while the deep-body temperature was 38.6°C (fig. 1). This probably reflects a lowering of the set-point for temperature regulation during sleep (Hammel et al., J. Applied Physiol. 18:1146, 1963). It would, however, be valuable to have some information on the lower critical temperature of tropical sea birds.

SUMMARY

The deep-body temperature of two nesting Red-footed Boobies was measured by telemetry. The birds were able to keep their body temperatures below 40°C during exposure to direct sunlight by gular fluttering and behavioral adjustments. At night, the body temperature decreased to 38.1°C and the birds were observed to shiver in the early morning at an air temperature of 22°C. The highest body temperature was recorded after the birds returned to the nest, presumably after flying over the ocean for many hours.

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NEST-SITE SELECTION IN BLACK-CAPPED CHICKADEES

SUSAN M. SMITH

Department of Biological Sciences
Wellesley College
Wellesley, Massachusetts 02181

The choice of a suitable nesting site is of prime importance to breeding birds. Any factor that so directly affects the survival of offspring must be under very strong selective pressures.

In many cases it is extremely difficult to determine which member of a pair takes the lead in deciding where the nest will be. This is made even more complicated in species such as the Black-capped Chickadee (*Parus atricapillus*), in which both members of a pair regularly explore and excavate several potential nest sites before a final decision is made. Yet Odum (Auk 58:518, 1941) wrote of the Black-capped Chickadee, ". . . the female apparently takes the lead in the selection of the site . . ." (p. 518), although he did not present his evidence for this conclusion. This paper gives evidence which suggests that, at least in some instances, the male may take considerable part in nest-site selection in this species.

The observations reported here were made during a 3-year study of color-banded chickadees in Wellesley, Massachusetts. Much of the study area, on Wellesley College campus, was covered with natural mixed woods, approximately 75% deciduous and 25% coniferous. Major deciduous species included red oak (*Quercus borealis*), white oak (*Q. alba*), and gray birch (*Betula populifolia*); most of the cavities used for nests by chickadees in this study were located in trees of these three species.

The observations for this paper center around male O/O, banded 12 November 1970. During the winter of 1970–71 he was the dominant bird in a flock of six and was frequently observed associating closely with Blue/O, a female banded 20 November 1970. These two birds paired the following spring. Their breeding territory, comprising almost all of the winter flock territory, was approximately 18 acres, of which an estimated 45%, or just over 8 acres, was covered with natural mixed woods. Although they excavated at least three natural nest sites in these woods, their final choice was in a black metal sign post in a parking lot, in an unwooded part of their territory. This post was 59 inches high and 2 inches in inner diameter and was completely open from above. The nest was supported by the lower of two screws attached to the sign; this screw was 13 inches from the top of the post. The only branch overhanging the post was the tip of a white oak branch, 27 ft above the nest entrance. Nevertheless, the nest in 1971 was successful, fledging at least four young.

O/O was once again the dominant bird of a six-bird flock in the winter of 1971–72. His mate Blue/O disappeared from this flock in late October 1971. After her disappearance, O/O associated closely with Y/Y, a female who had been part of his flock the previous winter, and who had mated with another male in 1971. However, Y/Y was found dead on 8 March 1972. O/O associated briefly with still a third color-banded female, from a flock some distance away, but she too disappeared in early May, and for the next 5 weeks O/O was alone in his territory. The boundaries of this territory were essentially the same as in the previous year. During this 5-week period, he vigorously defended his territory from the two neighboring pairs and sang far more frequently than the other territorial males, especially during the middle of the day. This unusual singing behavior stopped abruptly on 12 June 1972, with the appearance of

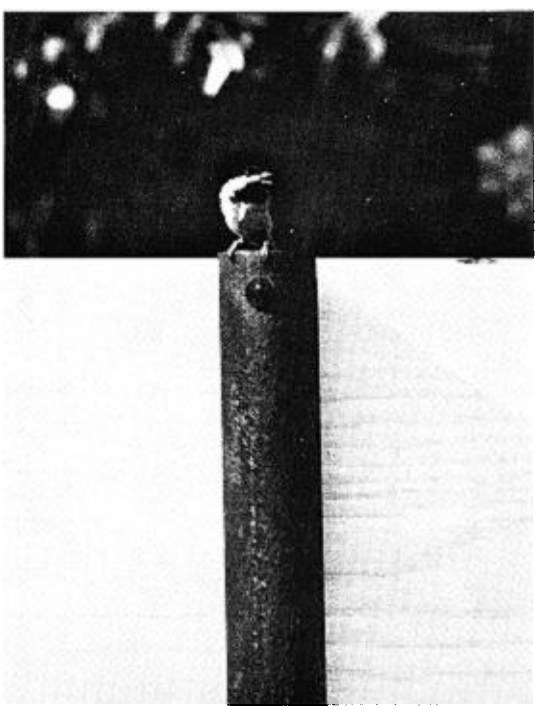

FIGURE 1. Female Black-capped Chickadee perched at the entrance to her nest in a sign post. Note the open bill and the sharp shadow caused by the afternoon sun.

an unbanded female. The newly formed pair investigated several natural cavities in the wooded section of their territory, yet once again, with this new female, the final choice was the same exposed sign post in the parking lot.

The sign post was situated so that it received no shade from the south or west; therefore it was unprotected from the afternoon sun. Since the nest was started so late, the female's incubation lasted well into July. On sunny afternoons the temperature within the black metal post must have been extremely high; at least five times per hour the female would come to the entrance of the nest and sit with her mouth open, in an apparent effort to cool off (fig. 1). As mentioned above, the nest site had minimal protection from rain; the one egg that was laid did hatch, but the nestling died unfledged 18 days later in a torrential storm.

The new female, who had been banded near the nest, deserted O/O immediately after post-breeding molt and joined a neighboring flock whose dominant male (Y) had just lost his mate. As of April 1973, she and Y were clearly mates, while O/O had yet another mate. Such desertion when both members of a pair are alive is rare in this species (see for example Odum, Bird-Banding 13:155, 1942; Bent, U.S. Natl. Mus. Bull. 191:1, 1946). It is interesting that it followed an unsuccessful nesting attempt in such an unusual nest site.

Bent (op. cit.) includes no statement concerning which sex selects the nest site for any North American species of *Parus*. S. Smith (Publ. Nuttall Ornithol. Club, No. 11, 1972) reported what was ". . . probably a nest site showing display . . ." (p. 19) seen in three males of the Carolina Chickadee (*P. carolinensis*). However, the only published report that I have found regarding this question in *P. atricapillus* is Odum's (op. cit.) statement suggesting that the female makes the final decision.

There are several reasons why the selection of the sign post for a nest site was unusual. First, the territory contained 8 acres of woodland, including many natural nest cavities; second, the sign post was in one corner of the territory, within 25 ft of a three-way boundary with two other nesting pairs of chickadees, whereas the wooded part of the territory was edged by fields unoccupied by territorial chickadees; and finally, it was in a very exposed position, unprotected from both afternoon sun and rain, and located in a well-used parking lot that was brightly lighted at night. The fact that the same male nested in such a peculiar site for two successive years with two different females strongly suggests that at least occasionally the male plays a significant role in nest-site selection in this species.

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TELEMETRY OF ELECTROCARDIOGRAMS FROM FREE-LIVING BIRDS: A METHOD OF ELECTRODE PLACEMENT

SCOTT W. SAWBY AND JAMES A. GESSAMAN
Department of Zoology and Ecology Center
Utah State University
Logan, Utah 84322

Monitoring the heart rate of a bird in the wild requires an electrode placement that is not easily accessible to the bird's mandibles and feet, and that can remain functional for several weeks to months. In addition, electrode placement must give a discernible ECG signal while the bird is at rest as well as during flight when strong electromyogram (EMG) potentials from the active pectoral muscles are present. We experimented with several electrode placements in the American Kestrel (*Falco sparverius*) and found the following one to be superior.

METHOD

Briefly, two electrodes were anchored into the keel of the sternum near the heart from inside the body cavity. The electrode leads were brought through an incision in the abdominal muscle wall and threaded under the skin from the abdominal incision to the bird's back. They then passed through the skin and terminated at a position that is not readily accessible to the bird.

This procedure will now be described in detail. An incision about 6 mm long was made just posterior to the sternum through the midline of the abdominal wall of an anesthetized bird. An electrode, consisting of a No Knot Eyelet (available at sporting goods stores) silver-soldered to 8 cm of very flexible, multistrand, teflon-coated, stainless steel wire (available from Narco Bio-Systems, Inc., Houston, Texas), was grasped firmly with a hemostat and inserted through the incision. It was slipped carefully along the dorsal surface of the sternum (parallel to the keel) to a position near the apex of the heart. (It is helpful to practice on a dead bird before attempting a live implant.) The point of the No Knot Eyelet was then thrust into the keel while the breast of the bird was braced anteriorally with the other hand. The second electrode was anchored similarly in the midline of the sternum 1–2 cm posterior to the first (fig. 1A and B). The muscle of the abdominal wall was then stitched closed around the electrodes with triple zero chromic sutures; one or two stitches were usually sufficient.

The two electrode leads were then threaded under the skin to the bird's back through a curved 15-gauge hypodermic needle. The needle was inserted under the skin on the bird's side, just anterior to the femur, and was guided through the subcutaneous tissue to the incision. The wires were then threaded into the tip and through the bore of the needle. The needle was withdrawn leaving the wires under the skin (fig. 1C). The abdominal incision in the skin now can be sutured closed. This same procedure was repeated, starting from a point in the middle of the bird's back and going to the lead wires which protrude from the skin on the side (fig. 1D).

Connectors compatible with those on the transmitter were soldered to the lead wires protruding through the skin on the back. A harness was used to secure the ECG transmitter to the bird (fig. 1E and 2). We used a Narco Bio-Systems, Inc. Model E-3 ECG transmitter, weight—7 g. When the transmitter was not in place on the harness, the exposed electrode leads were taped to the harness to protect them from the bird's mandibles.

Figures 3A and B are X-rays of a kestrel with electrodes and harness (without a transmitter) in in place. The accompanying sketch (fig. 3C) is included to clarify the X-ray.