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Supplementary Material

Intra-annual patterns in adult band-tailed pigeon survival estimates

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The analytic methods used in the manuscript were performed using the Known Fates subroutine of Program Mark version 6.1 (White and Burnham 1999) and/or RMark (Laake 2013). Analysis of VHF-radio telemetry derived survival was focused on estimation of a single period survival rate estimate. Analysis of PTT-satellite telemetry derived survival tested contrasted several models relating to hypotheses of differential survival throughout the year. Development of an *a priori* suite of candidate models followed a simple idea that annual band-tailed pigeon survival probability was actually a mixture of multiple seasonal survival probabilities that could be decomposed to produce more parsimonious results.

Four time periods were readily identifiable and included Breeding and Winter time periods as well as both Spring and Fall Migrations. We could readily identify migration periods from all PTT marked individuals to set “administrative” time periods (the range of observed migratory behavior) and “individual” behavior state or phenological periods. Although breeding behavior could not be specifically deduced from PTT locations, we use the term breeding season as a general identifier of the predominant behavior in the population across the entire period. The identified “administrative” time periods were:

Season	Administrative Time Period	Survival Rate Short-hand
Winter	December 1 to March 23	S_w
Spring Migration	March 23 to June 1	S_s
Breeding/Nesting	June 1 to September 1	S_n
Fall Migration	September 1 to December 1	S_f

Several factors unrelated to our central question, timing of survival differences and annual survival rate estimation, are known to affect bird population survival rates including sex-based differences, body condition, and age but Likelihood ratio tests that included these two metrics all indicated lower support with these factors included compared to reduced models without those effects in all instances, and we excluded them from additional analysis. Therefore, we began with a null model that stipulated all seasonal/phenological survival rates were equal, or a constant annual survival probability (S_T):

Eq 1: $\hat{S}_T = \hat{S}_s = \hat{S}_n = \hat{S}_f = \hat{S}_w$ or S(.)

A priori models then added complexity in survival probabilities by estimating difference survival rates during different periods and which contributed to annual survival using a weighted geometric mean model (where the weights reflect the proportion of the year [e.g. N_s] for which the estimate occurred). This a priori model set included:

Difference in survival during breeding/nesting period than the rest of the year

Eq 2: $\hat{S}_T = \hat{S}_s^{\,N_s} * \hat{S}_o^{\,1-N_s}$

Difference in survival during winter

Eq 3: $\hat{S}_T = \hat{S}_w^{\,N_w} * \hat{S}_o^{\,1-N_w}$

Difference in survival during migration (A special case where $\hat{S}_m = \hat{S}_s = \hat{S}_f$)

Eq 4: $\hat{S}_T = \hat{S}_m^{\,N_m} * \hat{S}_o^{\,1-N_m}$

Difference in survival between breeding, winter, and migration

Eq 5: $\hat{S}_T = \hat{S}_s^{\,N_s} * \hat{S}_w^{\,N_w} * \hat{S}_m^{\,1-N_s-N_w}$

Difference between all 4 seasons: spring migration, breeding, fall migration, winter

Eq 6: $\hat{S}_T = \hat{S}_s^{\,N_s} * \hat{S}_f^{\,N_f} * \hat{S}_b^{\,N_b} * \hat{S}_w^{\,N_w}$

Since we were most concerned with estimating the least biased survival parameters accounting for model level uncertainty, we model averaged survival rates across all candidate models using the Akaike weights calculated based on the proportional weight of evidence across the entire set of candidate models which was calculated directly within program MARK (White and Burnham 1999).

Model	AICc	Delta AICc	AICc Weights	Model Likelihood	Num. Par
Eq4	112.2791	0	0.36242	1	2
Eq 1	113.6947	1.4156	0.17857	0.4927	1
Eq 5	114.2295	1.9504	0.13668	0.3771	3
Eq 2	114.3645	2.0854	0.12775	0.3525	2
Eq 3	114.5623	2.2832	0.11572	0.3193	2
Eq 6	115.3296	3.0505	0.07885	0.2176	4