

FEATURE ARTICLES

ASSESSING THE DEVELOPMENT OF SHOREBIRD EGGS USING THE FLOTATION METHOD: SPECIES-SPECIFIC AND GENERALIZED REGRESSION MODELS

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Abstract. We modeled the relationship between egg flotation and age of a developing embryo for 24 species of shorebirds. For 21 species, we used regression analyses to estimate hatching date by modeling egg angle and float height, measured as continuous variables, against embryo age. For eggs early in incubation, we used linear regression analyses to predict hatching date from logit-transformed egg angles only. For

late incubation, we used multiple regression analyses to predict hatching date from both egg angles and float heights. In 30 of 36 cases, these equations estimated hatching date to within four days of the true hatching date for each species. After controlling for incubation duration and egg size, flotation patterns did not differ between shorebirds grouped by mass (≥ 100 g or < 100 g) or taxonomy (Scolopacidae versus Charadriidae). Flotation progressed more rapidly in species in which both adults incubate the clutch versus species in which only one adult incubates the clutch, although this did not affect prediction accuracy. We also pooled all continuous data and created a generalized regression equation that can be applied to all shorebird species. For the remaining three species, we estimated hatching date using five float categories. Estimates of hatching date using categorical data were, overall, less accurate than those generated using continuous data (by 3%–5% of a given incubation period). Our equations were less accurate than results reported in similar studies; data collected by multiple observers and at multiple sites, as well as low sample sizes for some species, likely increased measurement error. To minimize flotation method prediction error, we recommend sampling in early incubation, collecting both egg angle and float height data in late incubation, and developing site- and species-specific regression models where possible.

Key words: Charadriidae, embryo age, hatching date, Scolopacidae.