Aging Laughing Gull Nestlings Using Head-Bill Length

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Abstract.—We examined growth of several body components in Laughing Gull (Larus atricilla) nestlings to determine a simple method to estimate age of chicks based on a single visit to the nest. Head-bill length provided the most precise and repeatable estimate of age of the several components we measured. The cubic equation we developed estimated age with a standard error of 1.95 days. Use of head-bill length is a suitable technique for aging Laughing Gull nestlings when a precision of one to two days is sufficient. Received 23 January 1998, accepted 31 August 1998.

Keywords.—Aging, head-bill length, Larus atricilla, Laughing Gull.


Predictive relationships between nesting age and morphology represent a valuable research tool that can substantially increase the efficiency of field work. Typically, nesting age is determined by forward-dating from the hatching date or back-dating from the fledging date. In the former case, age can be determined with great precision, but with considerable effort and disturbance because repeated visits to the nest are required. Back-dating from fledging may require fewer visits with less disturbance, but it has inherent inaccuracies due to variation in fledging age. When relationships can be defined between age and size of body components, age can be estimated with a statistically defined variance based on a single visit to the nest.

We studied growth in Laughing Gull (Larus atricilla) nestlings to identify relationships between growth of major body components and age. Our goal was to develop a method to estimate age of nestlings based on a single visit to the nest.

STUDY AREA AND METHODS

Our study took place on Egg Island, Edwin B. Forsythe National Wildlife Refuge, Atlantic County, New Jersey at 39°28' N, 74°21' W. Egg Island is a barrier beach island located 3.2 km offshore. It is dominated by Spartina spp. and is typical of coastal salt marshes of the mid-Atlantic region. This island supported at least four Laughing Gull colonies (Caccamise et al, 1995), each containing at least 500 nests. We monitored nest sites 11 times from 6 June to 22 July 1996. Nests were visited each two to three days until all hatching dates were established, and about every five days until the young fledged.

On our first visit to the colony we located and marked 28 nests. To confine nestlings to the nest area after they hatched, we erected fencing around each nest. We constructed 60-cm high fences using woven polypropylene soil erosion fabric placed in a two to three meter circle around each nest. We have used this type of fencing previously (Caccamise et al, 1995), with little apparent effect on parental behavior. Eggs from each nest were marked and nestlings were color banded. We took measurements only from the chick that hatched first. If the first-hatched chick died then measurements from the next oldest chick were used. Nest losses and mortality left us with a final sample size of 19 Laughing Gull chicks.

On each nest visit we weighed and measured each chick. Measurements included exposed culmen length, gonyx depth (from anterior point of the nostrils), total head bill length (hb: bill tip to occipital condyle), tarsus length, wing chord (blunt end of wrist to tip of longest primary), tail length (between central rectrices), and length of longest primary (primary 9 from insertion to tip). Weight was taken with either a 100 gm x 10 gm Pesola scale or a 600 gm x 100 gm Pesola scale. Culmen, gonyx, head-bill, and tarsus measurements were taken with a General dial caliper (resolution to 0.1 mm) while wing and tail measurements were taken with a plastic ruler (resolution to one mm).

We determined hatching dates by noting the presence of pipped eggs and/or the presence of new nest-
lings that hatched during the interval between visits. Because of these clues as well as the frequency of our visits, we feel we were able to determine age to within 24 hours of hatching. Statistical analysis was performed using SPSS (Regression, Curve Estimation), Windows release 6.0 (Norusis 1994). Analyses of covariance methods were obtained from Zar (1974).

RESULTS

We obtained 78 values for each of the seven measurements taken from the 19 chicks during the nestling period (hatch to 31 days): We made four or more measurements of each variable from ten of the 19 chicks. Sixty-three measurements from these ten chicks were used in the initial analysis to justify pooling the data.

All measurements correlated highly and significantly with both age and with each other (Table 1). We did not perform a multiple regression to predict age because of the probability of multicollinearity effects, based on the high degree of correlation among the variables. Instead, we identified a single variable that predicted age with minimal error while offering other characteristics that would assure utility in its actual application.

Total head-bill length (hbl) was the most useful variable for predicting age. It provided the highest correlation with nestling age among individual variables (Table 1). In addition, hbl offered other favorable characteristics including: (1) large size throughout the nestling period lessening the chance of errors in measurement, (2) a sufficiently rapid growth rate throughout the nestling period to provide quantifiable daily incremental growth, (3) resistance to short term variability in local conditions (feeding interval, weather conditions), (4) low susceptibility to damage or injury. Head-bill length was the only variable that offered all of these favorable characteristics while providing the least variable statistical relationship with age.

Since the data from the ten chicks was not independent, we determined whether the data could be pooled through analysis of covariance. We performed separate linear regressions of hbl on age for each chick (Fig. 1a). All equations were significant at P < 0.01 except for chick 10, which was significant at P < 0.03. The slopes of these ten regression equations did not differ significantly from each other (F<sub>9,45</sub> = 0.27, P > 0.05) nor did their y-intercepts differ (F<sub>9,52</sub> = -1.19, P > 0.05). This indicated that the data could be considered to come from the same population, so the data from all ten chicks were pooled, along with 15 additional measurements from nine other chicks.

A linear equation can be used with reasonable confidence to describe the relationship between hbl and age. The linear equation predicts age near the middle of the growth interval quite well. However, like many growth relationships, we found that growth in Laughing Gull nestlings was decidedly non-linear. As a result the linear equation provides less precise estimates of age at the beginning of the growth interval and near the end. One way to minimize this effect is to use a higher order equation to describe the relationship.

We found that the cubic equation provided the best-fit model (Fig. 1b). We used the above ANCOVA analysis to justify pooling the data since the resulting non-linear equa-

<table>
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<th>Variable</th>
<th>Age</th>
<th>Weight</th>
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<th>Gonys</th>
<th>Head-bill</th>
<th>Tarsus</th>
<th>Wing chord</th>
<th>Primary</th>
<th>Tail</th>
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Repeated measures should be less than the variance of the estimate provided by the predictive equation. We found low variances in repeated measurements of the hbl on these adult Laughing Gulls (paired \( t = -0.86 \), \( p = 0.41 \) with a Pearson correlation of 0.88 between first and second measurements). The standard deviation was 1.6 hbl units (mm), translating to 1.149 days. This was lower than the standard error of the regression estimate for our predictive equation.

**DISCUSSION**

Head-bill length provides a strongly predictive relationship with age of Laughing Gull nestlings. This measurement provides a means of estimating age that is reliable and easily taken at a single nest visit. While other linear measurements also showed similar relationships, hbl was the best. As opposed to body mass, hbl is immune to the short term effects of feeding state or temporary changes in food availability. Yet the rate of increase for hbl is large enough over intervals of two or three days to generate an equation with beta values greater than zero. However, with a standard error of 1.93 days, estimates of age using this technique are most useful when accuracy within a day or two is adequate.

Hailman (1961) suggested that tarsal length was an imprecise indicator of age in Laughing Gull chicks because of the low growth rate of the tarsus during the first five days after hatching. Indeed, growth rate of hbl was also low for the first few days after hatch and again near the end of the growth interval. However, the growth rate appears adequate at both observed extremes, and, by using the cubic equation, the effects of larger variances at the extremes is minimized. Thus, it is possible to generate reliable estimates of age at the beginning and end of the growth interval.

The standard error of the predictive equation was larger than the error from taking the measurement itself. This ensures that most uncertainty in the age estimate is based on the variability of hbl themselves rather than on the measurement technique.
From the scatter of data in Figure 1, it appears that there is more variability at the late end of the growth interval when chicks are ready to fledge. This may indicate a divergence of the morphology by sex: hbl is used in sexing a number of species, including adult Laughing Gulls (Caccamise et al. 1995). The average hbl for our oldest chicks (31 days, about four days prior to fledging) was 81 mm, representing about 96% of the average size for an adult female Laughing Gull and 90.7% for an adult male (adult data from Caccamise et al. 1995). Thus, a better predictive equation may be possible by accounting for differences in size between sexes.

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LITERATURE CITED


