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ELECTRONIC APPENDIX A

This appendix derives Equation (4.1), which gives an approximation for the increase in genetic variance caused by nonrandom mating and selection when those forces are weak. The calculation uses the methods and notation of Kirkpatrick et al. (2002).

For our model, the genetic variance for a trait controlled by additive autosomal genes is

$$V = 2 \left\{ \sum_i b_i^2 p_i q_i + \sum_i b_i^2 D_{i_{ff}i_{fm}} + \sum_{i \neq j} \sum b_i b_j D_{i_{ff}j_{fm}} + \sum_{i \neq j} \sum b_i b_j D_{i_{ff}j_{ff}} \right\}, \quad (\text{A1})$$

where p_i and q_i are the frequencies of alternative alleles at locus i , b_i is the difference in their effect on the trait. The disequilibria $D_{i_{xy}j_{xz}}$ are the associations (or statistical covariance) between alleles at positions i_{xy} and j_{xz} , where i indicates the locus, x (= f for female, m for male) is the sex of the individual carrying the genes, and y and z are the sexes of the individuals from which the genes were inherited. For autosomal genes, $D_{i_{fy}j_{fz}} = D_{i_{my}j_{mz}}$ at birth.

The first term on the right of (A1) is the genic variance, which is the genetic variance of a population at Hardy-Weinberg and linkage equilibrium. The second, third, and fourth terms are caused by associations (disequilibria) generated by selection and nonrandom mating. The second term corresponds to Hardy-Weinberg disequilibria within loci, the third to associations between alleles at different loci that were inherited from different parents (inter-locus HW disequilibria), and the last term is from associations between alleles at different loci inherited from the same parent (gametic linkage disequilibrium).

To find the change in genetic variance caused by selection and nonrandom mating, we need to calculate the D s. They can be found using the “quasi-linkage equilibrium” (QLE) approximation developed by Barton and Turelli (1991) and extended by Kirkpatrick et al. (2002). When selection is weak relative to recombination, a population rapidly approaches a quasi-equilibrium in which the D s are small relative to their maximum possible values. For the plant model, in which selection acts the same on males and females, QLE approximations for the associations are

$$\tilde{D}_{i_{ff}j_{fm}} = \tilde{D}_{i_{fm}j_{ff}} = a_{i_{ff}j_{mf}} p_i q_i p_j q_j, \quad (\text{A2})$$

$$\tilde{D}_{i_{ff}j_{ff}} = p_i q_i p_j q_j [a_{i_{ff}j_{mf}} + (a_{i_{ff}j_{ff}} / r_{ij})] \quad (\text{A3})$$

(see Equations 21 and 22 of Kirkpatrick et al. 2002). The a s are selection coefficients that reflect the strength of selection bringing alleles at loci i and j together. The selection coefficients are

$$a_{i_{xy}j_{xz}} \approx b_i b_j (c_1 c_2 - a - m), \quad (\text{A4})$$

$$a_{i_{ff}j_{mz}} \approx b_i b_j m, \quad (\text{A5})$$

where $x, y,$ and z can take the values m or f , and $c_1, c_2, a,$ and m are the coefficients of competition, abiotic selection, and assortative mating defined in the text. The allelic effect for locus i , b_i , is equal to $1/2n$ when all loci have equal effects. The first selection coefficient, $a_{i_{xy}j_{xz}}$, reflects natural and sexual selection acting on genes carried by a single individual (male or female), and comes from Kirkpatrick et al.'s Equation 41. The second selection coefficient, $a_{i_{ff}j_{mz}}$, corresponds to sexual selection that brings together similar alleles in mating males and females; it is similar to Equation 48 of Kirkpatrick et al..

Substituting (A4) and (A5) into (A2) and (A3), and then those results into (A1), gives Equation (4.1) of the text for the plant model. The calculations for the animal model follow the same logic.