Table 1. Life history parameter values used in the population model simulation, largely similar to Ono et al., (2015) and Hurtado-ferro et al., (2015). The “Estimated” column denotes whether a parameter was estimated or fixed within the assessment models (Yes = Y, No = N).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameter** | **Symbol** | **Estimated** | **Cod** | **Flatfish** | **Sardine** |
| Natural Mortality | *M* | Y | 0.2 | 0.2 | 0.4 |
| Start age | *a0* | N | 0 | 0 | 0 |
| Reference age | *a3* | N | 0.5 | 0.5 | 0.5 |
| Plus group age | *A* | N | 25 | 25 | 15 |
| Length at *a0* (cm) | *L0* | N | 20 | 12.7 | 10 |
| Length at *a+* (cm) | *L∞* | N | 132 | 47.4 | 25 |
| Growth rate (year-1) | *K* | N | 0.2 | 0.35 | 0.4 |
| Length-weight scaling (kg cm-3) | α | N | 6.8e-6 | 1.0e-5 | 1.7e-5 |
| Allometric factor | β | N | 3.1 | 3.0 | 2.9 |
| Maturity slope (cm-1) | Ω1 | N | -0.27 | -0.42 | -0.9 |
| Length at 50% maturity (cm) | Ω2 | N | 38.2 | 28.9 | 15.9 |
| Log mean virgin recruitment | *ln(R0)* | Y | 18.7 | 10.5 | 16 |
| Steepness | *h* | N | 0.65 | 0.76 | 0.59 |
| Recruitment SD | σr | Y | 0.4 | 0.7 | 0.73 |
| Mean fishery length-at-50% selectivity (cm) | S1 | Y | 38.2 | 28.9 | 15.9 |
| Fishery selectivity slope (cm) | S2 | Y | 10.6 | 7 | 3.3 |
| Max fishing mortality in fishing time series |  | N | 0.2025 | 0.5425 | 0.7875 |
| Terminal fishing mortality in fishing time series |  | N | 0.0623 | 0.1259 | 0.2037 |
| Annual fully selected fishing mortality |  | Y | \* | \* | \* |
| Catchability of fishery index | *q* | Y | 0.0001 | 0.0001 | 0.0001 |

\*see methods for derivation of annual fishing mortality levels in the operating model

Table 2. Population model equations. These apply to both simulator and estimator.

|  |  |
| --- | --- |
| Description | Equation |
| Length at age |  |
| Weight at age | = α |
| Maturity at age |  |
| Fecundity at age |  |
| Selectivity |  |
| Fishing mortality |  |
| Total mortality |  |
| Recruitment |  |
| Spawning biomass |  |
| Unfished survivorship |  |
| Initial abundance at age\* |  |
| Abundance at age |  |
| **Predicted Data** |  |
| Predicted catch |  |
| Predicted composition with ageing error () |  |
| Predicted index |  |

\*Note simulator starts in year 1 and estimator in year 26 (when fishing begins)