday, 29° at 4 and 5 p.m., and 22° at 6. A northwest surface wind of 13 knots at 4 p.m. fell to 6 knots at 6 p.m.

Emergence in the morning began at 7:50, all 14 birds leaving within a few minutes. Manner of flight and of dispersal was as described for the preceding day, except that no birds fluttered to the ground.

Two males were the first to arrive in the evening, at 4:50. They

seemed to spend several minutes adjusting the hay, which again had been renewed, and then remained in the roost. The next birds came at 5:20, a large group, but observation had to be discontinued at this time.

February 20. Temperature 16° at 6 and 7 a.m., 18° at 8, 45° at midday, 42° at 4 p.m., 39° at 5, and 34° at 6. A west and southwest breeze of 3 knots rose at 5 p.m. and freshened to 5 knots at 6 p.m.

By 7:20, when morning observation began, all but four birds had left the roost; these four emerged at 7:30. Only five bluebirds used the box on the night of Feb. 20, arriving together at 5:40 p.m. Their departure next day went unobserved, and roosting was not seen again. The minimum temperatures were 22° and 33° on Feb. 21 and 22, respectively, and during the rest of the spring there were no further periods of cold comparable to that described above.

BLUEBIRD OBSERVATIONS BY OTHERS

Forbush's statement that 20 to 30 bluebirds passed winter nights in the bird houses about the home of a correspondent is one of the two factual references we have found to social roosting by Eastern Bluebirds. The other is by Thomas (1946), who noted that "only in the coldest weather have the Bluebirds slept in boxes," and who once saw two pairs sleep peacefully together on a snowy night at 5° F. in a box for which they had fought a day or two earlier. The same investigator watched five fledglings go to roost pressed against each other in a row on a limb, when the temperature dropped suddenly on the day they left the nest. Evidently, too, she considered it normal for three or four bluebirds to spend moderate winter nights roosting in a terminal cluster of dead leaves. T. E. Musselman (*in litt.*) has occasionally found bluebirds, believed to be migrants, sleeping in nest boxes in late fall and early spring; once three roosted together, and several times two used the same box.

Forbush describes the Eastern Bluebird's habit of crowding together on a limb during the day to seek shelter from a snowstorm. His reference to the discovery of bluebirds found huddled together dead in hollow trees where they had taken refuge from "late spring storms" carries the implication that snow or ice was a factor in these fatalities; it is unknown, of course, when the birds entered the trees.

It is worth noting that Eastern Bluebirds, whose most formidable enemy Bent regarded as the elements, seem quick to take advantage of adventitious sources of heat. After a March snowstorm in Kansas had brought day-time air temperatures of -12° F., several bluebirds spent much time on the south rim of a chimney, evidently basking in the warm air blown over them by a light northwest wind (Parker, 1950). Others have been seen perched in the cracks of a log cabin in which cotton was stored, enjoying the heat emanating from it (Bent).

Both Western Bluebirds (*Sialia mexicana*) (Allen and Brewster, 1883) and Mountain Bluebirds (*Sialia currucoides*) (Henderson, 1903) sometimes assemble in great numbers after snowstorms. These congregations seem to be produced to some degree by social impulses and not to be merely assemblages at sources of food. Indeed, social roosting on "a fairly cold night—slightly below freezing" in February has been observed in the Western Bluebird (Stoner, 1932). What was evidently

a large flock broke into a number of small groups composed of from seven to ten birds, each group roosting in a cluster of mistletoe in a leafless host tree.

DISCUSSION AND ANALYSIS

Perspective on the observations described in this paper may be gained by comparing them with the considerable body of known facts, recently summarized and augmented by Armstrong (1955), about the winter communal roosting of the Winter Wren.

The weather. It is clear that with the bluebird, unlike the wren, it is not true that "high humidity and low temperature in association are crucial in eliciting and maintaining" the behavior. Relative humidity in the period under discussion is unknown, but it was not high. However, snow or possibly rain may stimulate social roosting on nights that are not excessively cold, and the facts described in this communication suggest that snow and ice and their effect on the availability of food are the most important cause of bluebird winter weather mortality.

Manner of assembling. Armstrong describes the wren's noisy exploratory behavior in late afternoon and discusses the role that singing, calling, and pursuit play in attracting members to the flock; some come to roost from a mile away. Following the first few gatherings, song is confined to the period just before retirement for the night, indicating that after a few days voice becomes less important in establishing and maintaining contact among the birds.

In the bluebirds, the increasing directness and facility with which they entered the roost after Feb. 16 and the similarity of roosting numbers each night till Feb. 20 suggest two points: Feb. 16 may have been the first night on which the flock slept together or used the box in question, and there probably was little change in group membership from night to night. It is entirely consistent with the senior author's observations throughout the fall and winter of 1957 and 1958, and with the facts found by Mrs. Thomas in Arkansas, to suppose that the birds roosting communally were among those present in the area during the fall, and that some had bred locally. Perhaps, then, the autumn interest in nest boxes and cavities functions in part to familiarize prospective winter residents with their future refuges in bad weather.

To one watching from inside the house it sometimes seemed that birds arrived separately and nearly simultaneously from all directions, but it is very likely that small loose flocks, maintaining contact during the late afternoon, worked their way together to perches surrounding the box and then flew to it at about the same moment. The alternative hypothesis, that several dissociated birds reacted independently but identically to the same stimulus, e.g., a low intensity of light, is scarcely acceptable in view of the wide range of arrival times even on a single night.

Arrangement in the box. The heads-together position seems well suited to minimize the risk of suffocation while at the same time permitting the birds to crowd together and thus reduce heat loss. It is also conceivable that the group's exhalation at the convergence of heads warms the air each bird breathes and that this is beneficial. Again, thermal receptors in the head region may be especially sensitive, so

that cold birds would seek warmth by directing the head toward heat sources. That some of these points may be valid is indicated by the discovery of a regular sleeping formation in wrens, possibly similar to that of bluebirds. While Armstrong's description (p. 282) of the arrangement admits of the interpretation that the birds line up, heads all in one direction, it is more probable that wrens too sleep with heads converging: "[T]hey squat on each other's backs, forming two or three layers or tiers. The birds rest with their heads inwards and tail towards the entrance or sides and the whole mass heaves gently as the wrens breathe. . . ."

The fact that the bluebirds' heads are below the level of their bodies may serve only the purpose of attaining convergence and maximum crowding, but perhaps additional ends are achieved. For example, the proportion of carbon dioxide at the bottom of the box may be slightly higher than it is at the top, and if so metabolism may be affected. In mammals, increased carbon dioxide tension in the blood stimulates respiration, while in birds carbon dioxide produces effects that vary from species to species and, of course, with the conditions of the experiment (Hiestand and Randall, 1941). In some birds the gas inhibits breathing (Sturkie, 1954). The effect on the bluebird is capable of experimental determination and further speculation on the point would be idle.

Times and duration of roosting. It is striking that the beginning of retirement for the night grew progressively later and the hour of arising in the morning progressively earlier (although the latter data are incomplete) during the period of the observations. This decrease in the duration of roosting corresponds with a gradual moderation of the weather from its coldest point on Feb. 17, and it is fair to suppose that the correlation is not accidental. However, as will appear below in connection with the reference to the work of Steen (1958), it is also possible that the bluebirds were becoming acclimated to cold and would have shortened their roosting period even had the temperature remained constant. In either event, the length of sleep and especially the late hour of rising (Wright, 1913, sets the average time of first song of the species at 3:19 a.m. in summer, 46 minutes before sunrise) point out the problem: On the coldest days of the period, when the metabolic cost of maintaining body temperature was presumably at its maximum, the time during which foraging was possible was at its briefest.

Some compensation for loss of foraging time may have come from a more rapid feeding rate and some from the use of energy reserves built up during favorable weather. Prolonged inactivity saved energy (Wetmore, 1921), and it is clear that heat conservation during the night was important, evidently so much so that the orderly assembling within the roost cavity outweighed the advantages of last-minute feeding before dark. But the condition of the birds on the morning of Feb. 18 and the sluggishness of their behavior immediately after arising on that and other mornings suggest that still another compensating factor was involved:

Hypothermia. The observations above seem to reflect a drop in body temperature as a physiological response to extreme cold. It is not

hard to see how two early observers listed by McAtee (1947) (originals not seen by us) were misled into believing that bluebirds hibernate.

Recently published results of Steen's experiments with certain ploceids and fringillids in Norway are highly suggestive. Placed in darkness and exposed to constant cold, "newly captured birds suffered a more or less pronounced hypothermia . . . with body temperatures between 30 and 38° C." and "seemed to be in a torporlike sleep. . . ." The birds awoke by themselves in the morning, although still in darkness; Steen therefore regards the hypothermia and deep sleep as a normal reaction. (Armstrong remarks that wrens sleeping in clusters are very difficult to wake.) After a short time in captivity, the birds became acclimated to the cold; their metabolism rose and their body temperatures no longer declined so greatly. Steen concludes that "nocturnal hypothermia may be regarded as a sort of 'second defense' against abnormally cold weather," when such behavioral defenses as seeking shelter fail.

After the present experience it would seem desirable to explore experimentally the probability that there is in the Eastern Bluebird, below certain air temperatures, a reduction in nocturnal body temperature more extreme than that which normally occurs in sleeping birds (Wetmore; Irving, 1955).

SUMMARY

From five to 14 Eastern Bluebirds roosted together in a bird house near Bloomington, Indiana, during cold, clear weather on five nights in February, 1958. The birds slept heads together and bodies pointed downward, forming an inverted cone. Retirement was earlier on colder nights; arising was later on colder mornings, over an hour after sunrise. The long duration of roosting and the very evident sluggishness of the birds lead to the suggestion that Eastern Bluebirds may respond physiologically to intense cold by reducing body temperature during sleep to a degree not previously known for the species.

REFERENCES

- ALLEN, J. A., and BREWSTER, W. 1883. Lists of birds observed in the vicinity of Colorado Springs, Colorado, during March, April, and May, 1882. *Bull. Nutt. Orn. Club*, **8**: 151-161.
- ARMSTRONG, E. A. 1955. *The Wren*. London, Collins. viii, 312 pp.
- BENT, A. C. 1949. *Life histories of North American thrushes, kinglets, and their allies*. Bull. 196, U. S. Nat. Mus. Washington, viii, 454 pp.
- FORBUSH, E. H. 1929. *Birds of Massachusetts and other New England states*, Part III. Mass. Dept. Agric. xlvii, 466 pp.
- HENDERSON, J. 1903. Mountain Bluebird increasing in Boulder, Colo. *Wilson Bull.*, **15**: 74-75.
- HIESTAND, W. A., and W. C. RANDALL. 1941. Species differentiation in the respiration of birds following carbon dioxide administration and the location of inhibitory receptors in the upper respiratory tract. *Jour. Cell. and Comp. Phys.*, **17**: 333-340.
- IRVING, L. 1955. Nocturnal decline in the temperature of birds in cold weather. *Condor*, **57**: 362-365.
- MCATEE, W. L. 1947. Torpidity in birds. *Amer. Mid. Nat.*, **38**: 191-206.
- MOORE, A. D. 1945. Winter night habits of birds. *Wilson Bull.*, **57**: 253-260.
- PARKER, R. L., and I. D. 1950. Note on behavior of birds on a cold, winter day. *Auk*, **67**: 108.
- STEEN, J. 1958. Climatic adaptation in some small northern birds. *Ecology*, **39**: 625-629.
- STONER, E. A. 1932. Some avian uses for mistletoe. *Auk*, **49**: 365-366.

- STURKIE, P. D. 1954. *Avian physiology*. Ithaca, Comstock. xx, 423 pp.
 THOMAS, R. H. 1946. A study of Eastern Bluebirds in Arkansas. *Wilson Bull.*,
58: 143-183.
 U. S. NAVAL OBSERVATORY. 1956. *The American ephemeris and nautical almanac
 for the year 1958*. Washington, xvii, 593 pp.
 WETMORE, A. 1921. A study of the body temperature of birds. *Smithsonian
 Misc. Coll.* 72, No. 12. Washington. 52 pp.
 WRIGHT, H. W. 1913. Morning awakening and even-song. Second paper. *Auk*,
30: 512-537.

Ellettsville, Indiana and Indiana University, Bloomington, Indiana.

EVENING GROSBEAK JUVENALS AT HADLEY, MASSACHUSETTS — JULY 1958*

By MARY S. SHAUB

After an unprecedentedly heavy and extensive Evening Grosbeak incursion in the northeast during the winter of 1957-58 it was not surprising to find that the breeding area has been extended to the middle of the Connecticut Valley in Massachusetts in 1958.

The first definite breeding record for the State was established in 1937 at Mt. Hermon where on July 28th Harry C. Holton observed an adult male molting and on July 29th "a very young bird 'more buff or brownish than the female' was also studied in the pines behind Mr. Holton's house." (Bagg & Eliot, p. 788). Despite this record, a survey of the literature revealed only a few summer records of adult Evening Grosbeaks for Massachusetts and no other juvenal observations. These reports included Cape Cod 1923, Bedford 1946, Middleboro and Wilbraham 1950 and West Hatfield 1952. (Shaub 1954, p. 93). No adult or juvenal grosbeaks were reported in the State in the summers of 1953-57 inclusive although in 1957 grosbeaks were observed at Bloomfield, Connecticut (Shaub 1958, p. 9). In the meantime juvenals were observed at Glebe Farm, South Londonderry, Vermont in the summers of 1953-57 inclusive, a locality only about 33 air miles north of the Massachusetts-Vermont line.

After the deep penetration of the Evening Grosbeak during the winter of 1957-58, the lagging movement north in May was watched with keen interest. In the Connecticut Valley region of Massachusetts there was unusually late activity. At Northampton on May 29th two pairs were observed fluttering their wings and a male offered a seed to a female (J. Watrous). In Pelham as many as 50 grosbeaks were still present on May 13th with subsequently a decline to one male which remained until June 6th. (J. Seitz). In Amherst Mrs. Alden Tuttle observed a pair in her yard on June 19th and in the same town Mr. Merrill Thompson and Mrs. Kenneth Bullis noted a female on the 26th. Also in Amherst Mrs. Elmer Staples observed a male flying over Gray Street on July 1st (fide J. Seitz).

Of more significance were the observations made by Mrs. Marion Durgin in the town of Hadley between Northampton and Amherst. Mrs. Durgin's home is located on North Maple Street just off Route 5 and

*Contribution No. 22 from the Shaub Ornithological Research Station