# ORY-2024-01 Report 2: The 2025 stock assessment of orange roughy (*Hoplostethus atlanticus*) for the Walter Shoal Ridge in SIOFA Statistical Area 2

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## Abstract

We provide a range of plausible stock assessment models for orange roughy on Walter's Shoal Ridge in SIOFA Statistical Area 2, using data to 2023. The data contain little information on values of natural mortality and total acoustic catchability; models are driven by priors assigned to those parameters. Declining acoustic estimates, on Sleeping Beauty in particular, indicate lower initial biomass and higher acoustic survey catchability than estimated in previous assessments.

We carried out a range of model runs with different priors on these two parameters. Results suggested that spawning stock biomass was above the interim target biomass status of 40% of initial biomass, but fishing pressure was likely at or above the interim target. Projections resulted in stock status dropping below its interim target in a number of instances. In a few, more extreme, scenarios the stock status dropped below the interim limit of 20% of initial biomass. Projections also often resulted in fishing pressure exceeding the interim target. Future scenarios that apply an annual F-based catch limit are likely to maintain the fishing pressure below the interim target.

Better informed natural mortality and acoustic catchability parameters would improve model estimates. Natural mortality may be better estimated with further accumulation of age data. The sum of acoustic catchabilities is uncertain because the survey time-series is short, only a subset of hills have been surveyed each year, fish may move hills between years, and catchabilities vary within and between years. Continued acoustic surveys of hills with long time-series should be a priority. Surveying multiple hills per year, although technically difficult, would help inform this parameter. Hills with large declines in acoustic biomass estimates, such as Porky's, should be prioritized in order to establish whether there has been localised depletion, or the acoustic estimates have a high variability for that hill.


## Recommendations

- Orange roughy stock sizes and status in the SIOFA Region remain highly uncertain.
- Acoustic surveys provide the main information on those stocks.
- Better informed population models could be achieved with better informed natural mortality (M) and acoustic catchability (q).
- Acoustic surveys of hills with a long time series should remain a priority.
- Acoustic surveys of multiple hills within one season would help inform q.
- Some hills have been surveyed once only and further surveys would allow some degree of monitoring of those hills.
- Multiple hills have shown a large decline in acoustic biomass indices and could benefit from specific management as a precautionary measure (Da Vinci, Angelo's, Porky's and M.M.).

# 1. Introduction

The orange roughy (*Hoplostethus atlanticus*) fishery in the Southern Indian Ocean Fisheries Agreement (SIOFA) region is mainly carried out using bottom trawls with most catches associated with underwater features. Although orange roughy has been caught in a wide area of the SIOFA region, the majority of the orange roughy catches have historically been taken from the Walter Shoal Ridge (WSR, Figure 1). The WSR is also the area with most information available, including biomass estimates using acoustic surveys and some length and age information (Hoyle & Mormede 2025).

The SIOFA Scientific Committee (SC) provides scientific advice to the Meeting of Parties (MoP) on the status of stocks and sustainable yields of deep-sea fisheries resources. The stock assessment of orange roughy in the WSR was developed in 2018 (Cordue 2018; Cordue et al. 2018) and updated in 2021 (Roa-Ureta et al. 2022). Two larger stocks were also considered in 2021: the Long Walter's Shoal Ridge and the South-west Indian Ocean Ridge, although these were rejected by SIOFA (SIOFA Secretariat 2023). These two larger stocks are considered separately (Mormede & Hoyle 2025).

As required under SIOFA CMM 15, orange roughy stock assessments are conducted every 3-5 years, and new orange roughy stock assessments were developed in 2025 for consideration by SIOFA. This report updates the stock assessment of orange roughy in the Walter Shoal Ridge using all available data up to and including 2023.

As required by the Terms of Reference (provided in Appendix B), these build on the previous two assessment, with improvements implemented where possible and incorporate the SIOFA recommendations (SIOFA Secretariat 2023). This document addresses part of item 3 of the Project Objectives, which states: 'Review the previous stock assessments, and use all new information (including updated growth, maturity, and local area acoustic abundance data), and other relevant information to undertake a statistical catch-at-age stock assessment to determine the stock status of orange roughy for Walters Shoal and the Southwest Indian Rise.'

A glossary of some of the terms used in the document is provided in Table 1.

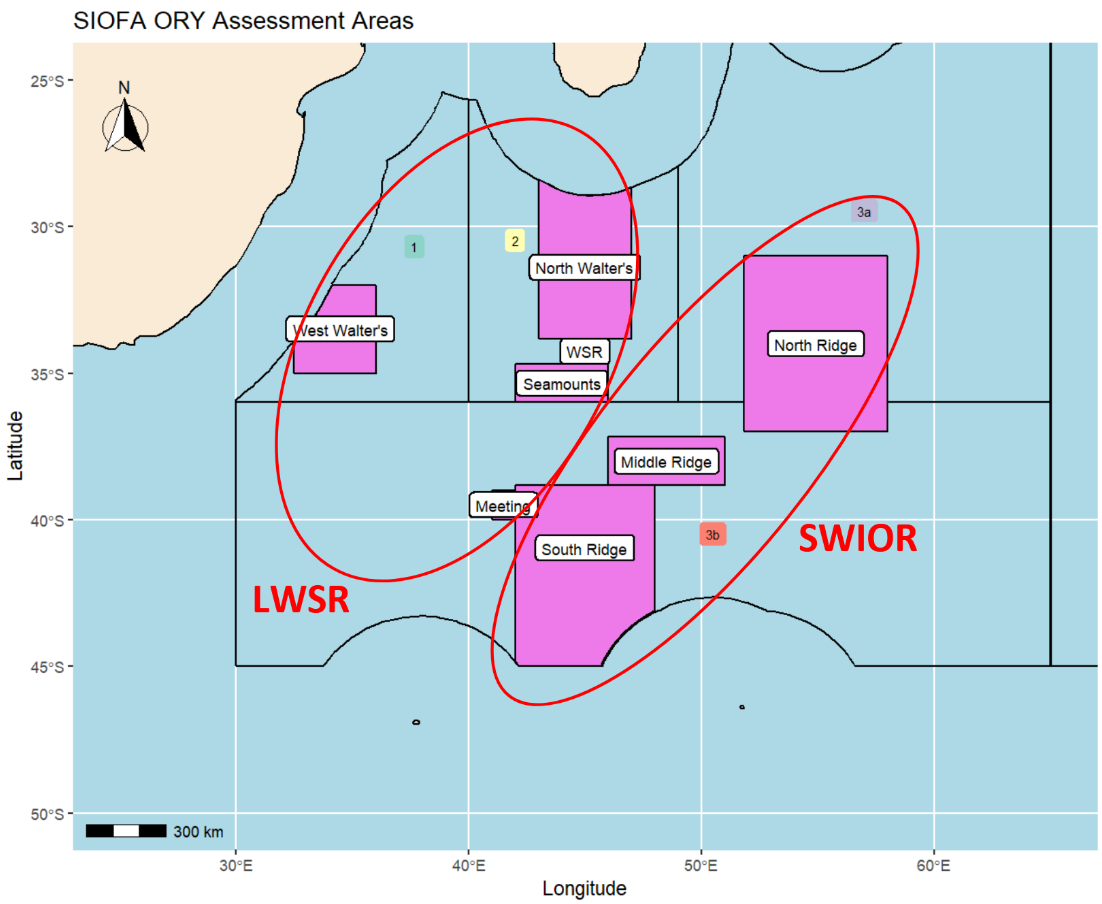


*Figure 1: Map of SIOFA areas used for orange roughy assessments (in magenta). Labels indicate the names of single assessment areas with the Walter Shoal Ridge area noted as WSR. The red ovals denote the grouping into two larger areas for stock assessment purposes: the Long Walter's Shoal Ridge (LWSR) and South-West Indian Ocean Ridge (SWIOR). Reproduced from Figure 2 of the SIOFA fisheries summary for orange roughy (SIOFA Secretariat 2023).*

# 2. Methods

## 2.1 Fisheries data

Data used were provided by the SIOFA Secretariat. The data series used in the stock assessment models are summarised in Table 2 and Figure 2.

Total orange roughy catches in the WSR were extracted from the 2021 stock assessment files (Roa-Ureta et al. 2022) up to and including 2021, and the fishery summary report (SIOFA Secretariat 2023) thereafter. The standardised catch per unit effort (CPUE) for the WSR was used as two indices because there was no overlap between vessels before and after 2015 (Hoyle & Mormede 2025).

The unsexed age frequency distribution for 2017 was extracted from the 2021 stock assessment files (Roa-Ureta et al. 2022), as the raw data were not available. The 2019 and 2020 unsexed scaled age frequency distributions for the WSR were recalculated based on available data (Hoyle & Mormede 2025). The growth parameters and length-weight parameters were updated using all the data available (Hoyle & Mormede 2025).

An update of the acoustic biomass estimates was carried out in 2022 (Macaulay 2022). The annual mean biomass per feature was calculated for this study with weight inversely proportional to cv, as per the process carried out in the previous assessment (Roa-Ureta et al. 2022). The resulting estimates for the features used in the stock assessment (Sleeping Beauty) were quite different from those used in the 2022 assessment (Figure 3).

## 2.2 Stock assessment models

Bayesian age- and sex-based models were developed for orange roughy in the WSR using the modelling platform Casal2 (Casal2 Development Team 2023). A summary of the parameters used is given in Table 3 and data weighting in Figure 2. The model generally followed the structure of the 2021 model (Roa-Ureta et al. 2022). Three time-steps were implemented in the model with recruitment in the first time-step, fishing in the second time-step and ageing in the third time-step.

Ages 1-120 by sex were modelled with a plus group at the oldest age, and the model ranging from 1950 to 2023. The models assumed a Beverton-Holt stock-recruit relationship with a steepness value of 0.57 and spawning biomass defined as mature males and females. Maturity was assumed to be equal to selectivity, which was assumed to be logistic (asymptotic) and age-dependent and was estimated within the model. A logistic selectivity might not be totally accurate but is deemed conservative as it avoids cryptic biomass and therefore used. Growth was assumed to follow a Von Bertalanffy relationship. Both the growth and length-weight relationships were updated using the latest data (Hoyle & Mormede 2025).

Some changes were applied to the model compared with the 2021 model. These changes were tested iteratively.

- Growth and length-weight relationships were updated.
- Catches were updated, and age frequency distributions for 2019 and 2020 added.
- The acoustic biomass estimates were updated using the latest estimates (Macaulay 2022). Alternative treatments of the acoustic data within the model were also explored (see below). The base case model included acoustic series for all the features in the WSR rather than just for Sleeping Beauty as in the 2021 assessment.
- Fishery CPUE was included in the models as two independent series split in 2015 to reflect the change in fishing fleet.
- Year class strengths (YCS) were initially estimated using the simplex transformation, but ultimately fixed in the final models.

Initial biomass, catchabilities, selectivities and YCS (for some initial model runs) were estimated (Table 4).

- Initial biomass ($B_0$) was estimated with a uniform prior on the log scale.
- Natural mortality (*M*) for both males and females combined was estimated with a normal prior of various means and cv of 0.1 (see below).
- Acoustic catchability *q* parameters were estimated as free parameters with a uniform prior for each acoustic series.
- The sum of the acoustic catchabilities was given a normal prior with various means and cv of 0.1 (see below).
- Maturity (equal to selectivity) was assumed identical for males and females with a uniform prior.
- Annual recruitments (when estimated) were estimated from 1888 to 1993 as a recruitment multiplier (i.e., year class strengths centred on 1) with a lognormal distribution using the simplex method (aka a broken stock approach). The simplex method rescales *n* parameters as *n-1* parameters with the constraint that they average one, making it a natural transformation for the

estimation of annual recruitment multipliers with the constraint that they have mean one over some year range.

Age frequency distributions were provided to the model with their effective sample size, and both acoustic and CPUE series with their externally-calculated cv. Data were then weighted with the Francis method (Francis 2011a, 2011b). The acoustic and CPUE series were given 20% additional process error. Penalty functions were used to constrain the model so that any combination of parameters that did not allow the historical catch to be taken was penalised.

Median posterior density (MPD) estimates were used to compare diagnostics and fits between models. For final runs, the full posterior distribution was sampled using Markov chain Monte Carlo (MCMC), based on the Metropolis-Hastings algorithm. Three MCMC chains with a total length of $4 \times 10^6$ iterations each were constructed. A burn-in length of $1 \times 10^6$ iterations was used, with every 1000th sample taken from the final $3 \times 10^6$ iterations (i.e., a final sample of length 3000 was sampled from the posterior for each of the three independent chains).

Once the base model was finalised, sensitivities were carried out to investigate the effects of the main assumptions on the model. A range of priors on natural mortality and on the sum of the acoustic catchabilities were investigated, as noted above.

## 2.3 Projections

For each final model, we calculated the exploitation rate that achieved 50% probability of being above 40% $B_0$ ($F_{40}$), the biomass at maximum sustainable yield ($B_{MSY}$), and the exploitation rate that achieved 50% probability of being above $B_{MSY}$ ($F_{MSY}$). The final models were then projected for 20 years under average future recruitment and with different future catch assumptions (Figure 4):

- Constant catch: 478 t (mean of the 2015-2020 catches) and ±10, 20, 30, or 40% of that value
- Constant exploitation rate: $F_{40}$ with catch changed every year or every five years
- Constant exploitation rate: $F_{MSY}$ with catch changed every year or every five years

# 3. Results and discussion

## 3.1 Update of the 2021 model to the base case model

*Data updates*

The 2021 base case (Roa-Ureta et al. 2022) was used as the starting point for model development. Incremental changes were applied to the 2021 base case, including updating to Casal2 (Casal2 Development Team 2024), the model structure, catches, biological parameters, and observations. Reweighting of the data was only done after the final data and model structure updates, to allow comparison of the models throughout this process. Details of the steps are given in Table 4.

As expected, updating the model to Casal2 and updating the catches did not change the model outcome (R0.1 to R0.3). Updating the acoustic series (R0.4) resulted in an increase in initial biomass due to an increase in the average of the acoustic series (Figure 3) whilst the prior on the acoustic series remained unchanged.

Updating biological parameters and reducing the cv of the *M* and *Sum(q)* priors to 0.1 instead of 0.2 was also inconsequential (R0.6 and R1.0, see rationale below). The addition of the two CPUE series was also largely ignored by the model as the series are short, and the late CPUE series shows an increasing trend at the same time as the acoustic series show a decline (R1.3).

Removing the estimates of YCS resulted in the estimation of 105 fewer parameters and an improvement in negative log likelihood (NLL) of 502 points, a much-improved model (R0.5). The effect on the remaining estimated parameters was small, although the status in 2023 increased. Orange roughy live up to 150 years and therefore require large sample sizes to estimate relative year class strength. Furthermore, this model only has three years of age frequency distribution data available, from 2017, 2019 and 2020, providing insufficient information to estimate more than 150 year-classes.

The addition of the 2019 and 2020 age frequency distributions to the existing 2017 age frequency data resulted in an increase in $M$ and a reduction in the maturity $a_{50}$ parameter, but no change in the estimate of initial biomass (R1.2).

*Using all acoustic biomass series*

The other structural change of consequence since the 2021 model was the addition of all the available acoustic series for the WSR region (R1.1) as opposed to the series for Sleeping Beauty only. The models with the acoustic series for Sleeping Beauty only assumed a normal prior on the catchability $q$ of mean 0.2 (Roa-Ureta et al. 2022), therefore assuming that 20% of the orange roughy biomass of the WSR is on Sleeping Beauty. The updated model structure included the acoustic series for all five features that have been acoustically surveyed, regardless of the length of the series. These were given a uniform catchability prior, and an additional prior on the sum of all the catchabilities was provided, with a normal distribution centred on 0.8 and cv of 0.1. In effect all series were assumed to be independent and to contribute to the total biomass estimate. The advantage of this approach is that the prior on the sum of the catchabilities represents the amount of biomass expected to be in the WSR but away from these features. One limitation of this approach is that it assumes that the series are independent and contain a fixed proportion of the population over time, with no movement between hills and years.

This structural change resulted in a sum of acoustic catchabilities estimate of 0.84, and an estimate of acoustic catchability for Sleeping Beauty of 0.28 instead of 0.2 for the previous models. Consequently, the estimate of initial biomass reduced somewhat, and so did status in 2023. Estimates of natural mortality and maturity remained largely unchanged.

*Base case model*

The final base case model included all acoustic biomass series, the 2017, 2019 and 2020 age frequency distributions and the early and late CPUE series. The age frequency distributions were reweighted, leading to a down-weighting of those data by multiplying their effective sample size by a factor of 0.022. Reweighting resulted in a small reduction in the estimates of both $M$ and maturity $a_{50}$ but no marked change in initial biomass or status in 2023 (R1.4, Table 4).

MPD profiles were carried out on initial biomass ($B_0$), natural mortality ($M$) and acoustic catchability for the Sleeping Beauty feature. The estimate of initial biomass was driven by the prior on the sum of the acoustic catchabilities and on the acoustic biomass series for Sleeping Beauty (Figure 5). In turn, the estimate of the acoustic catchability for the Sleeping Beauty feature was driven by the acoustic biomass series for that feature and its prior (Figure 6). The estimate of natural mortality was almost exclusively driven by its prior, with age frequency distributions pushing for a slightly higher value and the Sleeping Beauty acoustic series for a slightly lower value (Figure 7). In all instances, the model was poorly informed, with a maximum of six NLL points informing those parameters, and only two for natural mortality.

MCMC results of the base case run are given in Appendix A. The MCMC was well behaved (Figure A.1), *rhat* values were all close to zero and effective sample sizes close to 1 (not shown). The biomass trajectory was highly uncertain, and status likely well above 40% $B_0$ (Figure A.2). Fits to the acoustic data were mostly adequate, but the CPUE series were largely ignored (Figure A.3). Fits to the age frequency distributions were also adequate given the variability of the input data (Figure A.4). They did not seem to be as variable as seen other orange roughy stocks where the mode of the age frequency distribution could shift by up to 10 years between different years sampled, indicating non homogeneous plumes and difficulty in representative sampling of the population (e.g., Dunn 2024a, 2024a). Density distributions of the estimated parameters were stable; the distribution of M was almost identical to its prior, but the sum of the acoustic catchabilities was to the right of the prior distribution (Figure A.5). Maturity $a_{50}$ was estimated at age 31.5, consistent with existing literature, which reported maturity at between 23 and 40 years (Tingley & Dunn 2018; e.g., Dunn 2024b, 2024a).

The base case model long term exploitation rate that achieves a 50% probability of being above 40% $B_0$ ($F_{40}$) was estimated at 0.033, the biomass at sustainable yield ($B_{MSY}$) at 30.8% $B_0$ and the long-term exploitation rate that achieves a 50% probability of being above $B_{MSY}$ ($F_{MSY}$) at 0.045 (Table 6). The Kobe plot shows that although the biomass has remained above the interim target biomass of 40% $B_0$, the exploitation rate has often been above the interim target exploitation rate (Figure 8).

## 3.2 Model sensitivities

Because the priors on natural mortality and on the sum of the acoustic catchability priors were so influential on the estimate of initial biomass and stock status in 2023, a range of model sensitivities were carried out. Instead of increasing the cv on the prior of those parameters and obtaining one single uncertain model result, the cv was kept constrained at 0.1 and different values of the means of the priors were given, resulting in different plausible hypotheses for the population status.

Alternative mean priors on natural mortality used were 0.024 following some New Zealand estimates (Dunn 2024b; Fisheries New Zealand 2024), and 0.058, because the predicted plus group was quite large and fitted the data poorly, which indicated a higher natural mortality might be warranted (Figure A.4). These are consistent with the range of M values reported in the literature (0.03 to 0.06, Tingley & Dunn 2018) and with the maximum age recorded in the SIOFA region of 180 years, which would correspond to a natural mortality of 0.03 based on Hamel & Cope (2022)

Alternative mean priors on the sum of the acoustic catchabilities used were 0.7, 0.8, 0.9 and 1.0. The value of 0.8 was based on the assumption applied in the 2018 and 2021 models (Cordue 2018; Roa-Ureta et al. 2022) and on work elsewhere (Dunn 2024b), a lower value was tested in line with the lower prior on Sleeping Beauty in the 2021 assessment, and values up to 1.0 were also considered, representing if most of the orange roughy population was within those surveyed features. A sum of catchability value of 1.0 is plausible for multiple reasons, including incorrect target strength, under-corrected background scatter, the presence of other species in the marks, and movement between hills during and between surveys. This model construct assumes that there is no movement between the hills between years; the 2018 model estimated movement but data were sparse (Cordue 2018). Movement between hills during surveys and between years has been inferred on the Challenger Plateau in New Zealand, where the current model now sums the acoustic estimate values between hills (Fisheries New Zealand 2024).

Results are presented in Table 6. In summary,

- The estimates of M were almost identical to the mean value of the prior for all runs.

- The sum of the estimates of catchabilities was generally slightly higher than the sum of their priors.
- The negative log likelihoods were within 4 points of each other for all runs, which indicated that there was very little information in the data to differentiate between these models. The lowest values and therefore best fitting models had the highest sum of acoustic priors of 1 and a natural mortality prior of either 0.024 or 0.045. A natural mortality of 0.058 was very slightly less likely based on the data and model structure.
- The estimates of maturity were mostly influenced by the values of M, with age at 50% maturity positively correlated with natural mortality. The range of maturity $a_{50}$ was from 28 to 33 years, well within expected values.
- Median initial biomass ranged from 21 538 t to 29 169 t and median status ranged from 44.5 to 66.9% $B_0$. The most likely models (with low M and high q priors) had a median status of 44.3 or 52.7% $B_0$ and had a 90% or higher probability of being above 40% $B_0$.
- $B_{MSY}$ remained mostly unchanged between model runs at about 30.3 to 32.8% $B_0$. It is expected that natural mortality and maturity $a_{50}$ balance each other to lead to the same $B_{MSY}$.
- $F_{40}$ and $F_{MSY}$ were strongly influenced by the value of natural mortality, with lower values of natural mortality leading to lower long term exploitation rates.
- The 2024 catch that would correspond to $F_{40}$ ranged from 193 to 799 t and ranged from 264 t to 1087 t for $F_{MSY}$. These were affected by both the value of natural mortality and of the sum of catchabilities, with lowest long-term catches associated with lowest natural mortality and highest catchability. For comparison purposes, the 2015-2020 average catch was 478 t.

An additional sensitivity run was carried out whereby the age frequency distributions were given a multiplier of 0.5, effectively upweighting that dataset by a factor of 20 compared with other runs, and the prior on the sum of catchabilities was weakened with a mean of 0.8 and cv of 0.4 (Table 5). This resulted in a lower initial biomass (19 500 t instead of 26 600 t for the base case) and a higher sum of catchabilities (1.4 instead of 0.85). The model fitted to the reduction in the Sleeping Beauty acoustic biomass series better by estimating a higher catchability for this feature (0.46 rather than 0.28). This higher value is deemed less likely but still possible as in years when multiple features were surveyed, the Sleeping Beauty portion was between about 30 and 50% of the total estimated biomass, and such a $q$ value would have required fish to move between features in between the surveys or an over-estimate of acoustic biomass, both of which are possible.

## 3.3 Projections

Projections were carried out on the sensitivity runs over 20 years for a range of future constant catch or constant exploitation rate scenarios (Table 7, Table 8, Figure 9 to Figure 11).

A number of the scenarios tested did not satisfy the interim biomass target of 50% probability of being above 40% $B_0$ in 2043 (Table 7, Figure 9 to Figure 11), specifically all constant catch scenarios associated with a natural mortality prior of 0.024 (R1.5 to 1.53) and the two highest constant catch scenarios associated with a natural mortality prior of 0.045 and catchability prior of 0.9 or 1.0 (R1.42 and R1.43). Only runs R1.52 and R1.52 would also not satisfy the interim biomass limit of 90% probability of being above 20% $B_0$ (not tabled due to the small number of values breaching the interim limit).

The interim target fishing pressure ($F_{40}$) was exceeded as early as in 2026 in many constant-catch scenarios (Table 8). At the expected average natural mortality prior of 0.045 and the reasonable q prior of 0.9, a catch of 382 t would be the highest that would not exceed the interim target fishing pressure. As expected, annual $F_{40}$ constant exploitation rate scenarios achieved the interim target fishing pressure whilst 5-year updated $F_{50}$ always exceeded the interim target fishing pressure.

# 4. Conclusions

We have developed a range of plausible stock assessment models for orange roughy on Walter's Shoal Ridge in SIOFA Statistical Area 2. In a 2024 development, we included all the acoustic biomass surveys in the model and assigned a normal prior on the sum of the individual acoustic catchability parameters.

The data contained little information on the potential values of natural mortality (*M*) and total acoustic catchability (*Sum(q)*), resulting in models that were driven by the priors assigned to *M* and to *Sum(q)*. Declining acoustic estimates on Sleeping Beauty indicate that lower initial biomass and higher acoustic survey catchability are likely.

We carried out a range of model runs with different priors for those two parameters. This range of models suggested that the spawning stock biomass was above the interim target biomass status of $B_{40}$, but the fishing pressure was likely to be above the interim target of $F_{40}$. Projections resulted in the stock status dropping below its interim target in a number of instances but below the interim limit only in the more extreme of situations. These projections also resulted in fishing pressure exceeding the interim target in many instances, including the more likely scenarios of *M* = 0.045 and *Sum(q)* = 0.9 and catches above 382 t, which is lower than the reference mean 2015-2020 catches of 478 t. Future scenarios that apply an annual F-based catch limit are likely to maintain the fishing pressure below the interim target fishing pressure.

Better informed models could be achieved through better informed *M* and *Sum(q)*. Better estimates of natural mortality may be obtained with further accumulation of age data. In the interim, the commonly used value of 0.045 could be used as a baseline for the normal prior. The value of the sum of acoustic catchabilities is uncertain for numerous reasons, including because the time-series is still short, only some hills have been acoustically surveyed in any one year, and fish may move between hills and years. A continuation of acoustic surveys of hills that have a long time-series should be a priority. Additionally, surveying multiple hills in any one year, although technically difficult to achieve, would be helpful in informing this parameter. Furthermore, some hills that have shown a large decline in acoustic biomass, such as Porky's, should be given priority, to establish whether there has been localised depletion or the acoustic estimates for that hill have high variability.

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# 7. Tables

*Table 1. Glossary of some of the terms used in this document.*

| Term | Definition |
|---|---|
| $B_0$ | Initial unexploited spawning stock biomass |
| $B_{lim}$ | Spawning stock biomass at the limit reference point, the current interim level is 20% $B_0$ |
| $B_{40}$ | Target spawning stock biomass, the current interim target is 40% $B_0$ |
| $B_{MSY}$ | Spawning stock biomass at the maximum sustainable yield |
| *MSY* | Maximum sustainable yield |
| $F$ | The instantaneous fishing mortality rate, often expressed as a rate per year. This is a measure of the proportion of the vulnerable biomass that is expected to be caught at a point in time. Reported in this document as the fishing exploitation rate ($U$), where the annual fishing exploitation rate ($U$) is calculated using the formula $U$=1-exp(-$F$) |
| $F_{MSY}$ | The long-term instantaneous fishing mortality rate that would result in the spawning stock biomass being at the maximum sustainable yield on average. |
| $F_{40}$ | The long-term instantaneous fishing mortality rate that would result in the spawning stock biomass being at 40% $B_0$ on average. |

*Table 2. Observations fitted to by the models.*

| Data series | Model years |
|---|---|
| Age frequency distributions | 2017, 2019, 2020 |
| Acoustics – Sleeping Beauty | 2007, 2009, 2010, 2015, 2018, 2022, 2023 |
| Acoustics – Bounty | 2004, 2007, 2009, 2010, 2015, 2018 |
| Acoustics – Hollows | 2009, 2011 |
| Acoustics – OK Coral | 2015 |
| Acoustics – Porky's | 2015, 2018 |
| Early CPUE | 2002, 2003 – 2006, 2009 – 2012, 2014 |
| Late CPUE | 2019 – 2022 |

*Table 3. Setup and model parameters.*

| Relationship | Parameter (units) | Value |
|---|---|---|
| Ages modelled | | 1-120 |
| Years modelled | | 1885-2023 |
| Length bins in the model | (cm) | 2 to 68 in 2cm bins |
| von Bertalanffy growth (males) | $t_0$ (y) | -4.97 |
| | $k$ ($y^{-1}$) | 0.045 |
| | $L_\infty$ (cm) | 50.56 |
| | CV | 0.10 |
| von Bertalanffy growth (females) | $t_0$ (y) | -0.67 |
| | $k$ ($y^{-1}$) | 0.041 |
| | $L_\infty$ (cm) | 55.71 |
| | CV | 0.10 |
| Length-weight (males) | $a$ ($g.cm^{-1}$) | $0.86e^{-9}$ |
| | $b$ | 2.73 |
| Length-weight (females) | $a$ ($g.cm^{-1}$) | $0.49\ e^{-9}$ |
| | $b$ | 2.90 |
| Stock recruitment relationship: | | |
| Spawning stock biomass definition | *SSB* | Mature males and females |
| Maturity curve (both sexes) | | estimated |
| Stock recruitment steepness | $h$ | 0.57 |
| Ageing error | CV | 0.1 |
| Age at recruitment | (year) | 1 |
| Proportion male at birth | | 0.5 |
| Maximum exploitation rate | $U_{max}$ | 0.6 |
| Natural mortality (both sexes) | $M$ ($year^{-1}$) | estimated |

*Table 4. Parameters estimated in the models and their priors.*

| Parameter | Shape / transformation | Starting value | Prior | | | | Bounds |
|---|---|---|---|---|---|---|---|
| | | | Distribution | Mean | cv | | |
| $B_0$ | Log transform | 50 000 | Uniform | | | 8 | 12.5 |
| Natural mortality (combined) | | 0.045 | Normal | 0.045 | 0.1* | 0.01 | 0.1 |
| Maturity / selectivity (combined) | Logistic | | Uniform | | | | |
| | a50 | | | | | 10 | 100 |
| | ato95 | | | | | 2.5 | 20 |
| Acoustic *q*s | | 0.2 | Uniform | | | $1e^{-4}$ | 0.8 |
| Sum of acoustic *qs* | | 0.8 | Normal | 0.8* | 0.1 | | |
| CPUE *q*s | | 0.01 | Uniform | | | $1e^{-4}$ | 0.8 |

* A range of values were used.

*Table 5. Incremental models build from the 2021 base case to the 2025 initial model run at MPD level. The data were not re-weighted between models until R1.4. The estimated values for natural mortality (M), the acoustic catchability for Sleeping Beauty q(SB) and the sum of acoustic q are also reported.*

| Run | Model label (cv is process error cv) | $SSB_0$ (t) | $SSB_{2023}$ (t) | $SSB_{2020}$ (%) | $SSB_{2023}$ (%) | *M* | *q*(SB) | Sum *q* | Maturity $a_{50}$ |
|---|---|---|---|---|---|---|---|---|---|
| | Model 2021 (MCMC values) | 29 984 | | 62 (34-103) | | 0.042 | 0.23 | | |
| R0.1 | Update to Casal2 | 28 786 | | 58.0 | | 0.041 | 0.21 | | 30.7 |
| R0.2 | Add acoustic process error estimation | 27 759 | | 61.2 | | 0.042 | 0.19 | | 34.0 |
| R0.3 | 2023 update catches | 27 759 | 16 998 | 61.2 | 61.2 | 0.042 | 0.19 | | 34.0 |
| R0.4 | 2023 update acoustics | 38 482 | 27 067 | 70.3 | 70.3 | 0.042 | 0.19 | | 32.5 |
| R0.5 | YCS not estimated | 38 166 | 28 385 | 74.5 | 74.4 | 0.041 | 0.19 | | 33.6 |
| R0.6 | Update biological parameters | 38 456 | 27 972 | 72.7 | 72.4 | 0.041 | 0.19 | | 33.6 |
| R1.0 | priors cv 0.1 | 37 143 | 26 938 | 72.5 | 72.2 | 0.043 | 0.20 | | 34.5 |
| R1.1 | Sum acoustic *q* prior 0.8 | 26 712 | 16 224 | 60.7 | 60.2 | 0.041 | 0.28 | 0.84 | 34.0 |
| R1.2 | Add AF 2019 2020 | 26 100 | 15 888 | 60.9 | 60.7 | 0.046 | 0.28 | 0.86 | 31.3 |
| R1.3 | Add CPUE | 26 177 | 15 970 | 61.0 | 60.8 | 0.046 | 0.28 | 0.85 | 31.3 |
| R1.4 | Reweight AF | 26 636 | 16 061 | 60.3 | 60.0 | 0.044 | 0.28 | 0.85 | 30.3 |
| R2.0 | Upweight AF and wider q cv | 19 501 | 9 213 | 47.7 | 47.2 | 0.045 | 0.46 | 1.37 | 32.7 |

*Table 6. MCMC results of the sensitivity runs. Values provided are medians unless otherwise stated. Results are provided for natural mortality (M), the sum of the acoustic catchabilities sum(q), the total negative log likelihood (NLL, not reported when not comparable), initial biomass ($B_0$) and biomass in 2023 ($B_{2023}$) mean and 95% credible interval (CI), the percentage of MCMC chains where $B_{2023}$ was above 40% $B_0$, $B_{MSY}$, $F_{40}$ and $F_{MSY}$, the 2024 total allowable catch (TAC) corresponding to $F_{40}$ and $F_{MSY}$ and the estimated maturity $a_{50}$. * denotes the cv on the Sum(q) prior was increased from 0.1 to 0.4 for this run.*

| Run | *M* prior | *M* | Sum(*q*) prior | Sum(*q*) | NLL | $B_0$ (t) | $B_0$ CI (t) | $B_{2023}$ (%$B_0$) | $B_{2023}$ CI (%$B_0$) | $B_{2023}$>40%$B_0$ (%) | $F_{40}$ | $B_{MSY}$ (%$B_0$) | $F_{MSY}$ | $TAC_{F40}$ (t) | $TAC_{FMSY}$ (t) | Maturity a50 (years) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R1.51 | 0.024 | 0.025 | 0.7 | 0.78 | 79.2 | 29 169 | (25 591 – 34 003) | 55.3 | (49.0 - 61.9) | 100.0 | 0.018 | 30.8 | 0.025 | 300 | 402 | 28.3 |
| R1.5 | 0.024 | 0.025 | 0.8 | 0.89 | 78.1 | 26 726 | (23 658 – 30 855) | 51.3 | (44.8 - 58.1) | 100.0 | 0.018 | 30.7 | 0.025 | 255 | 347 | 28.6 |
| R1.52 | 0.024 | 0.025 | 0.9 | 1.00 | 77.1 | 24 802 | (22 060 – 28 419) | 47.6 | (41.0 - 54.5) | 98.8 | 0.018 | 30.6 | 0.025 | 220 | 301 | 29.1 |
| R1.53 | 0.024 | 0.025 | 1.0 | 1.12 | 76.2 | 23 334 | (20 868 – 26 507) | 44.3 | (37.6 - 51.3) | 90.5 | 0.018 | 30.5 | 0.025 | 193 | 264 | 29.4 |
| R1.41 | 0.045 | 0.044 | 0.7 | 0.77 | 78.7 | 28 156 | (24 459 – 33 129) | 62.9 | (56.5 - 69.1) | 100.0 | 0.033 | 30.9 | 0.045 | 596 | 797 | 31.2 |
| R1.4 | 0.045 | 0.043 | 0.8 | 0.88 | 77.9 | 25 627 | (22 409 – 30 034) | 59.3 | (52.4 - 66.1) | 100.0 | 0.033 | 30.8 | 0.045 | 513 | 685 | 31.5 |
| R1.42 | 0.045 | 0.043 | 0.9 | 0.99 | 77.1 | 23 673 | (20 742 – 27 520) | 55.9 | (48.8 - 62.7) | 100.0 | 0.033 | 30.8 | 0.045 | 446 | 595 | 31.8 |
| R1.43 | 0.045 | 0.043 | 1.0 | 1.10 | 76.3 | 22 127 | (19 497 – 25 685) | 52.7 | (45.5 - 60.1) | 100.0 | 0.033 | 30.8 | 0.044 | 388 | 521 | 31.8 |
| R1.61 | 0.058 | 0.054 | 0.7 | 0.76 | 79.7 | 27 562 | (23 709 – 32 714) | 66.9 | (60.1 - 73.6) | 100.0 | 0.043 | 30.4 | 0.058 | 799 | 1 087 | 32.9 |
| R1.6 | 0.058 | 0.054 | 0.8 | 0.87 | 79.0 | 25 078 | (21 725 – 29 548) | 63.5 | (56.3 - 70.6) | 100.0 | 0.043 | 30.4 | 0.058 | 690 | 938 | 33.0 |
| R1.62 | 0.058 | 0.054 | 0.9 | 0.98 | 78.3 | 23 114 | (20 083 – 27 048) | 60.3 | (53.0 - 67.8) | 100.0 | 0.043 | 30.4 | 0.058 | 597 | 814 | 33.2 |
| R1.63 | 0.058 | 0.053 | 1.0 | 1.09 | 77.6 | 21 538 | (18 712 – 25 219) | 57.3 | (49.5 - 65.2) | 100.0 | 0.042 | 30.3 | 0.058 | 525 | 722 | 33.5 |

*Table 7. Projected mean stock status in five-year intervals for the different sensitivity runs and different future catches. Cells highlighted in red represent scenarios which do not satisfy the interim target (50% probability of being above 40% $B_0$). A future catch of 478 t (rows in bold) represents the 2015-2020 average catch, and the other future catches are ±10, 20, 30 or 40% of that value.*

| **Run** | **Future catch scenario** | **R1.5** | **R1.51** | **R1.52** | **R1.53** | **R1.4** | **R1.41** | **R1.42** | **R1.43** | **R1.6** | **R1.61** | **R1.62** | **R1.63** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***M* prior** | | 0.024 | 0.024 | 0.024 | 0.024 | 0.045 | 0.045 | 0.045 | 0.045 | 0.058 | 0.058 | 0.058 | 0.058 |
| **Sum(*q*) prior** | | 0.8 | 0.7 | 0.9 | 1.0 | 0.7 | 0.8 | 0.9 | 1.0 | 0.8 | 0.7 | 0.9 | 1.0 |
| $B_{2028}$ | 287 t | 49.7 | 53.8 | 45.9 | 42.5 | 59.9 | 63.5 | 56.5 | 53.4 | 64.9 | 68.3 | 61.8 | 59.0 |
| (%$B_0$) | 335 t | 49.0 | 53.2 | 45.1 | 41.7 | 59.1 | 62.8 | 55.8 | 52.5 | 64.3 | 67.6 | 61.1 | 58.2 |
| | 382 t | 48.3 | 52.5 | 44.3 | 40.9 | 58.5 | 62.2 | 55.0 | 51.7 | 63.6 | 67.0 | 60.3 | 57.4 |
| | 430 t | 47.5 | 51.8 | 43.5 | 40.0 | 57.7 | 61.5 | 54.2 | 50.9 | 62.9 | 66.4 | 59.6 | 56.6 |
| | **478 t** | **46.8** | **51.1** | **42.7** | **39.2** | **57.0** | **60.9** | **53.5** | **50.1** | **62.2** | **65.8** | **58.8** | **55.8** |
| | 526 t | 46.0 | 50.4 | 41.9 | 38.3 | 56.3 | 60.2 | 52.7 | 49.3 | 61.5 | 65.1 | 58.1 | 55.0 |
| | 574 t | 45.3 | 49.7 | 41.1 | 37.5 | 55.6 | 59.6 | 52.0 | 48.5 | 60.9 | 64.5 | 57.4 | 54.3 |
| | 621 t | 44.6 | 49.1 | 40.4 | 36.7 | 54.9 | 58.9 | 51.2 | 47.7 | 60.2 | 63.9 | 56.6 | 53.5 |
| | 669 t | 43.8 | 48.4 | 39.6 | 35.8 | 54.2 | 58.3 | 50.5 | 46.9 | 59.5 | 63.3 | 55.9 | 52.7 |
| | $F_{40}$ (5 years) | 50.3 | 53.8 | 47.2 | 44.3 | 56.7 | 59.4 | 54.1 | 51.7 | 59.3 | 61.6 | 56.9 | 55.1 |
| | $F_{40}$ (annual) | 50.4 | 53.8 | 47.2 | 44.3 | 56.8 | 59.6 | 54.2 | 51.8 | 59.5 | 61.9 | 57.1 | 55.3 |
| | $F_{MSY}$ (5 years) | 48.9 | 52.2 | 45.8 | 43.0 | 54.0 | 56.6 | 51.6 | 49.5 | 55.8 | 58.0 | 53.7 | 51.9 |
| | $F_{MSY}$ (annual) | 49.0 | 52.3 | 45.9 | 43.1 | 54.3 | 56.9 | 51.9 | 49.7 | 56.4 | 58.6 | 54.2 | 52.2 |
| $B_{2033}$ | 287 t | 48.6 | 52.8 | 44.7 | 41.2 | 60.7 | 64.3 | 57.4 | 54.3 | 66.5 | 69.7 | 63.4 | 60.7 |
| (%$B_0$) | 335 t | 47.1 | 51.4 | 43.1 | 39.5 | 59.3 | 63.0 | 55.9 | 52.6 | 65.1 | 68.4 | 61.9 | 59.1 |
| | 382 t | 45.6 | 50.0 | 41.4 | 37.8 | 57.8 | 61.7 | 54.4 | 51.0 | 63.7 | 67.2 | 60.5 | 57.6 |
| | 430 t | 44.0 | 48.6 | 39.8 | 36.0 | 56.4 | 60.3 | 52.8 | 49.3 | 62.4 | 65.9 | 59.0 | 56.0 |
| | **478 t** | **42.5** | **47.2** | **38.1** | **34.2** | **55.0** | **59.0** | **51.3** | **47.7** | **61.0** | **64.7** | **57.5** | **54.4** |
| | 526 t | 40.9 | 45.8 | 36.5 | 32.5 | 53.5 | 57.7 | 49.7 | 46.0 | 59.7 | 63.4 | 56.0 | 52.8 |
| | 574 t | 39.4 | 44.3 | 34.8 | 30.7 | 52.1 | 56.4 | 48.2 | 44.4 | 58.3 | 62.2 | 54.6 | 51.3 |
| | 621 t | 37.9 | 43.0 | 33.2 | 29.1 | 50.7 | 55.1 | 46.7 | 42.8 | 57.0 | 61.0 | 53.2 | 49.7 |
| | 669 t | 36.4 | 41.5 | 31.6 | 27.3 | 49.3 | 53.8 | 45.2 | 41.2 | 55.6 | 59.8 | 51.7 | 48.2 |
| | $F_{40}$ (5 years) | 50.0 | 52.9 | 47.3 | 45.0 | 54.6 | 56.6 | 52.8 | 51.0 | 55.8 | 57.3 | 54.3 | 53.3 |
| | $F_{40}$ (annual) | 50.0 | 52.9 | 47.4 | 45.0 | 54.8 | 56.8 | 52.9 | 51.1 | 56.2 | 57.8 | 54.6 | 53.5 |
| | $F_{MSY}$ (5 years) | 47.1 | 49.7 | 44.6 | 42.4 | 49.7 | 51.4 | 48.2 | 47.0 | 50.0 | 51.2 | 48.7 | 47.7 |
| | $F_{MSY}$ (annual) | 47.2 | 49.9 | 44.8 | 42.5 | 50.3 | 52.1 | 48.7 | 47.3 | 50.9 | 52.3 | 49.5 | 48.3 |
| $B_{2038}$ | 287 t | 47.5 | 51.8 | 43.5 | 39.9 | 61.2 | 64.8 | 58.0 | 54.9 | 67.5 | 70.6 | 64.5 | 61.8 |
| (%$B_0$) | 335 t | 45.2 | 49.7 | 41.0 | 37.3 | 59.1 | 62.9 | 55.8 | 52.5 | 65.5 | 68.8 | 62.4 | 59.6 |
| | 382 t | 42.9 | 47.6 | 38.6 | 34.7 | 57.1 | 61.0 | 53.6 | 50.1 | 63.6 | 67.1 | 60.3 | 57.3 |
| | 430 t | 40.6 | 45.5 | 36.1 | 32.1 | 55.0 | 59.1 | 51.3 | 47.7 | 61.7 | 65.3 | 58.2 | 55.0 |
| | **478 t** | **38.3** | **43.4** | **33.7** | **29.5** | **52.9** | **57.2** | **49.1** | **45.3** | **59.7** | **63.5** | **56.0** | **52.8** |
| | 526 t | 36.0 | 41.3 | 31.2 | 26.9 | 50.9 | 55.3 | 46.8 | 42.9 | 57.8 | 61.7 | 53.9 | 50.6 |
| | 574 t | 33.8 | 39.2 | 28.8 | 24.3 | 48.8 | 53.4 | 44.6 | 40.5 | 55.8 | 60.0 | 51.9 | 48.3 |
| | 621 t | 31.5 | 37.1 | 26.4 | 21.7 | 46.8 | 51.6 | 42.4 | 38.2 | 54.0 | 58.3 | 49.8 | 46.2 |
| | 669 t | 29.2 | 35.0 | 23.9 | 19.2 | 44.7 | 49.7 | 40.2 | 35.8 | 52.0 | 56.5 | 47.8 | 44.0 |
| | $F_{40}$ (5 years) | 49.6 | 52.0 | 47.4 | 45.5 | 52.8 | 54.2 | 51.6 | 50.2 | 53.2 | 54.2 | 52.1 | 51.8 |
| | $F_{40}$ (annual) | 49.7 | 52.1 | 47.4 | 45.5 | 53.1 | 54.6 | 51.8 | 50.3 | 53.6 | 54.8 | 52.5 | 52.1 |
| | $F_{MSY}$ (5 years) | 45.6 | 47.7 | 43.6 | 41.9 | 46.6 | 47.7 | 45.6 | 45.0 | 46.1 | 46.9 | 45.3 | 44.8 |
| | $F_{MSY}$ (annual) | 45.8 | 48.0 | 43.8 | 42.0 | 47.2 | 48.5 | 46.2 | 45.4 | 47.1 | 48.0 | 46.2 | 45.5 |
| $B_{2043}$ | 287 t | 46.3 | 50.8 | 42.2 | 38.5 | 61.4 | 65.0 | 58.1 | 55.0 | 67.9 | 71.0 | 64.9 | 62.2 |
| (%$B_0$) | 335 t | 43.3 | 48.0 | 38.9 | 35.0 | 58.7 | 62.6 | 55.3 | 51.9 | 65.5 | 68.8 | 62.3 | 59.4 |
| | 382 t | 40.3 | 45.3 | 35.8 | 31.6 | 56.1 | 60.2 | 52.5 | 48.9 | 63.1 | 66.6 | 59.7 | 56.6 |
| | 430 t | 37.3 | 42.5 | 32.5 | 28.2 | 53.5 | 57.8 | 49.6 | 45.8 | 60.6 | 64.4 | 57.0 | 53.8 |
| | **478 t** | **34.3** | **39.7** | **29.3** | **24.8** | **50.9** | **55.3** | **46.8** | **42.8** | **58.3** | **62.2** | **54.4** | **51.0** |
| | 526 t | 31.3 | 37.0 | 26.1 | 21.3 | 48.2 | 52.9 | 44.0 | 39.8 | 55.8 | 60.0 | 51.8 | 48.2 |
| | 574 t | 28.3 | 34.2 | 22.9 | 18.0 | 45.6 | 50.5 | 41.1 | 36.7 | 53.4 | 57.8 | 49.2 | 45.4 |
| | 621 t | 25.4 | 31.5 | 19.8 | 14.7 | 43.0 | 48.2 | 38.4 | 33.8 | 51.1 | 55.7 | 46.7 | 42.7 |
| | 669 t | 22.4 | 28.8 | 16.6 | 11.4 | 40.4 | 45.8 | 35.6 | 30.8 | 48.7 | 53.5 | 44.1 | 40.0 |
| | $F_{40}$ (5 years) | 49.2 | 51.2 | 47.3 | 45.7 | 51.3 | 52.3 | 50.3 | 49.2 | 51.1 | 51.9 | 50.3 | 50.3 |
| | $F_{40}$ (annual) | 49.2 | 51.3 | 47.3 | 45.7 | 51.5 | 52.7 | 50.5 | 49.4 | 51.6 | 52.4 | 50.7 | 50.6 |
| | $F_{MSY}$ (5 years) | 44.1 | 45.9 | 42.6 | 41.2 | 44.2 | 44.9 | 43.5 | 43.2 | 43.6 | 44.1 | 43.0 | 42.6 |
| | $F_{MSY}$ (annual) | 44.4 | 46.2 | 42.8 | 41.3 | 44.8 | 45.7 | 44.0 | 43.6 | 44.5 | 45.1 | 43.8 | 43.3 |

*Table 8. Projected percentage of simulations where the exploitation rate exceeds the target exploitation rate ($F_{40}$). Cells highlighted in red represent scenarios which do not satisfy the interim target (50% probability of being below $F_{40}$). A future catch of 478 t (rows in bold) represents the 2015-2020 average catch, and the other future catches are ±10, 20, 30 or 40% of that value.*

| Run | Future catch scenario | R1.5 | R1.51 | R1.52 | R1.53 | R1.4 | R1.41 | R1.42 | R1.43 | R1.6 | R1.61 | R1.62 | R1.63 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***M* prior** | | 0.024 | 0.024 | 0.024 | 0.024 | 0.045 | 0.045 | 0.045 | 0.045 | 0.058 | 0.058 | 0.058 | 0.058 |
| **Sum(*q*) prior** | | 0.8 | 0.7 | 0.9 | 1.0 | 0.8 | 0.7 | 0.9 | 1.0 | 0.8 | 0.7 | 0.9 | 1.0 |
| $F_{2026}$ | 287 | 89.5 | 51.7 | 99 | 100 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| $>F_{40}$ | 335 | 99.1 | 89 | 100 | 100 | 0 | 0 | 1.7 | 14 | 0 | 0 | 0 | 0 |
| (%) | 382 | 100 | 98.5 | 100 | 100 | 1.2 | 0 | 16.3 | 51.7 | 0 | 0 | 0 | 0.7 |
| | 430 | 100 | 99.9 | 100 | 100 | 12 | 0.5 | 50.4 | 83.1 | 0 | 0 | 0.3 | 7.2 |
| | **478** | **100** | **100** | **100** | **100** | **40.4** | **6** | **81.2** | **96.2** | **0.1** | **0** | **3.8** | **29.1** |
| | 526 | 100 | 100 | 100 | 100 | 70.7 | 23.8 | 95 | 99.3 | 1.7 | 0 | 16.9 | 59.7 |
| | 574 | 100 | 100 | 100 | 100 | 89 | 51.6 | 98.9 | 99.9 | 9.4 | 0.4 | 43.2 | 83.8 |
| | 621 | 100 | 100 | 100 | 100 | 96.8 | 75.9 | 99.8 | 100 | 25.9 | 2.8 | 68.7 | 94.3 |
| | 669 | 100 | 100 | 100 | 100 | 99.1 | 90.9 | 100 | 100 | 50.5 | 10.6 | 86 | 98.2 |
| | $F_{40}$ (5 years) | 100 | 100 | 99.6 | 97.7 | 100 | 100 | 99.7 | 97.8 | 100 | 100 | 100 | 99.8 |
| | $F_{40}$ (annual) | 48.6 | 47.8 | 47.6 | 48.4 | 48.8 | 48.8 | 48.4 | 49.4 | 49.5 | 49.9 | 50.5 | 47.9 |
| | $F_{MSY}$ (5 years) | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | $F_{MSY}$ (annual) | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| $F_{2028}$ | 287 | 90.4 | 54.3 | 99.2 | 100 | 0 | 0 | 0 | 0.9 | 0 | 0 | 0 | 0 |
| $>F_{40}$ | 335 | 99.4 | 90.5 | 100 | 100 | 0 | 0 | 1.7 | 14.4 | 0 | 0 | 0 | 0 |
| (%) | 382 | 100 | 98.8 | 100 | 100 | 1.6 | 0 | 17.7 | 53.5 | 0 | 0 | 0 | 0.7 |
| | 430 | 100 | 99.9 | 100 | 100 | 14 | 0.7 | 54.2 | 85 | 0 | 0 | 0.4 | 8.3 |
| | **478** | **100** | **100** | **100** | **100** | **45.3** | **7.8** | **83.9** | **97** | **0.2** | **0** | **4.8** | **32.5** |
| | 526 | 100 | 100 | 100 | 100 | 75.7 | 29.4 | 96.1 | 99.6 | 2.7 | 0 | 21.1 | 64.7 |
| | 574 | 100 | 100 | 100 | 100 | 92 | 58.3 | 99.3 | 99.9 | 12.8 | 0.6 | 49.5 | 86.7 |
| | 621 | 100 | 100 | 100 | 100 | 97.9 | 81.4 | 99.9 | 100 | 33 | 4.4 | 74.7 | 96 |
| | 669 | 100 | 100 | 100 | 100 | 99.5 | 93.6 | 100 | 100 | 59.7 | 15.6 | 90.3 | 98.9 |
| | $F_{40}$ (5 years) | 97.9 | 99.9 | 88.5 | 67.9 | 100 | 100 | 99.1 | 92.1 | 100 | 100 | 100 | 99.5 |
| | $F_{40}$ (annual) | 48.6 | 48.7 | 49.3 | 48.2 | 48.5 | 47.6 | 48.4 | 48.3 | 49.7 | 49.9 | 49.8 | 47.1 |
| | $F_{MSY}$ (5 years) | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | $F_{MSY}$ (annual) | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| $F_{2033}$ | 287 | 92.4 | 59.6 | 99.3 | 100 | 0 | 0 | 0 | 0.7 | 0 | 0 | 0 | 0 |
| $>F_{40}$ | 335 | 99.7 | 93.2 | 100 | 100 | 0 | 0 | 1.9 | 15 | 0 | 0 | 0 | 0 |
| (%) | 382 | 100 | 99.3 | 100 | 100 | 2.6 | 0.1 | 21.2 | 57.3 | 0 | 0 | 0 | 0.9 |
| | 430 | 100 | 100 | 100 | 100 | 20 | 1.3 | 61.7 | 88.7 | 0 | 0 | 0.7 | 10.9 |
| | **478** | **100** | **100** | **100** | **100** | **56.5** | **13.4** | **89.3** | **98.2** | **0.5** | **0** | **8** | **41.2** |
| | 526 | 100 | 100 | 100 | 100 | 84.3 | 42.4 | 97.9 | 99.8 | 5.6 | 0.2 | 32.2 | 74.8 |
| | 574 | 100 | 100 | 100 | 100 | 95.9 | 73.1 | 99.7 | 100 | 22.9 | 2.2 | 64.3 | 92.1 |
| | 621 | 100 | 100 | 100 | 100 | 99.1 | 90.9 | 100 | 100 | 50.8 | 11.1 | 85.8 | 98.2 |
| | 669 | 100 | 100 | 100 | 100 | 99.9 | 97.4 | 100 | 100 | 75.8 | 31.2 | 96 | 99.6 |
| | $F_{40}$ (5 years) | 75.3 | 96.6 | 38.5 | 14.2 | 100 | 100 | 97.4 | 82.4 | 100 | 100 | 100 | 99.2 |
| | $F_{40}$ (annual) | 48.3 | 48.6 | 48 | 49.7 | 48.1 | 48.1 | 49 | 49.2 | 50.8 | 49.6 | 50.7 | 47.7 |
| | $F_{MSY}$ (5 years) | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | $F_{MSY}$ (annual) | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| $F_{2038}$ | 287 | 93.7 | 64.6 | 99.4 | 100 | 0 | 0 | 0 | 0.7 | 0 | 0 | 0 | 0 |
| $>F_{40}$ | 335 | 99.8 | 95.2 | 100 | 100 | 0.1 | 0 | 2.3 | 16.2 | 0 | 0 | 0 | 0 |
| (%) | 382 | 100 | 99.6 | 100 | 100 | 3.8 | 0.1 | 25.5 | 61.7 | 0 | 0 | 0 | 1.2 |
| | 430 | 100 | 100 | 100 | 100 | 27 | 2.8 | 68.8 | 92 | 0 | 0 | 1.3 | 14.4 |
| | **478** | **100** | **100** | **100** | **100** | **66.5** | **20.8** | **93.1** | **99** | **1.2** | **0** | **12.2** | **49.6** |
| | 526 | 100 | 100 | 100 | 100 | 90.1 | 55 | 99 | 99.9 | 10.4 | 0.5 | 43.1 | 82.6 |
| | 574 | 100 | 100 | 100 | 100 | 98 | 83.2 | 99.9 | 100 | 34.7 | 5.4 | 75.3 | 95.7 |
| | 621 | 100 | 100 | 100 | 100 | 99.6 | 95.3 | 100 | 100 | 65.5 | 21.3 | 92.1 | 99.1 |
| | 669 | 100 | 100 | 100 | 100 | 100 | 99 | 100 | 100 | 86.5 | 46.8 | 98.2 | 99.8 |
| | $F_{40}$ (5 years) | 78 | 97.2 | 40.9 | 15.5 | 100 | 100 | 98.9 | 90.9 | 100 | 100 | 100 | 99.8 |
| | $F_{40}$ (annual) | 47.3 | 47.1 | 50.1 | 48.3 | 49.3 | 48.5 | 47.5 | 49 | 48.9 | 49.3 | 50.2 | 47.6 |
| | $F_{MSY}$ (5 years) | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | $F_{MSY}$ (annual) | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| $F_{2043}$ | 287 | 95 | 69.1 | 99.5 | 100 | 0 | 0 | 0 | 0.8 | 0 | 0 | 0 | 0 |
| $>F_{40}$ | 335 | 99.8 | 96.4 | 100 | 100 | 0.2 | 0 | 3.3 | 18.8 | 0 | 0 | 0 | 0 |

| Run | Future catch scenario | R1.5 | R1.51 | R1.52 | R1.53 | R1.4 | R1.41 | R1.42 | R1.43 | R1.6 | R1.61 | R1.62 | R1.63 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***M* prior** | | 0.024 | 0.024 | 0.024 | 0.024 | 0.045 | 0.045 | 0.045 | 0.045 | 0.058 | 0.058 | 0.058 | 0.058 |
| **Sum(*q*) prior** | | 0.8 | 0.7 | 0.9 | 1.0 | 0.8 | 0.7 | 0.9 | 1.0 | 0.8 | 0.7 | 0.9 | 1.0 |
| **(%)** | 382 | 100 | 99.8 | 100 | 100 | 5.6 | 0.1 | 30.8 | 67.3 | 0 | 0 | 0 | 1.7 |
| | 430 | 100 | 100 | 100 | 100 | 35.4 | 5.2 | 75.5 | 94.3 | 0.1 | 0 | 2.3 | 19.2 |
| | **478** | **100** | **100** | **100** | **100** | **74.4** | **29.7** | **95.5** | **99.4** | **2.8** | **0.1** | **18.6** | **58.8** |
| | 526 | 100 | 100 | 100 | 100 | 93.7 | 66 | 99.5 | 100 | 16.7 | 1.5 | 54.4 | 87.7 |
| | 574 | 100 | 100 | 100 | 100 | 98.9 | 89.7 | 100 | 100 | 47.3 | 10.4 | 83.2 | 97.5 |
| | 621 | 100 | 100 | 100 | 100 | 99.9 | 97.6 | 100 | 100 | 75.9 | 32.7 | 95.6 | 99.5 |
| | 669 | 100 | 100 | 100 | 100 | 100 | 99.5 | 100 | 100 | 92.3 | 61.1 | 99.3 | 99.9 |
| | $F_{40}$ (5 years) | 90.1 | 99.2 | 61.7 | 29.8 | 100 | 100 | 99.9 | 99.1 | 100 | 100 | 100 | 100 |
| | $F_{40}$ (annual) | 49.4 | 48.4 | 47.6 | 49.2 | 48.7 | 48.4 | 47.8 | 49 | 50.4 | 49.4 | 50.2 | 47.9 |
| | $F_{MSY}$ (5 years) | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | $F_{MSY}$ (annual) | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

# 8. Figures

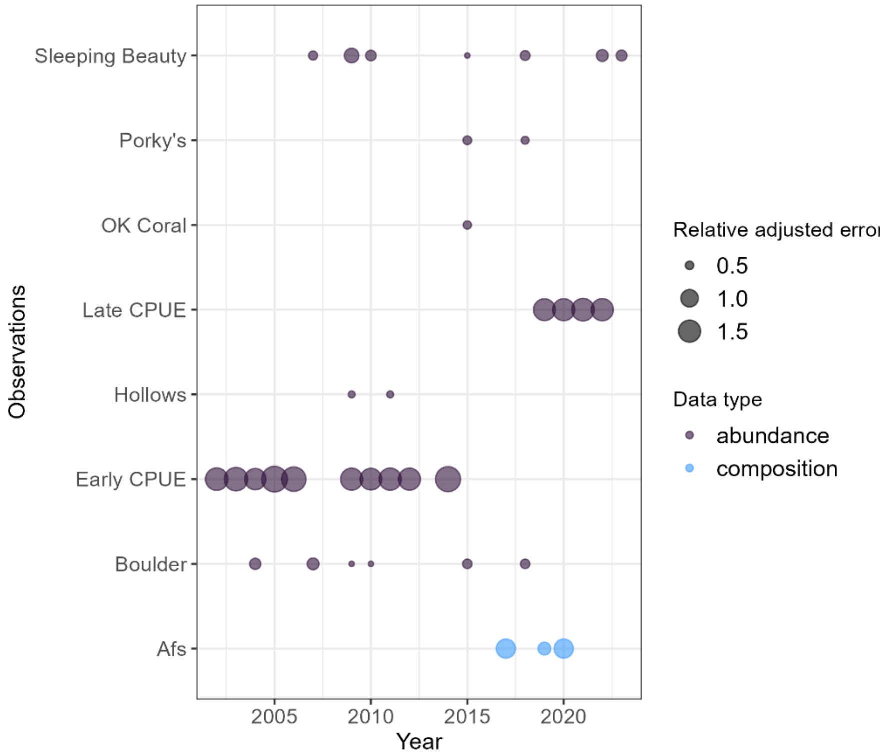


*Figure 2. Observations included in the base case model (R1.4) and their relative adjusted error (CV and additional process error combined). The adjusted errors of abundance and composition data are not comparable and are plotted as different colours. AFs represents age frequency distributions, CPUE are the standardised catch per unit effort series, and the other datasets are acoustic series for the feature named.*

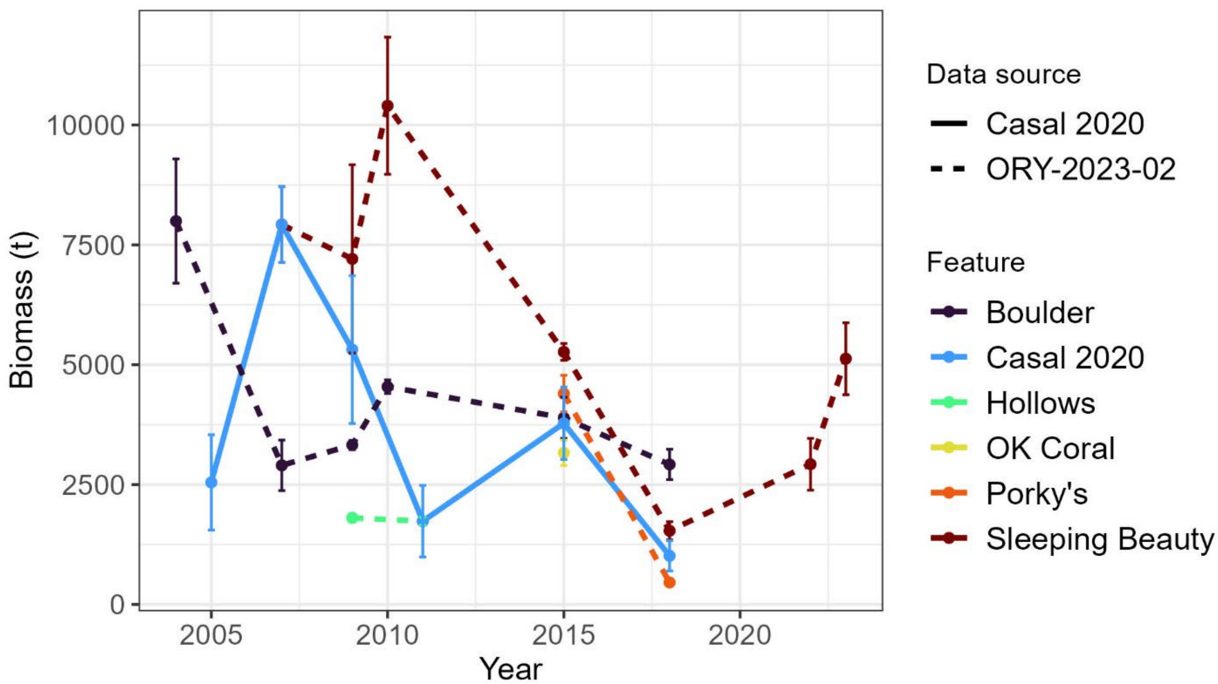


*Figure 3. Acoustic biomass estimates for the Walter Shoal Ridge for each feature based on the 2023 data (labelled ORY-2023-02 as per the project for which they were calculated), and the estimates of Sleeping Beauty used in the 2021 assessment (labelled Casal 2020).*

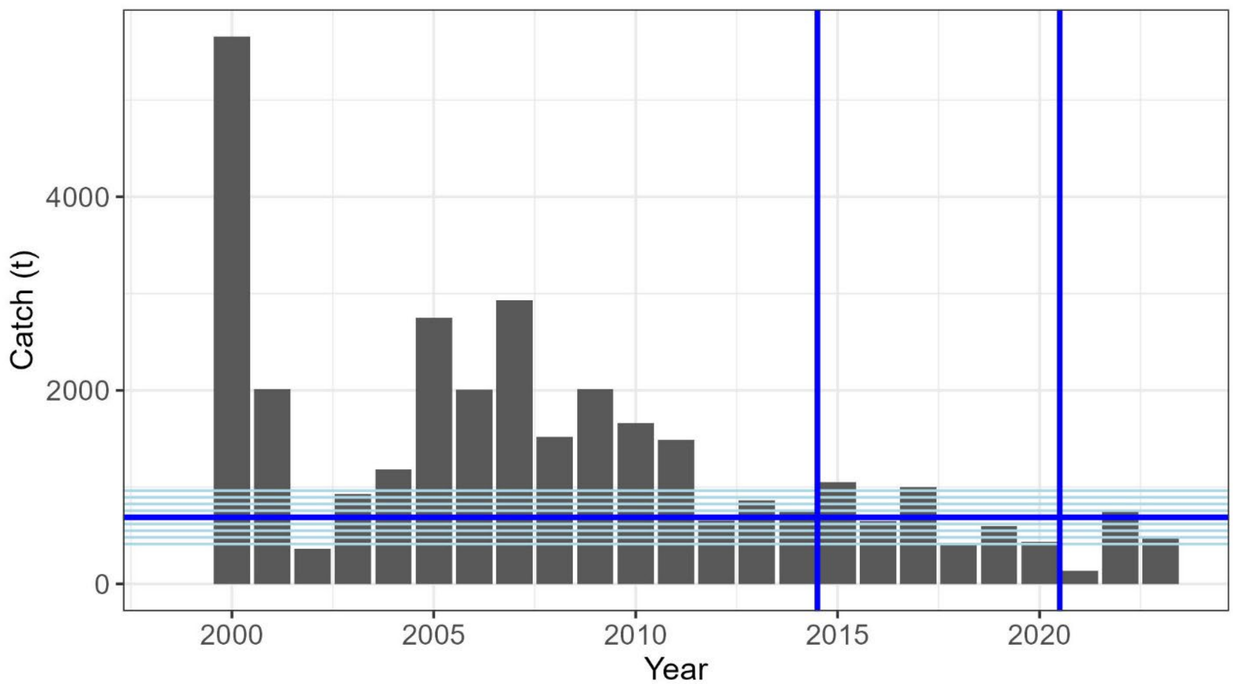


*Figure 4. Historic catches used in the stock assessment models, and level of projected catches: average of 2015-2020 (vertical dark blue lines) catches (horizontal dark blue line) and ±10%, ±20%, ±30%, ±40% of the 2015-2020 level (horizontal light blue lines).*

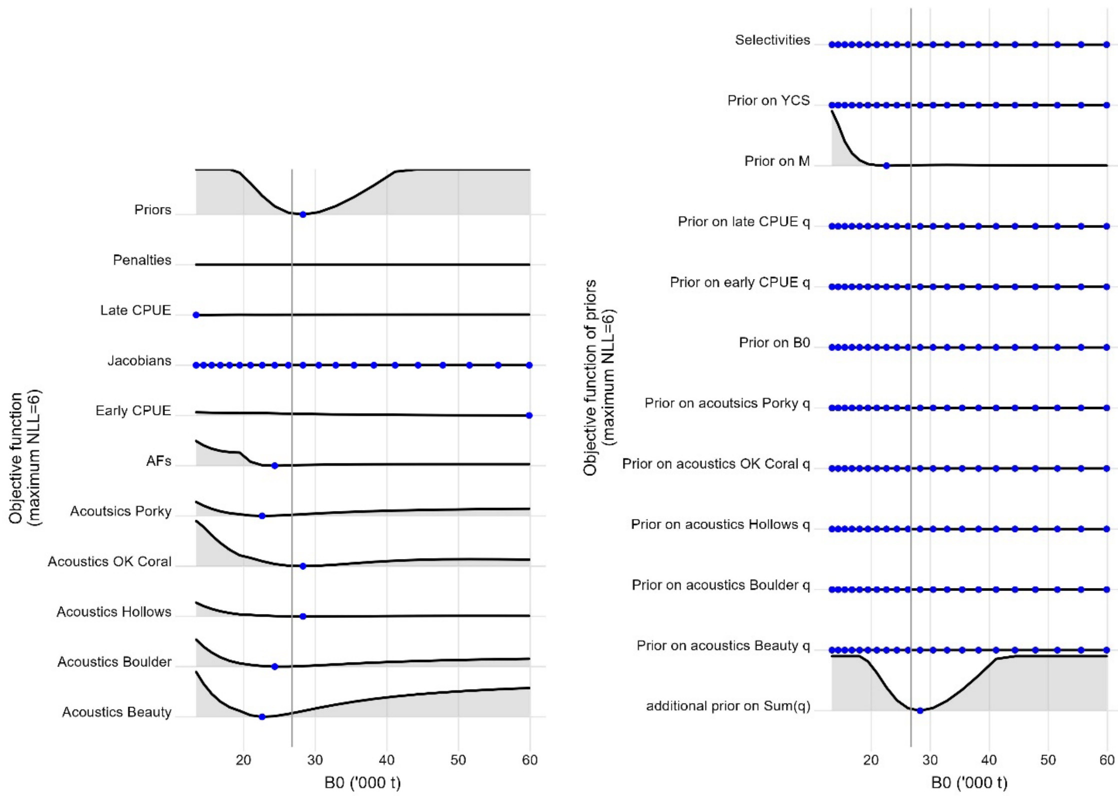


*Figure 5. Base case model (R1.4) MPD profile on $B_0$ (left) and of the prior contributions to $B_0$ (right). The blue dot represents the minimum for each series and the vertical line is the MPD estimated value. The maximum negative log likelihood (NLL) difference plotted is given in the y axis.*

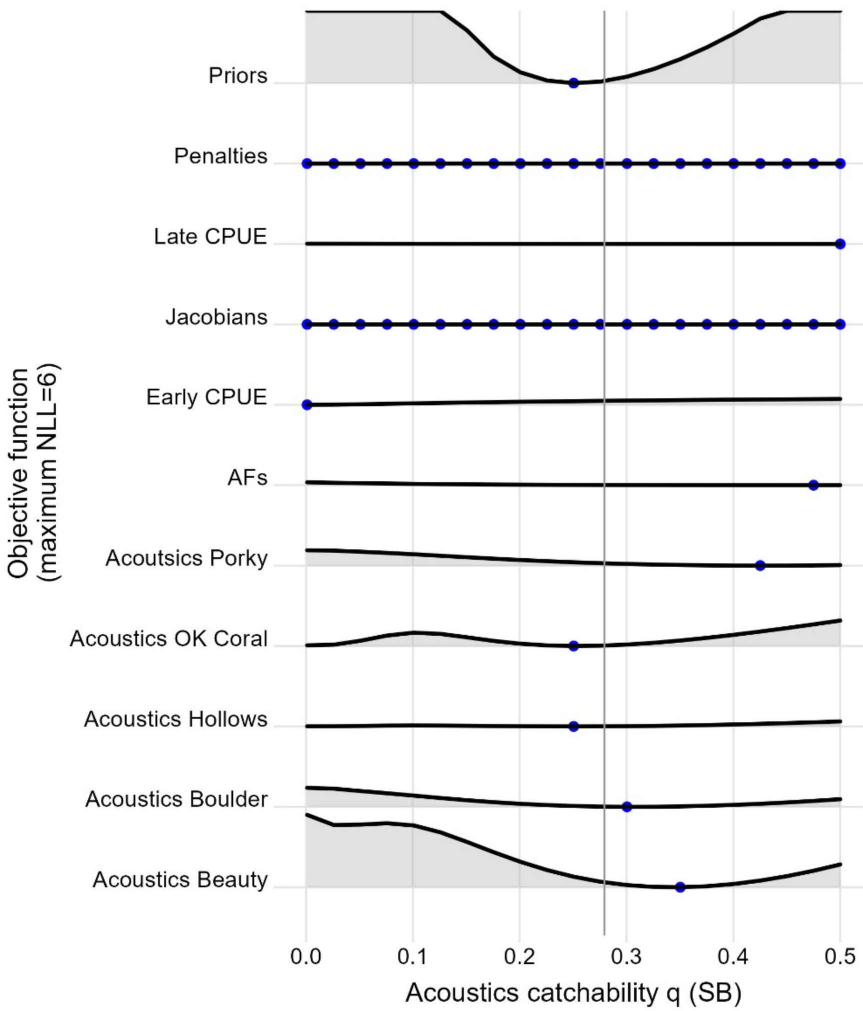


*Figure 6. Base case model (R1.4) MPD profile on the acoustic catchability parameter q for the Sleeping Beauty feature (SB). The blue dot represents the minimum for each series and the vertical line is the MPD estimated value. The maximum negative log likelihood (NLL) difference plotted is given in the y axis.*

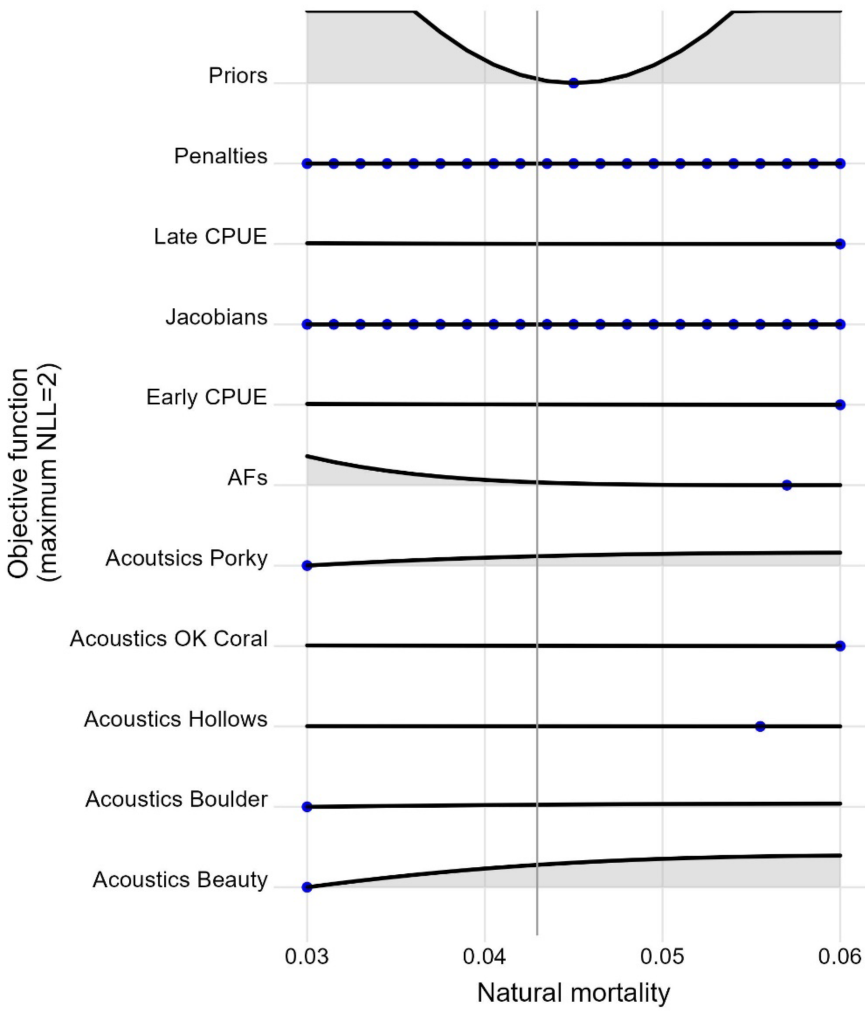


*Figure 7. Base case model (R1.4) MPD profile on natural mortality (M). The blue dot represents the minimum for each series and the vertical line is the MPD estimated value. The maximum negative log likelihood (NLL) difference plotted is given in the y axis.*

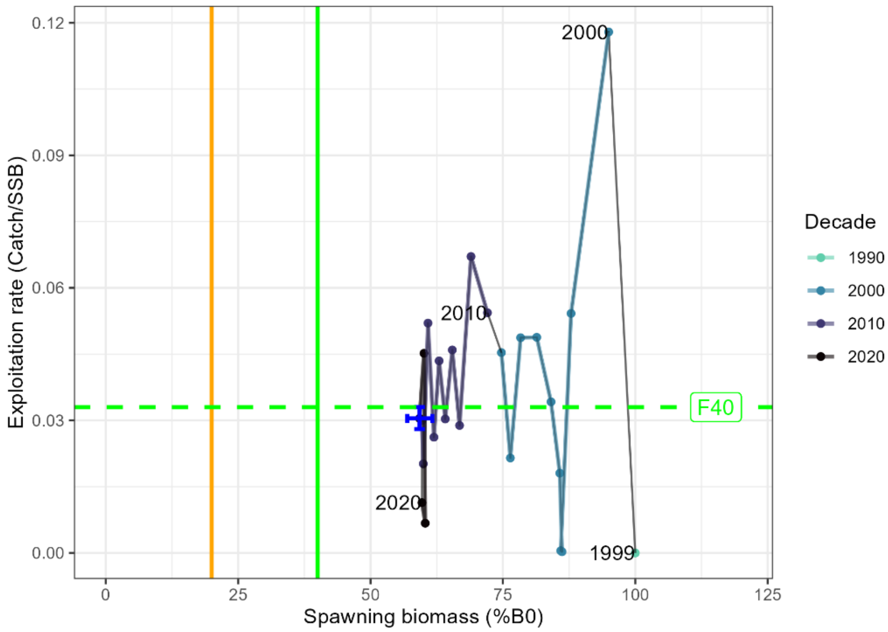


*Figure 8. Base case model (R1.4) Kobe plot: trajectory over time of exploitation rate (catch/SSB) and spawning biomass (% $B_0$). The red vertical line at 10% $B_0$ represents the hard limit, the orange line at 20% $B_0$ is the soft limit, and green lines are the % $B_0$ target (40% $B_0$) and the corresponding exploitation rate (catch divided by SSB $F_{40}$ = 0.176 under average recruitment assumptions). Biomass and exploitation rate estimates are medians from posterior distributions for the base model. The blue cross represents the limits of the 95% credible intervals of the estimated ratio of the SSB to $B_0$ and exploitation rate in 2023.*

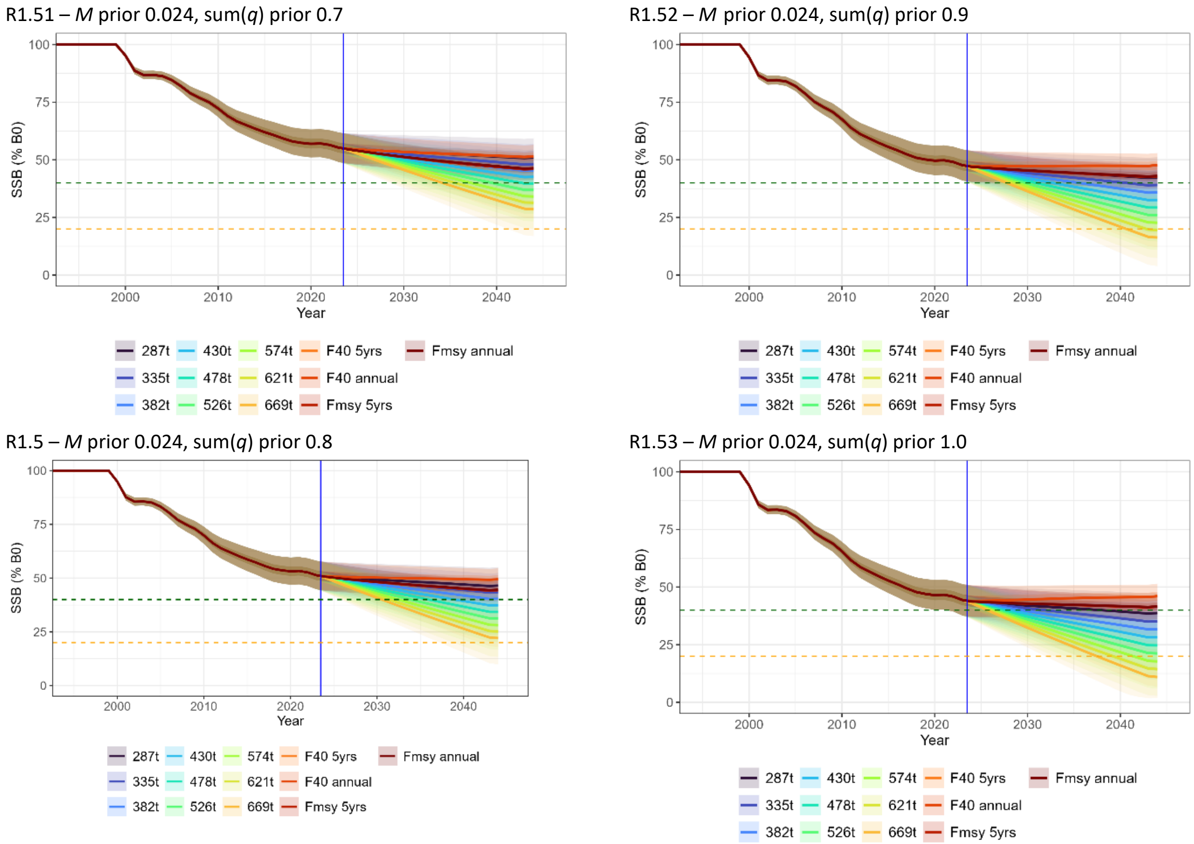


*Figure 9. Plots of the projections for the sensitivity runs with M prior of 0.024.*

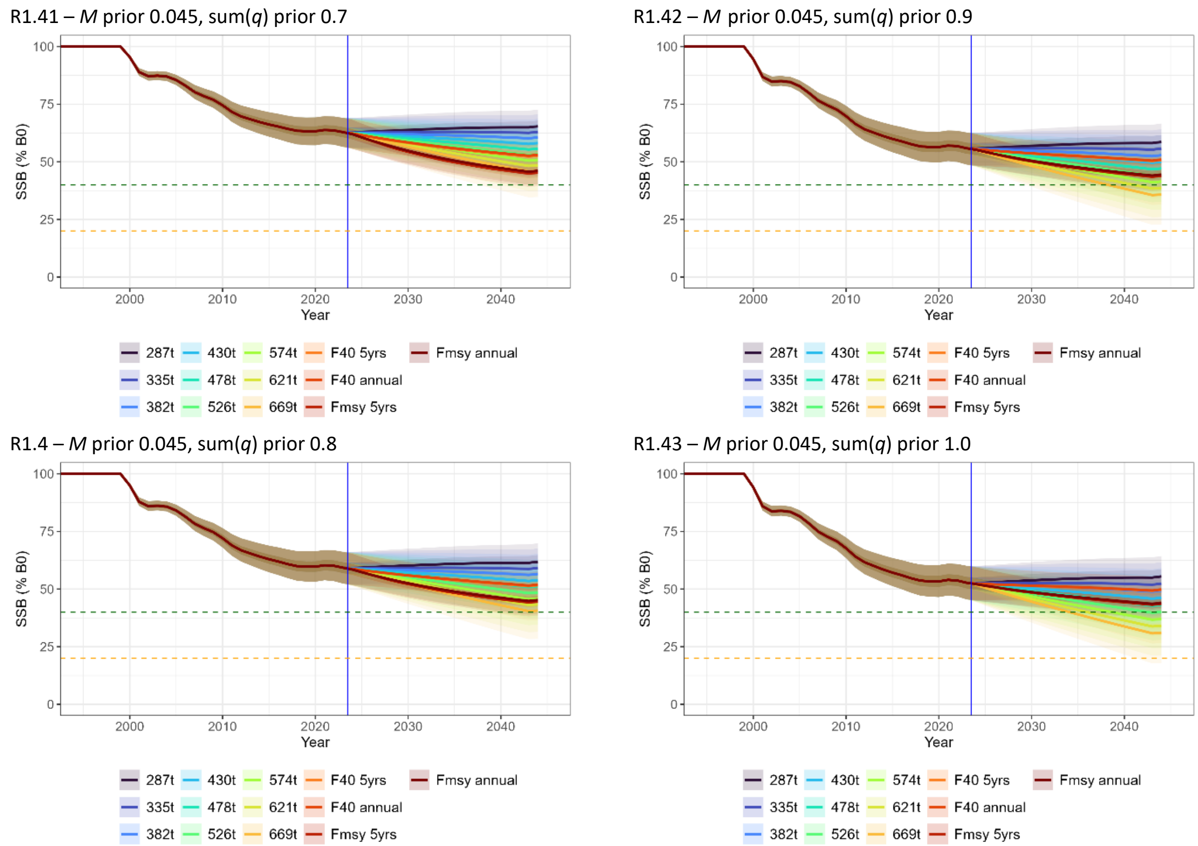


*Figure 10. Plots of the projections for the sensitivity runs with M prior of 0.045.*

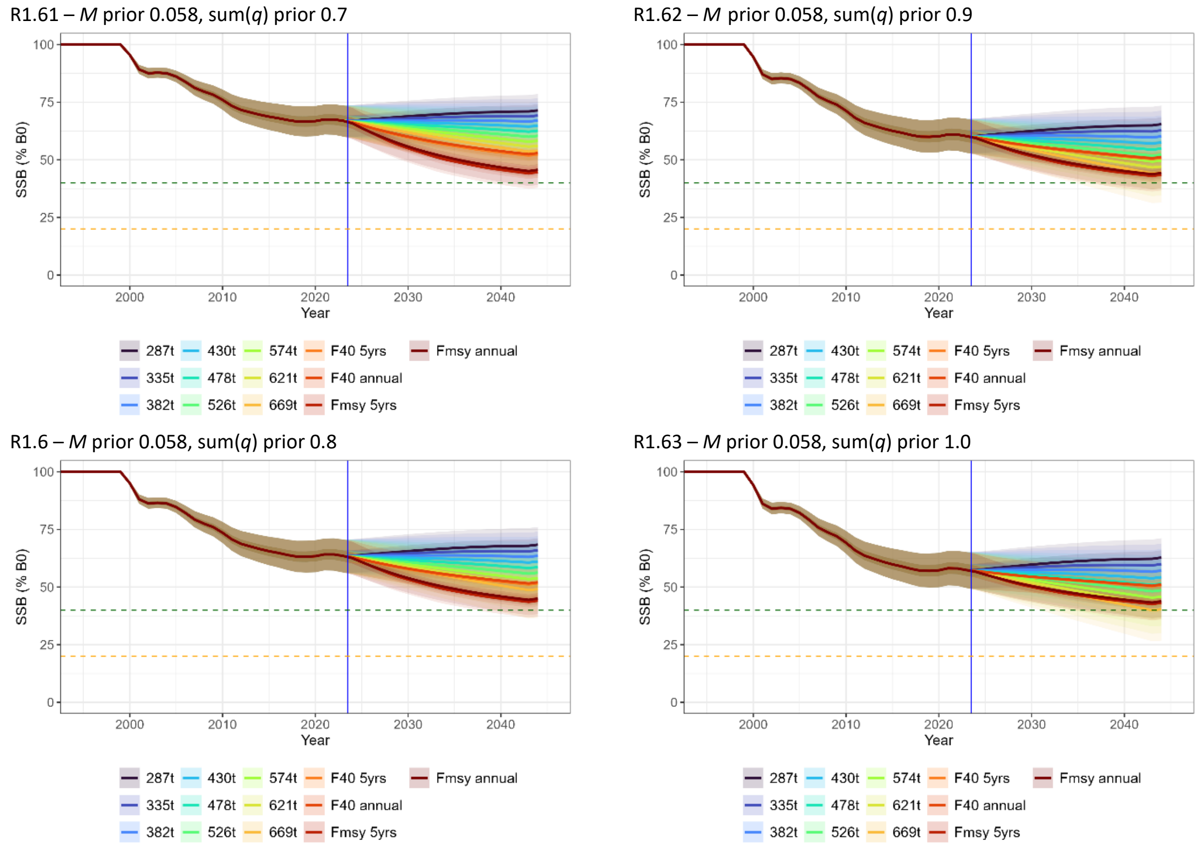


*Figure 11. Plots of the projections for the sensitivity runs with M prior of 0.058.*

# 9. Appendix A – Additional outputs of the base case model

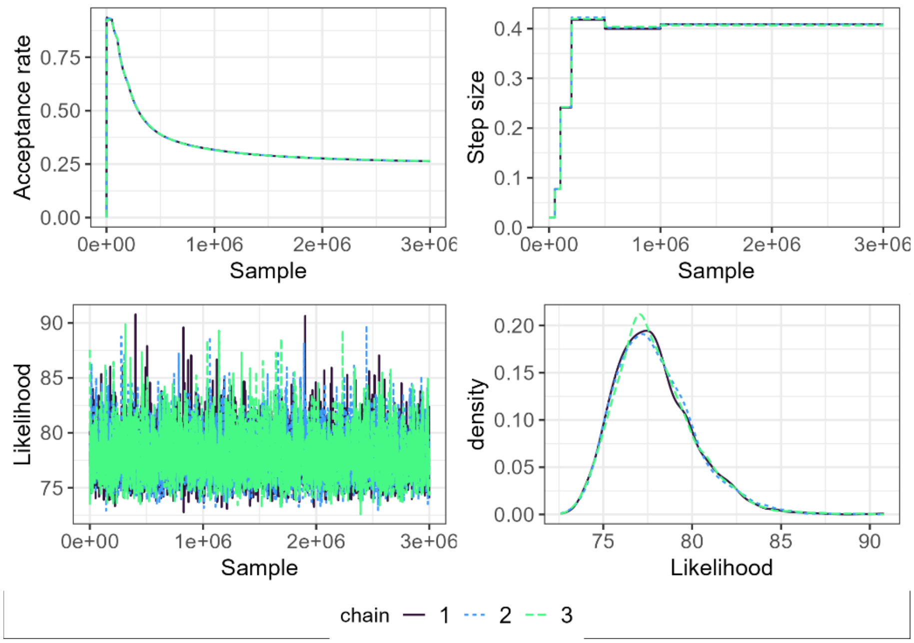


*Figure A.1. MCMC diagnostic plots, showing the acceptance rate for each chain (top left), the adaptive step size for each chain (top right), the likelihood of the objective function as a function of the chain number (bottom left) and as a density distribution (bottom right).*

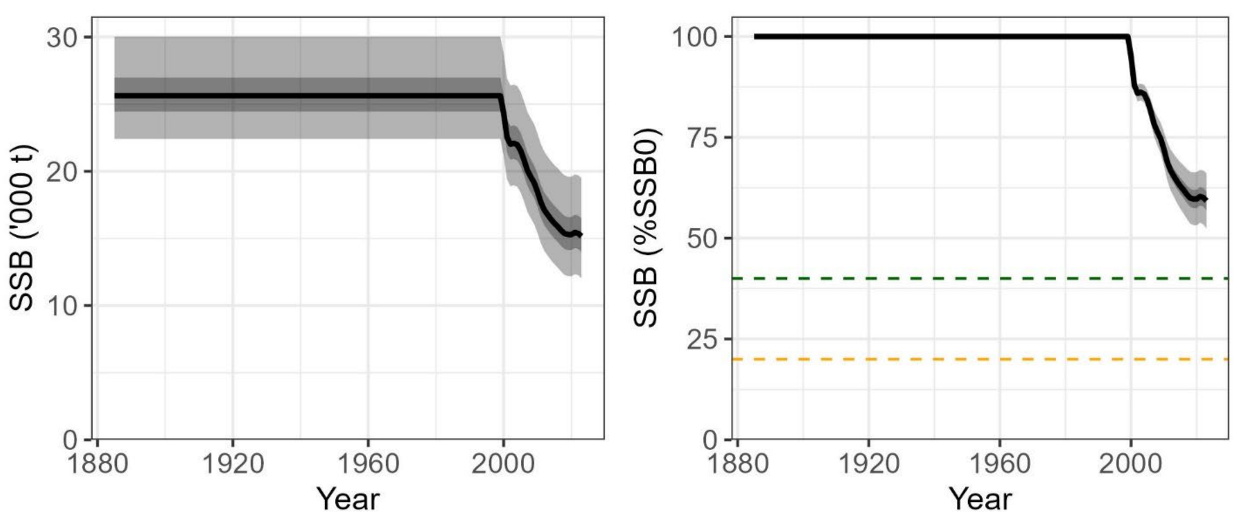


*Figure A.2. MCMC estimates of spawning stock biomass (left) and status (right)for the base case model, with median (lines) and 95% credible interval (shading). Also shown 40% B0 (green horizontal line) and 20% B0 (orange horizontal line).*

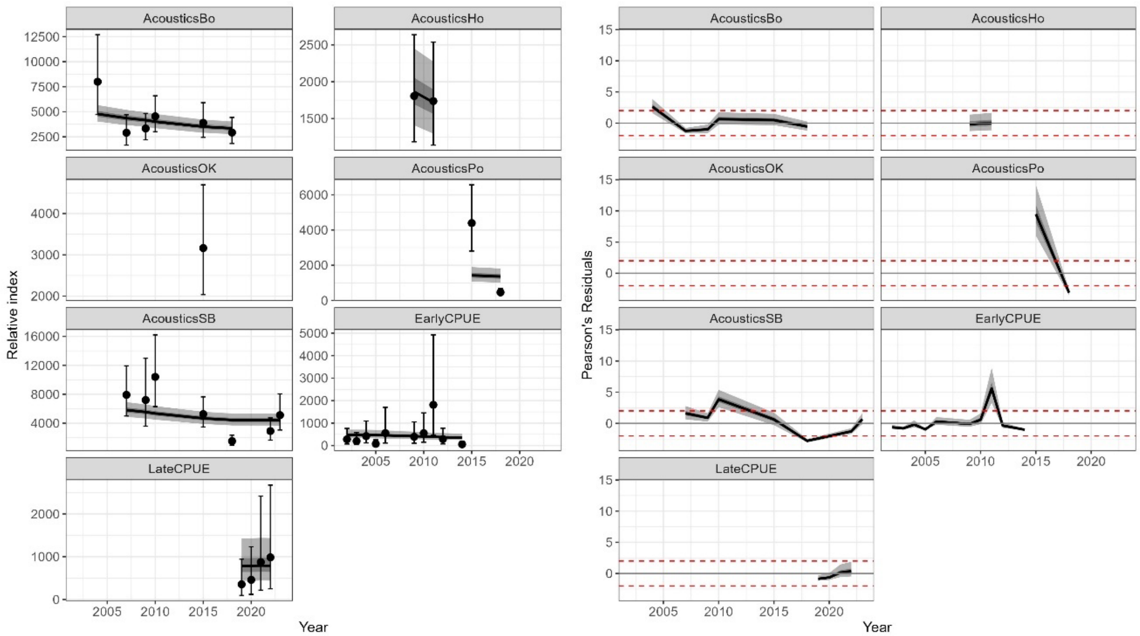


*Figure A.3. MCMC median (black line), 95% credible intervals (dark area) and 50% credible intervals (light area) fits to the acoustic biomass and fishery CPUE series (left) and Pearson's residuals (right) for the base case model. Features are as follows: B0 – Boulders, Ho – Hollows, OK – OK Coral, Po – Porky's, SB – Sleeping Beauty.*

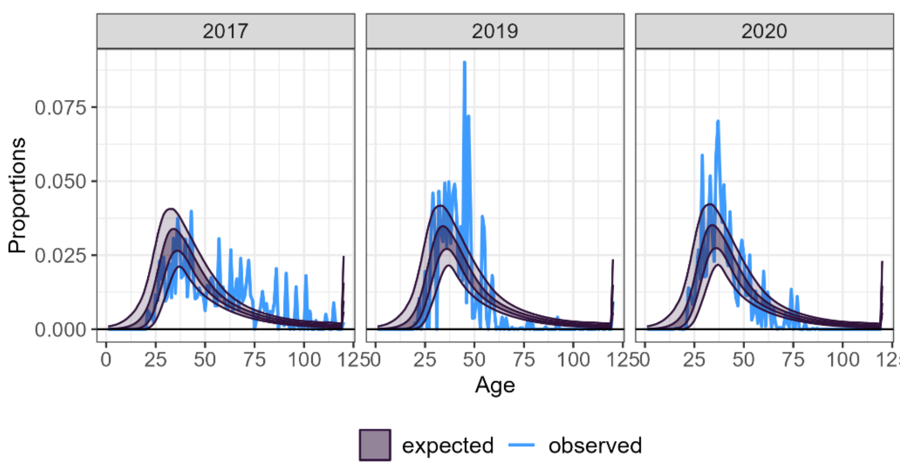


*Figure A.4. MCMC 95% credible intervals (dark area) and 50% credible intervals (light area) fits to the age compositions (blue line) for the base case model.*

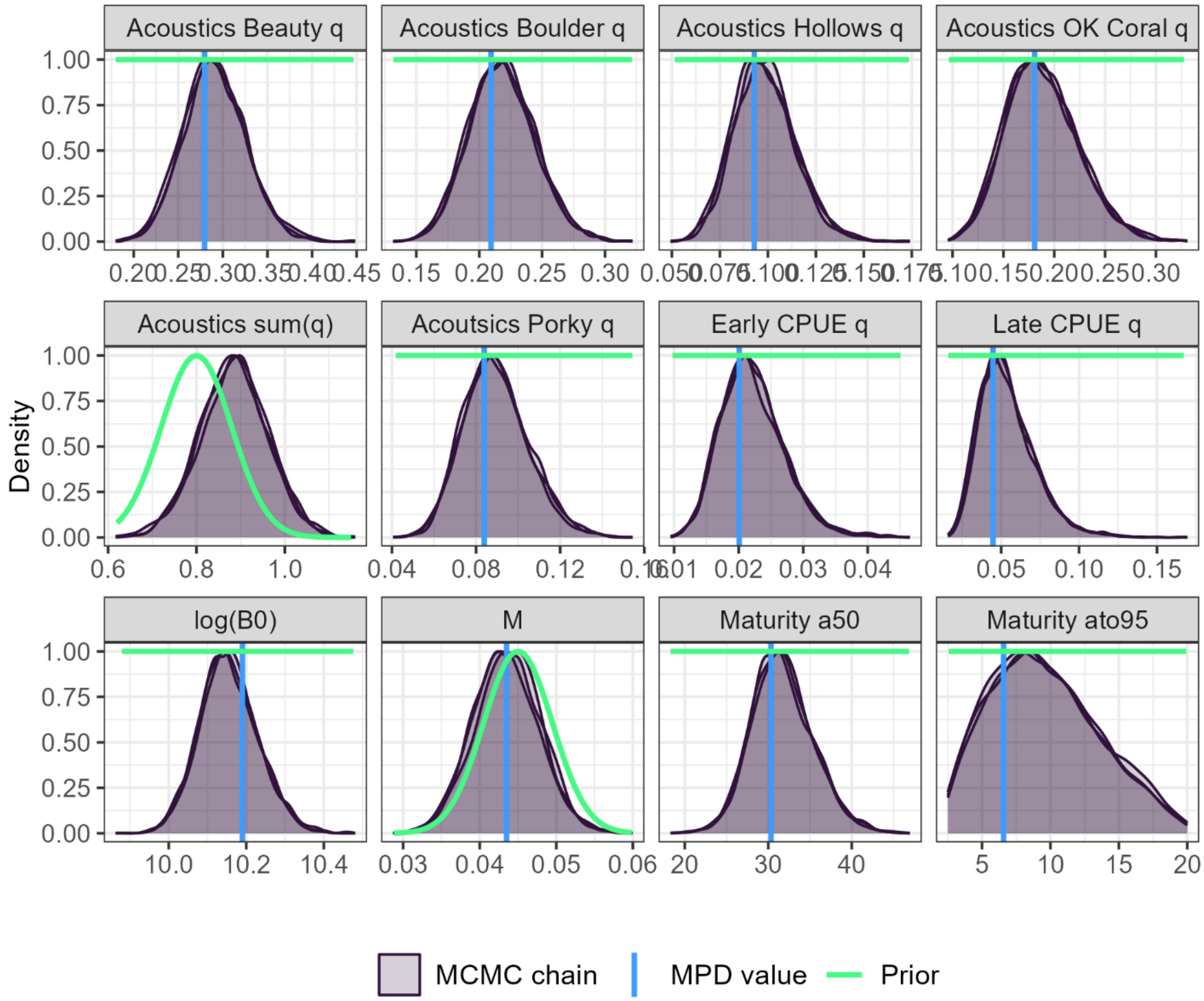


*Figure A.5. MCMC density estimates of the catchability parameters of the three chains for the base case model, with maximum posterior density (MPD) estimated value and prior distribution. The additional prior on the sum of the acoustic catchabilities Sum(q) is also plotted.*

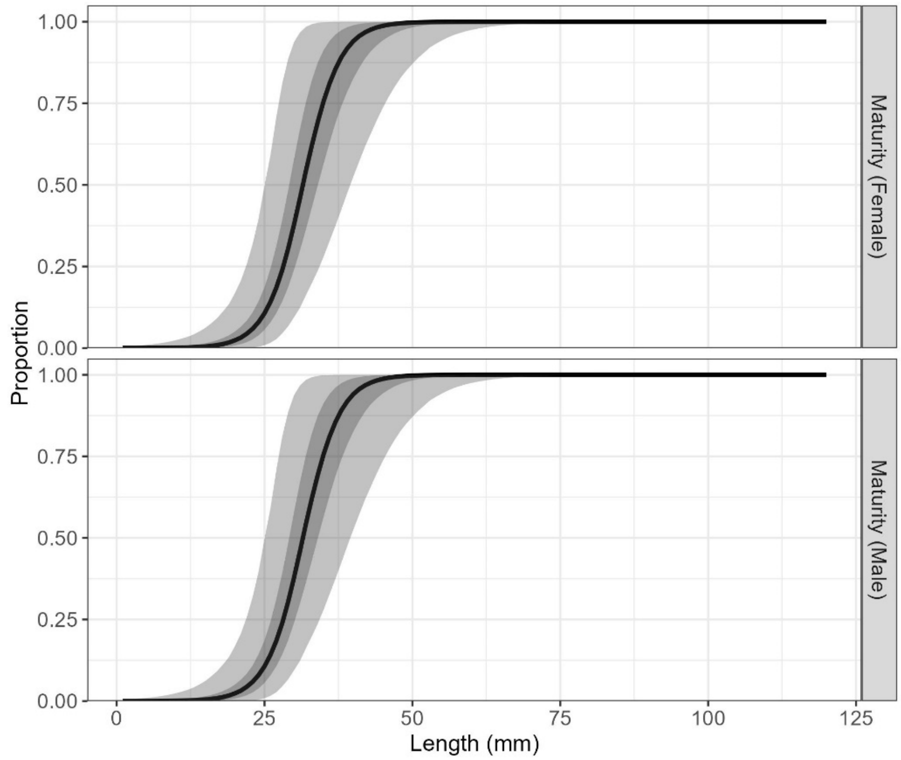


*Figure A.6. MCMC median (black line), 95% credible intervals (dark area) and 50% credible intervals (light area) estimates of maturity (assumed equal to selectivity) for the base case model. Note that both males and females were forced to have the same maturity.*

## 10. Appendix B: Terms of Reference

SIOFA | APSOI

Southern Indian Ocean Fisheries Agreement

Accord relatif aux Pêches dans le Sud de l'Océan Indien

# Project title: Orange roughy stock assessment (2024-2025)

Project Code: ORY-2024-01

## Terms of Reference

### 1. Introduction

The SIOFA Scientific Committee (SC) provides scientific advice to the Meeting of Parties (MoP) on the status of stocks and sustainable yields of deep-sea fisheries resources. In 2018, the SIOFA Scientific Committee (SC3) conducted the first orange roughy stock assessments in the SIOFA region and provided advice to the Meeting of Parties on the stock status and sustainable yields for orange roughy. An updated orange roughy stock assessment was conducted and presented to SC7 in 2022.

As required under SIOFA CMM 15, orange roughy stock assessments are conducted every 3-5 years, and the next Scientific Committee (SC10) (March 2025) will consider the new orange roughy stock assessments to provide its advice to the MoP.

Summaries of the Scientific Committees advice from previous assessments are available in the reports from SC3 and SC7.

### 2. Methods

Undertake assessments of the orange roughy stocks in the SIOFA area. This should build on and improve the work of the two previous assessments (Cordue 2018a and b, Roa-Ureta et al. 2022). While there could be multiple sub-stocks of orange roughy in the SIOFA area, until work is completed on the stock structure, two stocks should be assumed: one on Long Walter's Shoal Ridge (LWSR, Walter's shoal, Walter's Shoal Ridge, and associated seamounts) and another on the South-west Indian Ocean Ridge (SWIOR, Meeting, South Ridge, Middle Ridge, and North Ridge) (Figure 1).

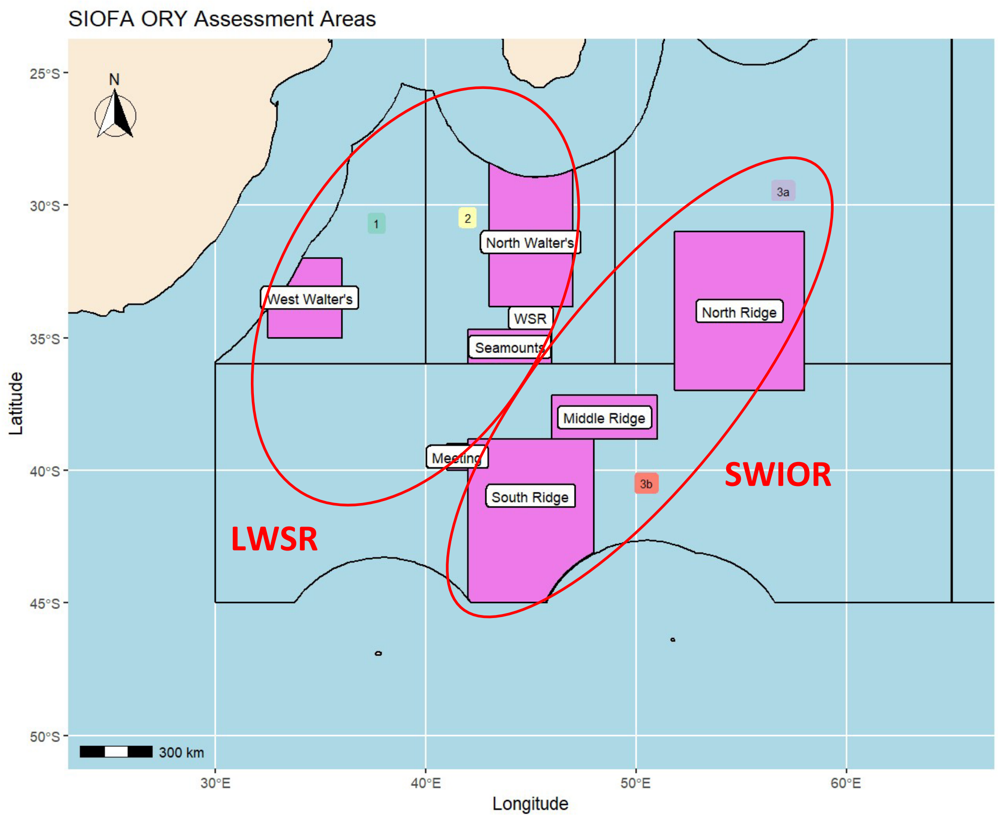


*Figure 1 – Map of SIOFA Areas used for assessments (in magenta) for orange roughy as defined by Cordue (2018a, 2018b) and used by Roa-Ureta et al. (2022) (source: SIOFA Spatial layers). Labels indicate names of single assessment areas. Red ovals denote the grouping of single assessment areas into two larger management units for purposes of stock assessment by Roa-Ureta et al (2022). These management units are labelled Long Walter's Shoal Ridge (LWSR) and South-west Indian Ocean Ridge (SWIOR).*

New information since the previous assessments include updated age and growth analyses, maturity analyses, acoustic biomass indices, and catch/effort data.

The outcomes of the assessments should be collated in a report and presented to SC10 in 2025. As a part of this project, the consultants will be required to present preliminary methods, draft reports, and results as they are developed to the project Advisory Panel for review.

## 3. Project objectives

1. During the project, present the work to the SIOFA orange roughy assessment Advisory Panel to discuss data inputs, the assessment approach, and preliminary results.
2. Develop standardised CPUE indices for each stock. Note this should standardise, to the extent possible, using factors such as location (e.g., area and seamount), season, gear parameters, alfonsino

bycatch, prevailing weather, etc. As the fishery has been undertaken by 1-3 vessels only, standardisation by vessel may not be possible.

3. Review the previous stock assessments, and use all new information (including updated growth, maturity, and local area acoustic abundance data), and other relevant information to undertake a statistical catch-at-age stock assessment to determine the stock status of orange roughy for Walters Shoal and the Southwest Indian Rise. The outcomes of the assessment should include the following:
    a. Evaluation of the stock against the SIOFA interim reference points (Target = 40%B0 and Limit = 20%$B_0$). A range of other reference points should also be considered and estimates of stock status, fishing mortality, and biomass should be provided in the terminal year of the assessment and over time including, at least but not limited to status in relationship to B40% and B20%, MSY, $SB_{MSY}$, $SB_0$, $SB_{F=0}$, $SB/SB_{MSY}$, $SB/SB_{F=0}$, $SB/SB_0$, F, $F_{MSY}$, $F/F_{MSY}$, F40%$B_0$.
    b. Appropriate sensitivities to model structural assumptions, choices of biological parameters, acoustic and CPUE abundance indices, and age composition data.
    c. Estimates of 20-year projected status (at 5-year intervals) under a range of future catch scenarios and appropriate estimates of future productivity (i.e., year class strengths). Analysis should include projections using constant catch and constant fishing mortality strategies with both annual and 5-year changes in catch limits.
    d. Kobe I (stock status trajectories) and appropriate Kobe II (strategy risk matrix) summaries of the stock assessment results. Refer to Table 1 below as an example of the Kobe II risk strategy matrix from Indian Ocean Tuna Commission (IOTC), showing risk probabilities violating target and limit reference levels for F and B (biomass) next 3 and 10 years in 9 different catch levels (0%, ±10%, ±20%, ±30% and ±40% of the current level).
4. Provide relevant text to update Section 6 of the SIOFA Fisheries Summary: orange roughy.

**Table 1: Example of a Kobe II Risk Strategy Matrix.**

**Table 2.** Albacore: SS3 aggregated Indian Ocean assessment Kobe II Strategy Matrix based on the model options (i) Model 1 (ii) Model 2 (iii) Model 3 (Model 4 was not used for management advice). Probability (percentage) of violating the MSY-based target (top) and limit (bottom) reference points for constant catch projections (2017 catch level, ± 10%, ± 20%, ± 30% ± 40%) projected for 3 and 10 years.

| Reference point and projection timeframe | Alternative catch projections (relative to the catch level for 2017) and probability (%) of violating MSY-based target reference points ($SB_{targ} = SB_{MSY}$; $F_{targ} = F_{MSY}$) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 60% (22,901) | 70% (26,718) | 80% (30,534) | 90% (34,351) | 100% (38,168) | 110% (41,985) | 120% (45,802) | 130% (49,618) | 140% (53,435) |
| $SB_{2020} < SB_{MSY}$ | 0.614 | 0.678 | 0.715 | 0.769 | 0.818 | 0.828 | 0.87 | 0.883 | 0.898 |
| $F_{2020} > F_{MSY}$ | 0.074 | 0.224 | 0.4 | 0.556 | 0.654 | 0.731 | 0.766 | 0.788 | 0.782 |
| $SB_{2027} < SB_{MSY}$ | 0.176 | 0.307 | 0.456 | 0.572 | 0.713 | 0.823 | 0.898 | 1 | 1 |
| $F_{2027} > F_{MSY}$ | 0.002 | 0.085 | 0.287 | 0.473 | 0.718 | 0.878 | 1 | 1 | 1 |

## 4. Relevant SIOFA information

1. SIOFA data (provided by the SIOFA Secretariat upon request) 2. SIOFA spatial data layers. Available at: https://github.com/SIOFASecretariat/SIOFA_SC_Spatial_layers
3. SIOFA reporting templates. Available at: https://github.com/SIOFASecretariat/SIOFA_Reporting_templates
4. SIOFA reports:
    a. SIOFA SC, SC Working Group, and National Reports. Scientific Committee Meeting | SIOFA (https://siofa.org/)
    b. SIOFA MoP reports. Meeting of the Parties | SIOFA (https://siofa.org/)
    c. SIOFA technical and scientific reports (public reports and abstracts of restricted reports are available from https://siofa.org/, and full restricted reports will be made available by the SIOFA Secretariat to the project consultant upon request and after the approval of relevant CCPs.

## 5. Key project indicators

1. Follow the project timeline as detailed in this agreement, including the submission of deliverables, to meet the project objectives.
2. Collect any necessary data as early as possible, e.g., by submitting a data request to the SIOFA Secretariat.
3. Attend the project pre-assessment electronic meeting with the Advisory Panel (composed of members of the SIOFA Scientific Committee and the SIOFA Secretariat) to discuss the project setup and development. Further engage, as requested, with the Advisory Panel during the project to assist the consultant access and interpret reports, data, and obtain the Advisory Panels advice on relevant analyses, methods, and data interpretation for the project.
4. Present preliminary results during the project, as required, to the project Advisory Panel, and respond and revise any project outputs based on their review.
5. Provide regular (i.e. every 2-3 months), proactive updates to the Project Coordinator and the Advisory Panel throughout the project, in particular informing promptly of any unforeseen delay or variations to the project.
6. Submit deliverables on time and appropriately formatted, as required. Each deliverable will go through a SIOFA review to ensure that it meets the quality targets and the project objectives as set out in the Terms of Reference.
7. Appropriately acknowledge the project funding source (SIOFA) within each deliverable.
8. Take into reasonable account the outcomes of the SIOFA review or any comments made by meeting attendees, when revising the deliverables.

## 6. Deliverables

1. Attend (virtually) the project Advisory Panel meetings.
2. Presentation of methods and results to the SIOFA SC annual meetings (March 2025) 3. A Draft Report that addresses the project objectives and tasks as laid out in this contract. Revise and

update the Draft Report based on review by the project Advisory Panel, and the SIOFA Scientific Committee. The report should follow the guidelines and format available at https://github.com/SIOFASecretariat/SIOFA_Reporting_templates. In particular, the report should include a concise (max 300 words) summary, and should detail the methods, the outcomes, conclusions, and concise recommendations. The Draft Report will also be submitted to the SIOFA Scientific Committee.

4. Provide relevant revisions to Section 6 of the SIOFA Fisheries Summary: orange roughy.
5. A Final Report that follows the guidelines and format available at https://github.com/SIOFASecretariat/SIOFA_Reporting_templates and includes any review comments from the SIOFA Scientific Committee on the Draft Report. The Final Report will also be submitted to the next SIOFA Scientific Committee.
6. Provide all the information collected as a part of this project to the SIOFA Secretariat (including that sourced from the Secretariat) before the final payment of the contract. Such information includes electronic data files, analysis code, biological samples, and other relevant data where applicable.
7. Presentations of reports to the Scientific Committee may be given virtually and travel to the meetings is not obligatory. All project meetings will take place virtually. No additional travel costs will be paid.

## 7. Acceptance of Draft and Final Reports

1. Draft and Final Reports must be submitted in English to the Project Coordinator at the SIOFA Secretariat.
2. Draft and Final Reports will be reviewed using the procedures outlined in paper MOP-09-12 (Annex B), see also: https://github.com/SIOFASecretariat/SIOFA_Reporting_templates/tree/main/SC%20reports/Review%20template%20for%20consultant%20reports.
3. Payment of contracts milestones will be subject to acceptance of the submitted reports by SIOFA.

## 8. Intellectual property clause and confidentiality

The Consultant shall submit all the information collected to the SIOFA Secretariat (including that sourced from the Secretariat) before the final payment of the contract is made to the consultant.

Such information includes electronic data files, analysis codes, biological samples, and other relevant data if applicable. Any arrangements for ownership, storage, or disposal of physical samples shall be agreed by SIOFA as a part of the contract. All Intellectual Property generated as a part of this contract shall become the property of SIOFA unless otherwise excluded in the proposal and agreed by SIOFA in the contract.

The Consultant shall not release confidential data provided for conducting this study to any persons nor any organizations, other than SIOFA Secretariat.

The Consultant shall delete all the confidential data upon the completion of the contract.

## 9. Work timeline and payment schedule

The funds for this project, budgeted under the SIOFA budget, allow for a maximum total budget of 50,000 Euro (including all costs and any travel related expenses).

The consultant shall follow the timeline described in Table 1 below.

**Table 1: Timeline for payments, milestones, and report submission**

| Milestone | Date | Activities |
|---|---|---|
| Initiation of contract | September 2024 | First instalment payment (30% of the total contract sum) |
| Delivery of draft report | 30 January 2025 | Second instalment payment (30% of the total contract sum) upon satisfactorily submission of draft report, in a format suitable for submission to SC, to the Project Coordinator.<br><br>The draft report will be submitted to SC10 (on 15 February). |
| Presentation of preliminary results | 17-26 March 2025 | Presentation of preliminary methods and results to the SC10 meeting (virtual) |
| Delivery of final report | 15 April 2025 | Submission of final report in a format suitable for submission to SC and submission of all project information to the project coordinator.<br><br>Final instalment payment (40% of the total contract sum) on acceptance of the final report by the advisory panel and the final submission of project information |

## 10. Submission of applications

1. A current CV that summarises the applicant(s) relevant educational background and professional experience.
2. A brief proposal (indicatively 3-4 pages) outlining the proposed methods and analyses, including a description of how the objectives of the ToR will be achieved.
3. Any proposed exclusions to the intellectual property clause or variations to the work timeline and payment schedule.
4. The proposed consultancy price (including all consultant expenses and project related costs), noting that the available budget for this work indicated in Section 9.
5. Identification of any project risks and associated mitigation and management required to successfully complete the project.
6. A statement that identifies any perceived, potential, or actual conflicts of interest of the applicant(s), including those described in paragraph 4 of the SIOFA recruitment procedure (see Section 12), and
7. Any additional relevant information the applicant(s) wish to submit.

The applicants must have appropriate experience and knowledge of similar work in their portfolio.

Applications must be submitted to the SIOFA Science Officer Marco Milardi (marco.milardi@siofa.org, CC secretariat@siofa.org). Only those applications received before 12:00 PM (9:00 AM UTC) on Sunday the 1st of September 2024, Reunion Island time, will be considered.

## 11. Evaluation criteria for the selection of candidates

An evaluation panel, the SIOFA Secretariat, and the Chair and Vice-Chair of the SIOFA Scientific Committee will select one successful applicant for this contract. The selection criteria will include the following:

1. Adequate submission of information to allow the panel to evaluate the candidate
2. Evaluation of the proposal from the candidate, including the proposed contract price
3. Ability to undertake and complete the analyses or work required in this ToR
4. The candidate's agreement with confidentiality provisions required for the project
5. Acceptable conflict of interest statement
6. Agreement with the data submission and intellectual property terms required in this ToR, and 7. Financial and resourcing considerations.

## 12. Conflicts of interest. Paragraph 4 of SIOFA's Recruitment Procedure

To ensure that situations relating to potential and actual conflict of interests are avoided, persons falling into the following categories may not normally be considered for SIOFA consultancy: (i). any person designated as a designated representative or alternate representative of a CCP to the Meeting of Parties (MOP) as per Rule 3.1 of the Rules of Procedure, and to the SC and any other subsidiary bodies of the MOP, as per Rule 21.3 of the Rules of Procedure; (ii). Any person fulfilling the function of Chair or Vice-Chair of the MOP or Chair or Vice-Chair of a SIOFA subsidiary body or working group; (iii). Any person acting as a member of a delegation involved in the SIOFA decision-making process resulting in recommendations and/or approval for the SIOFA work requiring the engagement of a consultant; and (iv). Individuals who were SIOFA Secretariat staff members at the time when the recommendations and/or approval for the SIOFA works were adopted or who are members of immediate family (e.g., spouse or partner, father, mother, son, daughter, brother, or sister) of any Secretariat staff member or of the persons identified in 4 (i), (ii), and (iii).

## 13. Contacts

Project Coordinator – SIOFA Science Officer (Marco Milardi, marco.milardi@siofa.org)

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## 14. References

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https://siofa.org/sites/default/files/documents/meetings/SC-07-35-%5BABSTRACT%5D-ORY-stockassessment-2021-v4-reduced.pdf The full version will be made available on request to the successful consultant.