Fig-1-equations

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Cooperation

$$\frac{dE}{dt} = \mu_e \times E \times \frac{\alpha_{e,s} \times S}{(\alpha_{e,s} \times S) + \kappa_e} \times (R - E) - (\zeta_{e,2} \times gen \times E) - (\delta_e * E)$$

$$\frac{dS}{dt} = \mu_s \times S \times \frac{\alpha_{s,e} \times E}{(\alpha_{s,e} \times E) + \kappa_s} \times (R - S) - (\zeta_{s,1} \times sp \times S) - (\zeta_{s,2} \times gen \times S) - (\delta_s * S)$$

$$\frac{dgen}{dt} = (\gamma_{s,2} \times gen \times S) + (\gamma_{e,2} \times gen \times E) - (\delta_g * gen)$$

$$\frac{dsp}{dt} = (\gamma_{s,1} \times sp \times S) - (\delta_p * sp)$$

Competition

$$\frac{dE}{dt} = \mu_e \times E \times (R - E - (\beta_{e,s} \times S)) - (\zeta_{e,2} \times gen \times E) - (\delta_e * E)$$

$$\frac{dS}{dt} = \mu_s \times S \times (R - S - (\beta_{s,e} \times E)) - (\zeta_{s,1} \times sp \times S) - (\zeta_{s,2} \times gen \times S) - (\delta_s * S)$$

$$\frac{dgen}{dt} = (\gamma_{s,2} \times gen \times S) + (\gamma_{e,2} \times gen \times E) - (\delta_g * gen)$$

$$\frac{dsp}{dt} = (\gamma_{s,1} \times sp \times S) - (\delta_p * sp)$$

Parameter	Default Value	Description
$\alpha_{j,i}$	1.0	Cooperation coefficient, benefit of host species i to host species j
$\beta_{j,i}$	0.9	Competition coefficient, effect of host species i on host species j
μ_i	0.5	Intrinsic growth rate of host species i
$\gamma_{i,x}$	0.02	Efficiency of predator with range x on host species i
$\zeta_{i,x}$	0.001	Consumption rate of predator with range x on host species i
δ_i	0.03	Natural rate of death for species i
κ_i	1.0	Half-saturation Monod constant of species i
R	1.0 (coop) or 2.0 (comp)	System carrying capacity

Trade-off	Parameter Combinations	Significance
None	$\gamma_{i,2} = \gamma_{i,1}$ $\zeta_{i,2} = \zeta_{i,1}$	Generalist and specialist predators are parametrically identical
Benefit of specialism	$\gamma_{i,2} \neq \gamma_{i,1}$ or $\zeta_{i,2} \neq \zeta_{i,1}$	Predators differ in their ability to kill hosts
Host rate	$\mu_i \neq \mu_j$	Host species coexistence in the absence of predators is biased or impossible
Generalist preference	$\gamma_{i,2} \neq \gamma_{j,2}$ or $\zeta_{i,2} \neq \zeta_{j,2}$	Generalist predators are better at killing one host than another