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Appendix from P. A. Stephens et al., "Dispersal, Eviction, and Conflict in Meerkats (*Suricata suricatta*): An Evolutionarily Stable Strategy Model"

(Am. Nat., vol. 165, no. 1, p. 120)

Modeling Outline

Here we present a 10-step outline of the modeling approach. Specifically, this describes the process of solving for ESS dispersal probabilities, $P_D(x, y)$. The process of solving for ESS eviction probabilities, $P_E(x, y)$, was very similar except for the modifications of step 7 described by equation (9). Equation (9) and all other equations referred to here are found in the "Methods" section under "Model Derivation."

1. Set dispersal (or eviction) probabilities for all dominant $(1, y)$ states to 0 and for all subordinate (x, y) states to 0.5.

2. Determine useful probabilities for current iteration. For all group sizes, these include probabilities that

(a) k of the n highest-ranked individuals will leave the group;

(b) k of the n highest-ranked individuals will be present in a new group (formed by dispersal);

(c) k of the n lowest-ranked individuals will leave the group; and

(d) k of the n lowest-ranked individuals will be present in a new group (formed by dispersal).

Determining these probabilities involves identifying all possible combinations of k of n individuals and summing the probabilities for each of those combinations.

3. Determine probabilities for each $(x, y) \rightarrow (x', y')$ transition, for a single time step, for

(a) individuals that stay in their natal group (probabilities are derived from changes in rank, which depend on the fates of the $x - 1$ higher-ranked individuals, and changes in group size, which also depend on the fates of the $y - x$ lower-ranked individuals, plus any group augmentation by maturing young already present; see fig. A1);

(b) individuals that stay in a group that they helped to found (probabilities as in step 3a, but it is assumed that no more highly ranked individuals will disperse, given that they also helped to found the group; this assumption should also cover all lower-ranked founders, but keeping track of all of these individuals—who may die and be replaced by another founder or a natal individual—would be extremely computationally intensive); and

(c) individuals that disperse to help form a new group (dependent on the probabilities with which other group members disperse to be present in the new group; no augmentation by maturing young, i.e., $P_{(a=0)} = 1$).

4. Determine the direct fitness of a disperser, projected forward over all T time steps. This uses the transition probabilities from step 3c for the first time step and those from step 3b thereafter to calculate the probabilities that the disperser attains any (x, y) state, t time steps into the future. These probabilities are then multiplied by the mean direct fitness for one time step of an individual in the relevant state.

5. Determine the direct fitness of an animal that has already dispersed and is in state (x, y) for $T - 1$ time steps into the future.

6. Determine the direct fitness of an individual that stays, projected forward over all T time steps. For the first time step, this uses transition probabilities from step 3a. Thereafter, the individual may or may not disperse at any time step, according to the dispersal probabilities of the state it has attained. If the individual does not disperse, this uses the transition probabilities determined in step 3a, but if it does disperse, it accrues the fitness of a disperser (from step 4), discounted by the probability of attaining the state from which it dispersed and adjusted for the amount of time remaining until T.

7. Determine the inclusive fitness of a decision to disperse. This involves two components:

(a) The direct fitness of the actor's decision, given by her fitness if she departs (from step 4) less her fitness if she stays (from step 6).

(b) The direct fitness of other group members, depending on the actor's decision. If another group member disperses, her fitness is affected only by the change in the distribution of new group destination states, as influenced by the actor's decision. The fitness accrued from any of these destination states is taken from step 5. Similarly, if the other group member stays in the group, the distribution of potential states at $t + 1$ is also affected by the actor's decision. The fitnesses of other group members are then adjusted by relatedness, according to equation (8).

8. Recalculate dispersal probabilities for each state on the basis of inclusive fitnesses (from step 7), using equations (10) and (11).

9. Determine whether any of the new dispersal probabilities differ from their previous value by more than 0.01% of that previous value. If none do, and this has been the case for 20 iterations, terminate the program.

10. Return to step 2.

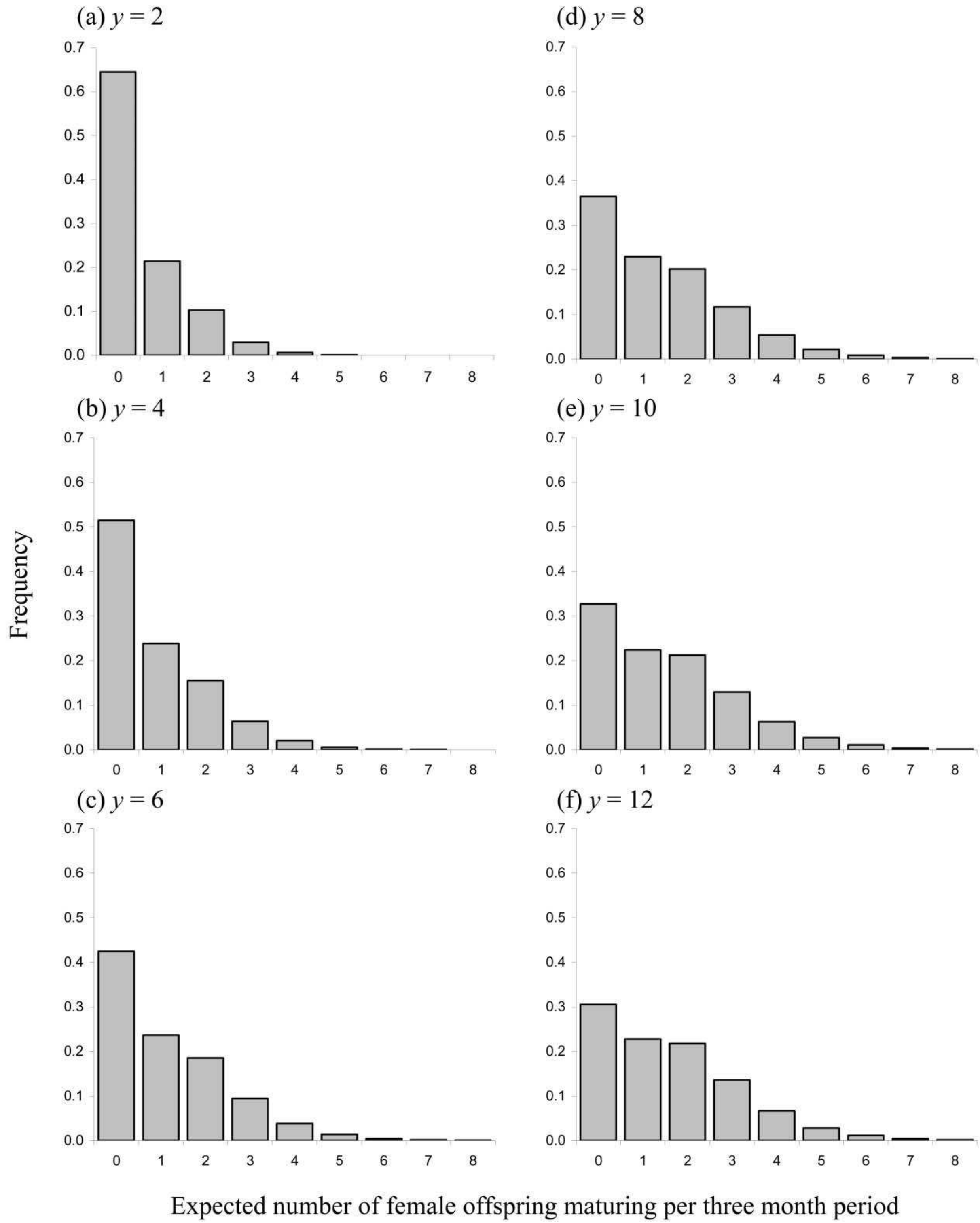

Figure A1: Sample probability distributions for augmentation by mature female young. Probability distributions were determined by one million Monte-Carlo simulations, using the probabilities with which dominant and subordinate females produce an emergent litter, as well as survival probabilities and the birth sex ratio. Panels show probability distributions for different female group sizes, *y*, as indicated.