

## Tristan rock lobster OMP development: some initial notes

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Operating models provide numbers-at-age (and length) for the start of 2013/14 season. Projections thus start at this point, with the first catch set by the OMP being for the 2013/14 season.

### Reference case models

OMs are fitted to the following data:

- Catch 1990 - 2012<sup>1</sup>
- Commercial CPUE 1997 – 2011
- Biomass survey index data Leg1 2006-2012
- Biomass survey index data Leg2 2006-2011
- Commercial CAL from observers 1997 – 2011
- CAL data from Leg1 biomass survey 2006-2012
- CAL data from Leg2 biomass survey 2006-2011

### Assumptions required for projections

#### *Recruitment*

The model estimates stock-recruit residuals  $\varepsilon_y$  for 1990-2010. As there is clear serial correlation in the stock-recruit residuals (estimated for the 1990-2010 period), the recruitment for 2011+, is calculated as follows for each simulation  $S$ :

$$R_y^S = \frac{\alpha B_y^{sp}}{\beta + B_y^{sp}} e^{\varepsilon_y^S - \sigma_R^2/2} \text{ where}$$

$$\varepsilon_y^S = s_R \varepsilon_{y-1}^S + \sqrt{1 - s_R^2} \eta_{y-1}^S$$

where  $\eta_{y-1}^S \sim N(0, \sigma_R^2)$  and  $\sigma_R = 0.4$ , and

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<sup>1</sup> Here 2012 refers for example to the split season 2012/13

where the serial correlation  $s_R = \frac{\sum_{1990}^{2010} \varepsilon_y^S \varepsilon_{y-1}^S}{\sum_{1990}^{2010} (\varepsilon_{y-1}^S)^2}$ .

### *Selectivity*

Future selectivity functions are set equal to those estimated for the 2006-2012 period for the RC. Robustness tests where the future selectivity is fixed at an earlier period selectivity will be developed.

### *Somatic growth rate*

Future somatic growth stays unchanged.

### *Minimum legal carapace length*

Remains constant at 2012/13 value.

### **Input data for OMP**

- Commercial CPUE
- Biomass survey Leg1 index
- Biomass survey Leg2 index

The initial OMP will use only the commercial CPUE as input. Further improvements to the initial OMP will likely involve incorporating biomass survey data into a combined resource index as input into the OMP.

### **Generation of simulated data (S = simulation)**

- i) Commercial CPUE data: for years  $y = 2012+$

$$CP\hat{U}E_y^S = CP\hat{U}E_y e^{\varepsilon_y^S}$$

where  $\varepsilon_y^S = N(0, \sigma^2)$  and where  $\sigma$  is taken from the model fit to the observed CPUE data.

- ii) Biomass survey data (SUR<sup>Leg</sup>): for years  $y = 2013+$

$$S\hat{U}R_y^{Leg,S} = S\hat{U}R_y^{Leg} e^{\varepsilon_y^S}$$

where  $\varepsilon_y^S = N(0, \sigma^2)$  and where  $\sigma$  is taken to equal  $\sqrt{(\overline{CV}^{Leg})^2 + \sigma_{add}^2}$  with  $\overline{CV}^{Leg}$  being the average CV of the data pre-2013.

### Simulation framework and summary statistics

There will be a RC operating model for each island. Each OMP will be tuned to achieve the desired management objective using the RC model. However, each OMP will be run however for a fairly wide range of robustness tests, where each robustness test alters one of the underlying assumptions made in the RC e.g. alternate natural mortality value.

For each OMP, 1000 simulations are run. Medians, 5<sup>th</sup> and 95<sup>th</sup> %iles are calculated for the following summary statistics:

- i)  $C_{ave}(5)$  - the average of the TAC over the next 5 years (2013-2017)
- ii)  $C_{ave}(10)$  - the average of the TAC over the next 10 years (2013-2022)
- iii)  $C_{ave}(20)$  - the average of the TAC over the next 20 years (2013-2032)
- iv) AAV(5) – the average inter-annual TAC change over the next 5 years
- v) AAV(10) – the average inter-annual TAC change over the next 10 years
- vi) AAV(20) – the average inter-annual TAC change over the next 20 years
- vii) Final level of depletion after 10 years
  - Bsp(2023)/Ksp
  - Bsp(2023)/Bsp(2013)
  - Bexp(2023)/Bexp(2012)
- viii) Final level of depletion after 20 years
  - Bsp(2033)/Ksp
  - Bsp(2033)/Bsp(2013)
  - Bexp(2033)/Bexp(2012)
- ix) Catch rate after 10 years - CPUE(2022)/CPUE(2012) \* **use this for tuning (either 0.70, 0.80, 0.90..1.10)**
- x) Catch rate after 20 years - CPUE(2032)/CPUE(2012)

### Management objectives

Objective is to keep catch rates within the range of 70%-110% of current (2012) catch rates.

Do 10 and 20-year trajectories.

Look at 5% inter-annual TAC change constraint.

Look at MIN and MAX TAC values (MAX value of 180t suggested for Tristan?)

### Initial OMP

First calculate the future CC levels that will achieve the different levels of catch rates (relative to current) at the median level. Idea is to show an OMP which is better than CC!

The OMP is a target-based rule based on the recent commercial CPUE, *viz.*

$$TAC_{y+1} = TAC_y + \alpha(I^{rec} - I^{tar})$$

where

$I_y$  is the resource index for year  $y$ , either based on commercial CPUE only, or a combination of commercial CPUE and biomass survey index data,

$I^{rec}$  is the average CPUE over the last three years ( $y-2, y-1, y$ ), and

$I^{tar}$  is the target index.

Both  $\alpha$  and  $I^{tar}$  are tuning parameters, which are adjusted to achieve a certain median catch rate in 2022.

A rule to control the inter-annual TAC variation is also applied e.g. no more than 5% up or down from year to year.

### Robustness tests

The initial OMP candidates are tuned on the reference case (RC) model as reported in Johnston and Butterworth (2013). The performance of each OMP candidate is however evaluated over a range of robustness tests. These tests explore alternative assumptions underlying the RC operating model, and assumptions relating to future projections.

#### *Robustness tests relating to underlying OM assumptions*

RC  $M=0.1, F(2009)=0.3, \sigma_R = 0.4$

R1  $M=0.1, \mathbf{F(2009)=0.2}, \sigma_R = 0.4$

R2  $M=0.1, \mathbf{F(2009)=0.4}, \sigma_R = 0.4$

R3  $\mathbf{M=0.05}, \mathbf{F(2009)=0.2}, \sigma_R = 0.4$

R4  $\mathbf{M=0.05}, F(2009)=0.3, \sigma_R = 0.4$

R5  $\mathbf{M=0.05}, \mathbf{F(2009)=0.4}, \sigma_R = 0.4$

R6  **$M=0.2, F(2009)=0.2, \sigma_R = 0.4$**

R7  **$M=0.2, F(2009)=0.3, \sigma_R = 0.4$**

R8  **$M=0.2, F(2009)=0.4, \sigma_R = 0.4$**

SIGR1  **$M=0.1, F(2009)=0.3, \sigma_R = 0.2$**

SIGR2  **$M=0.1, F(2009)=0.3, \sigma_R = 0.8$**

*Robustness tests relating to future projection assumptions*

These are yet to be determined.

#### **Reference List**

Johnston, S.J. and Butterworth, D.S. Assessment of the Tristan rock lobster at Tristan da Cunha island.  
MARAM/TRISTAN/2013/08.