EEID 2023 model equations

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Model Equations

$$\frac{dR}{dt} = rR(1 - \frac{R}{K}) - f_j R(S_j + I_j) - f_a R(S_a + I_a) \tag{1}$$

$$\frac{dS_j}{dt} = ef_a R(S_a + I_a) - dS_j - \beta_j S_j(I_j + I_a) - p_j S_j - gf_j RS_j \tag{2}$$

$$\frac{dS_a}{dt} = gf_j R(I_j + S_j) - dS_a - \beta_a S_a(I_j + I_a) - p_a S_a \tag{3}$$

$$\frac{dI_j}{dt} = \beta_j S_j(I_j + I_a) - (d + v)I_j - p_j I_j - gf_j RI_j \tag{4}$$

$$\frac{dI_a}{dt} = \beta_a S_a(I_j + I_a) - (d + v)I_a - p_a I_a \tag{5}$$

$$p_a = p(p_{bias}); p_j = p(1 - p_{bias}) \tag{6}$$

$$\beta_a = \beta(\beta_{bias}); \beta_j = \beta(1 - \beta_{bias}) \tag{7}$$

R0 Expression

$$R0 = \frac{\beta_a d S_a^* + \beta_a p_j S_a^* + beta_a f_j g R^* S_a^* + \beta_j d S_j^* + \beta_j p_a S_j^* + \beta_a S_a^* v + \beta_j S_j^* v}{(d + p_a + v)(d + p_j + f_j g R^* + v)} \tag{8}$$

Table 1: Description of all parameters in Equations 1-8

Parameter	Description
$f_{j,a}$	Feeding rate (juvenile and adult)
$\beta_{j,a}$	Transmission rate (towards juveniles/adults)
β_{bias}	Parasite bias towards adults (0-1)
$d_{j,a}$	Mortality rate (juvenile and adult)
$v_{j,a}$	Disease induced additional mortality rate (juvenile and adult)
e	Conversion efficiency of resources to offspring
$g_{s,i}$	Maturation rate per resource consumed (susceptible and infected)
m	Resource background mortality rate
r	Resource intrinsic growth rate
K	Resource carrying capacity
$p_{j,a}$	Predation rate (on juveniles/adults)
p_{bias}	Predator bias towards adults (0-1)