one of its own bodily products, a feather, to attain a goal in what seemed to me to be an easier performance than its typical preening and oiling behavior. Furthermore, this observation adds another facet to the use of tools by birds and other vertebrates—use of a tool to care for the surface of the body by means of a brush.—ANDREW J. MEYERRIECKS, *Department of Biology, University of South Florida, Tampa, Florida 33620, 11 February 1972.*

Cold hardiness and the development of homeothermy in young Black-bellied Tree Ducks.—The Black-bellied Tree Duck (*Dendrocygna autumnalis*) is a southern species and dump nesting is extensive in Texas (Bolen, 1962 and 1967). Dump nests are the results of several females laying eggs in the same nest. Large broods with as many as 43 ducklings have been recorded and are a direct result of these dump nests (Cain, 1970).

Koskimies and Lahti (1964) have shown that surface ducks (Mallard, *Anas platyrhynchos*, and Common Teal, *A. crecca*) could not maintain combined broods because the ducklings were not cold hardy. Combined broods are common however in most genera of diving ducks, such as *Aythya* and *Melanitta* (Hochbaum, 1944) and *Bucephala* and *Mergus* (Mendall, 1958).

This study was conducted to determine the cold-hardiness and ontogeny of thermoregulation in the Black-bellied Tree Duck young and relate this to possible success of large brood that result from dump nests.

METHODS

Forty ducklings hatched in forced-air incubators were kept for 3 days at 42° C and then placed at 32° C. Another 40 ducklings were placed in outdoor pens at one day of age without a brooder.

The fate of 22 ducklings found abandoned in nests were recorded for comparative purposes.

During the temperature regulating experiment ducklings were placed in a perforated paper box in a dark cabinet held at 0° C. At 5-minute intervals a quick-registering thermister was inserted into the duckling's mouth to a depth of 40 mm. This core temperature was then recorded on a Yellow Springs Inc. telethermometer. Cotton gloves were worn to reduce heat transfer to the ducklings.

The ducklings were removed from the cold when they were unable to stand up, or after 30 minutes, and returned to their initial room temperature. Maintenance of the ducklings followed the procedure used by Cain (op. cit.).

RESULTS AND DISCUSSION

Temperature regulation.—Ducklings of this species apparently are unable to maintain a constant body temperature for several days after hatching (Fig. 1) when exposed to a low ambient temperature. The body temperature dropped rapidly (1.26° C per minute) for ducklings 1 day old and slowed as the age increased (0.50° C per minute for 6 day old ducklings). At 12 days of age the rate of cooling was 0.35° C per minute for 20 minutes and then the ducklings maintained a steady temperature of 32° C.

The slower rate of cooling for older ducklings may be due partly to an increase in metabolism (Cain, in prep.), a decreased surface to volume ratio as the duckling increased in weight, and the increased insulation afforded by the development of the juvenal down between 10–12 days of age (Cain, 1970). A similar cooling trend for nestling House Wrens

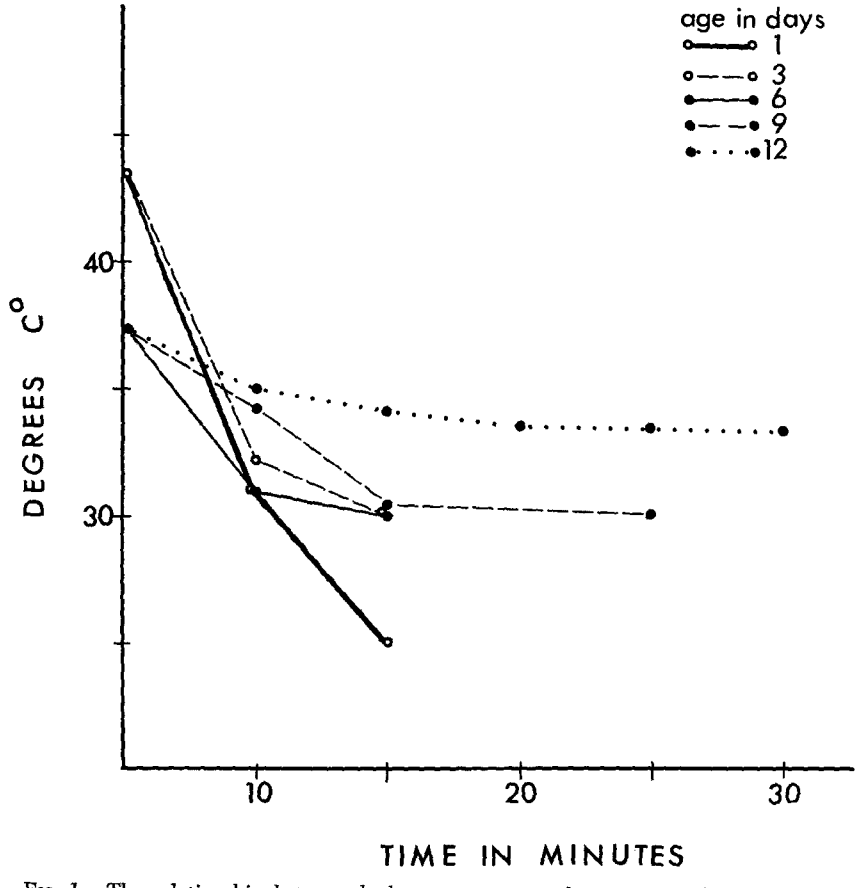

FIG. 1. The relationship between body temperature and time exposed to the ambient temperature (0° C) as a function of age.

(*Troglodytes aedon*) was reported by Kendeigh and Baldwin (1928) and for nestling Cactus Wrens (*Campylorhynchus brunneicapillus*) as reported by Ricklefs and Hainsworth (1968).

Cold-hardiness.—Both parents stay with the brood in this species even after the young have attained flight (pers. observ.) and it is assumed that both adults contribute to the brooding in the early stages. The importance of brooding may be seen in Table 1. Ducklings not brooded died before 7 days of age and their body weight at death was significantly lower than ducklings of the same age that were brooded.

This low degree of cold-hardiness, before thermoregulation develops, should restrict the independence of the young Black-bellied Tree Ducks and increase the adult's burden of supplying energy. This may be a considerable amount for the parents of large broods and this attentiveness may lead to the strong family bonds in this species.

I suggest then that large broods resulting from dump nests in south Texas may enjoy

TABLE 1

COMPARISON OF DUCKLINGS BROODED ARTIFICIALLY AND THOSE NOT BROODED

The average body weight is for 7-day-old ducklings or as indicated.

Ducklings considered	Number hatched	Number survived	Per cent survival	Body weight (in grams)
Artificially incubated				
Unbrooded	40	0	0	22.0[1]
Brooded	40	30	75	31.5
Wild caught				
Unbrooded	10	0	0	21.5[1]
Brooded	12	6	50	32.0

[1] Average body weight at death.

a high success if adverse weather conditions do not occur during the first 10 days after hatching. This high degree of success would be a function of the low energetic stress upon the young themselves and the increased frequency of brooding because of both parents being present.

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