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Effect of different sampling designs and methods on the estimation of secondary production: A simulation

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Web Appendix 1

This appendix describes 13 estimation techniques that were investigated in the Monte Carlo simulation study, in addition to the 7 classic methods. The notation used throughout this section is the same as in the main body of the text.

IS-2 Same as IS-1, except that

$$P_1 = \left(B_{t_1 1\bullet} - B_{11\bullet}\right) + \sum_{t=t_1}^{T-1}\left(N_{(t+1)1\bullet} + N_{t1\bullet}\right)\left(W_{(t+1)1\bullet} - W_{t1\bullet}\right)/2,$$

where t_1 is the sampling occasion on which $N_{t1\bullet}$ is the largest, i.e., as per the suggestion of Siegismund (1982).

IS-3 Same as IS-1, but discarding values to ensure positive production, i.e., computing P_i using only the largest possible subset of times for which $W_{ti\bullet}$ increases in t, starting with $W_{1i\bullet}$.

IS-4 Keeping all points as in IS-1, but replacing negative productions by zeros, i.e., using

$$P_i = \sum_{t=1}^{T-1}\left(N_{(t+1)i\bullet} + N_{ti\bullet}\right)\max\left(0, W_{(t+1)i\bullet} - W_{ti\bullet}\right)/2.$$

IG-2 Same as IG-1, but replacing negative productions by zeros, i.e.,

$$P_i = \sum_{t=1}^{T-1}\left(B_{(t+1)i\bullet} + B_{ti\bullet}\right)\max\left\{0, \log\left(\frac{W_{(t+1)i\bullet}}{W_{ti\bullet}}\right)\right\}/2.$$

AC-2 Same as AC-1, but discarding points prior to the largest N, i.e., for each cohort i, find the time t_i at which $N_{ti\bullet}$ is maximized, and discard couples ($N_{ti\bullet}$, $W_{ti\bullet}$) for which $t < t_i$.

AC-3 An Allen curve obtained by merging all cohorts in one; specifically, sampling cohort i at time T_t was treated as equivalent to sampling cohort 1 at time $365(i - 1) + T_t$ and the curve $\log N = \alpha + \beta W$ was fitted, which led to

$$P = \frac{e^{\alpha}}{\beta}\left(e^{\beta W_{\max}} - e^{\beta W_{\min}}\right)$$

with $W_{\max}$ and $W_{\min}$, respectively, standing for the largest and smallest weights, overall.

SF-2 A variant of SF-1 proposed by Krueger and Martin (1980), i.e.,

$$P = K\sum_{k=1}^{K-1}\left(N_{\bullet\bullet(k+1)} - N_{\bullet\bullet k}\right)\sqrt{W_{\bullet\bullet(k+1)}W_{\bullet\bullet k}}.$$

SF-3 Another variant of SF-1 mentioned by Cusson (2004), i.e.,

$$P = K\sum_{k=1}^{K-1}\left(N_{\bullet\bullet(k+1)} + N_{\bullet\bullet k}\right)\left(W_{\bullet\bullet(k+1)} - W_{\bullet\bullet k}\right)/2.$$

GR-2 A variant of GR-1 with a von Bertalanffy adjustment curve, i.e.,

$$P = K\sum_{k=1}^{K-1} B_{\bullet\bullet k}\left\{\hat{a} - \hat{a}\frac{L_K}{\ell(k)}\right\}\log\left\{\frac{\hat{L}_{\max} - \ell(k+1)}{\hat{L}_{\max} - \ell(k)}\right\},$$

where $\ell(k) = (L_k + L_{k+1})/2$ and $\hat{L}_{\max}$ is obtained by fitting a von Bertalanffy growth curve

$$L(T) = \hat{L}_{\max}\{1 - \exp\hat{\lambda}(T - \hat{T}_0)\},$$

while $\hat{a}$ results from adjusting the linear regression curve

$$\log(W) = \hat{a}\log(L) + \hat{b}.$$

In both cases, the adjustment is based on cohort-merged data.

GR-3 A variant of GR-1 assuming length growth to be linear in time, i.e.,

$$P = I\sum_{k=1}^{K} B_{\bullet\bullet k}\,\hat{a}\hat{\lambda}\left\{1 - \frac{\hat{L}_{\max}}{\ell(k)}\right\}$$

where $\hat{a}$, $\ell(k)$, $\hat{L}_{\max}$, and $\hat{\lambda}$ are as defined above. The same substitution as in GR-2 was made, except that time was assumed to be a linear function of the size in length.

GR-4 A variant of GR-1 using length as a surrogate for time, i.e.,

$$P = K\sum_{k=1}^{K} B_{\bullet\bullet k}\frac{\hat{a}}{k},$$

where $\hat{a}$ is the same as above.

MR-2 A variant of MR-1 assuming that length growth is linear in time, i.e.,

$$P = -\hat{z}\,I\sum_{k=1}^{K} B_{\bullet\bullet k},$$

where $\hat{z}$ was obtained from regressing $\log(N) = \hat{z}_0 + \hat{z}\,T$ on the cohort-merged data (as in AC-3).

MR-3 Similar to MR-2, but using length as a surrogate for time, i.e.,

$$P = K\sum_{k=1}^{K} B_{\bullet\bullet k}\left\{\frac{\hat{z}}{\hat{\lambda}(K+1-k)}\right\},$$

where $\hat{z}$ is defined as in MR-2 and $\hat{\lambda}$ has the same meaning as in GR-2.