**Table S2.** Sample sizes and estimated root mean-squared errors ($\widehat{\text{RMSE}}$) from Poisson2, Darroch and Gamma3.5 heterogeneity corrections[1] in loglinear estimation models $\mathcal{M}_h$ and $\mathcal{M}_{th}$ for estimation of population size $N$ from five lists generated from models $\mathcal{M}_h$, $\mathcal{M}_{bh}$, $\mathcal{M}_{th}$, and $\mathcal{M}_{bth}$. A total of $n = 1,600$ estimates were available for each combination of estimation model, encounter probability and number of encounter events, but those for which variance estimation failed were excluded. The Poisson2 heterogeneity correction produced the smallest $\widehat{\text{RMSE}}$s in all but two of 24 comparisons in the simulated data in fits to models $\mathcal{M}_{bh}$ and $\mathcal{M}_{tbh}$. The Darroch and Gamma3.5 corrections occasionally produced $\widehat{\text{RMSE}}$s that were more than one order of magnitude larger than the Poisson2 correction. Conversely, the Gamma3.5 correction produced the largest $\widehat{\text{RMSE}}$s in all but two comparisons.

| | Estimation | Expected | Poisson2 | | Darroch | | Gamma3.5 | |
|---|---|---|---|---|---|---|---|---|
| $N$ | model | Pr(encounter)[2] | n | $\widehat{\text{RMSE}}$ | n | $\widehat{\text{RMSE}}$ | n | $\widehat{\text{RMSE}}$ |
| 1,000 | $\mathcal{M}_h$ | 0.025 | 366 | 1,667,192 | 365 | $> 10^9$ | 339 | $> 10^9$ |
| | | 0.050 | 1,055 | 671 | 1,055 | 2,257 | 1,051 | 7,536 |
| | | 0.100 | 1,562 | 434 | 1,562 | 635 | 1,560 | 1,061 |
| | | 0.150 | 1,600 | 364 | 1,600 | 449 | 1,599 | 633 |
| | | 0.200 | 1,600 | 292 | 1,600 | 294 | 1,600 | 368 |
| | $\mathcal{M}_{th}$ | 0.025 | 366 | 1,614,888 | 365 | $> 10^9$ | 341 | $> 10^9$ |
| | | 0.050 | 1,055 | 668 | 1,055 | 2,256 | 1,051 | 7,568 |
| | | 0.100 | 1,562 | 433 | 1,562 | 635 | 1,560 | 1,064 |
| | | 0.150 | 1,600 | 363 | 1,600 | 449 | 1,599 | 636 |
| | | 0.200 | 1,600 | 291 | 1,600 | 294 | 1,600 | 371 |
| 20,000 | $\mathcal{M}_h$ | 0.025 | 1,363 | 13,259 | 1,363 | 27,030 | 1,363 | 53,402 |
| | | 0.050 | 1,599 | 9,664 | 1,599 | 12,554 | 1,599 | 17,513 |
| | | 0.100 | 1,600 | 7,851 | 1,600 | 8,198 | 1,600 | 9,691 |
| | | 0.150 | 1,600 | 6,680 | 1,600 | 6,478 | 1,600 | 7,291 |
| | | 0.200 | 1,600 | 5,720 | 1,600 | 5,178 | 1,600 | 5,663 |
| | $\mathcal{M}_{th}$ | 0.025 | 1,363 | 13,252 | 1,363 | 27,030 | 1,363 | 53,421 |
| | | 0.050 | 1,599 | 9,658 | 1,599 | 12,554 | 1,599 | 17,522 |
| | | 0.100 | 1,600 | 7,839 | 1,600 | 8,197 | 1,600 | 9,711 |
| | | 0.150 | 1,600 | 6,662 | 1,600 | 6,477 | 1,600 | 7,325 |
| | | 0.200 | 1,600 | 5,699 | 1,600 | 5,175 | 1,600 | 5,707 |

[1] See: Baillargeon S, Rivest L. Rcapture: Loglinear models for capture-recapture in R. Journal of Statistical Software. 2007;19(5):1–31. doi:10.18637/jss.v019.i05.

[2] For first encounters in data-generating models $\mathcal{M}_{bh}$ and $\mathcal{M}_{tbh}$.