**Table 1.** Multi-level statistical model to estimate population trajectories in pre-defined geographic strata by integrating daily counts of migrants at a series of monitoring stations with estimates of breeding origins for a sample of migrants at a subset of stations. Equations are indexed by geographic strata (j), year (y), monitoring station (s), and day of year (d).

|  |  |  |
| --- | --- | --- |
| Description | Equations |  |
| *Stratum-level population process model:* | | |
| Log-linear population change within stratum *j*, starting from baseline year |  | (1) |
| *Migration process model:* | | |
| Number of migrants arriving at each station from each stratum controlled by migration parameter . |  | (2) |
| Expected abundance migrants arriving at a station from all regions. Additional temporal variance () is controlled by parameter . | where: | (3) |
| Seasonal temporal distribution of migrants arriving at the station follows a normal curve with a mean date and a standard deviation , where day of the year is indexed by . | , where: | (4) |
| *Observation models:* | | |
| Observed number of migrants at each station on each day of year is Poisson distributed with log-normal overdispersion (controlled by ), and an offset for survey effort (e.g., number of hours nets were operational on a day). | , where: | (5) |
| Multinomial distribution describes the observed breeding origins for a sample of birds collected at a station in a given year. |  | (6) |

**Table 2.** Specification of Bayesian priors for analysis of seasonal migration counts.

|  |  |  |
| --- | --- | --- |
| *Parameter* | *Prior* | *Notes* |
| *Stratum-level parameters:* | | |
|  | *Fixed to 1* | Ensuresterms are identifiable. terms are rescaled to outside of fitting procedure based on independent estimate of abundance (e.g., based on a species distribution model describing breeding season abundance across a geographic stratum). |
|  | *Normal(0,1)* | Log-linear temporal trend within stratum. |
| *Station-level parameters:* | | |
|  | *Lognormal(0,4)* | Migration parameters (from stratum *j* to station *s*) |
|  | *Uniform(0,2)* | Magnitude of year-to-year variation in station-level indices |
|  | *Uniform(1,360)* | Day of year at which peak of migration occurs. |
|  | *Uniform(0,20)* | Describes temporal dispersion of migration period within a season. Migration is assumed to follow a normal curve, such that approximately 95% of birds arrive at station within ± 1.96 |
|  | *Uniform(0,2)* | Magnitude of extra-Poisson error in daily counts. |

**Table 3.** Estimates of population trend and percent change relative to 1998 and 2008 within each stratum. Values are expressed as posterior median value followed by 95% credible interval in parentheses.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Stratum | Source of trend estimate | 20-year trend | Prob trend is positive | % change since 1998 | % change since 2008 |
| West | Mig (pre) | +1.7 (-0.7 to +4.1) | 0.92 | +38.7 (-12.3 to +123.1) | +17.8 (-6.4 to +49.4) |
| West | Mig (post) | +1.3 (-1.6 to +3.5) | 0.79 | +29.7 (-27.2 to +98.1) | +13.9 (-14.7 to +40.7) |
| West | BBS | -2.7 (-5.3 to +0.3) | 0.03 | -42.7 (-66.1 to +5.9) | -33.2 (-59.2 to -2.7) |
|  |  |  |  |  |  |
| East | Mig (pre) | -4.6 (-7.3 to -2.1) | < 0.01 | -61.3 (-78.2 to -33.9) | -37.8 (-53.3 to -18.7) |
| East | Mig (post) | -5.5 (-18.2 to +4.7) | 0.31 | -67.6 (-98.2 to +150.7) | -43.1 (-86.6 to +58.3) |
| East | BBS | -3.8 (-6.1 to -1.4) | < 0.01 | -54.2 (-71.4 to -24) | -44.1 (-63.6 to -20) |
|  |  |  |  |  |  |
| Continental | Mig (pre) | -3.0 (-5.4 to -0.9) | < 0.01 | -45.7 (-66.7 to -17.1) | -29.1 (-46.5 to -10.4) |
| Continental | Mig (post) | -3.7 (-16.1 to 2.1) | 0.30 | -53 (-97 to +51.3) | -34.7 (-85.7 to +21) |
| Continental | BBS | -3 (-5.1 to -0.7) | 0.01 | -46.1 (-64.9 to -12.6) | -36.9 (-56.7 to -14.7) |