Supplementary Table 1

Model structures and prior distributions for the 4 models compared in the study. The M_{PS} model uses pooled capture probability (p) and simple marked abundance (U) parameters, the within-year M_{HW} model uses hierarchical p and hierarchical U parameters, the M_{SPLINE} model uses the parameters of hierarchical p and Bayesian penalized spline U, and the hierarchical multiyear M_{HB} model uses hierarchical p and hierarchical U parameters. Knots are spaced evenly across temporal strata at 4-strata intervals for the P-spline model.

Model	Structure
M_{PS}	Low level: $\log(U_i) \sim Normal(mean = 10, variance = 4)$ $\mathrm{logit}(p) \sim Normal(mean = -2, variance = 1.5)$
M_{HW}	Low level: $\log(U_i) \sim Normal(mean = \eta_U, variance = \varepsilon^2{}_U)$ $\mathrm{logit}(p_i) \sim Normal(mean = \eta_p, variance = \varepsilon^2{}_p)$ Hierarchical component: $1/\varepsilon^2{}_U \sim Gamma(shape = .001, rate = .001)$ $\eta_U \sim Normal(mean = 10, variance = 4)$ $1/\varepsilon^2{}_p \sim Gamma(shape = .001, rate = .001)$ $\eta_p \sim Normal(mean = -2, variance = 1.5)$
M_{SPLINE}	Low level: $\log(U_i) = \sum_{k-1}^{K} b_k B_k(i) + \varepsilon^2{}_U$ $\mathrm{logit}(p_i) \sim Normal(mean = \eta_p, variance = \varepsilon^2{}_p)$ Hierarchical component: $1/\varepsilon^2{}_U \sim Gamma(shape = 1, rate = .05)$ $b[1] \sim Uniform(alpha = -\infty, beta = \infty)$ $b[2] \sim Uniform(alpha = -\infty, beta = \infty)$ $b_1, \ldots, b_{k+4} \sim Normal(mean = b_k + (b_k - b_{k-1}), variance = \varepsilon^2{}_b)$ $1/\varepsilon^2{}_b \sim Gamma(shape = 1, rate = .05)$ $1/\varepsilon^2{}_p \sim Gamma(shape = .001, rate = .001)$ $\eta_p \sim Normal(mean = -2, variance = 1.5)$
M_{HB}	Low level: $\log(U_{ij}) \sim Normal(mean = \eta_{iU}, variance = \varepsilon^2{}_{iU})$ $\mathrm{logit}(p_{ij}) \sim Normal(mean = \eta_{ip}, variance = \varepsilon^2{}_{ip})$ Hierarchical component: $\eta_{iU} \sim Normal(mean = \eta_U, variance = \varepsilon^2{}_U)$ $1/\varepsilon^2{}_{iU} \sim Gamma(shape = .001, rate = .001)$ $\eta_U \sim Normal(mean = 10, variance = 4)$ $1/\varepsilon^2{}_U \sim Gamma(shape = .001, rate = .001)$ $\eta_{ip} \sim Normal(mean = \eta_p, variance = \varepsilon^2{}_p)$ $1/\varepsilon^2{}_{ip} \sim Gamma(shape = .001, rate = .001)$ $\eta_p \sim Normal(mean{=}-2, variance{=}1.5)$ $1/\varepsilon^2{}_p \sim Gamma(shape = .001, rate = .001)$