APPENDIX S1 | Simulations of mark-recapture model sensitivity to different initial and recapture probabilities (i.e., trap response)

We assessed the bias in key parameter estimates from mark-recapture models due to trap response, in our case higher recapture probability than initial capture probability due to a higher threshold for photo quality for initial catalog entry than for recapture. We used large-sample approximation per Hines and Nichols (2002), which achieves stable results equivalent to those from many simulations of small populations by simulating an extremely large population size. We considered two types of capture histories, those excluding "precaptures" (recapture-quality records that preceded the catalog-quality occasion) and those including precaptures. We set an initial population size of 1,000,000 individuals, a population growth rate of 1, and survival rate of 0.95 between occasions. We simulated ten mark-recapture occasions with two sets of initial and recapture probabilities: 0.075 and 0.075 (a bias-free base case), 0.06 and 0.075. The relative proportions of the latter were derived from the proportions of annualized capture histories for recapture-quality records with and without at least one catalog-qualifying record. The resulting capture histories were fitted with (1) a Pradel-lambda model, and (2) a closed-population model fitted to only the last three occasions, with and without separate intercepts allowed for initial and recapture probabilities. Each simulation was repeated three times to assess variability in the results.

Our results show that inclusion of precaptures in the data set can eliminate associated bias in estimates of population growth rate from the Pradel-lambda model, which is considerably greater than the bias this modification in turn introduces in the estimate of apparent survival (Table S1.1). For closed-population models, on the other hand, admission of precaptures to the data set can lead to considerable abundance underestimation compared to the base case (Table S1.2).

TABLE S1.1 Summaries of simulation results for Pradel-lambda model fits of apparent survival ϕ, capture probability p, and population growth rate λ. Three scenarios were simulated with three repetitions each: (1) a bias-free base case ($p_i = c = 0.075$), where p_i is initial capture probability and c is recapture probability; (2) lower initial than recapture probabilities ($p_i = 0.06$, $c = 0.075$), with precaptures excluded from the data set; and (3) same as scenario 2 but with precaptures included in the data set.

Scenario	Estimate of ϕ	Estimate of p	Estimate of λ
base case	0.949	0.075	0.999
base case	0.951	0.075	1.000
base case	0.950	0.075	1.000
precaptures excluded	0.950	0.075	1.011
precaptures excluded	0.950	0.075	1.012
precaptures excluded	0.952	0.074	1.011
precaptures included	0.956	0.082	1.000
precaptures included	0.956	0.082	1.000
precaptures included	0.955	0.082	1.000

TABLE S2.2 Summaries of simulation results for closed-population model fits to the last three occasions of eleven-year capture histories. Six scenarios were simulated with three repetitions each to assess stability of results: (1) a bias-free base case ($p_i = c = 0.075$) with model assuming $p_i = c$; (2) same as Scenario 1 but with model allowing for separate estimates of p_i and c; (3) lower initial than recapture probabilities ($p_i = 0.06$, $c = 0.075$), with precaptures excluded from the data set and model assuming $p_i = c$; and (4) same as Scenario 3 but with model allowing for separate estimates of p_i and c; (5) and (6) same as Scenarios 3 and 4, respectively, but with precaptures included in the data set.

Scenario	Estimate of p_i	Estimate of c	Estimate of N
base case (true $p_i = c$), model $p_i = c$	0.070	0.070	1,062,905
base case (true $p_i = c$), model $p_i = c$	0.070	0.070	1,077,749
base case (true $p_i = c$), model $p_i = c$	0.070	0.070	1,071,366
base case (true $p_i = c$), model $p_i \neq c$	0.071	0.071	1,053,820
base case (true $p_i = c$), model $p_i \neq c$	0.070	0.070	1,074,524
base case (true $p_i = c$), model $p_i \neq c$	0.067	0.070	1,125,808
true $p_i \neq c$, precaptures excluded, model $p_i = c$	0.069	0.069	946,126
true $p_i \neq c$, precaptures excluded, model $p_i = c$	0.070	0.070	950,044
true $p_i \neq c$, precaptures excluded, model $p_i = c$	0.069	0.069	957,009
true $p_i \neq c$, precaptures excluded, model $p_i \neq c$	0.062	0.070	1,050,931
true $p_i \neq c$, precaptures excluded, model $p_i \neq c$	0.060	0.071	1,092,019
true $p_i \neq c$, precaptures excluded, model $p_i \neq c$	0.062	0.071	1,047,177
true $p_i \neq c$, precaptures included, model $p_i = c$	0.079	0.079	842,012
true $p_i \neq c$, precaptures included, model $p_i = c$	0.077	0.077	858,056
true $p_i \neq c$, precaptures included, model $p_i = c$	0.077	0.077	864,226
true $p_i \neq c$, precaptures included, model $p_i \neq c$	0.076	0.078	868,192
true $p_i \neq c$, precaptures included, model $p_i \neq c$	0.077	0.079	861,972
true $p_i \neq c$, precaptures included, model $p_i \neq c$	0.074	0.076	896,239