

# Supporting Information

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## SI Materials and Methods

**Mark–Recapture Survival Analysis.** To estimate daily chick survival (DCS), we used Cormack–Jolly–Seber models with 1-day encounter intervals. Because there is a strong nonlinear age effect on DCS in plovers (73, 74), our design matrices included chick age as a quadratic covariate (i.e.,  $\text{age}^2$ ) with sex and year as factors. Thus, the probability of survival from hatching to fledging was calculated simply as the product of all 25 age-specific estimates of DCS. Likewise, we used Cormack–Jolly–Seber models to estimate juvenile and adult survival but with 1-year encounter intervals. Juvenile and adult survival models were constructed from design matrices that included sex, year, and stage as factors.

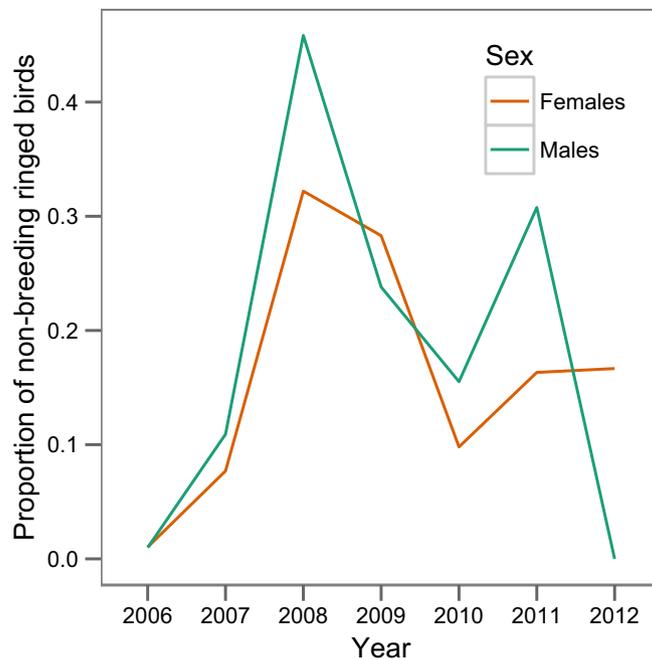
Because we were interested in stage- and sex-specific estimates of survival, all models included a  $\phi \sim \text{sex} \times \text{stage}$  component in the case of juvenile and adult analyses or a  $\phi \sim \text{sex} \times \text{age}^2$  component in the case of chick analyses. Two-way interactions between all variables were assessed for encounter probability modeling. We constructed survival models with the R package “RMark” (75) and estimated demographic parameters via maximum likelihood implemented in program MARK (76). We evaluated whether our data was appropriately dispersed (29) (i.e.,  $c\text{-hat} \leq 3$ ) by using the “median  $c\text{-hat}$ ” goodness-of-fit bootstrap simulation in program MARK (76).

**Estimating Hatching Sex Ratio.** To account for potential sex biases arising before the chick stage (i.e., sex allocation), we evaluated if the hatching sex ratio deviated significantly from parity using a general linear mixed effect model fit with binomial error and a logit function (R package “lme4”) (77). In this model, the response variable was chick sex, and brood identifier was included as a random factor to control for the nonindependence of siblings. Significance was inferred from the intercept estimate,

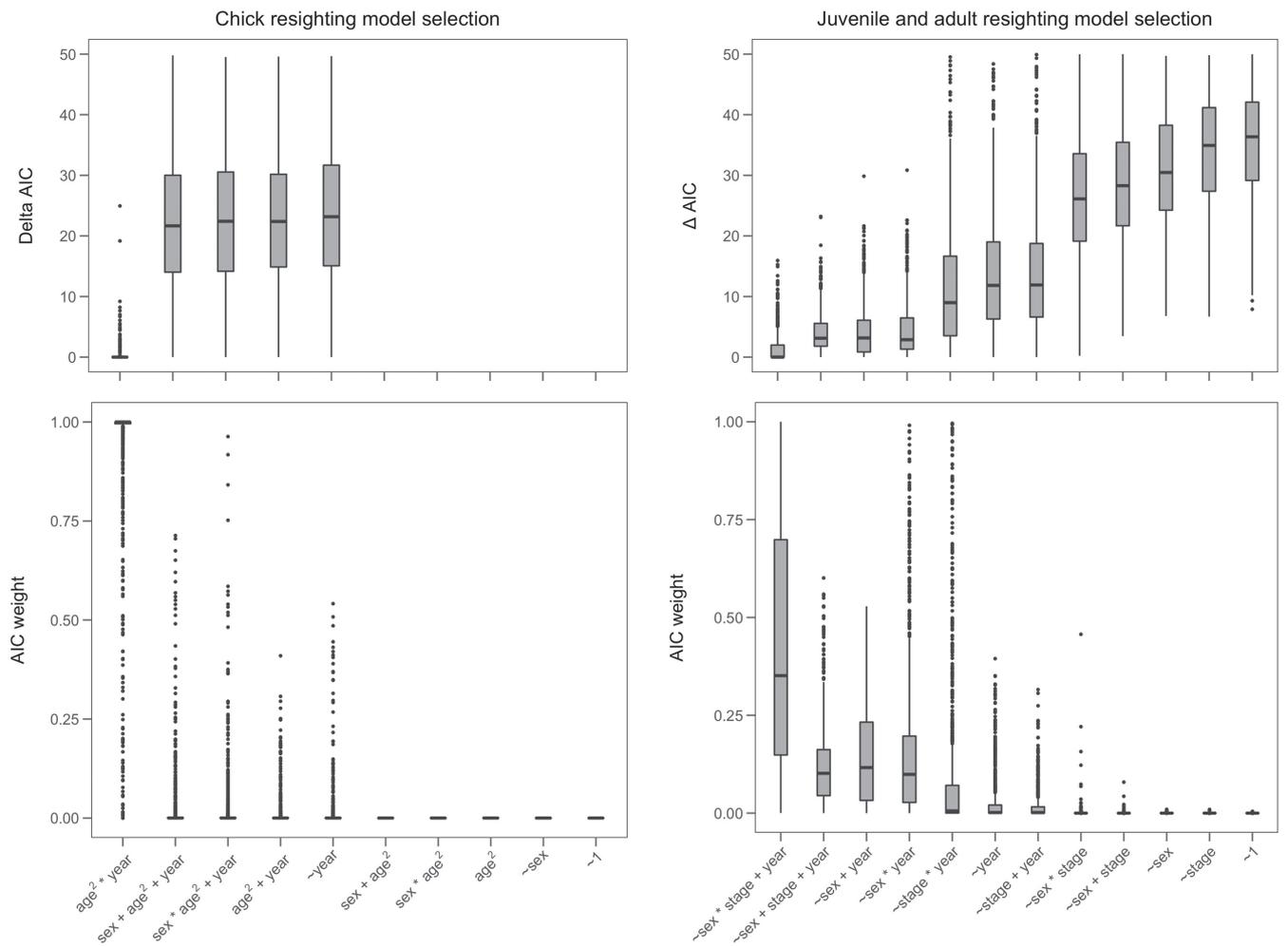
with  $\alpha = 0.05$ . Because of the precocial nature of plover chicks, posthatch brood mixing can occur. Consequently, our dataset for analyzing hatching sex ratio included only complete broods (i.e., no missing chicks) that were captured at the nest on the same day of hatching.

**Evaluating Uncertainty of the ASR.** To evaluate uncertainty in our estimate of ASR caused by sampling and process variation in our survival parameters, we implemented a bootstrapping procedure in which each bootstrap (i) randomly sampled our mark–recapture data with replacement, (ii) ran the survival analyses described above, (iii) derived stage- and sex-specific estimates of apparent survival based on the model with the lowest corrected Akaike’s information criterion (AICc), (iv) constructed the matrix model of these estimates, (v) derived the stable stage distribution through simulation of 1,000 time steps, and (vi) calculated ASR from the final stage distribution. This approach ensured that parameter correlations within the matrix were retained for each bootstrap and that the nonlinear mating function reached equilibrium. We ran 1,000 bootstraps and evaluated the accuracy of our ASR estimate by determining the 95% confidence interval of its bootstrapped distribution.

Our bootstrap procedure showed that variation in encounter probability of juveniles and adults was best explained by sex, year, and stage [model  $p \sim \text{year} + \text{stage} \times \text{sex}$ : median  $\Delta\text{AICc} = 0$  (95% CI = 0–7.58), mean  $w_i = 0.43$  (95% CI = 0.02–0.99)] (Fig. S2). In contrast, the encounter probability of chicks was the same for males and females but varied among years and as a quadratic function of age [model  $p \sim \text{year} \times \text{age}^2$ : median  $\Delta\text{AICc} = 0$  (95% CI = 0–1.97), mean  $w_i = 0.94$  (95% CI = 0.18–1)] (Fig. S2). Our mark–recapture data were not overdispersed [median  $c\text{-hat} = 1.36$  (95% CI = 1.11–1.62)].



**Fig. S1.** Annual variation in the nonbreeding female and male proportions of the marked population. Nonbreeding marked birds constitute resightings of uniquely color-marked birds that were not observed breeding in the focal year. Because our captures are limited to breeding birds, the first two study years (2006 and 2007) show very few nonbreeding birds in the marked population. Excluding 2006 and 2007, there was no sex difference in the nonbreeding sample (paired  $t$  test:  $t = -0.429$ ,  $df = 4$ ,  $P = 0.69$ ).



**Fig. S2.** Summary statistics of bootstrapped mark–recapture modeling. *Upper* illustrates variation in  $\Delta\text{AICc}$  for (*Left*) chick and (*Right*) juvenile and adult survival analyses. *Lower* illustrates variation in  $\text{AICc } w_i$  for (*Left*) chick and (*Right*) juvenile and adult survival analyses. Model structure of encounter probability ( $p$ ) is shown as labels on the x axes. *SI Materials and Methods* has additional details about this analysis.

## Other Supporting Information Files

[Dataset S1 \(PDF\)](#)