Table 1. Summary of the yearly stock assessment surveys of surf clam *Mesodesma donacium* in Cucao, and used to conditioning the operating model. The exploitation rate (μ) was computed as the ratio between the quota and the vulnerable biomass.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Stock assessment results** | **2011\*** | **2012\*** | **2013\*** | **2014\*** | **2015\*\*** | **2017\*\*** |
| Date of the stock assessment | 14-06-11 | 30-03-12 | 26-04-13 | 14-01-14 | 04-12-15 | 31-01-17 |
| Sampling units (quadrats) | 647 | 1063 | 328 | 1116 | 800 | 236 |
| Average density (ind/m²) | 110.5 | 213.2 | 441.5 | 197.5 | 359.1 | 78.7 |
| Estimated bank surface (ha) | 69.37 | 112.66 | 117.19 | 70.66 | 108.68 | 120.61 |
| Abundance (103 individuals) | 72,530 | 221,053 | 203,711 | 68,008 | 385,039 | 94,972 |
| Biomass (ton) | 1,356.2 | 4,638.8 | 5,407.2 | 1,687.1 | 3,257.5 | 1,618.3 |
| Vulnerable biomass (ton) | 1,261.3 | 4,459.9 | 5,398.6 | 1,646.3 | 1,992.4 | 1,539.5 |
| Quota (103 individuals) | 16,671 | 52,173 | 44,578 | 8,878 | 24,628 | 19,060 |
| Quota (ton) | 347 | 1169 | 1350 | 356 | 450 | 403 |
| μ=Quota/Vulnerable Biomass | 0.275 | 0.262 | 0.250 | 0.216 | 0.226 | 0.262 |
| Catch (ton) | 199 | 662 | 800 | 304 | 101 | 592 |

\* Source: Data obtained from Fundación Chinquihue (2012)

\*\* Source: Data obtained from Technical Reports of the Undersecretariat of Fisheries and Aquaculture (SUBPESCA). We allocated the sampling in 2015 to the next year 2016 in the operating model.

Table 2. General configuration of the operating model (OM) of surf clam *Mesodesma donacium* population in Cucao.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Process** | **Definition** | **Parameter or vector** | **Value** | **Prior** | **Penalization or bounded** | **OM** |
| Growth | Asymptotic length of VBGF |  | Fixed | 93.4 mm | - | 93.4 mm |
|  | Growth coefficient of VBGF |  | Estimated | 0.25 year-1 | Eq. T3.1 | 0.21 year-1 |
|  | Standard deviation for K penalty |  | Fixed | 0.1 | Eq. T3.1 | - |
|  | Length at recruitment |  | Estimated | 20 mm | - | 8.8 mm |
|  | Standard deviation of |  | Estimated | 1.5 mm | - | 2.72 mm |
|  | Growth increment shape |  | Estimated | 0.2 | - | 0.313 |
| Mortality | Natural mortality rate |  | Fixed | 0.3 | - | - |
|  | Fishing mortality |  | Estimated |  |  | See Fig. 5 |
| Recruitment | Steepness of SRR |  | Fixed | 0.7 | - | - |
|  | Average unexploited recruitment |  | Estimated |  | - | 38.5 106 |
|  | Standard deviation of recruitments |  | Fixed | 0.4 | - | - |
|  | Recruitment deviations (log-scale) |  | Estimated |  | Eq. T3.2 | See Fig. 5 |
| Catchability | Survey catchability coefficient |  | Estimated | 0.99 | Eq. T3.3 | 0.99 |
|  | Standard deviation for penalty |  | Fixed | 0.1 | Eq. T3.3 | - |
| Selectivity | Fishery selectivity at length |  | Fixed | - | - | - |
|  | Survey selectivity at length |  | Fixed | - | - | - |
| Reproduction | Maturity ogive |  | Fixed | - | - | - |
|  | Spawning time |  | Fixed | 0.7 | - | - |

Table 3. Penalties ( and negative log-likelihood functions () that are contributing to the objective function (*f*) in the estimation of unknown parameters () of the conditioning process of the surf clam *Mesodesma donacium* operating model in Cucao. Standard deviations for fitting: Standard deviation for total harvest , standard deviation for total survey biomass , effective size for multinomial length composition .

|  |  |  |
| --- | --- | --- |
| Components | Equation | Number |
| Growth coefficient of VBGF |  | T3.1 |
| Recruitment deviations (log-scale) |  | T3.2 |
| Survey catchability coefficient |  | T3.3 |
| Total annual harvest |  | T3.4 |
| Survey biomass |  | T3.5 |
| Survey length composition |  | T3.6 |
| Objective function |  | T3.7 |