Methods

Data simulations

We used simulated data to test the ability of our model to estimate the ...

We simulated Wood Thrush and Cowbird reproductive success data for 40 nests on 12 study plots (total nests = 480). We randomly assigned each nest i a clutch completion date (CC_i) and distance to patch edge ($dist_i$) as:

$$CC_i \sim Uniform(0, 30)$$

$$dist_i \sim Uniform(0, 100)$$

For each plot p, we simulated Cowbird density ($dens_p$) as:

$$dens_p \sim Uniform(0, 20)$$

The probability that each nest was parasitized by a Brown-headed Cowbird ($\phi^P_{i,p}$) was modeled as a function of the mean parasitism rate (α^P), clutch completion date, the distance of the nest from the plot edge ($dist_i$), and the density of Cowbirds on the plot ($dens_p$):

$$\phi^P_{i,p} = \alpha^p + \beta^2 CC_i + \beta^3 dist_i + \beta^4 dens_p$$

Observed parasitism of each nest ($P_{i,p}$) was then modeled as the outcome of a Bernoulli trial with probability $\phi^P_{i,p}$.

The probability of cowbird hatching success ($\phi^{CH}_{i,p}$) was modeled as a constant (α^{CH}), conditional on the nest being parasitized. Thus,

$$\phi^{CH}_{i,p} = \begin{cases} \alpha^{CH}, & \text{if } P_{i,p} = 1. \\ 0, & \text{if } P_{i,p} = 0. \end{cases} \tag{1}$$

The observed Cowbird hatching success ($HC_{i,p}$) was treated as a Bernoulli trial with probability $\phi^{CH}_{i,p}$.

The expected probability of Wood Thrush hatching success ($\phi^{WH}_{i,p}$) was modeled as a function of whether or not Cowbirds nestlings were present in the nest:

$$\phi^{WH}_{i,p} = \alpha^{WH} + \beta^5 HC_{i,p}$$

where α^{WH} the mean hatching success rate for Wood Thrush and β^5 is the slope parameter controlling the effect of Cowbird hatching success on Wood Thrush hatching success. The observed Wood Thrush hatching success ($WH_{i,p}$) was then modeled as a Bernoulli trial with probability $\phi^{WH}_{i,p}$.

Next, the number of Cowbird fledglings in each nest ($CF_{i,p}$) was drawn from a zero-truncated Poisson distribution with mean $\lambda^{CF}_{i,p}$, conditional on Cowbird hatching success:

$$CF_{i,p} = \begin{cases} \sim Poisson(\lambda^{CF}_{i,p})T(1,), & \text{if } CH_{i,p} = 1. \\ 0, & \text{if } CH_{i,p} = 0. \end{cases} \tag{2}$$

The expected number of Cowbird offspring in each nest ($\lambda_{i,p}^{CF}$) was modeled a function of Wood Thrush hatching success:

$$\lambda_{i,p}^{CF} = \mu^{CF} + \beta^6 HW_{i,p}$$

where μ^{CF} is the mean number of Cowbird fledglings per nest and β^6 is the slope parameter controlling the effect of Wood Thrush hatching success on Cowbird offspring.

Finally, the number of Wood Thrush fledglings in each nest ($WF_{i,p}$) was drawn from a zero-truncated Poisson distribution with mean $\lambda_{i,p}^{WF}$, conditional on Wood Thrush hatching success:

$$WF_{i,p} = \begin{cases} \sim Poisson(\lambda_i^{WT})T(1,), & \text{if } WH_{i,p} = 1. \\ 0, & \text{if } WH_{i,p} = 0. \end{cases} \tag{3}$$

The expected number of Wood Thrush offspring in each nest (λ_i^{CF}) was modeled a function of the number of Cowbird offpsring in the nest:

$$\lambda_{i,p}^{WF} = \mu^{WF} + \beta^7 CF_{i,p}$$

where μ^{WF} is the mean number of Cowbird fledglings per nest and β^7 is the slope parameter controlling the effect of Cowbird offspring on Wood Thrush offspring.