NOTES ON INCUBATION AND NESTLING TEMPERATURES AND BEHAVIOR OF CAPTIVE OWLS

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TEMPERATURES of eggs, nestlings, and parent owls are infrequently reported, for the nests are often inaccessible, the adult birds are difficult to handle, and owls rarely nest in captivity. Nice (1962) has recently called attention to the scarcity of studies of development of young owls. One pair each of the Burrowing Owl (*Speotyto cunicularia*) and the Barn Owl (*Tyto alba pratincola*) undertook nesting in captivity at the University of California, Los Angeles, and some temperature data and observations on behavior were obtained.

BURROWING OWL

Two Burrowing Owls (*Speotyto cunicularia hypugaea*) were acquired by Mrs. Anita Long Bailey from Los Alamitos, Orange County, California, in May 1958. The nest burrow had been excavated by some small boys and contained five young birds; two of these, of an estimated age of one week, were given to Mrs. Bailey, who was at that time employed in the Department of Zoology at U.C.L.A.

On the first day in captivity the birds were force-fed small pieces of raw meat every two hours; from the second day on, they opened their mouths whenever a hand was brought near them and feeding became simpler. As might be expected, these burrow-adapted nestlings showed little skill in locomotion. When still in the downy stage but with their eyes fully open, the young owls showed no hesitancy in crawling off the edge of some surface such as a tabletop, and they were also inept at avoiding any stationary object that happened to be in their path. After they reached the fledgling stage the birds were kept in a cage measuring about 1.3 m × 1 m × 1 m. Even when full grown, the owls would never kill live mice placed in their cage and actually showed fear of them; however, freshly killed mice were accepted and eaten readily. The cage was kept in a windowless office in the Life Sciences Building at the University of California, Los Angeles. No fixed light regime was maintained, but the fluorescent lights in the room were usually on for at least eight hours every day.

Beginning on 18 February 1959, a male Burrowing Owl from Florida (*S. c. floridana*) that had been in captivity elsewhere for several years was kept in a cage with one of the California birds that proved to be female. The latter was then about nine months old. As both these birds were relatively tame, they were frequently taken out of the cage and allowed the freedom

of the office. During these periods of liberty the birds explored the room, and the female appeared to be seeking a nest site as she investigated various semienclosed spaces at or near the level of the floor. Usually, the male either watched or followed the lead of the female in these movments. A space about 15 cm high between the lowest shelf of a bookcase and the floor was looked into most often, and a dark corner of this space was especially favored. The female repeatedly entered and emerged from this corner, frequently followed by the male, and both birds often appeared highly excited by this activity. On one occasion when both birds were on the floor of the room, the male assumed a very erect posture with the feathers of the head and neck region fully fluffed out and the white throat patch showing conspicuously; he then bowed stiffly and rapidly toward the female. During this display he appeared to be larger than the female although he was actually smaller in weight and other dimensions. Possibly in response to the display, the female went through the pattern of entering and emerging repeatedly from the favored corner. Her behavior suggested an inducement to the male to follow her into the presumed nest site, but he did not follow or continue the display. Whether or not this or similar displays pertained to courtship or some other behavior was difficult to determine under the highly artificial conditions of captivity. The necessary routine use of the room disturbed the birds at irregular intervals, and therefore no attempt was made to describe and interpret all of the birds' activities.

On the morning of 5 March, an egg was present on the bare floor of the cage. Both birds were highly excited, and although the female did not incubate, she was unusually aggressive and would fly at one's hand if it were put into the cage. By late afternoon, however, the bird no longer was aggressive nor did she show any interest in the egg. It was removed and was found to be cracked. In an attempt to encourage a successful nesting, a cardboard box about 15 cm square and 25 cm long was placed in the favored corner under the bookshelf and arranged so that the open end of the box faced outward into the room. The birds' cage was then placed on the floor in front of the bookcase so that the box opened into the cage. Sand was provided on the cage floor and in the box, and although dry grass was placed in the cage, it was not used as nesting material. The box was evidently acceptable as a nesting burrow substitute, and both birds frequently went into it together. The male spent much more time outside the box, however, and he was aggressive toward anyone who approached the cage. No copulations were observed, but a total of five eggs were laid on the following dates: 8, 9, 12, 14 or 15, and 17 March. Whether or not any of the eggs were fertile is unknown. All were eventually eaten or broken, and no more than four were present in the nest at any one time. However, the female developed an incubation patch and

spent most of her time on the eggs as long as any remained. The male often stayed in the nest box with the female, but he did not have an incubation patch and presumably took no part in incubation.

As the owl eggs were about the same size as those of the California Quail (*Lophortyx californicus*), a quail egg that was available was prepared for recording of incubation temperature with a thermister thermometer. A hole was bored in the large end of the egg, and a small, vinyl-sheathed thermister probe was inserted so that its tip was near the undersurface of the shell. The probe was fixed to the shell with a small piece of adhesive tape, and the egg was placed in the nest among the owl's own eggs in such a way that the thermister tip was uppermost. The lead from the thermister probe was run through a small hole in the side of the nest box to the instrument proper, and temperatures could be read from it without disturbing the owl. On 6 April, at an air temperature of 23 C, the prepared-egg temperature remained constant at 35.5 C for 20 minutes; this should be virtually identical with the incubation temperature of the owl's own eggs.

On 7 April, skin and cloacal temperatures of both adult birds were taken during midday at an air temperature of 25 C. Skin temperatures were taken with a "banjo-tip" probe that was pressed flat against the body surface. The temperatures were:

Male	Female
Abdominal skin: 39.8	Abdominal skin: 39.8
Pectoral skin: 39.0	Pectoral skin: 38.5
Deep (25 mm) cloacal: 40.5	Deep (25 mm) cloacal: 40.2

The temperatures for both sexes were identical or virtually so; this included the abdominal skin temperature although the incubation patch of the female was well developed and conspicuous. The data indicate that in this species the presumably increased vascularization of the incubation patch does not bring about a rise in the surface temperature of this area. However, an augmented blood supply to the defeathered abdominal skin would result in an increase in the amount of heat continuously available for warming the eggs.

BARN OWL

On 8 April 1959 a female Barn Owl of unknown age that had been in captivity for about six months was acquired. On that date the abdominal skin temperature was 38.8 C and the cloacal temperature was 40.0 C. A few months later a male Barn Owl of unknown age was acquired, and the two birds were kept together in a small outdoor cage that included a wooden compartment at one end into which the owls could withdraw from view. They were fed freshly killed laboratory rats and guinea pigs. No courtship by the birds

was observed, but in March 1960 the female was found to be incubating four eggs. The female had an incubation patch and the male did not. On 17 March, an egg of a bantam hen was prepared with an inserted thermister probe in the manner previously described. The small hen's egg was about the same size as a Barn Owl egg although not as rounded. During approximately one hour (2 to 3 PM) of continuous incubation, the temperature inside the egg reached equilibrium at 34.3 C. On 7 April, another continuous record for almost two hours (8:15 to 10 PM) showed an internal egg temperature at equilibrium of 34.0 C. On both dates, the air temperature was about 20 C. On 19 April, temperatures of the adult owls taken during the day were as follows:

Male	Female
Abdominal skin: 38.0	Abdominal skin: 39.3
Deep cloacal: 38.7	(incubation patch)
	Deep cloacal: 40.8

The temperature of the abdominal skin in the female was somewhat above that in the male, but this appears to reflect a slightly higher overall body temperature in the female rather than an increase associated with incubation patch development.

The first clutch of eggs did not hatch as three were eaten by one or both adults and the fourth was abandoned. The latter contained an embryo about two-thirds grown, and presumably the other eggs were also fertile. Sometime in May four more eggs were laid, and this time the male owl was removed to another cage. On 7 June one egg disappeared, presumably eaten by the female, and on 8 June the other three were transferred to an incubator that was kept at approximately 37 C (36–37.7 C). One of the eggs was already pipped on 8 June, and it hatched sometime between 9 PM on 9 June and 9:30 AM on 10 June. A second egg hatched two days later. The third one, although fertile, failed to hatch. The following weights were recorded:

Unpipped egg: 26.8 g
Pipped egg: 25.2 g
Hatchling owls: 18.5 g; 18.4 g

These are higher than the figures given by the Heinroths (1924–33, II:9–10) for eggs and hatchlings of the European form, *T. a. guttata*, but accord well with the data of Sumner (1929) for other examples of *T. a. pratincola*. During the next 10 days the capacity for body temperature regulation of the two owl chicks was studied. All temperatures of chicks recorded were deep esophageal and were taken with a vinyl plastic-sheathed, copper-constantan thermocouple. Between experiments the birds were returned to their nest and were

attended by the female parent. The older of the two chicks grew much more rapidly than the other; the latter disappeared from the nest on 22 June (age about 10 days) and was presumably eaten by the female parent. The other chick grew to maturity, and this bird and both parents were released in the fall of 1960.

When less than 12 hours out of the eggs, the hatchlings were sparsely covered with short white down; this was present even on the toes, extending over the proximal ⅔ of their length. The skin, bill, and cere were pink, and the cere seemed relatively large. The feet were zygodactylous and no reversal of toes was seen. The eyes were completely closed. Two different vocalizations were recognizable—a strong, oft-repeated "peep" and a harsh note that seemed to express protest. A hatchling could right itself readily when placed on its back and could even hold its head up for a few seconds, but it could crawl only slightly. At a body temperature of 24.7 C, an owl chick could still "peep," extend its wings, and move its feet, but it could barely raise its head.

The responses of the body temperatures of the owl chicks at different ages to ambient temperatures of about 22 C are shown in Figs. 1 and 2. At a post-hatching age of less than 12 hours, a chick's body temperature had almost reached the level of ambient temperature after one hour. As they grew older the chicks showed only gradual improvement in body temperature regulation, and even at 10 days of age there was a decline of about 7 C during one hour of exposure to moderate air temperature. As body temperature fell, shivering was first noticeable in the extremities and then showed over the entire body. The 3-day-old chick began strong total-body shivering at a body temperature of 28.5 C, but its temperature continued to decline. The 8- and 10-day-old chicks showed pronounced body shivering at a body temperature of about 31–32 C, and at this point a slight leveling-off of the decline was noted.

Sumner (1933) mentions an experiment on "a day old barn owl whose temperature rose only [!] to 46.3°C. in an artificially induced air temperature of 50.5°C., although the bird died as a result of the treatment." I attempted a similar experiment using a lower ambient temperature than did Sumner. A hatchling Barn Owl less than 12 hours old was taken from the incubator and immediately placed in a chamber in which the air temperature was maintained at 45 C (Fig. 1). Body temperature rose rapidly, reaching 41.2 C after 7 minutes, and the bird "peeped" and panted vigorously. After 15 minutes the chamber was again opened, and the owl chick bore an alarming resemblance to a cartoonist's characterization of a "dead bird"— it was lying on its back, neck extended, beak vertical, with legs slightly flexed and pointed upward. There was no vocalization or movement, and body temperature had reached almost 44 C. The bird was not dead, however, and it rapidly recovered when

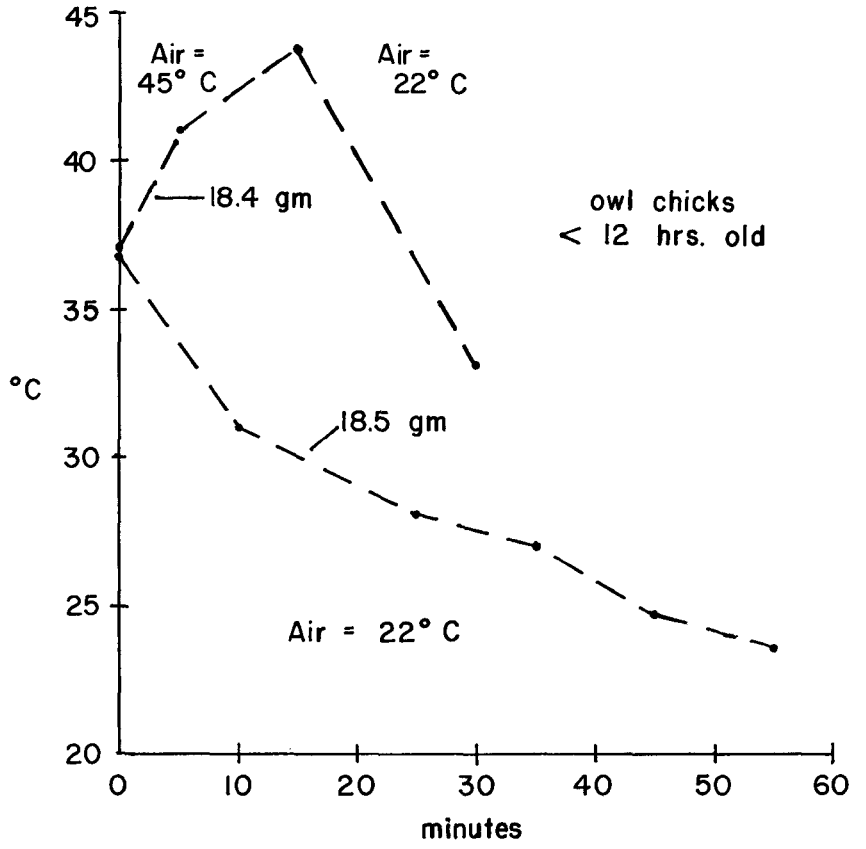

FIG. 1. Body temperatures of Barn Owl chicks exposed to high and moderate air temperatures.

removed to the moderate room temperature. There was no panting—only slow, irregular respiration—during the interval of body temperature decline, and the cooling-down process was apparently entirely passive.

DISCUSSION

Only two nestling Barn Owls were available for study, and it is possible that the experimental treatment to which they were subjected soon after hatching could have affected their later responses (Ryser and Morrison, 1954); extensive comparisons or generalizations would thus be unwarranted. Information on thermoregulation in young owls is so scarce, however, that the present data may appropriately be discussed if the above-mentioned caveat is kept in mind.

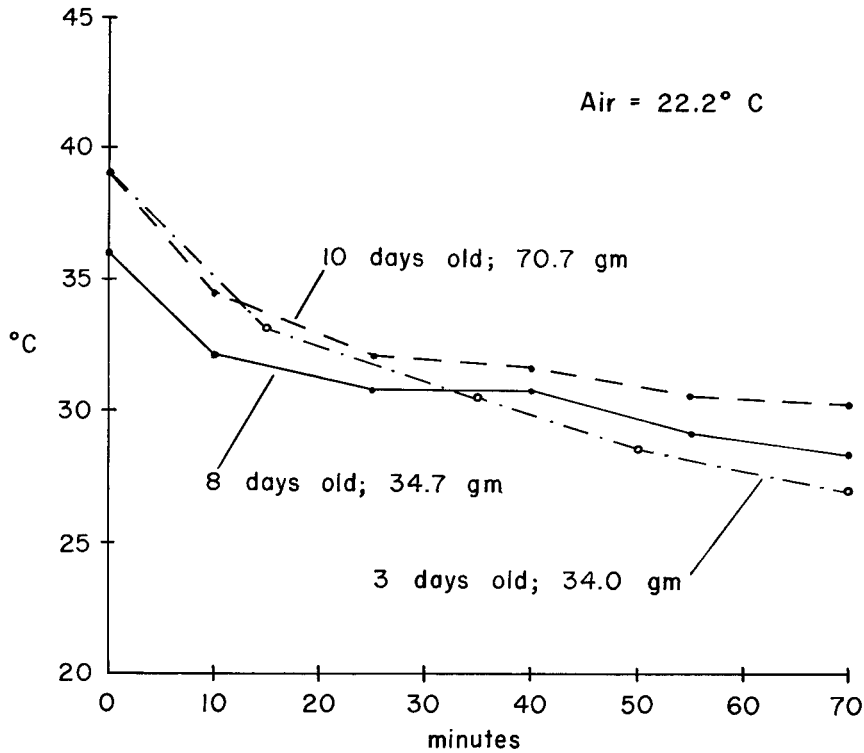

FIG. 2. Body temperatures of Barn Owl chicks of various ages exposed to moderate air temperatures.

Barth (1949) recorded body temperatures of nestling Snowy Owls (*Nyctea scandiaca*) from 0.5 to 12 days of age exposed to air temperatures of 5.5 to 10.5 C for intervals of 15 to 29 minutes after the departure of the brooding parent. The initial body temperatures of the Snowy Owl nestlings are not given, but presumably they were close to those of brooded Barn Owl nestlings (36–39 C). Despite the cold conditions to which the young Snowy Owls were exposed, the decline in their body temperatures was no greater than that shown by Barn Owls at the same ages exposed to much milder ambient temperatures. The adaptive advantage of better heat retention in nestling Snowy Owls is obvious, for this species nests on open arctic tundra; the Barn Owl usually nests in sheltered sites under mild climatic conditions.

Comparison of the capacity for body temperature regulation in nestling Barn Owls with that of various altricial and precocial species indicates that these owls are closer to the altricial condition. Nice (1962) designates newly hatched owls as semialtricial. The newly hatched Barn Owl appears unable to

maintain body temperature above even moderate ambient temperature for more than one hour, and its body temperature rises rapidly toward the lethal level at high ambient temperature. At the age of three days the rate of decline in body temperature at moderate ambient temperature seems to have slowed slighly, but the rate is more rapid and the decline greater than in a precocial pheasant chick (*Phasianus colchicus*) of the same age under similar conditions (Ryser and Morrison, 1954). Effective body temperature control is acquired much more slowly in the Barn Owl than in small altricial passerines, which may be relatively homeothermic beyond seven days of age (Dawson and Evans, 1960). Thermoregulatory ability in the Barn Owl nestlings seems also to develop more slowly than in precocial chicks. Pheasants at ages of 7 and 11 days experienced a drop in body temperature of only 2 to 3 C after 30 minutes exposure to an air temperature of 20 C (Ryser and Morrison, 1954: 257); Barn Owl chicks at age 8 and 10 days showed a considerably greater drop after 30 minutes exposure at about 22 C (Fig. 2). Young gulls (*Larus*) in this age bracket exposed to air temperatures below 22 C maintained higher body temperatures (Barth, 1951) than did the Barn Owl nestlings under less cool conditions.

The natal down does not seem to contribute importantly to heat retention in the Barn Owl, but it is probably more significant in the Snowy Owl and other species that nest under cold conditions. In nestling owls of the temperate and tropical regions, the first covering of down may possibly function to protect the skin from excessive soiling during feeding.

SUMMARY

Burrowing Owls (*Speotyto cunicularia*) and Barn Owls (*Tyto alba*) nested in captivity at the University of California, Los Angeles. The fertility of the Burrowing Owl eggs was uncertain; although incubated, they were all eventually eaten by the adults. The Barn Owl eggs were fertile and one young bird was successfully raised. Only the females developed an incubation patch, and its temperature was 39.8 C (*Speotyto*) and 39.3 C (*Tyto*). Continuous recordings of temperatures inside incubated eggs gave figures of 35.5 C (*Speotyto*) and 34.0 to 34.3 C (*Tyto*). Nestling Barn Owls are ptilopaedic but develop capacity for body temperature regulation very gradually; this is consistent with Nice's (1962) designation of newly hatched owls as semialtricial.

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