APPENDIX 1. Description of approach for fine-scale perturbation analysis of population viability for large-bodied woodpeckers.

To examine model responses to small changes in the input parameters, we calculated pairwise differences between extinction rates before and after changing a focal parameter for all combinations of input values. This difference can be represented generally by the following equation:

$$\Delta e_i = e_i - e'_i \tag{2}$$

where i indexes a particular (henceforth, focal) input parameter. Δe_i is the change in extinction rate, and e_i is the mean extinction rate across 200 iterations for one set of input parameter values. These input parameter values comprise a vector (henceforth, Θ_i), which includes the initial number of adults, mean survival, variance in survival, mean fecundity, variance in fecundity, and the Allee effect.. Finally, e'_i is the mean extinction rate across 200 iterations for another set of input parameter values (henceforth, Θ'_i) that is identical to Θ_i except for one input value that is altered by a constant $\Delta\theta_i$:

$$\Delta\theta_i = \frac{a}{r_a} r_i \tag{3}$$

where a is a constant for the additional initial adult (i.e., $a = 1$), r_a is another constant for the range of initial adults tested (30-5 = 25), and r_i is the range of the focal input parameter (e.g., adult survival: 0.9 – 0.7 = 0.2). To ensure consistency among Δe_i values for each input parameter, the calculation of each value of a focal parameter in Θ'_i is contingent upon the expected relationship between that focal parameter and extinction rate:

$$\begin{cases} \theta'_i \propto e_i \Rightarrow \theta'_{ij} = \theta_{ij} - \Delta\theta_i \\ \theta'_i \propto 1/e_i \Rightarrow \theta'_{ij} = \theta_{ij} + \Delta\theta_i \end{cases} \tag{4}$$

where θ'_i is a focal parameter from the set of Θ_i parameters, θ'_{ij} is a particular value of that focal parameter, j indexes each value for that focal parameter, and e'_i is defined in equation (2). Thus, each extinction rate is a function of the respective combination of input values:

$$\begin{aligned} e_i &= f(\Theta_i) \\ e'_i &= f(\Theta'_i) \end{aligned} \tag{5}$$

We calculated Δe_i for each Θ_i and respective Θ'_i for a total of 27 perturbations in each of the three analyses. We calculated means and confidence intervals surrounding Δe_i for each of the three parameters in each of the three analyses, across the 27 combinations of input values.