## Supplement 1. Model notation and equations

*Table S1.1. Notation for Grey Seal/Cod/Herring model. * indicates parameters that were directly estimated, ** indicates model arrays for which some subset of values were directly estimated, *** indicates parameters that were conditionally estimated, and **** indicates parameters that were post-fitted (i.e., fitted to model estimates) for use in projections.*

| Symbol | Description | Value |
|---|---|---|
| **Indices** | | |
| $i, j$ | Species ($i$ = prey, $j$ = predator) | 1=Grey Seal, 2=Cod, 3=Herring |
| $x, y$ | Subpopulation ($x$ = prey, $y$ = predator) | |
| $a, b$ | Age (yr) ($a$ = prey, $b$ = predator) | $a_i^{(R)}, a_i^{(R)}+1, \ldots, A_i-1, A_i$ |
| $t$ | Year | 1,2,…,48 |
| $g$ | Survey index | Table 1 |
| **Data and inputs** | | |
| $a_i^{(R)}$ | Age-at-recruitment for species $i$ (yr) | 1,2,2 |
| $A_i$ | Maximum age-class for species $i$ (yr) | 30,12,11 |
| $I_{g,i,t}$ | Abundance or biomass index | |
| $u_{g,i,x,a,t}^{(F)}$ | Fishery/survey age-composition ($i \geq 2$) | |
| $u_{j,a,t}^{(P)}$ | Age-composition of Herring in predator diet ($j \leq 2$) | |
| $C_{j,y,b,i,t}^{(P)}$ | Bioenergetic-derived prey consumption by predator $jy$ at age $b$ of prey species $i$ at age $a$ (kt) | |
| $C_{x,t}^{(pup)}$ | Age-0 Grey Seal removals (1000s) | |
| $C_{x,t}^{(1+)}$ | Age-1+ Grey Seal removals (1000s) | |
| $C_{i,x,t}^{(F)}$ | Observed commercial fishery catch ($i \geq 2$) | |
| $p_{x,t}^{(ice)}$ | Proportion of Grey Seals born on pack-ice | |
| $s_{x,t}^{(ice)}$ | Survival rate of Grey Seals born on pack-ice | |

| | | |
|---|---|---|
| $f_{j,y}$ | Proportion of time predator *j* in subpopulation *y* spends foraging near prey | $f_{j=1,y=1} = 0.024$<br>$f_{j=1,y=2} = 0.038$<br>$f_{j=1,y=3} = 0.729$<br>$f_{j=1,y=4} = 0.493$<br>$f_{j=2,y=1} = 1$ |
| $m_{i,a,t}$ | Proportion mature-at-age | |
| $w^{(\mathrm{S})}_{i,x,a,t}$ | Fish weight at start of year (kt) | |
| $w^{(\mathrm{F})}_{g,i,x,a,t}$ | Average weight-at-age of prey *ix* caught by gear *g* (kt) ($i \geq 2$) | |
| $d_{g,i,x}$ | Survey date (expressed as Julian date / 365) | |
| $p^{(\mathrm{init})}_{x,a}$ | Initial proportion of Grey Seals by age and sex/subpopulation | |
| $\gamma^{(n)}_{a,t}$ | Number of seals sampled for reproductive status | |
| $\gamma^{(k)}_{a,t}$ | Observed number of pregnant seals | |
| $\zeta_{i,x}$ | Spawn timing (expressed as Julian date / 365) | $\zeta_{j=2,y=1} = 0.37$<br>$\zeta_{j=3,y=1} = 0.25$<br>$\zeta_{j=3,y=2} = 0.58$<br>$\zeta_{j=3,y=3} = 0.58$<br>$\zeta_{j=3,y=4} = 0.58$ |
| **Parameters** | | |
| $N^{(\mathrm{init})}_{x}$ | Initial Grey Seal abundance ('000s) | * |
| $D_{x,1}, D_{x,2}$ | Seal juvenile density dependence half-saturation and shape | * |
| $\bar{\gamma}$ | Mature female seal reproductive rate | * |
| $a^{(50\%)}, a^{(95\%)}$ | Female seal age-at-50% and 95% maturity | * |
| $\bar{R}_x$ | Initial equilibrium Herring recruitment (millions) | * |
| $\varepsilon^{(\mathrm{R})}_{i,x,t}$ | Recruitment process errors ($i \geq 2$) | * |
| $M_{i,x,a,t}$ | Instantaneous natural mortality rate ($\mathrm{yr}^{-1}$) | ** |

| | | |
|---|---|---|
| $\varepsilon_t^{(\mathrm{M,c})}$ | Cod other natural mortality process errors ($t > 1$) | * |
| $\varepsilon_t^{(\mathrm{M,h1})}$ | Herring other natural mortality process errors, ages 2-6 ($t > 1$) | * |
| $\varepsilon_t^{(\mathrm{M,h2})}$ | Herring other natural mortality process errors, ages 7-11+ ($t > 1$) | * |
| $\varphi_{j,y,i,t}$ | Per-capita capacity of predator *jy* to prey on species *i* ($i \geq 2, j < 3$) | ** |
| $\varepsilon_{j,i,t}^{(\varphi)}$ | Predation capacity process errors ($t > 1$) | * |
| $s_{g,i,x,t}^{50\%}, s_{g,i,x,t}^{95\%}$ | Age-at-50% and 95% selectivity for fishing gear *g* ($i \geq 2$) | * |
| $\rho_{j,y}^{50\%}, \rho_{j,y}^{95\%}$ | Age at which prey consumption by predator *jy* is 50% and 95% of its maximum consumption levels | * |
| $k_j$, $\theta_j$ | Shape and scale parameters for predator selectivity of Herring | * |
| $q_{g,i,x,t}$ | Catchability of species *ix* to gear *g* ($i \geq 2$, $g > 1$) | * |
| $\varepsilon_{g,i,x,t}^{(\mathrm{q})}$ | Catchability process errors ($t > 1$) | * |
| $\tau_{g,i,t}^{(I)}$ | Abundance or biomass index variance | ** (see Table 3) |
| $\tau_{g,i,\mathrm{x}}^{(u)}$ | Fishery/survey age-composition variance | ** |
| $\tau_{j,t}^{(P)}$ | Age-composition of herring in predator diet variance | ** |
| $F_{x,t}^{(1+)}$ | Grey seal exploitation rate ($\mathrm{yr}^{-1}$) | *** |
| $F_{i,x,t}$ | Fully-selected fishery exploitation rate ($\mathrm{yr}^{-1}$; $i > 1$) | *** |
| $\eta_{j,y,i}$ | Encounter rate between predator *jy* and prey *i* | **** |
| $h_{j,y,i}$ | Time predator *jy* spends consuming prey i | **** |
| $\beta_0, \beta_C, \beta_H$ | Parameters for fecundity, density-dependence and Herring effect in Ricker stock-recruitment function for Cod | **** |
| $\Psi_{1,x}, \Psi_{2,x}$ | Fecundity and density-dependence parameters of Herring stock-recruitment function in projections | **** |

**State variables**

| | | |
|---|---|---|
| $N_{i,x,a,t}$ | Abundance (thousands for Grey Seals, millions for Cod and Herring) | ** |
| $Z_{i,x,a,t}$ | Instantaneous total mortality rate ($yr^{-1}$) | |
| $M_{i,a,t}^{(P)}$ | Instantaneous predation mortality rate ($yr^{-1}$) | |
| $m_{j,y,b,i,a,t}^{(P)}$ | Fully-selected instantaneous predation mortality imposed on prey *i* by predator *jy* at age *b* ($yr^{-1}$) | |
| $M_{i,x,a,t}^{(O)}$ | Other (non-predation) natural mortality rate ($yr^{-1}$) | |
| $S_{j,i,a}^{(\mathrm{P})}$ | Selectivity of species *i* at age *a* by predator *j* | |
| $S_{g,i,x,a,t}^{(\mathrm{F})}$ | Selectivity of prey *ix* at age *a* to fishing gear *g* | |
| $B_{i,x,t}^{(\mathrm{S})}$ | Spawner biomass ($i \geq 2$) | |
| $B_{j,i,x,a,t}^{(\mathrm{P})}$ | Biomass of prey *ix* at age *a* available to predator *j* ($i \geq 2$, $j < 3$) | |
| $V_{g,i,x,a,t}$ | Number of fish vulnerable to fishing gear *g* (millions) | |
| $G_{x,t}$ | Grey Seal pup production (thousands) | |
| $G_{x,t}^{*}$ | Grey Seal post-weaning pup abundance (thousands) | |
| $D_{x,t}$ | Density-dependent Grey Seal pup survival rate | |
| $E_{y,t}$ | Grey seal foraging effort in the sGSL (seal-yrs) | |
| $\rho_{j,y,b}$ | Relative prey consumption by predator *jy* at age *b* | |
| $\hat{c}_{j,y,b,i,\mathrm{x},a,t}^{(N)}$ | Per-capita catch by predator *jy* at age *b* of prey *ix* at age *a* (millions) | |
| $\hat{c}_{j,y,b,i,a,t}$ | Per-capita catch by predator *jy* at age *b* of prey *i* at age *a* (kt) | |
| $m_{i,a,t}$ | Proportion mature-at-age for species *i* in year *t* | |
| $\gamma_{a,t}$ | Grey Seal reproductive rate-at-age in year *t* | |
| $s_{x,a=1}^{(\mathrm{init})}$ | Initial Herring survivorship | |
| $\hat{I}_{g,i,t}$ | Predicted abundance/biomass index | |
| $\hat{u}_{g,i,x,a,t}^{(\mathrm{F})}$ | Predicted fishery/survey age-composition | |

| | |
|---|---|
| $\hat{u}_{j,a,t}^{(\mathrm{P})}$ | Predicted age-composition of Herring consumed by predator *j* |

Table S1.2. *Population dynamics equations for Grey Seal/Cod/Herring model.*

| Equation | Formula |
|---|---|
| *Grey seal demographic rates* | |
| (S1) Proportion of females mature-at-age, $i = 1$, $a < 4$ | $m_{i=1,a,t} = 0$ |
| (S2) Proportion of females mature-at-age, $i = 1$, $4 \leq a \leq 11$ | $m_{i=1,a,t} = \left(1 + \exp\left[\frac{-\ln(19)\left(a - a^{(50\%)}\right)}{a^{(95\%)} - a^{(50\%)}}\right]\right)^{-1}$ |
| (S3) Proportion of females mature-at-age, $i = 1$, $a \geq 12$ | $m_{i=1,a,t} = 1$ |
| (S4) Annual reproductive rate-at-age | $\gamma_{a,t} = \bar{\gamma} m_{i=1,a,t}$ |
| *Selectivity* | |
| (S5) Fishery and survey selectivity ($i > 1$) | $S^{(\mathrm{F})}_{g,i,x,a,t} = \left(1 + \exp\left[\frac{-\ln(19)\left(a - s^{50\%}_{g,i,x,t}\right)}{s^{95\%}_{g,i,x,t} - s^{50\%}_{g,i,x,t}}\right]\right)^{-1}$ |
| (S6) Seal selectivity of cod | $S^{(\mathrm{P})}_{j=1,i=2,a} = \begin{cases} 0, & a \leq 4 \\ 1, & a \geq 5 \end{cases}$ |
| (S7) Herring selectivity by seal | $S^{(\mathrm{P})}_{j=1,i=3,a} = \left(1 + \exp\left[\frac{-\ln(19)\left(a - b^{50\%}\right)}{b^{95\%} - b^{50\%}}\right]\right)^{-1}$ |
| (S8) Herring selectivity by cod | $S^{(\mathrm{P})}_{j=2,i=3,a} \propto \frac{1}{\Gamma(k)\theta^{k}} \theta^{k-1} \exp\left(-\frac{a}{\theta}\right)$ |
| *Prey consumption* | |
| (S9) Relative prey consumption-at-age ($i \leq 2$) | $\rho_{j,y,b} = \left(1 + \exp\left[\frac{-\ln(19)\left(b - \rho^{50\%}_{j,y}\right)}{\rho^{95\%}_{j,y} - \rho^{50\%}_{j,y}}\right]\right)^{-1}$ |
| (S10) Per-capita predation capacity (Historical) ($t > 2$; $j \leq 2$; $i > j$) | $\varphi_{j,y,i,t} = \varphi_{j,y,i,t-1} \exp\left(\varepsilon^{(\varphi)}_{j,i,t}\right)$ |
| (S11) Per-capita predation capacity (Projection) ($t > 2$; $j \leq 2$; $i > j$) | $\varphi_{j,y,i,t} = \frac{\eta_{j,y,i}\left(\sum_x B_{i,x,t}\right)^{\lambda_{j,y,i}-1}}{1 + \sum_l \left(\eta_{j,y,l} h_{j,y,l} \left(\sum_x B_{l,x,t}\right)^{\lambda_{j,y,l}}\right)}$ |
| *Mortality rates* | |

(S12) Seal exploitation $F_{i,x,a,t} = F_{x,t}^{(1+)}$

(S13) Predation mortality per predator $m_{j,y,b,i,a,t}^{(P)} = S_{j,i,a}^{(\mathrm{P})} f_{j,y}\, \varphi_{j,y,i,t}\, \rho_{j,y,b}$

(S14) Total predation mortality $M_{i,a,t}^{(P)} = \sum_j \sum_y \sum_b N_{j,y,b,t}\, m_{j,y,b,i,a,t}^{(P)}$

(S15) Other natural mortality ($t \geq 2$, $i = 2$) $M_{i=2,x=1,a,t}^{(O)} = M_{2,1,a,t-1}^{(O)} \exp\left(\varepsilon_t^{(\mathrm{M,c})}\right)$

(S16) Other natural mortality ($t \geq 2$, $i = 3$, $a \leq 7$) $M_{i=3,x,a,t}^{(O)} = M_{3,x,a,t-1}^{(O)} \exp\left(\varepsilon_t^{(\mathrm{M,h1})}\right)$

(S17) Other natural mortality ($t \geq 2$, $i = 3$, $a \geq 8$) $M_{i=3,x,a,t}^{(O)} = M_{3,x,a,t-1}^{(O)} \exp\left(\varepsilon_t^{(\mathrm{M,h2})}\right)$

(S18) Total mortality rate $Z_{i,x,a,t} = S_{g=1,i,x,a,t}^{(\mathrm{F})} F_{i,x,t} + M_{i,a,t}^{(P)} + M_{i,x,a,t}^{(O)}$

*Initial abundance*

(S19) Initial grey seal abundance $N_{i=1,x,a,t=1} = N_x^{(\mathrm{init})} p_{x,a}^{(\mathrm{init})}$

(S20) Herring survivorship, (a=1) $s_{x,a=1}^{(\mathrm{init})} = 1$

(S21) Herring survivorship, (a<11) $s_{x,a}^{(\mathrm{init})} = s_{x,a-1}^{(\mathrm{init})} \exp\left(-M_{3,x,a-1,1} - S_{1,3,x,a-1,1}^{(\mathrm{F})} F_{3,x,1}\right)$

(S22) Herring survivorship, (a=11)

$$s_{x,a}^{(\mathrm{init})} = \frac{s_{x,a-1}^{(\mathrm{init})} \exp\left(-M_{3,x,a-1,1} - S_{1,3,x,a-1,1}^{(\mathrm{F})} F_{3,x,1}\right)}{\left(1 - \exp\left(-M_{3,x,a,1} - S_{1,3,x,a,1}^{(\mathrm{F})} F_{3,x,1}\right)\right)}$$

(S23) Herring abundance $N_{i=3,x,a,t=1} = \bar{R}_x s_{x,a}^{(\mathrm{init})}$

*State dynamics*

(S24) Shelf seal pup production ($x \in \{1,2\}$) $G_{x,t} = 0.5 \sum_a N_{1,2,a,t} \gamma_{a,t}$

(S25) Gulf seal pup production ($x \in \{3,4\}$) $G_{x,t} = 0.5 \sum_a N_{1,4,a,t} \gamma_{a,t}$

(S26) Post-weaning pup abundance $G_{x,t}^{*} = 0.95 \left(G_{x,t} p_{x,t}^{(\mathrm{ice})} s_{x,t}^{(\mathrm{ice})} + G_{x,t}\left[1 - p_{x,t}^{(\mathrm{ice})}\right]\right)$

(S27) Post-harvest pup abundance $Y_{x,t} = \left(G_{x,t}^{*} - C_{x,t}^{(\mathrm{pup})}\right)$

| | |
|---|---|
| (S28) Shelf seal recruitment ($x=\{1,2\}$, $a = 1$, $t \geq 2$) | $N_{1,x,1,t} = 0.9Y_{x,t-1}\left(\frac{D_{x,1}^{D_{x,2}}}{D_{x,1}^{D_{x,2}} + \left[\sum_{x=1}^{2} Y_{x,t-1}\right]^{D_{x,2}}}\right)$ |
| (S29) Gulf seal recruitment ($x=\{3,4\}$, $a = 1$, $t \geq 2$) | $N_{1,x,1,t} = 0.9Y_{x,t-1}\left(\frac{D_{x,1}^{D_{x,2}}}{D_{x,1}^{D_{x,2}} + \left[\sum_{x=3}^{4} Y_{x,t-1}\right]^{D_{x,2}}}\right)$ |
| (S30) Age 1+ Shelf seal removals | $C_t^{(1+,\mathrm{S})} = \sum_{x=1}^{2}\sum_a \frac{F_{x,t}^{(1+)}}{Z_{1,x,a,t}} N_{1,x,a,t}\left(1 - \exp\left(-Z_{1,x,a,t}\right)\right)$ |
| (S31) Age 1+ Gulf seal removals | $C_t^{(1+,\mathrm{G})} = \sum_{x=3}^{4}\sum_a \frac{F_{x,t}^{(1+)}}{Z_{1,x,a,t}} N_{1,x,a,t}\left(1 - \exp\left(-Z_{1,x,a,t}\right)\right)$ |
| (S32) Cod/herring recruitment (Historical) ($t \geq 2$; $i \geq 2$) | $N_{i,x,2,t} = N_{i,x,2,t-1} \exp\left(\varepsilon_{i,x,t}^{(\mathrm{R})}\right)$ |
| (S33) Cod/herring recruitment (Projection) ($i = 2$) | $N_{i,x,2,t} = \beta_0 B_{2,1,t-2} \exp\left(-\beta_C B_{2,1,t-2} - \beta_H \sum_x B_{3,x,t-2}\right)$ |
| (S34) Recruitment (Projection) ($i = 3$) | $N_{i,x,2,t} = \Psi_{x,1} B_{3,x,t-2} / \left(1 + \Psi_{x,2} B_{3,x,t-2}\right)$ |
| (S35) Abundance, $a_i^{(\mathrm{R})} < a < A_i$ | $N_{i,x,a,t} = N_{i,x,a-1,t-1} \exp\left(-Z_{i,x,a-1,t-1}\right)$ |
| (S36) Spawner biomass on Jan 1 ($i \geq 2$) | $B_{i,x,t}^{(1)} = \sum_a N_{i,x,a,t} m_{i,a,t} w_{i,a,t}^{(\mathrm{S})}$ |
| (S37) Spawner biomass at time of spawning ($i \geq 2$) | $B_{i,x,t} = \sum_a N_{i,x,a,t} m_{i,a,t} w_{i,a,t}^{(\mathrm{S})} \left(-\zeta_{i,x} Z_{i,x,a,t}\right)$ |
| (S38) Seal foraging effort | $E_{y,t} = f_{j=1,y} \sum_a N_{i=1,y,a,t}$ |
| (S39) Per-capita prey consumption (numbers) | $\hat{c}_{j,y,b,i,x,a,t}^{(N)} = \frac{m_{j,y,b,i,a,t}^{(P)}}{Z_{i,x,a,t}} N_{i,x,a,t}\left(1 - \exp\left(-Z_{i,x,a,t}\right)\right)$ |
| (S40) Per-capita prey consumption (weight) | $\hat{c}_{j,y,b,i,a,t} = \sum_x \hat{c}_{j,y,b,i,x,a,t}^{(N)} w_{i,x,a,t}$ |
| (S41) Abundance vulnerable to fishery/survey ($i \geq 2$) | $V_{g,i,x,a,t} = N_{i,x,a,t} S_{g,i,x,a,t}^{(\mathrm{F})} \exp\left(-d_{g,i,x} Z_{i,x,a,t}\right)$ |
| (S42) Fishery catch ($i \geq 2$) | $C_{i,x,t}^{(F)} = \sum_a \frac{F_{i,x,t}}{Z_{i,x,a,t}} V_{1,i,x,a,t} w_{1,i,x,a,t}^{(\mathrm{F})}\left(1 - \exp\left(-Z_{i,x,a,t}\right)\right)$ |

*Predicted observations*

(S43) Shelf seal pup production indices $$\hat{I}_{g=1,i=1,t} = \sum_{x=1}^{2} G^{*}_{x,t}$$

(S44) Gulf seal pup production indices $$\hat{I}_{g=2,i=1,t} = \sum_{x=3}^{4} G^{*}_{x,t}$$

(S45) Biomass indices ($i \geq 2$, $g > 1$) $$\hat{I}_{g,i,t} = q_{g,i,x,t} \sum_{a} V_{g,i,x,a,t} w^{(\mathrm{F})}_{g,i,x,a,t}$$

(S46) Fishery/survey age-composition ($i \geq 2$) $$\hat{u}^{(\mathrm{F})}_{g,i,x,a,t} = \frac{V_{g,i,x,a,t}}{\sum_a V_{g,i,x,a,t}}$$

(S47) Age-composition of herring in predator diet $$\hat{u}^{(\mathrm{P})}_{j,a,t} = \frac{\sum_y \sum_b \sum_x \hat{c}^{(N)}_{j,y,b,i=3,\mathrm{x},a,t} N_{j,y,b,t}}{\sum_a \sum_y \sum_b \sum_x \hat{c}^{(N)}_{j,y,b,i=3,\mathrm{x},a,t} N_{j,y,b,t}}$$

*Table S1.3. Objective function components for Grey Seal/Cod/Herring model.*

| **Model variable** | **Distribution** | **Notes** |
|---|---|---|
| *Likelihood* | | |
| Abundance or biomass indices | $\ln I_{g,i,t} \sim N\left(\ln \hat{I}_{g,i,t}, \tau^{(I)}_{g,i,t}\right)$ | - $\tau^{(I)}$ for grey seals was fixed at herd- and year-specific values<br>- $\tau^{(I)}$ for cod was conditionally estimated by gear<br>- $\tau^{(I)}$ for herring was fixed at 0.1 for CPUE indices and 0.2 for all other indices |
| Fishery/survey age-composition | $\left\{u^{(\mathrm{F})}_{g,i,x,a,t}\right\}_{a=a^{(\min)}_{g,i}}^{a^{(\max)}_{g,i}} \sim P\left(N\left(\hat{u}^{(F)}_{g,i,x,a,t}, \tau^{(u)}_{g,i,x}\right)\right)$ | -$\tau^{(u)}$ was conditionally estimated<br>-$a^{(\min)}_{g,i}$ and $a^{(\max)}_{g,i}$ are the minimum and maximum ages respectively of sampled fish |
| Age-composition of herring in predator diets | $\left\{u^{(\mathrm{P})}_{j,a,t}\right\}_{a=a^{(\mathrm{R})}_{i=3}}^{A_{i=3}} \sim P\left(N\left(\hat{u}^{(\mathrm{P})}_{j,a}, \tau^{(\mathrm{P})}_{j,t}\right)\right)$ | -$P(N(u,\tau))$ is the logistic-normal distribution<br>- $\tau^{(\mathrm{P})}$ was conditionally estimated |
| Per-capita consumption | $\ln \sum_a c_{j=1,y,b,i,a,t} \sim \mathrm{N}\left(\ln \hat{c}_{j=1,y,b,i,t}, 1\right)$<br>$\ln \sum_a c_{j=2,y,b,i,a,t} \sim \mathrm{N}\left(\ln \hat{c}_{j=2,y,b,i,t}, 0.1^2\right)$ | -For $i < j$ |
| Grey seal pregnancy rates | $\gamma^{(k)}_{a,t} \sim B\left(\gamma^{(n)}_{a,t}, \gamma_{a,t}\right)$ | |
| *Priors* | | |

| | | |
|---|---|---|
| Recruitment deviations | $\varepsilon_{i,x,t}^{(\mathrm{R})} \sim N(0,1)$ | -High variance to account for potentially large interannual changes in recruitment |
| Consumption deviations | $\varepsilon_{j=1,i,t}^{(\varphi)} \sim N(0,0.25^2)$<br>$\varepsilon_{j=2,i,t}^{(\varphi)} \sim N(0,0.05^2)$ | -Variance chosen to allow for large decadal-scale shifts in consumption while preventing excessive interannual variation. Seal (*j*=1) was less prone to chasing noise so higher variance was allowed. |
| Catchability deviations | $\varepsilon_{x,t}^{(q)} \sim N(0,0.05^2)$ | -$\varepsilon_{x,t}^{(q)}$ was estimated between 1991-2018 for Spring (*x*=1) herring and between 1987-2018 for Fall (*x*>1) herring to match herring assessment (DFO 2018)<br>-Variance chosen to match herring assessment (DFO 2018) |
| Cod other natural mortality deviations | $\varepsilon_{t}^{(\mathrm{M,c})} \sim N(0,0.05^2)$ | -$\varepsilon_{t}^{(\mathrm{M})}$ was fixed at 0 until 1978 and was estimated thereafter |
| Herring other natural mortality deviations | $\varepsilon_{t}^{(\mathrm{M,h1})} \sim N(0,0.05^2)$<br>$\varepsilon_{t}^{(\mathrm{M,h2})} \sim N(0,0.05^2)$ | |
| Herring selectivity | $s_{g,i=3,x,t}^{50\%} \sim N(5,3^2)$<br>$\left(s_{g,i=3,x,t}^{95\%} - s_{g,i=3,x,t}^{50\%}\right) \sim N(1.5,2^2)$ | -Applied to all uniquely estimated Herring selectivity parameters |

| | |
|---|---|
| Herring pre-1978 biomass index catchability | $q_{g=3,i=3,x,t} \sim N(1,1)$ |
| Grey seal initial abundance | $N_h^{(\text{init})} \sim N(5,5^2)$ |
| Grey seal density dependence | $D_{h=1,1} \sim N(25,25^2)$<br>$D_{h=2,2} \sim N(5,10^2)$<br>$D_{h,2} \sim N(1,3^2)$ |
| Grey seal female age-at-maturity | $a^{(50\%)} \sim N(5,4^2)$<br>$\left(a^{(95\%)} - a^{(50\%)}\right) \sim N(2,2^2)$ |

**Supplement 2. Estimating Grey Seal and Atlantic Cod prey consumption-at-age from bioenergetics**

We used bioenergetic models to estimate age-specific, per-capita prey consumption by Northwest Atlantic Grey Seals (hereafter "seals") and southern Gulf of St. Lawrence (sGSL) Atlantic Cod (hereafter "cod"). We estimated seal consumption of cod and sGSL Atlantic Herring (hereafter "herring"), and cod consumption of herring, based on total consumption estimates, the spatiotemporal overlap between predator and prey species, and the proportional contribution of prey to predator diets.

**Grey seals**

Benoît et al. (2011a) estimated the daily gross energy intake (GEI) of individual seals based on a number of factors, including body mass, metabolism, assimilation efficiency and age-specific growth premiums. We converted daily GEI to monthly GEI, then divided by the average energy of prey (Trzcinski et al. 2006) to estimate the amount of biomass needed to maintain growth (Figure S2.1).

The proportion of each month seals spend foraging near cod and herring was estimated from the movements of satellite-tracked seals (Breed et al. 2006, Harvey et al. 2008, Benoît and Rail 2016). Cod and herring were assumed to occupy the same areas each month (specifically, the sGSL year-round, plus NAFO Subdivision 4Vn from November to April).

The relative contribution of prey to the seal diet is highly uncertain due to spatiotemporal gaps in diet sampling as well heterogeneities in foraging behaviour across seasons, areas and individuals. The seal diet has previously been inferred from prey hard parts found in the digestive tracts of grey seals collected (i) in coastal areas of the sGSL between late spring and August (Hammill et al. 2007), (ii) from the west coast of Cape Breton Island between September and January, and (iii) in the Cabot Strait near St Paul Island, mostly between October and December (Hammill et al. 2014). Seals were sampled on or near shore and the inferred diets likely reflect feeding that occurred near (~30 km) the sampling site (Benoît et al. 2011b). We assume that the observed inshore diet also reflects the offshore diet, given the considerable spatial overlap among these species (Benoît and Rail 2016).

For seal consumption of herring, we assumed that the Cape Breton samples represented the fall (Sept-Nov) seal diet, the Cabot Strait samples represented the winter seal diet (Dec-Mar), and the sGSL samples represented the seal diet from April to August (Figure S2.2). For seal consumption of cod, the Cabot Strait samples represented the seal diet while cod are migrating and overwintering (Oct-May) while the sGSL samples represented the summer (June-Sept) seal diet. The winter Cabot Strait samples were assumed to represent feeding on migrating cod, given that migrating cod occur at densities similar to that on the overwintering ground. This is reflected by the intense fisheries that used to target these migrating fish.

Seal consumption of individual prey species was calculated as the product of total prey consumption, monthly foraging behaviour, and diet composition, each of which were assumed to be year-invariant. Gulf herd seals consumed significantly more prey in the sGSL than Shelf herd seals (Figure S2.3).

**Atlantic Cod**

Benoît and Rail (2016) estimated monthly, size-specific prey consumption by cod $\left(C_{l,m}\right)$ from mean stomach content mass and gastric evacuation rates. We converted size-specific consumption to age-specific consumption using an age-length key and diet composition estimates, i.e.,

$$c_{a,t,m} = \sum_{l} p_{a,l,t} C_{l,m} d_{l,t} \quad (1)$$

where $c_{a,t,m}$ is the per-capita consumption-at-age for cod, $p_{a,l,t}$ is the proportion of age-*a* cod at length *l* in year *t* and $d_{l,t}$ is the proportional contribution of herring to the of length-*l* cod diet. Monthly consumption rates were converted to annual rates, accounting for mortality each month (Figure S2.4), i.e.,

$$c_{a,t} = \sum_{m} c_{a,t,m} \exp\left(-Z_{a,m} \frac{m}{12}\right) \quad (2)$$

where $Z_{a,m}$ is the annual instantaneous cod mortality rate (Swain et al. 2015).

**References**

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Benoît HP, Rail JF, (2016) Principal predators and consumption of juvenile and adult Atlantic Herring (*Clupea harengus*) in the southern Gulf of St. Lawrence. DFO Can Sci Advis Sec Res Doc 2016/065. Fisheries and Oceans Canada, Ottawa

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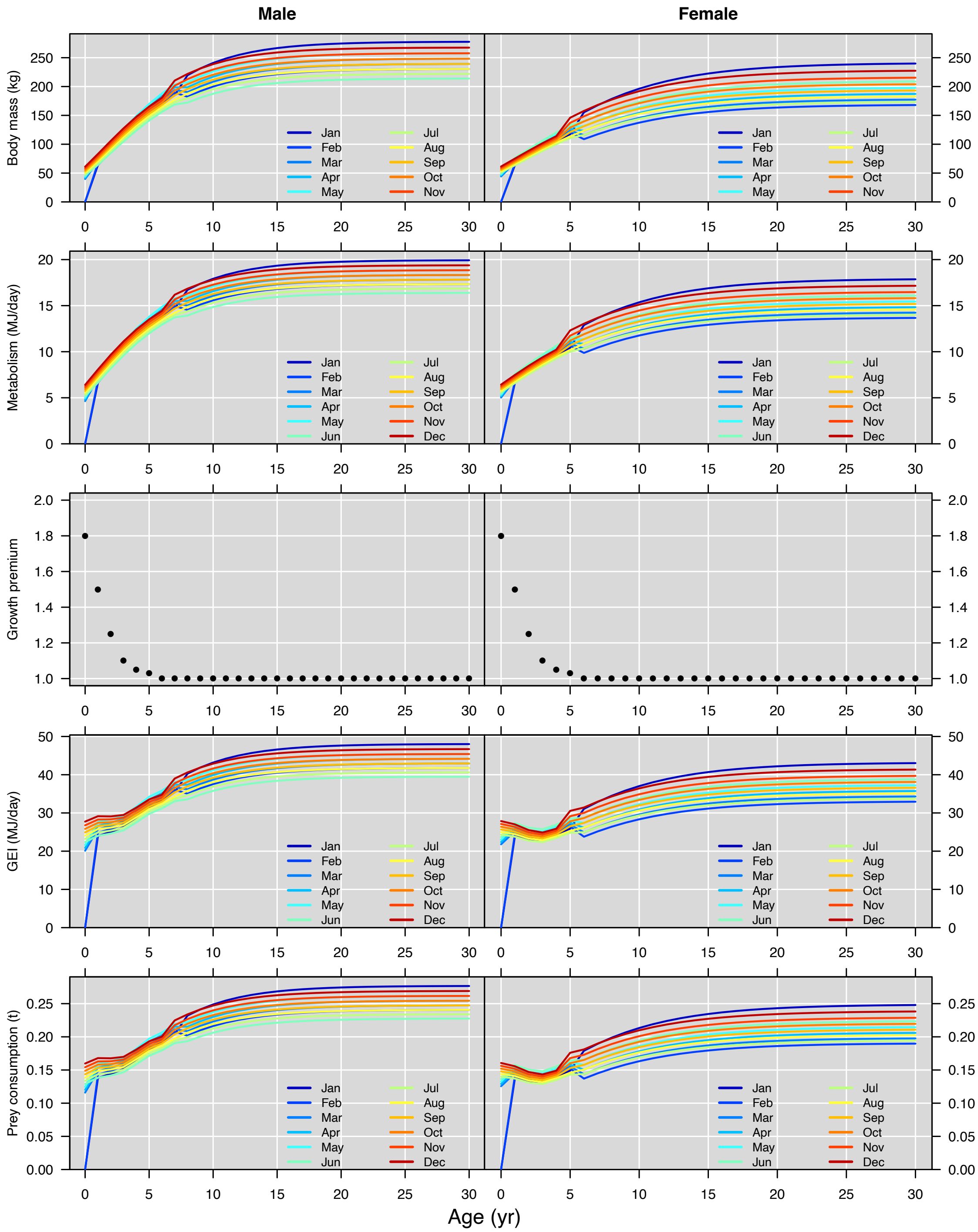


*Figure S2.1. Grey seal body mass (top row, estimated from Gompertz growth model), daily metabolism (second row, assuming Kleiber allometric relationship between body mass and metabolism), growth premium for younger seals (third row), daily gross energy intake (fourth row, product of metabolism, growth premium, and conversion factors) and monthly prey consumption (bottom row, quotient of gross energy intake and average energy of prey).*

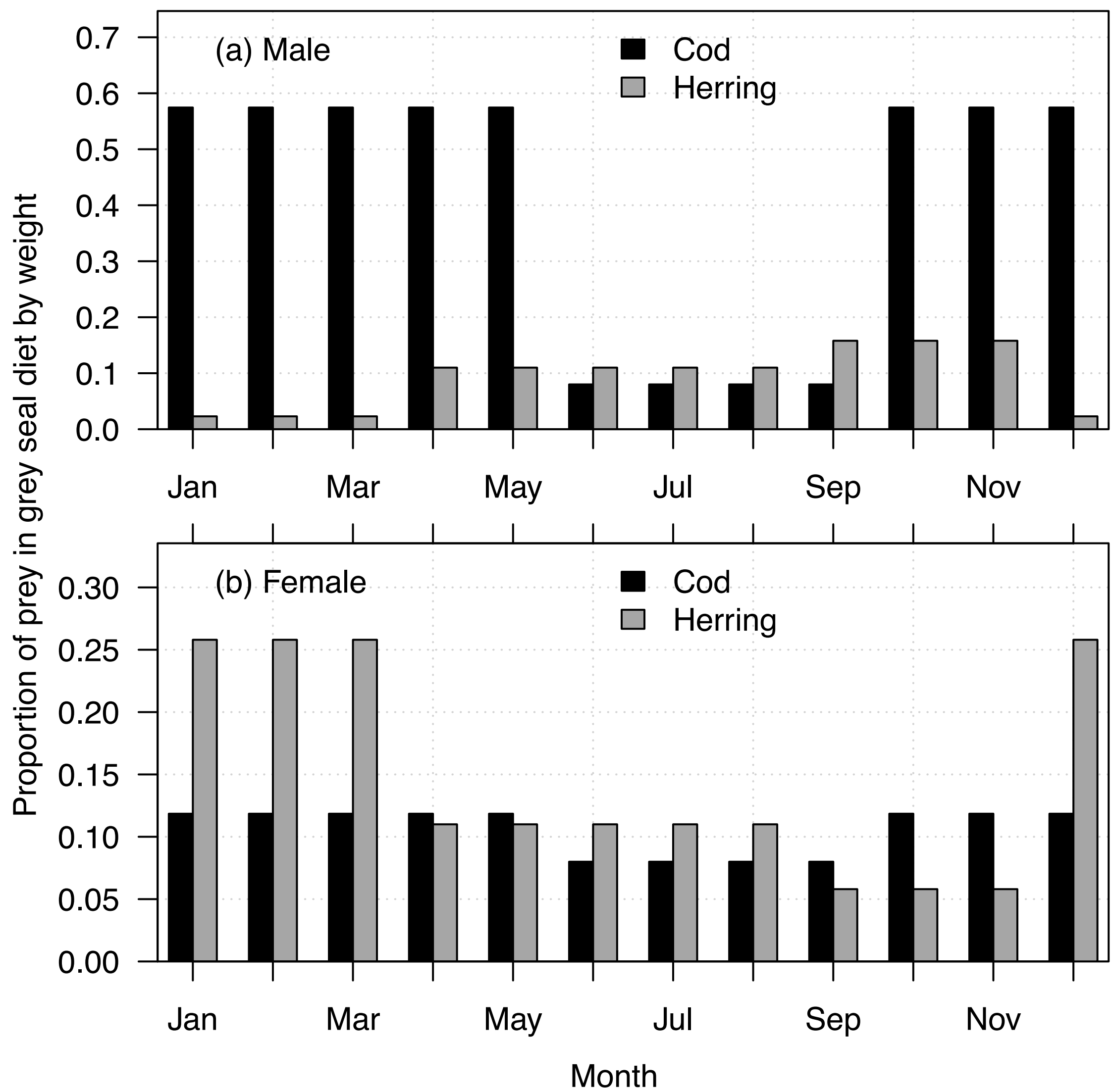


*Figure S2.2. Monthly diet composition of (a) male and (b) female Grey Seals foraging near sGSL Cod and Herring.*

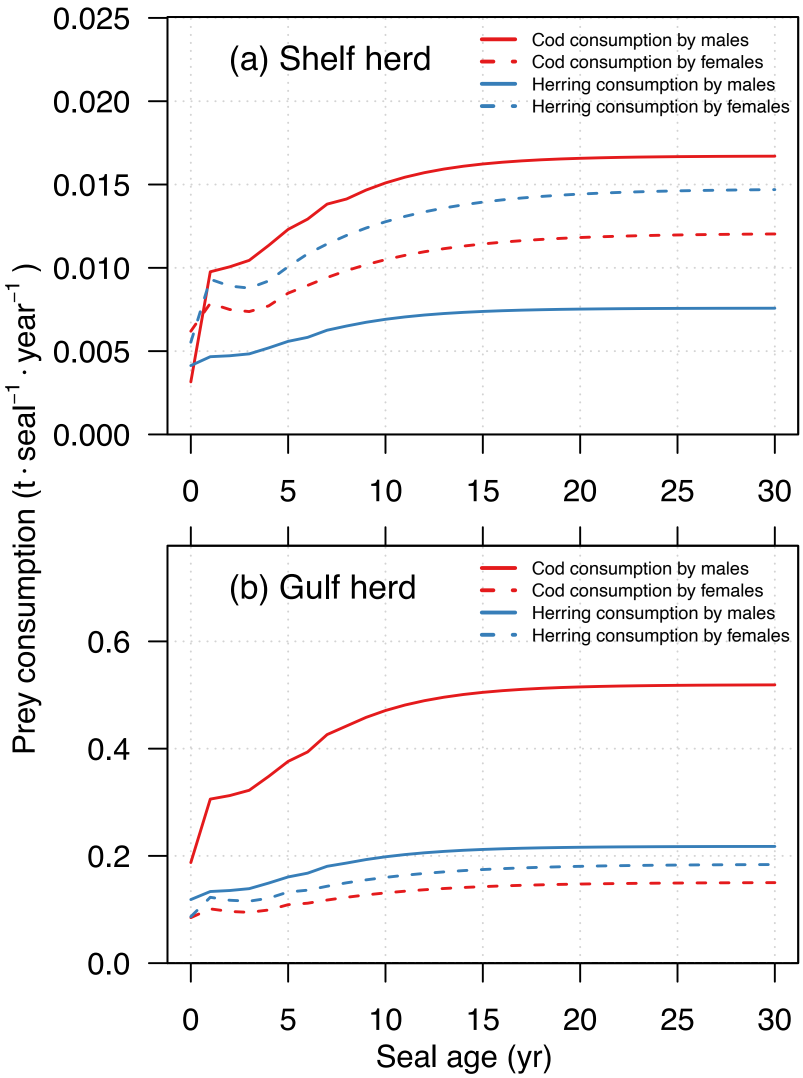


*Figure S2.3. Annual per-capita consumption-at-age in the sGSL (plus NAFO Subdivision 4Vn from November to April) by Grey Seals from the (a) Shelf herd and (b) Gulf herd.*

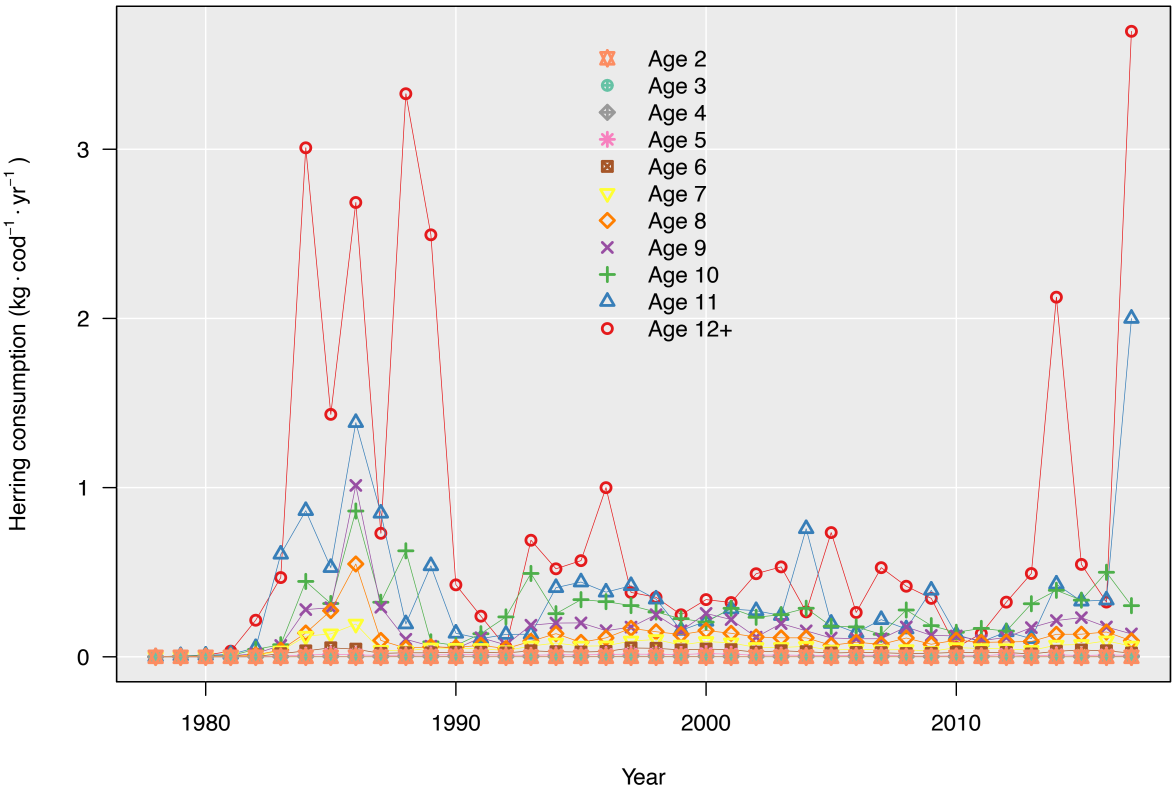


*Figure S2.4. Herring consumption by individual sGSL Cod aged 2-12+ yr, 1978-2017.*

**Supplement 3: Sensitivity analysis of consumption prior**

In the multispecies model, we calculated the per-capita consumption by predator *j* in subpopulation *y* at age *b* of prey *i* in year *t* ($\hat{c}_{j,y,b,i,t}$) and applied a lognormal prior to this quantity to constrain prey consumption within biologically plausible ranges:

$$\ln \hat{c}_{j,y,b,i,t} \sim \mathrm{N}\left(\ln c_{j,y,b,i,t}\, , \sigma^2_{\mathrm{c},j}\right)$$

Prior means $c$ were calculated from the bioenergetic requirements of predators (grey seals and cod), predator diet composition data, and the spatiotemporal overlap between predator and prey species (Appendix A). Prior standard deviation ($\sigma$) was set to 2.0 for seal predation and 0.1 for cod predation. In this appendix, we summarize the sensitivity of the multispecies model to alternative choices of prior standard deviation.

**Seal predation**

We tested alternative values of $\sigma_{\mathrm{c},j=1}$ = 0.5, 1.0 and 2.5 for seal predation on cod and herring. Each of the alternative models fit the observed data approximately as well as the base model ($\sigma_{\mathrm{c},j=1}$ = 2.0); increasing $\sigma$ did not visually improve fits to abundance or biomass indices (Figure S3.1). Median consumption-at-age estimates were similar across values of $\sigma_{\mathrm{c},j=1}$, though estimates were more variable under less constraining priors (Figures S3.2-S3.4). Estimates of biomass and key population processes for all species were very similar across different values of $\sigma_{\mathrm{c},j=1}$ (Figure S3.5). Compared to the base model, setting $\sigma_{\mathrm{c},j=1}$ to 0.5 and 1.0 increased the average rate of natural mortality arising from sources other than fishing and predation ($M^{(O)}$) for cod aged 5 years and older by 19.5% and 14.6% respectively, while setting $\sigma_{\mathrm{c},j=1}$ to 2.5 reduced $M^{(O)}$ by 7.9% (Figure S3.5).

**Cod predation**

We tested alternative values of $\sigma_{\mathrm{c},j=2}$ = 0.05, 0.20, and 1.00 for cod predation on herring. Each of the alternative models fit the observed data approximately as well as the base model ($\sigma_{\mathrm{c},j=2}$ = 0.1; Figure S3.6). Increasing prior standard deviation resulted in less intense predation in the mid-1980s and the mid- to late-1990s, which was offset by higher levels of other natural mortality and reduced cod biomass (Figure S3.7). The more modest consumption estimated by models with higher $\sigma_{c,j=2}$, particularly $\sigma_{c,j=2}$=1.00, was inconsistent with previous studies of cod predation on herring (Benoît and Rail 2016).

**References**

Benoît HP, Rail J-F (2016) Principal predators and consumption of juvenile and adult Atlantic Herring (*Clupea harengus*) in the southern Gulf of St. Lawrence. DFO Can Sci Advis Sec Res Doc 2016/065. Fisheries and Oceans Canada, Ottawa.

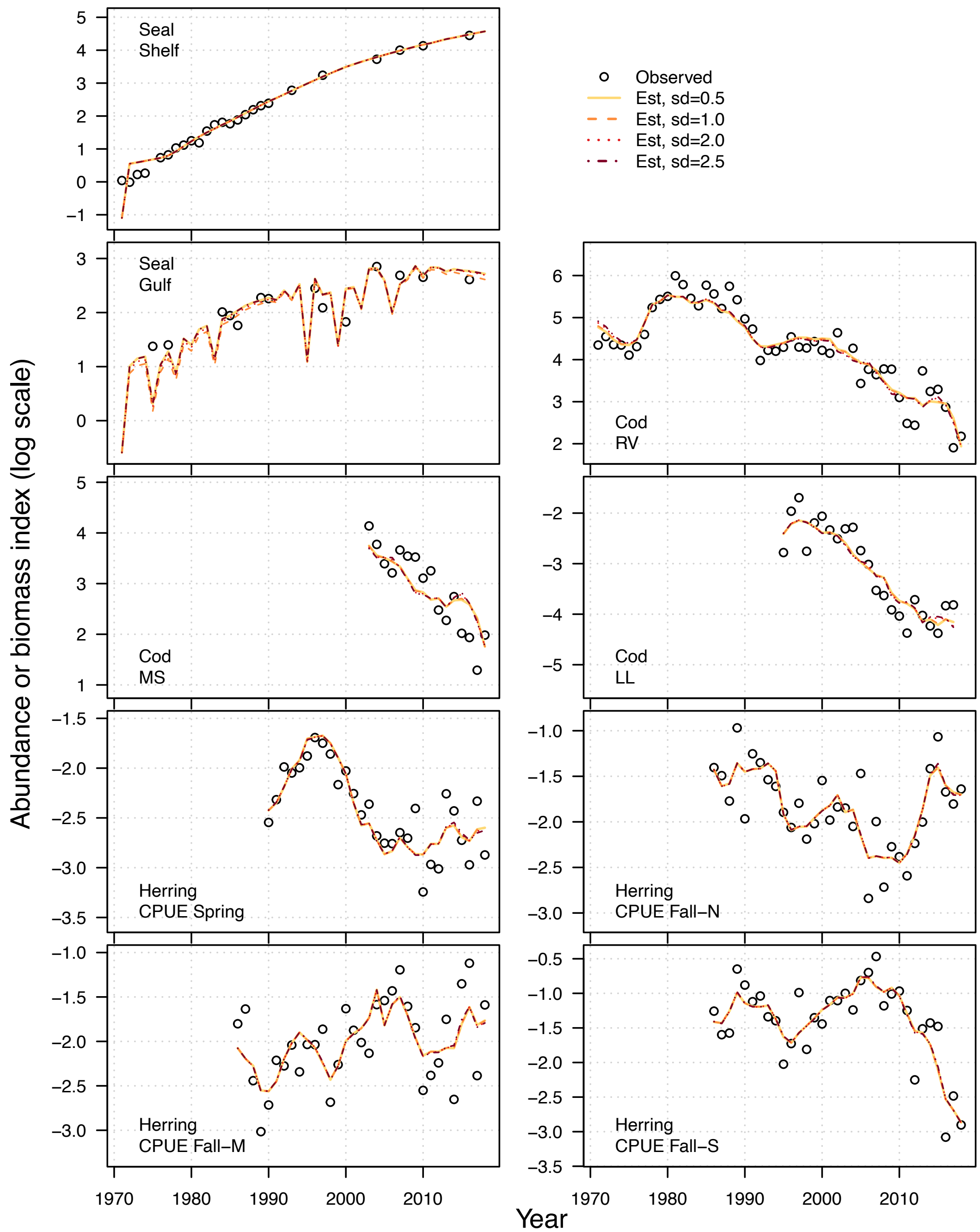


*Figure S3.1. Model fits (posterior modes; lines) under four values of $\sigma_{c,j=1}$ to observed abundance or biomass indices (circles). The index represents pup production in numbers for grey seals and vulnerable biomass for cod and herring.*

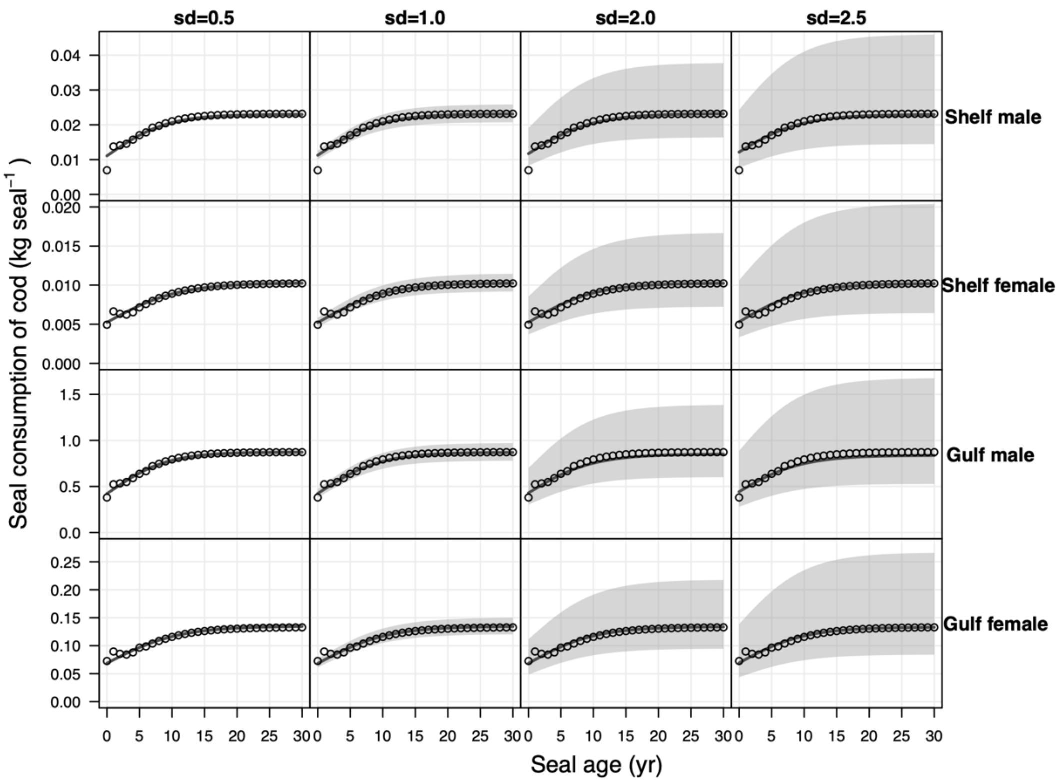


*Figure S3.2. Prior mean (circles) and model-estimated (lines, shaded regions) cod consumption per seal using alternative values of $\sigma_{c,j=1}$ (columns). Each row represents a seal subpopulation. Lines represent posterior modes while shaded regions represent central 95% uncertainty intervals.*

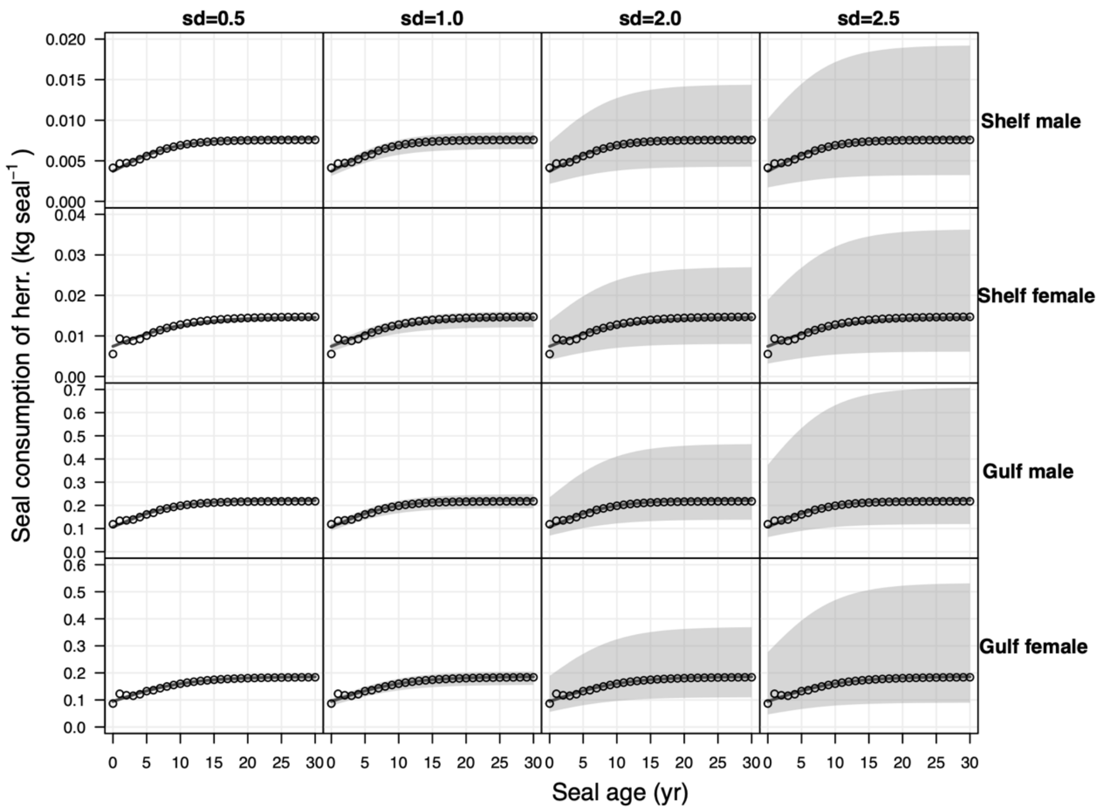


*Figure S3.3. Prior mean (circles) and model-estimated (lines, shaded regions) herring consumption per seal using alternative values of $\sigma_{c,j=1}$ (columns). Each row represents a seal subpopulation. Lines represent posterior modes while shaded regions represent central 95% uncertainty intervals.*

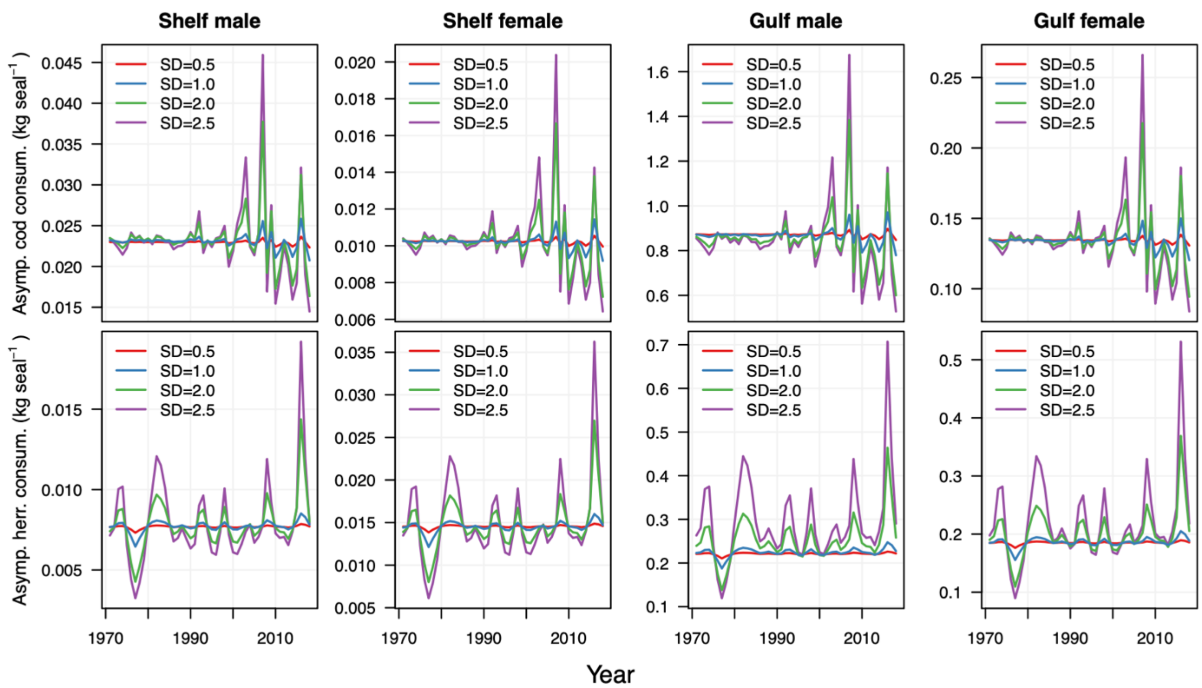


*Figure S3.4. Model-estimated prey consumption per seal for the oldest seal age-class (30+) using alternative values of $\sigma_{c,j=1}$ (columns).*

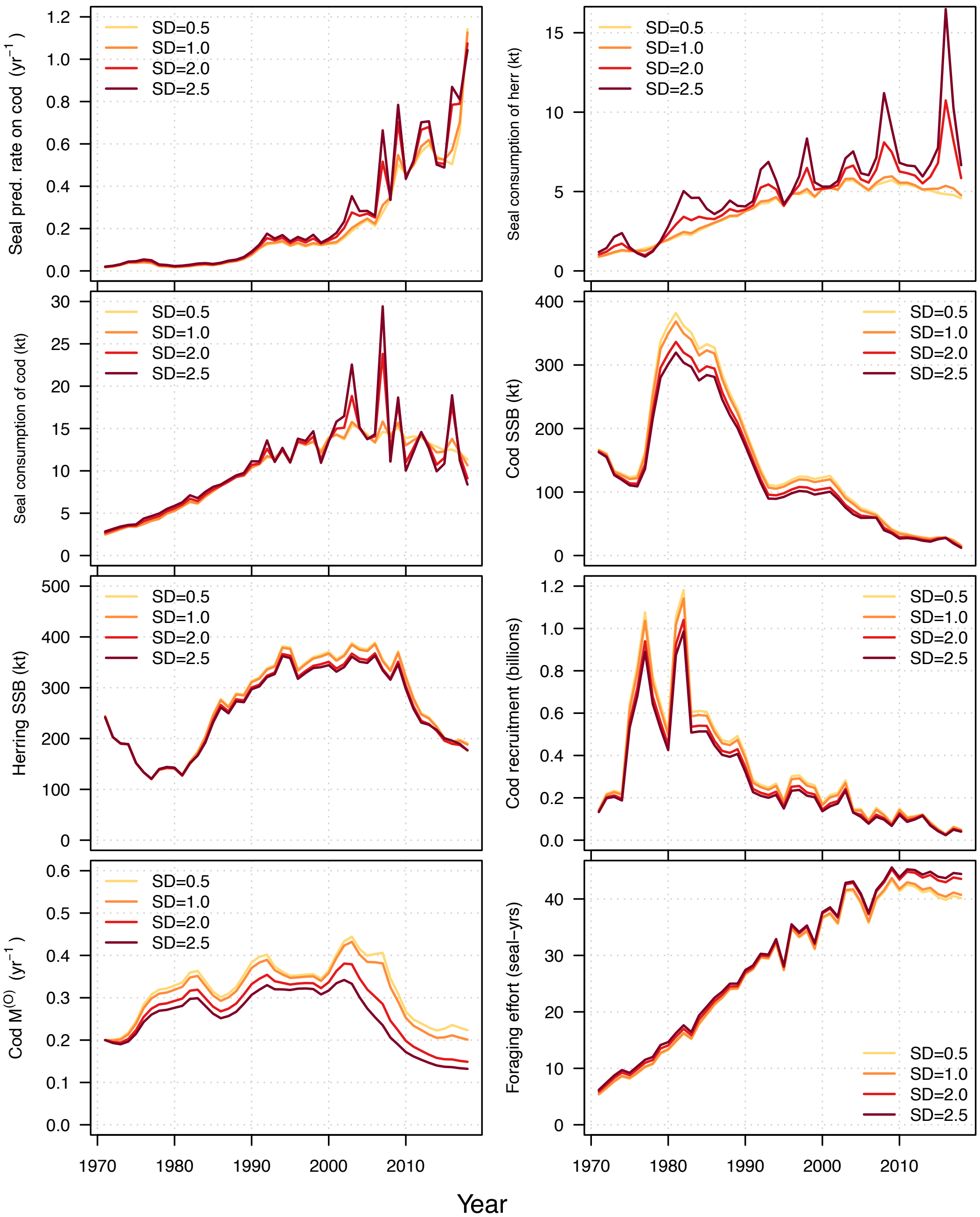


*Figure S3.5. Estimated time-series of key model quantities using alternative values of* $\sigma_{c,j=1}$.

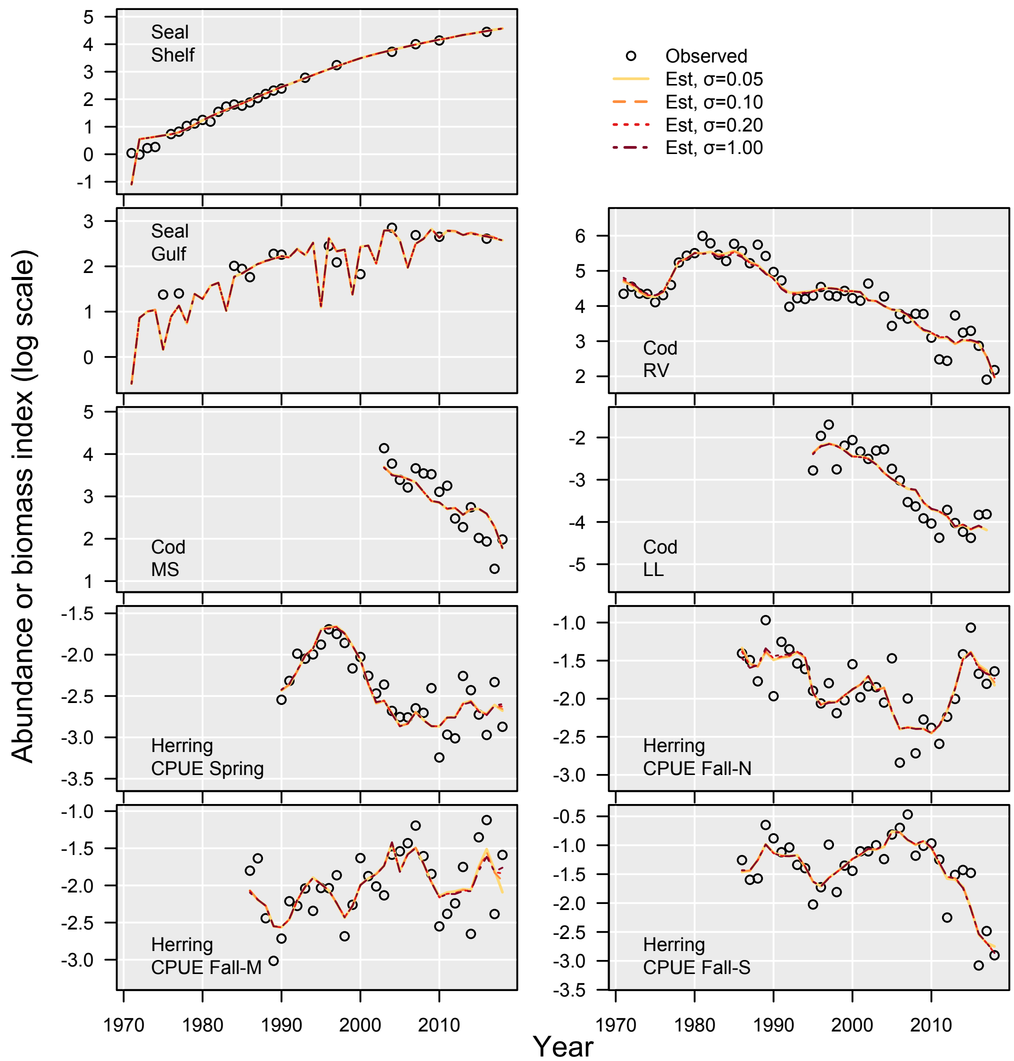


*Figure S3.6. Model fits (posterior modes; lines) under four values of* $\sigma_{c,j=2}$ *to observed abundance or biomass indices (circles). The index represents pup production in numbers for grey seals and vulnerable biomass for cod and herring.*

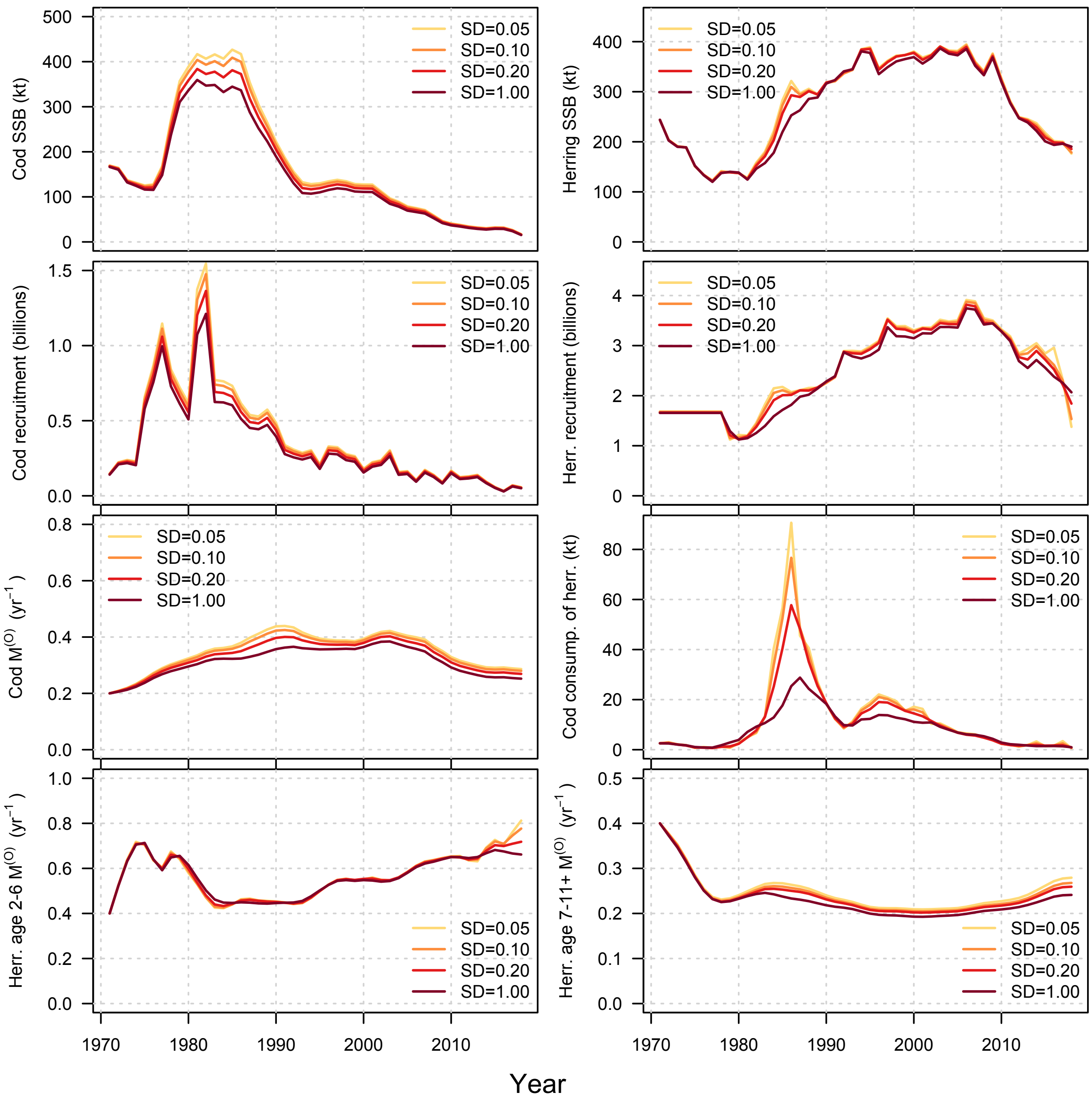


*Figure S3.7. Estimated time-series of key model quantities using alternative values of* $\sigma_{c,j=2}$.

## Supplement 4: Stock-recruitment in Herring projections

In our analysis, we fit a Model of Intermediate Complexity for Ecosystem assessments (MICE) to observed data for Grey Seals, Atlantic Cod, and Atlantic Herring, then projected the model forward in time based on the optimized model parameters as well as stock-recruitment and functional response curves fitted to model outputs. In this appendix, we detail the (post-)fitting of stock-recruitment models to MICE estimates and summarize MICE projections using these post-fitted models.

### MICE estimates of herring recruitment and spawning biomass

The Spring, Fall-Middle, and Fall-South subpopulations exhibited generally positive relationships between spawning biomass and resulting recruitment, while there was no discernable pattern for Fall-North (Figure S4.1). Density-dependence was somewhat apparent for Spring herring, as the largest stock sizes generated only moderate recruitment (Figure S4.1). In contrast, large stock sizes for Fall-Middle and Fall-South generated large recruitment (Figure S4.1).

### Fitting spawner-recruitment relationships to MICE estimates

The shape of the stock-recruitment relationship for herring in the southern Gulf of St. Lawrence is unknown. Herring egg mortality often arises from suffocation at high densities (Haegele & Schweigert 1985), which suggests that a dome-shaped function such as the Ricker may be preferable; however, overcompensation is not always evident in herring stock-recruitment analyses (Zheng 1996). Both Ricker and Beverton-Holt functions were previously fit to recruitment and spawning biomass estimates for herring in the southern Gulf of St. Lawrence, but neither curve was clearly preferable in that analysis (DFO 2005). Given the *a priori* uncertainty around the shape of the stock-recruitment and given the lack of clear evidence for overcompensation in our MICE estimates, we tested both Ricker (1) and Beverton-Holt (2) functions in our analysis, i.e.,

$$\hat{R}_{x,t} = \Psi_{0,x}^{(\mathrm{R})} S_{x,t-2} \exp\left(-\Psi_{1,x}^{(\mathrm{R})} S_{x,t-2}\right) \quad (\mathrm{C.1})$$

$$\hat{R}_{x,t} = \Psi_{0,x}^{(\mathrm{BH})} S_{x,t-2} \Big/ \left(1 + \Psi_{1,x}^{(\mathrm{BH})} S_{x,t-2}\right) \quad (\mathrm{C.2})$$

where $R_{x,t}$ and $S_{x,t}$ to represent herring recruitment and spawning biomass, respectively, for subpopulation *x* in year *t*, $\Psi_{0,x}$ represents density-independent fecundity and $\Psi_{1,x}$ represents the strength of density-dependence. We use the notation $R_{x,t}$ and $S_{x,t}$ for simplicity in this appendix; in MICE notation, these variables correspond to $N_{i=3,x,a=2,t}$ and $B_{i=3,x,t}$.

MICE-estimated recruitments were assumed to be lognormally-distributed around stock-recruitment function predictions, i.e.,

$$\log(R_{x,t}) \sim N\left(\log(\hat{R}_{x,t}), \sigma_x^2\right)$$

The standard deviation parameters ($\sigma_x^2$) were estimated. Each stock-recruitment model was fitted to each posterior MICE sample.

Ricker and Beverton-Holt models fits to the MICE estimates of spawning biomass and recruitment for the Fall subpopulations were nearly identical (Figure S4.2). Residual variance was particularly high for the Fall-North population, which was not surprising given the lack of a clear spawner-recruitment relationship in the MICE estimates. The North subpopulation had the highest productivity at low density and the strongest density-dependent effect (Table S4.1).

**Extirpation risk projections under Beverton-Holt recruitment**

Projections of the MICE assuming Beverton-Holt stock-recruitment dynamics for herring were nearly identical to the Ricker projections presented in the main article. The herring recruitment rate was insensitive to the choice of spawner-recruitment function, resulting in very similar levels of herring spawning biomass (Figure S4.3). Consequently, the choice of spawner-recruitment function had virtually no impact on the projected recovery of cod (Figure S4.4).

**References**

DFO 2005. Spawning Stock Biomass Reference Points for Southern Gulf of St. Lawrence Herring. DFO Can Sci Advis Sec Sci Advis Rep 2005/070. Fisheries and Oceans Canada, Ottawa

Haegele CW, Schweigert JF 1985. Distribution and characteristics of herring spawning grounds and description of spawning behavior. Can J Fish Aquat Sci 42(Suppl. I):39-55

Zheng J (1996) Herring stock-recruitment relationships and recruitment patterns in the North Atlantic and Northeast Pacific oceans. Fish Res 26:257–277

*Table S4.1. Post-fitted herring stock-recruitment parameter estimates.* $\Psi_{0,x}$ *represents fecundity for subpopulation* $x$, $\Psi_{1,x}$ *represents the effect of density dependence for subpopulation* $x$, *and* $\sigma_x^2$ *is the residual standard deviation for subpopulation* $x$.

| **Parameter** | **Posterior quantiles** | | | | | |
|---|---|---|---|---|---|---|
| | **2.5%** | **50%** | **97.5%** | **2.5%** | **50%** | **97.5%** |
| | *Ricker* | | | *Beverton-Holt* | | |
| $\Psi_{0,x=1}$ | 12.48 | 14.42 | 16.24 | 14.04 | 18.24 | 23.55 |
| $\Psi_{0,x=2}$ | 7.24 | 10.63 | 15.61 | 7.31 | 11.97 | 30.25 |
| $\Psi_{0,x=3}$ | 9.28 | 9.8 | 10.34 | 9.28 | 9.8 | 10.34 |
| $\Psi_{0,x=4}$ | 6.22 | 6.98 | 8.93 | 6.22 | 6.98 | 9.21 |
| $\Psi_{1,x=1}$ | 7.99E-03 | 9.59E-03 | 1.11E-02 | 1.45E-02 | 2.31E-02 | 3.39E-02 |
| $\Psi_{1,x=2}$ | 1.05E-08 | 4.55E-03 | 9.79E-03 | 1.40E-08 | 7.71E-03 | 4.25E-02 |
| $\Psi_{1,x=3}$ | 6.08E-19 | 1.50E-12 | 2.91E-09 | 1.59E-18 | 5.95E-12 | 9.50E-10 |
| $\Psi_{1,x=4}$ | 3.75E-11 | 3.45E-10 | 1.69E-03 | 9.98E-12 | 2.34E-10 | 2.20E-03 |
| $\sigma_{x=1}^2$ | 0.477 | 0.564 | 0.723 | 0.476 | 0.564 | 0.724 |
| $\sigma_{x=2}^2$ | 0.741 | 1.07 | 1.411 | 0.741 | 1.07 | 1.411 |
| $\sigma_{x=3}^2$ | 0.457 | 0.504 | 0.55 | 0.457 | 0.504 | 0.55 |
| $\sigma_{x=4}^2$ | 0.473 | 0.649 | 0.972 | 0.471 | 0.649 | 0.972 |

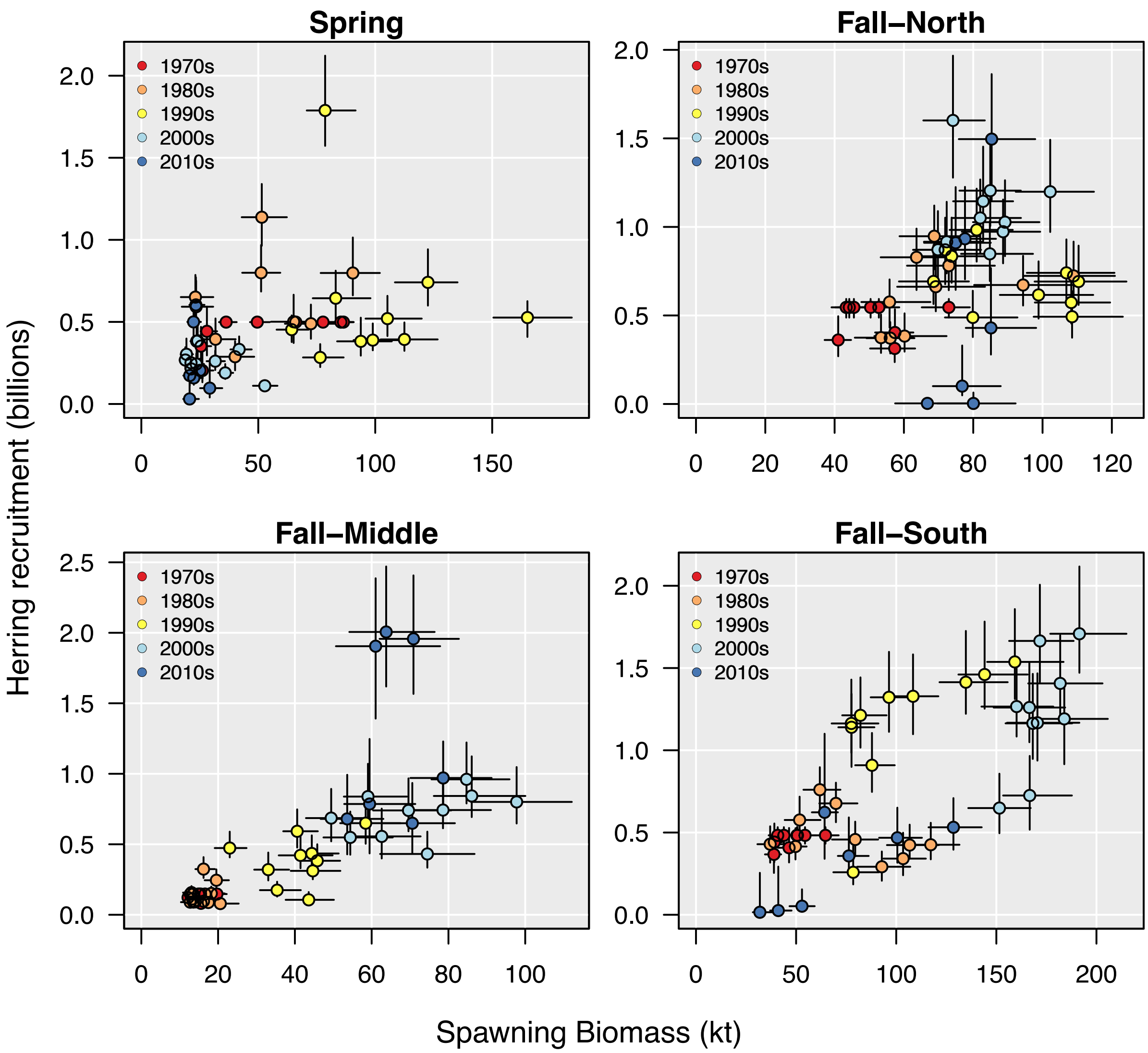


*Figure S4.1. MICE estimates of spawning biomass and recruitment for each herring subpopulation. Circles represent posterior modes while lines indicate the central 95% posterior interval.*

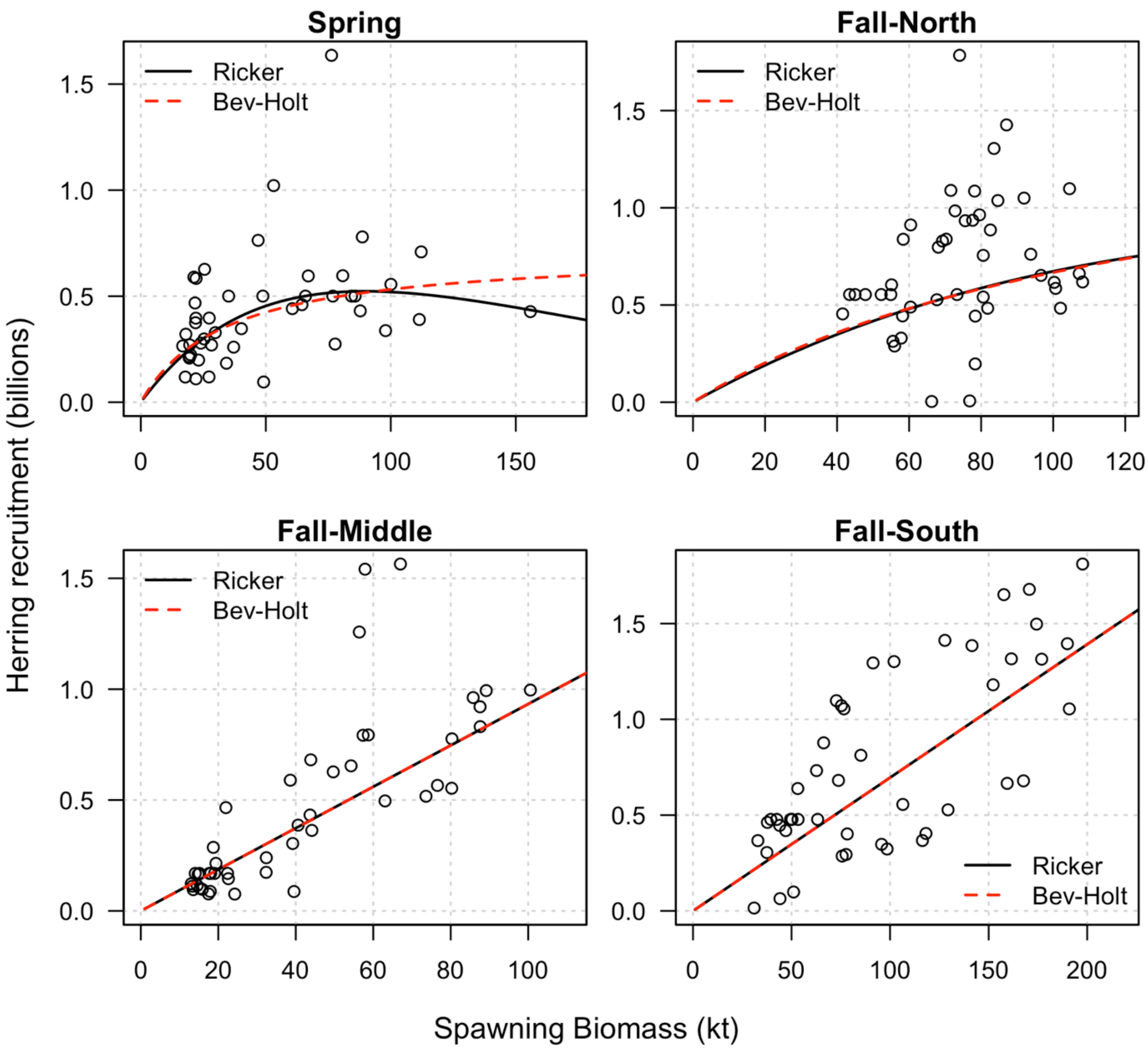


*Figure S4.2. Post-fitted stock-recruitment relationships for a randomly selected posterior sample of spawning biomass and recruitment from the MICE.*

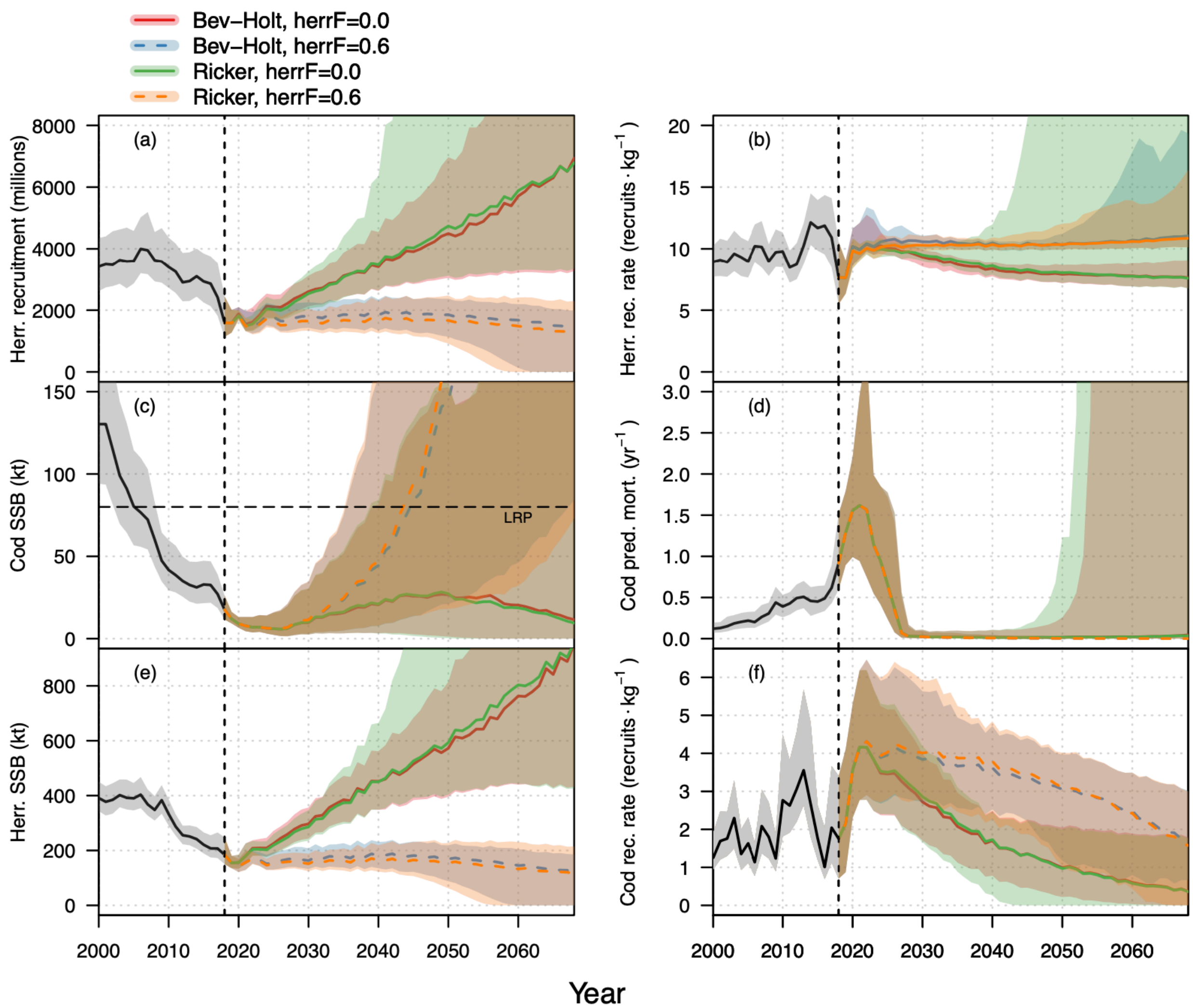


*Figure S4.3. Model projections under four harvest plans with annual quotas of 12,000 seals targeting 50% YOY for 10 years. Lines represent posterior modes while shaded regions indicate the central 95% uncertainty interval. Black lines and grey shaded regions represent historical estimates while coloured lines and shaded regions represent projections.*

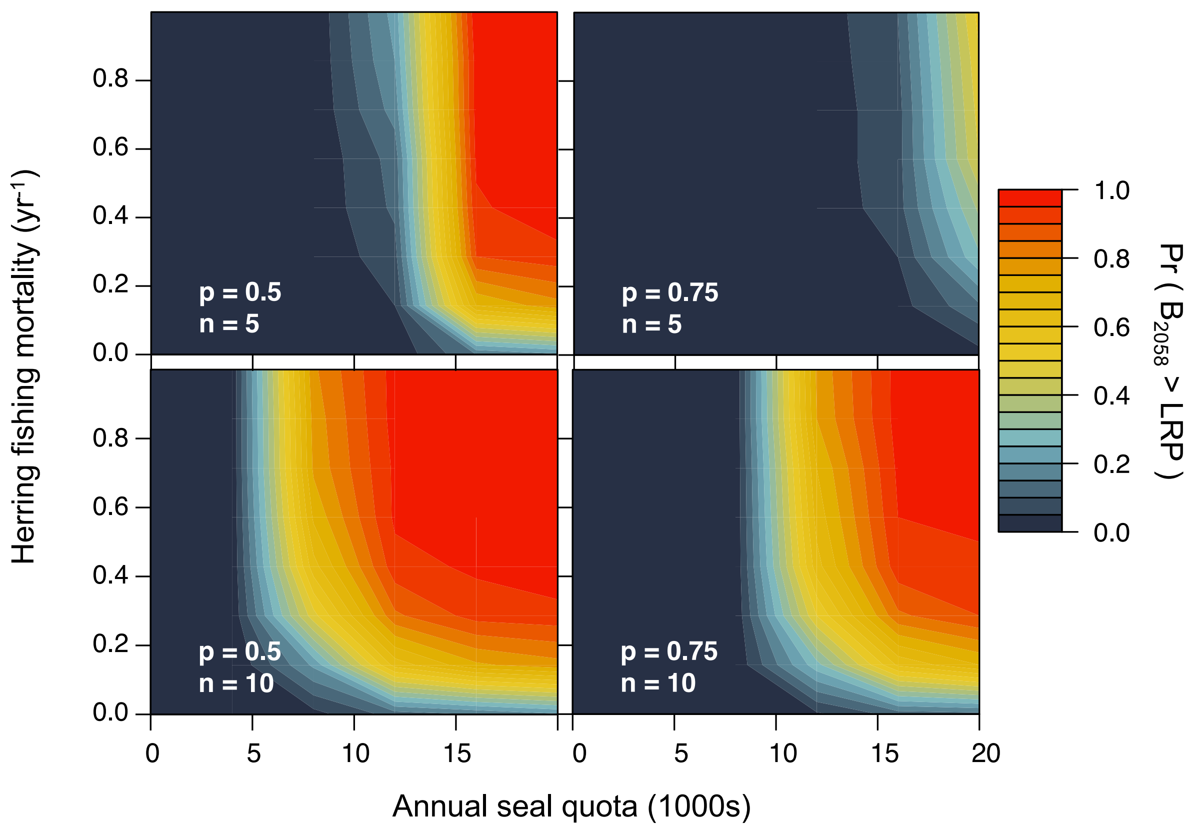


*Figure S4.4. Probability of cod biomass in 2058 exceeding the limit reference point (LRP = 80 kt) given Beverton-Holt stock-recruitment functions for Herring, varying levels of seal quota (x-axis) and herring fishing mortality (y-axis), and four combinations of the proportion of YOY seals targeted for removal (p) and the length of the seal harvest period (n; number of years).*

## Supplement 5. Model fits and diagnostics

*Table S5.1. Posterior distribution summaries and parameter-specific diagnostics. tESS and bESS represent tail and bulk effective sample sizes, respectively. For the grey seal component of the model, D and $\theta$ represent the half-saturation point and shape of the grey seal juvenile density-dependence relationship, $P_{\max}$ is the reproductive rate among mature females, $\alpha_{50\%}$ and $\alpha_{\text{step}}$ are parameters of the reproductive rate-at-age.*

| Parameter | Mean | SD | 2.5% | 25% | 50% | 75% | 97.5% | tESS | bESS | Rhat |
|---|---|---|---|---|---|---|---|---|---|---|
| *Grey seal population dynamics* | | | | | | | | | | |
| $\ln N_1^{(\text{init})}$ | 1.968 | 0.033 | 1.901 | 1.945 | 1.968 | 1.990 | 2.029 | 1186 | 970 | 1.001 |
| $\ln N_2^{(\text{init})}$ | 2.500 | 0.086 | 2.359 | 2.438 | 2.491 | 2.554 | 2.704 | 602 | 693 | 1.004 |
| $\ln D_{1,1}$ | 3.138 | 0.130 | 2.917 | 3.052 | 3.125 | 3.216 | 3.435 | 1161 | 957 | 1.001 |
| $\ln D_{1,2}$ | 1.731 | 0.074 | 1.572 | 1.684 | 1.735 | 1.783 | 1.864 | 625 | 751 | 1.002 |
| $\ln D_{2,1}$ | -0.403 | 0.137 | -0.688 | -0.490 | -0.395 | -0.306 | -0.158 | 923 | 807 | 1.003 |
| $\ln D_{2,2}$ | 0.866 | 0.155 | 0.562 | 0.762 | 0.872 | 0.972 | 1.149 | 588 | 646 | 1.004 |
| $\text{logit}\bar{\gamma}$ | 2.038 | 0.059 | 1.921 | 1.999 | 2.036 | 2.077 | 2.157 | 1309 | 1003 | 1.003 |
| $\ln a^{(50\%)}$ | 1.575 | 0.009 | 1.557 | 1.569 | 1.575 | 1.582 | 1.593 | 2271 | 1044 | 0.999 |
| $\ln(a^{(95\%)}-a^{(50\%)})$ | 0.558 | 0.081 | 0.398 | 0.505 | 0.557 | 0.614 | 0.715 | 1596 | 952 | 1.000 |
| *Grey seal relative consumption-at-age* | | | | | | | | | | |
| $\rho_{1,1}^{50\%}$ | -0.497 | 0.987 | -2.604 | -1.087 | -0.415 | 0.196 | 1.226 | 1257 | 1281 | 1.002 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\rho_{1,2}^{50\%}$ | -0.309 | 1.001 | -2.324 | -0.965 | -0.281 | 0.388 | 1.545 | 2009 | 986 | 1.002 |
| $\rho_{1,1}^{95\%}$-$\rho_{1,1}^{50\%}$ | 15.080 | 1.935 | 11.345 | 13.730 | 15.188 | 16.373 | 18.851 | 1824 | 866 | 1.002 |
| $\rho_{1,2}^{95\%}$-$\rho_{1,2}^{50\%}$ | 15.588 | 1.883 | 11.875 | 14.296 | 15.568 | 16.836 | 19.397 | 1665 | 1055 | 1.003 |
| *Grey seal per-capita consumption* | | | | | | | | | | |
| $\ln\varphi_{1,1,1,1}$ | -8.735 | 0.220 | -9.146 | -8.887 | -8.733 | -8.597 | -8.279 | 401 | 696 | 1.008 |
| $\ln\varphi_{1,1,2,1}$ | -8.341 | 0.197 | -8.730 | -8.474 | -8.334 | -8.208 | -7.969 | 445 | 779 | 1.004 |
| $\ln\varphi_{1,2,1,1}$ | -9.545 | 0.218 | -9.942 | -9.697 | -9.551 | -9.408 | -9.078 | 409 | 684 | 1.007 |
| $\ln\varphi_{1,2,2,1}$ | -7.706 | 0.197 | -8.080 | -7.836 | -7.701 | -7.574 | -7.328 | 437 | 814 | 1.005 |
| $\ln\varphi_{1,3,1,1}$ | -5.125 | 0.217 | -5.525 | -5.266 | -5.131 | -4.984 | -4.660 | 422 | 733 | 1.008 |
| $\ln\varphi_{1,3,2,1}$ | -4.872 | 0.200 | -5.267 | -5.007 | -4.867 | -4.740 | -4.483 | 429 | 840 | 1.004 |
| $\ln\varphi_{1,4,1,1}$ | -6.974 | 0.220 | -7.383 | -7.130 | -6.978 | -6.837 | -6.500 | 431 | 741 | 1.007 |
| $\ln\varphi_{1,4,2,1}$ | -5.094 | 0.199 | -5.475 | -5.231 | -5.092 | -4.962 | -4.717 | 426 | 711 | 1.003 |
| $\varepsilon_{1,2,2}^{(\varphi)}$ | 0.033 | 0.287 | -0.533 | -0.156 | 0.026 | 0.236 | 0.597 | 701 | 972 | 1.005 |
| $\varepsilon_{1,3,2}^{(\varphi)}$ | 0.194 | 0.252 | -0.299 | 0.010 | 0.197 | 0.368 | 0.677 | 665 | 965 | 1.002 |
| $\varepsilon_{1,2,3}^{(\varphi)}$ | 0.152 | 0.295 | -0.429 | -0.057 | 0.162 | 0.359 | 0.701 | 1692 | 1102 | 1.006 |
| $\varepsilon_{1,3,3}^{(\varphi)}$ | 0.136 | 0.261 | -0.365 | -0.041 | 0.132 | 0.320 | 0.652 | 1238 | 963 | 1.000 |
| $\varepsilon_{1,2,4}^{(\varphi)}$ | 0.194 | 0.282 | -0.359 | 0.008 | 0.185 | 0.388 | 0.735 | 1595 | 1051 | 1.003 |
| $\varepsilon_{1,3,4}^{(\varphi)}$ | -0.030 | 0.271 | -0.560 | -0.213 | -0.029 | 0.148 | 0.509 | 1389 | 1036 | 1.000 |
| $\varepsilon_{1,2,5}^{(\varphi)}$ | 0.048 | 0.292 | -0.516 | -0.151 | 0.048 | 0.238 | 0.639 | 1421 | 911 | 1.002 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{1,3,5}^{(\varphi)}$ | -0.013 | 0.257 | -0.543 | -0.180 | -0.007 | 0.159 | 0.451 | 1145 | 1026 | 1.004 |
| $\varepsilon_{1,2,6}^{(\varphi)}$ | 0.010 | 0.303 | -0.569 | -0.189 | 0.012 | 0.209 | 0.618 | 1459 | 1094 | 1.002 |
| $\varepsilon_{1,3,6}^{(\varphi)}$ | -0.167 | 0.237 | -0.628 | -0.325 | -0.170 | -0.009 | 0.291 | 1199 | 1028 | 1.001 |
| $\varepsilon_{1,2,7}^{(\varphi)}$ | -0.192 | 0.310 | -0.791 | -0.400 | -0.184 | 0.015 | 0.406 | 1555 | 1105 | 1.002 |
| $\varepsilon_{1,3,7}^{(\varphi)}$ | -0.126 | 0.199 | -0.544 | -0.250 | -0.122 | 0.007 | 0.251 | 1450 | 1054 | 1.000 |
| $\varepsilon_{1,2,8}^{(\varphi)}$ | -0.550 | 0.307 | -1.129 | -0.756 | -0.550 | -0.341 | 0.054 | 1440 | 1124 | 1.000 |
| $\varepsilon_{1,3,8}^{(\varphi)}$ | -0.083 | 0.209 | -0.483 | -0.226 | -0.079 | 0.062 | 0.330 | 1396 | 1119 | 1.001 |
| $\varepsilon_{1,2,9}^{(\varphi)}$ | -0.216 | 0.301 | -0.805 | -0.414 | -0.212 | -0.014 | 0.380 | 1524 | 1134 | 1.000 |
| $\varepsilon_{1,3,9}^{(\varphi)}$ | 0.184 | 0.221 | -0.250 | 0.035 | 0.182 | 0.332 | 0.629 | 1446 | 1249 | 1.001 |
| $\varepsilon_{1,2,10}^{(\varphi)}$ | -0.248 | 0.289 | -0.793 | -0.452 | -0.247 | -0.046 | 0.319 | 1604 | 1255 | 1.000 |
| $\varepsilon_{1,3,10}^{(\varphi)}$ | 0.369 | 0.233 | -0.097 | 0.210 | 0.373 | 0.522 | 0.828 | 1368 | 1134 | 0.999 |
| $\varepsilon_{1,2,11}^{(\varphi)}$ | -0.009 | 0.299 | -0.560 | -0.214 | -0.004 | 0.191 | 0.594 | 1663 | 1040 | 1.001 |
| $\varepsilon_{1,3,11}^{(\varphi)}$ | -0.079 | 0.261 | -0.582 | -0.249 | -0.087 | 0.096 | 0.429 | 1654 | 1126 | 0.999 |
| $\varepsilon_{1,2,12}^{(\varphi)}$ | 0.077 | 0.298 | -0.515 | -0.122 | 0.069 | 0.282 | 0.661 | 1433 | 1169 | 1.003 |
| $\varepsilon_{1,3,12}^{(\varphi)}$ | 0.012 | 0.272 | -0.501 | -0.170 | 0.019 | 0.205 | 0.526 | 1629 | 1065 | 0.999 |
| $\varepsilon_{1,2,13}^{(\varphi)}$ | 0.219 | 0.311 | -0.357 | 0.006 | 0.223 | 0.436 | 0.800 | 1290 | 785 | 1.002 |
| $\varepsilon_{1,3,13}^{(\varphi)}$ | -0.160 | 0.279 | -0.698 | -0.346 | -0.159 | 0.027 | 0.368 | 1392 | 1282 | 1.000 |
| $\varepsilon_{1,2,14}^{(\varphi)}$ | -0.063 | 0.304 | -0.665 | -0.277 | -0.070 | 0.146 | 0.518 | 1184 | 1069 | 1.003 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{1,3,14}^{(\varphi)}$ | -0.256 | 0.279 | -0.803 | -0.446 | -0.243 | -0.069 | 0.270 | 1407 | 877 | 1.001 |
| $\varepsilon_{1,2,15}^{(\varphi)}$ | -0.167 | 0.297 | -0.740 | -0.366 | -0.158 | 0.027 | 0.409 | 1424 | 1174 | 1.002 |
| $\varepsilon_{1,3,15}^{(\varphi)}$ | -0.254 | 0.261 | -0.768 | -0.430 | -0.247 | -0.076 | 0.238 | 1111 | 871 | 1.002 |
| $\varepsilon_{1,2,16}^{(\varphi)}$ | 0.094 | 0.289 | -0.466 | -0.103 | 0.090 | 0.294 | 0.654 | 1500 | 1147 | 1.003 |
| $\varepsilon_{1,3,16}^{(\varphi)}$ | -0.136 | 0.246 | -0.614 | -0.305 | -0.134 | 0.030 | 0.332 | 1201 | 1082 | 0.999 |
| $\varepsilon_{1,2,17}^{(\varphi)}$ | 0.196 | 0.302 | -0.385 | -0.015 | 0.201 | 0.396 | 0.794 | 1563 | 1195 | 1.002 |
| $\varepsilon_{1,3,17}^{(\varphi)}$ | 0.020 | 0.241 | -0.468 | -0.138 | 0.029 | 0.186 | 0.486 | 1219 | 1141 | 1.001 |
| $\varepsilon_{1,2,18}^{(\varphi)}$ | 0.045 | 0.298 | -0.518 | -0.156 | 0.043 | 0.253 | 0.642 | 1459 | 1278 | 1.003 |
| $\varepsilon_{1,3,18}^{(\varphi)}$ | 0.046 | 0.245 | -0.432 | -0.114 | 0.041 | 0.201 | 0.521 | 1335 | 1072 | 1.000 |
| $\varepsilon_{1,2,19}^{(\varphi)}$ | 0.209 | 0.283 | -0.348 | 0.025 | 0.205 | 0.403 | 0.768 | 1311 | 1248 | 1.002 |
| $\varepsilon_{1,3,19}^{(\varphi)}$ | -0.132 | 0.241 | -0.594 | -0.292 | -0.136 | 0.022 | 0.346 | 1422 | 1269 | 1.002 |
| $\varepsilon_{1,2,20}^{(\varphi)}$ | 0.248 | 0.307 | -0.320 | 0.039 | 0.249 | 0.460 | 0.847 | 1447 | 1137 | 1.001 |
| $\varepsilon_{1,3,20}^{(\varphi)}$ | -0.134 | 0.240 | -0.626 | -0.297 | -0.130 | 0.021 | 0.334 | 1638 | 1317 | 1.002 |
| $\varepsilon_{1,2,21}^{(\varphi)}$ | 0.266 | 0.300 | -0.314 | 0.070 | 0.259 | 0.467 | 0.867 | 1430 | 1254 | 1.002 |
| $\varepsilon_{1,3,21}^{(\varphi)}$ | 0.058 | 0.234 | -0.395 | -0.093 | 0.059 | 0.210 | 0.535 | 1549 | 1372 | 1.001 |
| $\varepsilon_{1,2,22}^{(\varphi)}$ | 0.233 | 0.303 | -0.367 | 0.028 | 0.231 | 0.446 | 0.813 | 1522 | 1398 | 1.001 |
| $\varepsilon_{1,3,22}^{(\varphi)}$ | 0.139 | 0.254 | -0.376 | -0.034 | 0.134 | 0.308 | 0.646 | 1344 | 1028 | 1.001 |
| $\varepsilon_{1,2,23}^{(\varphi)}$ | -0.125 | 0.295 | -0.738 | -0.324 | -0.128 | 0.074 | 0.435 | 1448 | 1052 | 1.000 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon^{(\varphi)}_{1,3,23}$ | -0.111 | 0.249 | -0.611 | -0.287 | -0.101 | 0.057 | 0.379 | 1552 | 1228 | 1.000 |
| $\varepsilon^{(\varphi)}_{1,2,24}$ | 0.015 | 0.284 | -0.525 | -0.185 | 0.018 | 0.198 | 0.564 | 1459 | 1199 | 1.004 |
| $\varepsilon^{(\varphi)}_{1,3,24}$ | -0.115 | 0.247 | -0.585 | -0.282 | -0.126 | 0.055 | 0.366 | 1353 | 1012 | 1.002 |
| $\varepsilon^{(\varphi)}_{1,2,25}$ | -0.078 | 0.287 | -0.625 | -0.267 | -0.075 | 0.103 | 0.503 | 1125 | 1170 | 1.000 |
| $\varepsilon^{(\varphi)}_{1,3,25}$ | -0.033 | 0.230 | -0.496 | -0.192 | -0.025 | 0.125 | 0.398 | 1523 | 1109 | 1.001 |
| $\varepsilon^{(\varphi)}_{1,2,26}$ | -0.045 | 0.273 | -0.580 | -0.225 | -0.047 | 0.143 | 0.477 | 1249 | 1121 | 0.999 |
| $\varepsilon^{(\varphi)}_{1,3,26}$ | -0.010 | 0.230 | -0.453 | -0.168 | -0.013 | 0.147 | 0.431 | 1221 | 1006 | 1.007 |
| $\varepsilon^{(\varphi)}_{1,2,27}$ | -0.058 | 0.281 | -0.599 | -0.251 | -0.060 | 0.122 | 0.493 | 1275 | 1301 | 1.001 |
| $\varepsilon^{(\varphi)}_{1,3,27}$ | 0.133 | 0.236 | -0.310 | -0.027 | 0.132 | 0.292 | 0.602 | 1021 | 854 | 1.007 |
| $\varepsilon^{(\varphi)}_{1,2,28}$ | 0.127 | 0.297 | -0.412 | -0.082 | 0.118 | 0.330 | 0.733 | 1429 | 1168 | 1.002 |
| $\varepsilon^{(\varphi)}_{1,3,28}$ | 0.154 | 0.257 | -0.368 | -0.017 | 0.152 | 0.324 | 0.658 | 1220 | 889 | 1.004 |
| $\varepsilon^{(\varphi)}_{1,2,29}$ | -0.163 | 0.281 | -0.701 | -0.357 | -0.156 | 0.016 | 0.395 | 1422 | 1248 | 1.000 |
| $\varepsilon^{(\varphi)}_{1,3,29}$ | -0.200 | 0.256 | -0.663 | -0.376 | -0.212 | -0.030 | 0.330 | 1252 | 1123 | 0.999 |
| $\varepsilon^{(\varphi)}_{1,2,30}$ | 0.009 | 0.278 | -0.516 | -0.164 | 0.017 | 0.185 | 0.545 | 1342 | 1200 | 1.002 |
| $\varepsilon^{(\varphi)}_{1,3,30}$ | -0.087 | 0.248 | -0.576 | -0.257 | -0.093 | 0.087 | 0.411 | 1519 | 1017 | 1.004 |
| $\varepsilon^{(\varphi)}_{1,2,31}$ | 0.118 | 0.292 | -0.459 | -0.073 | 0.128 | 0.310 | 0.694 | 1158 | 1147 | 1.002 |
| $\varepsilon^{(\varphi)}_{1,3,31}$ | 0.012 | 0.223 | -0.437 | -0.137 | 0.018 | 0.158 | 0.444 | 1589 | 1244 | 0.999 |
| $\varepsilon^{(\varphi)}_{1,2,32}$ | 0.290 | 0.306 | -0.318 | 0.083 | 0.290 | 0.496 | 0.893 | 1232 | 1012 | 1.002 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{1,3,32}^{(\varphi)}$ | -0.026 | 0.237 | -0.470 | -0.192 | -0.029 | 0.127 | 0.457 | 1471 | 1099 | 0.999 |
| $\varepsilon_{1,2,33}^{(\varphi)}$ | 0.240 | 0.311 | -0.351 | 0.026 | 0.238 | 0.444 | 0.862 | 933 | 1015 | 1.001 |
| $\varepsilon_{1,3,33}^{(\varphi)}$ | 0.110 | 0.238 | -0.357 | -0.049 | 0.109 | 0.265 | 0.583 | 1283 | 881 | 0.999 |
| $\varepsilon_{1,2,34}^{(\varphi)}$ | -0.127 | 0.298 | -0.714 | -0.330 | -0.134 | 0.065 | 0.494 | 1054 | 1221 | 1.002 |
| $\varepsilon_{1,3,34}^{(\varphi)}$ | -0.006 | 0.244 | -0.489 | -0.177 | -0.008 | 0.160 | 0.467 | 1224 | 1237 | 1.000 |
| $\varepsilon_{1,2,35}^{(\varphi)}$ | 0.063 | 0.271 | -0.467 | -0.121 | 0.056 | 0.250 | 0.616 | 1069 | 899 | 1.000 |
| $\varepsilon_{1,3,35}^{(\varphi)}$ | -0.114 | 0.242 | -0.584 | -0.274 | -0.118 | 0.036 | 0.388 | 1326 | 1348 | 1.000 |
| $\varepsilon_{1,2,36}^{(\varphi)}$ | 0.030 | 0.274 | -0.514 | -0.151 | 0.033 | 0.208 | 0.566 | 1277 | 1068 | 1.000 |
| $\varepsilon_{1,3,36}^{(\varphi)}$ | 0.055 | 0.243 | -0.414 | -0.097 | 0.056 | 0.219 | 0.535 | 1603 | 1125 | 1.002 |
| $\varepsilon_{1,2,37}^{(\varphi)}$ | 0.783 | 0.283 | 0.237 | 0.592 | 0.791 | 0.972 | 1.337 | 961 | 987 | 0.999 |
| $\varepsilon_{1,3,37}^{(\varphi)}$ | 0.121 | 0.246 | -0.353 | -0.043 | 0.113 | 0.292 | 0.587 | 1302 | 1031 | 1.001 |
| $\varepsilon_{1,2,38}^{(\varphi)}$ | -0.589 | 0.261 | -1.097 | -0.766 | -0.593 | -0.423 | -0.042 | 750 | 1039 | 1.001 |
| $\varepsilon_{1,3,38}^{(\varphi)}$ | 0.229 | 0.266 | -0.282 | 0.041 | 0.236 | 0.405 | 0.730 | 1481 | 1195 | 1.003 |
| $\varepsilon_{1,2,39}^{(\varphi)}$ | 0.767 | 0.234 | 0.288 | 0.612 | 0.770 | 0.922 | 1.219 | 890 | 1068 | 1.002 |
| $\varepsilon_{1,3,39}^{(\varphi)}$ | -0.106 | 0.270 | -0.637 | -0.293 | -0.097 | 0.081 | 0.417 | 1373 | 1305 | 1.001 |
| $\varepsilon_{1,2,40}^{(\varphi)}$ | -0.511 | 0.224 | -0.951 | -0.657 | -0.511 | -0.366 | -0.057 | 881 | 910 | 1.001 |
| $\varepsilon_{1,3,40}^{(\varphi)}$ | -0.024 | 0.244 | -0.510 | -0.184 | -0.020 | 0.139 | 0.434 | 1126 | 1110 | 1.006 |
| $\varepsilon_{1,2,41}^{(\varphi)}$ | 0.155 | 0.231 | -0.301 | 0.002 | 0.146 | 0.316 | 0.600 | 771 | 1162 | 1.000 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{1,3,41}^{(\varphi)}$ | 0.109 | 0.239 | -0.348 | -0.057 | 0.111 | 0.273 | 0.574 | 1405 | 1136 | 1.000 |
| $\varepsilon_{1,2,42}^{(\varphi)}$ | 0.329 | 0.227 | -0.094 | 0.168 | 0.330 | 0.483 | 0.781 | 682 | 998 | 1.002 |
| $\varepsilon_{1,3,42}^{(\varphi)}$ | 0.063 | 0.240 | -0.412 | -0.089 | 0.062 | 0.236 | 0.512 | 1570 | 1260 | 1.000 |
| $\varepsilon_{1,2,43}^{(\varphi)}$ | 0.033 | 0.230 | -0.435 | -0.125 | 0.030 | 0.191 | 0.475 | 753 | 945 | 1.002 |
| $\varepsilon_{1,3,43}^{(\varphi)}$ | -0.036 | 0.239 | -0.499 | -0.201 | -0.036 | 0.120 | 0.446 | 1762 | 1155 | 1.000 |
| $\varepsilon_{1,2,44}^{(\varphi)}$ | -0.314 | 0.228 | -0.769 | -0.462 | -0.319 | -0.164 | 0.155 | 863 | 841 | 1.000 |
| $\varepsilon_{1,3,44}^{(\varphi)}$ | 0.141 | 0.230 | -0.328 | -0.013 | 0.142 | 0.304 | 0.573 | 1768 | 1094 | 0.999 |
| $\varepsilon_{1,2,45}^{(\varphi)}$ | -0.005 | 0.229 | -0.474 | -0.153 | 0.002 | 0.150 | 0.441 | 894 | 1000 | 0.999 |
| $\varepsilon_{1,3,45}^{(\varphi)}$ | 0.203 | 0.238 | -0.278 | 0.047 | 0.205 | 0.364 | 0.681 | 1535 | 1332 | 0.999 |
| $\varepsilon_{1,2,46}^{(\varphi)}$ | 0.581 | 0.234 | 0.135 | 0.427 | 0.571 | 0.737 | 1.046 | 853 | 933 | 1.001 |
| $\varepsilon_{1,3,46}^{(\varphi)}$ | 0.492 | 0.272 | -0.042 | 0.311 | 0.487 | 0.680 | 1.026 | 1269 | 1128 | 1.007 |
| $\varepsilon_{1,2,47}^{(\varphi)}$ | -0.041 | 0.226 | -0.481 | -0.191 | -0.048 | 0.100 | 0.427 | 1068 | 1023 | 1.003 |
| $\varepsilon_{1,3,47}^{(\varphi)}$ | -0.187 | 0.288 | -0.760 | -0.374 | -0.184 | 0.002 | 0.378 | 1203 | 1209 | 1.005 |
| $\varepsilon_{1,2,48}^{(\varphi)}$ | 0.255 | 0.245 | -0.245 | 0.098 | 0.256 | 0.418 | 0.753 | 1628 | 1124 | 1.006 |
| $\varepsilon_{1,3,48}^{(\varphi)}$ | -0.246 | 0.263 | -0.737 | -0.415 | -0.251 | -0.069 | 0.286 | 1907 | 1216 | 1.006 |
| *Cod relative consumption-at-age* | | | | | | | | | | |
| $\rho_{2,1}^{50\%}$ | 6.410 | 0.113 | 6.198 | 6.332 | 6.411 | 6.487 | 6.629 | 1114 | 1138 | 1.001 |
| $\rho_{2,1}^{95\%}$-$\rho_{2,1}^{50\%}$ | 1.319 | 0.041 | 1.240 | 1.292 | 1.319 | 1.346 | 1.399 | 1150 | 1165 | 1.002 |

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|---|---|---|---|---|---|---|---|---|---|---|
| *Cod per-capita consumption* | | | | | | | | | | |
| $\ln\varphi_{2,1,3,1}$ | -8.131 | 0.270 | -8.667 | -8.316 | -8.127 | -7.945 | -7.620 | 1587 | 1242 | 1.011 |
| $\varepsilon_{2,3,2}^{(\varphi)}$ | 0.931 | 0.483 | 0.013 | 0.603 | 0.910 | 1.250 | 1.931 | 1056 | 981 | 1.002 |
| $\varepsilon_{2,3,3}^{(\varphi)}$ | -0.438 | 0.516 | -1.452 | -0.768 | -0.437 | -0.090 | 0.567 | 1291 | 956 | 1.000 |
| $\varepsilon_{2,3,4}^{(\varphi)}$ | -0.239 | 0.439 | -1.107 | -0.536 | -0.246 | 0.064 | 0.623 | 1297 | 1129 | 1.001 |
| $\varepsilon_{2,3,5}^{(\varphi)}$ | -0.622 | 0.407 | -1.413 | -0.900 | -0.616 | -0.346 | 0.133 | 1389 | 851 | 1.000 |
| $\varepsilon_{2,3,6}^{(\varphi)}$ | 0.405 | 0.377 | -0.316 | 0.145 | 0.407 | 0.662 | 1.128 | 1657 | 1177 | 0.999 |
| $\varepsilon_{2,3,7}^{(\varphi)}$ | -0.497 | 0.351 | -1.164 | -0.739 | -0.508 | -0.256 | 0.183 | 1705 | 1141 | 1.001 |
| $\varepsilon_{2,3,8}^{(\varphi)}$ | -0.028 | 0.366 | -0.733 | -0.281 | -0.033 | 0.216 | 0.675 | 1658 | 1286 | 1.000 |
| $\varepsilon_{2,3,9}^{(\varphi)}$ | -0.891 | 0.373 | -1.591 | -1.140 | -0.900 | -0.651 | -0.163 | 1306 | 1190 | 1.000 |
| $\varepsilon_{2,3,10}^{(\varphi)}$ | 1.227 | 0.399 | 0.467 | 0.952 | 1.216 | 1.489 | 2.022 | 1271 | 865 | 1.000 |
| $\varepsilon_{2,3,11}^{(\varphi)}$ | 0.103 | 0.413 | -0.707 | -0.160 | 0.101 | 0.381 | 0.904 | 1702 | 1107 | 1.000 |
| $\varepsilon_{2,3,12}^{(\varphi)}$ | -0.127 | 0.399 | -0.897 | -0.386 | -0.127 | 0.141 | 0.673 | 1819 | 1117 | 1.001 |
| $\varepsilon_{2,3,13}^{(\varphi)}$ | 0.414 | 0.368 | -0.308 | 0.171 | 0.419 | 0.666 | 1.109 | 1488 | 1063 | 1.002 |
| $\varepsilon_{2,3,14}^{(\varphi)}$ | 0.771 | 0.350 | 0.115 | 0.516 | 0.774 | 1.017 | 1.437 | 1330 | 1124 | 1.001 |
| $\varepsilon_{2,3,15}^{(\varphi)}$ | 0.064 | 0.334 | -0.576 | -0.160 | 0.061 | 0.287 | 0.741 | 1035 | 1033 | 1.000 |
| $\varepsilon_{2,3,16}^{(\varphi)}$ | 0.338 | 0.317 | -0.271 | 0.118 | 0.335 | 0.551 | 0.981 | 1315 | 1282 | 1.003 |
| $\varepsilon_{2,3,17}^{(\varphi)}$ | -0.191 | 0.352 | -0.880 | -0.433 | -0.188 | 0.040 | 0.462 | 1426 | 1304 | 1.000 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon^{(\varphi)}_{2,3,18}$ | -0.150 | 0.395 | -0.954 | -0.412 | -0.142 | 0.117 | 0.610 | 1542 | 1249 | 1.001 |
| $\varepsilon^{(\varphi)}_{2,3,19}$ | -0.448 | 0.358 | -1.128 | -0.691 | -0.447 | -0.207 | 0.268 | 1544 | 1131 | 1.003 |
| $\varepsilon^{(\varphi)}_{2,3,20}$ | -0.100 | 0.371 | -0.837 | -0.352 | -0.106 | 0.153 | 0.595 | 1382 | 1147 | 1.000 |
| $\varepsilon^{(\varphi)}_{2,3,21}$ | -0.046 | 0.369 | -0.781 | -0.297 | -0.055 | 0.207 | 0.681 | 1373 | 1029 | 1.001 |
| $\varepsilon^{(\varphi)}_{2,3,22}$ | -0.121 | 0.397 | -0.858 | -0.395 | -0.132 | 0.142 | 0.702 | 1225 | 995 | 0.999 |
| $\varepsilon^{(\varphi)}_{2,3,23}$ | 0.186 | 0.396 | -0.602 | -0.080 | 0.190 | 0.456 | 0.965 | 1145 | 898 | 1.002 |
| $\varepsilon^{(\varphi)}_{2,3,24}$ | 0.149 | 0.344 | -0.494 | -0.084 | 0.150 | 0.384 | 0.819 | 1556 | 1283 | 1.002 |
| $\varepsilon^{(\varphi)}_{2,3,25}$ | 0.126 | 0.350 | -0.569 | -0.106 | 0.132 | 0.363 | 0.808 | 1357 | 1091 | 1.004 |
| $\varepsilon^{(\varphi)}_{2,3,26}$ | 0.235 | 0.352 | -0.476 | -0.010 | 0.247 | 0.483 | 0.905 | 1223 | 1098 | 1.005 |
| $\varepsilon^{(\varphi)}_{2,3,27}$ | 0.257 | 0.411 | -0.533 | -0.028 | 0.253 | 0.551 | 1.057 | 1294 | 1066 | 1.002 |
| $\varepsilon^{(\varphi)}_{2,3,28}$ | -0.150 | 0.412 | -0.936 | -0.438 | -0.157 | 0.111 | 0.702 | 1327 | 1249 | 1.001 |
| $\varepsilon^{(\varphi)}_{2,3,29}$ | -0.438 | 0.373 | -1.160 | -0.691 | -0.429 | -0.189 | 0.278 | 1442 | 1054 | 1.002 |
| $\varepsilon^{(\varphi)}_{2,3,30}$ | 0.237 | 0.376 | -0.498 | -0.016 | 0.241 | 0.491 | 0.952 | 1449 | 1171 | 0.999 |
| $\varepsilon^{(\varphi)}_{2,3,31}$ | -0.013 | 0.380 | -0.744 | -0.263 | -0.010 | 0.234 | 0.732 | 1500 | 1099 | 1.001 |
| $\varepsilon^{(\varphi)}_{2,3,32}$ | -0.582 | 0.377 | -1.301 | -0.841 | -0.580 | -0.342 | 0.167 | 1305 | 1254 | 1.000 |
| $\varepsilon^{(\varphi)}_{2,3,33}$ | 0.171 | 0.367 | -0.548 | -0.072 | 0.168 | 0.421 | 0.910 | 1608 | 1183 | 1.004 |
| $\varepsilon^{(\varphi)}_{2,3,34}$ | -0.082 | 0.368 | -0.755 | -0.340 | -0.081 | 0.174 | 0.652 | 1603 | 1092 | 1.005 |
| $\varepsilon^{(\varphi)}_{2,3,35}$ | -0.076 | 0.371 | -0.817 | -0.326 | -0.072 | 0.175 | 0.647 | 1376 | 1042 | 1.004 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon^{(\varphi)}_{2,3,36}$ | 0.115 | 0.382 | -0.622 | -0.149 | 0.112 | 0.384 | 0.847 | 1413 | 1273 | 1.003 |
| $\varepsilon^{(\varphi)}_{2,3,37}$ | -0.022 | 0.395 | -0.796 | -0.283 | -0.019 | 0.233 | 0.742 | 1516 | 964 | 1.003 |
| $\varepsilon^{(\varphi)}_{2,3,38}$ | -0.156 | 0.386 | -0.892 | -0.431 | -0.154 | 0.099 | 0.622 | 1484 | 1252 | 1.003 |
| $\varepsilon^{(\varphi)}_{2,3,39}$ | -0.034 | 0.390 | -0.792 | -0.300 | -0.027 | 0.235 | 0.710 | 1322 | 1042 | 1.001 |
| $\varepsilon^{(\varphi)}_{2,3,40}$ | -0.098 | 0.374 | -0.831 | -0.356 | -0.098 | 0.141 | 0.639 | 1420 | 1150 | 1.000 |
| $\varepsilon^{(\varphi)}_{2,3,41}$ | 0.105 | 0.399 | -0.660 | -0.185 | 0.107 | 0.372 | 0.901 | 1718 | 1143 | 1.000 |
| $\varepsilon^{(\varphi)}_{2,3,42}$ | -0.384 | 0.400 | -1.126 | -0.662 | -0.381 | -0.106 | 0.427 | 1511 | 1121 | 1.002 |
| $\varepsilon^{(\varphi)}_{2,3,43}$ | 0.564 | 0.394 | -0.212 | 0.313 | 0.563 | 0.821 | 1.349 | 1400 | 980 | 1.000 |
| $\varepsilon^{(\varphi)}_{2,3,44}$ | 0.758 | 0.377 | 0.035 | 0.506 | 0.752 | 1.027 | 1.509 | 1392 | 1403 | 1.000 |
| $\varepsilon^{(\varphi)}_{2,3,45}$ | -0.877 | 0.380 | -1.586 | -1.139 | -0.878 | -0.615 | -0.128 | 1479 | 1065 | 1.002 |
| $\varepsilon^{(\varphi)}_{2,3,46}$ | 0.174 | 0.375 | -0.559 | -0.074 | 0.167 | 0.420 | 0.917 | 1658 | 1222 | 1.002 |
| $\varepsilon^{(\varphi)}_{2,3,47}$ | 0.831 | 0.381 | 0.090 | 0.574 | 0.832 | 1.083 | 1.579 | 1669 | 1283 | 1.002 |
| $\varepsilon^{(\varphi)}_{2,3,48}$ | -1.377 | 0.391 | -2.122 | -1.649 | -1.376 | -1.108 | -0.584 | 2006 | 1241 | 1.000 |
| *Cod fishery and survey selectivity* | | | | | | | | | | |
| $\ln s^{50\%}_{1,2,1,1:11}$ | 1.474 | 0.014 | 1.447 | 1.464 | 1.473 | 1.483 | 1.500 | 1101 | 970 | 0.999 |
| $\ln s^{50\%}_{1,2,1,12:24}$ | 1.632 | 0.012 | 1.608 | 1.624 | 1.632 | 1.640 | 1.657 | 1413 | 1146 | 1.000 |
| $\ln s^{50\%}_{1,2,1,25:48}$ | 1.868 | 0.015 | 1.840 | 1.857 | 1.868 | 1.878 | 1.896 | 665 | 927 | 1.011 |
| $\ln s^{50\%}_{2,2,1,1:48}$ | 1.394 | 0.020 | 1.355 | 1.382 | 1.394 | 1.407 | 1.433 | 1097 | 945 | 1.002 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\ln s^{50\%}_{3,2,1,1:48}$ | 1.324 | 0.028 | 1.269 | 1.305 | 1.324 | 1.343 | 1.379 | 974 | 941 | 1.000 |
| $\ln s^{50\%}_{4,2,1,1:48}$ | 1.971 | 0.014 | 1.944 | 1.961 | 1.971 | 1.980 | 1.999 | 926 | 1071 | 1.003 |
| $\ln(s^{95\%}_{1,2,1,1:11}-s^{50\%}_{1,2,1,1:11})$ | -0.225 | 0.044 | -0.307 | -0.256 | -0.227 | -0.194 | -0.137 | 1021 | 1070 | 1.001 |
| $\ln(s^{95\%}_{1,2,1,12:24}-s^{50\%}_{1,2,1,12:24})$ | -0.066 | 0.031 | -0.128 | -0.088 | -0.066 | -0.045 | -0.006 | 820 | 1132 | 1.006 |
| $\ln(s^{95\%}_{1,2,1,25:48}-s^{50\%}_{1,2,1,25:48})$ | 0.609 | 0.034 | 0.544 | 0.586 | 0.609 | 0.632 | 0.675 | 416 | 809 | 1.016 |
| $\ln(s^{95\%}_{2,2,1,1:48}-s^{50\%}_{2,2,1,1:48})$ | 0.835 | 0.050 | 0.744 | 0.799 | 0.832 | 0.868 | 0.939 | 457 | 700 | 1.012 |
| $\ln(s^{95\%}_{3,2,1,1:48}-s^{50\%}_{3,2,1,1:48})$ | 0.621 | 0.062 | 0.501 | 0.579 | 0.621 | 0.663 | 0.741 | 1027 | 1047 | 1.004 |
| $\ln(s^{95\%}_{4,2,1,1:48}-s^{50\%}_{4,2,1,1:48})$ | 0.980 | 0.038 | 0.906 | 0.954 | 0.980 | 1.004 | 1.057 | 1070 | 1110 | 1.001 |
| *Recruitment deviations* | | | | | | | | | | |
| $\varepsilon^{(R)}_{2,1,2}$ | 0.427 | 0.099 | 0.227 | 0.357 | 0.431 | 0.495 | 0.614 | 1892 | 1189 | 1.000 |
| $\varepsilon^{(R)}_{2,1,3}$ | 0.068 | 0.102 | -0.134 | 0.002 | 0.065 | 0.137 | 0.261 | 1691 | 1052 | 1.002 |
| $\varepsilon^{(R)}_{2,1,4}$ | -0.049 | 0.100 | -0.242 | -0.120 | -0.044 | 0.016 | 0.141 | 1372 | 934 | 1.000 |
| $\varepsilon^{(R)}_{2,1,5}$ | 1.053 | 0.096 | 0.863 | 0.987 | 1.051 | 1.118 | 1.235 | 1479 | 1416 | 1.000 |
| $\varepsilon^{(R)}_{2,1,6}$ | 0.252 | 0.090 | 0.079 | 0.189 | 0.249 | 0.314 | 0.431 | 1655 | 1374 | 1.000 |
| $\varepsilon^{(R)}_{2,1,7}$ | 0.268 | 0.093 | 0.093 | 0.204 | 0.265 | 0.331 | 0.458 | 1796 | 1226 | 1.002 |
| $\varepsilon^{(R)}_{2,1,8}$ | -0.326 | 0.096 | -0.520 | -0.387 | -0.325 | -0.263 | -0.141 | 1562 | 1224 | 1.002 |
| $\varepsilon^{(R)}_{2,1,9}$ | -0.181 | 0.101 | -0.377 | -0.248 | -0.178 | -0.111 | 0.014 | 1329 | 1091 | 1.003 |
| $\varepsilon^{(R)}_{2,1,10}$ | -0.216 | 0.101 | -0.410 | -0.285 | -0.215 | -0.147 | -0.012 | 1271 | 1161 | 1.003 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon^{(R)}_{2,1,11}$ | 0.715 | 0.101 | 0.520 | 0.646 | 0.717 | 0.782 | 0.916 | 1253 | 1230 | 1.002 |
| $\varepsilon^{(R)}_{2,1,12}$ | 0.103 | 0.101 | -0.095 | 0.036 | 0.102 | 0.170 | 0.309 | 1514 | 958 | 1.000 |
| $\varepsilon^{(R)}_{2,1,13}$ | -0.675 | 0.096 | -0.869 | -0.738 | -0.674 | -0.611 | -0.487 | 1263 | 1311 | 0.999 |
| $\varepsilon^{(R)}_{2,1,14}$ | 0.007 | 0.098 | -0.180 | -0.060 | 0.003 | 0.072 | 0.197 | 1281 | 1164 | 1.001 |
| $\varepsilon^{(R)}_{2,1,15}$ | -0.009 | 0.101 | -0.202 | -0.075 | -0.010 | 0.059 | 0.195 | 1258 | 1191 | 1.000 |
| $\varepsilon^{(R)}_{2,1,16}$ | -0.147 | 0.103 | -0.348 | -0.214 | -0.147 | -0.078 | 0.055 | 1287 | 1141 | 1.002 |
| $\varepsilon^{(R)}_{2,1,17}$ | -0.108 | 0.090 | -0.272 | -0.170 | -0.109 | -0.048 | 0.073 | 1331 | 956 | 1.002 |
| $\varepsilon^{(R)}_{2,1,18}$ | -0.022 | 0.085 | -0.187 | -0.077 | -0.023 | 0.034 | 0.148 | 1508 | 1284 | 1.000 |
| $\varepsilon^{(R)}_{2,1,19}$ | 0.056 | 0.084 | -0.109 | -0.001 | 0.056 | 0.115 | 0.213 | 1264 | 1227 | 1.001 |
| $\varepsilon^{(R)}_{2,1,20}$ | -0.219 | 0.085 | -0.384 | -0.278 | -0.219 | -0.162 | -0.051 | 1398 | 945 | 1.002 |
| $\varepsilon^{(R)}_{2,1,21}$ | -0.365 | 0.082 | -0.529 | -0.420 | -0.366 | -0.308 | -0.216 | 1837 | 1149 | 1.005 |
| $\varepsilon^{(R)}_{2,1,22}$ | -0.086 | 0.078 | -0.236 | -0.139 | -0.088 | -0.034 | 0.069 | 1432 | 1185 | 1.001 |
| $\varepsilon^{(R)}_{2,1,23}$ | -0.052 | 0.080 | -0.203 | -0.107 | -0.052 | 0.007 | 0.101 | 1286 | 1187 | 1.000 |
| $\varepsilon^{(R)}_{2,1,24}$ | 0.070 | 0.079 | -0.085 | 0.017 | 0.070 | 0.123 | 0.227 | 1315 | 1057 | 0.999 |
| $\varepsilon^{(R)}_{2,1,25}$ | -0.358 | 0.078 | -0.511 | -0.409 | -0.358 | -0.306 | -0.204 | 1684 | 938 | 1.001 |
| $\varepsilon^{(R)}_{2,1,26}$ | 0.453 | 0.079 | 0.299 | 0.400 | 0.453 | 0.506 | 0.602 | 1268 | 1015 | 1.001 |
| $\varepsilon^{(R)}_{2,1,27}$ | 0.022 | 0.075 | -0.130 | -0.029 | 0.019 | 0.072 | 0.171 | 1389 | 1098 | 1.003 |
| $\varepsilon^{(R)}_{2,1,28}$ | -0.121 | 0.075 | -0.262 | -0.174 | -0.123 | -0.069 | 0.026 | 1524 | 1210 | 1.002 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon^{(R)}_{2,1,29}$ | -0.042 | 0.077 | -0.197 | -0.098 | -0.039 | 0.007 | 0.110 | 1552 | 1142 | 1.002 |
| $\varepsilon^{(R)}_{2,1,30}$ | -0.401 | 0.076 | -0.546 | -0.453 | -0.401 | -0.350 | -0.251 | 1503 | 1141 | 1.001 |
| $\varepsilon^{(R)}_{2,1,31}$ | 0.171 | 0.079 | 0.015 | 0.118 | 0.173 | 0.223 | 0.326 | 1285 | 1220 | 1.001 |
| $\varepsilon^{(R)}_{2,1,32}$ | 0.072 | 0.076 | -0.081 | 0.021 | 0.072 | 0.123 | 0.223 | 1396 | 1200 | 1.000 |
| $\varepsilon^{(R)}_{2,1,33}$ | 0.284 | 0.074 | 0.133 | 0.235 | 0.287 | 0.334 | 0.427 | 1353 | 1223 | 1.006 |
| $\varepsilon^{(R)}_{2,1,34}$ | -0.615 | 0.075 | -0.768 | -0.664 | -0.613 | -0.565 | -0.472 | 1353 | 1167 | 1.002 |
| $\varepsilon^{(R)}_{2,1,35}$ | -0.137 | 0.092 | -0.323 | -0.195 | -0.134 | -0.077 | 0.037 | 992 | 1068 | 1.000 |
| $\varepsilon^{(R)}_{2,1,36}$ | -0.377 | 0.082 | -0.536 | -0.432 | -0.378 | -0.322 | -0.218 | 1055 | 814 | 1.003 |
| $\varepsilon^{(R)}_{2,1,37}$ | 0.371 | 0.089 | 0.202 | 0.309 | 0.372 | 0.431 | 0.545 | 927 | 1097 | 1.004 |
| $\varepsilon^{(R)}_{2,1,38}$ | -0.142 | 0.077 | -0.292 | -0.192 | -0.143 | -0.092 | 0.009 | 999 | 1144 | 1.003 |
| $\varepsilon^{(R)}_{2,1,39}$ | -0.372 | 0.084 | -0.531 | -0.427 | -0.372 | -0.315 | -0.202 | 877 | 1028 | 1.002 |
| $\varepsilon^{(R)}_{2,1,40}$ | 0.577 | 0.092 | 0.395 | 0.518 | 0.581 | 0.637 | 0.757 | 823 | 823 | 1.001 |
| $\varepsilon^{(R)}_{2,1,41}$ | -0.314 | 0.094 | -0.500 | -0.374 | -0.317 | -0.249 | -0.133 | 972 | 900 | 1.002 |
| $\varepsilon^{(R)}_{2,1,42}$ | 0.111 | 0.091 | -0.069 | 0.049 | 0.112 | 0.176 | 0.292 | 1295 | 1193 | 1.004 |
| $\varepsilon^{(R)}_{2,1,43}$ | 0.152 | 0.093 | -0.028 | 0.086 | 0.156 | 0.215 | 0.323 | 1178 | 1029 | 1.002 |
| $\varepsilon^{(R)}_{2,1,44}$ | -0.492 | 0.110 | -0.706 | -0.568 | -0.492 | -0.418 | -0.277 | 1190 | 1098 | 1.003 |
| $\varepsilon^{(R)}_{2,1,45}$ | -0.496 | 0.118 | -0.722 | -0.577 | -0.497 | -0.414 | -0.275 | 1728 | 1240 | 1.006 |
| $\varepsilon^{(R)}_{2,1,46}$ | -0.582 | 0.132 | -0.843 | -0.669 | -0.586 | -0.494 | -0.320 | 1652 | 1218 | 1.000 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{2,1,47}^{(R)}$ | 0.749 | 0.151 | 0.459 | 0.644 | 0.746 | 0.850 | 1.056 | 2067 | 1118 | 1.002 |
| $\varepsilon_{2,1,48}^{(R)}$ | -0.194 | 0.221 | -0.632 | -0.348 | -0.198 | -0.036 | 0.230 | 2368 | 1194 | 1.005 |
| *Initial cod abundance* | | | | | | | | | | |
| $\ln N_{2,1,2,2}$ | 4.954 | 0.175 | 4.616 | 4.839 | 4.953 | 5.071 | 5.308 | 342 | 605 | 1.020 |
| $\ln N_{2,1,2,3}$ | 4.976 | 0.127 | 4.731 | 4.893 | 4.973 | 5.054 | 5.250 | 360 | 600 | 1.020 |
| $\ln N_{2,1,2,4}$ | 4.407 | 0.095 | 4.228 | 4.345 | 4.405 | 4.470 | 4.599 | 583 | 716 | 1.011 |
| $\ln N_{2,1,2,5}$ | 3.825 | 0.083 | 3.668 | 3.768 | 3.824 | 3.878 | 3.986 | 1799 | 1088 | 1.007 |
| $\ln N_{2,1,2,6}$ | 3.517 | 0.091 | 3.344 | 3.454 | 3.517 | 3.580 | 3.695 | 1487 | 1145 | 1.003 |
| $\ln N_{2,1,2,7}$ | 3.023 | 0.091 | 2.845 | 2.958 | 3.021 | 3.087 | 3.201 | 1416 | 1129 | 1.003 |
| $\ln N_{2,1,2,8}$ | 1.634 | 0.112 | 1.414 | 1.560 | 1.632 | 1.711 | 1.854 | 2151 | 1094 | 1.001 |
| $\ln N_{2,1,2,9}$ | 0.771 | 0.133 | 0.514 | 0.679 | 0.776 | 0.865 | 1.025 | 2025 | 1135 | 1.000 |
| $\ln N_{2,1,2,10}$ | 0.739 | 0.154 | 0.440 | 0.639 | 0.739 | 0.838 | 1.061 | 2713 | 1013 | 1.002 |
| $\ln N_{2,1,2,11}$ | -0.042 | 0.207 | -0.451 | -0.184 | -0.041 | 0.100 | 0.351 | 1900 | 943 | 1.003 |
| $\ln N_{2,1,2,12}$ | 0.314 | 0.314 | -0.312 | 0.107 | 0.321 | 0.529 | 0.868 | 2521 | 1072 | 0.999 |
| *Cod natural mortality* | | | | | | | | | | |
| $\ln M_{2,1,2:4,1:48}$ | -0.584 | 0.086 | -0.757 | -0.641 | -0.580 | -0.524 | -0.431 | 340 | 748 | 1.017 |
| $\varepsilon_{2}^{(M,c)}$ | 0.018 | 0.095 | -0.168 | -0.048 | 0.015 | 0.086 | 0.200 | 1242 | 960 | 1.002 |
| $\varepsilon_{3}^{(M,c)}$ | 0.018 | 0.093 | -0.157 | -0.044 | 0.018 | 0.082 | 0.201 | 1658 | 1177 | 1.002 |
| $\varepsilon_{4}^{(M,c)}$ | 0.059 | 0.090 | -0.128 | 0.002 | 0.060 | 0.118 | 0.237 | 2344 | 1219 | 1.001 |
| $\varepsilon_{5}^{(M,c)}$ | 0.112 | 0.096 | -0.069 | 0.049 | 0.115 | 0.174 | 0.296 | 2087 | 1149 | 1.002 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_6^{(M,c)}$ | 0.137 | 0.092 | -0.042 | 0.076 | 0.136 | 0.196 | 0.314 | 2078 | 1111 | 1.002 |
| $\varepsilon_7^{(M,c)}$ | 0.075 | 0.099 | -0.110 | 0.006 | 0.071 | 0.146 | 0.259 | 1687 | 1079 | 1.000 |
| $\varepsilon_8^{(M,c)}$ | 0.031 | 0.091 | -0.146 | -0.031 | 0.033 | 0.092 | 0.206 | 2173 | 1201 | 1.002 |
| $\varepsilon_9^{(M,c)}$ | 0.006 | 0.090 | -0.161 | -0.058 | 0.004 | 0.067 | 0.179 | 2791 | 1096 | 1.008 |
| $\varepsilon_{10}^{(M,c)}$ | 0.023 | 0.094 | -0.159 | -0.041 | 0.021 | 0.088 | 0.205 | 2438 | 914 | 1.004 |
| $\varepsilon_{11}^{(M,c)}$ | 0.022 | 0.090 | -0.151 | -0.040 | 0.022 | 0.083 | 0.199 | 1708 | 1128 | 1.003 |
| $\varepsilon_{12}^{(M,c)}$ | 0.073 | 0.093 | -0.101 | 0.008 | 0.073 | 0.141 | 0.253 | 1622 | 1163 | 1.000 |
| $\varepsilon_{13}^{(M,c)}$ | 0.015 | 0.090 | -0.149 | -0.048 | 0.012 | 0.079 | 0.197 | 2285 | 1450 | 1.002 |
| $\varepsilon_{14}^{(M,c)}$ | -0.056 | 0.092 | -0.231 | -0.117 | -0.058 | 0.007 | 0.129 | 2046 | 864 | 1.004 |
| $\varepsilon_{15}^{(M,c)}$ | -0.068 | 0.090 | -0.247 | -0.129 | -0.068 | -0.012 | 0.109 | 1663 | 1098 | 1.001 |
| $\varepsilon_{16}^{(M,c)}$ | -0.043 | 0.090 | -0.218 | -0.106 | -0.042 | 0.018 | 0.130 | 2035 | 1202 | 1.006 |
| $\varepsilon_{17}^{(M,c)}$ | 0.020 | 0.092 | -0.156 | -0.046 | 0.022 | 0.083 | 0.201 | 2936 | 1050 | 1.002 |
| $\varepsilon_{18}^{(M,c)}$ | 0.037 | 0.093 | -0.134 | -0.028 | 0.039 | 0.100 | 0.223 | 1889 | 1153 | 1.002 |
| $\varepsilon_{19}^{(M,c)}$ | 0.074 | 0.093 | -0.108 | 0.010 | 0.077 | 0.137 | 0.252 | 1841 | 1298 | 1.007 |
| $\varepsilon_{20}^{(M,c)}$ | 0.072 | 0.087 | -0.095 | 0.013 | 0.071 | 0.133 | 0.245 | 2026 | 1244 | 0.999 |
| $\varepsilon_{21}^{(M,c)}$ | 0.030 | 0.085 | -0.135 | -0.026 | 0.027 | 0.084 | 0.202 | 2081 | 1141 | 1.001 |
| $\varepsilon_{22}^{(M,c)}$ | 0.013 | 0.087 | -0.155 | -0.045 | 0.013 | 0.072 | 0.185 | 1956 | 1273 | 1.003 |
| $\varepsilon_{23}^{(M,c)}$ | -0.067 | 0.094 | -0.245 | -0.132 | -0.069 | -0.003 | 0.122 | 2150 | 1266 | 1.001 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{24}^{(M,c)}$ | -0.033 | 0.095 | -0.211 | -0.102 | -0.033 | 0.033 | 0.151 | 1974 | 1064 | 1.003 |
| $\varepsilon_{25}^{(M,c)}$ | -0.026 | 0.094 | -0.202 | -0.094 | -0.025 | 0.037 | 0.162 | 2003 | 1152 | 1.001 |
| $\varepsilon_{26}^{(M,c)}$ | -0.001 | 0.087 | -0.169 | -0.061 | 0.000 | 0.057 | 0.173 | 1696 | 1219 | 1.000 |
| $\varepsilon_{27}^{(M,c)}$ | 0.005 | 0.090 | -0.158 | -0.057 | 0.002 | 0.064 | 0.191 | 1738 | 1117 | 1.003 |
| $\varepsilon_{28}^{(M,c)}$ | -0.003 | 0.093 | -0.185 | -0.067 | -0.005 | 0.060 | 0.177 | 1791 | 1007 | 1.000 |
| $\varepsilon_{29}^{(M,c)}$ | -0.037 | 0.090 | -0.211 | -0.099 | -0.039 | 0.023 | 0.138 | 1561 | 1141 | 1.002 |
| $\varepsilon_{30}^{(M,c)}$ | 0.037 | 0.091 | -0.150 | -0.022 | 0.039 | 0.099 | 0.214 | 2212 | 860 | 1.002 |
| $\varepsilon_{31}^{(M,c)}$ | 0.075 | 0.094 | -0.109 | 0.013 | 0.075 | 0.139 | 0.254 | 1399 | 1102 | 1.002 |
| $\varepsilon_{32}^{(M,c)}$ | 0.042 | 0.094 | -0.147 | -0.020 | 0.043 | 0.104 | 0.224 | 1884 | 1125 | 1.001 |
| $\varepsilon_{33}^{(M,c)}$ | -0.003 | 0.096 | -0.191 | -0.064 | -0.003 | 0.060 | 0.184 | 1985 | 1039 | 1.002 |
| $\varepsilon_{34}^{(M,c)}$ | -0.090 | 0.094 | -0.273 | -0.156 | -0.090 | -0.022 | 0.088 | 2962 | 1133 | 1.000 |
| $\varepsilon_{35}^{(M,c)}$ | -0.073 | 0.096 | -0.263 | -0.143 | -0.069 | -0.006 | 0.113 | 1922 | 1093 | 1.003 |
| $\varepsilon_{36}^{(M,c)}$ | -0.048 | 0.095 | -0.235 | -0.115 | -0.047 | 0.018 | 0.136 | 2129 | 1232 | 1.000 |
| $\varepsilon_{37}^{(M,c)}$ | -0.056 | 0.099 | -0.251 | -0.126 | -0.056 | 0.010 | 0.137 | 2404 | 1143 | 1.000 |
| $\varepsilon_{38}^{(M,c)}$ | -0.131 | 0.092 | -0.306 | -0.195 | -0.131 | -0.069 | 0.049 | 1886 | 998 | 1.001 |
| $\varepsilon_{39}^{(M,c)}$ | -0.080 | 0.092 | -0.261 | -0.141 | -0.080 | -0.020 | 0.101 | 2027 | 1258 | 1.003 |
| $\varepsilon_{40}^{(M,c)}$ | -0.101 | 0.095 | -0.290 | -0.164 | -0.101 | -0.039 | 0.084 | 2150 | 1070 | 1.001 |
| $\varepsilon_{41}^{(M,c)}$ | -0.058 | 0.097 | -0.256 | -0.123 | -0.055 | 0.006 | 0.128 | 1808 | 915 | 1.000 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{42}^{(M,c)}$ | -0.046 | 0.099 | -0.237 | -0.114 | -0.044 | 0.019 | 0.143 | 1874 | 966 | 1.000 |
| $\varepsilon_{43}^{(M,c)}$ | -0.046 | 0.098 | -0.238 | -0.114 | -0.044 | 0.023 | 0.133 | 2215 | 1120 | 1.000 |
| $\varepsilon_{44}^{(M,c)}$ | -0.047 | 0.095 | -0.232 | -0.109 | -0.048 | 0.019 | 0.143 | 1840 | 1174 | 1.001 |
| $\varepsilon_{45}^{(M,c)}$ | -0.019 | 0.100 | -0.205 | -0.090 | -0.017 | 0.051 | 0.170 | 1884 | 961 | 0.999 |
| $\varepsilon_{46}^{(M,c)}$ | -0.001 | 0.095 | -0.195 | -0.066 | 0.000 | 0.065 | 0.182 | 2204 | 1285 | 1.000 |
| $\varepsilon_{47}^{(M,c)}$ | -0.021 | 0.094 | -0.203 | -0.083 | -0.019 | 0.040 | 0.164 | 1869 | 1009 | 1.003 |
| $\varepsilon_{48}^{(M,c)}$ | -0.013 | 0.096 | -0.202 | -0.079 | -0.013 | 0.056 | 0.170 | 2367 | 1150 | 1.001 |
| *Predator selectivity of herring* | | | | | | | | | | |
| $b^{50\%}$ | 7.986 | 0.162 | 7.664 | 7.884 | 7.991 | 8.090 | 8.309 | 430 | 570 | 1.001 |
| $\ln(b^{95\%}-b^{50\%})$ | 1.622 | 0.016 | 1.591 | 1.612 | 1.623 | 1.633 | 1.654 | 503 | 751 | 1.001 |
| $\ln k$ | 1.521 | 0.015 | 1.489 | 1.511 | 1.521 | 1.531 | 1.550 | 650 | 875 | 1.001 |
| $\ln\theta$ | 0.175 | 0.022 | 0.129 | 0.163 | 0.175 | 0.189 | 0.219 | 436 | 637 | 1.002 |
| *Herring recruitment* | | | | | | | | | | |
| $\ln\bar{R}_1$ | 6.219 | 0.027 | 6.171 | 6.201 | 6.217 | 6.236 | 6.274 | 581 | 929 | 1.004 |
| $\ln\bar{R}_2$ | 6.292 | 0.048 | 6.190 | 6.262 | 6.295 | 6.324 | 6.386 | 785 | 986 | 1.002 |
| $\ln\bar{R}_3$ | 5.012 | 0.052 | 4.908 | 4.978 | 5.012 | 5.049 | 5.115 | 730 | 1008 | 1.009 |
| $\ln\bar{R}_4$ | 6.177 | 0.054 | 6.069 | 6.142 | 6.179 | 6.214 | 6.278 | 773 | 969 | 1.001 |
| $\varepsilon_{3,1,9}^{(R)}$ | -0.134 | 0.190 | -0.551 | -0.248 | -0.114 | -0.004 | 0.190 | 743 | 881 | 1.000 |
| $\varepsilon_{3,2,9}^{(R)}$ | -0.691 | 0.337 | -1.341 | -0.924 | -0.697 | -0.465 | -0.015 | 845 | 771 | 1.006 |
| $\varepsilon_{3,3,9}^{(R)}$ | 0.465 | 0.313 | -0.151 | 0.262 | 0.460 | 0.672 | 1.072 | 955 | 1015 | 1.002 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{3,4,9}^{(R)}$ | 0.070 | 0.220 | -0.346 | -0.079 | 0.061 | 0.222 | 0.481 | 885 | 930 | 1.000 |
| $\varepsilon_{3,1,10}^{(R)}$ | 0.458 | 0.176 | 0.129 | 0.336 | 0.451 | 0.578 | 0.809 | 812 | 876 | 1.001 |
| $\varepsilon_{3,2,10}^{(R)}$ | 0.086 | 0.149 | -0.198 | -0.017 | 0.093 | 0.188 | 0.367 | 793 | 1077 | 1.001 |
| $\varepsilon_{3,3,10}^{(R)}$ | -0.481 | 0.170 | -0.802 | -0.596 | -0.481 | -0.365 | -0.158 | 1077 | 1119 | 1.001 |
| $\varepsilon_{3,4,10}^{(R)}$ | -0.348 | 0.210 | -0.751 | -0.487 | -0.358 | -0.202 | 0.078 | 1136 | 1119 | 1.002 |
| $\varepsilon_{3,1,11}^{(R)}$ | 0.581 | 0.217 | 0.162 | 0.429 | 0.580 | 0.738 | 0.995 | 1014 | 1147 | 1.000 |
| $\varepsilon_{3,2,11}^{(R)}$ | 0.493 | 0.191 | 0.108 | 0.360 | 0.491 | 0.619 | 0.880 | 843 | 914 | 1.001 |
| $\varepsilon_{3,3,11}^{(R)}$ | -0.518 | 0.152 | -0.807 | -0.625 | -0.517 | -0.413 | -0.226 | 851 | 1018 | 1.007 |
| $\varepsilon_{3,4,11}^{(R)}$ | 0.502 | 0.122 | 0.272 | 0.419 | 0.505 | 0.580 | 0.736 | 1037 | 840 | 1.001 |
| $\varepsilon_{3,1,12}^{(R)}$ | 0.335 | 0.094 | 0.147 | 0.272 | 0.334 | 0.398 | 0.515 | 1062 | 1123 | 1.000 |
| $\varepsilon_{3,2,12}^{(R)}$ | -0.559 | 0.131 | -0.820 | -0.646 | -0.558 | -0.468 | -0.300 | 800 | 786 | 1.004 |
| $\varepsilon_{3,3,12}^{(R)}$ | 1.023 | 0.115 | 0.803 | 0.948 | 1.020 | 1.097 | 1.260 | 865 | 1014 | 1.007 |
| $\varepsilon_{3,4,12}^{(R)}$ | -1.521 | 0.150 | -1.821 | -1.624 | -1.521 | -1.415 | -1.244 | 881 | 1089 | 1.001 |
| $\varepsilon_{3,1,13}^{(R)}$ | 0.646 | 0.173 | 0.316 | 0.526 | 0.644 | 0.757 | 0.997 | 832 | 1020 | 1.001 |
| $\varepsilon_{3,2,13}^{(R)}$ | -0.363 | 0.159 | -0.683 | -0.466 | -0.361 | -0.260 | -0.067 | 1042 | 989 | 1.001 |
| $\varepsilon_{3,3,13}^{(R)}$ | -0.030 | 0.153 | -0.335 | -0.133 | -0.027 | 0.075 | 0.266 | 1300 | 1239 | 1.003 |
| $\varepsilon_{3,4,13}^{(R)}$ | -0.237 | 0.152 | -0.530 | -0.342 | -0.239 | -0.135 | 0.065 | 1184 | 988 | 1.002 |
| $\varepsilon_{3,1,14}^{(R)}$ | -0.001 | 0.147 | -0.304 | -0.101 | 0.001 | 0.102 | 0.265 | 1183 | 1098 | 1.003 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon^{(R)}_{3,2,14}$ | -0.329 | 0.160 | -0.647 | -0.436 | -0.333 | -0.216 | -0.034 | 1022 | 1013 | 1.002 |
| $\varepsilon^{(R)}_{3,3,14}$ | 0.443 | 0.161 | 0.128 | 0.335 | 0.445 | 0.552 | 0.756 | 1045 | 971 | 1.002 |
| $\varepsilon^{(R)}_{3,4,14}$ | -1.391 | 0.152 | -1.694 | -1.488 | -1.388 | -1.288 | -1.099 | 1076 | 979 | 0.998 |
| $\varepsilon^{(R)}_{3,1,15}$ | 1.092 | 0.150 | 0.802 | 0.990 | 1.101 | 1.190 | 1.387 | 1084 | 1031 | 1.001 |
| $\varepsilon^{(R)}_{3,2,15}$ | -0.247 | 0.148 | -0.561 | -0.346 | -0.243 | -0.143 | 0.020 | 1086 | 928 | 1.001 |
| $\varepsilon^{(R)}_{3,3,15}$ | -0.300 | 0.153 | -0.612 | -0.404 | -0.298 | -0.202 | 0.000 | 955 | 854 | 1.000 |
| $\varepsilon^{(R)}_{3,4,15}$ | 0.139 | 0.145 | -0.136 | 0.037 | 0.137 | 0.238 | 0.434 | 1100 | 1115 | 1.003 |
| $\varepsilon^{(R)}_{3,1,16}$ | 0.083 | 0.141 | -0.194 | -0.016 | 0.080 | 0.177 | 0.363 | 1038 | 956 | 1.006 |
| $\varepsilon^{(R)}_{3,2,16}$ | 0.445 | 0.139 | 0.174 | 0.350 | 0.447 | 0.540 | 0.705 | 1009 | 935 | 1.004 |
| $\varepsilon^{(R)}_{3,3,16}$ | -0.381 | 0.141 | -0.662 | -0.479 | -0.378 | -0.282 | -0.117 | 1157 | 994 | 1.002 |
| $\varepsilon^{(R)}_{3,4,16}$ | 0.205 | 0.143 | -0.074 | 0.107 | 0.209 | 0.303 | 0.472 | 1147 | 1076 | 1.003 |
| $\varepsilon^{(R)}_{3,1,17}$ | -0.150 | 0.151 | -0.436 | -0.252 | -0.155 | -0.046 | 0.149 | 1206 | 1111 | 1.001 |
| $\varepsilon^{(R)}_{3,2,17}$ | -0.264 | 0.163 | -0.580 | -0.375 | -0.264 | -0.162 | 0.069 | 1344 | 1254 | 0.999 |
| $\varepsilon^{(R)}_{3,3,17}$ | 0.899 | 0.162 | 0.582 | 0.791 | 0.898 | 1.005 | 1.219 | 1612 | 1146 | 1.000 |
| $\varepsilon^{(R)}_{3,4,17}$ | -1.148 | 0.180 | -1.501 | -1.271 | -1.141 | -1.030 | -0.792 | 1689 | 1293 | 1.002 |
| $\varepsilon^{(R)}_{3,1,18}$ | 1.327 | 0.184 | 0.972 | 1.200 | 1.330 | 1.444 | 1.684 | 1465 | 1272 | 1.004 |
| $\varepsilon^{(R)}_{3,2,18}$ | -1.224 | 0.261 | -1.746 | -1.402 | -1.219 | -1.052 | -0.724 | 1905 | 1253 | 1.003 |
| $\varepsilon^{(R)}_{3,3,18}$ | -0.543 | 0.486 | -1.489 | -0.863 | -0.542 | -0.215 | 0.381 | 1467 | 1249 | 1.003 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{3,4,18}^{(R)}$ | -0.769 | 0.781 | -2.330 | -1.297 | -0.733 | -0.212 | 0.665 | 1977 | 1127 | 1.003 |
| $\varepsilon_{3,1,19}^{(R)}$ | -0.369 | 0.163 | -0.701 | -0.480 | -0.366 | -0.251 | -0.076 | 862 | 1182 | 1.003 |
| $\varepsilon_{3,2,19}^{(R)}$ | 0.100 | 0.197 | -0.266 | -0.035 | 0.090 | 0.232 | 0.514 | 939 | 1070 | 1.001 |
| $\varepsilon_{3,3,19}^{(R)}$ | -0.272 | 0.193 | -0.664 | -0.401 | -0.271 | -0.142 | 0.095 | 1108 | 1172 | 1.000 |
| $\varepsilon_{3,4,19}^{(R)}$ | 0.154 | 0.181 | -0.182 | 0.033 | 0.150 | 0.274 | 0.515 | 1096 | 1144 | 1.001 |
| $\varepsilon_{3,1,20}^{(R)}$ | 0.049 | 0.187 | -0.315 | -0.077 | 0.047 | 0.174 | 0.414 | 914 | 1038 | 0.999 |
| $\varepsilon_{3,2,20}^{(R)}$ | 0.016 | 0.200 | -0.373 | -0.120 | 0.010 | 0.152 | 0.416 | 1177 | 1117 | 1.000 |
| $\varepsilon_{3,3,20}^{(R)}$ | 0.360 | 0.190 | -0.003 | 0.230 | 0.362 | 0.488 | 0.720 | 897 | 934 | 1.000 |
| $\varepsilon_{3,4,20}^{(R)}$ | 0.359 | 0.175 | 0.017 | 0.238 | 0.357 | 0.476 | 0.701 | 814 | 1163 | 1.000 |
| $\varepsilon_{3,1,21}^{(R)}$ | 0.141 | 0.151 | -0.144 | 0.041 | 0.138 | 0.238 | 0.442 | 1003 | 1032 | 0.999 |
| $\varepsilon_{3,2,21}^{(R)}$ | -0.327 | 0.159 | -0.635 | -0.434 | -0.322 | -0.218 | -0.013 | 1070 | 946 | 1.001 |
| $\varepsilon_{3,3,21}^{(R)}$ | 0.153 | 0.154 | -0.145 | 0.045 | 0.151 | 0.257 | 0.458 | 1002 | 1058 | 1.001 |
| $\varepsilon_{3,4,21}^{(R)}$ | -0.131 | 0.132 | -0.388 | -0.221 | -0.132 | -0.043 | 0.123 | 1274 | 1061 | 0.999 |
| $\varepsilon_{3,1,22}^{(R)}$ | 0.055 | 0.166 | -0.287 | -0.053 | 0.060 | 0.165 | 0.377 | 1017 | 1035 | 1.001 |
| $\varepsilon_{3,2,22}^{(R)}$ | -0.003 | 0.191 | -0.381 | -0.128 | -0.008 | 0.121 | 0.386 | 747 | 1097 | 1.000 |
| $\varepsilon_{3,3,22}^{(R)}$ | -0.371 | 0.197 | -0.744 | -0.506 | -0.372 | -0.238 | 0.011 | 911 | 739 | 1.001 |
| $\varepsilon_{3,4,22}^{(R)}$ | 0.403 | 0.193 | 0.031 | 0.278 | 0.393 | 0.534 | 0.783 | 976 | 994 | 1.000 |
| $\varepsilon_{3,1,23}^{(R)}$ | -0.170 | 0.179 | -0.516 | -0.291 | -0.168 | -0.049 | 0.188 | 930 | 847 | 1.002 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{3,2,23}^{(R)}$ | -0.057 | 0.183 | -0.397 | -0.185 | -0.061 | 0.061 | 0.293 | 989 | 1278 | 1.001 |
| $\varepsilon_{3,3,23}^{(R)}$ | 0.519 | 0.166 | 0.190 | 0.404 | 0.518 | 0.627 | 0.853 | 1222 | 1246 | 1.000 |
| $\varepsilon_{3,4,23}^{(R)}$ | -0.143 | 0.154 | -0.456 | -0.243 | -0.143 | -0.039 | 0.153 | 1185 | 1083 | 1.001 |
| $\varepsilon_{3,1,24}^{(R)}$ | -0.007 | 0.155 | -0.327 | -0.106 | -0.003 | 0.098 | 0.287 | 992 | 872 | 1.002 |
| $\varepsilon_{3,2,24}^{(R)}$ | -0.180 | 0.161 | -0.489 | -0.289 | -0.182 | -0.078 | 0.153 | 838 | 1199 | 1.001 |
| $\varepsilon_{3,3,24}^{(R)}$ | -0.366 | 0.184 | -0.737 | -0.483 | -0.363 | -0.235 | -0.031 | 1176 | 1269 | 1.001 |
| $\varepsilon_{3,4,24}^{(R)}$ | 0.538 | 0.172 | 0.181 | 0.428 | 0.545 | 0.655 | 0.861 | 1108 | 995 | 1.002 |
| $\varepsilon_{3,1,25}^{(R)}$ | 0.130 | 0.143 | -0.151 | 0.037 | 0.128 | 0.225 | 0.412 | 1015 | 985 | 1.003 |
| $\varepsilon_{3,2,25}^{(R)}$ | 0.080 | 0.143 | -0.203 | -0.010 | 0.080 | 0.169 | 0.361 | 908 | 962 | 1.000 |
| $\varepsilon_{3,3,25}^{(R)}$ | -0.165 | 0.158 | -0.477 | -0.268 | -0.166 | -0.060 | 0.134 | 881 | 781 | 1.000 |
| $\varepsilon_{3,4,25}^{(R)}$ | 0.037 | 0.163 | -0.279 | -0.074 | 0.038 | 0.148 | 0.361 | 926 | 1140 | 1.000 |
| $\varepsilon_{3,1,26}^{(R)}$ | 0.272 | 0.148 | -0.020 | 0.169 | 0.275 | 0.372 | 0.574 | 1104 | 912 | 1.004 |
| $\varepsilon_{3,2,26}^{(R)}$ | -0.161 | 0.139 | -0.446 | -0.253 | -0.160 | -0.067 | 0.111 | 855 | 1008 | 1.001 |
| $\varepsilon_{3,3,26}^{(R)}$ | 0.119 | 0.154 | -0.209 | 0.017 | 0.128 | 0.222 | 0.404 | 737 | 1012 | 1.003 |
| $\varepsilon_{3,4,26}^{(R)}$ | 0.326 | 0.152 | 0.039 | 0.229 | 0.323 | 0.427 | 0.640 | 824 | 707 | 0.999 |
| $\varepsilon_{3,1,27}^{(R)}$ | -0.286 | 0.149 | -0.586 | -0.385 | -0.288 | -0.184 | 0.002 | 783 | 830 | 1.004 |
| $\varepsilon_{3,2,27}^{(R)}$ | -0.255 | 0.182 | -0.611 | -0.376 | -0.257 | -0.135 | 0.098 | 777 | 982 | 1.002 |
| $\varepsilon_{3,3,27}^{(R)}$ | -0.043 | 0.225 | -0.477 | -0.199 | -0.039 | 0.100 | 0.413 | 785 | 911 | 1.003 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{3,4,27}^{(R)}$ | 0.504 | 0.217 | 0.079 | 0.363 | 0.505 | 0.652 | 0.923 | 835 | 884 | 1.001 |
| $\varepsilon_{3,1,28}^{(R)}$ | -1.168 | 0.294 | -1.730 | -1.374 | -1.172 | -0.953 | -0.591 | 1495 | 1288 | 1.002 |
| $\varepsilon_{3,2,28}^{(R)}$ | -1.273 | 0.502 | -2.313 | -1.603 | -1.257 | -0.923 | -0.332 | 1630 | 1248 | 1.003 |
| $\varepsilon_{3,3,28}^{(R)}$ | -3.092 | 0.754 | -4.571 | -3.593 | -3.093 | -2.561 | -1.623 | 2363 | 1213 | 1.000 |
| $\varepsilon_{3,4,28}^{(R)}$ | -0.027 | 1.011 | -1.889 | -0.727 | -0.034 | 0.653 | 1.937 | 2201 | 1092 | 1.007 |
| $\varepsilon_{3,1,29}^{(R)}$ | -0.220 | 0.183 | -0.577 | -0.343 | -0.217 | -0.103 | 0.155 | 990 | 990 | 1.006 |
| $\varepsilon_{3,2,29}^{(R)}$ | -0.329 | 0.277 | -0.848 | -0.516 | -0.336 | -0.136 | 0.214 | 1208 | 1065 | 1.001 |
| $\varepsilon_{3,3,29}^{(R)}$ | 0.279 | 0.260 | -0.240 | 0.100 | 0.282 | 0.451 | 0.796 | 1095 | 931 | 1.002 |
| $\varepsilon_{3,4,29}^{(R)}$ | 0.321 | 0.220 | -0.126 | 0.177 | 0.323 | 0.468 | 0.758 | 946 | 1080 | 1.000 |
| $\varepsilon_{3,1,30}^{(R)}$ | -0.540 | 0.217 | -0.945 | -0.682 | -0.545 | -0.395 | -0.106 | 1041 | 1055 | 1.006 |
| $\varepsilon_{3,2,30}^{(R)}$ | -0.037 | 0.207 | -0.440 | -0.185 | -0.031 | 0.110 | 0.355 | 1249 | 1084 | 0.999 |
| $\varepsilon_{3,3,30}^{(R)}$ | 0.046 | 0.182 | -0.313 | -0.072 | 0.043 | 0.161 | 0.419 | 1741 | 1254 | 1.003 |
| $\varepsilon_{3,4,30}^{(R)}$ | -0.044 | 0.173 | -0.384 | -0.166 | -0.038 | 0.073 | 0.286 | 1424 | 1058 | 0.999 |
| $\varepsilon_{3,1,31}^{(R)}$ | -0.121 | 0.204 | -0.528 | -0.262 | -0.119 | 0.009 | 0.263 | 1134 | 1107 | 1.000 |
| $\varepsilon_{3,2,31}^{(R)}$ | 0.640 | 0.216 | 0.219 | 0.495 | 0.635 | 0.780 | 1.078 | 1154 | 1092 | 1.002 |
| $\varepsilon_{3,3,31}^{(R)}$ | 0.782 | 0.193 | 0.393 | 0.661 | 0.783 | 0.908 | 1.162 | 1108 | 934 | 0.999 |
| $\varepsilon_{3,4,31}^{(R)}$ | -0.271 | 0.162 | -0.589 | -0.381 | -0.268 | -0.154 | 0.028 | 1325 | 1173 | 1.003 |
| $\varepsilon_{3,1,32}^{(R)}$ | -0.930 | 0.192 | -1.315 | -1.057 | -0.929 | -0.805 | -0.542 | 1274 | 1173 | 1.000 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{3,2,32}^{(R)}$ | 1.598 | 0.198 | 1.214 | 1.465 | 1.594 | 1.731 | 1.980 | 1240 | 1067 | 1.002 |
| $\varepsilon_{3,3,32}^{(R)}$ | -1.486 | 0.228 | -1.942 | -1.637 | -1.489 | -1.340 | -1.031 | 1255 | 1054 | 1.001 |
| $\varepsilon_{3,4,32}^{(R)}$ | 1.065 | 0.240 | 0.592 | 0.902 | 1.066 | 1.227 | 1.527 | 1220 | 938 | 1.002 |
| $\varepsilon_{3,1,33}^{(R)}$ | -0.601 | 0.204 | -0.997 | -0.746 | -0.594 | -0.459 | -0.200 | 1416 | 1067 | 1.003 |
| $\varepsilon_{3,2,33}^{(R)}$ | 0.786 | 0.198 | 0.400 | 0.657 | 0.783 | 0.919 | 1.175 | 1310 | 975 | 1.000 |
| $\varepsilon_{3,3,33}^{(R)}$ | 0.454 | 0.186 | 0.067 | 0.330 | 0.458 | 0.588 | 0.797 | 892 | 1098 | 1.002 |
| $\varepsilon_{3,4,33}^{(R)}$ | -0.337 | 0.174 | -0.659 | -0.458 | -0.340 | -0.218 | 0.006 | 876 | 1096 | 1.001 |
| $\varepsilon_{3,1,34}^{(R)}$ | -0.269 | 0.178 | -0.614 | -0.380 | -0.271 | -0.153 | 0.078 | 1000 | 1189 | 0.999 |
| $\varepsilon_{3,2,34}^{(R)}$ | 0.283 | 0.185 | -0.061 | 0.155 | 0.281 | 0.401 | 0.664 | 651 | 997 | 1.003 |
| $\varepsilon_{3,3,34}^{(R)}$ | 0.425 | 0.201 | 0.031 | 0.294 | 0.425 | 0.555 | 0.821 | 606 | 904 | 1.005 |
| $\varepsilon_{3,4,34}^{(R)}$ | 0.227 | 0.196 | -0.149 | 0.085 | 0.229 | 0.360 | 0.606 | 509 | 699 | 1.004 |
| $\varepsilon_{3,1,35}^{(R)}$ | -0.202 | 0.188 | -0.576 | -0.327 | -0.205 | -0.073 | 0.173 | 521 | 896 | 1.000 |
| $\varepsilon_{3,2,35}^{(R)}$ | -0.206 | 0.184 | -0.574 | -0.328 | -0.206 | -0.081 | 0.147 | 665 | 847 | 1.001 |
| $\varepsilon_{3,3,35}^{(R)}$ | -0.233 | 0.194 | -0.613 | -0.364 | -0.231 | -0.102 | 0.144 | 880 | 999 | 1.003 |
| $\varepsilon_{3,4,35}^{(R)}$ | 0.613 | 0.174 | 0.267 | 0.498 | 0.614 | 0.730 | 0.959 | 897 | 888 | 1.005 |
| $\varepsilon_{3,1,36}^{(R)}$ | 0.185 | 0.135 | -0.085 | 0.099 | 0.190 | 0.270 | 0.448 | 1069 | 1076 | 0.999 |
| $\varepsilon_{3,2,36}^{(R)}$ | -0.233 | 0.142 | -0.503 | -0.331 | -0.234 | -0.139 | 0.044 | 805 | 1016 | 1.000 |
| $\varepsilon_{3,3,36}^{(R)}$ | -0.021 | 0.162 | -0.357 | -0.124 | -0.018 | 0.089 | 0.285 | 1044 | 1044 | 1.001 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon^{(R)}_{3,4,36}$ | -0.321 | 0.184 | -0.708 | -0.439 | -0.316 | -0.197 | 0.046 | 835 | 1052 | 1.007 |
| $\varepsilon^{(R)}_{3,1,37}$ | 0.463 | 0.182 | 0.119 | 0.345 | 0.458 | 0.581 | 0.833 | 765 | 837 | 1.007 |
| $\varepsilon^{(R)}_{3,2,37}$ | 0.105 | 0.155 | -0.206 | 0.003 | 0.107 | 0.207 | 0.407 | 750 | 885 | 1.003 |
| $\varepsilon^{(R)}_{3,3,37}$ | -0.393 | 0.210 | -0.834 | -0.528 | -0.384 | -0.253 | 0.013 | 831 | 1032 | 1.003 |
| $\varepsilon^{(R)}_{3,4,37}$ | 0.016 | 0.271 | -0.513 | -0.171 | 0.021 | 0.192 | 0.555 | 786 | 953 | 1.002 |
| $\varepsilon^{(R)}_{3,1,38}$ | 0.157 | 0.320 | -0.487 | -0.055 | 0.173 | 0.377 | 0.759 | 815 | 740 | 1.001 |
| $\varepsilon^{(R)}_{3,2,38}$ | 0.917 | 0.255 | 0.478 | 0.737 | 0.900 | 1.072 | 1.481 | 1025 | 778 | 1.001 |
| $\varepsilon^{(R)}_{3,3,38}$ | 0.026 | 0.098 | -0.174 | -0.035 | 0.027 | 0.092 | 0.209 | 1217 | 968 | 1.000 |
| $\varepsilon^{(R)}_{3,4,38}$ | -0.076 | 0.115 | -0.302 | -0.152 | -0.072 | 0.002 | 0.137 | 1672 | 1053 | 1.002 |
| $\varepsilon^{(R)}_{3,1,39}$ | -0.293 | 0.178 | -0.653 | -0.410 | -0.284 | -0.172 | 0.037 | 681 | 1186 | 1.001 |
| $\varepsilon^{(R)}_{3,2,39}$ | 0.177 | 0.212 | -0.241 | 0.034 | 0.173 | 0.315 | 0.603 | 805 | 935 | 1.002 |
| $\varepsilon^{(R)}_{3,3,39}$ | -0.035 | 0.186 | -0.399 | -0.158 | -0.043 | 0.082 | 0.350 | 869 | 1000 | 1.002 |
| $\varepsilon^{(R)}_{3,4,39}$ | 0.017 | 0.169 | -0.321 | -0.094 | 0.012 | 0.129 | 0.352 | 812 | 1055 | 0.999 |
| $\varepsilon^{(R)}_{3,1,40}$ | -0.005 | 0.175 | -0.346 | -0.120 | -0.021 | 0.116 | 0.321 | 815 | 819 | 1.000 |
| $\varepsilon^{(R)}_{3,2,40}$ | 0.319 | 0.165 | 0.002 | 0.210 | 0.319 | 0.423 | 0.650 | 830 | 974 | 1.001 |
| $\varepsilon^{(R)}_{3,3,40}$ | 0.256 | 0.131 | 0.007 | 0.170 | 0.252 | 0.341 | 0.519 | 791 | 860 | 1.001 |
| $\varepsilon^{(R)}_{3,4,40}$ | -0.097 | 0.116 | -0.319 | -0.178 | -0.096 | -0.022 | 0.132 | 751 | 1071 | 1.001 |
| $\varepsilon^{(R)}_{3,1,41}$ | -0.399 | 0.142 | -0.695 | -0.491 | -0.390 | -0.303 | -0.136 | 1063 | 974 | 0.999 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{3,2,41}^{(R)}$ | -0.461 | 0.188 | -0.833 | -0.584 | -0.460 | -0.331 | -0.106 | 967 | 937 | 1.004 |
| $\varepsilon_{3,3,41}^{(R)}$ | 0.414 | 0.178 | 0.081 | 0.291 | 0.411 | 0.539 | 0.773 | 952 | 1175 | 1.000 |
| $\varepsilon_{3,4,41}^{(R)}$ | 0.005 | 0.157 | -0.286 | -0.103 | 0.002 | 0.108 | 0.305 | 1226 | 1075 | 1.000 |
| $\varepsilon_{3,1,42}^{(R)}$ | -0.215 | 0.217 | -0.651 | -0.355 | -0.218 | -0.066 | 0.193 | 918 | 998 | 1.003 |
| $\varepsilon_{3,2,42}^{(R)}$ | 0.955 | 0.220 | 0.539 | 0.801 | 0.953 | 1.103 | 1.383 | 776 | 1091 | 1.003 |
| $\varepsilon_{3,3,42}^{(R)}$ | -1.189 | 0.230 | -1.633 | -1.343 | -1.191 | -1.033 | -0.735 | 854 | 889 | 1.002 |
| $\varepsilon_{3,4,42}^{(R)}$ | 1.472 | 0.209 | 1.066 | 1.327 | 1.479 | 1.612 | 1.881 | 901 | 1016 | 0.999 |
| $\varepsilon_{3,1,43}^{(R)}$ | -0.022 | 0.078 | -0.174 | -0.074 | -0.021 | 0.032 | 0.124 | 925 | 1053 | 1.000 |
| $\varepsilon_{3,2,43}^{(R)}$ | 0.108 | 0.076 | -0.039 | 0.060 | 0.106 | 0.157 | 0.256 | 931 | 815 | 1.002 |
| $\varepsilon_{3,3,43}^{(R)}$ | -0.172 | 0.088 | -0.347 | -0.230 | -0.173 | -0.111 | -0.006 | 838 | 893 | 1.003 |
| $\varepsilon_{3,4,43}^{(R)}$ | 0.184 | 0.086 | 0.014 | 0.126 | 0.183 | 0.236 | 0.357 | 802 | 845 | 1.001 |
| $\varepsilon_{3,1,44}^{(R)}$ | 0.074 | 0.071 | -0.067 | 0.027 | 0.074 | 0.124 | 0.210 | 960 | 1048 | 1.000 |
| $\varepsilon_{3,2,44}^{(R)}$ | 0.083 | 0.069 | -0.057 | 0.035 | 0.083 | 0.131 | 0.213 | 701 | 1010 | 1.006 |
| $\varepsilon_{3,3,44}^{(R)}$ | -0.046 | 0.078 | -0.200 | -0.098 | -0.046 | 0.007 | 0.101 | 573 | 746 | 1.006 |
| $\varepsilon_{3,4,44}^{(R)}$ | -0.133 | 0.093 | -0.306 | -0.196 | -0.135 | -0.068 | 0.042 | 526 | 726 | 1.004 |
| $\varepsilon_{3,1,45}^{(R)}$ | -0.033 | 0.102 | -0.231 | -0.100 | -0.032 | 0.034 | 0.171 | 604 | 720 | 1.003 |
| $\varepsilon_{3,2,45}^{(R)}$ | 0.109 | 0.095 | -0.079 | 0.045 | 0.112 | 0.169 | 0.303 | 754 | 1073 | 1.000 |
| $\varepsilon_{3,3,45}^{(R)}$ | 0.224 | 0.085 | 0.063 | 0.168 | 0.220 | 0.278 | 0.392 | 806 | 734 | 1.000 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{3,4,45}^{(R)}$ | -0.044 | 0.083 | -0.212 | -0.100 | -0.042 | 0.013 | 0.123 | 748 | 970 | 1.002 |
| $\varepsilon_{3,1,46}^{(R)}$ | -0.354 | 0.108 | -0.560 | -0.427 | -0.354 | -0.281 | -0.146 | 799 | 991 | 1.003 |
| $\varepsilon_{3,2,46}^{(R)}$ | -0.033 | 0.133 | -0.279 | -0.118 | -0.034 | 0.053 | 0.242 | 726 | 913 | 1.012 |
| $\varepsilon_{3,3,46}^{(R)}$ | 0.022 | 0.147 | -0.273 | -0.071 | 0.023 | 0.117 | 0.306 | 904 | 786 | 1.005 |
| $\varepsilon_{3,4,46}^{(R)}$ | -0.496 | 0.208 | -0.922 | -0.624 | -0.488 | -0.363 | -0.105 | 730 | 902 | 1.005 |
| $\varepsilon_{3,1,47}^{(R)}$ | -0.077 | 0.219 | -0.510 | -0.224 | -0.078 | 0.066 | 0.363 | 736 | 821 | 1.005 |
| $\varepsilon_{3,2,47}^{(R)}$ | -0.208 | 0.208 | -0.623 | -0.351 | -0.207 | -0.075 | 0.208 | 943 | 1055 | 1.000 |
| $\varepsilon_{3,3,47}^{(R)}$ | -0.140 | 0.255 | -0.645 | -0.318 | -0.134 | 0.040 | 0.304 | 865 | 1123 | 1.000 |
| $\varepsilon_{3,4,47}^{(R)}$ | -0.183 | 0.316 | -0.781 | -0.396 | -0.188 | 0.037 | 0.437 | 999 | 939 | 1.001 |
| $\varepsilon_{3,1,48}^{(R)}$ | 0.509 | 0.368 | -0.231 | 0.264 | 0.526 | 0.763 | 1.194 | 1335 | 1094 | 1.001 |
| $\varepsilon_{3,2,48}^{(R)}$ | -2.289 | 0.424 | -3.120 | -2.584 | -2.290 | -1.999 | -1.473 | 2030 | 1257 | 1.000 |
| $\varepsilon_{3,3,48}^{(R)}$ | -0.328 | 0.880 | -2.038 | -0.928 | -0.314 | 0.260 | 1.403 | 1834 | 1220 | 1.001 |
| $\varepsilon_{3,4,48}^{(R)}$ | -0.308 | 0.882 | -2.103 | -0.897 | -0.294 | 0.300 | 1.407 | 1694 | 1162 | 1.000 |
| *Herring catchability* | | | | | | | | | | |
| $\ln q_{2,3,1,1:20}$ | -4.922 | 0.129 | -5.166 | -5.010 | -4.922 | -4.836 | -4.686 | 699 | 983 | 1.002 |
| $\ln q_{3,3,1,1:48}$ | -7.813 | 0.049 | -7.910 | -7.847 | -7.812 | -7.780 | -7.720 | 794 | 931 | 1.004 |
| $\ln q_{4,3,2:4,1:48}$ | -3.164 | 0.194 | -3.537 | -3.292 | -3.167 | -3.037 | -2.788 | 624 | 753 | 1.000 |
| $\ln q_{5,3,2:4,1:48}$ | -3.333 | 0.152 | -3.622 | -3.436 | -3.340 | -3.233 | -3.020 | 765 | 857 | 1.003 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\ln q_{2,3,2,1:20}$ | -3.378 | 0.132 | -3.635 | -3.471 | -3.380 | -3.290 | -3.117 | 723 | 923 | 1.000 |
| $\ln q_{2,3,3,1:20}$ | 0.029 | 0.049 | -0.066 | -0.003 | 0.029 | 0.062 | 0.125 | 3130 | 1054 | 1.002 |
| $\ln q_{2,3,4,1:20}$ | 0.024 | 0.046 | -0.065 | -0.007 | 0.024 | 0.054 | 0.113 | 1980 | 1276 | 1.002 |
| $\ln q_{6,3,1:4,1:48}$ | -0.027 | 0.045 | -0.114 | -0.058 | -0.027 | 0.005 | 0.062 | 2440 | 1194 | 1.002 |
| $\varepsilon^{(q)}_{1,21}$ | -0.018 | 0.045 | -0.111 | -0.049 | -0.018 | 0.013 | 0.067 | 2556 | 1056 | 1.002 |
| $\varepsilon^{(q)}_{1,22}$ | 0.000 | 0.043 | -0.084 | -0.029 | 0.001 | 0.029 | 0.083 | 2563 | 926 | 1.001 |
| $\varepsilon^{(q)}_{1,23}$ | 0.043 | 0.044 | -0.044 | 0.013 | 0.043 | 0.072 | 0.128 | 2254 | 1181 | 1.000 |
| $\varepsilon^{(q)}_{1,24}$ | 0.045 | 0.046 | -0.047 | 0.013 | 0.045 | 0.078 | 0.134 | 2196 | 1058 | 0.999 |
| $\varepsilon^{(q)}_{1,25}$ | 0.061 | 0.045 | -0.027 | 0.031 | 0.061 | 0.094 | 0.149 | 2077 | 1072 | 1.000 |
| $\varepsilon^{(q)}_{1,26}$ | 0.090 | 0.043 | 0.003 | 0.061 | 0.089 | 0.122 | 0.173 | 1960 | 1065 | 1.000 |
| $\varepsilon^{(q)}_{1,27}$ | 0.155 | 0.046 | 0.065 | 0.125 | 0.155 | 0.186 | 0.245 | 1798 | 1083 | 0.999 |
| $\varepsilon^{(q)}_{1,28}$ | 0.148 | 0.045 | 0.058 | 0.120 | 0.148 | 0.178 | 0.235 | 2613 | 1107 | 1.002 |
| $\varepsilon^{(q)}_{1,29}$ | 0.125 | 0.045 | 0.042 | 0.094 | 0.123 | 0.155 | 0.215 | 2486 | 741 | 1.001 |
| $\varepsilon^{(q)}_{1,30}$ | 0.100 | 0.047 | 0.005 | 0.069 | 0.100 | 0.133 | 0.187 | 2225 | 1073 | 1.001 |
| $\varepsilon^{(q)}_{1,31}$ | 0.051 | 0.045 | -0.038 | 0.020 | 0.051 | 0.080 | 0.139 | 2945 | 1038 | 1.002 |
| $\varepsilon^{(q)}_{1,32}$ | 0.037 | 0.049 | -0.053 | 0.001 | 0.037 | 0.070 | 0.130 | 2643 | 1143 | 1.004 |
| $\varepsilon^{(q)}_{1,33}$ | 0.012 | 0.045 | -0.077 | -0.020 | 0.012 | 0.042 | 0.100 | 2375 | 957 | 1.007 |
| $\varepsilon^{(q)}_{1,34}$ | -0.006 | 0.045 | -0.091 | -0.038 | -0.006 | 0.026 | 0.081 | 2402 | 1113 | 1.007 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{1,35}^{(q)}$ | -0.018 | 0.044 | -0.102 | -0.049 | -0.018 | 0.012 | 0.066 | 1775 | 1108 | 1.000 |
| $\varepsilon_{1,36}^{(q)}$ | -0.039 | 0.044 | -0.123 | -0.069 | -0.038 | -0.010 | 0.051 | 2709 | 1089 | 1.008 |
| $\varepsilon_{1,37}^{(q)}$ | -0.155 | 0.045 | -0.242 | -0.184 | -0.154 | -0.125 | -0.070 | 2110 | 1145 | 1.003 |
| $\varepsilon_{1,38}^{(q)}$ | -0.061 | 0.045 | -0.149 | -0.092 | -0.062 | -0.030 | 0.026 | 2187 | 1052 | 1.004 |
| $\varepsilon_{1,39}^{(q)}$ | -0.010 | 0.046 | -0.101 | -0.040 | -0.011 | 0.021 | 0.082 | 2253 | 1001 | 1.004 |
| $\varepsilon_{1,40}^{(q)}$ | 0.053 | 0.048 | -0.042 | 0.021 | 0.052 | 0.084 | 0.147 | 2134 | 1069 | 1.002 |
| $\varepsilon_{1,41}^{(q)}$ | -0.030 | 0.045 | -0.118 | -0.061 | -0.031 | 0.000 | 0.058 | 2492 | 1067 | 1.003 |
| $\varepsilon_{1,42}^{(q)}$ | -0.064 | 0.044 | -0.152 | -0.091 | -0.064 | -0.035 | 0.026 | 2288 | 1155 | 1.001 |
| $\varepsilon_{1,43}^{(q)}$ | -0.051 | 0.044 | -0.137 | -0.082 | -0.052 | -0.022 | 0.035 | 2088 | 941 | 1.001 |
| $\varepsilon_{1,44}^{(q)}$ | 0.011 | 0.045 | -0.075 | -0.020 | 0.011 | 0.041 | 0.102 | 2124 | 930 | 1.003 |
| $\varepsilon_{1,45}^{(q)}$ | -0.064 | 0.049 | -0.159 | -0.098 | -0.064 | -0.030 | 0.031 | 2342 | 929 | 1.000 |
| $\varepsilon_{1,46}^{(q)}$ | -0.005 | 0.049 | -0.100 | -0.036 | -0.005 | 0.027 | 0.089 | 2129 | 952 | 1.001 |
| $\varepsilon_{1,47}^{(q)}$ | -0.028 | 0.049 | -0.125 | -0.061 | -0.029 | 0.006 | 0.072 | 2199 | 913 | 1.000 |
| $\varepsilon_{1,48}^{(q)}$ | 0.019 | 0.046 | -0.071 | -0.013 | 0.020 | 0.051 | 0.107 | 2619 | 1191 | 1.008 |
| $\varepsilon_{2,17}^{(q)}$ | -0.081 | 0.044 | -0.164 | -0.111 | -0.081 | -0.052 | 0.008 | 1771 | 1134 | 1.000 |
| $\varepsilon_{2,18}^{(q)}$ | 0.046 | 0.043 | -0.036 | 0.016 | 0.046 | 0.075 | 0.130 | 2599 | 1253 | 1.002 |
| $\varepsilon_{2,19}^{(q)}$ | 0.004 | 0.046 | -0.083 | -0.027 | 0.003 | 0.035 | 0.091 | 1551 | 1038 | 1.005 |
| $\varepsilon_{2,20}^{(q)}$ | -0.014 | 0.044 | -0.095 | -0.043 | -0.014 | 0.014 | 0.076 | 1630 | 1094 | 1.001 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{1,21}^{(q)}$ | 0.029 | 0.045 | -0.062 | 0.000 | 0.028 | 0.058 | 0.119 | 2448 | 886 | 1.000 |
| $\varepsilon_{1,22}^{(q)}$ | 0.070 | 0.049 | -0.027 | 0.038 | 0.071 | 0.104 | 0.162 | 1998 | 922 | 1.000 |
| $\varepsilon_{1,23}^{(q)}$ | 0.066 | 0.047 | -0.024 | 0.033 | 0.065 | 0.098 | 0.161 | 2325 | 1217 | 1.001 |
| $\varepsilon_{1,24}^{(q)}$ | 0.060 | 0.047 | -0.029 | 0.028 | 0.059 | 0.091 | 0.155 | 3867 | 1143 | 1.000 |
| $\varepsilon_{1,25}^{(q)}$ | -0.004 | 0.044 | -0.091 | -0.032 | -0.005 | 0.024 | 0.083 | 2866 | 1179 | 1.005 |
| $\varepsilon_{1,26}^{(q)}$ | 0.031 | 0.045 | -0.056 | 0.001 | 0.030 | 0.060 | 0.122 | 2271 | 1055 | 1.002 |
| $\varepsilon_{1,27}^{(q)}$ | 0.046 | 0.046 | -0.049 | 0.018 | 0.045 | 0.075 | 0.138 | 2743 | 1071 | 1.007 |
| $\varepsilon_{1,28}^{(q)}$ | -0.035 | 0.047 | -0.128 | -0.065 | -0.036 | -0.004 | 0.059 | 2034 | 1211 | 1.007 |
| $\varepsilon_{1,29}^{(q)}$ | 0.006 | 0.044 | -0.079 | -0.024 | 0.006 | 0.037 | 0.091 | 2414 | 1219 | 1.003 |
| $\varepsilon_{1,30}^{(q)}$ | 0.037 | 0.045 | -0.049 | 0.007 | 0.037 | 0.068 | 0.127 | 2535 | 1156 | 0.999 |
| $\varepsilon_{1,31}^{(q)}$ | 0.026 | 0.049 | -0.068 | -0.008 | 0.027 | 0.060 | 0.124 | 2321 | 1179 | 1.001 |
| $\varepsilon_{1,32}^{(q)}$ | 0.072 | 0.049 | -0.022 | 0.038 | 0.071 | 0.108 | 0.166 | 1880 | 1051 | 1.004 |
| $\varepsilon_{1,33}^{(q)}$ | -0.096 | 0.048 | -0.195 | -0.129 | -0.094 | -0.064 | -0.005 | 2261 | 1086 | 1.000 |
| $\varepsilon_{1,34}^{(q)}$ | 0.016 | 0.051 | -0.081 | -0.018 | 0.016 | 0.049 | 0.117 | 2342 | 1146 | 1.002 |
| $\varepsilon_{1,35}^{(q)}$ | -0.080 | 0.049 | -0.176 | -0.112 | -0.080 | -0.049 | 0.020 | 2375 | 839 | 1.002 |
| $\varepsilon_{1,36}^{(q)}$ | 0.000 | 0.047 | -0.095 | -0.031 | -0.001 | 0.030 | 0.094 | 2020 | 1003 | 1.004 |
| $\varepsilon_{1,37}^{(q)}$ | -0.031 | 0.046 | -0.120 | -0.064 | -0.031 | 0.000 | 0.059 | 2563 | 1237 | 1.003 |
| $\varepsilon_{1,38}^{(q)}$ | -0.046 | 0.049 | -0.136 | -0.080 | -0.046 | -0.012 | 0.050 | 2756 | 1148 | 1.004 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{1,39}^{(q)}$ | 0.014 | 0.046 | -0.075 | -0.017 | 0.013 | 0.045 | 0.102 | 3404 | 1086 | 1.005 |
| $\varepsilon_{1,40}^{(q)}$ | 0.036 | 0.045 | -0.057 | 0.006 | 0.036 | 0.067 | 0.130 | 2176 | 895 | 1.001 |
| $\varepsilon_{1,41}^{(q)}$ | 0.067 | 0.048 | -0.024 | 0.034 | 0.067 | 0.102 | 0.159 | 2756 | 972 | 1.005 |
| $\varepsilon_{1,42}^{(q)}$ | 0.050 | 0.045 | -0.039 | 0.018 | 0.049 | 0.081 | 0.139 | 2067 | 1042 | 1.002 |
| $\varepsilon_{1,43}^{(q)}$ | -0.031 | 0.045 | -0.119 | -0.063 | -0.031 | 0.000 | 0.057 | 2043 | 1069 | 1.000 |
| $\varepsilon_{1,44}^{(q)}$ | -0.013 | 0.046 | -0.104 | -0.044 | -0.014 | 0.017 | 0.076 | 2574 | 1131 | 1.002 |
| $\varepsilon_{1,45}^{(q)}$ | 0.015 | 0.049 | -0.080 | -0.018 | 0.015 | 0.048 | 0.113 | 2430 | 1057 | 1.000 |
| $\varepsilon_{1,46}^{(q)}$ | -0.066 | 0.048 | -0.160 | -0.098 | -0.067 | -0.034 | 0.029 | 2300 | 1150 | 1.002 |
| $\varepsilon_{1,47}^{(q)}$ | -0.204 | 0.048 | -0.295 | -0.238 | -0.204 | -0.171 | -0.113 | 1810 | 1139 | 1.005 |
| $\varepsilon_{1,48}^{(q)}$ | -0.164 | 0.046 | -0.249 | -0.196 | -0.163 | -0.132 | -0.078 | 2616 | 943 | 1.000 |
| $\varepsilon_{2,17}^{(q)}$ | -0.051 | 0.047 | -0.143 | -0.081 | -0.050 | -0.019 | 0.042 | 2272 | 1095 | 0.999 |
| $\varepsilon_{2,18}^{(q)}$ | -0.013 | 0.047 | -0.104 | -0.045 | -0.014 | 0.020 | 0.080 | 2508 | 1214 | 1.001 |
| $\varepsilon_{2,19}^{(q)}$ | -0.072 | 0.049 | -0.171 | -0.104 | -0.073 | -0.040 | 0.029 | 2200 | 1051 | 1.000 |
| $\varepsilon_{2,20}^{(q)}$ | -0.050 | 0.045 | -0.140 | -0.079 | -0.050 | -0.021 | 0.038 | 2683 | 994 | 1.001 |
| $\varepsilon_{1,21}^{(q)}$ | -0.048 | 0.044 | -0.133 | -0.079 | -0.047 | -0.018 | 0.037 | 1970 | 1012 | 1.000 |
| $\varepsilon_{1,22}^{(q)}$ | 0.061 | 0.045 | -0.025 | 0.029 | 0.061 | 0.091 | 0.150 | 2268 | 1151 | 1.001 |
| $\varepsilon_{1,23}^{(q)}$ | 0.073 | 0.045 | -0.011 | 0.042 | 0.072 | 0.103 | 0.166 | 1790 | 1064 | 1.003 |
| $\varepsilon_{1,24}^{(q)}$ | 0.063 | 0.045 | -0.020 | 0.033 | 0.064 | 0.094 | 0.147 | 2192 | 1334 | 0.999 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{1,25}^{(q)}$ | -0.027 | 0.046 | -0.116 | -0.061 | -0.028 | 0.006 | 0.063 | 2338 | 1247 | 1.001 |
| $\varepsilon_{1,26}^{(q)}$ | 0.036 | 0.046 | -0.053 | 0.004 | 0.037 | 0.068 | 0.124 | 2490 | 936 | 1.000 |
| $\varepsilon_{1,27}^{(q)}$ | 0.033 | 0.045 | -0.059 | 0.002 | 0.033 | 0.063 | 0.122 | 2706 | 1070 | 1.004 |
| $\varepsilon_{1,28}^{(q)}$ | -0.054 | 0.046 | -0.146 | -0.085 | -0.054 | -0.023 | 0.036 | 2335 | 1154 | 1.001 |
| $\varepsilon_{1,29}^{(q)}$ | -0.066 | 0.045 | -0.158 | -0.095 | -0.068 | -0.034 | 0.023 | 2285 | 1114 | 1.006 |
| $\varepsilon_{1,30}^{(q)}$ | -0.027 | 0.045 | -0.114 | -0.057 | -0.027 | 0.005 | 0.059 | 2204 | 1371 | 1.000 |
| $\varepsilon_{1,31}^{(q)}$ | 0.074 | 0.046 | -0.021 | 0.041 | 0.075 | 0.105 | 0.165 | 2154 | 1097 | 0.999 |
| $\varepsilon_{1,32}^{(q)}$ | 0.111 | 0.048 | 0.015 | 0.079 | 0.110 | 0.145 | 0.201 | 1798 | 984 | 1.003 |
| $\varepsilon_{1,33}^{(q)}$ | 0.046 | 0.049 | -0.049 | 0.012 | 0.047 | 0.079 | 0.142 | 2429 | 1130 | 1.005 |
| $\varepsilon_{1,34}^{(q)}$ | 0.008 | 0.046 | -0.080 | -0.023 | 0.006 | 0.041 | 0.098 | 2346 | 1089 | 1.001 |
| $\varepsilon_{1,35}^{(q)}$ | -0.066 | 0.047 | -0.159 | -0.098 | -0.067 | -0.034 | 0.024 | 1982 | 938 | 1.002 |
| $\varepsilon_{1,36}^{(q)}$ | -0.092 | 0.044 | -0.178 | -0.121 | -0.092 | -0.063 | -0.003 | 2176 | 953 | 1.010 |
| $\varepsilon_{1,37}^{(q)}$ | -0.118 | 0.047 | -0.211 | -0.149 | -0.118 | -0.089 | -0.022 | 2142 | 993 | 1.001 |
| $\varepsilon_{1,38}^{(q)}$ | -0.020 | 0.045 | -0.114 | -0.050 | -0.018 | 0.011 | 0.067 | 2054 | 1174 | 0.998 |
| $\varepsilon_{1,39}^{(q)}$ | 0.043 | 0.045 | -0.047 | 0.015 | 0.044 | 0.072 | 0.133 | 3281 | 1126 | 1.002 |
| $\varepsilon_{1,40}^{(q)}$ | 0.073 | 0.047 | -0.016 | 0.041 | 0.072 | 0.104 | 0.166 | 2005 | 1354 | 1.000 |
| $\varepsilon_{1,41}^{(q)}$ | -0.008 | 0.047 | -0.096 | -0.040 | -0.008 | 0.024 | 0.085 | 2494 | 1132 | 1.004 |
| $\varepsilon_{1,42}^{(q)}$ | 0.139 | 0.046 | 0.050 | 0.108 | 0.138 | 0.171 | 0.231 | 2394 | 1285 | 1.001 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{1,43}^{(q)}$ | 0.032 | 0.048 | -0.058 | 0.001 | 0.032 | 0.065 | 0.125 | 2512 | 1049 | 1.001 |
| $\varepsilon_{1,44}^{(q)}$ | -0.088 | 0.048 | -0.177 | -0.119 | -0.088 | -0.057 | 0.007 | 2102 | 1089 | 1.001 |
| $\varepsilon_{1,45}^{(q)}$ | 0.046 | 0.049 | -0.052 | 0.013 | 0.047 | 0.078 | 0.147 | 2183 | 1106 | 1.004 |
| $\varepsilon_{1,46}^{(q)}$ | -0.038 | 0.046 | -0.132 | -0.070 | -0.037 | -0.005 | 0.050 | 2121 | 1227 | 1.001 |
| $\varepsilon_{1,47}^{(q)}$ | 0.004 | 0.045 | -0.082 | -0.026 | 0.004 | 0.034 | 0.093 | 1589 | 1043 | 1.000 |
| $\varepsilon_{1,48}^{(q)}$ | 0.080 | 0.045 | -0.012 | 0.051 | 0.081 | 0.110 | 0.168 | 2291 | 1037 | 1.000 |
| $\varepsilon_{2,17}^{(q)}$ | -0.004 | 0.046 | -0.094 | -0.035 | -0.005 | 0.028 | 0.091 | 2072 | 964 | 1.000 |
| $\varepsilon_{2,18}^{(q)}$ | -0.069 | 0.043 | -0.154 | -0.096 | -0.070 | -0.041 | 0.016 | 1970 | 969 | 1.005 |
| $\varepsilon_{2,19}^{(q)}$ | -0.087 | 0.044 | -0.172 | -0.117 | -0.087 | -0.056 | -0.001 | 2087 | 977 | 0.999 |
| $\varepsilon_{2,20}^{(q)}$ | -0.125 | 0.048 | -0.218 | -0.155 | -0.125 | -0.094 | -0.030 | 2594 | 753 | 0.999 |
| $\varepsilon_{1,21}^{(q)}$ | -0.085 | 0.046 | -0.181 | -0.116 | -0.087 | -0.052 | 0.005 | 2375 | 955 | 1.001 |
| $\varepsilon_{1,22}^{(q)}$ | -0.080 | 0.043 | -0.167 | -0.110 | -0.080 | -0.049 | 0.002 | 2415 | 1182 | 1.001 |
| $\varepsilon_{1,23}^{(q)}$ | 0.020 | 0.043 | -0.065 | -0.010 | 0.019 | 0.050 | 0.102 | 2472 | 1110 | 0.999 |
| $\varepsilon_{1,24}^{(q)}$ | 0.026 | 0.044 | -0.062 | -0.003 | 0.025 | 0.054 | 0.111 | 1851 | 958 | 1.002 |
| $\varepsilon_{1,25}^{(q)}$ | -0.118 | 0.043 | -0.200 | -0.148 | -0.118 | -0.089 | -0.032 | 2163 | 1052 | 0.999 |
| $\varepsilon_{1,26}^{(q)}$ | -0.038 | 0.043 | -0.123 | -0.065 | -0.037 | -0.009 | 0.043 | 2389 | 1033 | 0.999 |
| $\varepsilon_{1,27}^{(q)}$ | -0.038 | 0.042 | -0.119 | -0.067 | -0.039 | -0.008 | 0.043 | 2636 | 1192 | 1.002 |
| $\varepsilon_{1,28}^{(q)}$ | 0.011 | 0.043 | -0.074 | -0.018 | 0.011 | 0.041 | 0.095 | 2410 | 933 | 1.002 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{1,29}^{(q)}$ | -0.005 | 0.044 | -0.087 | -0.036 | -0.005 | 0.025 | 0.081 | 2127 | 1172 | 1.002 |
| $\varepsilon_{1,30}^{(q)}$ | 0.007 | 0.046 | -0.084 | -0.026 | 0.005 | 0.037 | 0.095 | 1896 | 1112 | 1.002 |
| $\varepsilon_{1,31}^{(q)}$ | -0.009 | 0.047 | -0.103 | -0.040 | -0.010 | 0.023 | 0.082 | 1603 | 1014 | 1.002 |
| $\varepsilon_{1,32}^{(q)}$ | 0.045 | 0.047 | -0.046 | 0.012 | 0.045 | 0.077 | 0.135 | 2216 | 1185 | 1.002 |
| $\varepsilon_{1,33}^{(q)}$ | 0.059 | 0.046 | -0.033 | 0.029 | 0.059 | 0.089 | 0.148 | 2045 | 1101 | 1.005 |
| $\varepsilon_{1,34}^{(q)}$ | 0.043 | 0.044 | -0.046 | 0.013 | 0.041 | 0.074 | 0.127 | 2268 | 1232 | 0.999 |
| $\varepsilon_{1,35}^{(q)}$ | -0.064 | 0.044 | -0.154 | -0.092 | -0.063 | -0.035 | 0.019 | 2198 | 1225 | 1.000 |
| $\varepsilon_{1,36}^{(q)}$ | -0.016 | 0.042 | -0.098 | -0.044 | -0.015 | 0.013 | 0.065 | 2018 | 1101 | 1.002 |
| $\varepsilon_{1,37}^{(q)}$ | 0.006 | 0.044 | -0.076 | -0.024 | 0.007 | 0.037 | 0.092 | 2340 | 1128 | 1.001 |
| $\varepsilon_{1,38}^{(q)}$ | -0.014 | 0.044 | -0.103 | -0.043 | -0.014 | 0.017 | 0.069 | 2187 | 1337 | 1.002 |
| $\varepsilon_{1,39}^{(q)}$ | -0.025 | 0.047 | -0.120 | -0.056 | -0.025 | 0.005 | 0.067 | 2420 | 1035 | 1.001 |
| $\varepsilon_{1,40}^{(q)}$ | 0.146 | 0.046 | 0.059 | 0.115 | 0.145 | 0.175 | 0.241 | 2251 | 889 | 1.000 |
| $\varepsilon_{1,41}^{(q)}$ | 0.131 | 0.046 | 0.039 | 0.101 | 0.132 | 0.162 | 0.220 | 2130 | 1276 | 1.001 |
| $\varepsilon_{4,42}^{(q)}$ | 0.051 | 0.046 | -0.040 | 0.019 | 0.053 | 0.081 | 0.140 | 1953 | 1221 | 1.003 |
| $\varepsilon_{4,43}^{(q)}$ | -0.098 | 0.046 | -0.189 | -0.129 | -0.097 | -0.067 | -0.006 | 2076 | 1093 | 1.000 |
| $\varepsilon_{4,44}^{(q)}$ | 0.042 | 0.049 | -0.052 | 0.010 | 0.043 | 0.074 | 0.136 | 2395 | 899 | 1.004 |
| $\varepsilon_{4,45}^{(q)}$ | -0.011 | 0.048 | -0.108 | -0.043 | -0.009 | 0.021 | 0.079 | 2134 | 1117 | 1.003 |
| $\varepsilon_{4,46}^{(q)}$ | -4.922 | 0.129 | -5.166 | -5.010 | -4.922 | -4.836 | -4.686 | 699 | 983 | 1.002 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{4,47}^{(q)}$ | -7.813 | 0.049 | -7.910 | -7.847 | -7.812 | -7.780 | -7.720 | 794 | 931 | 1.004 |
| $\varepsilon_{4,48}^{(q)}$ | -3.164 | 0.194 | -3.537 | -3.292 | -3.167 | -3.037 | -2.788 | 624 | 753 | 1.000 |
| *Herring selectivity* | | | | | | | | | | |
| $\ln s_{1,3,1,8:19}^{(50\%)}$ | 1.384 | 0.038 | 1.311 | 1.359 | 1.382 | 1.410 | 1.458 | 584 | 690 | 1.005 |
| $\ln s_{1,3,2,8:19}^{(50\%)}$ | 2.155 | 0.133 | 1.907 | 2.062 | 2.153 | 2.244 | 2.414 | 763 | 919 | 1.002 |
| $\ln s_{1,3,3,8:19}^{(50\%)}$ | 1.399 | 0.024 | 1.351 | 1.383 | 1.399 | 1.415 | 1.447 | 777 | 1068 | 1.003 |
| $\ln s_{1,3,4,8:19}^{(50\%)}$ | 1.518 | 0.028 | 1.461 | 1.501 | 1.519 | 1.537 | 1.569 | 596 | 646 | 0.999 |
| $\ln s_{1,3,1,20:34}^{(50\%)}$ | 1.457 | 0.024 | 1.410 | 1.441 | 1.457 | 1.472 | 1.504 | 829 | 928 | 1.002 |
| $\ln s_{1,3,2,20:34}^{(50\%)}$ | 1.503 | 0.024 | 1.457 | 1.487 | 1.503 | 1.519 | 1.547 | 939 | 1057 | 0.999 |
| $\ln s_{1,3,3,20:34}^{(50\%)}$ | 1.512 | 0.020 | 1.475 | 1.499 | 1.512 | 1.525 | 1.552 | 971 | 961 | 1.000 |
| $\ln s_{1,3,4,20:34}^{(50\%)}$ | 1.651 | 0.018 | 1.617 | 1.640 | 1.651 | 1.664 | 1.687 | 840 | 821 | 1.004 |
| $\ln s_{1,3,1,35:48}^{(50\%)}$ | 1.829 | 0.030 | 1.770 | 1.808 | 1.830 | 1.850 | 1.889 | 1086 | 1216 | 1.001 |
| $\ln s_{1,3,2,35:48}^{(50\%)}$ | 1.566 | 0.018 | 1.530 | 1.554 | 1.566 | 1.578 | 1.599 | 858 | 1104 | 0.999 |
| $\ln s_{1,3,3,35:48}^{(50\%)}$ | 1.672 | 0.018 | 1.638 | 1.660 | 1.672 | 1.684 | 1.706 | 982 | 958 | 1.004 |
| $\ln s_{1,3,4,35:48}^{(50\%)}$ | 1.727 | 0.013 | 1.700 | 1.718 | 1.727 | 1.736 | 1.753 | 985 | 1172 | 1.003 |
| $\ln s_{2,3,1,8:34}^{(50\%)}$ | 1.814 | 0.033 | 1.755 | 1.791 | 1.812 | 1.837 | 1.882 | 669 | 650 | 1.003 |
| $\ln s_{2,3,2,8:34}^{(50\%)}$ | 2.035 | 0.048 | 1.952 | 2.002 | 2.032 | 2.065 | 2.138 | 634 | 699 | 1.005 |
| $\ln s_{2,3,3,8:34}^{(50\%)}$ | 1.784 | 0.030 | 1.724 | 1.764 | 1.784 | 1.805 | 1.845 | 640 | 911 | 1.002 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $\ln s^{(50\%)}_{2,3,4,8:34}$ | 1.964 | 0.033 | 1.903 | 1.941 | 1.962 | 1.985 | 2.032 | 776 | 1092 | 1.005 |
| $\ln s^{(50\%)}_{2,3,1,35:48}$ | 1.742 | 0.019 | 1.704 | 1.730 | 1.742 | 1.755 | 1.781 | 1095 | 1146 | 1.000 |
| $\ln s^{(50\%)}_{2,3,2,35:48}$ | 1.866 | 0.018 | 1.833 | 1.854 | 1.866 | 1.877 | 1.902 | 639 | 921 | 1.000 |
| $\ln s^{(50\%)}_{2,3,3,35:48}$ | 1.808 | 0.015 | 1.777 | 1.798 | 1.808 | 1.818 | 1.838 | 871 | 1200 | 1.001 |
| $\ln s^{(50\%)}_{2,3,4,35:48}$ | 1.822 | 0.016 | 1.789 | 1.812 | 1.822 | 1.833 | 1.856 | 879 | 1070 | 1.000 |
| $\ln s^{(50\%)}_{3,3,1:4,1:7}$ | 1.193 | 0.144 | 0.909 | 1.103 | 1.195 | 1.296 | 1.453 | 571 | 824 | 1.003 |
| $\ln(s^{(95\%)}_{1,3,1,8:19}-s^{(50\%)}_{1,3,1,8:19})$ | 2.084 | 0.112 | 1.846 | 2.010 | 2.093 | 2.165 | 2.276 | 805 | 958 | 1.001 |
| $\ln(s^{(95\%)}_{1,3,2,8:19}-s^{(50\%)}_{1,3,2,8:19})$ | -0.333 | 0.071 | -0.471 | -0.379 | -0.335 | -0.286 | -0.197 | 879 | 1048 | 1.002 |
| $\ln(s^{(95\%)}_{1,3,3,8:19}-s^{(50\%)}_{1,3,3,8:19})$ | 0.204 | 0.070 | 0.064 | 0.157 | 0.205 | 0.251 | 0.334 | 749 | 897 | 1.001 |
| $\ln(s^{(95\%)}_{1,3,4,8:19}-s^{(50\%)}_{1,3,4,8:19})$ | 0.186 | 0.065 | 0.057 | 0.144 | 0.186 | 0.230 | 0.309 | 1040 | 965 | 1.000 |
| $\ln(s^{(95\%)}_{1,3,1,20:34}-s^{(50\%)}_{1,3,1,20:34})$ | 0.011 | 0.060 | -0.109 | -0.032 | 0.013 | 0.052 | 0.126 | 1084 | 808 | 1.002 |
| $\ln(s^{(95\%)}_{1,3,2,20:34}-s^{(50\%)}_{1,3,2,20:34})$ | -0.424 | 0.077 | -0.575 | -0.475 | -0.422 | -0.372 | -0.270 | 972 | 1024 | 1.002 |
| $\ln(s^{(95\%)}_{1,3,3,20:34}-s^{(50\%)}_{1,3,3,20:34})$ | 0.164 | 0.049 | 0.069 | 0.132 | 0.163 | 0.196 | 0.264 | 756 | 996 | 1.004 |
| $\ln(s^{(95\%)}_{1,3,4,20:34}-s^{(50\%)}_{1,3,4,20:34})$ | 0.856 | 0.063 | 0.734 | 0.812 | 0.858 | 0.900 | 0.974 | 1315 | 1314 | 1.001 |
| $\ln(s^{(95\%)}_{1,3,1,35:48}-s^{(50\%)}_{1,3,1,35:48})$ | 0.032 | 0.052 | -0.067 | -0.004 | 0.033 | 0.067 | 0.131 | 1167 | 1236 | 0.999 |
| $\ln(s^{(95\%)}_{1,3,2,35:48}-s^{(50\%)}_{1,3,2,35:48})$ | -0.117 | 0.050 | -0.214 | -0.151 | -0.117 | -0.082 | -0.021 | 1190 | 1238 | 1.004 |
| $\ln(s^{(95\%)}_{1,3,3,35:48}-s^{(50\%)}_{1,3,3,35:48})$ | -0.070 | 0.039 | -0.146 | -0.095 | -0.070 | -0.044 | 0.005 | 1091 | 1169 | 1.001 |
| $\ln(s^{(95\%)}_{1,3,4,35:48}-s^{(50\%)}_{1,3,4,35:48})$ | 0.909 | 0.094 | 0.735 | 0.847 | 0.904 | 0.970 | 1.101 | 815 | 748 | 1.002 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\ln(s^{(95\%)}_{2,3,1,8:34}\text{-}s^{(50\%)}_{2,3,1,8:34})$ | 1.040 | 0.084 | 0.879 | 0.984 | 1.040 | 1.096 | 1.202 | 891 | 699 | 1.004 |
| $\ln(s^{(95\%)}_{2,3,2,8:34}\text{-}s^{(50\%)}_{2,3,2,8:34})$ | 0.692 | 0.090 | 0.511 | 0.635 | 0.691 | 0.752 | 0.878 | 710 | 994 | 1.001 |
| $\ln(s^{(95\%)}_{2,3,3,8:34}\text{-}s^{(50\%)}_{2,3,3,8:34})$ | 0.952 | 0.077 | 0.806 | 0.899 | 0.951 | 1.004 | 1.102 | 1092 | 1170 | 1.003 |
| $\ln(s^{(95\%)}_{2,3,4,8:34}\text{-}s^{(50\%)}_{2,3,4,8:34})$ | 0.380 | 0.070 | 0.242 | 0.333 | 0.379 | 0.425 | 0.517 | 1330 | 1196 | 1.001 |
| $\ln(s^{(95\%)}_{2,3,1,35:48}\text{-}s^{(50\%)}_{2,3,1,35:48})$ | 0.124 | 0.047 | 0.036 | 0.093 | 0.123 | 0.155 | 0.221 | 899 | 770 | 1.003 |
| $\ln(s^{(95\%)}_{2,3,2,35:48}\text{-}s^{(50\%)}_{2,3,2,35:48})$ | 0.160 | 0.050 | 0.065 | 0.126 | 0.159 | 0.195 | 0.254 | 1095 | 1074 | 1.001 |
| $\ln(s^{(95\%)}_{2,3,3,35:48}\text{-}s^{(50\%)}_{2,3,3,35:48})$ | 0.123 | 0.053 | 0.019 | 0.088 | 0.121 | 0.160 | 0.228 | 1085 | 1175 | 1.001 |
| $\ln(s^{(95\%)}_{2,3,4,35:48}\text{-}s^{(50\%)}_{2,3,4,35:48})$ | 1.384 | 0.038 | 1.311 | 1.359 | 1.382 | 1.410 | 1.458 | 584 | 690 | 1.005 |
| $\ln(s^{(95\%)}_{3,3,1:4,1:7}\text{-}s^{(50\%)}_{6,3,1:4,1:7})$ | 2.155 | 0.133 | 1.907 | 2.062 | 2.153 | 2.244 | 2.414 | 763 | 919 | 1.002 |
| *Herring natural mortality* | | | | | | | | | | |
| $\varepsilon^{(\mathrm{M,h1})}_{2}$ | -0.067 | 0.023 | -0.113 | -0.083 | -0.067 | -0.051 | -0.022 | 1789 | 1113 | 1.003 |
| $\varepsilon^{(\mathrm{M,h1})}_{3}$ | -0.072 | 0.024 | -0.118 | -0.088 | -0.072 | -0.056 | -0.024 | 1768 | 1114 | 1.001 |
| $\varepsilon^{(\mathrm{M,h1})}_{4}$ | -0.097 | 0.023 | -0.142 | -0.112 | -0.097 | -0.081 | -0.051 | 2508 | 1205 | 1.004 |
| $\varepsilon^{(\mathrm{M,h1})}_{5}$ | -0.114 | 0.024 | -0.165 | -0.130 | -0.114 | -0.099 | -0.064 | 2177 | 928 | 0.999 |
| $\varepsilon^{(\mathrm{M,h1})}_{6}$ | -0.111 | 0.023 | -0.160 | -0.126 | -0.111 | -0.096 | -0.065 | 2267 | 1087 | 1.003 |
| $\varepsilon^{(\mathrm{M,h1})}_{7}$ | -0.079 | 0.024 | -0.125 | -0.097 | -0.079 | -0.063 | -0.033 | 2531 | 1224 | 1.006 |
| $\varepsilon^{(\mathrm{M,h1})}_{8}$ | -0.030 | 0.024 | -0.076 | -0.047 | -0.029 | -0.012 | 0.017 | 1987 | 1087 | 1.009 |
| $\varepsilon^{(\mathrm{M,h1})}_{9}$ | 0.006 | 0.024 | -0.041 | -0.009 | 0.006 | 0.022 | 0.051 | 2236 | 1035 | 1.002 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{10}^{(M,h1)}$ | 0.022 | 0.024 | -0.023 | 0.006 | 0.022 | 0.039 | 0.068 | 1883 | 1253 | 1.000 |
| $\varepsilon_{11}^{(M,h1)}$ | 0.022 | 0.024 | -0.027 | 0.005 | 0.023 | 0.039 | 0.069 | 2512 | 1275 | 1.002 |
| $\varepsilon_{12}^{(M,h1)}$ | 0.019 | 0.024 | -0.027 | 0.002 | 0.019 | 0.034 | 0.063 | 2527 | 1207 | 1.004 |
| $\varepsilon_{13}^{(M,h1)}$ | 0.010 | 0.025 | -0.037 | -0.008 | 0.010 | 0.028 | 0.058 | 2764 | 909 | 1.000 |
| $\varepsilon_{14}^{(M,h1)}$ | -0.013 | 0.025 | -0.061 | -0.030 | -0.013 | 0.004 | 0.036 | 1940 | 1063 | 1.005 |
| $\varepsilon_{15}^{(M,h1)}$ | -0.024 | 0.025 | -0.072 | -0.041 | -0.024 | -0.008 | 0.027 | 2428 | 1085 | 1.003 |
| $\varepsilon_{16}^{(M,h1)}$ | -0.026 | 0.025 | -0.075 | -0.043 | -0.026 | -0.009 | 0.023 | 2700 | 1025 | 1.000 |
| $\varepsilon_{17}^{(M,h1)}$ | -0.022 | 0.025 | -0.071 | -0.039 | -0.022 | -0.006 | 0.029 | 2315 | 1058 | 1.009 |
| $\varepsilon_{18}^{(M,h1)}$ | -0.025 | 0.025 | -0.074 | -0.042 | -0.025 | -0.008 | 0.023 | 2226 | 1312 | 1.001 |
| $\varepsilon_{19}^{(M,h1)}$ | -0.028 | 0.024 | -0.077 | -0.045 | -0.029 | -0.012 | 0.022 | 1653 | 965 | 1.004 |
| $\varepsilon_{20}^{(M,h1)}$ | -0.025 | 0.026 | -0.076 | -0.042 | -0.024 | -0.008 | 0.027 | 3268 | 1040 | 0.999 |
| $\varepsilon_{21}^{(M,h1)}$ | -0.017 | 0.024 | -0.063 | -0.034 | -0.017 | -0.001 | 0.030 | 3017 | 1095 | 0.999 |
| $\varepsilon_{22}^{(M,h1)}$ | -0.013 | 0.024 | -0.060 | -0.029 | -0.013 | 0.004 | 0.035 | 3060 | 1164 | 0.999 |
| $\varepsilon_{23}^{(M,h1)}$ | -0.017 | 0.024 | -0.063 | -0.033 | -0.017 | -0.001 | 0.029 | 3440 | 965 | 1.002 |
| $\varepsilon_{24}^{(M,h1)}$ | -0.027 | 0.025 | -0.074 | -0.043 | -0.027 | -0.010 | 0.022 | 2772 | 1075 | 1.000 |
| $\varepsilon_{25}^{(M,h1)}$ | -0.026 | 0.024 | -0.075 | -0.042 | -0.026 | -0.009 | 0.020 | 2435 | 937 | 1.001 |
| $\varepsilon_{26}^{(M,h1)}$ | -0.017 | 0.023 | -0.061 | -0.032 | -0.018 | -0.001 | 0.028 | 3409 | 1229 | 1.001 |
| $\varepsilon_{27}^{(M,h1)}$ | -0.011 | 0.024 | -0.058 | -0.028 | -0.011 | 0.006 | 0.036 | 2220 | 1211 | 1.006 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{28}^{(M,h1)}$ | -0.009 | 0.025 | -0.057 | -0.026 | -0.008 | 0.009 | 0.039 | 2377 | 1006 | 1.003 |
| $\varepsilon_{29}^{(M,h1)}$ | -0.011 | 0.025 | -0.060 | -0.028 | -0.011 | 0.006 | 0.037 | 2124 | 1176 | 1.001 |
| $\varepsilon_{30}^{(M,h1)}$ | -0.011 | 0.024 | -0.060 | -0.028 | -0.011 | 0.004 | 0.036 | 2637 | 918 | 1.003 |
| $\varepsilon_{31}^{(M,h1)}$ | -0.005 | 0.026 | -0.052 | -0.022 | -0.006 | 0.011 | 0.047 | 2310 | 1214 | 1.004 |
| $\varepsilon_{32}^{(M,h1)}$ | -0.001 | 0.024 | -0.049 | -0.018 | -0.001 | 0.015 | 0.047 | 2726 | 1160 | 1.004 |
| $\varepsilon_{33}^{(M,h1)}$ | 0.001 | 0.025 | -0.048 | -0.016 | 0.000 | 0.018 | 0.051 | 2346 | 1057 | 1.002 |
| $\varepsilon_{34}^{(M,h1)}$ | -0.001 | 0.024 | -0.047 | -0.018 | -0.001 | 0.016 | 0.045 | 2084 | 1099 | 1.000 |
| $\varepsilon_{35}^{(M,h1)}$ | 0.000 | 0.025 | -0.045 | -0.018 | 0.000 | 0.018 | 0.047 | 2405 | 1275 | 1.002 |
| $\varepsilon_{36}^{(M,h1)}$ | 0.006 | 0.025 | -0.041 | -0.011 | 0.006 | 0.023 | 0.056 | 2163 | 952 | 0.999 |
| $\varepsilon_{37}^{(M,h1)}$ | 0.008 | 0.025 | -0.040 | -0.009 | 0.008 | 0.025 | 0.055 | 2738 | 1053 | 1.004 |
| $\varepsilon_{38}^{(M,h1)}$ | 0.008 | 0.025 | -0.040 | -0.009 | 0.008 | 0.025 | 0.056 | 2136 | 1106 | 1.000 |
| $\varepsilon_{39}^{(M,h1)}$ | 0.001 | 0.024 | -0.046 | -0.016 | 0.001 | 0.019 | 0.048 | 2468 | 1137 | 1.000 |
| $\varepsilon_{40}^{(M,h1)}$ | 0.001 | 0.024 | -0.047 | -0.015 | 0.002 | 0.017 | 0.048 | 2468 | 955 | 0.999 |
| $\varepsilon_{41}^{(M,h1)}$ | 0.005 | 0.024 | -0.043 | -0.012 | 0.005 | 0.021 | 0.052 | 1763 | 993 | 1.001 |
| $\varepsilon_{42}^{(M,h1)}$ | 0.007 | 0.025 | -0.041 | -0.010 | 0.007 | 0.023 | 0.057 | 2189 | 1076 | 1.000 |
| $\varepsilon_{43}^{(M,h1)}$ | 0.011 | 0.024 | -0.035 | -0.005 | 0.011 | 0.028 | 0.058 | 2442 | 1115 | 1.002 |
| $\varepsilon_{44}^{(M,h1)}$ | 0.014 | 0.025 | -0.036 | -0.002 | 0.014 | 0.031 | 0.063 | 2340 | 1124 | 1.004 |
| $\varepsilon_{45}^{(M,h1)}$ | 0.016 | 0.025 | -0.033 | -0.002 | 0.017 | 0.033 | 0.064 | 1859 | 1282 | 1.000 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{46}^{(M,h1)}$ | 0.016 | 0.025 | -0.030 | 0.000 | 0.016 | 0.032 | 0.067 | 2434 | 1145 | 1.000 |
| $\varepsilon_{47}^{(M,h1)}$ | 0.008 | 0.024 | -0.040 | -0.008 | 0.007 | 0.024 | 0.052 | 2063 | 892 | 1.001 |
| $\varepsilon_{48}^{(M,h1)}$ | 0.002 | 0.025 | -0.046 | -0.015 | 0.002 | 0.019 | 0.052 | 3228 | 952 | 1.002 |
| $\varepsilon_{2}^{(M,h2)}$ | 0.260 | 0.017 | 0.227 | 0.248 | 0.259 | 0.271 | 0.292 | 1523 | 1172 | 1.003 |
| $\varepsilon_{3}^{(M,h2)}$ | 0.191 | 0.019 | 0.153 | 0.178 | 0.191 | 0.203 | 0.227 | 1202 | 1083 | 1.003 |
| $\varepsilon_{4}^{(M,h2)}$ | 0.117 | 0.020 | 0.078 | 0.104 | 0.117 | 0.130 | 0.158 | 1596 | 1094 | 1.002 |
| $\varepsilon_{5}^{(M,h2)}$ | 0.016 | 0.019 | -0.023 | 0.003 | 0.016 | 0.028 | 0.055 | 1865 | 997 | 1.001 |
| $\varepsilon_{6}^{(M,h2)}$ | -0.109 | 0.019 | -0.148 | -0.121 | -0.108 | -0.095 | -0.071 | 1626 | 1022 | 0.999 |
| $\varepsilon_{7}^{(M,h2)}$ | -0.083 | 0.019 | -0.120 | -0.095 | -0.083 | -0.069 | -0.047 | 1609 | 1166 | 1.001 |
| $\varepsilon_{8}^{(M,h2)}$ | 0.087 | 0.021 | 0.047 | 0.074 | 0.086 | 0.101 | 0.128 | 1522 | 926 | 1.002 |
| $\varepsilon_{9}^{(M,h2)}$ | 0.015 | 0.022 | -0.027 | 0.000 | 0.016 | 0.030 | 0.059 | 1939 | 1101 | 1.002 |
| $\varepsilon_{10}^{(M,h2)}$ | -0.060 | 0.022 | -0.103 | -0.074 | -0.060 | -0.045 | -0.016 | 2379 | 1133 | 1.000 |
| $\varepsilon_{11}^{(M,h2)}$ | -0.099 | 0.022 | -0.142 | -0.113 | -0.099 | -0.084 | -0.056 | 2373 | 1226 | 1.001 |
| $\varepsilon_{12}^{(M,h2)}$ | -0.111 | 0.023 | -0.157 | -0.126 | -0.111 | -0.096 | -0.062 | 2230 | 1091 | 1.003 |
| $\varepsilon_{13}^{(M,h2)}$ | -0.097 | 0.023 | -0.140 | -0.111 | -0.097 | -0.081 | -0.054 | 2065 | 1127 | 1.003 |
| $\varepsilon_{14}^{(M,h2)}$ | -0.049 | 0.022 | -0.092 | -0.064 | -0.049 | -0.034 | -0.004 | 2352 | 1253 | 1.000 |
| $\varepsilon_{15}^{(M,h2)}$ | -0.018 | 0.023 | -0.065 | -0.033 | -0.018 | -0.003 | 0.029 | 2462 | 1103 | 1.000 |
| $\varepsilon_{16}^{(M,h2)}$ | -0.001 | 0.023 | -0.046 | -0.016 | 0.000 | 0.015 | 0.044 | 1945 | 1042 | 1.002 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{17}^{(M,h2)}$ | 0.003 | 0.023 | -0.043 | -0.013 | 0.003 | 0.019 | 0.049 | 2379 | 953 | 1.001 |
| $\varepsilon_{18}^{(M,h2)}$ | 0.005 | 0.023 | -0.038 | -0.010 | 0.006 | 0.020 | 0.048 | 2209 | 1315 | 0.999 |
| $\varepsilon_{19}^{(M,h2)}$ | 0.010 | 0.023 | -0.034 | -0.005 | 0.009 | 0.026 | 0.054 | 1896 | 1280 | 1.000 |
| $\varepsilon_{20}^{(M,h2)}$ | 0.014 | 0.023 | -0.032 | -0.003 | 0.014 | 0.030 | 0.061 | 2337 | 1283 | 1.002 |
| $\varepsilon_{21}^{(M,h2)}$ | 0.009 | 0.023 | -0.037 | -0.006 | 0.009 | 0.024 | 0.056 | 2489 | 1191 | 1.003 |
| $\varepsilon_{22}^{(M,h2)}$ | 0.005 | 0.023 | -0.038 | -0.011 | 0.005 | 0.021 | 0.048 | 1989 | 1289 | 1.002 |
| $\varepsilon_{23}^{(M,h2)}$ | 0.012 | 0.023 | -0.031 | -0.003 | 0.013 | 0.028 | 0.059 | 2191 | 1213 | 0.999 |
| $\varepsilon_{24}^{(M,h2)}$ | 0.039 | 0.023 | -0.004 | 0.023 | 0.039 | 0.055 | 0.085 | 1967 | 1307 | 1.001 |
| $\varepsilon_{25}^{(M,h2)}$ | 0.045 | 0.022 | -0.001 | 0.031 | 0.045 | 0.060 | 0.087 | 2309 | 918 | 1.003 |
| $\varepsilon_{26}^{(M,h2)}$ | 0.041 | 0.022 | -0.003 | 0.026 | 0.041 | 0.056 | 0.086 | 2122 | 1115 | 1.000 |
| $\varepsilon_{27}^{(M,h2)}$ | 0.030 | 0.022 | -0.014 | 0.016 | 0.030 | 0.045 | 0.073 | 2115 | 982 | 1.008 |
| $\varepsilon_{28}^{(M,h2)}$ | 0.007 | 0.022 | -0.036 | -0.007 | 0.007 | 0.021 | 0.049 | 1621 | 981 | 1.008 |
| $\varepsilon_{29}^{(M,h2)}$ | -0.003 | 0.023 | -0.048 | -0.017 | -0.004 | 0.011 | 0.043 | 2162 | 926 | 1.002 |
| $\varepsilon_{30}^{(M,h2)}$ | 0.010 | 0.023 | -0.038 | -0.006 | 0.009 | 0.027 | 0.055 | 1713 | 1135 | 1.001 |
| $\varepsilon_{31}^{(M,h2)}$ | 0.002 | 0.021 | -0.039 | -0.013 | 0.002 | 0.016 | 0.045 | 1621 | 1230 | 1.001 |
| $\varepsilon_{32}^{(M,h2)}$ | -0.005 | 0.022 | -0.048 | -0.020 | -0.006 | 0.009 | 0.037 | 2002 | 1173 | 0.999 |
| $\varepsilon_{33}^{(M,h2)}$ | 0.009 | 0.023 | -0.036 | -0.008 | 0.009 | 0.024 | 0.052 | 1987 | 1277 | 1.002 |
| $\varepsilon_{34}^{(M,h2)}$ | 0.026 | 0.022 | -0.017 | 0.011 | 0.027 | 0.041 | 0.069 | 1856 | 1088 | 1.003 |

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|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon_{35}^{(M,h2)}$ | 0.043 | 0.022 | -0.001 | 0.028 | 0.043 | 0.058 | 0.086 | 1843 | 1192 | 1.004 |
| $\varepsilon_{36}^{(M,h2)}$ | 0.045 | 0.022 | 0.002 | 0.030 | 0.045 | 0.060 | 0.088 | 1733 | 1110 | 1.001 |
| $\varepsilon_{37}^{(M,h2)}$ | 0.028 | 0.022 | -0.014 | 0.013 | 0.028 | 0.043 | 0.071 | 1837 | 1109 | 1.006 |
| $\varepsilon_{38}^{(M,h2)}$ | 0.016 | 0.022 | -0.026 | 0.000 | 0.016 | 0.031 | 0.059 | 2088 | 1282 | 1.003 |
| $\varepsilon_{39}^{(M,h2)}$ | 0.017 | 0.022 | -0.025 | 0.002 | 0.016 | 0.031 | 0.059 | 2237 | 1215 | 1.007 |
| $\varepsilon_{40}^{(M,h2)}$ | 0.014 | 0.021 | -0.026 | 0.000 | 0.014 | 0.028 | 0.056 | 1576 | 1257 | 1.005 |
| $\varepsilon_{41}^{(M,h2)}$ | -0.004 | 0.021 | -0.048 | -0.016 | -0.004 | 0.010 | 0.035 | 2059 | 1069 | 1.001 |
| $\varepsilon_{42}^{(M,h2)}$ | -0.011 | 0.021 | -0.053 | -0.026 | -0.011 | 0.003 | 0.032 | 2181 | 1168 | 1.003 |
| $\varepsilon_{43}^{(M,h2)}$ | 0.003 | 0.022 | -0.039 | -0.012 | 0.003 | 0.019 | 0.045 | 2771 | 1111 | 1.001 |
| $\varepsilon_{44}^{(M,h2)}$ | 0.025 | 0.022 | -0.017 | 0.009 | 0.025 | 0.040 | 0.070 | 2098 | 1128 | 1.002 |
| $\varepsilon_{45}^{(M,h2)}$ | 0.026 | 0.023 | -0.017 | 0.011 | 0.027 | 0.041 | 0.070 | 2249 | 989 | 1.004 |
| $\varepsilon_{46}^{(M,h2)}$ | -0.002 | 0.023 | -0.046 | -0.018 | -0.002 | 0.015 | 0.045 | 1641 | 1190 | 1.005 |
| $\varepsilon_{47}^{(M,h2)}$ | -0.012 | 0.023 | -0.057 | -0.027 | -0.012 | 0.002 | 0.032 | 3315 | 962 | 0.999 |
| $\varepsilon_{48}^{(M,h2)}$ | -0.008 | 0.026 | -0.058 | -0.026 | -0.008 | 0.010 | 0.043 | 2585 | 963 | 1.002 |

*Table S5.2. Chain-specific diagnostics for the fitted MICE.*

| Chain # | Warmup runtime (seconds) | Sampling runtime (seconds) | E-BFMI |
|---|---|---|---|
| 1 | 34944 | 28153 | 0.9303339 |
| 2 | 33851 | 30613 | 0.9877990 |
| 3 | 33730 | 28142 | 0.9922443 |

*Table S5.3. Post-fitted cod stock-recruitment parameter estimates. $\beta_0$ represents fecundity while $\beta_C$ and $\beta_H$ represent the effect of cod and herring biomass, respectively, on cod recruitment.*

| **Parameter** | **Posterior quantiles** | | |
|---|---|---|---|
| | **2.5%** | **50%** | **97.5%** |
| $\beta_0$ | 4.62 | 6.80 | 10.06 |
| $\beta_C$ | 1.30E-03 | 1.93E-03 | 2.67E-03 |
| $\beta_H$ | 2.57E-03 | 3.41E-03 | 4.25E-03 |

*Table S5.4. Post-fitted functional response parameter estimates. $\eta$, $h$, and $\lambda$ represent the encounter rate, handling time, and shape of the functional response, respectively.*

| **Predator** | **Par.** | **Prey** | **Posterior quantiles** | | |
|---|---|---|---|---|---|
| | | | **2.5%** | **50%** | **97.5%** |
| Seal, Shelf-M | $\eta$ | Cod | 1.72E+01 | 2.61E+02 | 4.26E+05 |
| | | Herring | 6.07E+00 | 1.23E+02 | 1.45E+05 |
| | $h$ | Cod | 3.64E+02 | 8.92E+03 | 1.69E+07 |
| | | Herring | 5.51E-09 | 5.48E+00 | 1.79E+04 |
| | $\lambda$ | Cod | 2.96E-05 | 4.96E-02 | 1.79E-01 |
| | | Herring | 1.40E-09 | 5.03E-03 | 1.69E-01 |
| Seal, Shelf-F | $\eta$ | Cod | 3.89E-01 | 8.16E+01 | 8.59E+08 |
| | | Herring | 6.09E-01 | 1.38E+02 | 1.09E+09 |
| | $h$ | Cod | 5.70E-03 | 2.38E+03 | 1.14E+09 |
| | | Herring | 3.49E-11 | 3.19E+02 | 1.51E+08 |
| | $\lambda$ | Cod | 1.51E-07 | 4.94E-02 | 4.06E-01 |
| | | Herring | 8.96E-10 | 1.37E-02 | 7.42E-01 |
| Seal, Gulf-M | $\eta$ | Cod | 3.20E+01 | 3.23E+02 | 5.77E+06 |
| | | Herring | 1.30E+01 | 1.18E+02 | 2.32E+06 |
| | $h$ | Cod | 4.39E-01 | 1.47E+02 | 2.93E+05 |
| | | Herring | 8.37E-01 | 7.85E+01 | 2.16E+05 |
| | $\lambda$ | Cod | 1.78E-08 | 4.86E-02 | 1.60E-01 |
| | | Herring | 5.72E-07 | 1.67E-02 | 1.66E-01 |

| | | | | | |
|---|---|---|---|---|---|
| Seal, Gulf-F | $\eta$ | Cod | 9.85E+00 | 1.27E+02 | 1.74E+07 |
| | | Herring | 1.80E+01 | 2.51E+02 | 2.75E+07 |
| | $h$ | Cod | 6.50E-04 | 9.90E+01 | 2.67E+05 |
| | | Herring | 9.53E-01 | 4.36E+02 | 7.04E+07 |
| | $\lambda$ | Cod | 1.53E-07 | 3.92E-02 | 1.72E-01 |
| | | Herring | 2.77E-11 | 5.79E-03 | 1.84E-01 |
| Cod | $\eta$ | Herring | 3.43E-15 | 3.18E-08 | 1.05E+00 |
| | $h$ | Herring | 6.57E-15 | 3.52E-09 | 5.52E+00 |
| | $\lambda$ | Herring | 2.48E-01 | 2.70E+00 | 5.62E+00 |

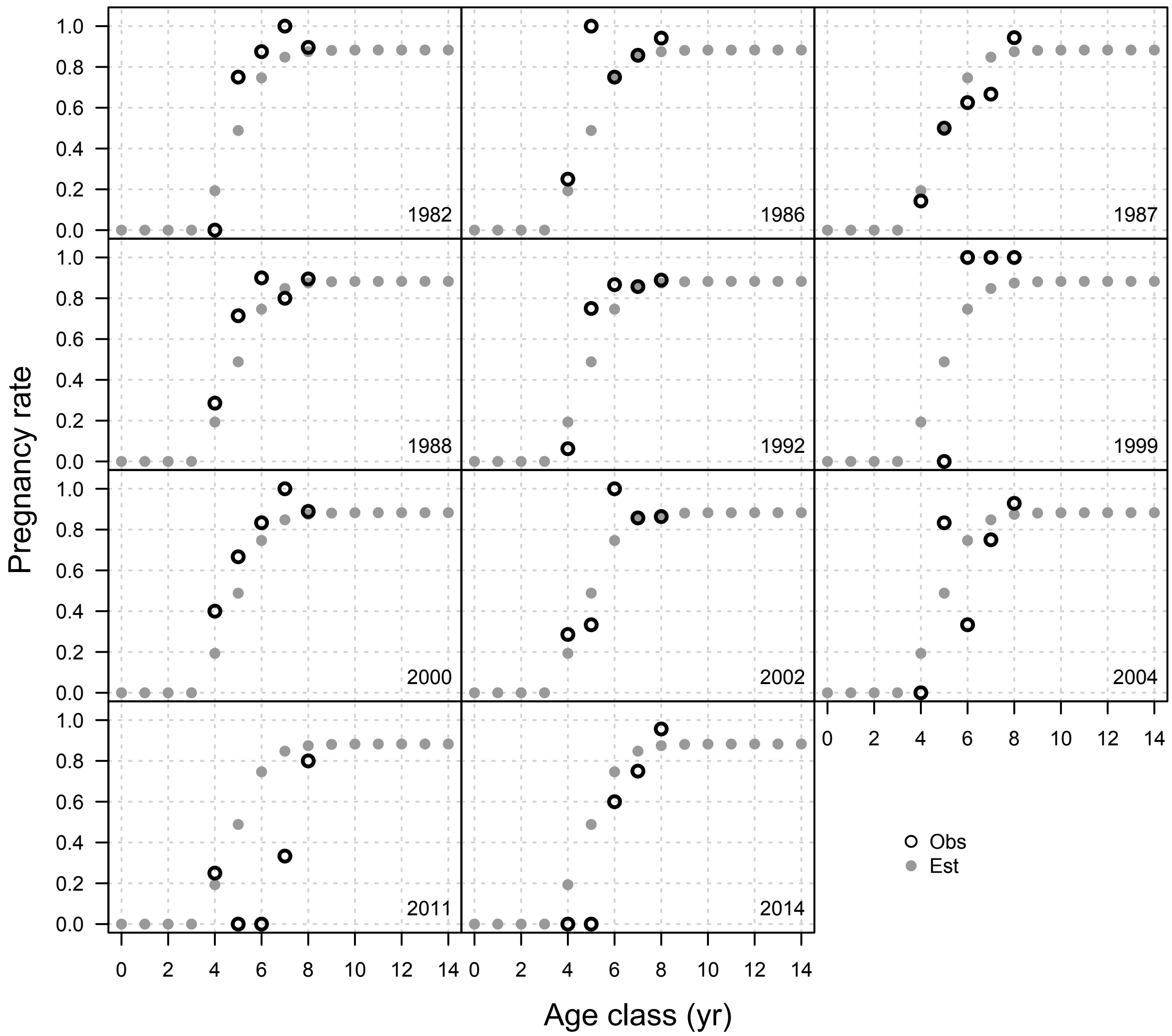


*Figure S5.1. Model fits (grey points) to observed grey seal pregnancy rates (circles) for years with more than 15 observations.*

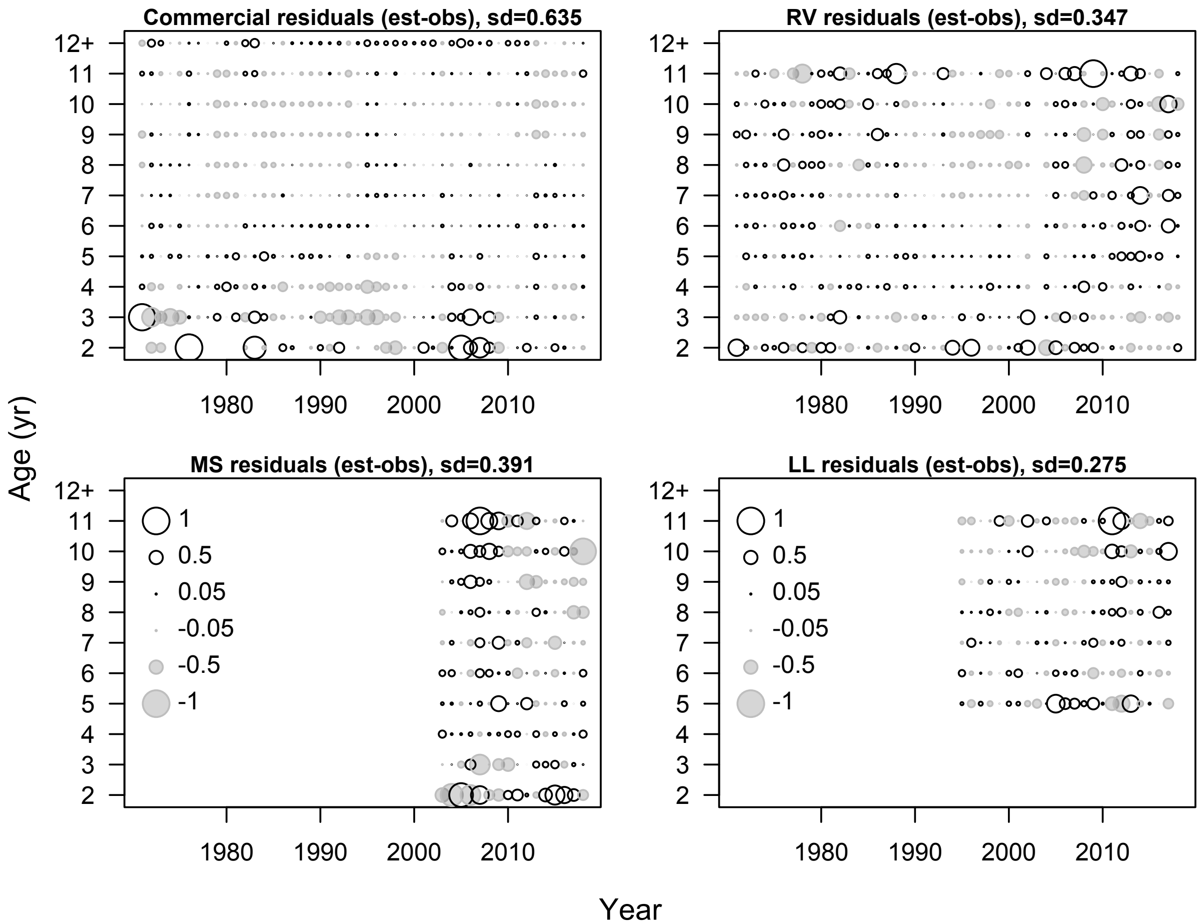


*Figure S5.2. Residuals between the observed proportions-at-age in the cod abundance indices and the model-estimated proportions. Residuals (estimated - observed) are proportional to circle radii.*

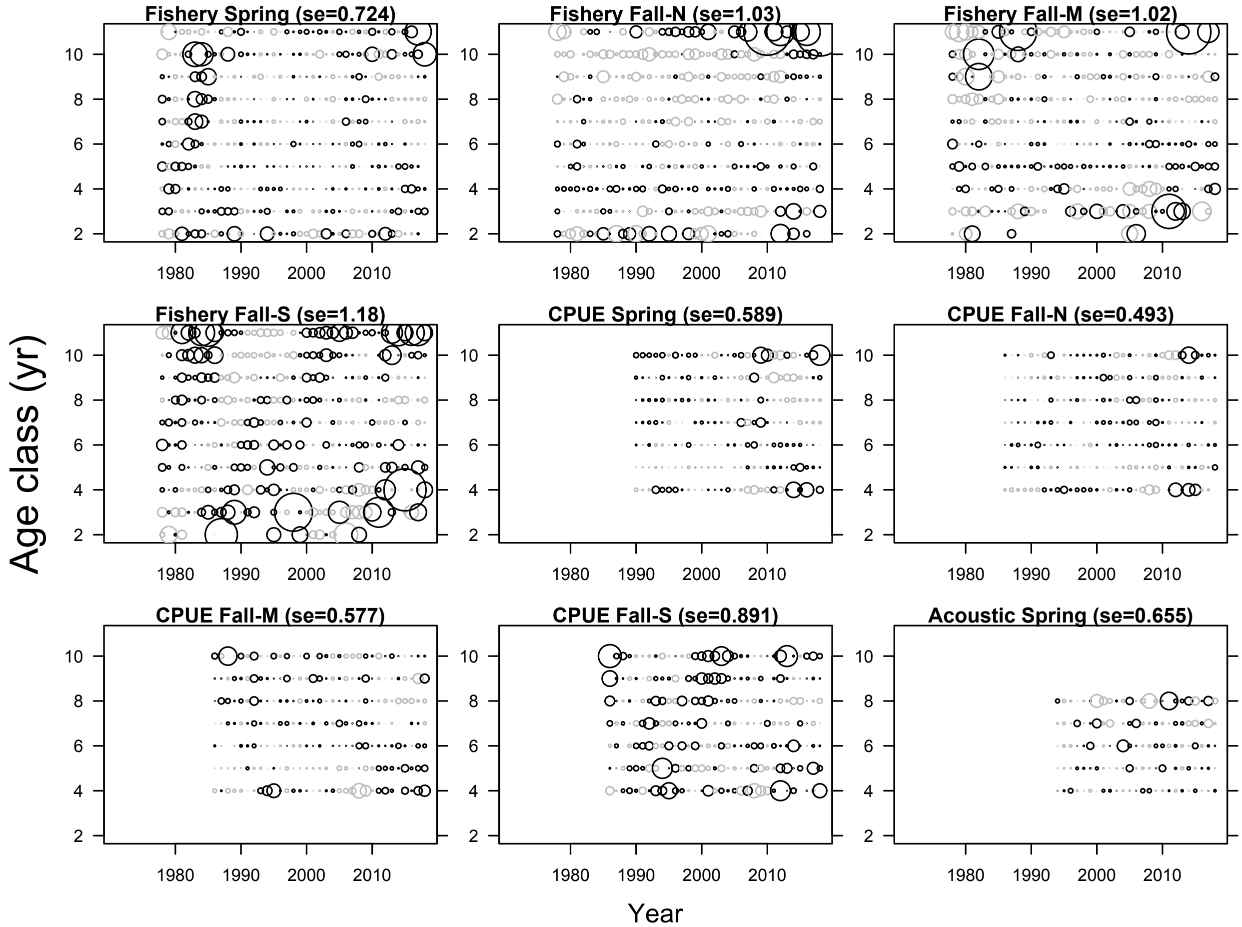


*Figure S5.3. Residuals between the observed proportions-at-age in the herring abundance indices and the model-estimated proportions. Residuals (estimated - observed) are proportional to circle radii. Black circles denote positive residuals.*

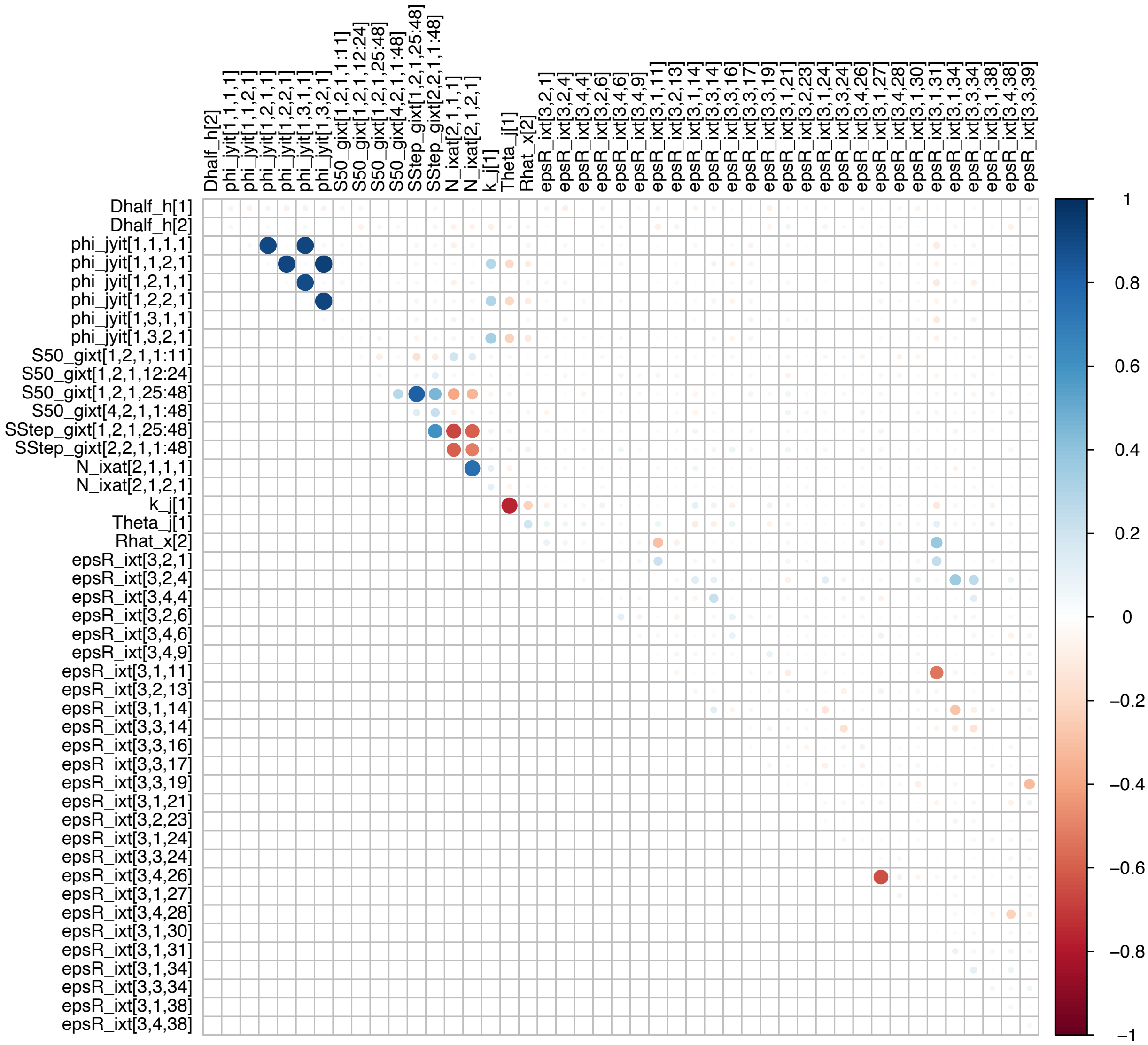


*Figure S5.4. Posterior correlation between pairs of parameters. Due to the large number of parameters, we omit parameters that do not have a correlation coefficient greater than 0.65 or less than -0.65 with at least one other parameter.*