

TABLE A1. Parameters used in the model, their definitions, Bayesian model structure, prior assumptions, means, 95% highest posterior density intervals, plant species used, and data sources. All Gamma distributions are parameterized with shape and rate parameters. All other distributions use standard parameterizations. Species abbreviations are: *Avena fatua* (AVFA), *Bromus hordeaceus* (BRHO), *Avena barbata* (AVBA), *Vulpia myuros* (VUMY), *Stipa pulchra* (STPU), *Bromus diandrus* (BRDI), *Elymus glaucus* (ELGL), *Hordeum brachyantherum ssp. brachyantherum* (HOBR), *Melica californica* (MECA), *Stipa cernua* (STCE), and *Poa secunda ssp. secunda* (POSE).

<i>Parameter</i>	<i>Definition</i>	<i>Formulas</i>	<i>Priors</i>	<i>Mean (95% HPD Interval)</i>	<i>Plant species</i>	<i>Data sources</i>
$g_a$	fraction of annual seeds that germinate and survive the spring	$Y \sim \text{Beta-Binomial}(a, b, n)$ , where $Y$ is the number of surviving germinants and $n$ is the initial number of seeds	<i>Uninformative:</i> $a, b \sim \text{Gamma}(1.001, 0.001)$ <i>Informative:</i> $a, b \sim \text{Gamma}(1, 1)$	0.45 (0.22, 0.67)	AVFA, BRHO, AVBA, VUMY	(1, 2)
$g_s$	fraction of perennial seeds that germinate and survive the spring	$Y \sim \text{Beta-Binomial}(a, b, n)$ , where $Y$ is the number of surviving germinants and $n$ is the initial number of seeds	<i>Uninformative:</i> $a, b \sim \text{Gamma}(1.001, 0.001)$ <i>Informative:</i> $a, b \sim \text{Gamma}(1, 1)$	0.34 (0.14, 0.54)	STPU	(3, 4)
$s_p$	fraction of perennial adults that survive the summer	$Y \sim \text{Beta-Binomial}(a, b, n)$ , where $Y$ is the number of surviving germinants and $n$ is the initial number of adults	<i>Uninformative:</i> $a, b \sim \text{Gamma}(1.001, 0.001)$ <i>Informative:</i> $a \sim \text{Gamma}(8, 1)$ $b \sim \text{Gamma}(0.01, 1)$	0.88 (0.84, 0.93)	STPU	(5–8)
$\lambda_a$	per-capita seed production in the absence of competition for the annual	$\text{mean} = \lambda_a / (1 + \alpha_{aa}x_a + \alpha_{ap}x_p)$ , $Y \sim \text{Normal}(\log(\text{mean}), \sigma = 1/\tau)$ , where $Y$ is the number of seeds per individual and $x_a$ and $x_p$ are the densities of annuals and perennial adults	<i>Uninformative:</i> $\lambda_a \sim \text{Uniform}(0, 600)$ $\tau \sim \text{Gamma}(0.001, 0.001)$ <i>Informative:</i> $\lambda_a \sim \text{Gamma}(30, 1)$ $\tau \sim \text{Gamma}(0.001, 0.001)$	29 (23, 37)	AVFA, BRDI	(9, Molinari et al. unpub.)

<i>Parameter</i>	<i>Definition</i>	<i>Formulas</i>	<i>Priors</i>	<i>Mean (95% HPD Interval)</i>	<i>Plant species</i>	<i>Data sources</i>
$\alpha_{aa}$	per-capita competitive effect of annuals on annuals	fitted with $\lambda_a$ , above	<i>Uninformative:</i> $\alpha_{aa} \sim \text{Gamma}(1, 10)$ <i>Informative:</i> $\alpha_{aa} \sim \text{Gamma}(1, 9)$	1.74E-03 (2.86E-04, 3.13E-03)	AVFA, BRDI	(9, Molinari et al. unpub.)

Table A1 continued

<i>Parameter</i>	<i>Definition</i>	<i>Formulas</i>	<i>Priors</i>	<i>Mean (95% HPD Interval)</i>	<i>Plant species</i>	<i>Data sources</i>
$\alpha_{ap}$	per-capita competitive effect of perennial adults on annuals	fitted with $\lambda_a$ , above	<i>Uninformative:</i> $\alpha_{ap} \sim \text{Gamma}(1, 10)$ <i>Informative:</i> $\alpha_{ap} \sim \text{Gamma}(1, 9)$	2.41E-02 (9.73E-06, 6.76E-02)	AVFA, BRDI, STPU	(Molinar i et al. unpub.)
$\lambda_p$	per-capita seed production in the absence of competition for the perennial	$mean = \lambda_p / (1 + \alpha_{pa}x_a + \alpha_{pp}x_p)$ , $Y \sim \text{Normal}(\log(mean), \sigma = 1/\tau)$ , where $Y$ is the number of seeds per individual and $x_a$ and $x_p$ are the densities of annuals and perennial adults	<i>Uninformative:</i> $\lambda_p \sim \text{Uniform}(0, 600)$ $\tau \sim \text{Gamma}(0.001, 0.001)$ <i>Informative:</i> $\lambda_p \sim \text{Gamma}(200, 1)$ $\tau \sim \text{Gamma}(0.001, 0.001)$	201 (173, 229)	STPU	(Molinar i et al. unpub)
$\alpha_{pa}$	per-capita competitive effect of annuals on perennial adults	fitted with $\lambda_p$ , above	<i>Uninformative:</i> $\alpha_{pa} \sim \text{Gamma}(1, 10)$ <i>Informative:</i> $\alpha_{pa} \sim \text{Gamma}(1, 9)$	1.38E-02 (1.77E-05, 3.62E-02)	STPU, BRDI	(Molinar i et al. unpub)
$\alpha_{pp}$	per-capita competitive effect of perennial adults on perennial adults	fitted with $\lambda_p$ , above	<i>Uninformative:</i> $\alpha_{pp} \sim \text{Gamma}(1, 10)$ <i>Informative:</i> $\alpha_{pp} \sim \text{Gamma}(1, 9)$	1.53E-01 (2.56E-04, 3.45E-01)	STPU	(Molinar i et al. unpub)

Table A1 continued

<i>Parameter</i>	<i>Definition</i>	<i>Formulas</i>	<i>Priors</i>	<i>Mean (95% HPD Interval)</i>	<i>Plant species</i>	<i>Data sources</i>
$s_s$	perennial seedling summer survival	$mean = s_s / (1 + \alpha_{sa}x_a + \alpha_{ss}x_s + \alpha_{sp}x_p)$ $Y \sim \text{Beta-Binomial}(a, a(1 - mean)/mean, x_s),$ where $Y$ is the number of surviving seedlings after the summer, and $x_a$ , $x_s$ , and $x_p$ are the densities of annuals, perennial seedlings, and perennial adults in the spring	<i>Uninformative:</i> $s_s \sim \text{Beta}(1, 1)$ $a \sim \text{Gamma}(1, 1)$ <i>Informative:</i> $s_s \sim \text{Beta}(1, 9)$ $a \sim \text{Gamma}(1, 1)$	0.29 (0.18, 0.41)	STPU, ELGL, HOBR, MECA, STCE, POSE	(3, 4, 8, 11, 12)
$\alpha_{sa}$	per-capita competitive effect of annuals on perennial seedlings	fitted with $s_s$ , above	<i>Uninformative:</i> $\alpha_{sa} \sim \text{Gamma}(1, 10)$ <i>Informative:</i> $\alpha_{sa} \sim \text{Gamma}(1, 9)$	2.84E-03 (1.75E-06, 8.16E-03)	STPU, ELGL, HOBR, MECA, STCE, POSE, VUMY	(3, 4, 8, 11, 12)
$\alpha_{ss}$	per-capita competitive effect of perennial seedlings on perennial seedlings	fitted with $s_s$ , above	<i>Uninformative:</i> $\alpha_{ss} \sim \text{Gamma}(1, 10)$ <i>Informative:</i> $\alpha_{ss} \sim \text{Gamma}(1, 9)$	8.74E-02 (3.16E-05, 2.41E-01)	STPU, ELGL, HOBR, MECA, STCE, POSE	(3, 4, 8, 11, 12)

Table A1 continued

<i>Parameter</i>	<i>Definition</i>	<i>Formulas</i>	<i>Priors</i>	<i>Mean (95% HPD Interval)</i>	<i>Plant species</i>	<i>Data sources</i>
$\alpha_{sp}$	per-capita competitive effect of perennial adults on perennial seedlings	fitted with $s_s$ , above	<i>Uninformative:</i> $\alpha_{sp} \sim \text{Gamma}(1, 10)$ <i>Informative:</i> $\alpha_{sp} \sim \text{Gamma}(1, 9)$	1.26E-01 (4.94E-05, 3.64E-01)	STPU, ELGL, HOBR, MECA, STCE, POSE	(3, 4, 8, 11, 12)
$\alpha_{as}, \alpha_{ps}$	per-capita competitive effects of perennial seedlings on annuals and perennial adults	$\alpha_{as} = \phi \alpha_{aa}$ $\alpha_{ps} = \phi \alpha_{pa}$ $\phi \sim \text{Uniform}(0, 1)$		0.50 (0.02, 0.97)		

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