**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:* | | |
| Time-varying random walk population growth process within each stratum.  describes the magnitude of annual fluctuations in stratum-level abundance. | where: | (1) |
| *Migration process model:* | | |
| Number of migrants arriving at each station from each stratum; controlled by time-varying migration parameter |  | (2) |
| Expected number of migrants that arrive at the station during a season, from all regions. | where: | (3) |
| The expected number of migrants counted on each day of the season at a station. Seasonal temporal distribution of migrants arriving at the station follows a normal curve with a mean date and a standard deviation | , 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 (net hours). | , 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 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 ( |
|  | *Normal(0,1)* | Expected log-normal annual change in each stratum |
|  | *Uniform(0,2)* | Magnitude of process variance in each stratum |
| *Station-level parameters:* | | |
|  | *Lognormal(0,100)* | Migration pressure parameters (from stratum *j* to station *s*) |
|  | *Uniform(0,2)* | Magnitude of year-to-year noise in station-level indices |
|  | *Uniform(1,360)* | Date of peak migration at each station |
|  | *Uniform(0,20)* | Describes width of migration period |
|  | *Uniform(0,2)* | Magnitude of extra-Poisson error in daily observations |

Table 3. Estimates of percent population change and trend between 2000 and 2018 within each stratum. Total % change and trend (% change/year??) expressed as predicted value followed by 95% Credible Interval in parens.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Stratum | Source of trend estimate | % change since 2000 | Trend between 2000 and 2018 | Probability of Decline | Probability of >50% Decrease | Probability of >100% Increase |
| West | Pre-breeding migration | -15.6 (-58.5 to +64.4) | -0.9 (-4.8 to +2.8) | 0.69 | 0.08 | 0.01 |
| West | Post-breeding migration | +38.7 (-36.4 to +192.9) | +1.8 (-2.5 to +6.2) | 0.21 | 0.01 | 0.19 |
| West | Breeding Bird Survey | -10.8 (-41.3 to +66.5) | -0.6 (-2.9 to +2.9) | 0.69 | 0.01 | 0.01 |
|  |  |  |  |  |  |  |
| East | Pre-breeding migration | -70.5 (-87 to -34.4) | -6.6 (-10.7 to -2.3) | 1 | 0.91 | 0 |
| East | Post-breeding migration | -8.8 (-97.4 to +198) | -0.5 (-18.3 to +6.3) | 0.54 | 0.34 | 0.13 |
| East | Breeding Bird Survey | -40.9 (-61.9 to -4.2) | -2.9 (-5.2 to -0.2) | 0.98 | 0.21 | 0 |
|  |  |  |  |  |  |  |
| Continental | Pre-breeding migration | -60.1 (-79.8 to -28.6) | -5 (-8.5 to -1.9) | 1 | 0.76 | 0 |
| Continental | Post-breeding migration | -1.6 (-95.4 to +82) | -0.1 (-15.8 to +3.4) | 0.51 | 0.27 | 0.01 |
| Continental | Breeding Bird Survey | -21.6 (-44.2 to +25.6) | -1.3 (-3.2 to +1.3) | 0.88 | 0.01 | 0 |