



## PREDICTORS OF JUVENILE SURVIVAL IN BIRDS

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**ABSTRACT.**—The survival probability of birds during the juvenile period, between the end of parental care and adulthood, is highly variable and has a major effect on population dynamics and parental fitness. As such, a large number of studies have attempted to evaluate potential predictors of juvenile survival in birds, especially predictors related to parental care. Lack's hypothesis linking body reserves accumulated from parental care to the survival of naive juveniles has organized much of this research, but various other predictors have also been investigated and received some support. We reviewed the literature in this area and identified a variety of methodological problems that obscure interpretation of the body of results. Most studies adopted statistical techniques that missed the opportunities to (1) evaluate the relative importance of several predictors, (2) control the confounding effect of correlation among predictor variables, and (3) exploit the information content of collinearity by evaluating indirect (via correlation) as well as direct effects of potential predictors on juvenile survival. Ultimately, we concluded that too few reliable studies exist to allow robust evaluations of any hypothesis regarding juvenile survival in birds. We used path analysis to test potential predictors of juvenile survival of 2,631 offspring from seven annual cohorts of a seabird, the Nazca Booby (*Sula granti*). Fledging age was the most important predictor of juvenile survival: fast-growing offspring survived best, when all other variables were held constant. Offspring sex was the next most important predictor, with juvenile males (the smaller sex) surviving better than females. Hatching day, an index of body weight, and wing length also showed important predictive ability, but cohort size, culmen length, and an index of clutch size and hatching success did not. Nestling growth was compromised under poor rearing conditions: overall weight fell, the number of days needed to reach fledging status increased, and the growth of some structures, but not others, was reduced. These effects were more pronounced in females, and the higher juvenile mortality of females accounts for most of the male bias in the adult sex ratio and its attendant "mate rotation" mating system in this population. Most previous studies did not evaluate sex as a potential predictor of juvenile survival. Had we omitted sex from our models, we would have made two erroneous conclusions: that weight did not influence juvenile survival, and that small structural size enhanced it. *Received 17 May 2012, accepted 8 February 2013.*

Key words: body condition index, nestling growth, path analysis, reproductive success, sexual size dimorphism.

### Predictores de la Supervivencia de Aves Juveniles

**RESUMEN.**—La probabilidad de supervivencia de las aves durante el periodo juvenil, entre el final del cuidado parental y la adultez, es altamente variable y tiene un gran efecto en la dinámica poblacional y en la aptitud de los padres. Por esto, un gran número de estudios han intentado evaluar los predictores potenciales de la supervivencia de los juveniles en aves, con un foco especial en los predictores relacionados con el cuidado parental. La hipótesis de Lack en la que se relacionan las reservas corporales acumuladas por el cuidado parental con la

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