(Table 1), thus resulting in a stable proportion of calcium in the bone. Depletion of cortical bone during egg laying was not evident. The geese in this study did not appear to suffer from a calcium deficiency. Medullary bone seemed to be sufficient to provide the calcium for the average clutch, because the femur and tibiotarsus bone and ash weights, and their calcium contents were greater at the end of egg laying than during the non-reproductive season. However, the contribution of minerals from other bones, especially ribs, sternum, vertebrae and pelvic girdle should be examined for a definitive conclusion (Taylor and Moore 1954).

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# TONIC IMMOBILITY RESPONSES OF HERRING GULL CHICKS

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Following physical restraint, many birds exhibit a state of pronounced immobility (Armstrong 1947). Such tonic immobility (TI), which may be accompanied by eye closure, leg extension and muscle tremors, has often been referred to as "death feigning." Animals in this state are sensitive to external stimulation. Immobility of captured prey can inhibit the attack behavior of a predator and may allow for escape, if the predator is distracted (Sargeant and Eberhardt 1975, Gallup 1977). With very few exceptions (e.g. Sargeant and Eberhardt 1975) almost all studies of tonic immobility in birds have been conducted in the laboratory with domesticated species.

During June and July 1976, 54 Herring Gull chicks (*Larus argentatus*) and eight Great Black-backed Gull chicks (*L. marinus*) on Little Bell Island, Con-

TABLE 1. Tonic immobility reactivity of Herring Gull chicks in relation to weight.

| Group | Weight range (g) | N | TI duration (s) ($\bar{x} \pm$ S.E. s) | No response (< 5 s) | Maximum response (600 s) |
|---|---|---|---|---|---|
| 1 | 50–190 | 6 | 12.3 ± 9.6 | 5 (83%) | 0 |
| 2 | 205–340 | 7 | 70.4 ± 37.7 | 2 (29%) | 0 |
| 1+2 | 50–340 | 13 | 43.6 ± 21.7 | 7 (54%) | 0 |
| 3 | 420–580 | 11 | 293.2 ± 69.3 | 1 (9%) | 3 (27%) |
| 4 | 600–675 | 8 | 392.3 ± 82.6 | 0 | 4 (50%) |
| 3+4 | 420–675 | 19 | 387.5 ± 51.7 | 1 (5%) | 7 (37%) |
| 5 | 710–790 | 13 | 457.8 ± 63.8 | 0 | 9 (69%) |
| 6 | 830–1175 | 9 | 317.7 ± 93.0 | 0 | 4 (44%) |
| 5+6 | 710–1175 | 22 | 400.5 ± 54.3 | 0 | 13 (59%) |
| *L. marinus* | 490–1200 | 8 | 410.0 ± 87.5 | 0 | 4 (50%) |

FIGURE 1. Herring Gull chick immobilized following manual restraint.

ception Bay, Newfoundland (47°38′N, 52°27′W, see Noseworthy and Lien (1976) for a description of the island) were tested for TI reactions. Each chick was placed on its back on level ground near the point of capture and restrained (not squeezed) with both hands (thumbs on the sternum) for 15 s after which the investigator removed his hands and sat back about 1 m from the chick. Tests ended when a chick got to its feet or 10 min elapsed; chicks were then weighed (Pesola scales) and banded. Most chicks had not been handled previously.

Older (heavier) chicks showed proportionately more and longer TI responses than younger ones (Table 1). The average duration of immobility for Weight Group 1 was not significantly different from that of Group 2 ($F = 1.92$, $P = 0.19$) but was significantly shorter than that of Group 3 ($F = 8.66$, $P < 0.01$). The mean durations of Group 2 and of Groups 1 and 2 combined were both significantly shorter than that of Group 3 ($F = 5.78$, $P < 0.05$ and $F = 13.59$, $P < 0.001$, respectively). Groups 4, 5 and 6 were not significantly different ($F = 1.66$, $P = 0.21$). TI duration and weight showed a significant positive correlation ($r = +0.50$, $P < 0.001$), and the linear regression of TI duration on chick weight was also significant ($Y = 54X + 432.62$, $F = 17.43$, $P < 0.001$).

As a possible result of developing fear motivation (Ratner and Thompson 1960) domestic chicks show increasing susceptibility to TI inductions with age. These reactions begin to appear around 7–10 days posthatch, an age when thermoregulatory mechanisms are developed and heart rate approaches adult levels (Braud and Ginsburg 1973). Younger gull chicks showed shorter TI reactions (righted themselves sooner) than older ones; this is interesting because young Herring Gull chicks are less mobile and slower to move than older ones following displacements from the nest (Noseworthy and Lien 1976). Weight data of the Herring Gull chicks indicate that TI reactivity begins around 15–20 days posthatch (420–580 g, Kadlec et al. 1969).

Mortality among larid chicks is greatest during the first week posthatch and appears to be largely due to pecking by adults (e.g. Kadlec et al. 1969). TI reactivity begins and increases as mortality rates are decreasing during the nestling period. Ventral TI inductions, unlike the dorsal ones used in the present tests, are effective in eliciting TI in neonatal domestic chicks (Braud and Ginsburg 1973). The potential anti-predator adaptiveness of TI responses remains to be studied. Tonic immobility may be of interest to some ornithologists who may find the dorsal induction procedure useful when banding chicks.

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