Appendix 1. Details of model implementation.

We used hierarchical generalized linear models to specify the likelihood for the dynamic occupancy model that accounts for detection probability and misclassification. We modeled survey data ($Y_{i,j,t}$) of Florida Grasshopper Sparrow observations at point count sites (i) during visit (j) and for year t in $\{1, 2, 3, \ldots T\}$ as $Y_{i,j,t} \sim categorical(\pi_{i,j,t,1:K})$ where π is the probability of a specific state occurring and survey data consisted of observed states *k* in {1,2,3} where K=3. The model estimated a discrete and latent occupancy state (z); detection probability ($p11$) that accounted for false negatives when a bird was present but undetected; misclassification probability ($p10$) that accounts for false positives when a bird was absent but detected; and the probability of certainty of detections (b). Our data had three observed states when a site was visited including no detections (*k*=1), certain detections (*k*=2), and uncertain detections (*k*=3). These three detection states enabled the model to distinguish between sites that were: truly occupied; misclassified as occupied sites; occupied but birds were not detected; and truly unoccupied.

The first observed state, no detection (Y=1) was the outcome when a site was either occupied by the focal species and no individuals were detected, or a site was unoccupied and without misclassification. We describe this as $\pi_{i,j,t,k=1} = z_{i,t}\left(1 - p11_{i,j,t}\right) + \left(1 - z_{i,t}\right)\left(1 - p10_{i,j,t}\right)$.

The second observed state included uncertain detections (Y=2) and was the outcome when a site was occupied and surveyors had an uncertain detection (i.e., there was ambiguity which subspecies was detected), or the site was unoccupied by the focal species but was misclassified as being occupied. We express this as $\pi_{i,j,t,k=2} = z_{i,t}\left(1 - b_{i,j,t}\right)p11_{i,j,t} + \left(1 - z_{i,t}\right)p10_{i,j,t}$.

The third observed state designated certain detections (Y=3) and was the outcome when a site was occupied by the focal species and a surveyor detected an individual with certainty. We express this as $\pi_{i,j,t,k=3} = z_{i,t}b_{i,j,t}p11_{i,j,t}$. We considered certain detections to include banded FGSP that were resighted and Grasshopper Sparrows detected after 1 May when >99% of Eastern Grasshopper Sparrow (migratory *pratensis*) detections had ceased from Florida counties where Florida Grasshopper Sparrow are not known to persist.

For the first year, initial probability of occupancy $z_{i,1} \sim Bernoulli(\psi_{i,1})$ with a mean (ψ). We included occupancy dynamics as a Markovian autoregressive structure where occupancy at future time steps ($z_{i,t+1}$) was a function of occupancy during previous time steps ($z_{i,t}$), site persistence (ϕ) and colonization (γ) as $z_{i,t+1}|z_{i,t} \sim Bernoulli(z_{i,t}\phi_{i,t} + (1 - z_{i,t})\gamma_{i,t})$.

We added complexity using covariates and link functions to customize the model for Florida Grasshopper Sparrow. We present the global model that includes all covariates for each response variable. Model-estimated parameters that represent intercepts and coefficients are indicated using the symbols β, δ, α, ρ, and ω. Detection probability included the covariates ordinal date of point count (DATE) and hours after civil twilight when a point count was conducted (HOUR, see Table 1 for full descriptions) and we centered and scaled these covariates, and included a random intercept for year (ε_{p11}).

$$logit(p11_{i,j,t}) \sim \beta_0 + \beta_1 DATE_{i,j,t} + \beta_2 DATE_{i,j,t}^2 + \beta_3 HOUR_{i,j,t} + \beta_4 HOUR_{i,j,t}^2 + \varepsilon_{p11,t}$$

$$\varepsilon_{p11,t} \sim normal(0, \sigma_{p11})$$

Probability of misclassification varied as a function of DATE and included a random intercept for year.

$$logit(p10_{i,j,t}) \sim \delta_0 + \delta_1 DATE_{i,j,t} + \delta_2 DATE_{i,j,t}^2 + \varepsilon_{p10,t}$$

$$\varepsilon_{p10,t} \sim normal(0, \sigma_{p10})$$

We allowed certainty to vary with DATE because eBird data indicated that most Eastern Grasshopper Sparrows (>99%) detections had occurred before 1 May.

$$logit(b_{i,j,t}) = \alpha_0 + \alpha_1 DATE_{i,j,t} + \alpha_2 DATE_{i,j,t}^2 + \alpha_3 DATE_{i,j,t}^3$$

We specified initial occupancy state as $logit(\psi_{i,t=1}) = \mu_{\psi,t=1}$. We included years-since-fire (YSF) and seasonality of the most recent fire (SEAS) and their interactions as covariates for dynamics (i.e., persistence and colonization).

$$logit(\phi_{i,t}) = \rho_0 + \rho_1 YSF_{i,t} +$$

$$\rho_2 \sin(SEAS_{i,t}) + \rho_3 \cos(SEAS_{i,t}) +$$

$$\rho_4 YSF_{i,t} \sin(SEAS_{i,t}) + \rho_5 YSF_{i,t} \cos(SEAS_{i,t}) +$$

$$\rho_6 YSF_{i,t}^2 \sin(SEAS_{i,t}) + \rho_7 YSF_{i,t}^2 \cos(SEAS_{i,t}) + \varepsilon_{\phi,t}$$

$$\varepsilon_{\phi,t} \sim normal(0, \sigma_\phi)$$

$$logit(\gamma_{i,t}) = \omega_0 + \omega_1 YSF_{i,t} + \omega_2 YSF_{i,t}^2 +$$

$$\omega_3 \sin(SEAS_{i,t}) + \omega_4 \cos(SEAS_{i,t}) +$$

$$\omega_5 YSF_{i,t} \sin(SEAS_{i,t}) + \omega_6 YSF_{i,t} \cos(SEAS_{i,t}) +$$

$$\omega_7 YSF_{i,t}\, YSF_{i,t}^2 \sin(SEAS_{i,t}) + \omega_8 YSF_{i,t} YSF_{i,t}^2 \cos(SEAS_{i,t}) + \varepsilon_{\gamma,t}$$

$$\varepsilon_{\gamma,t} \sim normal(0, \sigma_\gamma)$$

Seasonality covariates for persistence and colonization allowed a wave-like response over the duration of a year. This response could have a peak and a trough that were determined by model-estimated parameters. As an example of an effect from seasonality, ordinal date of the most recent fire could influence persistence, and this response would have a peak during times of year when persistence was greatest, and a trough when persistence was least. However, the mean response could become a flat line when these coefficients equal zero indicating no seasonality. We included interaction terms as covariates of both persistence and colonization between YSF and SEAS, YSF^2 and SEAS, and included random effects for year (ε_ϕ, ε_γ).