



Australian Government

Australian Fisheries Management Authority



Species Summaries for the Southern and Eastern Scalefish and Shark Fishery

For stock assessments completed in 2015 in preparation for the 2016-17 fishing season



Introduction

These species summaries provide information on quota species assessed by Southern and Eastern Scalefish and Shark Fishery (SESSF) Resource Assessment Groups (RAGs): Great Australian Bight RAG (GABRAG); SharkRAG; ShelfRAG; and SlopeRAG. These assessment summaries apply to stock assessments completed in 2015 in preparation for the 2016-17 fishing season.

The summaries contain basic information on stock status, TACs and catch trends, assessment details and RAG comments. The summaries are designed to be a quick reference, and should be read in conjunction with RAG minutes and the applicable species stock assessments. Annual updates are completed for species that have a new stock assessment, were considered by the RAGs or species that are under AFMA rebuilding strategies. The most recent full set of species summaries can be found on the AFMA website.

A glossary of commonly used terms is available at the end of the document.



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Bight redfish (*Centroberyx gerrardi*)



Common names: Nannygai, redfish, red snapper, king snapper, golden snapper.

Assessed by GABRAG in 2015. Species summary updated in 2015.

| Stock status summary | | |
|--|---|---|
| Stock structure | Assessed as a single stock. | |
| Stock status against reference points and trend | Limit reference is 20 per cent of unfished biomass. Target reference is 41 per cent of unfished biomass. 2015 assessment: 63 per cent of unfished biomass Modelling suggests a slow decline in abundance consistent with the fish-down of a developing fishery. Depletion of the stock occurred more rapidly in the mid-2000s when substantial fishing effort occurred, but the stock has never fallen below the maximum economic yield (MEY) biomass target. Current biomass is higher than the target biomass. | |
| ABARES most recent assessment (2015) | Biomass: Not overfished | Fishing mortality: Not subject to overfishing |
| GVP figures (2013-14 fishing season) | GVP | % fishery GVP |
| | \$1.2 million | 11 per cent |
| Recommended Biological Catch 2016-17 | 2016-17 = 862 t 5-year RBC = 797 t | |
| Overcatch/undercatch | 10 per cent undercatch | |
| | 10 per cent overcatch | |

| | |
|---|-----------------------------------|
| Probability of recommended biological catch (RBC) (or other levels of catch) causing a decline below limit reference <u>under proposed management</u> <u>Species that follow a HS rule that has been MSE tested will have a “very unlikely” score in this section (i.e. $P < 10\%$).</u> | RBC recommendation = Unlikely |
| | Alternative Catch Scenarios = N/A |

| TAC and catch | | | | | | | | |
|--------------------------------------|--------------|---------|--------------|---------|--------------|--------------|--------------|---------|
| Assessment Year | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
| Tier /rollover /MYTAC | Not assessed | Tier 1 | Not assessed | Tier 1 | MYTAC | MYTAC | MYTAC | Tier 1 |
| Stock Status | Not assessed | 77% | Not assessed | 90% | Not assessed | Not assessed | Not assessed | 63% |
| Fishing Year | 2009/10 | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
| RBC | Not assessed | 1653 | 1556 | 2358 | Rollover | Rollover | Rollover | 797 |
| Agreed TAC | 2000 | 1653 | 1556 | 2334 | 2334, MYTAC | 2358, MYTAC | 2358, MYTAC | |
| Actual TAC after overs/unders | 2200 | 1853 | 1716 | 2487 | 2588 | 2593 | 2358 | |
| % TAC caught | 19 | 15 | 20 | 11 | 8 | 8 | | |

| Tier Level & Discounts | |
|---|---|
| Tier Level | Tier 1- for details of Tiers and the Harvest Strategy, see: http://www.afma.gov.au |
| Discount factor | 0 per cent |
| Is a multi-year TAC in place? | <input checked="" type="checkbox"/> Yes (in place this season) 2015-16 will be fourth year of three year MYTAC <input type="checkbox"/> No |
| Is a multi-year TAC recommended? (please provide a clear indication on whether the multi-year recommendation is a RBC) | <input checked="" type="checkbox"/> Yes (recommended for future seasons) The one-year, 862 t RBC is based on the 2015 Tier 1 assessment, while the five-year RBC recommendation of 797 |



| | | |
|---|---|--|
| (e.g. based on Tier 1 model output) or TAC (e.g. a roll-over of catch)) | t used for MYTAC purposes is based on the average of RBC values projected over a five year period | |
| Breakout rules for multi-year TAC | If observed CPUE falls outside the 95 per cent confidence interval for projected CPUE If catches in a season exceed 400 t (approximately 75 per cent of the long-term yield) | |
| Have breakout rules been triggered? | Not applicable. Tier 1 stock assessment completed in 2015. | |

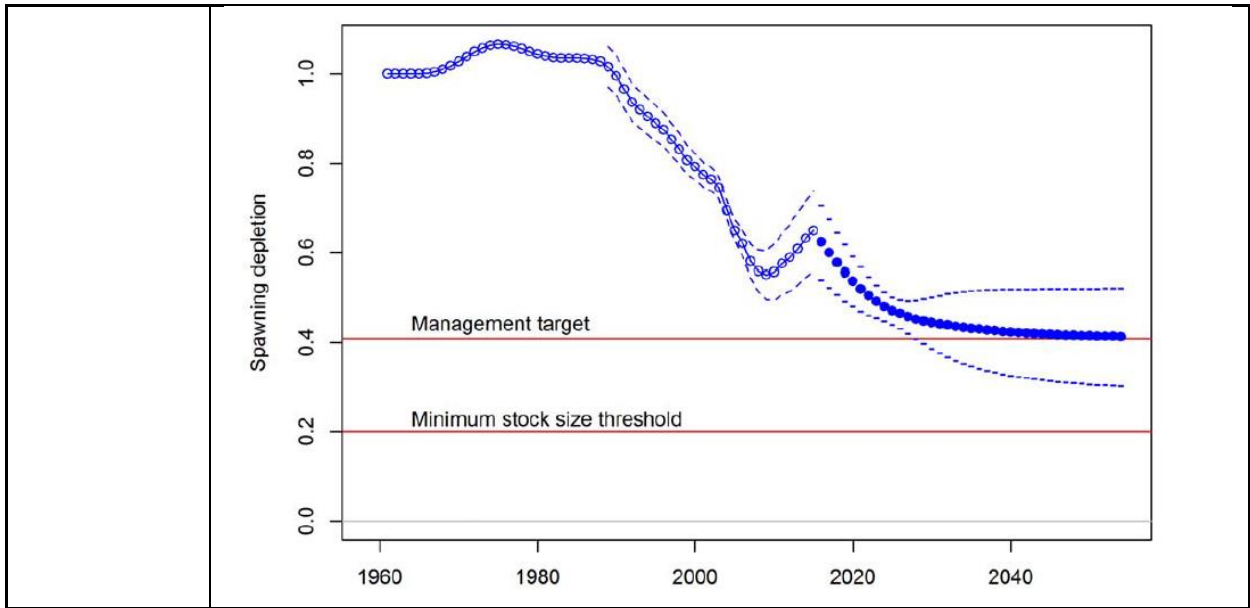
| Assessment: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|-------------|------------------------------|-----------|----------------------|-------|--|-----|-----------|----------------------|--|-----|-----------------|--------|--|--|--------------|----------|--|--|------------------------------|-------------|--|-----|------------|-----------|--|-------|-----------|-------------------|--|-----|--------------------------|-----------|--|-----|------|-----------------------|--|------------|------|-----------------|---|--|------------|--------|---|-----------|----------------|-----|--------|-----------|--------|----|--------|--|---|-------|-----------------------|------|-------|---------|---------|
| Stock indicator trends | Model fits a decline in abundance, consistent with the fishdown of a developing fishery. Biomass is high relative to targets. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RAG comments | <p>GABRAG has some concerns over the availability of bight redfish, as catches are much lower than the assessment would suggest</p> <p>The previous base case stock assessment (Klaer 2012) gave a much higher RBC of 4407 t, and a long-term yield of 2143 t. These RBCs were much higher because, as a result of a lack of contrast in the available data, the model estimate of unfished female spawning stock biomass was approximately 26 000 t (in contrast to the 2015 model's estimate of 5 451 t).</p> <p>The outcome of the substantially reduced virgin biomass estimate, is a substantially lower RBC estimate, even though the stock depletion levels are still well above the 41 per cent MEY target</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Key model technical assumptions/parameters | <p>Table 2. Summary of selected parameters from the base case model. Sources: (1) Analyses of biological samples collected during the 2004 GAB reproductive study (Brown and Sivakumaran, 2007), (2) length and age samples collected between 2000-2003 and (3) length samples collected during the 2001 FRDC project</p> <table border="1"> <thead> <tr> <th>Description</th> <th>Source</th> <th>Parameter</th> <th>Combined Male/Female</th> </tr> </thead> <tbody> <tr> <td>Years</td> <td></td> <td>y</td> <td>1960-2014</td> </tr> <tr> <td>Recruitment Deviates</td> <td></td> <td>r</td> <td>est 1960 - 2005</td> </tr> <tr> <td>Fleets</td> <td></td> <td></td> <td>1 trawl only</td> </tr> <tr> <td>Discards</td> <td></td> <td></td> <td>none significant, not Fitted</td> </tr> <tr> <td>Age classes</td> <td></td> <td>a</td> <td>0-65 years</td> </tr> <tr> <td>Sex ratio</td> <td></td> <td>p_s</td> <td>0.5 (1:1)</td> </tr> <tr> <td>Natural mortality</td> <td></td> <td>M</td> <td>estimated (0.1) per year</td> </tr> <tr> <td>Steepness</td> <td></td> <td>h</td> <td>0.75</td> </tr> <tr> <td>Recruitment variation</td> <td></td> <td>σ_r</td> <td>0.35</td> </tr> <tr> <td>Female maturity</td> <td>1</td> <td></td> <td>25 cm (SL)</td> </tr> <tr> <td rowspan="4">Growth</td> <td rowspan="4">2</td> <td>L_{max}</td> <td>37.939 cm (SL)</td> </tr> <tr> <td>K</td> <td>fitted</td> </tr> <tr> <td>L_{min}</td> <td>fitted</td> </tr> <tr> <td>CV</td> <td>fitted</td> </tr> <tr> <td rowspan="2">Length-weight (based on standard length)</td> <td rowspan="2">3</td> <td>f_1</td> <td>F 0.000128 cm (SL)/gm</td> <td>Male</td> </tr> <tr> <td>f_2</td> <td>F 2.559</td> <td>M 2.522</td> </tr> </tbody> </table> | Description | Source | Parameter | Combined Male/Female | Years | | y | 1960-2014 | Recruitment Deviates | | r | est 1960 - 2005 | Fleets | | | 1 trawl only | Discards | | | none significant, not Fitted | Age classes | | a | 0-65 years | Sex ratio | | p_s | 0.5 (1:1) | Natural mortality | | M | estimated (0.1) per year | Steepness | | h | 0.75 | Recruitment variation | | σ_r | 0.35 | Female maturity | 1 | | 25 cm (SL) | Growth | 2 | L_{max} | 37.939 cm (SL) | K | fitted | L_{min} | fitted | CV | fitted | Length-weight (based on standard length) | 3 | f_1 | F 0.000128 cm (SL)/gm | Male | f_2 | F 2.559 | M 2.522 |
| Description | Source | Parameter | Combined Male/Female | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Years | | y | 1960-2014 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Recruitment Deviates | | r | est 1960 - 2005 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fleets | | | 1 trawl only | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Discards | | | none significant, not Fitted | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Age classes | | a | 0-65 years | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sex ratio | | p_s | 0.5 (1:1) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Natural mortality | | M | estimated (0.1) per year | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Steepness | | h | 0.75 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Recruitment variation | | σ_r | 0.35 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Female maturity | 1 | | 25 cm (SL) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Growth | 2 | L_{max} | 37.939 cm (SL) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | K | fitted | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | L_{min} | fitted | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | CV | fitted | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Length-weight (based on standard length) | 3 | f_1 | F 0.000128 cm (SL)/gm | Male | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | f_2 | F 2.559 | M 2.522 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |



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| | |
| Significant changes to data inputs | <ol style="list-style-type: none"> 1. Repeat the assessment from 2011 using the new software version SS3.24u 2. Use the older version of SS3 (SS3.24f) to test the effect of using new software. 3. Add catch and commercial CPUE to 2014/15. 4. Add survey abundance estimates to 2014/15. 5. Add length composition data from 2011/12 to 2014/15; a new step this year was to keep the port and on-board ISMP data separate. In addition, length composition data from all surveys were included and, again new this year, the on-board length composition data obtained through crew sampling from 2010/2011 – 2014/2015 were also included. 6. Estimate the selectivity curve for the Fishery Independent Survey 7. Add age composition data from 2011/12 to 2014/15. 8. Add the ageing error matrix 9. Estimate L_{min} (a growth curve parameter) 10. Again use the older version of SS3 (SS3.24f) to test the effect of using new software. 11. New to this assessment, add the age composition data from the FIS for the years 2008/2009, 2010/2011, and 2014/2015, in which it is available. 12. Use variance estimates around the recruitment deviates to set the last estimated recruitment to 2004/2005. Accept fitted recruitment deviation bias adjustment values. 13. The variance of the different length and age composition data and the CPUE data were balanced to generate the initial base case. The balancing procedure this year attempts to apply more emphasis to the CPUE time series. The model balancing also involved increasing the recruitment variation from 0.2 to 0.34 as further bias adjustments were required after adjusting the variance estimates on different data streams. |
| Comments on data | Data in the 2015 is more informative than for previous assessments. This is the result of the heavier fishing pressure applied to the fishery in the mid-2000s, and the 10-15 year delay before recruitment effects are seen in the fishery (given bight redfish late age-at-maturity). |
| Implications for companion species/TEPs/multi-species fisheries | GABRAG has noted concerns regarding the lower catches of bight redfish in recent years, with catches being taken as bycatch when targeting deepwater flathead. |

| Tier 1 stock projection | |
|---|----------------------------------|
| Projected biomass (include confidence intervals) | Projections from 2015 assessment |

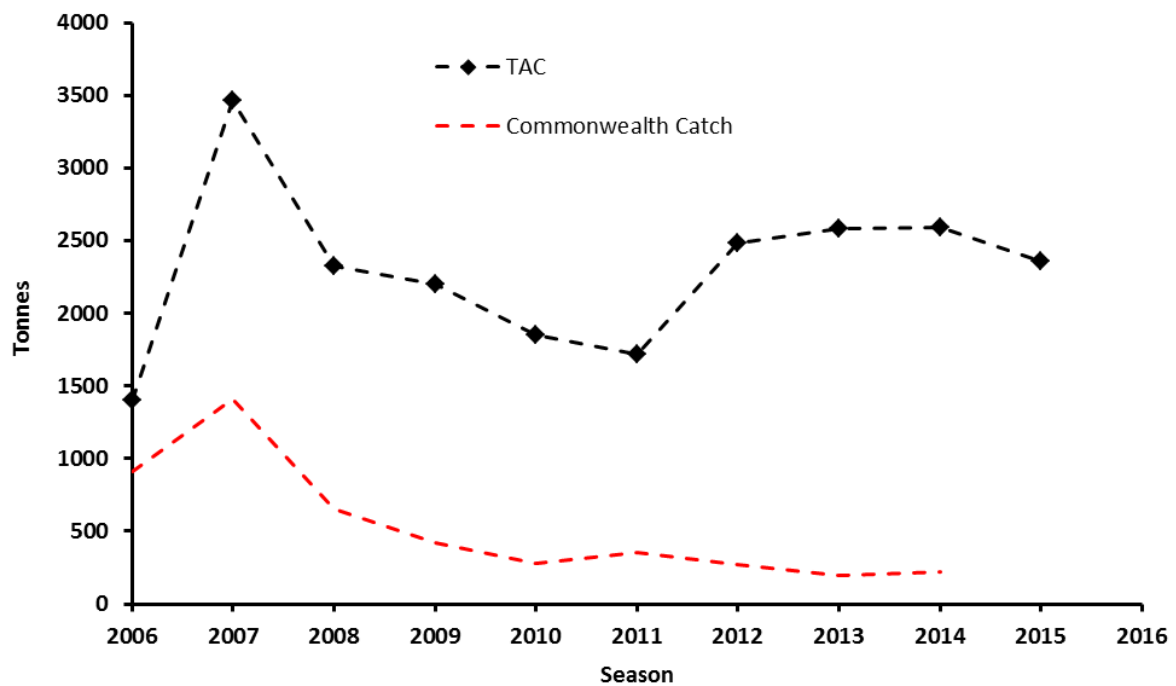
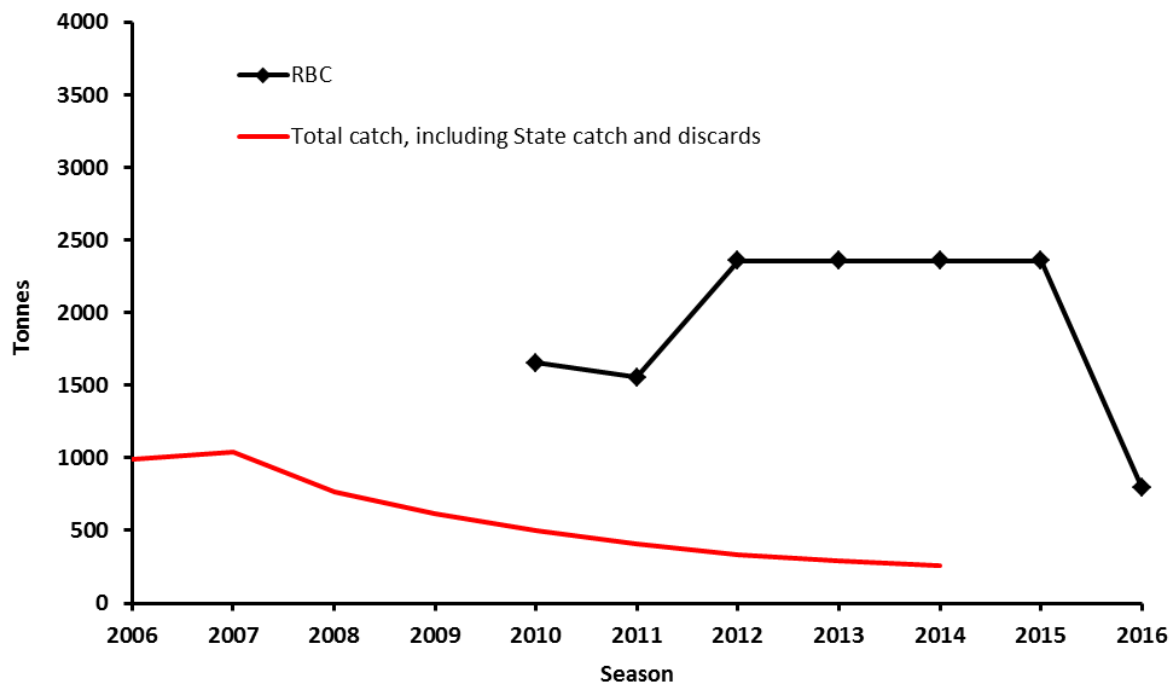




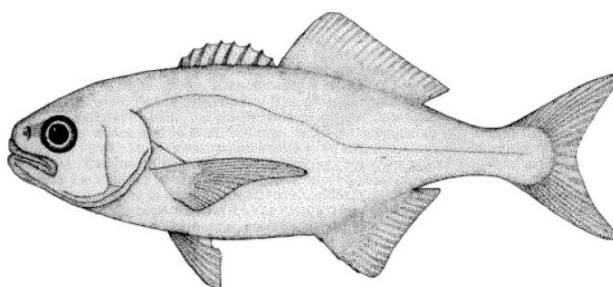
| Research | | |
|--------------------|--|---|
| Research allowance | N/A | |
| | <input type="checkbox"/> Included in TAC | <input type="checkbox"/> In addition to TAC |



Catch trends – Bight redfish
 (RBC and total catch are calendar year; TAC and Commonwealth catch are fishing season)



Blue eye trevalla (*Hyperoglyphe antarctica*)



ABARES (2012): Line drawing - FAO

Assessed by SlopeRAG in 2015. Species summary updated in 2015.

| Stock status summary | | | | | | | | | | | |
|---|---|------|--|-----------------|-----------|---------------|--------|--------------|--------|---------------|--------|
| <p>Stock structure</p> | <p>The assessment assumes one blue eye trevalla stock across the entire SESSF. Given current knowledge, the Slope Resource Assessment Group (SlopeRAG) recommended blue eye trevalla be assessed as a single stock (incorporating the continental shelf, seamounts and the Cascade Plateau). However, this advice may be reconsidered once the results of external work becomes available</p> <p>The Australian stock is considered to be separate from the New Zealand stock(s).</p> | | | | | | | | | | |
| <p>Stock status against reference points and trend</p> | <p>Tier 4 species use CPUE targets as a proxy of biomass targets.</p> <p>The Tier 4 target reference point is the level of CPUE assumed to produce a spawning biomass of 48 per cent of unfished levels. The limit reference point is 20 per cent of unfished levels.</p> <p>SlopeRAG agreed to use a revised catch per hook metric in the Tier 4 analysis in place of the previously used catch per record/day. The RAG considered the updated analysis to be a better reflection of CPUE in the early part of the fishery. The updated analysis confirmed that the previous Tier 4 assessment was conservative in nature, and that blue-eye trevalla are likely to be less depleted than the 2014 assessment indicated.</p> <table border="1" data-bbox="608 1646 1114 1839"> <thead> <tr> <th colspan="2">CPUE</th> </tr> </thead> <tbody> <tr> <td>Ref year</td> <td>1997-2006</td> </tr> <tr> <td>Target</td> <td>1.0779</td> </tr> <tr> <td>Limit</td> <td>0.4491</td> </tr> <tr> <td>Recent</td> <td>0.8573</td> </tr> </tbody> </table> <p>The RAG considered the effect of Orca depredation on blue eye trevalla catch rates, and noted that Orca depredation in the auto line fishery is assumed to have now reached equilibrium.</p> | CPUE | | Ref year | 1997-2006 | Target | 1.0779 | Limit | 0.4491 | Recent | 0.8573 |
| CPUE | | | | | | | | | | | |
| Ref year | 1997-2006 | | | | | | | | | | |
| Target | 1.0779 | | | | | | | | | | |
| Limit | 0.4491 | | | | | | | | | | |
| Recent | 0.8573 | | | | | | | | | | |

| | | |
|---|--|-------------------------------------|
| | <p>In an alternative Tier 4 analysis, loss of catch due Orca interactions was treated as a discard. The Tier 4 with Orca-influenced catch rates suggested that the stock is more productive than the base case analysis that used non-whale affected catch rates. The RAG recommended that Orca-influenced catch rates not be applied to the Tier 4 analysis used to set the RBC. The RAG noted that the RBC will be a conservative estimate because these data are omitted. However if depredation rates have declined exponentially that could explain the CPUE increase observed without any change in stock abundance. .</p> | |
| ABARES most recent assessment (2015) | Biomass: Not overfished | Fishing mortality: Uncertain |
| GVP figures (2013 - 14 fishing season) | GVP | % fishery GVP |
| | \$3.3 million | 5.4 per cent |
| Recommended Biological Catch 2016 - 17 | 444 t | |
| Overcatch/undercatch | <p>10 per cent undercatch</p> <p>10 per cent overcatch</p> | |
| <p>Probability of recommended biological catch (RBC) (or other levels of catch) causing a decline below limit reference <u>under proposed management</u> <u>Species that follow a HS rule that has been MSE tested will have a “very unlikely” score in this section (i.e. P<10 %).</u></p> | <p>Tier 4 assessments do not assess the probability of being below the reference point. However, the RAG considers the current assessment to be conservative.</p> <p>The RBC is taken from the MSE-tested harvest control rules. If the standardised CPUE series is a reasonable index of relative abundance the RBC will have a very low probability of causing a decline below the limit reference point.</p> | |
| | Alternative Catch Scenarios: N/A (Tier 4) | |



| Assessment Year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|--------------------------------------|-------------------------------|-------------------------------|-------------------------------|---------------------|-------------------------------|---------|-------------------------------|
| Tier /rollover /MYTAC | Tier 4 | Tier 4 | Tier 4 | Rollover | Tier 4 | MYTAC | Tier 4 |
| Stock Status | CPUE between target and limit | CPUE between target and limit | CPUE between target and limit | Not assessed | CPUE between target and limit | MYTAC | CPUE between target and limit |
| Fishing Year | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
| RBC(t) | 536 | 521 | 415 | N/A TAC rolled over | 269 | 269* | 444 |
| Agreed TAC | 428 | 326 | 387 | 388 | 335 | 335 | |
| Actual TAC after overs/unders | 473 | 361 | 385 | 417 | 355 | 363 | |
| % TAC caught | 77 | 98 | 86 | 85 | 76 | | |

* Based on additional work presented in 2014, SlopeRAG confirmed that the Tier 4 estimate from 2013 was very conservative in nature, and recommended that the current step-down be paused pending a 2015 stock assessment.

Tier Level & Discounts

| | | |
|--|---|--|
| Tier Level | Tier 4- for details of Tiers and the Harvest Strategy, see: http://www.afma.gov.au | |
| Discount factor | 0 per cent. The RAG recommended that the discount factor not be applied due to the conservative estimate of the RBC and protection afforded the stock by fishing closures | |
| Is a multi-year TAC in place? | <input type="checkbox"/> Yes (in place this season) | <input checked="" type="checkbox"/> No |
| Is a multi-year TAC recommended? (please provide a clear indication on whether the multi-year recommendation is a RBC (e.g. based on Tier 1 model output) or TAC (e.g. a roll-over of catch)) | <input type="checkbox"/> Yes (recommended for future seasons) | <input checked="" type="checkbox"/> No The RAG did not support putting blue eye trevalla on more than a single year TAC because: <ul style="list-style-type: none"> the CPUE is less than 65 per cent of the target the CPUE has changed rapidly and the 2014 CPUE data point is the only one above the target in the last seven years developing a CPUE-based breakout rule for blue eye trevalla would require a CPUE standardization; this is in effect a Tier 4 assessment |



| | | |
|--|-----|---|
| | | <ul style="list-style-type: none"> a report on stock structure will be available next year and this may inform assumptions used in the assessment. |
| Breakout rules for multi-year TAC | N/A | |
| Have breakout rules been triggered? | N/A | |

| Assessment | |
|-------------------------------|--|
| Stock indicator trends | <p>Total blue eye trevalla catches have been declining since 2009.</p> <p>The long term trend in CPUE is has been mostly below the target since 2001. There has been an increase in CPUE over the last two years.</p> |
| RAG comments | <p>In 2014 SlopeRAG reviewed additional work that looked at the early part of the blue eye trevalla CPUE series. The updated work applied a 'catch per hook' metric in place of the 'catch per day' metric used in previous Tier 4 blue eye trevalla stock assessments.</p> <p>In 2015 the RAG noted that:</p> <ul style="list-style-type: none"> catch per record CPUE is a blunt performance measure which ignores changes in fishing behavior catch per hook CPUE is more sensitive to changes but getting total hook numbers can be difficult the log (catch per hook) data are more normally distributed than the log (catch per record) data, indicating that catch per hook data are more representative of the true CPUE and abundance catch per hook data are less prone to distortion due to behavioral changes than catch per record data auto-line CPUE remains uncertain due to some confusion in the database using catch per hook data decreases the CPUE during the reference period, and increases the recent CPUE, making the recent biomass proxy more similar to that occurring during the reference period Orca depredation in the auto-line fishery is assumed to have now reached equilibrium, but appears to have had |

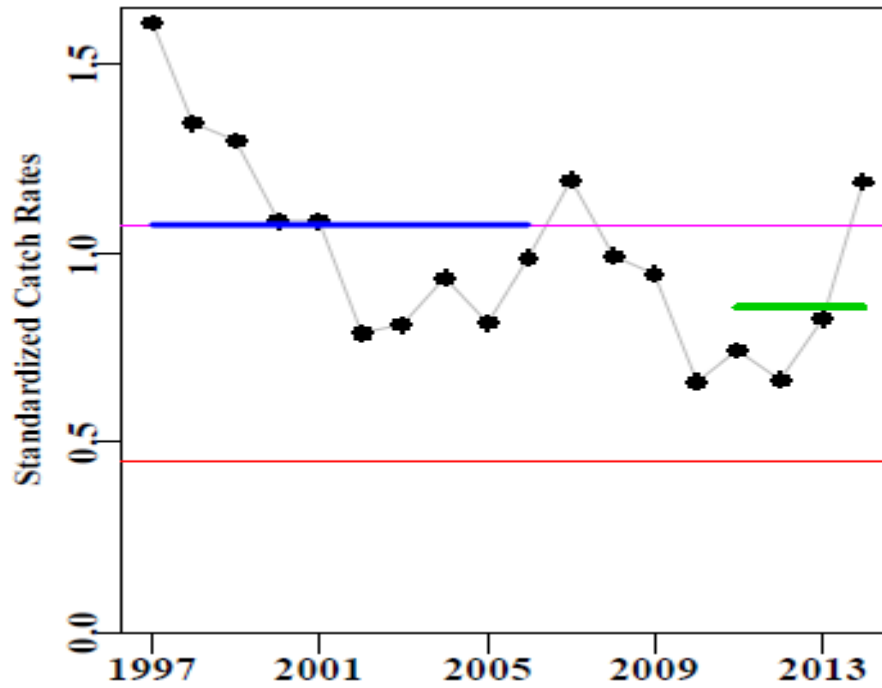


| | |
|--|---|
| | <p>negative effects on the CPUE from about the early 2000s</p> <ul style="list-style-type: none"> whale depredations and closures, if they have had an effect on CPUE, will make current estimates excluding these parameters more conservative and under-estimate abundance. <p>In 2015 the RAG agreed to use the catch per hook metric, noting that this is a better reflection of CPUE in the early part of the fishery. The updated analysis resulted in a lower CPUE in the early part of the data series, confirming that the previous Tier 4 assessment was conservative in nature and that blue eye trevalla are less depleted than the assessment indicated.</p> <p>Alan Williams, Paul Hamer, Kyne Krusic-Golub and Jonathon Cool presented a report on their work investigating blue-eye trevalla stock structure. The project is funded by AFMA and FRDC and is due to conclude next year.</p> |
| Key model technical assumptions/parameters | <p>Key model assumptions are:</p> <ul style="list-style-type: none"> a single stock CPUE is proportional to abundance best assessment is obtained by using catch per hook as the metric for CPUE effects of closures and Orcas are not accounted for in catch rates. |
| Changes to model structure/assumptions | See above |
| Significant changes to data inputs | See above |
| Comments on data | The potential (but unquantified) impact of closures make the standardization of CPUE data difficult. As Tier 4 assessments rely on analysis of CPUE this produces conservative RBC estimates. |
| Implications for companion species/TEPs/multi-species fisheries | Auto longline operators catch pink ling and blue eye trevalla in similar circumstances; there is potential for increased incidental ling catches due to an increase in blue eye trevalla RBC. |



Tier 4 CPUE series

Projected biomass (include confidence intervals)



Standardised Blue eye Trevalla catch rates (Haddon 2015)

Research

Research allowance

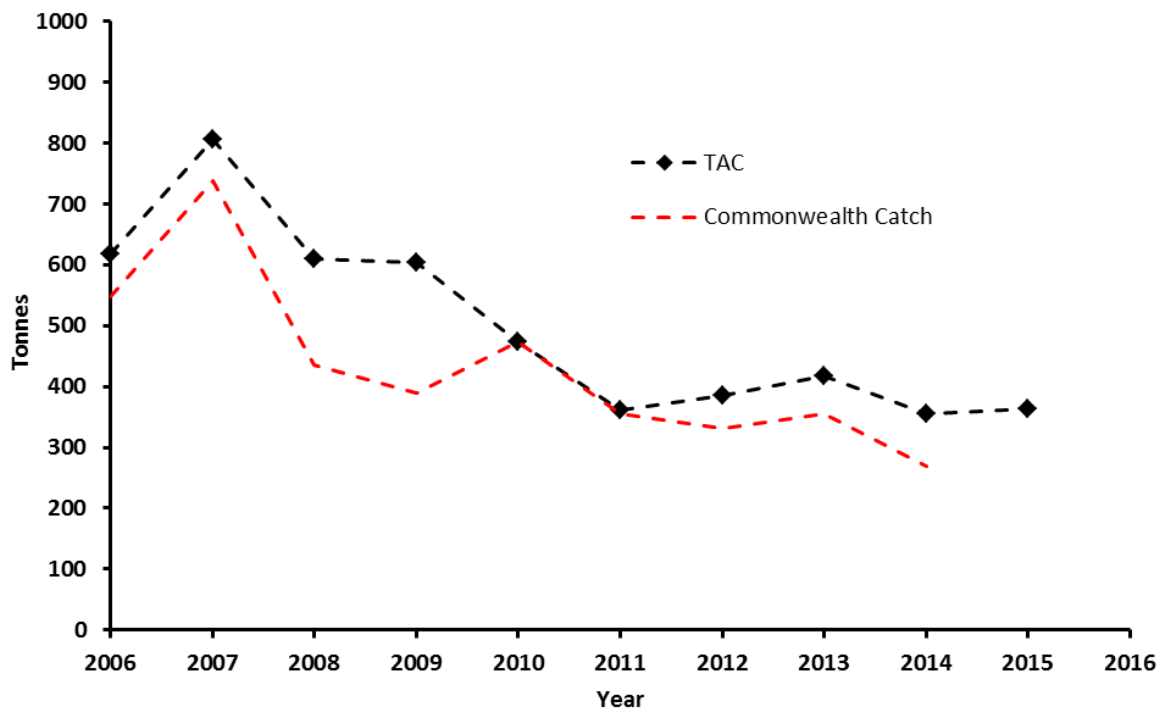
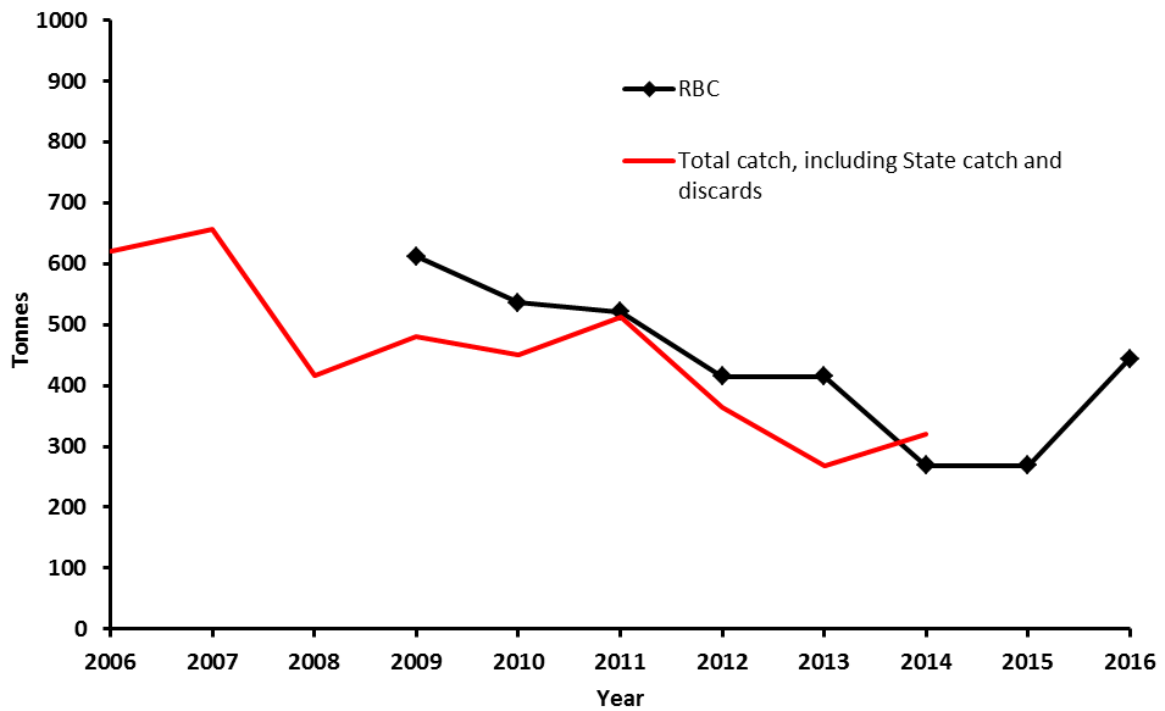
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Included in TAC

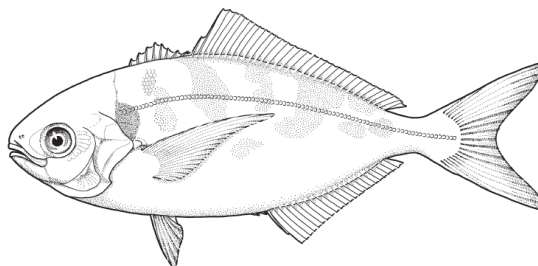
In addition to TAC



Catch trends – Blue eye trevalla
 (RBC and total catch are calendar year; TAC and Commonwealth catch are fishing season)



Blue warehou (*Seriolella brama*)



ABARES (2012): Line Drawing – Rosalind Poole

Common names: Black trevally, sea bream, snotgall, snotgall trevally, snotty trevala, snottynose trevala, Tasmanian trevally, trevally

Under a Stock Rebuilding Strategy.

Assessed by ShelfRAG in 2013. Species summary updated in 2015.

| Stock status summary | | | | | | | | | | | | | |
|--|--|--------|------|------|---------------|--------|--------|--------------|--------|--------|---------------|--------|--------|
| Stock structure | There is good evidence that there are two stocks of blue warehou, east and west of the Bass Strait, but the species is managed under a single TAC. | | | | | | | | | | | | |
| Stock status against reference points and trend | <p>Tier 4 species use CPUE targets as a proxy of biomass targets.</p> <p>The Tier 4 target reference point is the level of CPUE assumed to produce a spawning biomass of 48 per cent of unfished levels.</p> <p>The limit reference point is the level of CPUE assumed to produce a spawning biomass of 20 per cent of unfished levels.</p> <table border="1"> <thead> <tr> <th>CPUE</th> <th>East</th> <th>West</th> </tr> </thead> <tbody> <tr> <td>Target</td> <td>2.0717</td> <td>1.9249</td> </tr> <tr> <td>Limit</td> <td>0.8287</td> <td>0.7699</td> </tr> <tr> <td>Recent</td> <td>0.1861</td> <td>0.2681</td> </tr> </tbody> </table> <p>2013 Stock status: Currently blue warehou is expected to be below the limit reference point and is subject to a rebuilding strategy. The last agreed Tier 1 assessment in 2005-06 found the eastern stock to be depleted below the limit reference point. In contrast, the western stock was thought to be above the limit reference point and close to the biomass maximum sustainable yield (B_{40}) level. However, the assessment predicted that the western stock will have dropped below the limit reference point by 2007 if the landed catches remained high and if recruitment was average.</p> <p>Biomass trend: The standardised CPUE for both stocks</p> | CPUE | East | West | Target | 2.0717 | 1.9249 | Limit | 0.8287 | 0.7699 | Recent | 0.1861 | 0.2681 |
| CPUE | East | West | | | | | | | | | | | |
| Target | 2.0717 | 1.9249 | | | | | | | | | | | |
| Limit | 0.8287 | 0.7699 | | | | | | | | | | | |
| Recent | 0.1861 | 0.2681 | | | | | | | | | | | |

| | | |
|--|--|-------------------------------------|
| | <p>continue to be low and declining in 2012, however, due to avoidance of blue wareghou by operators the use of CPUE as an index of abundance is no longer considered reliable.</p> <p>Catches have been small over the last few years and below the incidental TAC, as a consequence of low catches there are little data.</p> | |
| ABARES most recent assessment (2015) | Biomass: Overfished | Fishing mortality: Uncertain |
| GVP figures (2013 – 14 fishing season) | GVP | % fishery GVP |
| | \$0.15 million | 0.24 per cent |
| Recommended Biological Catch 2016 - 17 | <p>0t – RBCs for both eastern and western stocks remain at zero as standardised catch rates are below the limit reference points.</p> <p>Blue warehou is managed under the blue warehou Stock Rebuilding Strategy.</p> <p>The Blue Warehou Stock Rebuilding Strategy was updated in 2014 and is available here.</p> <p>An incidental catch TAC of 118t is recommended by ShelfRAG.</p> | |
| Overcatch/undercatch | <p>0 per cent undercatch</p> <p>0 per cent overcatch</p> | |
| Probability of recommended biological catch (RBC) (or other levels of catch) causing a decline below limit reference <u>under proposed management</u> <u>Species that follow a HS rule that has been MSE tested will have a “very unlikely” score in this section (i.e. P<10 %).</u> | <p>N/A – Already considered to be below the limit reference point.</p> <p>Alternative Catch Scenarios: N/A – Already considered to be below the limit reference point.</p> | |



| Assessment Year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|-----------------------------------|--|--|--|--|--|--|--|
| Tier /rollover /MYTAC | Tier 4 | Tier 4 | Tier 4 | Tier 4 | Tier 4 | Not assessed | Not assessed |
| Stock Status | E: CPUE less than limit W: CPUE less than limit | E: CPUE less than limit W: CPUE less than limit | E: CPUE less than limit W: CPUE less than limit | E: CPUE less than limit W: CPUE less than limit | E: CPUE less than limit W: CPUE less than limit | E: CPUE less than limit W: CPUE less than limit | E: CPUE less than limit W: CPUE less than limit |
| Fishing Year | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
| RBC (t) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agreed TAC | 183 | 133 | 118 | 118 | 118 | 118 | 118 |
| Actual TAC (t) after overs/unders | 195 | 133 | 118 | 118 | 118 | 118 | 118 |
| % TAC caught | 71 | 73 | 41 | 55 | 14 | | |

Tier Level & Discounts

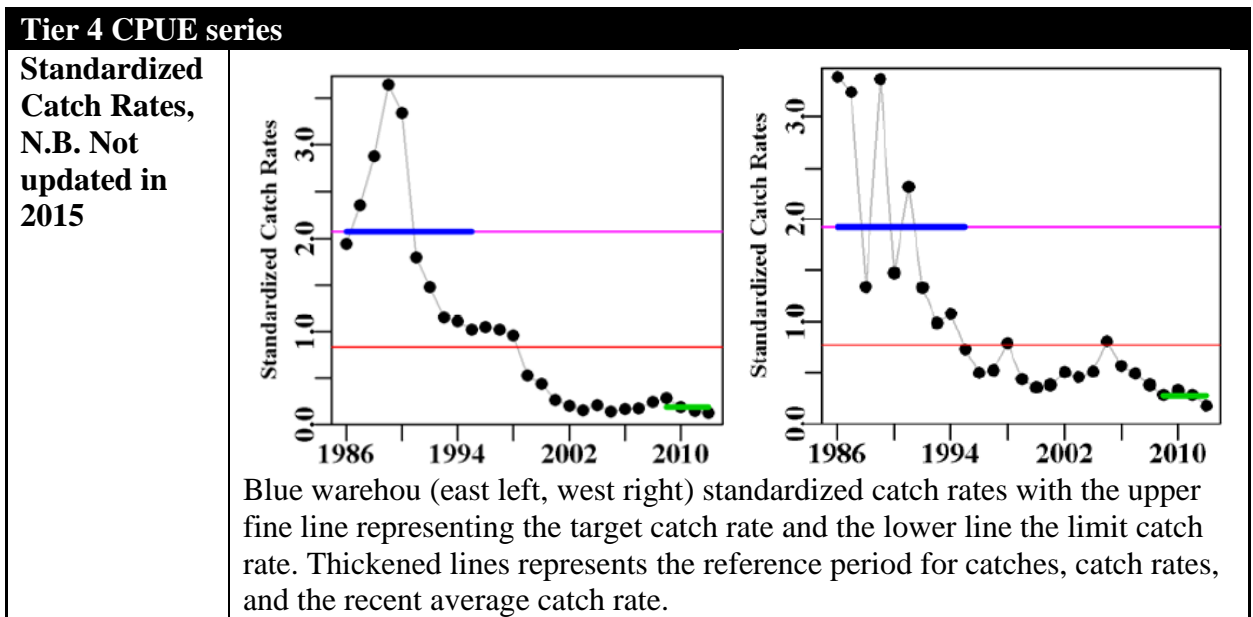
| | | |
|-------------------------------------|---|--|
| Tier Level | Tier 4- for details of Tiers and the Harvest Strategy, see: http://www.afma.gov.au | |
| Discount factor | N/A (incidental catch TAC) | |
| Is a multi-year TAC in place? | <input type="checkbox"/> Yes (in place this season) | <input checked="" type="checkbox"/> No |
| Is a multi-year TAC recommended? | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |
| Breakout rules for multi-year TAC | N/A | |
| Have breakout rules been triggered? | N/A | |

Assessment

| | |
|------------------------|--|
| Stock indicator trends | The RAG noted again its' concern that CPUE is not a good index of abundance while there is an incidental catch TAC in place and industry is actively avoiding the species. An alternative primary index of abundance needs to be developed as a high priority for use in future stock assessments. |
|------------------------|--|



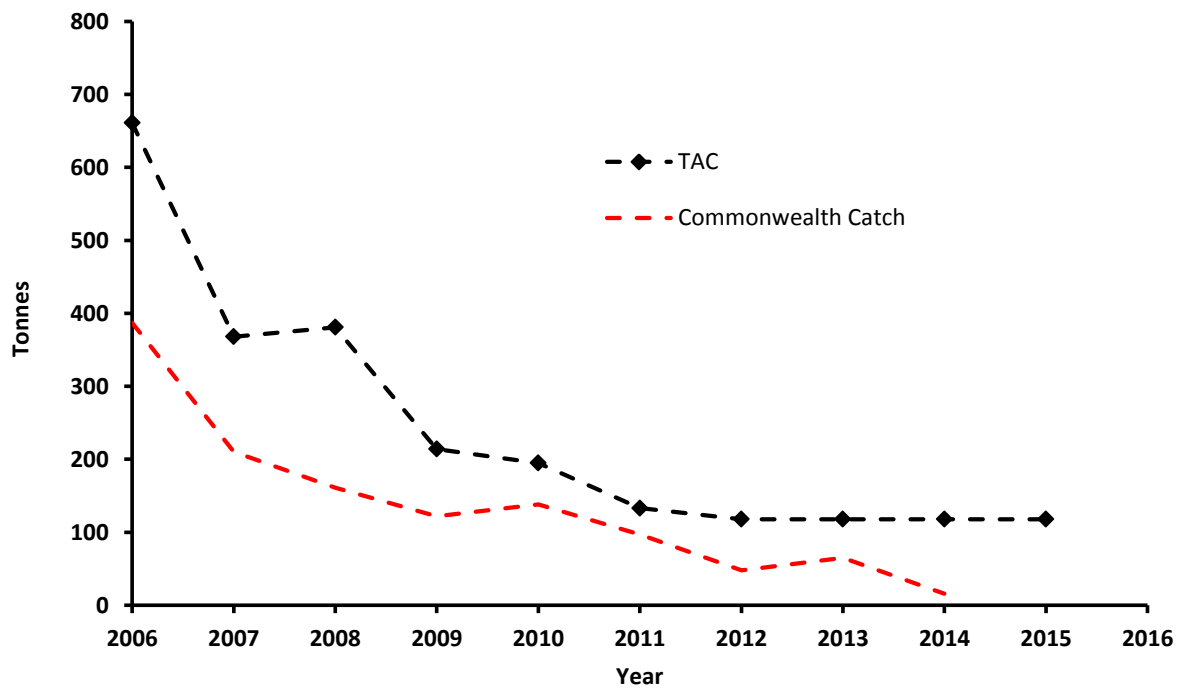
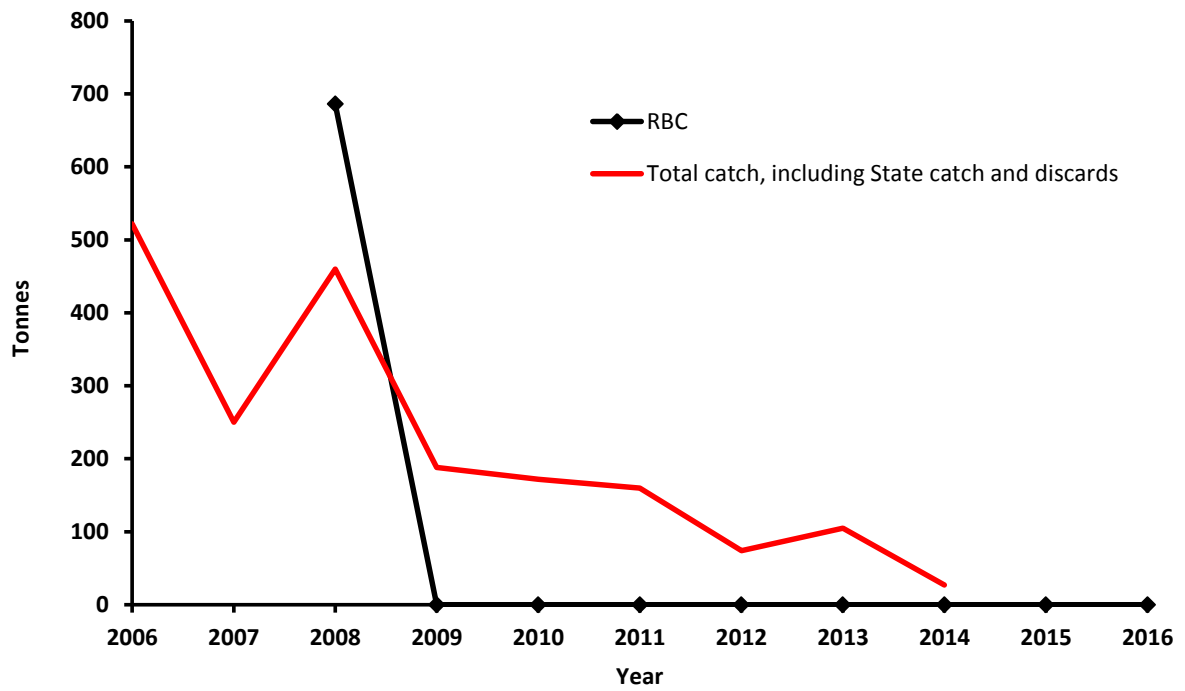
| | |
|--|-----|
| Key model technical assumptions/parameters | N/A |
| Changes to model structure/assumptions | N/A |
| Significant changes to data inputs | N/A |
| Comments on data | N/A |
| Implications for companion species/TEPs/multi-species fisheries | N/A |



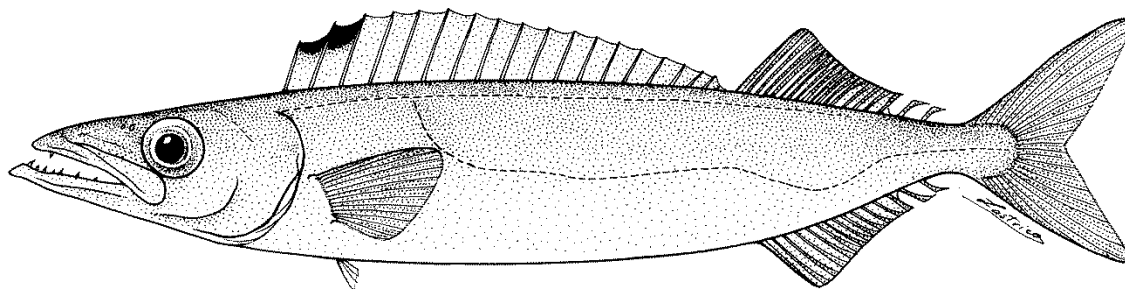
| | | |
|---------------------------|--|---|
| Research | | |
| Research allowance | 0 t | |
| | <input type="checkbox"/> Included in TAC | <input type="checkbox"/> In addition to TAC |



Catch trends – Blue warehou
 (RBC and total catch are calendar year; TAC and Commonwealth catch are fishing season)



Eastern gemfish (*Rexea solandri*)



Common names: Gemfish, silver gemfish and king couta.

Under a Stock Rebuilding Strategy.

Assessed by ShelfRAG in 2010. Species summary updated in 2015.

| Stock status summary | | |
|--|---|-------------------------------------|
| Stock structure | <p>Genetic analysis recognised two separate stocks with a boundary at the western end of Bass Strait (Paxton and Colgan 1993). Additional work (Moore, et.al, 2015) supports this stock structure hypothesis.</p> <p>The current assessment is based solely on eastern gemfish, caught south and east of Latitude 43° south off western Tasmania.</p> | |
| Stock status against reference points and trend | <p>Limit reference point is 20 per cent of unfished biomass.</p> <p>Target reference point is 48 per cent of unfished biomass.</p> <p>Stock status: The last updated assessment in 2010 (updated from 2008), assessed eastern gemfish to be at 16 per cent of its unfished biomass, and hence to be below the limit reference point.</p> <p>The Eastern gemfish Stock Rebuilding Strategy has been updated and was released in early 2015. The current rebuilding strategy is located here.</p> <p>Biomass trend: When last assessed, the stock was estimated to have started rebuilding.</p> | |
| ABARES most recent assessment (2015) | Biomass: Overfished | Fishing mortality: Uncertain |
| GVP figures (2013 - 14 fishing season) | GVP | % fishery GVP |
| | \$0.1 million | 0.16 per cent |
| Recommended Biological Catch 2016 - 17 | <p>0t (under a bycatch TAC)</p> <p>Incidental total allowable catch of 100t</p> | |

| | |
|---|---|
| Overcatch/undercatch | 0 per cent undercatch 0 per cent overcatch |
| Probability of recommended biological catch (RBC) (or other levels of catch) causing a decline below limit reference <u>under proposed management</u> <u>Species that follow a HS rule that has been MSE tested will have a “very unlikely” score in this section (i.e. $P < 10\%$).</u> | RBC recommendation – N/A, already considered to be below the limit reference point. Alternative Catch Scenarios: N/A |

| Assessment Year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|-------------------------------|---------|---------|--------------|--------------|--------------|--------------|--------------|
| Tier /rollover /MYTAC | Tier 1 | Tier 1 | Not assessed | Not assessed | Not assessed | Not assessed | Not assessed |
| Stock Status | 15 | 16 | Not assessed | Not assessed | Not assessed | Not assessed | Not assessed |
| Fishing Year | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
| RBC | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agreed TAC | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Actual TAC after overs/unders | 106 | 100 | 100 | 100 | 100 | 100 | 100 |
| % TAC caught | 83 | 77 | 63 | 52 | 37 | | |

| Tier Level & Discounts | |
|--|---|
| Tier Level | Tier 1 (last full assessment in 2009) - for details of Tiers and the Harvest Strategy, see: http://www.afma.gov.au |
| Discount factor | 0 per cent |
| Is a multi-year TAC in place? | <input type="checkbox"/> Yes (in place this season) <input checked="" type="checkbox"/> No |
| Is a multi-year TAC recommended? (please provide a clear indication on whether the multi-year recommendation is a RBC (e.g. based on Tier 1 model output) or TAC (e.g. a roll-over of catch)) | <input type="checkbox"/> Yes (recommended for future seasons) <input checked="" type="checkbox"/> No |



| | |
|--|--|
| Breakout rules for multi-year TAC | Observed standardised CPUE falls outside of 95 per cent confidence interval of that predicted by the Tier 1 assessment Aggregated catch and discards exceed 100t. |
| Have breakout rules been triggered? | N/A |

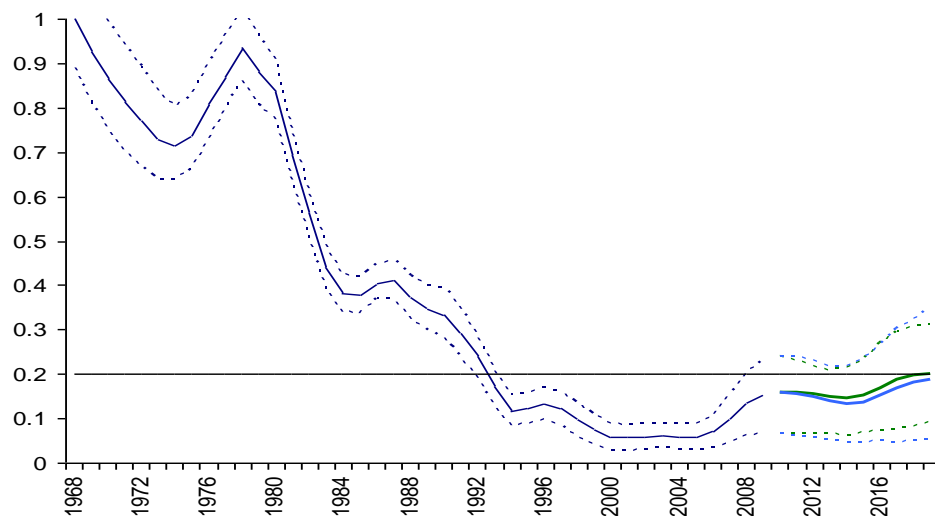
| Assessment | |
|-------------------------------|---|
| Stock indicator trends | Landed catches remain well below the incidental catch TAC and have been declining Aggregated landings and discards are less than the TAC and declining |
| RAG comments | <p>The RAG reviewed the 2014/15 data and noted:</p> <ul style="list-style-type: none"> • that 2014 was the first year that landings and discards totalled less than the 100 t TAC • generally over half the gemfish catch is discarded, mainly due to small size. The FIS data do not show these small cohorts however this is not unexpected due to the time of year the FIS is run and that the FIS was not designed to give good indications of gemfish abundance • there is little sign of older fish in the age frequencies • eastern gemfish range does not appear to be contracting. <p>There was no formal assessment of eastern gemfish during 2015. Projections from the most recent assessment, updated during 2010, indicate that with average recruitment the stock would recover within 13 years which is within the rebuilding timeframe specified in the HSP.</p> <p>CSIRO explored the sensitivity of an eastern gemfish survey on stock assessment. Different possible values of a survey index of abundance show that as the index increases, the spawning biomass correspondingly increases as well.</p> <p>The RAG identified some risks and benefits in running a survey. The RAG does not support a survey and agrees that funds would be better spent exploring inclusion of data from different fleets into the assessment and looking at different recruitment scenarios in the assessment. These options are less risky than a survey and may be more useful when investigating rebuilding timeframes.</p> <p>The RAG pointed out the eastern gemfish stock may now be at a new equilibrium and the stock may not rebuild under current conditions meaning the Eastern Gemfish Rebuilding Strategy under the Harvest Strategy Policy may be redundant.</p> |



| | |
|--|--|
| | <p>Noting that the last assessment was done in 2010 AFMA Management is of the view that it would be useful to have a new assessment.</p> <p>The RAG agreed that continuing with the 100t incidental catch MYTAC was appropriate. The RAG agreed to review the indicators and targeting analysis each year to monitor mortality levels.</p> |
| Key model technical assumptions/parameters | N/A |
| Changes to model structure/assumptions | N/A |
| Significant changes to data inputs | N/A |
| Comments on data | N/A |
| Implications for companion species/TEPs/multi-species fisheries | Historically there were reports of a companion species relationship between mirror dory and eastern gemfish which is likely to have changed due to avoidance of fishing the areas and depths that these species inhabit during the eastern gemfish spawning season. |

Tier 1 stock projection

Projected biomass (include confidence intervals)



Eastern gemfish base-case time-trajectories of spawning biomass depletion. Projections under 0t catch (green) and 100t catch (blue) (0.05 and 0.95 percentile). Note: total catches (including discards) are often in excess of the current 100t bycatch TAC, which means the above trajectories are optimistic (from Little and Rowling 2011).

Research

Research allowance

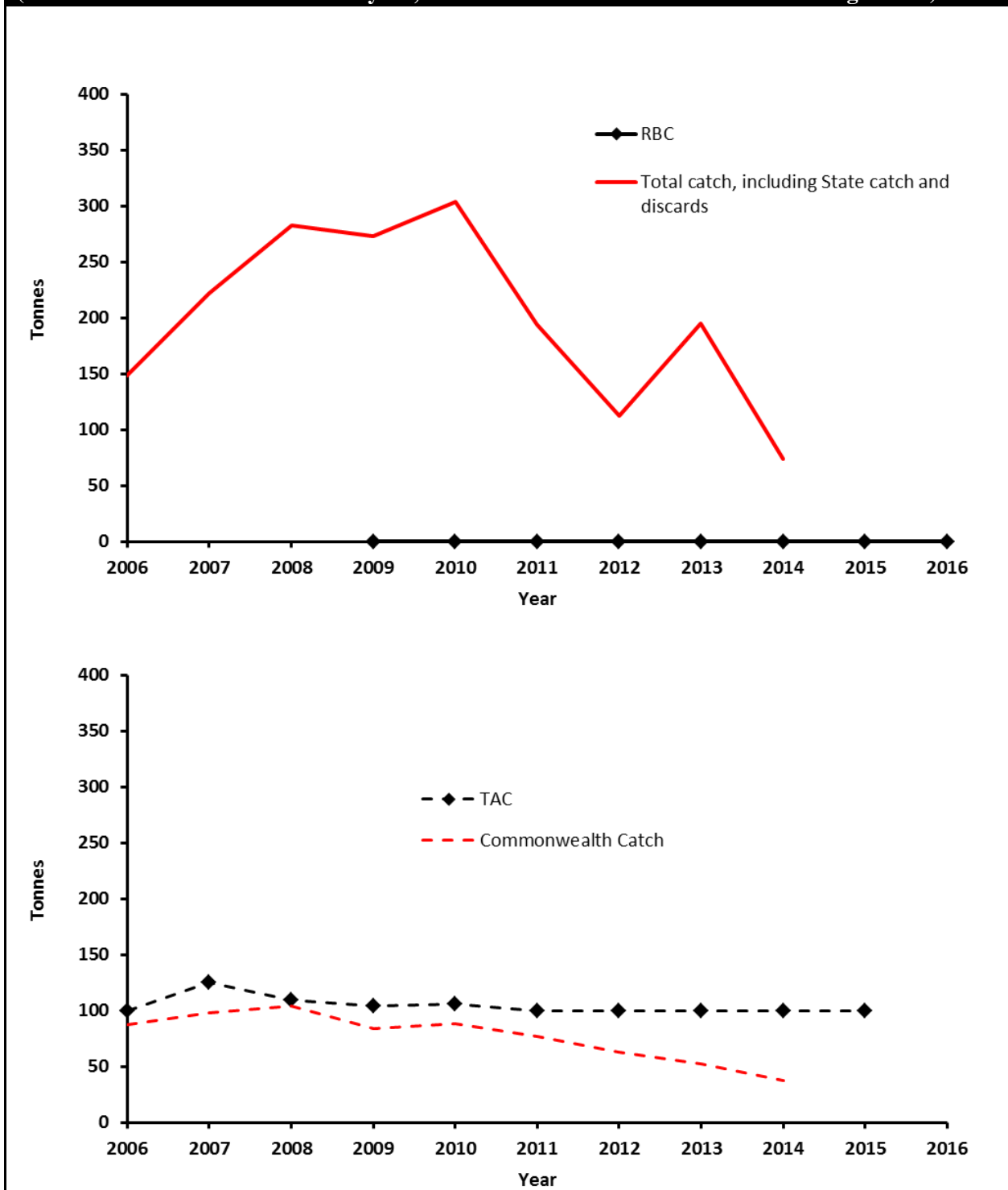
0 t

Included in TAC

In addition to TAC



Catch trends – Eastern gemfish
 (RBC and total catch are calendar year; TAC and Commonwealth catch are fishing season)



Elephantfish (*Callorhynchus milii*)



(Ken Graham © DPI Fisheries, 1984)

Assessed by SharkRAG in 2015. Species summary updated in 2015.

| Stock status summary | | | | | | | | | |
|--|---|-------------------------|---|----------------|---------------|--------------|--------|---------------|--------|
| Stock structure | Little is known about stock structure. Biology suggests some potential for regional management of stocks, however it is currently assessed as a single stock. | | | | | | | | |
| Stock status against reference points and trend | <p>Tier 4 species use CPUE targets as a proxy for biomass targets.</p> <p>SharkRAG reviewed the target reference point for elephantfish in 2014 and supported a maximum sustainable yield proxy target of 40 per cent of unfished levels. This was based on consideration that elephantfish is not targeted, is considered sustainable and is a secondary commercial species contributing less than 1 per cent to the fishery GVP.</p> <p>The Tier 4 target reference point is the level of CPUE assumed to produce a spawning biomass of 40 per cent of unfished levels.</p> <p>Stock status: In the 2015 Tier 4 assessment the recent average standardised CPUE-based proxy for biomass was above the target reference point.</p> <table border="1" data-bbox="732 1554 1299 1709"> <thead> <tr> <th></th> <th>CPUE</th> </tr> </thead> <tbody> <tr> <td>Target</td> <td>0.8341</td> </tr> <tr> <td>Limit</td> <td>0.4003</td> </tr> <tr> <td>Recent</td> <td>0.9111</td> </tr> </tbody> </table> | | CPUE | Target | 0.8341 | Limit | 0.4003 | Recent | 0.9111 |
| | CPUE | | | | | | | | |
| Target | 0.8341 | | | | | | | | |
| Limit | 0.4003 | | | | | | | | |
| Recent | 0.9111 | | | | | | | | |
| ABARES most recent assessment results (2014) | <table border="1" data-bbox="600 1733 1436 1812"> <tr> <td>Biomass: Not overfished</td> <td>Fishing mortality: Not subject to overfishing</td> </tr> </table> | Biomass: Not overfished | Fishing mortality: Not subject to overfishing | | | | | | |
| Biomass: Not overfished | Fishing mortality: Not subject to overfishing | | | | | | | | |
| GVP figures (2013 - 14 fishing season) | <table border="1" data-bbox="600 1812 1436 1890"> <tr> <td>GVP</td> <td>% fishery GVP</td> </tr> <tr> <td><\$0.1 million</td> <td><0.1 per cent</td> </tr> </table> | GVP | % fishery GVP | <\$0.1 million | <0.1 per cent | | | | |
| GVP | % fishery GVP | | | | | | | | |
| <\$0.1 million | <0.1 per cent | | | | | | | | |
| Recommended Biological Catch 2016 – 17 | <p>RBC based on model including discards and recreational catch is 306t.</p> <p><i>NB:</i> a discount factor of 15 per cent is to be applied.</p> | | | | | | | | |



| | |
|---|--|
| Overcatch/undercatch | 10 per cent undercatch 10 per cent overcatch |
| Probability of recommended biological catch (RBC) (or other levels of catch) causing a decline below limit reference <u>under proposed management</u> <u>Species that follow a HS rule that has been MSE tested will have a “very unlikely” score in this section (i.e. $P < 10\%$).</u> | RBC recommendation: <10 per cent (very unlikely) |
| | Alternative Catch Scenarios: N/A – Tier 4 assessment. |

| TAC and catch trends | | | | | | | |
|--------------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Assessment Year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
| Tier /rollover /MYTAC | Tier 4 | Tier 4 | Tier 4 | Tier 4 | Tier 4 | Tier 4 | Tier 4 |
| Stock Status | CPUE above target | CPUE above target | CPUE above target | CPUE above target | CPUE above target | CPUE above target | CPUE above target |
| Fishing season | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
| RBC | 94 | 122.8 | 136 | 136 | 116 | 357* | 306 |
| Agreed TAC | 65 | 89 | 89 | 109 | 109 | 163 | |
| Actual TAC after overs/unders | 70.65 | 91.97 | 96.16 | 116.15 | 117.43 | 172 | |
| % TAC caught | 85 | 72 | 77 | 61 | 52 | | |

| Tier Level & Discounts | |
|--|---|
| Tier Level | Tier 4 |
| Discount factor | SharkRAG supported applying the discount factor of 15 per cent for the 2016-17 fishing season. |
| Is a multi-year TAC in place? | <input type="checkbox"/> Yes (in place this season) <input checked="" type="checkbox"/> No |
| Is a multi-year TAC recommended? (please provide a clear indication on whether the multi-year recommendation is a RBC (e.g. based on Tier 1 model | <input checked="" type="checkbox"/> Yes (recommended for future seasons) <input type="checkbox"/> No SharkRAG supported a multi-year TAC for three years. SharkRAG recommended a RBC of 306 t based on a Tier 4 stock assessment which used standardised gillnet CPUE. |



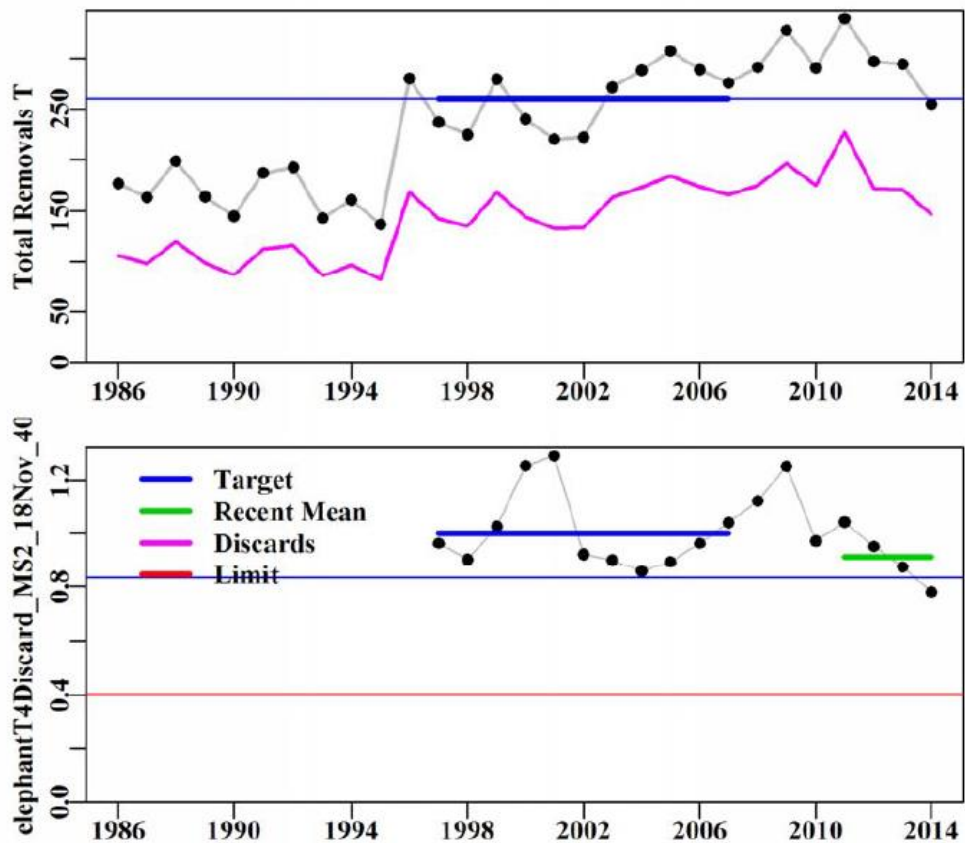
| | |
|--|---|
| output) or TAC (e.g. a roll-over of catch)) | |
| Breakout rules for multi-year TAC | <p>Breakout rules recommended were:</p> <ul style="list-style-type: none"> • If total mortality (including discards, state catch, and recreational catch) exceeds the most recent RBC by more than 10 per cent • If total mortality (including discards, state catch and recreational catch) is lower than 50 per cent of the most recent RBC • If there is a greater than 25 per cent change in any of the most recent standardised gillnet CPUE values |
| Have breakout rules been triggered? | N/A |

| Assessment | |
|--|---|
| Stock indicator trends | N/A |
| RAG comments | <p>In 2015 SharkRAG accepted an updated Tier 4 assessment for elephantfish based on standardised gillnet CPUE. SharkRAG recommended including discards in the assessment. This involved using the last four years of discard rate data and estimating the discard rate for the previous years.</p> <p>SharkRAG recommended an RBC of 306 t and supported a multi-year TAC.</p> |
| Key model technical assumptions/parameters | N/A |
| Changes to model structure/assumptions | <p>In 2014 SharkRAG recommended using the MSY proxy target of 40 per cent of unfished spawning biomass for elephantfish. This recommendation was accepted by AFMA management and subsequent RBCs have been calculated using the MSY proxy.</p> <p>In 2015 the model was based on standardized gillnet CPUE including discards. Discard estimates pre 2011 are based on average of the real discard estimates from 2011-14 (0.6009).</p> <p>The 2015 analysis also includes changes to annual recreational catch from 29 t in 2002 interpolated to 45 t in 2008 and 45 t thereafter.</p> |
| Significant changes to data inputs | Yes – model now includes updated discard and recreational catch data. |
| Comments on data | N/A |
| Implications for companion species/TEPs/multi-species fisheries | N/A |



Tier 4 assessment

Total removals and catch rates



Elephantfish – gillnet.

Top: total removals (black), target catch (fine blue line, C*).

Bottom: standardized CPUE (black), target CPUE (lower blue line) and limit reference CPUE (lower red line). Thick lines represent the reference period for catches (1997-2007; top panel, blue), CPUE (1997-2007; bottom panel, blue), and recent mean CPUE (last four years; bottom panel; green). The fine blue line below the target CPUE is the revised target based on a 40 per cent B_0 proxy target for non-target species in a mixed fishery. In this case the discard catches have been included in the CPUE estimates, thereby increasing them markedly.

Research

Research allowance

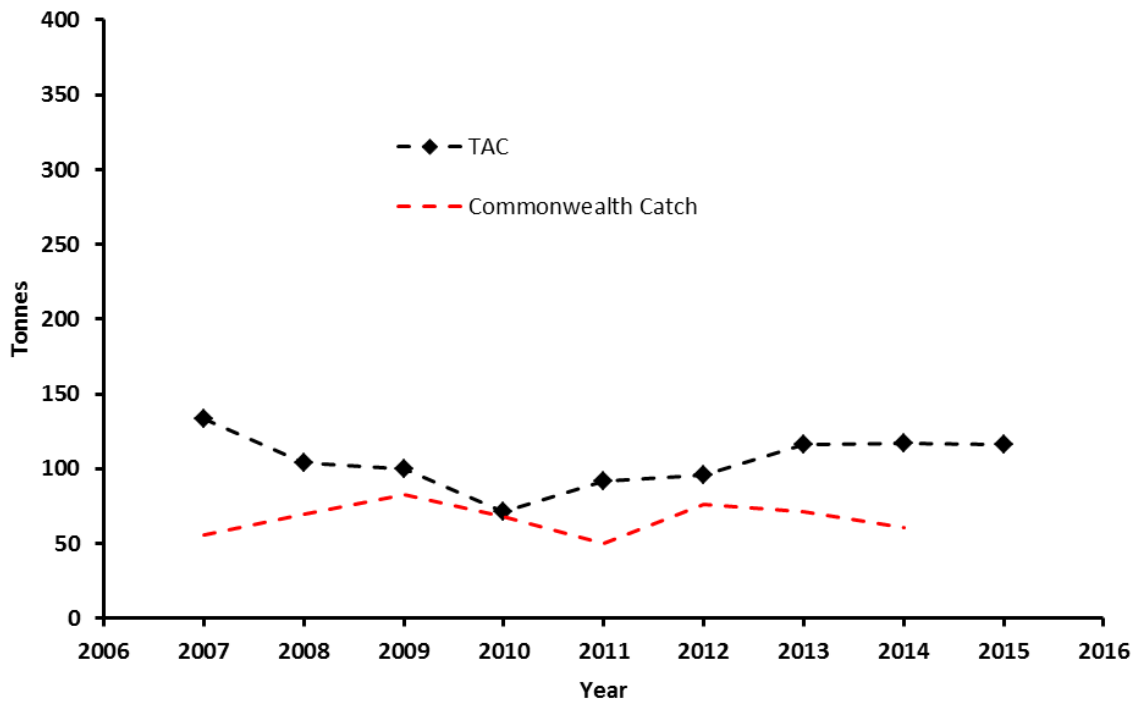
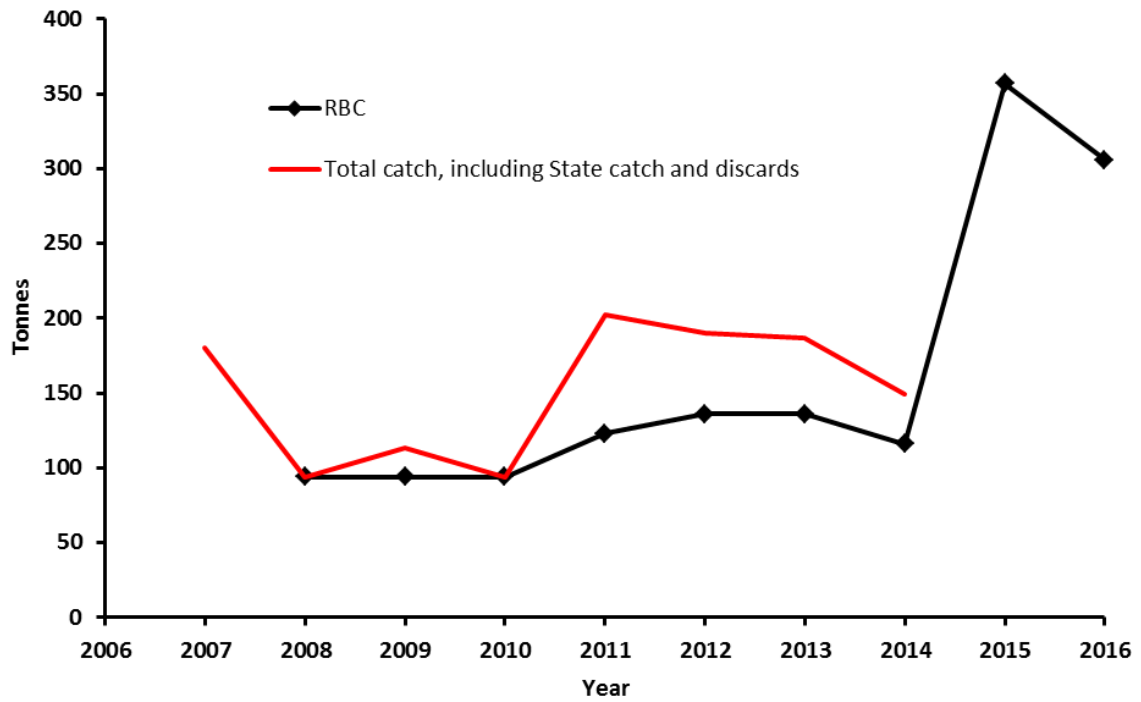
N/A

Included in TAC

In addition to TAC



Catch trends - Elephantfish
 (RBC and total catch are calendar year; TAC and Commonwealth catch are fishing season)



Gummy shark (*Mustelus antarcticus*)



(Fisheries Research & Development Corporation, 2012)

Assessed by SharkRAG in 2013. Species summary updated in 2015.

| Stock status summary | | |
|--|--|--|
| Stock structure | Gummy shark is endemic to southern Australia and harvested by the SESSF from a single genetic stock extending from Bunbury in Western Australia to Jervis Bay in NSW. This single genetic stock is assessed as four separate sub-stocks within the four broad regions on the continental shelf of Bass Strait, Tasmania, South Australia and Western Australia. These sub stocks are considered to be discrete reproductive stocks with tagging data showing there is low movement between them. | |
| Stock status against reference points and trend | <p>Limit reference point is 20 per cent of unfished biomass (pup production is used as a proxy for breeding biomass)</p> <p>Target reference point is 48 per cent of unfished biomass (pup production is used as a proxy for breeding biomass)</p> <p>The 2013 assessment estimates that the stock is above the target reference point for all sub-stocks.</p> | |
| ABARES most recent assessment (2015) | Biomass: Not overfished | Fishing mortality: Not subject to overfishing |
| GVP figures (2013-14 fishing season) | GVP | % fishery GVP |
| | \$13.5 million (\$12.7 m GHAT) | 22.2 per cent |



| <p>Recommended Biological Catch 2016-17</p> | <p>Based on the 2013 stock assessment, SharkRAG supported an RBC of 2010 t for the entire fishery. Noting larger hook catch reduces the RBC, the RBC of 2010 t is based on the scenario of 75 per cent hook catch in SA which reflects current and expected fishing activity.</p> <p>However, the RAG noted caution as:</p> <ul style="list-style-type: none"> • the RBC from the 2013 assessment is above historical catches for the fishery • Commonwealth catch has never been sustained above 1900 t and catches at this level have historically driven down catch rates. <p>It is important to maintain long term distribution of catches in the three areas of fishery in order to maintain catch rates. The concern is decreasing catch rates will mean higher levels of effort are required to land the TAC which is likely to increase the fishery's impact on incidental species and issues with localized depletion of gummy shark.</p> <p>Therefore the RAG supported maintaining the status quo of a Commonwealth TAC of 1836 t for the duration of the three year MYTAC.</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|-----------|-----|-------|---------|--|--|----------|------------|--|--|-------|--|----|----|----|-----|---------|---|------|-----|-----|------|------|----|------|-----|-----|------|------|----|------|-----|-----|------|------|----|------|-----|-----|------|------|----|-----|-----|-----|------|------|-----|-----|-----|-----|------|------|
| <p>Overcatch/undercatch</p> | <p>10 per cent undercatch 10 per cent overcatch</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p>Probability of recommended biological catch (RBC) (or other levels of catch) causing a decline below limit reference <u>under proposed management</u> <u>Species that follow a HS rule that has been MSE tested will have a "very unlikely" score in this section (i.e. P<10%).</u></p> | <p>RBC recommendation = <10 per cent (very unlikely)</p> <p>Alternative Catch Scenarios Alternative scenarios for hook caught v gillnet caught. RBCs for Bass Strait (BS), South Australian (SA) and Tasmanian (TS) populations. Calculations were done assuming that 0%, 10%, 25%, 75%, or 100% of the catch is taken by line gear (Line %). Totals are presented for situations where line gear is used in all regions (ALL), or in South Australia alone (SA only). RBCs are shown for 2014 (2014 RBCs) and for populations that are stable at 48 per cent of unfished biomass (long term RBCs)</p> <table border="1" data-bbox="576 1599 1353 2020"> <thead> <tr> <th colspan="6">2014 RBCs</th> </tr> <tr> <th rowspan="2">Line (%)</th> <th colspan="3">Population</th> <th colspan="2">Total</th> </tr> <tr> <th>BS</th> <th>SA</th> <th>TS</th> <th>All</th> <th>SA only</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>1234</td> <td>745</td> <td>253</td> <td>2232</td> <td>2232</td> </tr> <tr> <td>10</td> <td>1080</td> <td>617</td> <td>242</td> <td>1939</td> <td>2104</td> </tr> <tr> <td>25</td> <td>1049</td> <td>599</td> <td>233</td> <td>1881</td> <td>2086</td> </tr> <tr> <td>50</td> <td>1013</td> <td>582</td> <td>225</td> <td>1820</td> <td>2069</td> </tr> <tr> <td>75</td> <td>988</td> <td>567</td> <td>219</td> <td>1774</td> <td>2054</td> </tr> <tr> <td>100</td> <td>972</td> <td>557</td> <td>215</td> <td>1744</td> <td>2044</td> </tr> </tbody> </table> | 2014 RBCs | | | | | | Line (%) | Population | | | Total | | BS | SA | TS | All | SA only | 0 | 1234 | 745 | 253 | 2232 | 2232 | 10 | 1080 | 617 | 242 | 1939 | 2104 | 25 | 1049 | 599 | 233 | 1881 | 2086 | 50 | 1013 | 582 | 225 | 1820 | 2069 | 75 | 988 | 567 | 219 | 1774 | 2054 | 100 | 972 | 557 | 215 | 1744 | 2044 |
| 2014 RBCs | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Line (%) | Population | | | Total | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | BS | SA | TS | All | SA only | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 1234 | 745 | 253 | 2232 | 2232 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | 1080 | 617 | 242 | 1939 | 2104 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25 | 1049 | 599 | 233 | 1881 | 2086 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 50 | 1013 | 582 | 225 | 1820 | 2069 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 75 | 988 | 567 | 219 | 1774 | 2054 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 100 | 972 | 557 | 215 | 1744 | 2044 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |



| TAC and catch trends | | | | | | | | |
|--------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Assessment year | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
| Tier /rollover /MYTAC | Tier 3 | Tier 1 | Tier 1 | Rollover | Rollover | Tier 1 | MYTAC | MYTAC |
| Stock Status | $>B_{TARG}$ | $>B_{TARG}$ | $>B_{TARG}$ | $>B_{TARG}$ | $>B_{TARG}$ | N/A | N/A | N/A |
| Fishing season | 2009/10 | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
| RBC | 1800 | 1800 | 1836 | 1836 | 1836 | 2010 | 2010 | 2010 |
| Agreed TAC* | 1717 | 1717 | 1717 | 1717 | 1836 | 1836 | 1836 | 1836 |
| Actual TAC after overs/unders | 1771 | 1826 | 1847 | 1862 | 1964 | 1986 | 1978 | |
| % TAC caught | 91 | 85 | 79 | 79 | 77 | 77 | | |

*Note that Commonwealth TAC is set based on the RBC minus state allocation. Details of the state allocation are outlined in the MOU between the Commonwealth and the State of Victoria and South Australia. The total state allocation for Gummy shark is 4.6 per cent of the global catch limit (or RBC) and is apportioned for catch in South Australian internal waters (2.9 per cent) and catch in Victorian Bays and Inlets (1.7 per cent).

| Tier Level & Discounts | | |
|--|--|--|
| Tier Level | Tier 1 | |
| Discount factor | 0 per cent | |
| Is a multi-year TAC in place? | <input checked="" type="checkbox"/> Yes (in place this season) <ul style="list-style-type: none"> • 3 year = 1836 | <input type="checkbox"/> No |
| Is a multi-year TAC recommended? (please provide a clear indication on whether the multi-year recommendation is a RBC (e.g. based on Tier 1 model output) or TAC (e.g. a roll-over of catch)) | <input type="checkbox"/> Yes (recommended for future seasons) <ul style="list-style-type: none"> • | <input checked="" type="checkbox"/> No |



| | |
|---|---|
| <p>Breakout rules for multi-year TAC</p> | <p>SharkRAG recommended triggers for multi-year TACs review:</p> <ul style="list-style-type: none"> • Standardized CPUE value for Bass Strait approaches historical low (falls below the 10th percentile of the historical values for Bass Strait). Historical period being from 1997 to 2013. • catches fall below 1200 t • length frequencies from the line catch change substantially from the model parameters; <ul style="list-style-type: none"> a) more than 15% of gummy shark caught by the line sector are shorter than 76cm in total length; or b) more than 20% of the line caught gummy shark are greater than 130cm total length. |
| <p>Have breakout rules been triggered?</p> | <p>In 2015 SharkRAG reviewed the breakout rules for gummy shark and noted that none had been triggered.</p> <p>SharkRAG noted that the number of line caught gummy shark >130cm breakout rule is close to the trigger and agreed that this should be monitored. SharkRAG noted that more smaller and larger fish are caught on longlines than on gillnets.</p> |

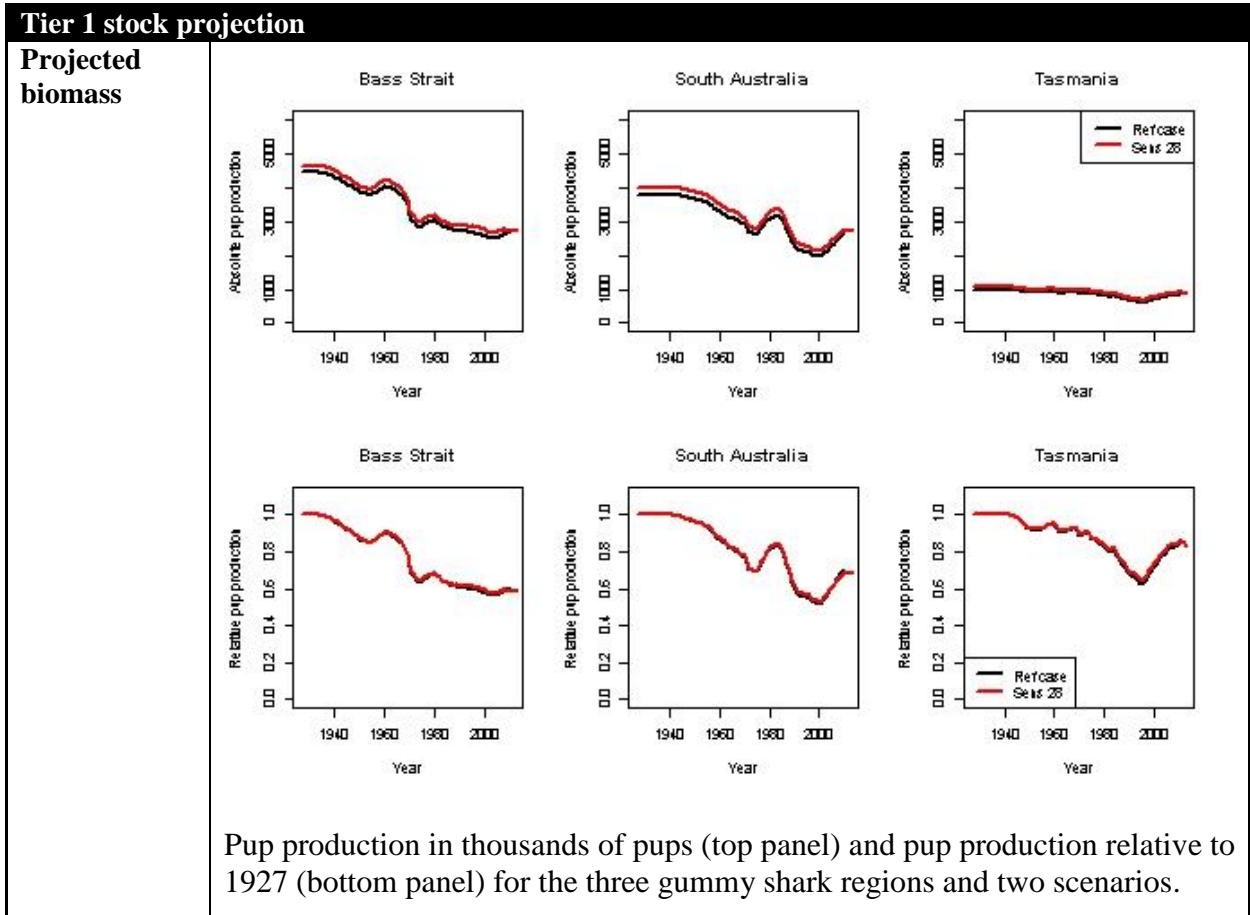
| <p>Assessment</p> | |
|--|---|
| <p>Stock indicator trends</p> | <p>N/A, due for assessment next year.</p> |
| <p>RAG comments</p> | <p>SharkRAG 2, 2013 noted that there are no sustainability concerns with the RBC set for the 2014/15 season.</p> <p>The RAG noted that careful monitoring is required of catch rates in Bass Strait and any impacts on size composition of sharks due to increased longline catches.</p> <p>In 2015 SharkRAG noted it had no concerns with continuing the MYTAC, and supported maintaining the MYTAC at 1836t.</p> |
| <p>Key model technical assumptions/parameters</p> | <p>Because of the close relationship between the number of shark pups and both the number and length of mature females, SharkRAG uses pup production as a proxy for spawning biomass.</p> <p>The model relies on gillnet caught shark that are primarily from four age classes of sub adults. Trends in adult biomass are poorly informed by the data. The model results are highly sensitive to the assumption made regarding density dependence. Density dependence is the way that modeled</p> |



| | |
|--|--|
| | <p>stock compensates for a fish down in the stock. i.e. how the productivity of the stock responds to changing abundance. Density dependence affects the mortality rate of sharks aged 0-30 years, as a function of 1+ biomass.</p> <p>It is assumed that larger / older sharks are less available to capture than younger sharks (this is in addition to gear selectivity constraints). This is applied to gillnet and line gear. While there is evidence supporting this assumption for gillnets, there as yet no evidence for longline.</p> <p>A non-linear relationship between CPUE and available biomass is implemented though the assumption that “gear competition” applies.</p> |
| Changes to model structure/assumptions | <p>There were no significant changes to the model used in 2013 compared to the last assessment in 2010.</p> <p>The model no longer considers tag return data after 2005.</p> <p>Forward projections now incorporate the assumption that the South Australian catch will be 75 per cent hook caught with the remainder of the fishery close to 100 per cent gillnet caught.</p> |
| Significant changes to data inputs | <p>The following data were added to the 2013 model:</p> <ul style="list-style-type: none"> • Reliable observer data are now available including length frequency data from Tasmania. • CPUE data up to 2012 were included for Bass Strait and Tasmania. • CPUE data from SA after 2009 were not included due influence of fishery closures. |
| Comments on data | <p>Recent large closures in South Australia are thought to have reduced the nominal and standardized CPUE in that state causing a break in the index of abundance.</p> <p>The RAG emphasizes the importance of collecting length frequency data for all longline caught gummy shark across the fishery.</p> |
| Implications for companion species/TEPs/multi-species fisheries | <p>The gillnet fishery interacts with Australian sea lions in waters off South Australia. Interactions are mitigated by using trigger limits that close spatial zones for 18 months if an interaction occurs. Similiarly dolphin inetractions in waters adjacent to the Coorong region in South Australia are manged in this way. The Coorong region is currently closed to gillnet fishing to mitigate dolphin interactions.</p> |



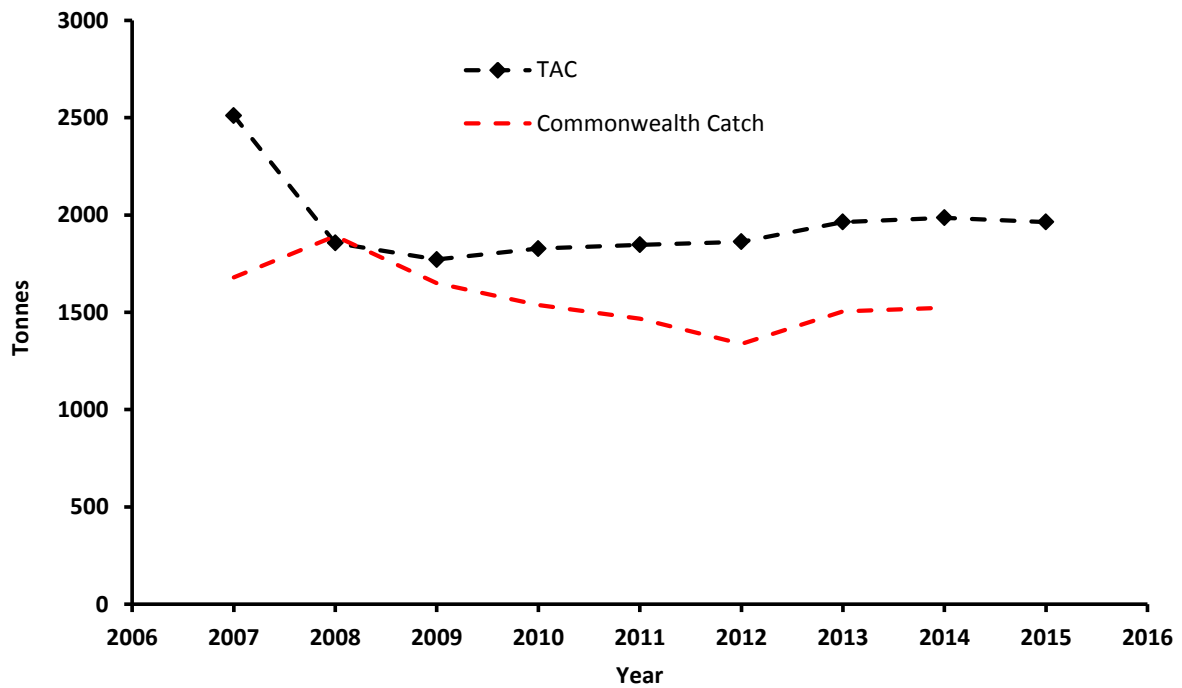
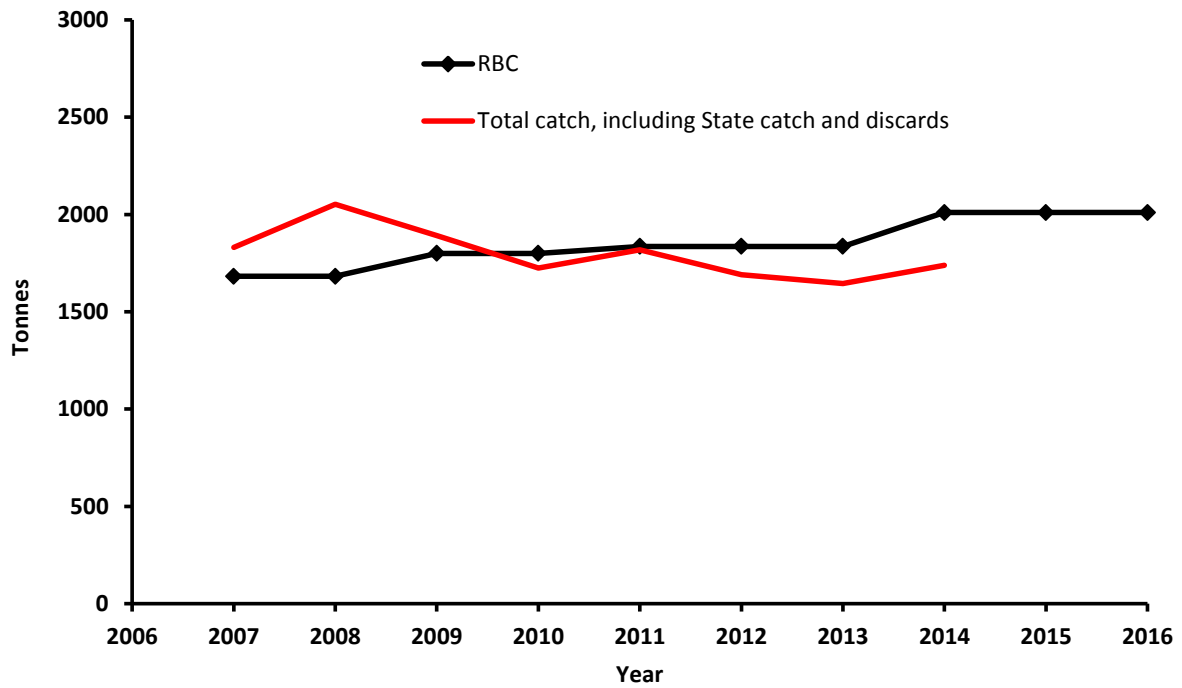
| | |
|--|---|
| | <p>To reduce targeting, gillnet operators are subject to a rule that constrains their catches of school shark to 20 per cent of their gummy shark catches.</p> <p>The RAG recommended that the same 20 per cent rule be applied to all school shark caught by longline inside 183m.</p> |
|--|---|



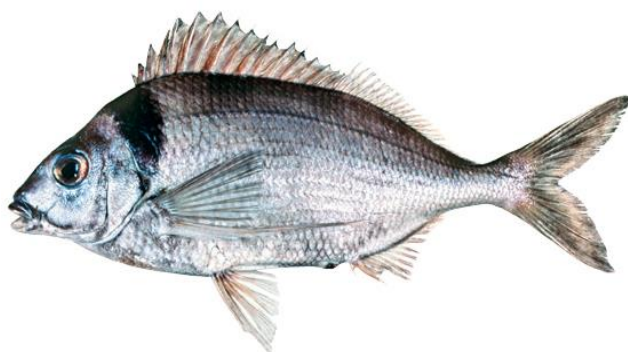
| Research | | |
|---------------------------|--|---|
| Research allowance | N/A | |
| | <input type="checkbox"/> Included in TAC | <input type="checkbox"/> In addition to TAC |



Catch trends – Gummy shark
 (RBC and total catch are calendar year; TAC and Commonwealth catch are fishing season)



Jackass morwong (*Nemadactylus macropterus*)



Common Names: Deep sea perch, deepsea perch, jackass fish, morwong, mowi, mowie, sea bream, silver perch, squeecker perch, tarakihi, terakihi

Assessed by ShelfRAG in 2015. Species summary updated in 2015.

| Stock status summary | | |
|---|---|---|
| Stock structure | For assessment purposes it is assumed there are separate stocks of jackass morwong in the eastern and western zones. | |
| Stock status against reference points and trend | <p>East Limit Reference Point is 20 per cent of the equilibrium spawning biomass corresponding to the lower recruitment regime starting in 1988. Target reference point is 48 per cent of the equilibrium spawning biomass corresponding to the lower recruitment regime starting in 1988. Stock status 2016: 36.5 per cent of 1988 spawning biomass. Trend: The decline in stock status has slowed and stock status is now relatively flat.</p> <p>West Limit reference point is 20 per cent of the unfished biomass. Target reference point is 48 per cent of the unfished biomass. Stock status 2016: 69 per cent of 1988 spawning biomass Trend: The trend in stock status is increasing.</p> | |
| ABARES most recent assessment (2015) (both stocks) | Biomass: Not overfished | Fishing mortality: Not subject to overfishing |
| GVP figures (2013-14 fishing season) | GVP | % fishery GVP |
| | \$0.7 million | 1.2 per cent |

| | | | |
|---|---|---------------------|---------------------|
| Recommended Biological Catch 2015-16 | Year | RBC-east (t) | RBC-west (t) |
| | 2016 | 314 | 249 |
| | 2017 | 320 | 231 |
| | 2018 | 327 | 216 |
| Overcatch/undercatch | 10 per cent undercatch 10 per cent overcatch | | |

| | |
|--|-----------------------------------|
| Probability of recommended biological catch (RBC) (or other levels of catch) causing a decline below limit reference <u>under proposed management</u> <u>Species that follow a HS rule that has been MSE tested will have a “very unlikely” score</u> | Alternative Catch Scenarios = N/A |
|--|-----------------------------------|

| TAC and catch trends | | | | | | | |
|---------------------------------------|------------------|------------------|------------------|-------------------|------------------|---------|------------------|
| Assessment Year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
| Tier /rollover /MYTAC | Tier 1 | Tier 1 | Tier 1 | Tier 1 projection | MYTAC | MYTAC | Tier 1 |
| Stock Status[~] | E: 24% W: 70% | E: 26% W: 69% | E: 35% W: 67% | E: 38% W: 66% | E: 40% W: 68% | | E: 37% W: 69% |
| Fishing Year | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
| RBC | 510 | 557 | 640 | 655 | 692 | 624 | 563 |
| Agreed TAC* | 450 | 450 | 565 | 568 | 568 | 568 | |
| Actual TAC after overs/unders* | 492 | 484 | 601 | 624 | 654 | 624 | |
| % TAC caught* | 73 | 81 | 58 | 35 | 20 | | |

| Tier Level & Discounts | |
|-----------------------------------|---|
| Tier Level | Tier 1- for details of Tiers and the Harvest Strategy, see: http://www.afma.gov.au |
| Discount factor | N/A |



| | | |
|--|--|-----------------------------|
| Is a multi-year TAC in place? | <input checked="" type="checkbox"/> Yes (in place this season) | <input type="checkbox"/> No |
| Is a multi-year TAC recommended? (please provide a clear indication on whether the multi-year recommendation is a RBC (e.g. based on Tier 1 model output) or TAC (e.g. a roll-over of catch)) | <input checked="" type="checkbox"/> Yes (recommended for future seasons) | <input type="checkbox"/> No |

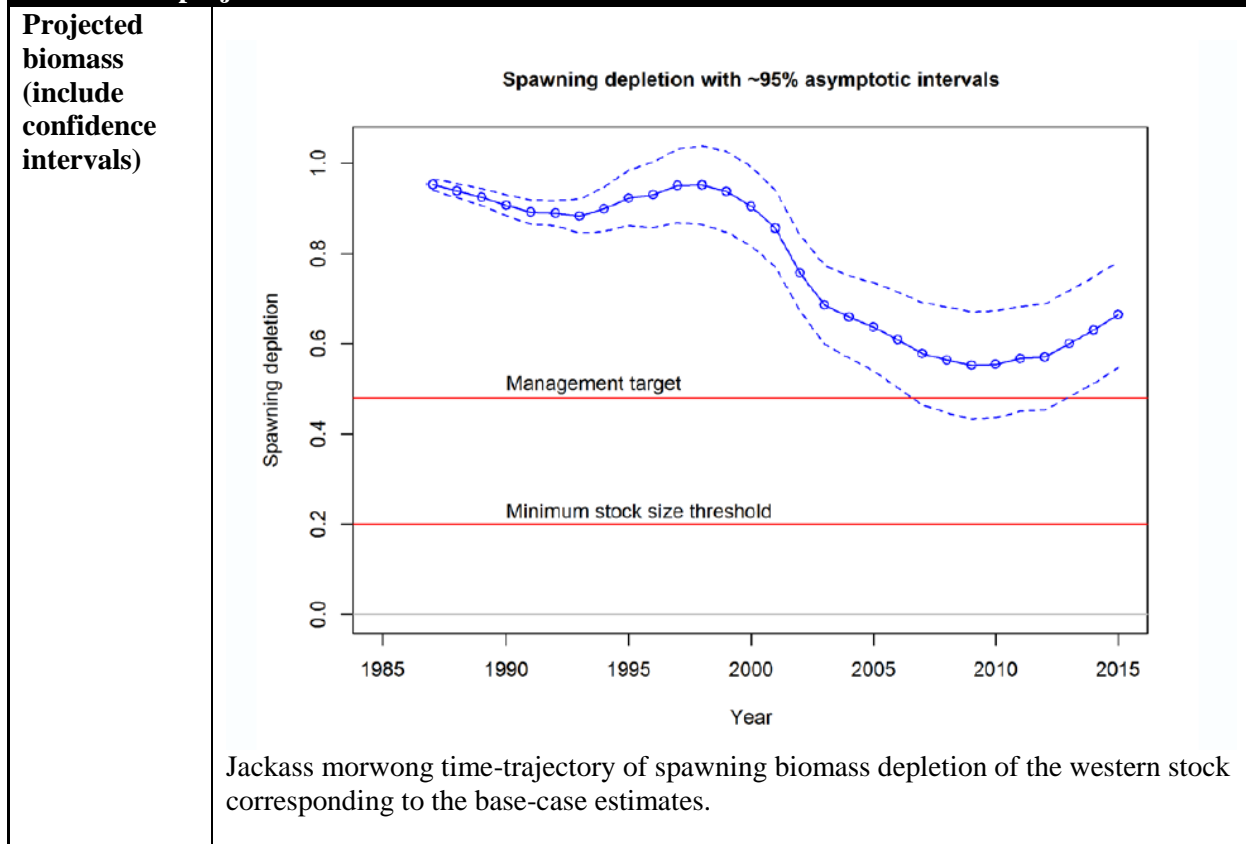
| | |
|--|---|
| Breakout rules for multi-year TAC | <p>The RAG has previously determined that if a MYTAC is adopted the following breakout rules are appropriate, which if triggered, the RAG would review the data and consider appropriate options that may include a new assessment:</p> <ul style="list-style-type: none"> observed standardized CPUE falls outside the 95 per cent confidence intervals catch exceeds the individual east and west RBCs. |
| Have breakout rules been triggered? | N/A |

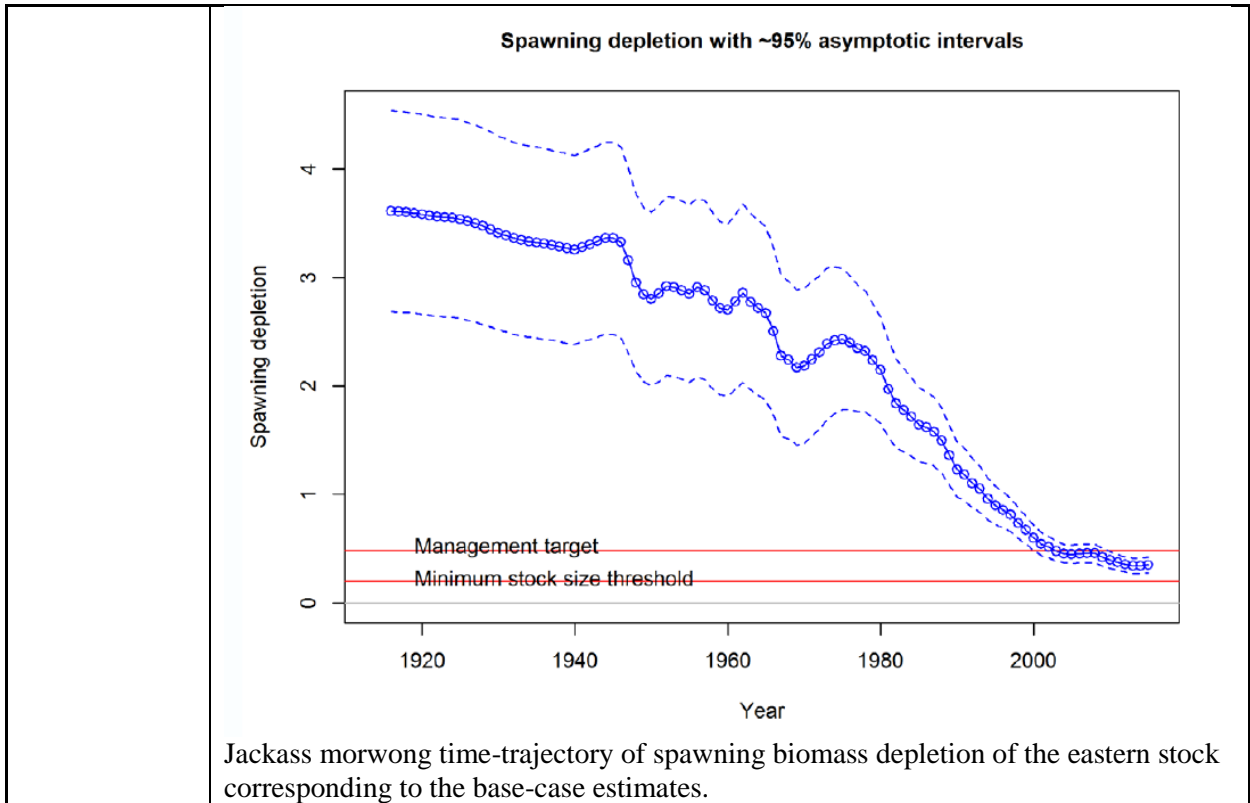
| Assessment | |
|-------------------------------|--|
| Stock indicator trends | <p>East Stock status 2016: 36.5 per cent of 1988 spawning biomass. Trend: The decline in stock status has slowed and stock status is now relatively flat. Zone 10 and 20 standardized CPUE continues to decline, Zone 30 CPUE is flat.</p> <p>West Stock status 2016: 69 per cent of the unfished biomass Trend: The trend in stock status is increasing. Zone 40 and 50 standardized CPUE has been declining since 2001 and this trend continues.</p> |
| RAG comments | <p>Both stocks are suitable for a three year MYTAC</p> <p>It should be noted that the assessment for the western stock is increasingly uncertain because;</p> <ul style="list-style-type: none"> only sporadic age data are available length compositions are based on very low numbers of sampled fish the catch in the western region is now very low. <p>Bearing in mind that the eastern zone biomass is below target and that jackass morwong is managed under a single global quota, the RAG cautioned that there may be some risk to the sustainability of the eastern stock if a large amount of the 'western' quota is caught in the eastern zone.</p> |



| | |
|--|--|
| Key model technical assumptions/parameters | Base case modelled using SS3 (v3.24U) 2015 model structure <ul style="list-style-type: none"> • 6 fleets in east, 1 in west • Model includes 7 surveys • Mortality and growth parameters <ul style="list-style-type: none"> - single sex model, age-structured - Female M fixed 0.15 - Steepness is 0.7 |
| Changes to model structure/assumptions | N/A |
| Significant changes to data inputs | N/A |
| Comments on data | The RAG emphasised their ongoing concern with limited data from the western stock. The RAG noted that the western assessment is uncertain because of this and there is a need for increased data. |
| Implications for companion species/TEPs/multi-species fisheries | N/A |

Tier 1 stock projection

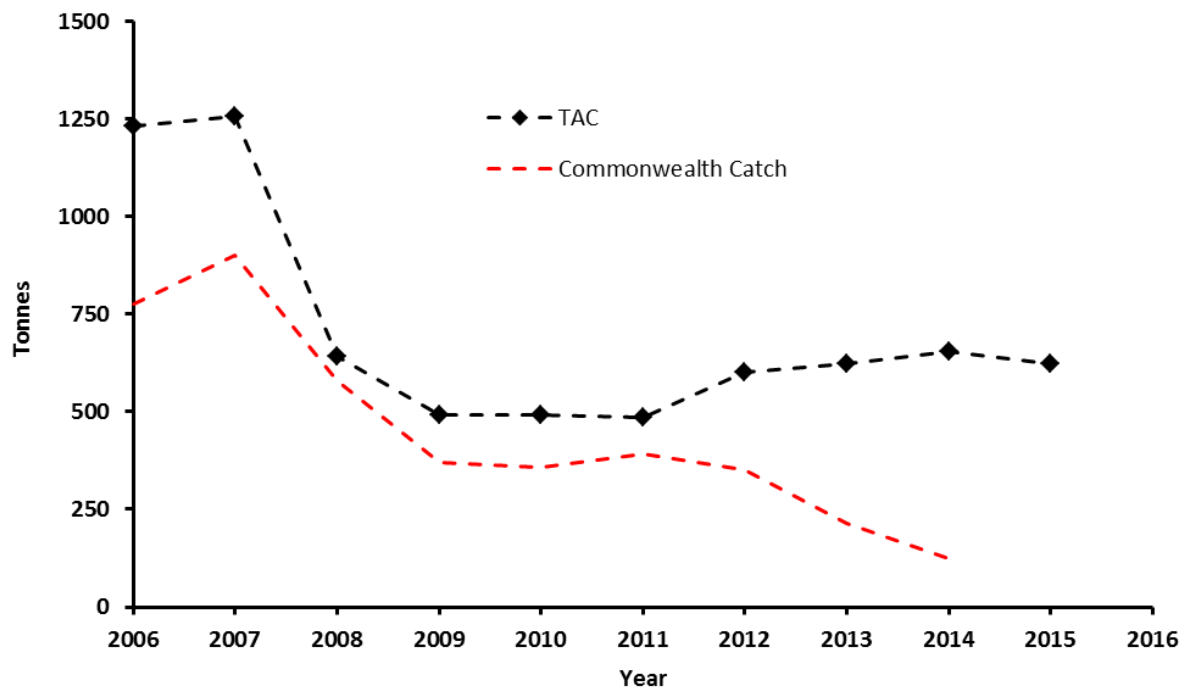
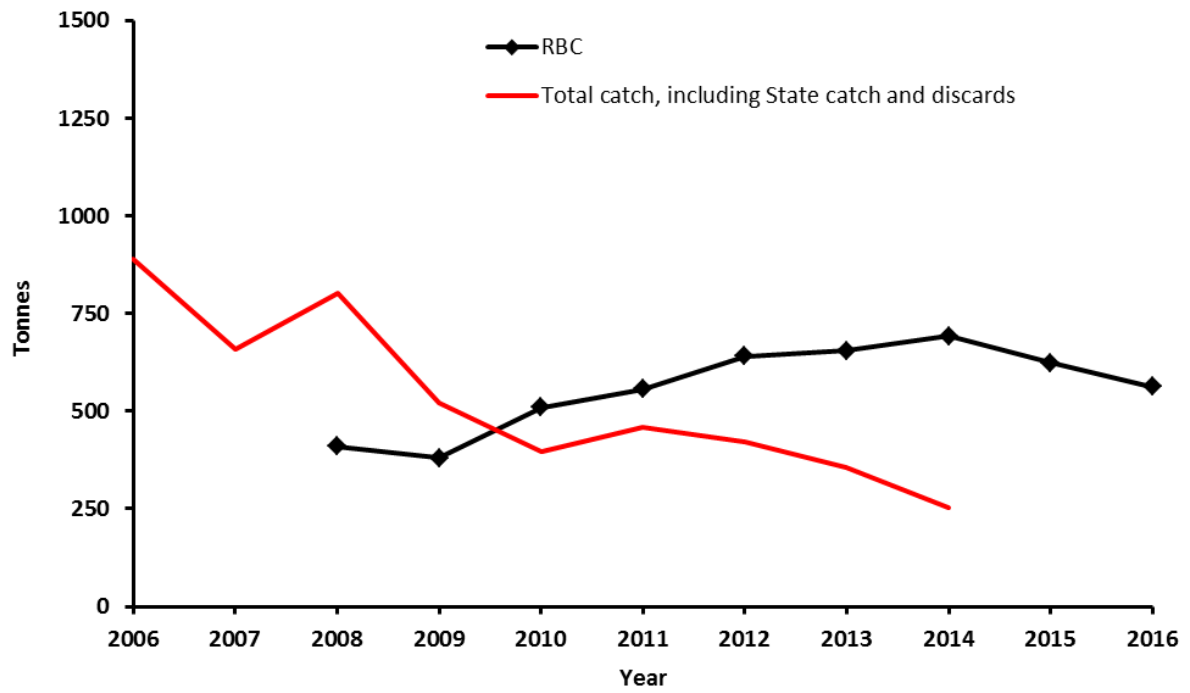




| Research | | |
|---------------------------|--|---|
| Research allowance | N/A | |
| | <input type="checkbox"/> Included in TAC | <input type="checkbox"/> In addition to TAC |



Catch trends – Jackass morwong
 (RBC and total catch are calendar year; TAC and Commonwealth catch are fishing season)



Mirror dory (*Zenopsis nebulosus*)



A Mirror Dory, *Zenopsis nebulosa*. Source: Australian National Fish Collection, CSIRO. License: CC by Attribution-Noncommercial

Assessed by ShelfRAG in 2015. Species summary updated in 2015.

| Stock status summary | | | | | | | | | | | | | | |
|--|--|---|------|------|------|---------------|--------|--------|--------------|--------|--------|---------------|--------|--------|
| Stock structure | An eastern and western stock is currently assumed for assessment purposes. However mirror dory is managed under a single global TAC. | | | | | | | | | | | | | |
| Stock status against reference points and trend | <p>Tier 4 species use CPUE targets as a proxy of biomass targets.</p> <p>The Tier 4 target reference point is the level of CPUE assumed to produce a spawning biomass of 48 per cent of unfished levels. The limit reference point is 20 per cent of unfished levels.</p> <table border="1" data-bbox="699 1279 1334 1435"> <thead> <tr> <th>CPUE</th> <th>East</th> <th>West</th> </tr> </thead> <tbody> <tr> <td>Target</td> <td>1.1095</td> <td>0.9644</td> </tr> <tr> <td>Limit</td> <td>0.4623</td> <td>0.4018</td> </tr> <tr> <td>Recent</td> <td>1.0762</td> <td>0.7617</td> </tr> </tbody> </table> <p>Biomass:</p> <p>East Recent CPUE-based proxy for biomass is above the limit and marginally below the target reference point. Trend: Standardised CPUE and catch levels have been declining.</p> <p>West Catches and CPUE are both highly variable however there are no concerning trends.</p> | | CPUE | East | West | Target | 1.1095 | 0.9644 | Limit | 0.4623 | 0.4018 | Recent | 1.0762 | 0.7617 |
| CPUE | East | West | | | | | | | | | | | | |
| Target | 1.1095 | 0.9644 | | | | | | | | | | | | |
| Limit | 0.4623 | 0.4018 | | | | | | | | | | | | |
| Recent | 1.0762 | 0.7617 | | | | | | | | | | | | |
| ABARES most recent assessment (2015) | Biomass: Not overfished | Fishing mortality: Not subject to overfishing | | | | | | | | | | | | |
| GVP figures (2013 - 14 fishing season) | GVP | % fishery GVP | | | | | | | | | | | | |
| | \$0.6 million | 1.0 per cent | | | | | | | | | | | | |

| | |
|---|---|
| Recommended Biological Catch 2016 - 17 | West, 129 t East, 362 t Total, 491 t |
| Overcatch/undercatch | 10 per cent undercatch 10 per cent overcatch |
| Probability of recommended biological catch (RBC) (or other levels of catch) causing a decline below limit reference <i>under proposed management</i> <u>Species that follow a HS rule that has been MSE tested will have a “very unlikely” score in this section (i.e. P<10 per cent).</u> | Very unlikely (P<10 per cent) |
| | Alternative Catch Scenarios: N/A |

| TAC and catch trends | | | | | | | |
|------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|--------------------------------|--|---|
| Assessment Year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
| Tier /rollover /MYTAC | Tier 3 | Tier 3 | Tier 3 | Tier 3 | Tier 4 | Tier 4 | Tier 4 |
| Target | F _{SPR48} | F _{SPR48} | F _{SPR48} | F _{SPR48} | East – 1.1382 West – 0.9529 | East – 1.0611 West – 0.9617 | East – 1.0195 West – 0.9644 |
| Stock Status | Fishing mortality less than target | Fishing mortality less than target | Fishing mortality less than target | Fishing mortality less than target | CPUE higher than target | East - CPUE higher than target West – CPUE between target and limit | East - CPUE at target West – CPUE between target and limit |
| Fishing Year | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
| RBC | 1196 | 906 | 7349 | 2794 | 680 | 684 | East – 362 West - 129 |
| Agreed TAC | 718 | 718 | 1077 | 1616 | 808 | 437 | |



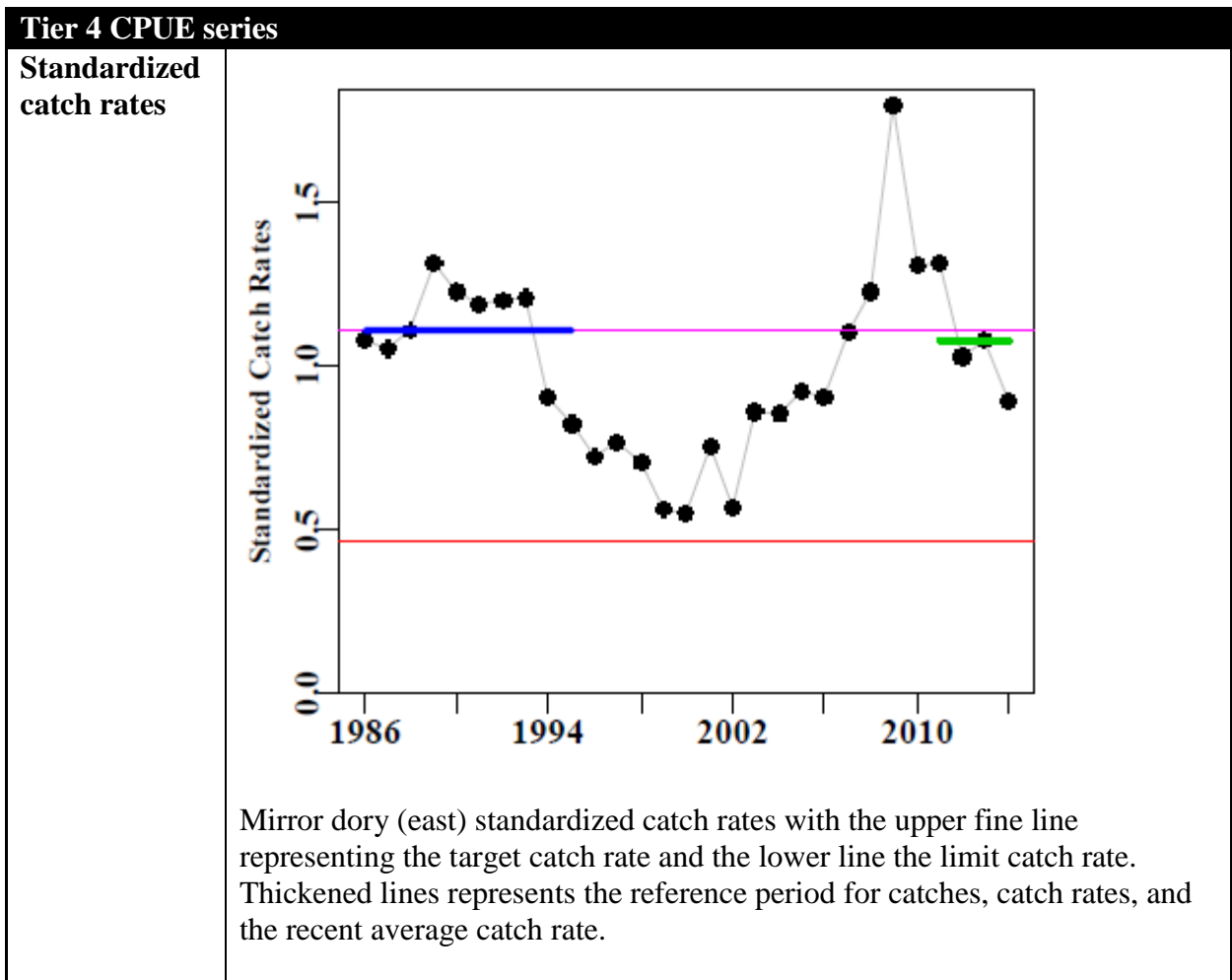
| | | | | | | | |
|-------------------------------|-----|-----|------|------|-----|-----|--|
| Actual TAC after overs/unders | 768 | 767 | 1135 | 1717 | 968 | 514 | |
| % TAC caught | 80 | 68 | 33 | 17 | 23 | | |

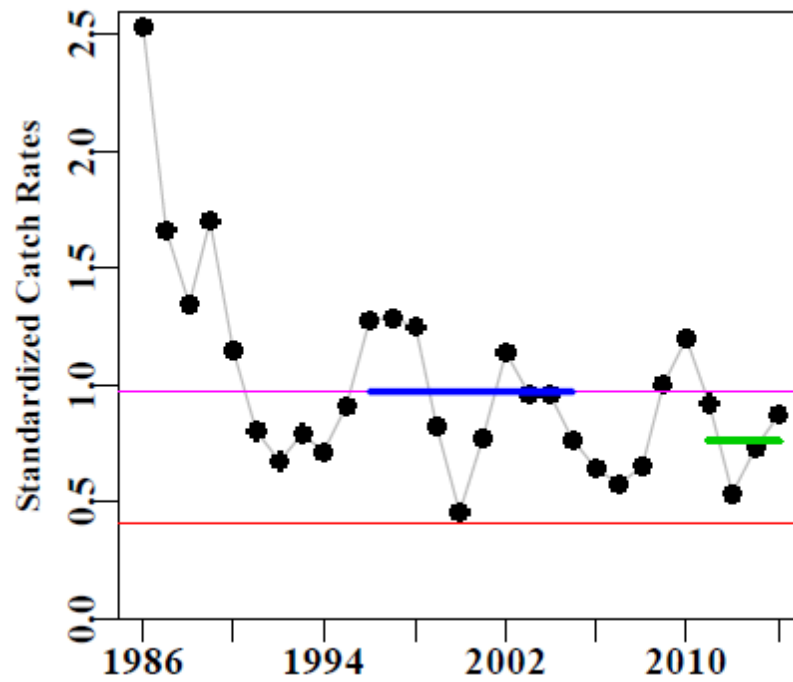
| Tier Level & Discounts | |
|--|--|
| Tier Level | Tier 4- for details of Tiers and the Harvest Strategy, see: http://www.afma.gov.au/ |
| Discount factor | 15 per cent |
| Is a multi-year TAC in place? | <input type="checkbox"/> Yes (in place this season) <input checked="" type="checkbox"/> No |
| Is a multi-year TAC recommended? (please provide a clear indication on whether the multi-year recommendation is a RBC (e.g. based on Tier 1 model output) or TAC (e.g. a roll-over of catch)) | <input type="checkbox"/> Yes (recommended for future seasons) <input checked="" type="checkbox"/> No A MYTAC is not recommended given the apparently cyclical nature of mirror dory stock status and catches, leading to concerns that a 3-year MYTAC will not be able to respond to relatively rapid changes in biomass. |
| Breakout rules for multi-year TAC | The observed standardized CPUE changes by 50 per cent or more. |
| Have breakout rules been triggered? | N/A |

| Assessment | |
|------------------------|---|
| Stock indicator trends | N/A |
| RAG comments | <p>An alternative Tier 4 analysis for the eastern mirror dory was performed to determine the impact of the recent increase in the discard rate on the catch rates. In this case there was a marked effect, especially in three of the last four years, which are used in the estimate of current CPUE. The effect of this is to increase the estimate of the eastern RBC. This enables a reduction to the RBC due to the increased discard levels to be accounted for in the calculation of the TAC.</p> <p>Discards are not included in the western catch rates, consequently discards do not need to be accounted for in TAC calculations.</p> <p>Consistent with the 2014 RAG advice the RAG did not recommend a MYTAC given the apparently cyclical nature of mirror dory stock status and catches, and concerns that a MYTAC will not be able to respond to relatively rapid changes in biomass.</p> |



| | |
|--|--|
| Key model technical assumptions/parameters | N/A |
| Changes to model structure/assumptions | N/A |
| Significant changes to data inputs | N/A |
| Comments on data | N/A |
| Implications for companion species/TEPs/multi-species fisheries | The RAG suggested in 2012 there may have been a companion species relationship between mirror dory and eastern gemfish but speculated that this is likely to have changed due to avoidance of eastern gemfish during their spawning run. |





Mirror dory (west) standardized catch rates with the upper fine line representing the target catch rate and the lower line the limit catch rate. Thickened lines represents the reference period for catches, catch rates, and the recent average catch rate.

Research

Research allowance

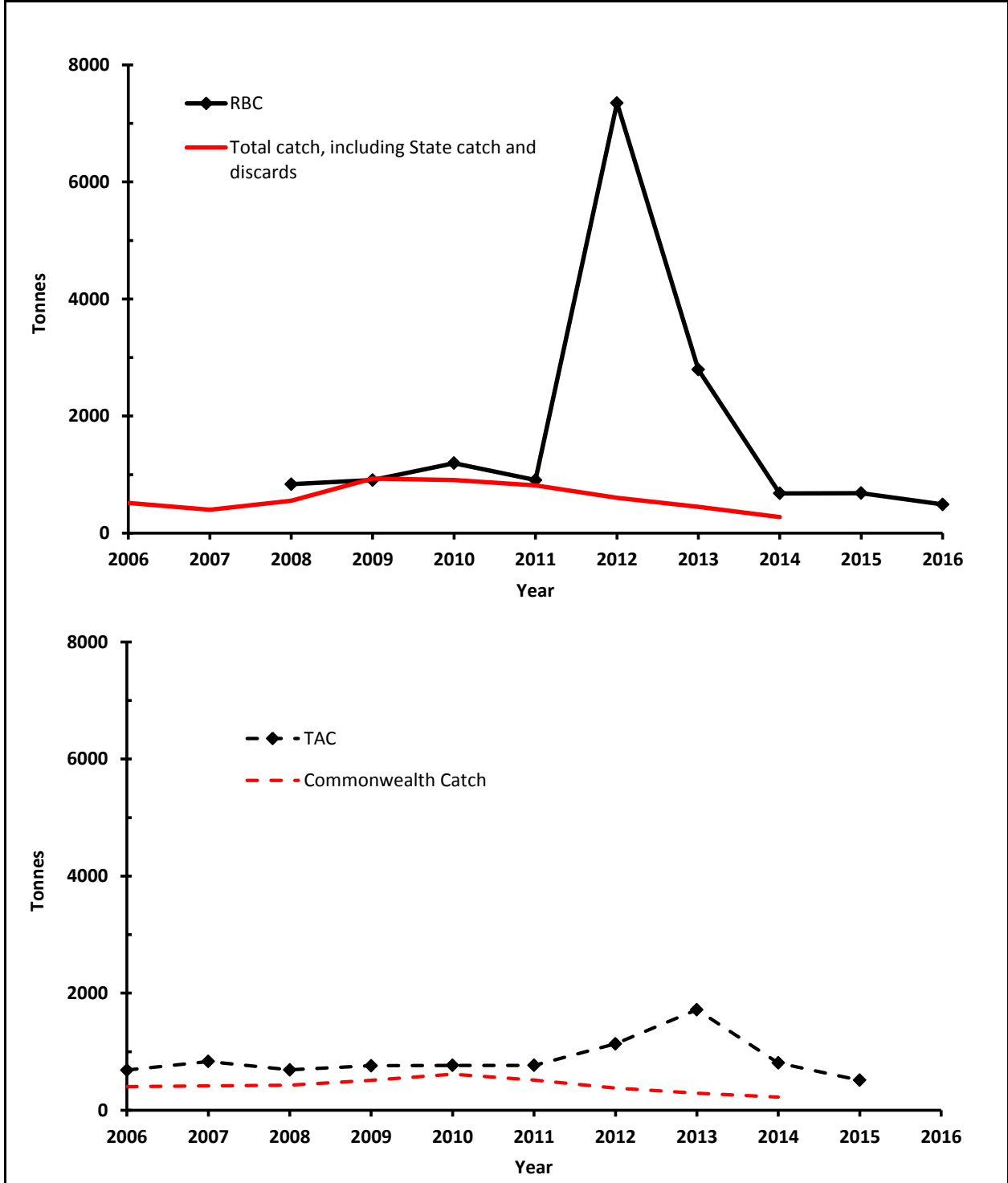
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Included in TAC

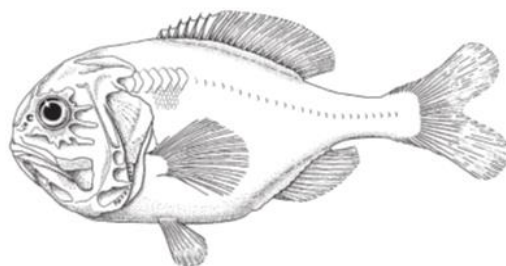
In addition to TAC



Catch trends – Mirror dory
 (RBC and total catch are calendar year; TAC and Commonwealth catch are fishing season)



Orange roughy (*Hoplostethus atlanticus*) - Southern zone



ABARES (2012): Line Drawing – Rosalind Poole

Reviewed by SlopeRAG in 2015. Species summary updated in 2015.

| Stock status summary | |
|--|---|
| Stock structure | <p>Based on the existing data and fishery dynamics multiple regional stocks of orange roughy are assumed and the fishery is managed and assessed as a number of discrete regional stocks. Recent genetic studies indicate little genetic diversity between all south east Australian stocks, however they may be demographically separate. The part of the southern zone catch that is caught on the Pedra Branca grounds is assumed to be part of the eastern stock and was assessed as part of the eastern zone 2014 base case assessment.</p> |
| Stock status against reference points and trend | <p>The most recent accepted assessment (2000) concluded that the southern stock was less than the limit reference point.</p> <p>Limit reference point is 20 per cent of unfished biomass. Target reference point is 48 per cent of unfished biomass.</p> <p>Stock status: unresolved in the southern zone but considering that there has been minimal fishing in the southern zone and the eastern stock has rebuilt to a harvestable level it is not inconsistent to think that similar rebuilding may have occurred in the southern zone.</p> <p>Orange roughy southern is managed under the Orange Roughy Rebuilding Strategy 2015.</p> <p>The component of the southern zone stock that is caught in the Pedra Branca seamounts area is assessed as a part of the eastern zone stock assessment due to stock structure assumptions. The eastern zone assessment in 2014 estimated the stock status in the Pedra Branca area to be 26 per cent of unfished biomass.</p> <p>Biomass trend: The 2004 and 2006 updates of abundance indices and observations of possible spawning aggregations (from acoustic surveys) indicated that rebuilding may be</p> |

| | | |
|---|---|--|
| | <p>occurring. The 2014 assessment of the eastern orange roughy stock also indicates that rebuilding is occurring in that area.</p> <p>Catches are extremely low therefore overfishing is unlikely to be occurring. The current TAC poses no risk to stock recovery.</p> | |
| ABARES 2015 assessment | Biomass: Overfished | Fishing mortality: Not subject to overfishing |
| GVP figures (2013 - 14 fishing season) | GVP | % fishery GVP |
| | <\$0.1 million | 0.13 per cent |
| Recommended Biological Catch 2016 - 17 | <p>0 t in the southern zone outside of the Pedra Branca area. No targeted fishing.</p> <p>27 t inside the Pedra Branca area</p> <p>plus incidental catch TAC of 31 t.</p> | |
| Overcatch/undercatch | <p>0 per cent undercatch</p> <p>0 per cent overcatch</p> | |
| Probability of recommended biological catch (RBC) (or other levels of catch) causing a decline below limit reference <i>under proposed management</i> <i>Species that follow a HS rule that has been MSE tested will have a “very unlikely” score in this section (i.e. $P < 10\%$).</i> | N/A | |
| | Alternative Catch Scenarios: not assessed | |



| Assessment Year | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|----------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-------------------------------------|
| Tier /rollover /MYTAC | Not assessed | Not assessed | Not assessed | Not assessed | Not assessed | Not assessed |
| Target | B ₄₈ | B ₄₈ | B ₄₈ | B ₄₈ | B ₄₈ | B ₄₈ |
| Stock Status | Not assessed | Not assessed | Not assessed | Not assessed | Not assessed | Not assessed# |
| Fishing Year | 2011/12 | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
| RBC | 0 | 0 | 0 | 0 | 0 | 0 incidental 35 Pedra Branca* |
| Agreed TAC | 35 | 35 | 35 | 35 | 66 | 66 |
| Actual TAC after overs/unders | 35 | 35 | 35 | 35 | 66 | 66 |
| % TAC caught | 48 | 52 | 62 | 50 | | |

The component of the southern zone stock that is in the Pedra Branca seamounts area is assessed as a part of the eastern zone stock assessment due to the stock structure assumptions. The eastern zone assessment in 2014 estimated the stock status in the Pedra Branca area to be 26 per cent of unfished biomass.

*Part of the RBC arising from the Eastern Zone Stock Assessment (Upston and Punt 2014) which includes the Pedra Branca in the Southern Zone is apportioned to the southern zone.

| Tier Level & Discounts | |
|--|---|
| Tier Level | Tier 2 in 2000, not assessed since. |
| Discount factor | 0 per cent |
| Is a multi-year TAC in place? | <input checked="" type="checkbox"/> Yes (in place this season) <input type="checkbox"/> No |
| Is a multi-year TAC recommended? (please provide a clear indication on whether the multi-year recommendation is a RBC (e.g. based on Tier 1 model output) or TAC (e.g. a roll-over of catch)) | <input checked="" type="checkbox"/> Yes (recommended for future seasons) <input type="checkbox"/> No SlopeRAG recommended a three year bycatch TAC providing that the MYTAC does not restrict future work/research on the stock. |
| Breakout rules for multi-year TAC | If 90 per cent of the MYTAC is caught this will trigger exploration of options for updating the assessments |
| Have breakout rules been triggered? | N/A |



| Assessment | |
|--|---|
| Stock indicator trends | <p>Due to the incidental catch TACs with no targeted fishing, CPUE is not a reliable index of abundance.</p> <p>The 2014 eastern orange roughy assessment (which includes stock residing in the Pedra Branca area of the southern quota zone), indicates that the stock referenced by the assessment has rebuilt to 26 per cent of unfished biomass.</p> |
| RAG comments | <p>The RAG has previously agreed that, despite the absence of an agreed assessment model, the data show there is little targeting or bycatch of orange roughy. As such the incidental catch TAC is applicable for the southern zone (apart from the Pedra Branca area) and does not impede recovery of the stock.</p> <p>Bearing in mind the rebuild of the eastern stock from a low biomass, it could be argued that the southern and western zones should have recovered somewhat. This is tempered by not knowing if recruitment processes and stock movement in the southern and western zones are similar or different to those in the eastern zone.</p> <p>It was pointed out that the eastern stock part of the southern stock had rebuilt to a certain degree and that the recovery will have to be watched for at least a decade to monitor if previous high catches have any effect on recruitment.</p> <p>The RAG noted that the southern zone continues to be on rebuilding incidental TAC and the RAG found there was no additional information that would provide a basis for the RAG to change its' previous TAC advice. The RAG recommended that the southern zone orange roughy MYTAC remains unchanged.</p> <p>The RAG supported undertaking an externally reviewed desktop study of how evidence of rebuilding should be collected, is there currently any evidence/likelihood of rebuilding and identification of information gaps that preclude a stock assessment of the southern and western orange roughy stocks.</p> |
| Key model technical assumptions/parameters | N/A |
| Changes to model structure/assumptions | N/A |
| Significant changes to data inputs | N/A |
| Comments on data | N/A |
| Implications for companion species/TEPs/multi-species fisheries | N/A |



Tier 1 stock projection**Projected biomass (include confidence intervals)**

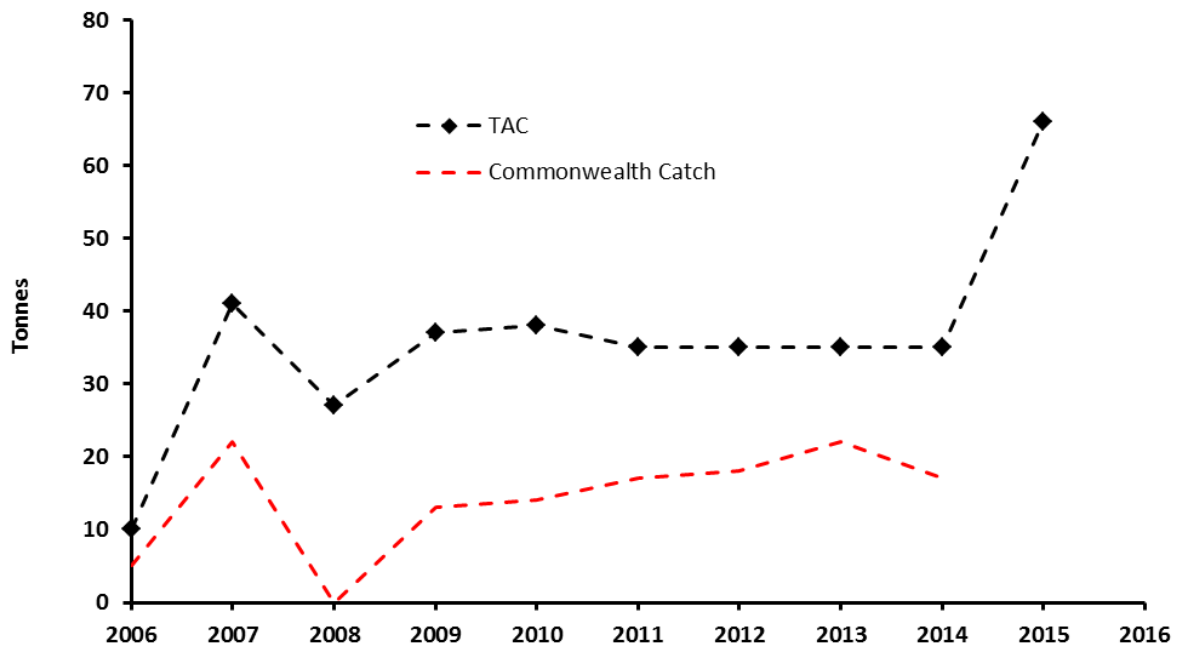
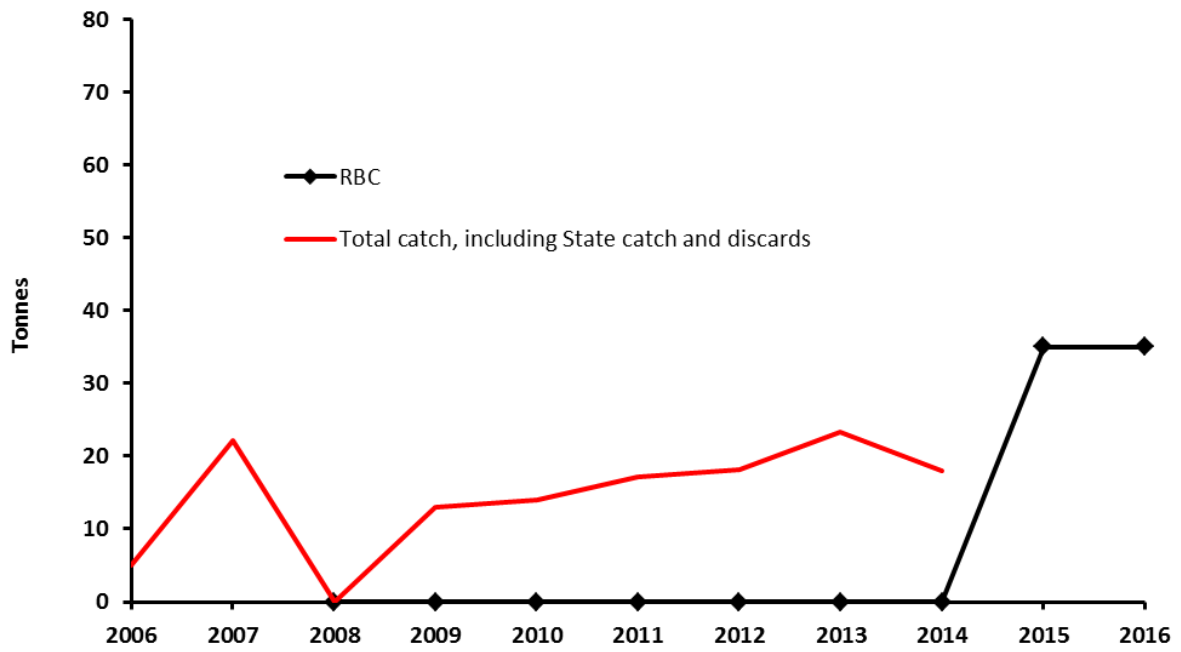
No biomass projection as there is no assessment for the southern zone outside of the Pedra Branca area. For a biomass projection for the eastern orange roughy stock (that includes the Pedra Branca area), see orange roughy – eastern zone.

Research**Research allowance**

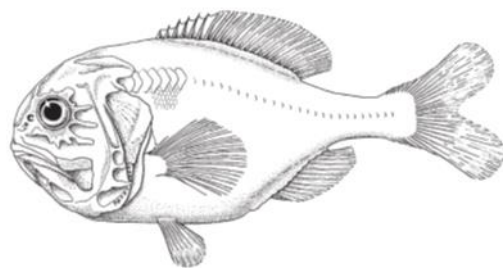
0 t

 Included in TAC In addition to TAC

Catch trends – Orange roughy – southern zone
 (RBC and total catch are calendar year; TAC and Commonwealth catch are fishing season)



Orange roughy (*Hoplostethus atlanticus*) - Western zone



ABARES (2012): Line Drawing – Rosalind Poole

Reviewed by SlopeRAG in 2015. Species summary updated in 2015.

| Stock status summary | | |
|--|---|--|
| Stock structure | Based on the existing data and fishery dynamics multiple regional stocks of orange roughy are assumed and the fishery is managed and assessed as a number of discrete regional stocks. Recent genetic studies indicate little genetic diversity between all South Eastern Australian stocks, however they may be demographically separate. | |
| Stock status against reference points and trend | <p>Orange roughy western is managed under the Orange roughy Rebuilding Strategy.</p> <p>Limit reference point is 20 per cent of unfished biomass. Target reference point is 48 per cent of unfished biomass.</p> <p>Stock status and biomass trend: The most recent assessment of western stock was in 2002 and estimated a biomass <30 per cent of 1985 biomass.</p> <p>Stock status is unresolved in the western zone however considering that there has been minimal fishing in the western zone and that the eastern stock has rebuilt to a harvestable level it is not inconsistent to think that similar rebuilding may have occurred in the western zone.</p> | |
| ABARES most recent assessment (2015) | Biomass: Overfished | Fishing mortality: Not subject to overfishing |
| GVP figures (2013 - 14 fishing season) | GVP | % fishery GVP |
| | \$0.12 million | 0.2 per cent |
| Recommended Biological Catch 2015 - 16 | <p>0 t. No targeted fishing.</p> <p>Incidental bycatch TAC of 60 t.</p> | |

| | |
|---|---|
| Overcatch/undercatch | 0 per cent undercatch 0 per cent overcatch |
| Probability of recommended biological catch (RBC) (or other levels of catch) causing a decline below limit reference <u>under proposed management</u> <u>Species that follow a HS rule that has been MSE tested will have a “very unlikely” score in this section (i.e. $P < 10\%$).</u> | N/A |
| | Alternative Catch Scenarios = not assessed |

| Assessment Year | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|--------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Tier /rollover /MYTAC | Not assessed | Not assessed | Not assessed | Not assessed | Not assessed | Not assessed |
| Stock Status | Not assessed | Not assessed | Not assessed | Not assessed | Not assessed | Not assessed |
| Fishing Year | 2011/12 | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
| RBC | 0 | 0 | 0 | 0 | 0 | 0 |
| Agreed TAC | 60 | 60 | 60 | 60 | 60 | 60 |
| Actual TAC after overs/unders | 60 | 60 | 60 | 60 | 60 | 60 |
| % TAC caught | 56 | 44 | 67 | 48 | | |

| Tier Level & Discounts | |
|--|--|
| Tier Level | Tier 2 in 2002. Not assessed since. |
| Discount factor | 0 per cent |
| Is a multi-year TAC in place? | <input type="checkbox"/> Yes (in place this season) <input checked="" type="checkbox"/> No |
| Is a multi-year TAC recommended? (please provide a clear indication on whether the multi-year recommendation is a RBC (e.g. based on Tier 1 model output) or TAC (e.g. a roll-over of catch)) | <input type="checkbox"/> Yes (recommended for future seasons) <input checked="" type="checkbox"/> No |



| | |
|--|-----|
| Breakout rules for multi-year TAC | N/A |
| Have breakout rules been triggered? | N/A |

| Assessment | |
|---|---|
| Stock indicator trends | Due to incidental catch TAC with no targeted fishing, CPUE is not a reliable index of abundance. |
| RAG comments | <p>The RAG has previously agreed that, despite the absence of an agreed assessment model, the data show there is little targeting or bycatch of Orange Roughy. As such the incidental catch TAC is applicable and does not impede recovery of the stock.</p> <p>Bearing in mind the rebuild of the eastern stock from a low biomass it could be argued that the southern and western zones should have recovered somewhat. This is tempered by not knowing if recruitment processes and stock movement in the southern and western zones are similar or different to those in the eastern zone.</p> <p>It was pointed out that the eastern stock part of the southern stock had rebuilt to a certain degree and that the recovery will have to be watched for at least a decade to monitor if previous high catches have any effect on recruitment.</p> <p>The RAG noted that the western zone continues to be on rebuilding incidental TAC and the RAG found there was no additional information that would provide a basis for the RAG to change its' previous TAC advice. The RAG recommended that the western zone orange roughy MYTAC remains unchanged.</p> <p>The RAG supported undertaking an externally reviewed desktop study of how evidence of rebuilding should be collected, is there currently any evidence/likelihood of rebuilding and identification of information gaps that preclude a stock assessment of the southern and western orange roughy stocks.</p> |
| Key model technical assumptions/parameters | N/A |
| Changes to model structure/assumptions | N/A |
| Significant changes to data inputs | N/A |
| Comments on data | N/A |



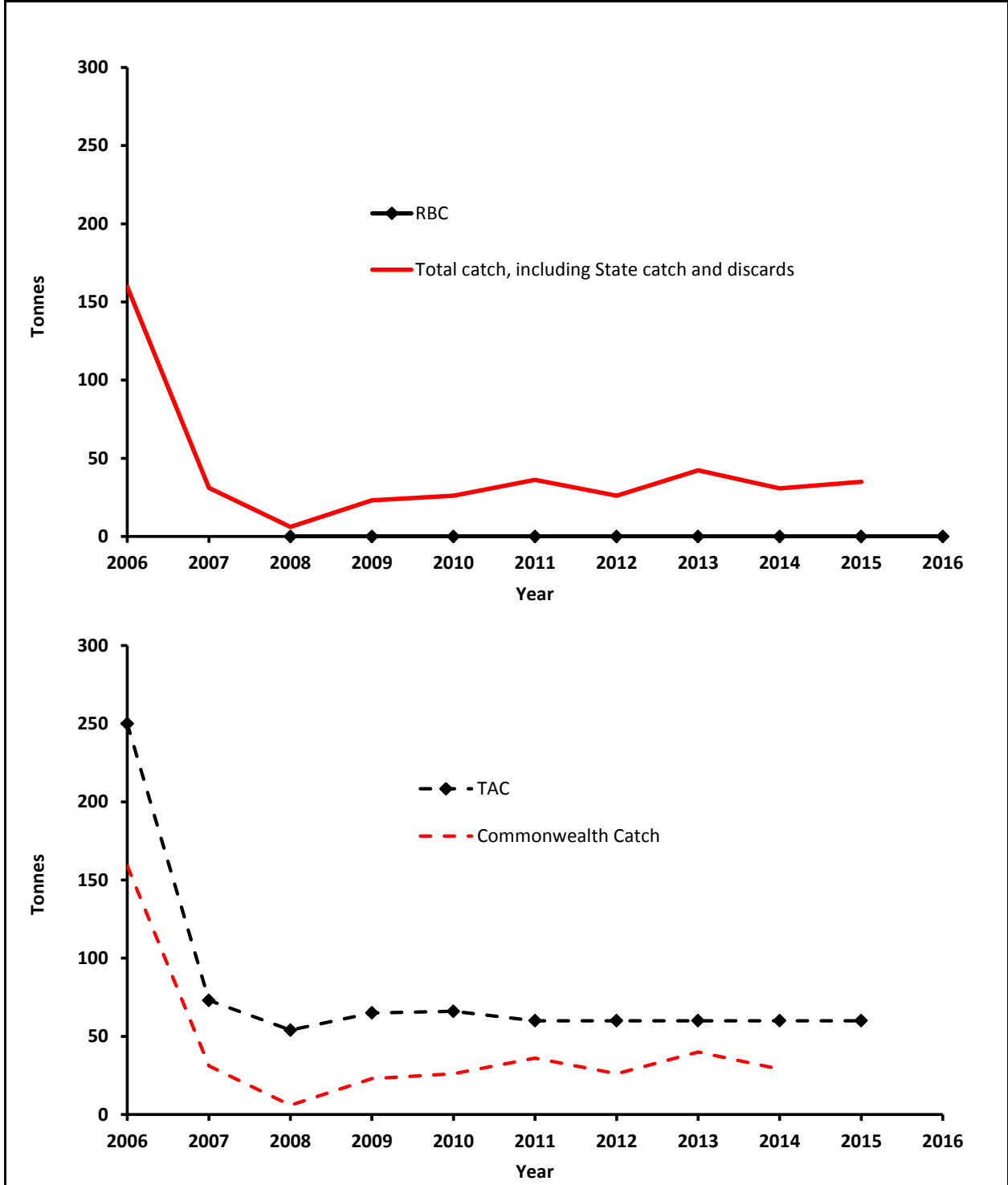
| | |
|--|-----|
| Implications for companion species/TEPs/multi-species fisheries | N/A |
|--|-----|

| Tier 1 stock projection | |
|---|---|
| Projected biomass (include confidence intervals) | No biomass projections as there is no assessment. |

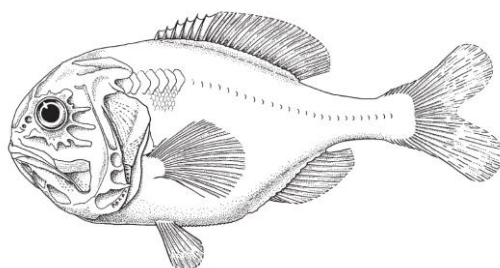
| Research | | |
|---------------------------|--|---|
| Research allowance | 0 t | |
| | <input type="checkbox"/> Included in TAC | <input type="checkbox"/> In addition to TAC |



Catch trends – Orange roughy – western zone
 (RBC and total catch are calendar year; TAC and Commonwealth catch are fishing season)



Orange roughy (*Hoplostethus atlanticus*) - Eastern zone



ABARES (2012): Line Drawing – Rosalind Poole

Assessed by SlopeRAG in 2014, reviewed by SlopeRAG in 2015.

| Stock status summary | | |
|--|---|--|
| Stock structure | Based on the existing data and fishery dynamics, multiple regional stocks of orange roughy are assumed and the fishery is managed and assessed as a number of discrete regional stocks. Recent genetic studies indicate little genetic diversity between all SE Australian stocks. However, they may be demographically separate. For assessment purposes the eastern stock is assumed to also include catches taken from both the eastern zone and the Pedra Branca area in the southern zone. | |
| Stock status against reference points and trend | <p>Limit reference point is 20 per cent of unfished biomass. Target reference point is 48 per cent of unfished biomass.</p> <p>Stock status: The most recent assessment (2014) indicates that the stock is above the limit reference point, and is estimated to be at 26 per cent of unfished biomass for the beginning of 2015.</p> <p>Orange roughy eastern is managed under the Orange Roughy Rebuilding Strategy 2014.</p> <p>Biomass trend. Catches have previous to this year were extremely low and this population has increased to a biomass status of about 26 per cent of unfished biomass. The continued TAC poses no impediment to continued stock recovery.</p> | |
| ABARES most recent assessment (2015) | Biomass: Uncertain | Fishing mortality: Not subject to overfishing |
| GVP figures (2012-13 fishing season) | GVP | % fishery GVP |
| | \$0.7 million | 1.2 per cent |



| Recommended Biological Catch 2015 - 16 | The RAG recommended a 3-year MYRBC based on the modelled projection of stock recovery: Year 1 RBC – 381 t Year 2 RBC – 512 t Year 3 RBC – 647 t. Subsequently, noting the longevity of this species AFMA set a 3 year TAC of 500 t per year. NB. as the stock occurs across both the eastern and southern zones the TAC is apportioned across both zones. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|--|---------------------------|--------------|-------------------------|----|-----|-----------|------|------------------|------|------|--------------|------|------------------|------|------|-------------|------|------------------|------|------|-----|--------|---------------------------|--------|--------|--------|--------|-------------------------|-------|--------|-----------|------|--------------------|------|------|---------|-----|----------------|-----|-----|
| Overcatch/undercatch | 100 per cent undercatch 10 per cent overcatch | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Probability of recommended biological catch (RBC) (or other levels of catch) causing a decline below limit reference <u>under proposed management Species that follow a HS rule that has been MSE tested will have a “very unlikely” score in this section (i.e. P<10 %).</u> | Very unlikely Less than a 1 per cent chance of being below B ₂₀ . Table 1. MCMC analysis paper Upston & Punt (2014) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <table border="1"> <thead> <tr> <th>Key parameters</th> <th>MPD estimate</th> <th>MCMC Median (0.05-0.95)</th> <th>1%</th> <th>99%</th> </tr> </thead> <tbody> <tr> <td>SR_LN(RO)</td> <td>9.05</td> <td>9.16 (9.13-9.20)</td> <td>9.12</td> <td>9.20</td> </tr> <tr> <td>Q3_Towed_rel</td> <td>1.32</td> <td>1.31 (1.04-1.61)</td> <td>0.92</td> <td>1.80</td> </tr> <tr> <td>Q4_Hull_rel</td> <td>1.78</td> <td>1.79 (1.68-1.92)</td> <td>1.62</td> <td>1.95</td> </tr> <tr> <td>SBO</td> <td>38,931</td> <td>43,591 (42,095 - 45,116)</td> <td>41,641</td> <td>45,707</td> </tr> <tr> <td>SB2015</td> <td>10,185</td> <td>11,020 (9,720 - 12,322)</td> <td>9,320</td> <td>13,165</td> </tr> <tr> <td>SB2015/BO</td> <td>0.26</td> <td>0.25 (0.23 - 0.28)</td> <td>0.22</td> <td>0.29</td> </tr> <tr> <td>RBC2015</td> <td>381</td> <td>351 (170- 571)</td> <td>120</td> <td>718</td> </tr> </tbody> </table> | Key parameters | MPD estimate | MCMC Median (0.05-0.95) | 1% | 99% | SR_LN(RO) | 9.05 | 9.16 (9.13-9.20) | 9.12 | 9.20 | Q3_Towed_rel | 1.32 | 1.31 (1.04-1.61) | 0.92 | 1.80 | Q4_Hull_rel | 1.78 | 1.79 (1.68-1.92) | 1.62 | 1.95 | SBO | 38,931 | 43,591 (42,095 - 45,116) | 41,641 | 45,707 | SB2015 | 10,185 | 11,020 (9,720 - 12,322) | 9,320 | 13,165 | SB2015/BO | 0.26 | 0.25 (0.23 - 0.28) | 0.22 | 0.29 | RBC2015 | 381 | 351 (170- 571) | 120 | 718 |
| Key parameters | MPD estimate | MCMC Median (0.05-0.95) | 1% | 99% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SR_LN(RO) | 9.05 | 9.16 (9.13-9.20) | 9.12 | 9.20 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Q3_Towed_rel | 1.32 | 1.31 (1.04-1.61) | 0.92 | 1.80 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Q4_Hull_rel | 1.78 | 1.79 (1.68-1.92) | 1.62 | 1.95 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SBO | 38,931 | 43,591 (42,095 - 45,116) | 41,641 | 45,707 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SB2015 | 10,185 | 11,020 (9,720 - 12,322) | 9,320 | 13,165 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SB2015/BO | 0.26 | 0.25 (0.23 - 0.28) | 0.22 | 0.29 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RBC2015 | 381 | 351 (170- 571) | 120 | 718 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| TAC and catch | | | | | | | |
|--------------------------------------|--------------|--------------|--------------|--------------|--------------|---|--------------|
| Assessment Year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
| Tier /rollover /MYTAC | Not assessed | Not assessed | Not assessed | Not assessed | Not assessed | Tier 1 | Not assessed |
| Stock Status | Not assessed | Not assessed | Not assessed | Not assessed | Not assessed | 26% B ₀ | Not assessed |
| Fishing Year | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
| RBC | 0 | 0 | 0 | 0 | 0 | 2015/16 – 381 t 2016/17 – 512 t 2017/18 – 647 t | 512 |
| Agreed TAC | 25 | 25 | 25 | 25 | 25 | 465 | 465* (355t) |
| Actual TAC after overs/unders | 27 | 25 | 25 | 25 | 25 | 465 | |
| % TAC caught | 2 | 100 | 12 | 54 | 26 | | |

- * Research catch allowance of 110 t is included in the TAC



| Tier Level & Discounts | |
|--|--|
| Tier Level | <u>Tier 1</u> - for details of Tiers and the Harvest Strategy, see: http://www.afma.gov.au |
| Discount factor | 0 per cent |
| Is a multi-year TAC in place? | <input checked="" type="checkbox"/> Yes (in place this season) <input type="checkbox"/> No |
| Is a multi-year TAC recommended? (please provide a clear indication on whether the multi-year recommendation is a RBC (e.g. based on Tier 1 model output) or TAC (e.g. a roll-over of catch)) | <input checked="" type="checkbox"/> Yes (recommended for future seasons) Based on Tier 1 modelled stock projections <input type="checkbox"/> No |
| Breakout rules for multi-year TAC | Given the long-lived nature of orange roughy and an expectation that there would not be large year-to-year changes to age structure that reflect stock size, and that CPUE was not considered an adequate indicator of stock status for aggregating stocks, the RAG could not identify breakout rules for eastern Orange Roughy. It also, however, did not see a strong need for such rules. |
| Constant catch scenarios | <p>As part of the 2014 assessment AFMA requested CSIRO to undertake model runs for three constant future catch scenarios (400t, 450t and 513t).</p> <ul style="list-style-type: none"> Estimates of female spawning biomass were the same for using the HCR and the constant catch of 513 t. |



Table 1. Summary statistics for female spawning biomass in 2018 (beginning of year) and 2018 depletion from MCMC simulations for the base-case model for the 20:35:38 HCR and constant catch scenarios. ^{AV} Average of the total HCR catches over the three years. MPD estimates are included for reference.

| Catch scenario for 2015, 2016, 2017 | Female SB ₂₀₁₈ /SB ₀ | | |
|-------------------------------------|--|-------------|-------------------|
| | MPD estimate | MCMC Median | (95% Bayesian CI) |
| 20:35:48 CATCHES (381, 512, 647 t) | 0.31 | 0.29 | (0.26 - 0.32) |
| ANNUAL CATCH 400 t | 0.31 | 0.29 | (0.26 - 0.32) |
| ANNUAL CATCH 450 t | 0.31 | 0.29 | (0.26 - 0.32) |
| ANNUAL CATCH 513 t ^{AV} | 0.31 | 0.29 | (0.26 - 0.32) |

| Catch scenario for 2015, 2016, 2017 | Female SB ₂₀₁₈ | | |
|-------------------------------------|---------------------------|-------------|-------------------|
| | MPD estimate | MCMC Median | (95% Bayesian CI) |
| 20:35:48 CATCHES (381, 512, 647 t) | 11,974 | 12,621 | (11,118 - 14,309) |
| ANNUAL CATCH 400 t | 12,052 | 12,702 | (11,198 - 14,392) |
| ANNUAL CATCH 450 t | 12,017 | 12,666 | (11,163 - 14,355) |
| ANNUAL CATCH 513 t ^{AV} | 11,974 | 12,621 | (11,118 - 14,309) |

Have breakout rules been triggered?

N/A

Assessment

Stock indicator trends

Due to incidental catch TAC with no targeted fishing, CPUE is not a reliable index of abundance.

Acoustic survey results undertaken in 1999, 2006, 2010, 2012 and 2013 at St. Helen’s Hill and St. Patrick’s Head indicate an increasing population. A further survey is planned for 2016.

RAG comments

The Tier 1 model inputs include: re-aged otolith data, updated age error matrix, catches from eastern zone and Pedra Branca in the southern zone, male and female age composition and abundance indices from acoustic sampling.

The outcome of the assessment is sensitive to stock structure assumptions and across different stock structures gave depletion estimates. Given the model sensitivities to stock structure, further exploration of stock structure should be undertaken in future. The stock structure assumption used in the 2014 base case (East plus Pedra Branca) gave the best fits to data.

The RAG noted that because the catch series used in the assessment comes from both the eastern and southern zones the assessment does not fit in with current management



| | |
|--|--|
| | <p>boundaries.</p> <p>Given that it appears that orange roughy in the eastern zone (which was historically heavily fished) is above the limit reference point, the RAG asked whether the southern and western zones may also have recovered to a similar extent. However there have been no surveys in these areas and hence, without evidence, it is difficult to ascertain if any recovery is occurring.</p> <p>SlopeRAG, at its 2015 meeting, supported an acoustic optical survey (AOS) of the St Helen's Hill and St Patrick's Head areas in 2016. The main survey objectives are: obtaining an estimate of spawning orange roughy to add to the existing time series, collection of biological samples to add to the biological indicator series and collect orange roughy for reproductive potential assessment.</p> <p>The RAG recommended that the current 500 t eastern zone MYTAC remain noting that current orange roughy catches are within the TAC and there was no reason to depart from previous advice.</p> <p>The RAG recommended granting 110 t of eastern zone orange roughy 9research catch allowance (RCA) in season 2016-17 for the eastern zone AOS. The RAG recommended that the RCA is within the 500 t TAC.</p> |
| <p>Key model technical assumptions/parameters</p> | <p>The model assumptions include the stock structure hypothesis; eastern zone spawning roughy and Pedra Branca non-spawning roughy.</p> <p>The biomass is assumed to have been unfished at the start of 1979</p> <ul style="list-style-type: none"> • Recruitment is assumed to be distributed about a Beverton-Holt stock recruitment relationship • Plus group age was set at 80 years • Recruitment steepness – 0.75 • Recruitment variability – 0.58 • Rate of M – 0.04 is assumed to be independent of age and time, and not to differ between sexes • Length at maturity – 35.8 cm • VB growth co-efficient – 0.06 |



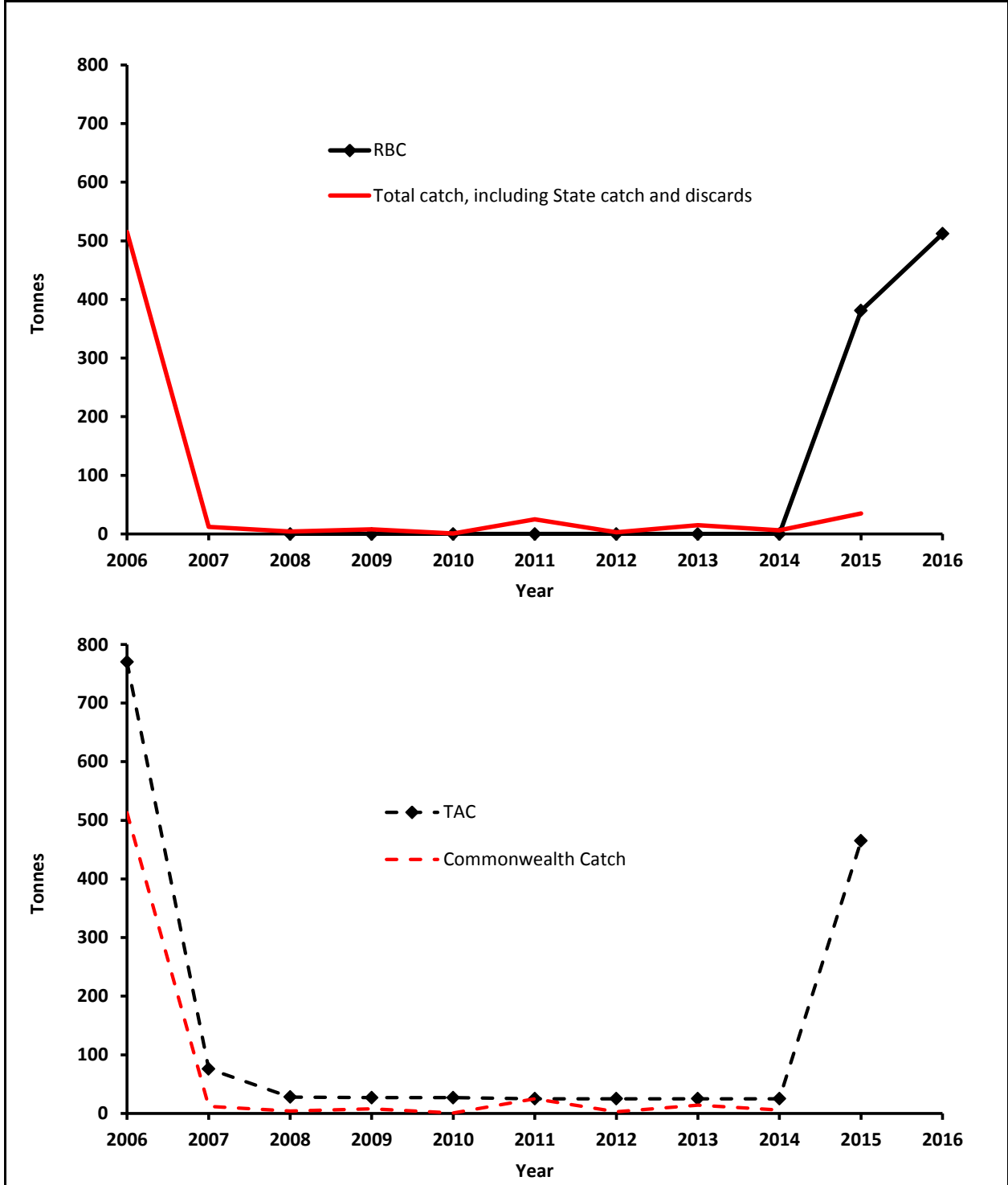
| | |
|--|-----------|
| Changes to model structure/assumptions | See above |
| Significant changes to data inputs | See above |
| Comments on data | See above |
| Implications for companion species/TEPs/multi-species fisheries | N/A |

| Tier 1 stock projection | |
|---|--|
| Projected biomass (include confidence intervals) | The 2014 base case model estimates female spawning unfished biomass to be 38,931 t and a current female spawning biomass of 26 per cent of unfished biomass. |

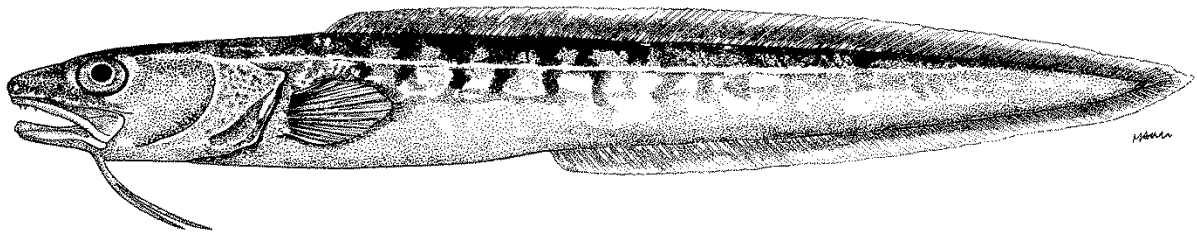
| Research | | |
|---------------------------|---|---|
| Research allowance | 110 t | |
| | <input checked="" type="checkbox"/> Included in TAC | <input type="checkbox"/> In addition to TAC |



Catch trends – Orange roughy – eastern zone
 (RBC and total catch are calendar year; TAC and Commonwealth catch are fishing season)



Pink ling (*Genypterus blacodes*)



Common names: Pink cusk-eel, ling, Australian rockling, New Zealand ling, kingklip, northern ling

Assessed by SlopeRAG in 2015. Species summary updated in 2015.

| Stock status summary | | |
|--|--|------------------------------|
| Stock structure | <p>In light of increasing evidence that there are two stocks of pink ling, they are assessed as separate stocks (east and west of Longitude 147° East).</p> <p>Genetic variation between eastern and western pink ling has not been found, however, there are differences in size and age structure, growth and catch rates between the eastern and western zones. These differences suggest there is little mixing of pink ling between the zones, and that fishing in one area will have limited impact on fish in the other area.</p> | |
| Stock status against reference points and trend | <p>Limit reference is 20 per cent of unfished biomass. Target reference is 48 per cent of unfished biomass.</p> <p>2015 estimated biomass (east): 30 per cent of unfished biomass. 2015 estimated biomass (west): 73 per cent of unfished biomass.</p> <p>East – biomass trend continuing recent increases. West – biomass increasing above management target.</p> | |
| ABARES most recent assessment (2015) | Biomass: Not overfished | Fishing mortality: Uncertain |
| GVP figures (2013 - 14 fishing season) | GVP | % fishery GVP |
| | \$2.9 million | 4.8 per cent |
| Recommended Biological Catch 2016 - 17 | <p>East: (1 year): 250 t (30-630 t, 95 per cent confidence interval) East: (long term): 580 t (540-640 t, 95 per cent confidence interval) (The alternative catch scenario table below presents risks/probability of alternative catches)</p> <p>West (1 year): 990 t (640-1590 t, 95 per cent confidence interval) West (long term): 680 t, (530-950 t 95 per cent confidence interval)</p> | |
| Overcatch/ undercatch | <p>10 per cent undercatch</p> <p>10 per cent overcatch</p> | |

| Probability of recommended biological catch (RBC) (or other levels of catch) causing a decline below limit reference <u>under proposed management Species that follow a HS rule that has been MSE tested will have a “very unlikely” score in this section (i.e. $P < 10\%$).</u> | RBC recommendation: 1-year RBC (east and west) is extremely unlikely to fall below the limit reference point (MSE tested) | | | | | |
|--|---|-----------------|-----------------|--------------------|--------------------|--------------------------|
| | Alternative Catch Scenarios – eastern stock at constant catch | | | | | |
| | Annual catch (t) | $E(B_{17}/B_0)$ | $E(B_{22}/B_0)$ | $P(SS_{17} < 0.2)$ | $P(SS_{22} < 0.2)$ | Rebuild year to B_{48} |
| | 0 | 0.38 | 0.63 | 0.00 | 0.00 | 2020 |
| | 300 | 0.35 | 0.48 | 0.01 | 0.00 | 2023 |
| | 400 | 0.33 | 0.43 | 0.02 | 0.01 | 2026 |
| | 500 | 0.31 | 0.38 | 0.04 | 0.04 | 2036 |
| | 550 | 0.30 | 0.35 | 0.07 | 0.08 | >2050 |
| | 600 | 0.29 | 0.32 | 0.09 | 0.13 | >2050 |
| | 700 | 0.27 | 0.27 | 0.15 | 0.28 | >2050 |

B_{17} means the biomass estimate in 2017.

B_0 means unfished biomass.

P means probability.

E means estimate

0.2 means 20 per cent of unfished biomass, the limit reference point.

Rebuild year means at least a 50 per cent probability of being at or above the target reference point of 48 per cent of the unfished biomass.

N.B. Uses Markov Chain Monte Carlo stochastic projections to determine performance indicators.

| Assessment Year | | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|-----------------------------------|------|---------|---------|----------------------|---------|---------|----------------|---------|
| Assessment Tier or rollover/MYTAC | East | Tier 1 | Tier 1 | No agreed assessment | Tier 1 | Tier 1 | Rollover MYTAC | Tier 1 |
| | West | Tier 1 | Tier 1 | | Tier 1 | Tier 1 | | Tier 1 |
| Stock Status | East | 36% | 35% | No agreed assessment | 26% | 25% | Not assessed | 30% |
| | West | 49% | 45% | | 43% | 58% | | 73% |
| Fishing Year | | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
| RBC | East | 656 | 531 | No agreed assessment | 223 | 122 t | Not assessed | 250 |
| | West | 813 | 844 | | 490 | 807 t | | 990 |
| Agreed TAC | East | 1200 | 1200 | 996 | 834 | 996 | 980 | 1240 |
| | West | | | | | | | |
| Actual TAC after overs/unders | East | 1208 | 1275 | 1022 | 844 | 1016 | 1006 | |
| | West | | | | | | | |
| % TAC caught | East | 87 | 96 | 97 | 97 | 95 | | |
| | West | | | | | | | |

Tier Level & Discounts

| | |
|------------|---|
| Tier Level | Tier 1- for details of Tiers and the Harvest Strategy, see: http://www.afma.gov.au |
|------------|---|



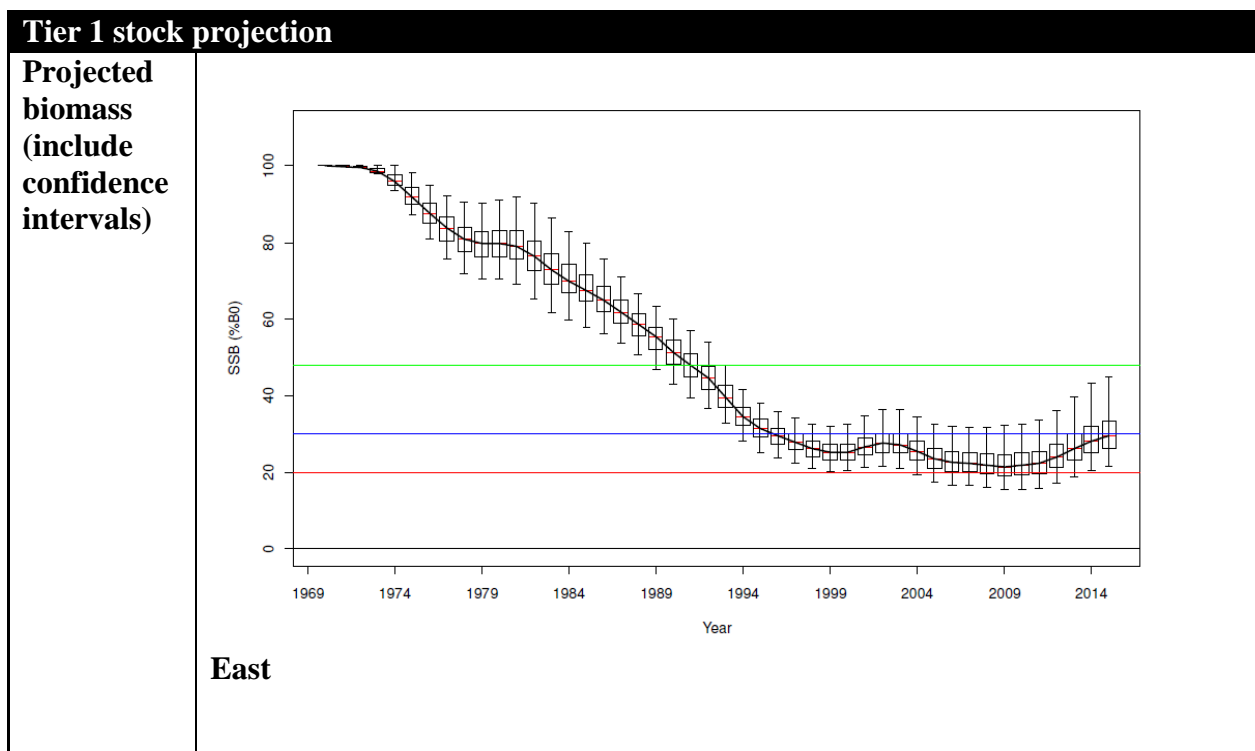
| | | |
|--|--|-----------------------------|
| Discount factor | N/A | |
| Is a multi-year TAC in place? | <input checked="" type="checkbox"/> Yes (in place this season) | <input type="checkbox"/> No |
| Is a multi-year TAC recommended? (please provide a clear indication on whether the multi-year recommendation is a RBC (e.g. based on Tier 1 model output) or TAC (e.g. a roll-over of catch)) | <input checked="" type="checkbox"/> Yes Three year RBC of 1240 tonnes | <input type="checkbox"/> No |
| Breakout rules for multi-year TAC | - | |
| Have breakout rules been triggered? | N/A (assessment year) | |

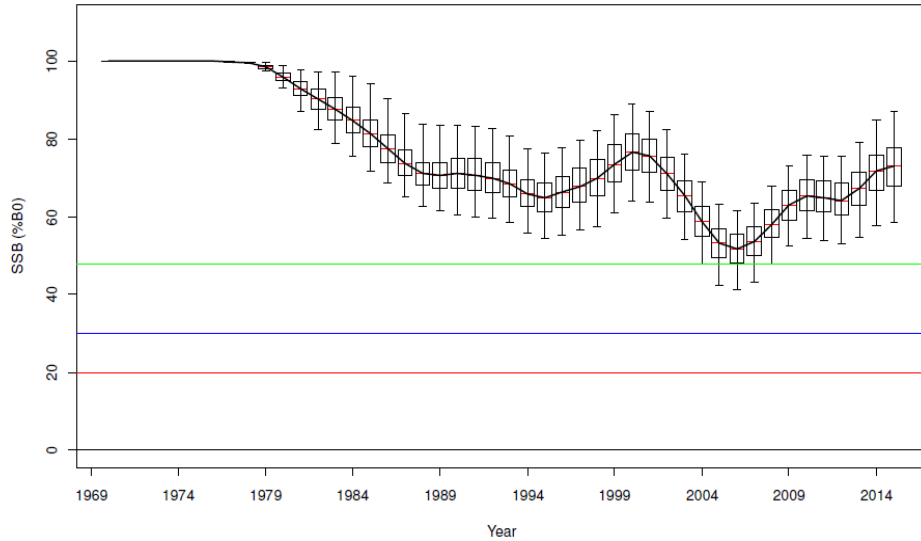
| Assessment | |
|---|--|
| Stock indicator trends | <p>East – biomass trend continuing recent increases.</p> <p>West – biomass increasing above management target.</p> |
| RAG comments | <p>RBC recommendations are provided using the Harvest Control Rules provided for in the SESSF Harvest Strategy Framework 2009.</p> <p>An additional table is provided outlining constant catch scenarios calculated using the agreed base-case model.</p> |
| Key model technical assumptions/parameters | Assessed using CASAL based stock assessment model. See Cordue (2015) for technical assumptions and parameters. |
| Changes to model structure/assumptions | <p>The 2015 pink ling assessment started as an update of ISL’s 2013 assessments however this was expanded to include further analysis of eastern selectivity and estimates of natural mortality (M) following MCMC runs.</p> <p>New data were added on to existing models and (as far as possible) the same methods were applied.</p> <p>A full Bayesian estimation was undertaken (MPD runs for diagnostics followed by MCMC runs for estimates).</p> <p>MCMC convergence proved problematic:</p> <ul style="list-style-type: none"> • West: one chain diverged substantially from the other two, giving very different stock status estimates. Reasons for this needed to be determined |



| | |
|--|--|
| | <ul style="list-style-type: none"> • East: one chain differed from the other five and looked anomalous and needed further investigation. <p>East- Two selectivities were estimated for the non-trawl fishery for port and at-sea sampling but they were very similar. The three trawl selectivities were all allowed to be domed. In the early period (before 2000), the selectivity was fairly flat, in the second period it was very domed, and in the most recent period it was moderately domed. This result differs from the MCMC assessment in 2013 where all three selectivities were domed (Cordue 2013).</p> <p>The RAG did not accept the the first eastern base case noting:</p> <ul style="list-style-type: none"> • that flat topped trawl selectivity prior to 2000 is unlikely and inconsistent with domed shaped selectivity over the two later periods • the optimistic estimate of natural mortality, median 0.26. <p>A further eastern MCMC model was run to produce a base model with more acceptable diagnostics. Only minor changes were made and the run was confirmed as the accepted base case model.</p> |
| <p>Significant changes to data inputs</p> | <p>Given the recent and changeable trip limits in the eastern ling fishery updating catch histories and CPUE was relatively complicated. The stock assessment models require data on catch (landings plus discards) rather than just landings. Trip limits could have been expected to cause some level of additional discarding in the eastern fisheries. The scale of the discards were estimated and used to prepare the eastern catch history and to give context to the eastern CPUE indices.</p> <p>Trip limits formed part of the management arrangements to constrain catches in the eastern zone and although trip limits will reduce landings is not so obvious whether they will reduce total fishing mortality (removals).</p> <p>In the eastern standardized CPUE analysis, period effects were estimated for when there was no trip limit, a 50 kg per day trip limit, and a 250 kg per day trip limit. The period effects include changes in behavior and the level of discarding:</p> <ul style="list-style-type: none"> • analysis of ISMP data for the same time periods produced “landings multipliers” (what the landings need to be multiplied by to get the removals) • the period effects and landings multipliers can be combined to compare total removals under the two trip limit levels against the expected removals when no trip |

| | |
|--|--|
| | <p>limit (for the same level of effort):50 kg per day</p> <ul style="list-style-type: none"> - removals $\approx 0.83 \times$ removals when no limit (i.e. a 17% reduction in the catch)250 kg per day - removals $\approx 0.88 \times$ removals when no limit (i.e. a 12% reduction in the catch). <p>The methods used by ISL in the 2013 assessment were applied (Cordue 2013). However, in some eastern runs, “period effects” were estimated to account for the discard and avoidance behaviour in 2013 and 2014 in response to trip limits. The eastern and western trawl fisheries were modelled separately. When the eastern “period effects” were not estimated, the form of the models was the same for both east and west:</p> |
| Comments on data | The above data changes (plus others not mentioned here) should be reviewed for future assessments. |
| Implications for companion species/TEPs/multi-species fisheries | <p>Multi-species fishery issue – pink ling is caught in close association with the following species:</p> <p>Line:blue-eye trevalla; Trawl:blue grenadier</p> |





West

Pink ling base model Marcov chain Monte Carlo (MCMC): Spawning stock biomass trajectory (Cordue 2015). The horizontal lines are plotted at 20 per cent, 30 per cent and 48 per cent of B_0 .

Research

Research allowance

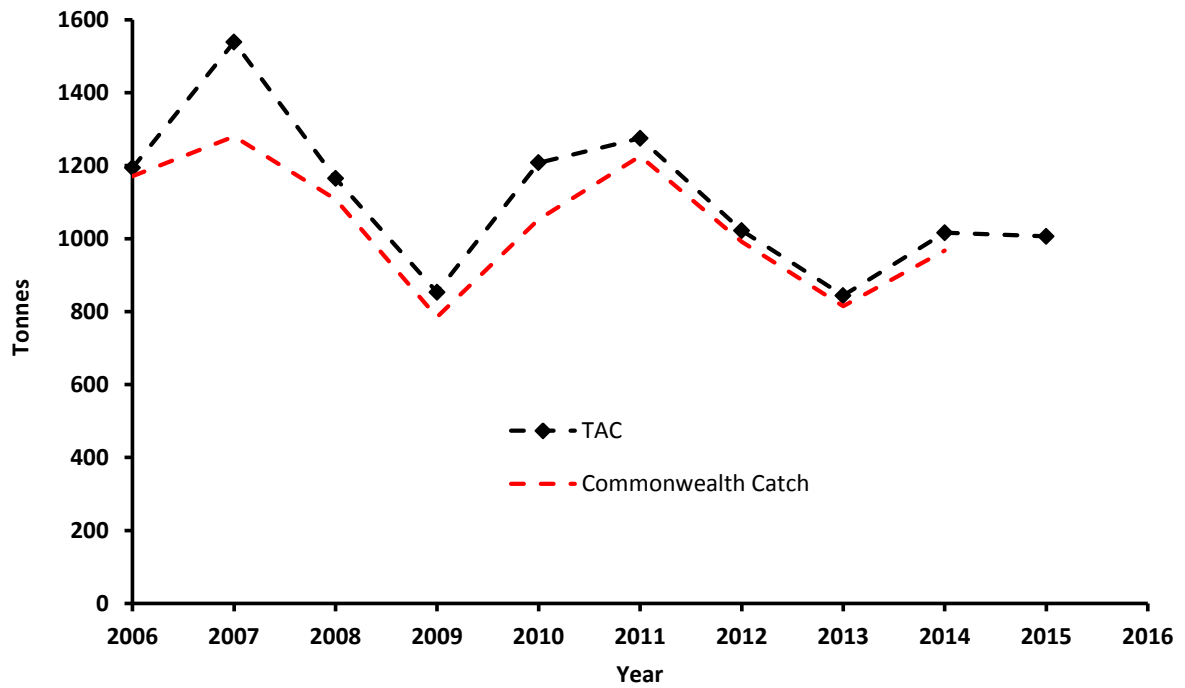
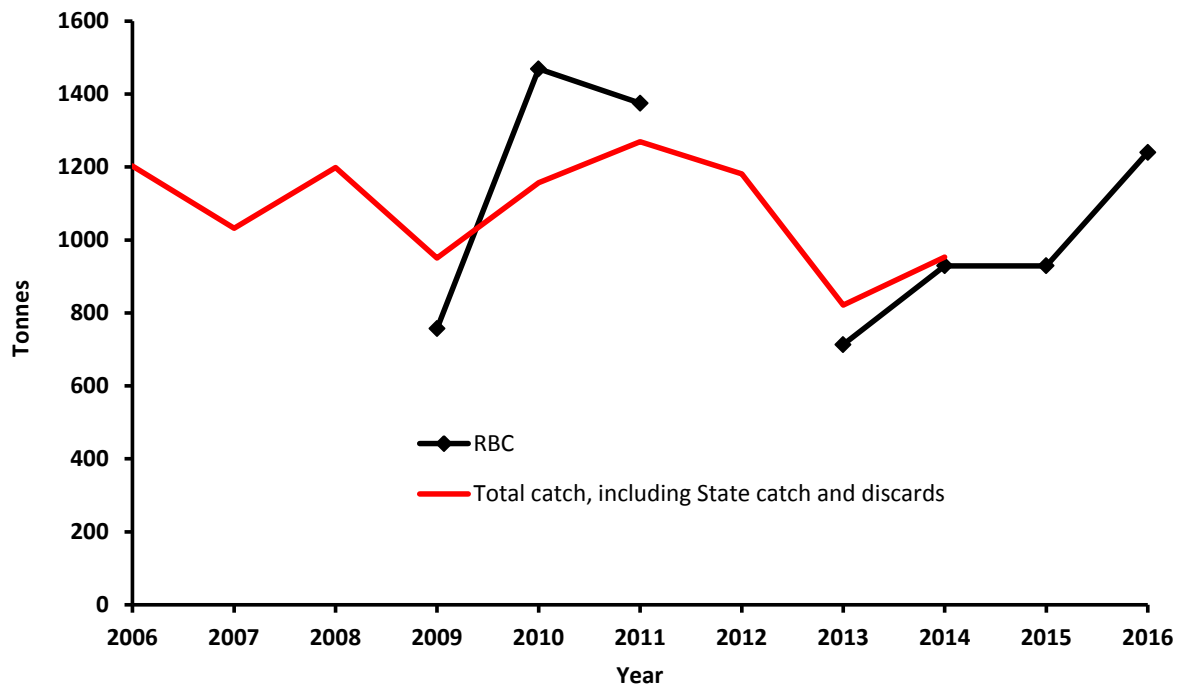
0 t

Included in TAC

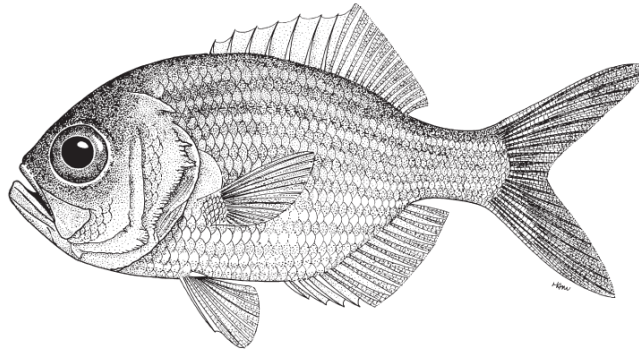
In addition to TAC



Catch trends – Pink Ling
 (RBC and total catch are calendar year; TAC and Commonwealth catch are fishing season)



Redfish (*Centroberyx affinis*)



ABARES (2012)

Common names: Nannygai, red snapper, king snapper, golden snapper.

Discussed by ShelfRAG in 2015. Species summary updated in 2015.

| Stock status summary | |
|--|--|
| Stock structure | <p>No formal stock discrimination studies have been done in Australia.</p> <p>Tagging studies suggested a single unit stock of redfish off NSW. Previous studies of mean length at age suggest differences in growth rates between the ‘northern’ and ‘southern’ sectors of the fishery off eastern Australia. The boundary being Latitude 36°S (just north of Montague Island).</p> <p>Previous assessments of the redfish stock have therefore also considered that the fishery exploits two separate populations, with the boundary between these ‘stocks’.</p> <p>However for the 2014 assessment, the RAG agreed to use a single stock model with no split at 36°S.</p> |
| Stock status against reference points and trend | <p>Limit reference point is 20 per cent of unfished biomass.</p> <p>Target reference point is 48 per cent of unfished biomass.</p> <p>The 2014 assessment estimated that the stock is below the limit reference point at an estimated 2015 stock status of 11 per cent of unexploited levels.</p> <p>As required by the HSP AFMA is developing a Redfish Stock Rebuilding Strategy.</p> |
| ABARES most recent assessment (2015) | <p>Biomass: Overfished</p> |
| | <p>Fishing mortality: Uncertain</p> |



| | | |
|---|---|----------------------|
| GVP figures (2013 - 14 fishing season) | GVP | % fishery GVP |
| | \$0.3 million | 0.5 per cent |
| Recommended Biological Catch 2016-17 | <p>Given there are no new data available that would inform a change of decision the RAG recommended continuing with a RBC of zero and an incidental catch TAC of 100 t.</p> <p>The 100 t bycatch TAC was recommended based on the analysis that indicated catches up to 150 t would allow rebuilding in a similar timeframe to lower catches, and making allowances of 50 t for state catches and discards. This also factors in the potential for strong recruitment to enter the fishery in the next few years, and the need to avoid unnecessary discards if possible.</p> | |
| Overcatch/undercatch | NIL | |
| Probability of recommended biological catch (RBC) (or other levels of catch) causing a decline below limit reference <u>under proposed management</u> <u>Species that follow a HS rule that has been MSE tested will have a “very unlikely” score in this section (i.e. $P < 10\%$).</u> | N/A – the stock is assessed as being below the limit reference point | |
| | Alternative Catch Scenarios: catches from between 0 t and 150 t provide for rebuilding to the limit reference point by 2019 (assuming average recruitment). | |



| TAC and catch trends | | | | | | | |
|--------------------------------------|--|------------------------------------|---|---|---|-----------------|-------------------|
| Assessment Year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
| Tier /rollover /MYTAC | Tier 3 | Tier 3 | Tier 3 Tier 4 | Tier 3 Tier 4 | Tier 3 Tier 4 | Tier 1 | Incidental TAC |
| Target | B ₄₈ | B ₄₈ | B ₄₈ | B ₄₈ | B ₄₈ | B ₄₈ | B ₄₈ |
| Stock Status | Fishing mortality between target and limit | Fishing mortality less than target | Tier 3 - Fishing mortality less than target Tier 4 – CPUE lower than limit | Tier 3 - Fishing mortality less than target Tier 4 – CPUE lower than limit | Tier 3 - Fishing mortality less than target Tier 4 – CPUE lower than limit | <BLIM | <BLIM |
| Fishing Year | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
| RBC | 700 | 1985 | Tier 3 – 1569 Tier 4 – 0 | Tier 3 – 2932 Tier 4 - 0 | Tier 3 – 3791 Tier 4 - 0 | 0 | 0 |
| Agreed TAC | 551 | 276 | 276 | 276 | 138 | 100 | |
| Actual TAC after overs/unders | 611 | 330 | 299 | 303 | 164 | 100 | |
| % TAC caught | 24 | 28 | 22 | 30 | 48 | | |

| Tier Level & Discounts | |
|--|---|
| Tier Level | A Tier 1 assessment was undertaken in 2014. For details of Tiers and the Harvest Strategy, see: http://www.afma.gov.au |
| Discount factor | 0 per cent |
| Is a multi-year TAC in place? | <input type="checkbox"/> Yes (in place this season) <input checked="" type="checkbox"/> No |
| Is a multi-year TAC recommended? (please provide a clear indication on whether the multi-year recommendation is a RBC (e.g. based on Tier 1 model output) or TAC (e.g. a roll-over of catch)) | <input type="checkbox"/> Yes (recommended for future seasons) <input checked="" type="checkbox"/> No |
| Breakout rules for multi-year TAC | N/A |
| Have breakout rules been triggered? | N/A |



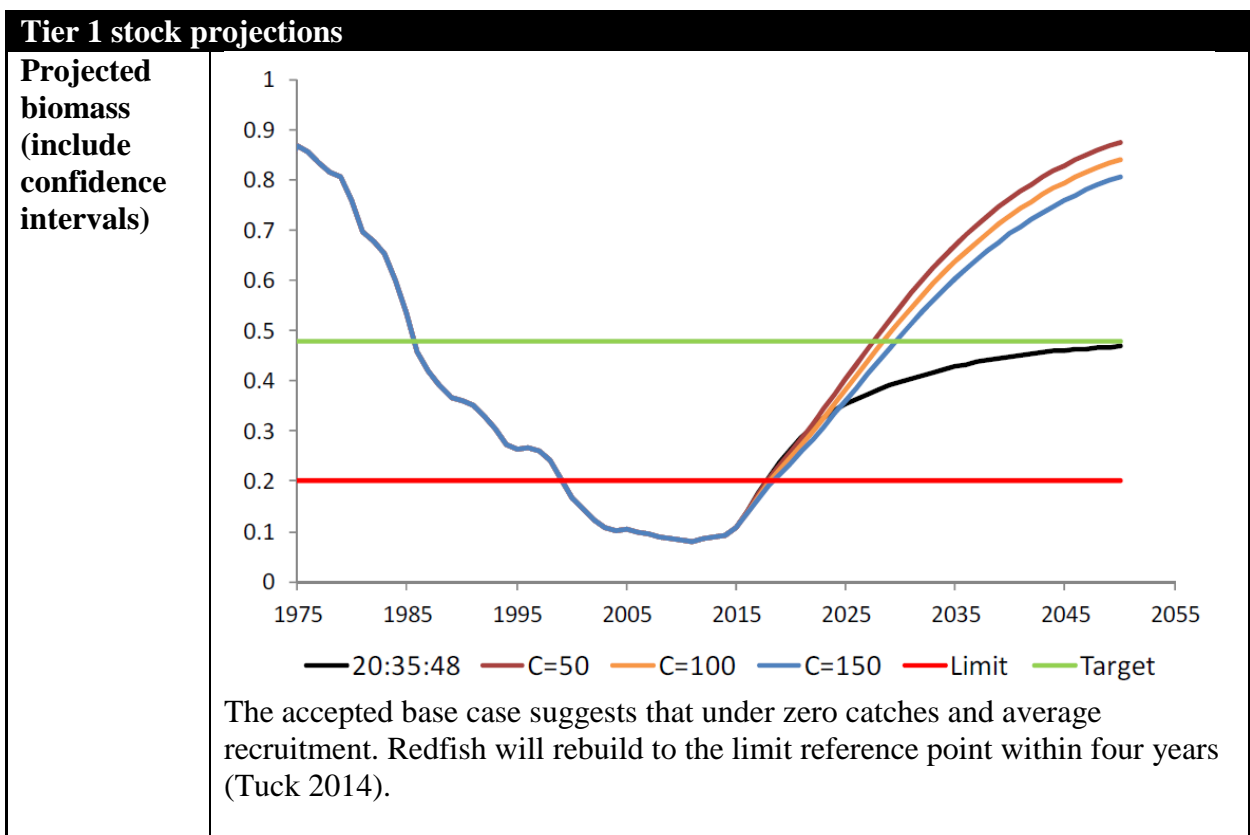
| Assessment | |
|--|---|
| Stock indicator trends | The 2014 Tier 1 assessment estimates an increase in recruitment. This was supported by preliminary results from the 2014 Fishery Independent Survey which show an increase in catch of smaller fish. |
| RAG comments | <p>The RAG noted:</p> <ul style="list-style-type: none"> • the model was heavily influenced by declining catch rates • changes to gear (a bigger diamond mesh) should be considered to reduce the bycatch of juvenile redbfish. However, the RAG noted that this may impact on the catches of other highly desirable species such as flathead • existing closed areas provide some degree of protection for redbfish however this has not been quantified • avoiding redbfish was more difficult than blue warehou and eastern gemfish because they were more evenly spread around the fishery. • the estimated depletion was relatively insensitive to a range of assumptions. Sensitivities explored by re-running the model with a wide range of different input parameters produced depletion estimates in the range of 7–19 per cent of B_0. |
| Key model technical assumptions/parameters | <p>Stock Synthesis software is used for this Tier 1 assessment</p> <p>M natural mortality is fixed at 0.1</p> <p>Beverton-Holt type recruitment is assumed with a steepness of 0.75</p> <p>Growth function is estimated by the model separately for females and males.</p> |
| Changes to model structure/assumptions | N/A – first Tier 1 assessment |
| Significant changes to data inputs | N/A – first Tier 1 assessment since the SESSF Harvest Strategy Framework was introduced |
| Comments on data | |
| Implications for companion species/TEPs/multi-species fisheries | <p>Companion species analysis indicates that the majority (64 per cent) of all redbfish are taken in shots where redbfish is not the most valuable component of the catch. This suggests it is not normally targeted.</p> <p>Flathead is the species most commonly being targeted when redbfish are caught (31 per cent).</p> |



The last companion species analysis (Klaer, 2010) indicated that of 156 t of redfish caught, 100 t was caught in shots where redfish was not main species taken.

In the 2013/14 fishing season, 90 t of redfish was landed while 2309 t of flathead was landed, suggesting that full quota utilisation of flathead does not result in substantial redfish mortality (total redfish discards in 2013 was 29 t).

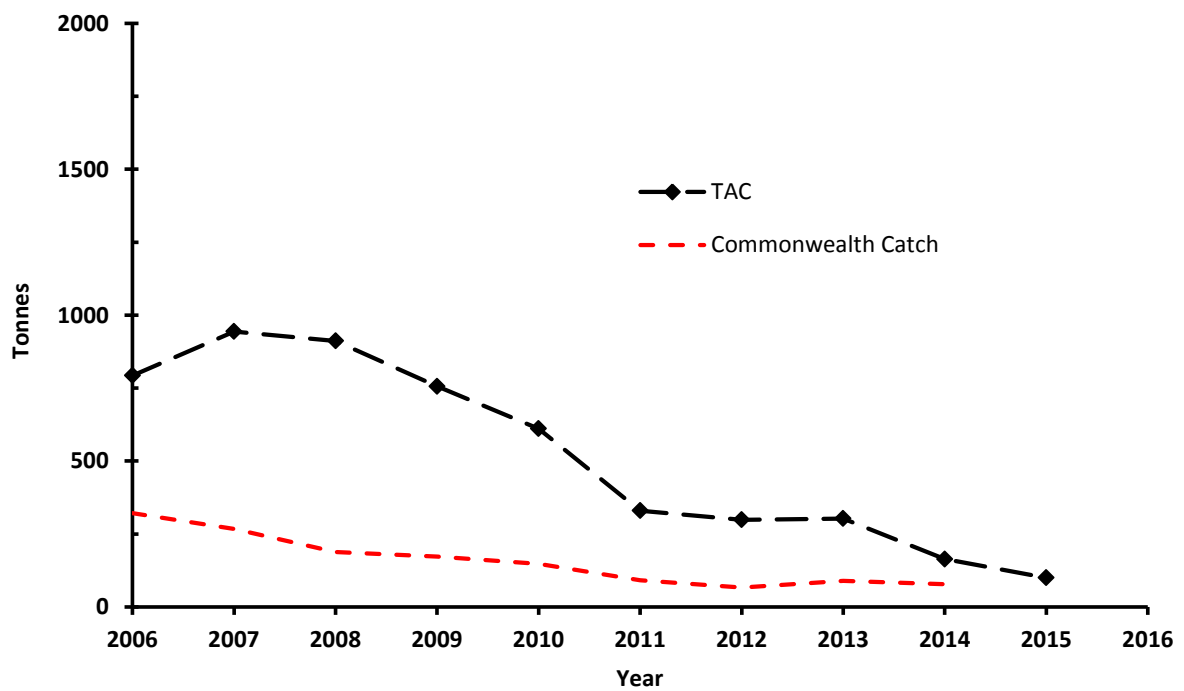
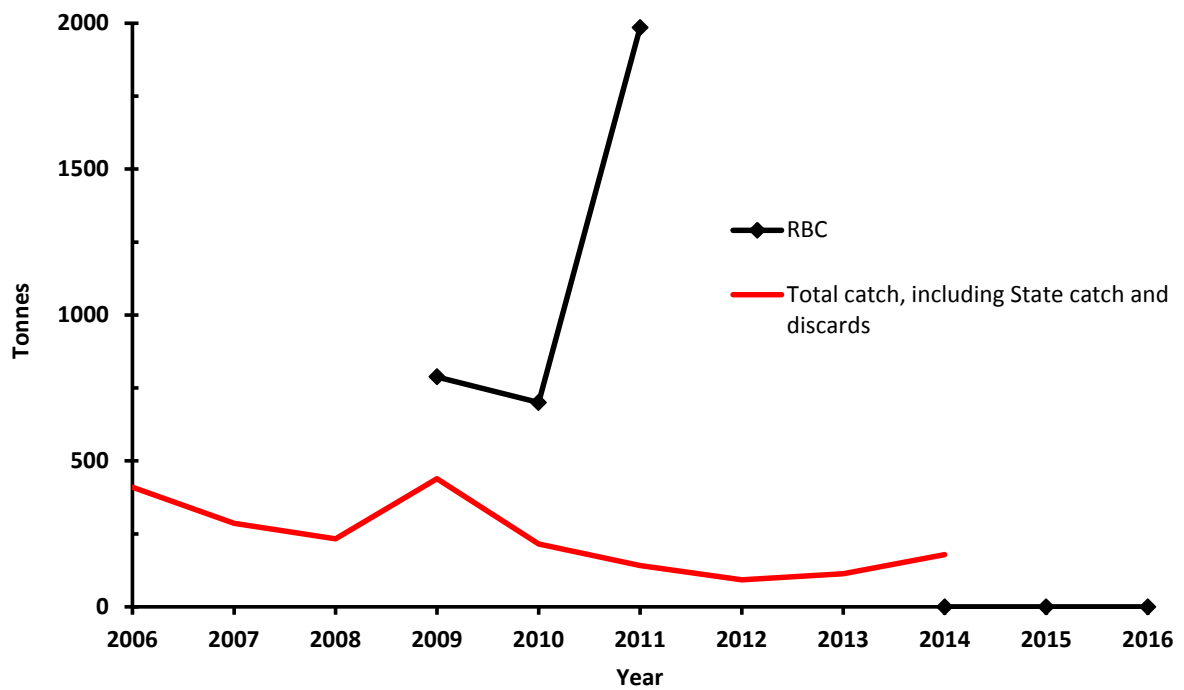
Projections completed in the 2014 redfish stock assessment showed that redfish would rebuild by 2018 or 2019 at catches of 0 t, 50 t, 100 t and 150 t (i.e. catches up to 150 t made little different to the projected rebuilding rate for redfish).



| Research | | |
|---------------------------|--|---|
| Research allowance | 0 t | |
| | <input type="checkbox"/> Included in TAC | <input type="checkbox"/> In addition to TAC |



Catch trends – Redfish
 (RBC and total catch are calendar year; TAC and Commonwealth catch are fishing season)



Sawshark (*Pristiophorus* spp.)



(CSIRO National Fish Collection, 2009)

Assessed by SharkRAG in 2015. Species summary updated in 2015.

| Stock status summary | | | | | | | | | |
|---|--|--|------|---------------|-------|--------------|--------|---------------|--------|
| <p>Stock structure</p> | <p>Three endemic species of sawsharks occur off southern Australia, but their distributions have not been described precisely. Common sawshark (<i>Pristiophorus cirratus</i>) is reported to range from Jurien Bay in WA to Eden in NSW, including Tasmania, to depths of 310m. Southern sawshark (<i>P. nudipinnis</i>) is reported to range from the western region of the Great Australian Bight to eastern Gippsland in Victoria, including Tasmania, to depths of 70m. The eastern sawshark (<i>Pristiophorus</i> sp. A) is reported to range from approximately Lakes Entrance in Victoria to Coffs Harbour in NSW at depths of 100–630m (Last and Stevens 1994).</p> <p>Little is known of stock structure or movement rates.</p> <p>For assessment purposes, all sawsharks south of the Victoria–NSW border are assumed to be common sawshark and southern sawshark, whereas those north of this border are assumed to be eastern sawshark.</p> | | | | | | | | |
| <p>Stock status against reference points and trend</p> | <p>SharkRAG reviewed the target reference point for sawshark and supported an MSY proxy target of B_{40}. This was based on consideration that sawshark is a secondary commercial species and not targeted, is considered sustainable and contributes about 1 per cent to the fishery GVP.</p> <p>This Tier 4 target reference point is the level of CPUE assumed to produce a spawning biomass of 40 per cent of unfished levels. The limit reference point is 20 per cent of unfished levels.</p> <table border="1" data-bbox="724 1856 1291 2011"> <thead> <tr> <th></th> <th>CPUE</th> </tr> </thead> <tbody> <tr> <td>Target</td> <td>0.756</td> </tr> <tr> <td>Limit</td> <td>0.3627</td> </tr> <tr> <td>Recent</td> <td>0.9346</td> </tr> </tbody> </table> | | CPUE | Target | 0.756 | Limit | 0.3627 | Recent | 0.9346 |
| | CPUE | | | | | | | | |
| Target | 0.756 | | | | | | | | |
| Limit | 0.3627 | | | | | | | | |
| Recent | 0.9346 | | | | | | | | |

| | | |
|--|--|--|
| ABARES most recent assessment (2015) | Biomass: Not overfished | Fishing mortality: Not subject to overfishing |
| GVP figures (2013 - 14 fishing season) | GVP SESSF | % fishery GVP |
| | \$0.5 million | 0.75 per cent |
| Recommended Biological Catch 2016-17 | The RBC based on trawl CPUE (discards not included) is 535t. Noting a discount factor 15 per cent is to be applied. | |
| Overcatch/undercatch | 10 per cent undercatch 10 per cent overcatch | |
| Probability of recommended biological catch (RBC) (or other levels of catch) causing a decline below limit reference <u>under proposed management</u> <u>Species that follow a HS rule that has been MSE tested will have a “very unlikely” score in this section (i.e. P<10 %).</u> | RBC recommendation: <10 per cent (very unlikely) | |
| | Alternative Catch Scenarios: N/A – Tier 4 species. | |

| TAC and catch trends | | | | | | | |
|--------------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------|-------------------|
| Assessment Year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
| Tier /rollover /MYTAC | Tier 4 | Tier 4 | Tier 4 | Tier 4 | Tier 4 | Tier 4 | Tier 4 |
| Stock Status | CPUE between target and limit | CPUE between target and limit | CPUE between target and limit | CPUE between target and limit | CPUE between target and limit | CPUE above target | CPUE above target |
| Fishing season | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
| RBC | 370 | 340 | 268 | 368 | 459 | 600 | 535 |
| Agreed TAC | 255 | 226 | 226 | 339 | 459 | 482 | |
| Actual TAC after overs/unders | 281 | 241 | 243 | 354 | 488 | 522 | |
| % TAC caught | 84 | 83 | 81 | 51 | 41 | | |

| Tier Level & Discounts | |
|-----------------------------------|---|
| Tier Level | Tier 4 |
| Discount factor | SharkRAG supported applying a discount factor of 15 per cent. |

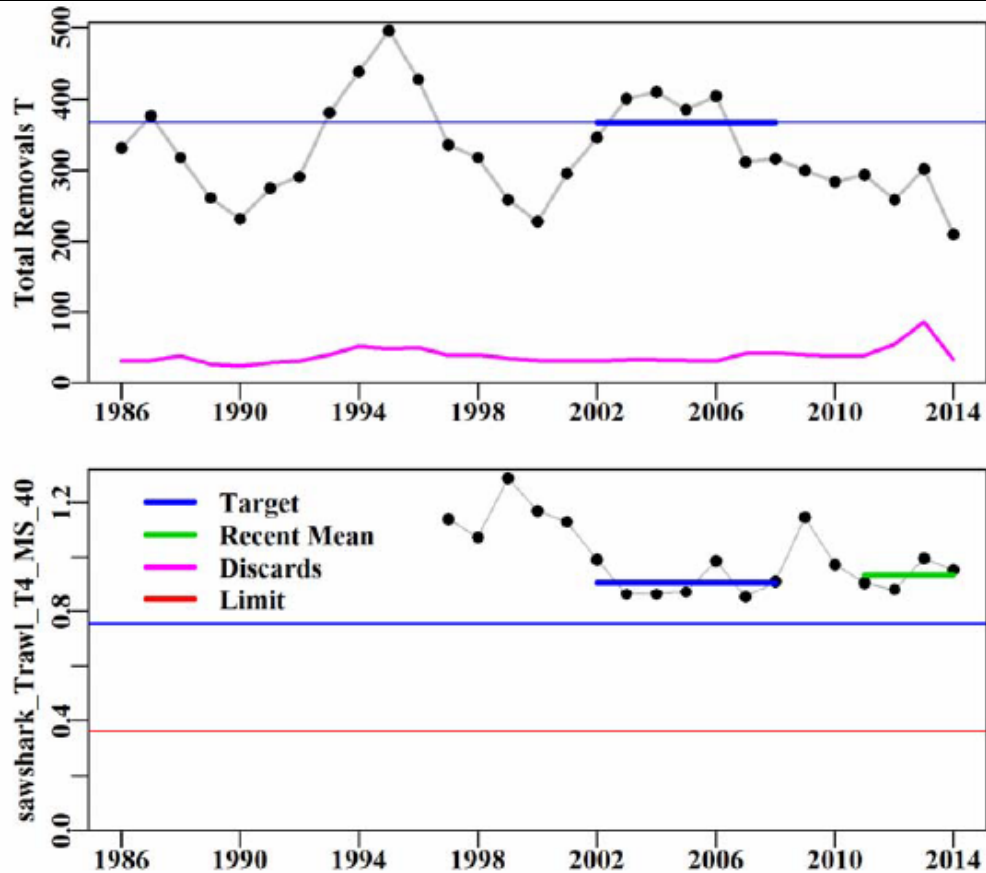


| | | |
|--|--|--|
| Is a multi-year TAC in place? | <input type="checkbox"/> Yes (in place this season) | <input checked="" type="checkbox"/> No |
| Is a multi-year TAC recommended? (please provide a clear indication on whether the multi-year recommendation is a RBC (e.g. based on Tier 1 model output) or TAC (e.g. a roll-over of catch)) | <input checked="" type="checkbox"/> Yes (recommended for future seasons) 3 Year multi-year TAC recommended. | <input type="checkbox"/> No |
| Breakout rules for multi-year TAC | SharkRAG recommends these breakout rules: <ul style="list-style-type: none"> • If total mortality (including discards, state catch, and recreational catch) exceeds most recent RBC by more than 10 per cent • If total mortality (including discards, state catch and recreational catch) is lower than 50 per cent of the most recent RBC • If there is a greater than 25 per cent change in any of the most recent standardised trawl or gillnet CPUE values | |
| Have breakout rules been triggered? | N/A | |
| Stock indicator trends | N/A | |
| RAG comments | <p>In 2015 SharkRAG reviewed catch and fishing behaviour and recommended using the trawl series (discards excluded) as the index of abundance. The RAG noted that the RBC is lower and more conservative with discards excluded.</p> <p>SharkRAG noted there were no concerns with the sawshark stock and recommended an RBC of 535 t. The RAG supported using a multi-year TAC for three years with a discount factor of 15 per cent to be applied.</p> <p>SharkRAG noted that separating the sawshark catches by species (common sawshark and southern sawshark) did not make a notable difference to the RBC.</p> | |
| Changes to model structure/assumptions | As above SharkRAG elected to move to trawl data. | |
| Significant changes to data inputs | In 2015 SharkRAG recommended using the trawl series as the index of abundance excluding discards. | |
| Comments on data | N/A | |
| Implications for companion species/TEPs/multi-species fisheries | N/A | |



Tier 4 assessment

Total removals and catch rates



Sawshark – trawl, excluding discards.

Top: total removals (black), target catch (fine blue line, C*).

Bottom: standardized CPUE (black), target CPUE (lower blue line) and limit CPUE (lower red line). Thick lines represent the reference period for catches (top panel, blue), CPUE (bottom panel, blue), and recent mean CPUE (bottom panel; green). The fine blue line below the target CPUE is the revised target based on a 40 per cent B0 proxy target for non-target species in a mixed fishery. The limit reference CPUE is represented by the red line.

Research

Research allowance

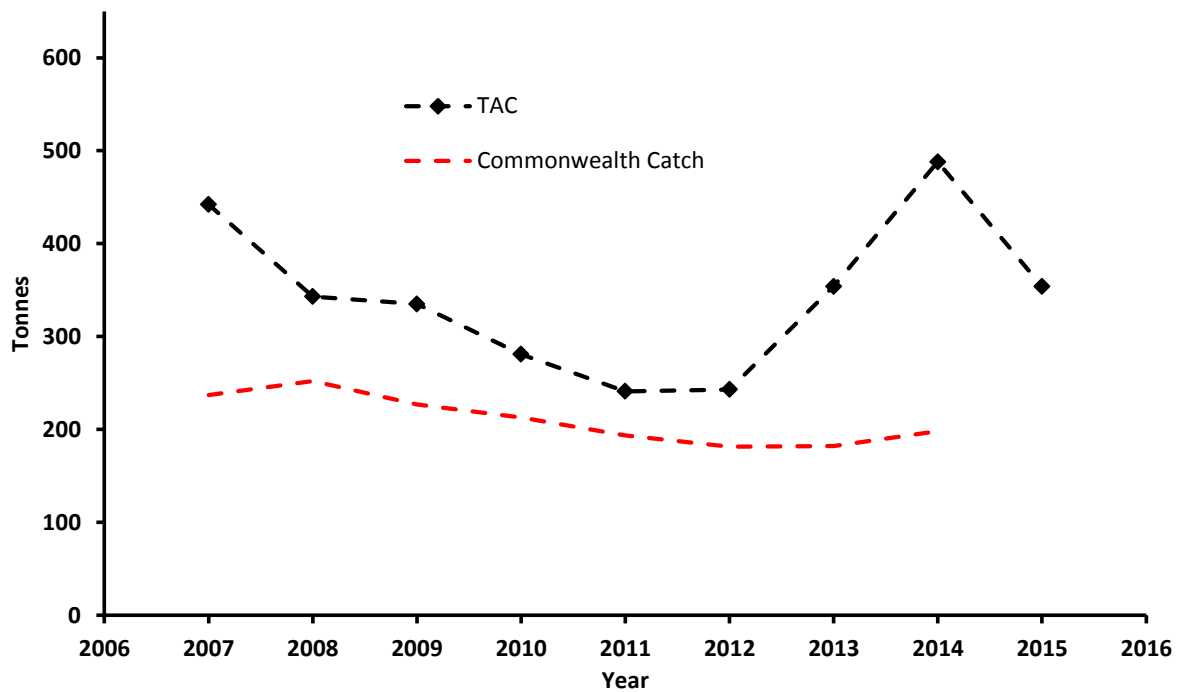
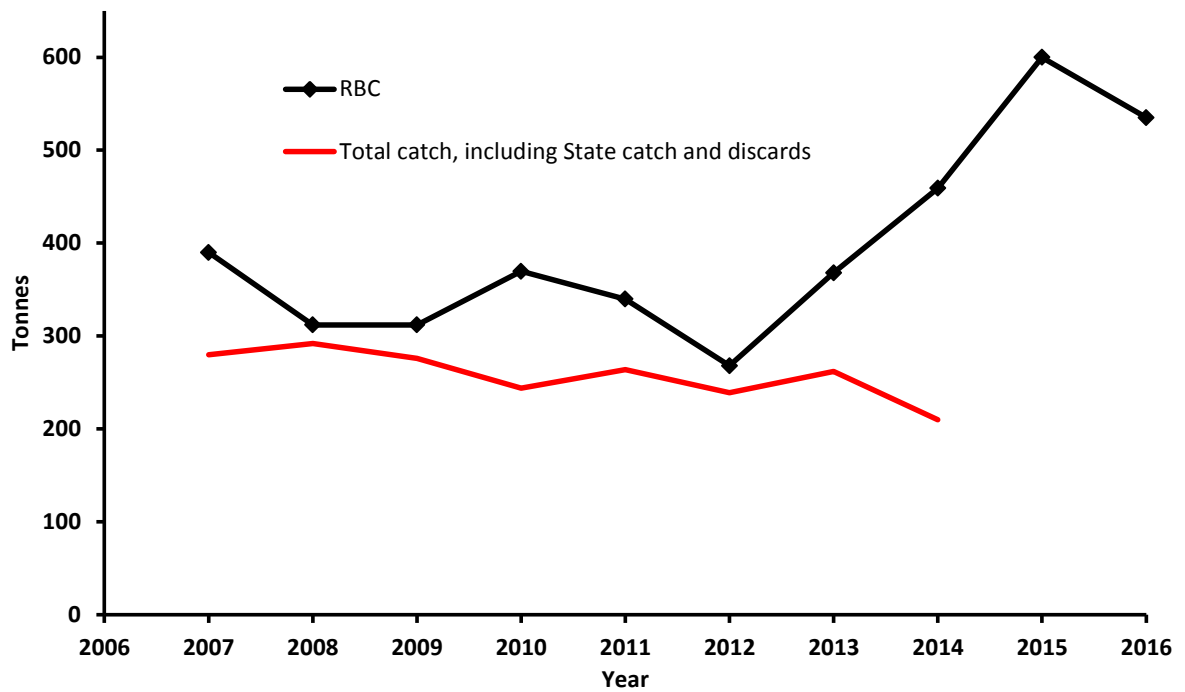
N/A

Included in TAC

In addition to TAC



Catch trends - Sawshark
 (RBC and total catch are calendar year; TAC and Commonwealth catch are fishing season)



School shark (*Galeorhinus galeus*)



(Fisheries Research & Development Corporation, 2012)

Under a *Stock Rebuilding Strategy*.

Assessed by SharkRAG in 2009. Species summary updated in 2015.

| Stock status summary | |
|--|---|
| Stock structure | <p>The assessment model assumes that there is one well mixed stock.</p> <p>Tagging and genetic data shows some evidence for one well mixed stock. However, earlier data suggests there could be an east/west divide in stocks. This is supported by research documenting a collapse in the eastern part of the fishery around Tasmania and Bass Strait. After this collapse a fishery subsequently established in the west suggesting a reproductively isolated stock.</p> |
| Stock status against reference points and trend | <p>Target reference point is 48 per cent of the unfished biomass (pup production is used as a proxy for breeding biomass).</p> <p>Limit reference point is 20 per cent of the unfished biomass (pup production is used as a proxy for breeding biomass).</p> <p>In 2014 SharkRAG noted for the first time that there is quantitative evidence from the trawl CPUE series that school shark is slowly rebuilding. There has been a sustained increase in trawl CPUE since 2003. Bottom longline CPUE data are available from 2012-14 and catch rates from this method also appear to be increasing over time.</p> <p>In 2015 SharkRAG noted there is an overall increasing trend in trawl CPUE and increased pupping in a historically important pupping area (Pittwater, Tasmania). This is consistent with anecdotal evidence and catch reports from industry that school shark abundance is increasing.</p> <p>The stock is currently assessed at below the limit reference point. However the RAG considers that the weight of evidence supports that the stock is rebuilding and not subject to overfishing within the rebuilding time of three generation times.</p> |

| | | |
|---|----------------------------|-------------------------------------|
| ABARES most recent assessment (2015) | Biomass: Overfished | Fishing mortality: Uncertain |
|---|----------------------------|-------------------------------------|

| GVP figures (2013 - 14 fishing season) | GVP | % fishery GVP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|--|----------------------|------|------|------|------|------|------|------|------|------|------|--|--|--|--|--|--|--|--|--|--|----------|----|----|----|----|----|----|----|----|---|----------|----|----|----|----|----|----|----|----|---|----------|----|----|----|----|----|----|----|-----|---|----------|----|----|----|----|----|----|-----|-----|---|--|--|--|--|--|--|--|--|--|--|----------|----|----|----|----|----|----|----|----|---|----------|----|----|----|----|----|----|----|-----|---|----------|----|----|----|----|----|----|-----|-----|---|----------|----|----|----|----|----|----|-----|-----|
| | \$1.8 million | 2.9 per cent | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Recommended Biological Catch 2014-15 | <ul style="list-style-type: none"> • 0 t. No targeted fishing as stock is $< B_{LIM}$ • Commonwealth TAC recommendation is 215 t. The TAC is set at the lowest level to cover unavoidable bycatch whilst still supporting rebuilding of the stock. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Overcatch/undercatch | <ul style="list-style-type: none"> • 0 per cent undercatch • 0 per cent overcatch | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Probability of recommended biological catch (RBC) (or other levels of catch) causing a decline below limit reference under proposed management Species that follow a HS rule that has been MSE tested will have a “very unlikely” score in this section (i.e. $P < 10\%$). | RBC recommendation: N/A as currently assessed at below the limit reference point. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <p>Alternative Catch Scenarios: Table 1. Number of years after 2008 when the school shark stock is predicted to achieve limit (B_{20}, B_{25}) or target reference points (B_{40}, B_{50}) under future catches ranging between 0 and 275t. Results are shown for the assumption that the distribution of fishing effort in the future matches that if either 2011, or 2008.</p> <table border="1"> <thead> <tr> <th></th> <th>0t</th> <th>100t</th> <th>125t</th> <th>150t</th> <th>175t</th> <th>200t</th> <th>225t</th> <th>250t</th> <th>275t</th> </tr> </thead> <tbody> <tr> <td colspan="10"><i>2009 Base Case – 2011 proportions</i></td> </tr> <tr> <td>B_{20}</td> <td>23</td> <td>30</td> <td>32</td> <td>36</td> <td>40</td> <td>47</td> <td>58</td> <td>80</td> <td>-</td> </tr> <tr> <td>B_{25}</td> <td>30</td> <td>38</td> <td>42</td> <td>46</td> <td>51</td> <td>59</td> <td>71</td> <td>95</td> <td>-</td> </tr> <tr> <td>B_{40}</td> <td>45</td> <td>57</td> <td>62</td> <td>67</td> <td>74</td> <td>83</td> <td>97</td> <td>124</td> <td>-</td> </tr> <tr> <td>B_{50}</td> <td>50</td> <td>62</td> <td>67</td> <td>73</td> <td>80</td> <td>89</td> <td>104</td> <td>132</td> <td>-</td> </tr> <tr> <td colspan="10"><i>2009 Base Case – 2008 proportions</i></td> </tr> <tr> <td>B_{20}</td> <td>23</td> <td>30</td> <td>33</td> <td>37</td> <td>42</td> <td>50</td> <td>64</td> <td>99</td> <td>-</td> </tr> <tr> <td>B_{25}</td> <td>30</td> <td>39</td> <td>42</td> <td>47</td> <td>53</td> <td>63</td> <td>78</td> <td>117</td> <td>-</td> </tr> <tr> <td>B_{40}</td> <td>45</td> <td>58</td> <td>63</td> <td>69</td> <td>76</td> <td>87</td> <td>105</td> <td>150</td> <td>-</td> </tr> <tr> <td>B_{50}</td> <td>50</td> <td>63</td> <td>68</td> <td>74</td> <td>82</td> <td>93</td> <td>111</td> <td>159</td> <td>-</td> </tr> </tbody> </table> | | | 0t | 100t | 125t | 150t | 175t | 200t | 225t | 250t | 275t | <i>2009 Base Case – 2011 proportions</i> | | | | | | | | | | B_{20} | 23 | 30 | 32 | 36 | 40 | 47 | 58 | 80 | - | B_{25} | 30 | 38 | 42 | 46 | 51 | 59 | 71 | 95 | - | B_{40} | 45 | 57 | 62 | 67 | 74 | 83 | 97 | 124 | - | B_{50} | 50 | 62 | 67 | 73 | 80 | 89 | 104 | 132 | - | <i>2009 Base Case – 2008 proportions</i> | | | | | | | | | | B_{20} | 23 | 30 | 33 | 37 | 42 | 50 | 64 | 99 | - | B_{25} | 30 | 39 | 42 | 47 | 53 | 63 | 78 | 117 | - | B_{40} | 45 | 58 | 63 | 69 | 76 | 87 | 105 | 150 | - | B_{50} | 50 | 63 | 68 | 74 | 82 | 93 | 111 | 159 |
| | 0t | 100t | 125t | 150t | 175t | 200t | 225t | 250t | 275t | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>2009 Base Case – 2011 proportions</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B_{20} | 23 | 30 | 32 | 36 | 40 | 47 | 58 | 80 | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B_{25} | 30 | 38 | 42 | 46 | 51 | 59 | 71 | 95 | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B_{40} | 45 | 57 | 62 | 67 | 74 | 83 | 97 | 124 | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B_{50} | 50 | 62 | 67 | 73 | 80 | 89 | 104 | 132 | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>2009 Base Case – 2008 proportions</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B_{20} | 23 | 30 | 33 | 37 | 42 | 50 | 64 | 99 | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B_{25} | 30 | 39 | 42 | 47 | 53 | 63 | 78 | 117 | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B_{40} | 45 | 58 | 63 | 69 | 76 | 87 | 105 | 150 | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B_{50} | 50 | 63 | 68 | 74 | 82 | 93 | 111 | 159 | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |



| Assessment Year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|-------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Tier /rollover /MYTAC | Tier 1 | rollover | rollover | rollover | rollover | rollover | rollover |
| Stock Status | <B _{LIM} | <B _{LIM} | <B _{LIM} | <B _{LIM} | <B _{LIM} | <B _{LIM} | <B _{LIM} |
| Fishing season | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016-17 |
| RBC | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Agreed TAC | 216 | 176 | 150 | 215 | 215 | 215 | 215 |
| Actual TAC after overs/unders | 216 | 176 | 150 | 214 | 215 | 215 | |
| % TAC caught | 100 | 92 | 85 | 90 | 94 | TBC | N/A |

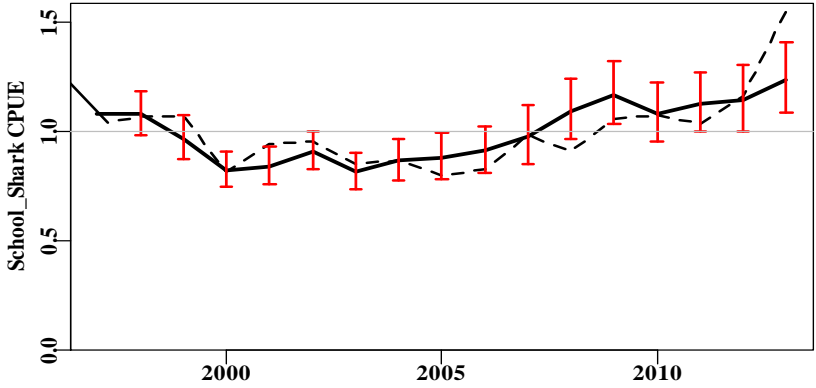
Tier Level & Discounts

| | | |
|--|--|--|
| Tier Level | Tier 1 | |
| Discount factor | 0 per cent | |
| Is a multi-year TAC in place? | <input type="checkbox"/> Yes (in place this season) | <input checked="" type="checkbox"/> No |
| Is a multi-year TAC recommended? (please provide a clear indication on whether the multi-year recommendation is a RBC (e.g. based on Tier 1 model output) or TAC (e.g. a roll-over of catch)) | <input type="checkbox"/> Yes (recommended for future seasons) N/A | <input checked="" type="checkbox"/> No |
| Breakout rules for multi-year TAC | N/A | |
| Have breakout rules been triggered? | N/A | |

Assessment

| | |
|------------------------|--|
| Stock indicator trends | <p>Gillnet CPUE is not considered a reliable index of abundance as school shark are actively avoided by gillnet fishers.</p> <p>In 2015 SharkRAG noted that there are continuing positive signs suggesting that the school shark is rebuilding. This is based on an overall increasing trend in trawl CPUE (since 2003) and increased pupping in an historically important pupping area. This is consistent with catch reports from industry that school shark</p> |
|------------------------|--|



| | |
|----------------------------|---|
| | <p>abundance is increasing.</p> <p>Figure below. School shark trawl CPUE.</p>  <p>Bottom longline CPUE data is available from 2012-15 and catch rates are increasing over this time.</p> <p>A close kin genetics project is in progress to develop alternative and independent measures of abundance for the stock. An absolute estimate of abundance is expected by the end of 2017.</p> |
| <p>RAG comments</p> | <p>Assessments (since 1991) have consistently estimated the school shark population to be below the limit reference point of 20 per cent of unfished levels.</p> <p>SharkRAG recommended school shark catches in 2016/17 be restricted to a level that covers unavoidable bycatch and discards only. SharkRAG considers 215 t to be the best estimate of unavoidable bycatch including discards.. This is based on landed catch from 2011 and ISMP estimates of discards of 9 per cent.</p> <p>SharkRAG noted that there are continuing positive signs suggesting that the school shark is rebuilding. This is based on an overall increasing trend in trawl CPUE and increased pupping in a historically important pupping area. This is consistent with anecdotal evidence and catch reports from industry that school shark abundance is increasing.</p> <p>SharkRAG expressed concern over the potentially high catch of school shark by state fisheries and would like reliable measures of total catch along with information on size frequency. SharkRAG strongly recommended that species specific catches are reported and efforts should be implemented to ensure the state catch of school shark is minimised.</p> <p>SharkRAG noted there were concerns about the total mortality given increasing discards. The RAG supports getting better information on the survivability of released sharks.</p> |

| | |
|--|---|
| Key model technical assumptions/parameters | The assessment model assumes that there is one well mixed stock. |
| Changes to model structure/assumptions | The stocks intrinsic rate of productivity, held fixed at 3.5 per cent since the 2006 stock assessment update, was estimated by the model during 2012, using (but not updating) the 2009 stock assessment model. The new runs of the model showed that a productivity value of 4.4 per cent is more consistent with the available data. |
| Significant changes to data inputs | N/A |
| Comments on data | There are concerns in relation to gillnet CPUE data used in the model due to operators avoiding school shark. As a result, concern remains about the ability of the school shark assessment to reliably estimate the state of the stock. A close kin project is underway and is expected to provide an absolute measure of abundance. |
| Implications for companion species/TEPs/multi-species fisheries | <p>The gillnet fishery interacts with Australian sea lions in waters off South Australia. Interactions are mitigated by using trigger limits that close spatial zones for 18 months if an interaction occurs. Similarly dolphin interactions in waters of the Coorong region in South Australia are managed in this way. The Coorong is currently closed to gillnet fishing to mitigate dolphin interactions.</p> <p>To reduce targeting, gillnet operators are subject to a rule that constrains their catches of school shark to 20 per cent of their gummy shark catches.</p> <p>The RAG recommended that the same 20 per cent rule be applied to all school shark caught by longline inside 183m.</p> |



Tier 1 stock projection

Projected biomass (include confidence intervals)

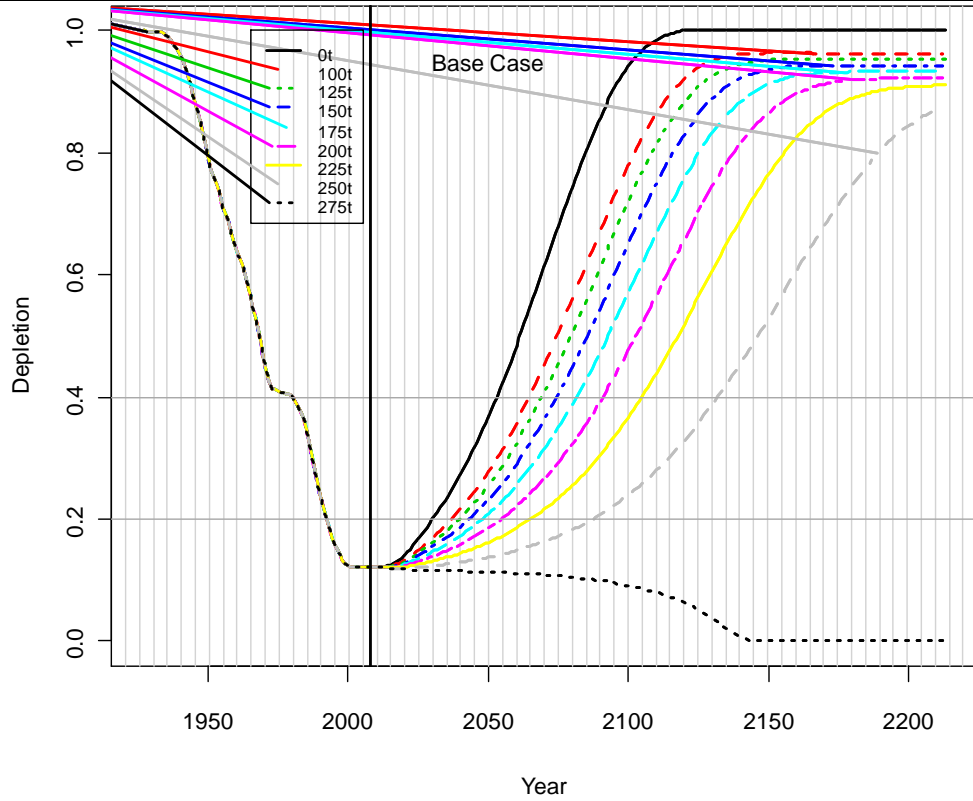


Figure 1. Projected future depletion from 2012 stock assessment re-run (pup production divided by pristine pup production) for the school shark stock for the Tier 1 2009 base case assessment model. Projections are shown for 9 future catch scenarios. Catches between 2008 (marked by a vertical line) and 2011 are the actual catches taken by the fishery.

Research

Research allowance

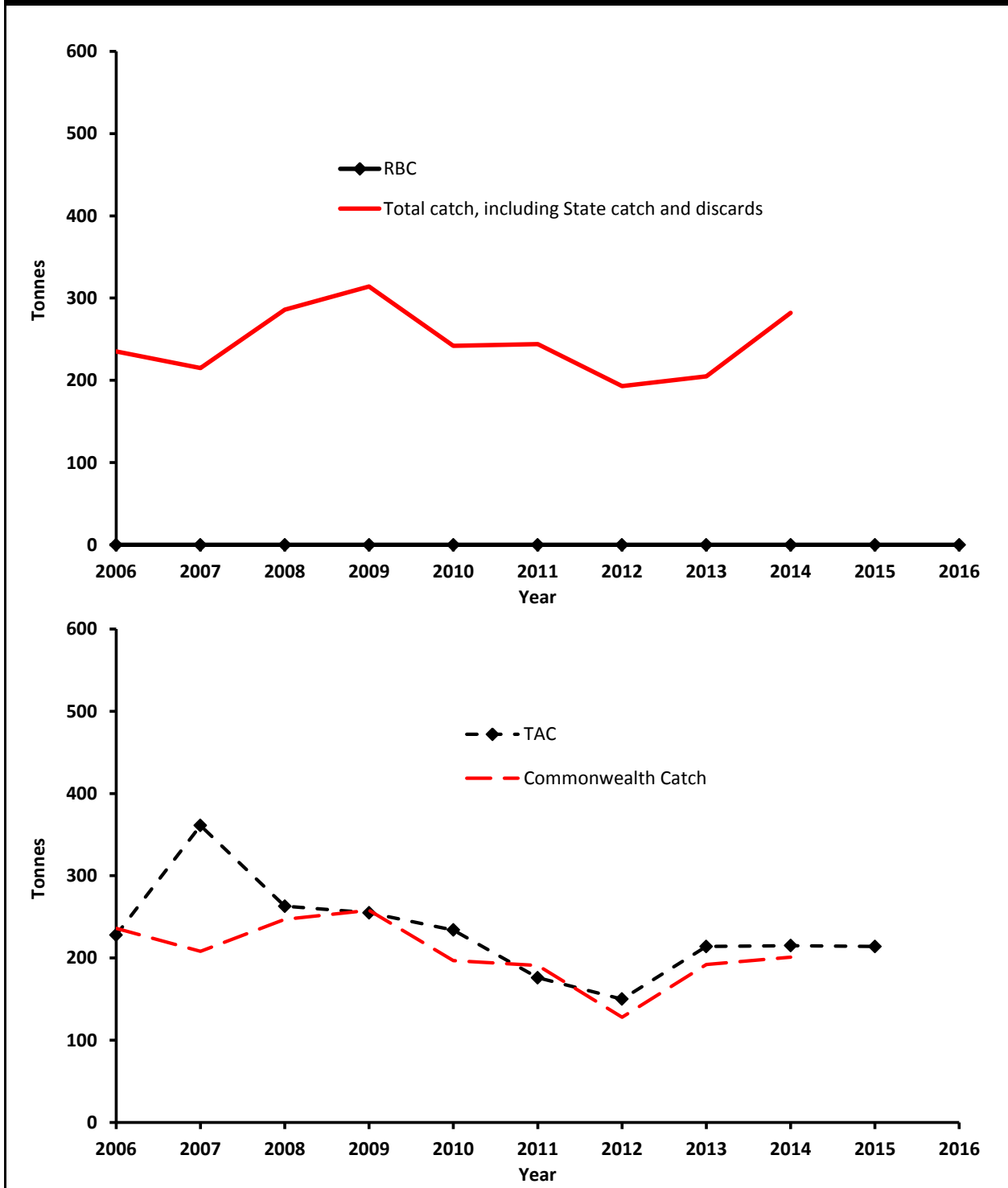
N/A

Included in TAC

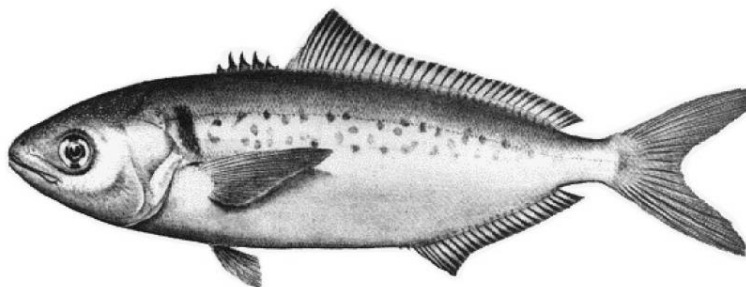
In addition to TAC



Catch trends – School shark
 (RBC and total catch are calendar year; TAC and Commonwealth catch are fishing season)



Silver warehou (*Seriolella punctata*)



ABARES (2012): Line drawing – FAO

Assessed by SlopeRAG in 2015. Species summary updated in 2015.

| Stock status summary | | |
|--|--|--|
| Stock structure | Considered to be a single stock in the SESSF. | |
| Stock status against reference points and trend | <p>Limit Reference is 20 per cent of unfished biomass Target is 48 per cent of unfished biomass</p> <p>Stock status: Following the 2015 assessment, at the start of 2016 the stock was projected to be 40 per cent of the unfished biomass</p> <p>Biomass trend: The biomass trend from the assessment is that the biomass has been increasing for the last 3 years, however the RAG advised that the increase in biomass towards the end of the series should be treated with some caution as this is a result of the model imposed average recruitment from 2013 onwards, when recruitment is unable to be estimated.</p> <p>Standardised CPUE has been on a gradual declining trend since 2005.</p> | |
| ABARES most recent assessment (2015) | Biomass: Not overfished | Fishing mortality: Not subject to overfishing |
| GVP figures (2013 - 14 fishing season) | GVP | % fishery GVP |
| | \$0.9 million | 1.5 per cent |
| Recommended Biological Catch 2016 - 17 | 1958 t | |
| Overcatch/undercatch | 10 per cent undercatch | |
| | 10 per cent overcatch | |

| | |
|--|---|
| <p>Probability of recommended biological catch (RBC) (or other levels of catch) causing a decline below limit reference <u>under proposed management</u> <u>Species that follow a HS rule that has been MSE tested will have a “very unlikely” score in this section (i.e. $P < 10\%$).</u></p> | <p>Alternative Catch Scenarios = Projections based on poor recruitment levels (below average recruitment) indicated that catches up to the RBC would deplete the stock rather than allow rebuilding.</p> |
|--|---|

| Assessment Year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|-------------------------------|---------|--------------|--------------|---------|--------------|--------------|---------|
| Tier /rollover /MYTAC | Tier 1 | MYTAC | MYTAC | Tier 1 | MYTAC | MYTAC | Tier 1 |
| Stock Status | 44% | Not assessed | Not assessed | 47% | Not assessed | Not assessed | 40% |
| Fishing Year | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
| RBC | 2660 | MYTAC | MYTAC | 2544 | MYTAC | MYTAC | 1958 |
| Agreed TAC | 2566 | 2566 | 2541 | 2329 | 2329 | 2417 | |
| Actual TAC after overs/unders | 2829 | 2784 | 2789 | 2579 | 2553 | 2643 | |
| % TAC caught | 44 | 38 | 26 | 23 | 14 | | |

| Tier Level & Discounts | |
|-------------------------------|---|
| Tier Level | Tier 1- for details of Tiers and the Harvest Strategy, see: http://www.afma.gov.au |
| Discount factor | N/A |
| Is a multi-year TAC in place? | <input checked="" type="checkbox"/> Yes (in place this season). 2014-15 will be the third year of a three year MYTAC <input type="checkbox"/> No |



| <p>Is a multi-year TAC recommended? (please provide a clear indication on whether the multi-year recommendation is a RBC (e.g. based on Tier 1 model output) or TAC (e.g. a roll-over of catch))</p> | <p><input checked="" type="checkbox"/> Yes (recommended for future seasons)</p> <p>The RAG recommended a three year MYTAC. Recognising constraints of the large change limiting rule the RAG recommended stepping down to the poor recruitment scenario RBC of 604 in two years.</p> <table border="1" data-bbox="603 524 954 712"> <thead> <tr> <th>Fishing season</th> <th>TAC (t)</th> </tr> </thead> <tbody> <tr> <td>2015/16</td> <td>2417</td> </tr> <tr> <td>2016/17</td> <td>1208</td> </tr> <tr> <td>2017/18</td> <td>604</td> </tr> <tr> <td>2018/19</td> <td>604</td> </tr> </tbody> </table> | Fishing season | TAC (t) | 2015/16 | 2417 | 2016/17 | 1208 | 2017/18 | 604 | 2018/19 | 604 | <p><input type="checkbox"/> No</p> |
|---|--|----------------|---------|---------|------|---------|------|---------|-----|---------|-----|------------------------------------|
| Fishing season | TAC (t) | | | | | | | | | | | |
| 2015/16 | 2417 | | | | | | | | | | | |
| 2016/17 | 1208 | | | | | | | | | | | |
| 2017/18 | 604 | | | | | | | | | | | |
| 2018/19 | 604 | | | | | | | | | | | |
| <p>Breakout rules for multi-year TAC</p> | <p>If the most recent observed value for the standardised CPUE falls outside of the 95 per cent confidence interval of the value for the CPUE predicted by the most recent Tier 1 stock assessment; or If discards exceed 20 per cent of the TAC; or If age composition of the silver warehou stock is significantly different from that predicted by the model; or If the proportion of the TAC caught differs by more than 20 per cent from the average over the last three years.</p> | | | | | | | | | | | |
| <p>Have breakout rules been triggered?</p> | <p>Silver warehou would have broken out in 2014 however as an assessment was scheduled for 2015 no further action was warranted.</p> <p>The RAG explained that the model assumes average recruitment and if recruitment is different from what is assumed the model may not be able to accurately predict biomass. The RAG warned that a new assessment model may still not be capable of predicting below average recruitment and breakouts may continue.</p> | | | | | | | | | | | |

| Assessment | |
|--------------------------------------|--|
| <p>Stock indicator trends</p> | <p>Standardised CPUE has continued to decline and is at historically low levels, but there are no major changes in other indicators (size composition, age composition, area of the fishery, or depth distribution of the catch).</p> <p>Biomass trend: The biomass trend from the assessment is that the biomass has been increasing for the last 3 years, however the RAG advised that the increase in biomass towards the end of the series should be treated with some caution as this is a result of the model imposed average recruitment from 2013 onwards, when recruitment is unable to be estimated.</p> |
| <p>RAG comments</p> | <p>Noting the difference in CPUEs, and a need to capture stock differences between the east and west, SESSFRAG recommended two separate fleets (east and west) be</p> |



considered in the upcoming assessment and that two models be presented to SlopeRAG for consideration i.e. combined fleet and east and west fleet. Recognising that silver warehou is managed under a single TAC SESSFRAG also recommended that SlopeRAG provide a single RBC.

The fit to the last two CPUE data points is poor - the model may be over estimating recruitment and CPUE could be less than predicted leading to a break out again in a relatively short time period.

Additional data will show if the initial signs of a moderate recruitment in 2010 and 2012 are confirmed. Recruitment at the end of the series is very influential and in past assessments has been revised through the inclusion of extra data.

An estimate of the catch for the 2015 calendar year is needed to run the model forward to calculate the 2016 spawning biomass and depletion. Given that recent TACs have been considerably under-caught, the catch in 2015 is assumed to equal that of 2014 (381 t).

The depletion in 2016 under the base-case parameterization is estimated to be 40.5 per cent. An application of the Tier 1 harvest control rule with a target depletion of 48 per cent leads to the 2016 an RBC of 1958t and long term RBC of 2281t.

The RAG has previously noted that there may be a retrospective pattern resulting in upward bias in recent recruitment estimates, and estimates of the spawning biomass kicking up at the end of the projection, despite the fact that the CPUE series continues downwards. The model appears to over-estimate recruitment for the last couple of years, subsequently revising these estimates downwards when additional years of data are added to the assessment.

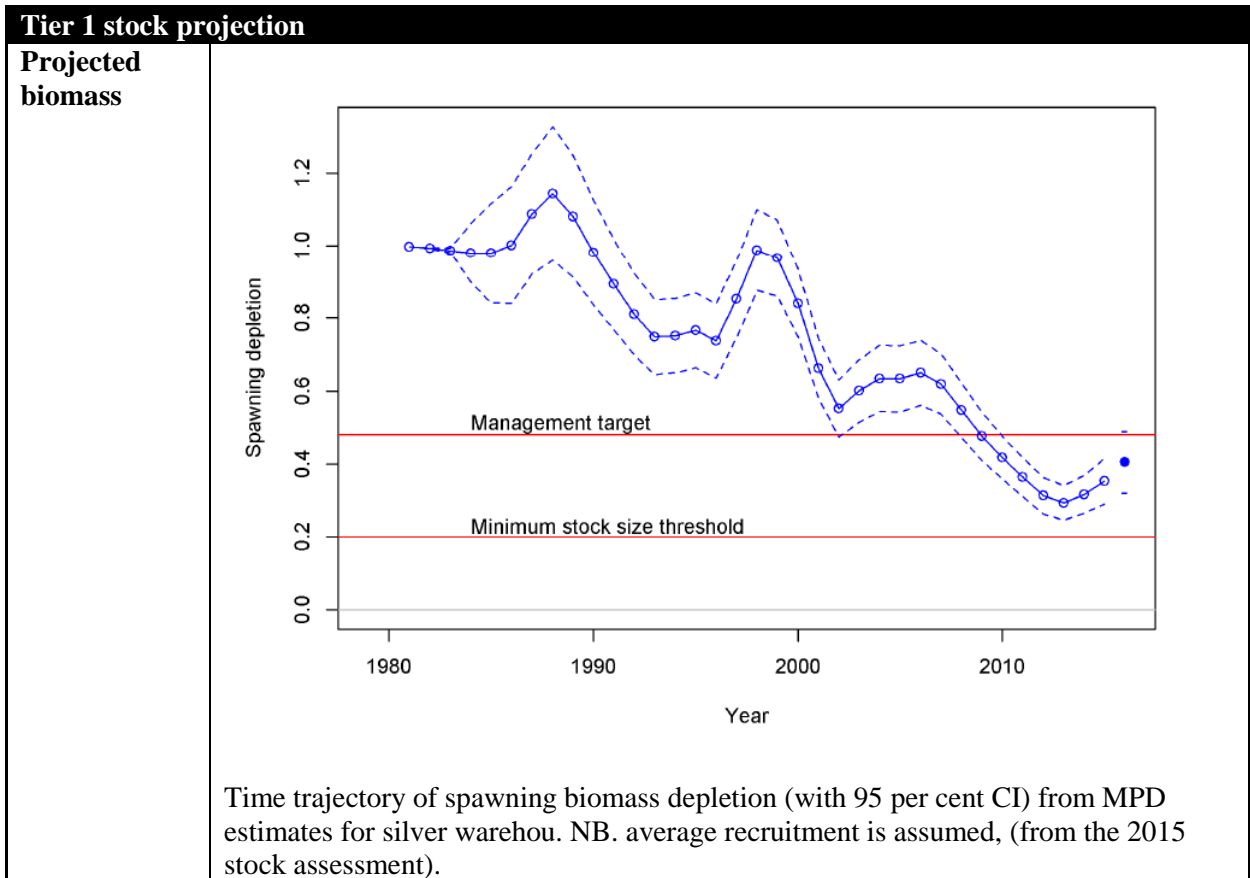
The RAG was concerned that the 2015 model depletion estimate projections are modelled on the assumption of average recruitment however recruitments have been below average for 9 of the last 10 years, Consequently catching the RBC may take stock to a depletion of just over 30 per cent of unfished biomass by 2019. Under poor recruitment, low catches well below the RBC may protect stock and depletion would be around 40 per cent by 2019.

The RAG briefly considered whether the observed decline in recruitment constituted a downward shift in the productivity of the stock. The RAG decided that it has had no discussions exploring if there are any reasons to substantiate a productivity shift and it would want some additional direct

| | |
|--|--|
| | <p>evidence in addition to the indirect evidence of recent lower estimated recruitment to indicate such a shift. The RAG therefore agreed that reference points should remain unchanged.</p> <p>The RAG recommended a three year MYTAC, see table above.</p> |
| <p>Key model technical assumptions/parameters</p> | <p>Stock Synthesis 3 software used for this Tier 1 assessment</p> <p>Single sex and single fleet are used in the assessment</p> <p>Single stock within the area of the fishery</p> <p>Unfished biomass with corresponding age structure is assumed to be at the start of 1979</p> <p>M is assumed to be constant with age and time-invariant. Base case value for M is 0.30 yr⁻¹</p> <p>Beverton-Holt type recruitment is assumed with a steepness of 0.75</p> <p>Growth is assumed to be time invariant</p> <p>Recruitment is estimated from 1980 to 2007</p> |
| <p>Changes to model structure/assumptions</p> | <p>The model software was updated from SS-V3.24f to SS-V3.24U.</p> <p>The following structural modifications were made to the 2012 model:</p> <ul style="list-style-type: none"> • discarding is now included: discards are estimated within the model and discard length frequencies are included in the model • an additional two years of recruitment are estimated as well as the three extra years due to new data (recruitment is now estimated to 2012 c.f. 2007) • a single trawl fleet split into east and west • length frequency is split into onboard and port components • length frequency is now initially weighted by shots/trips • Fishery Independent Survey abundance indices included • new tuning procedure (based on Francis 2011). |



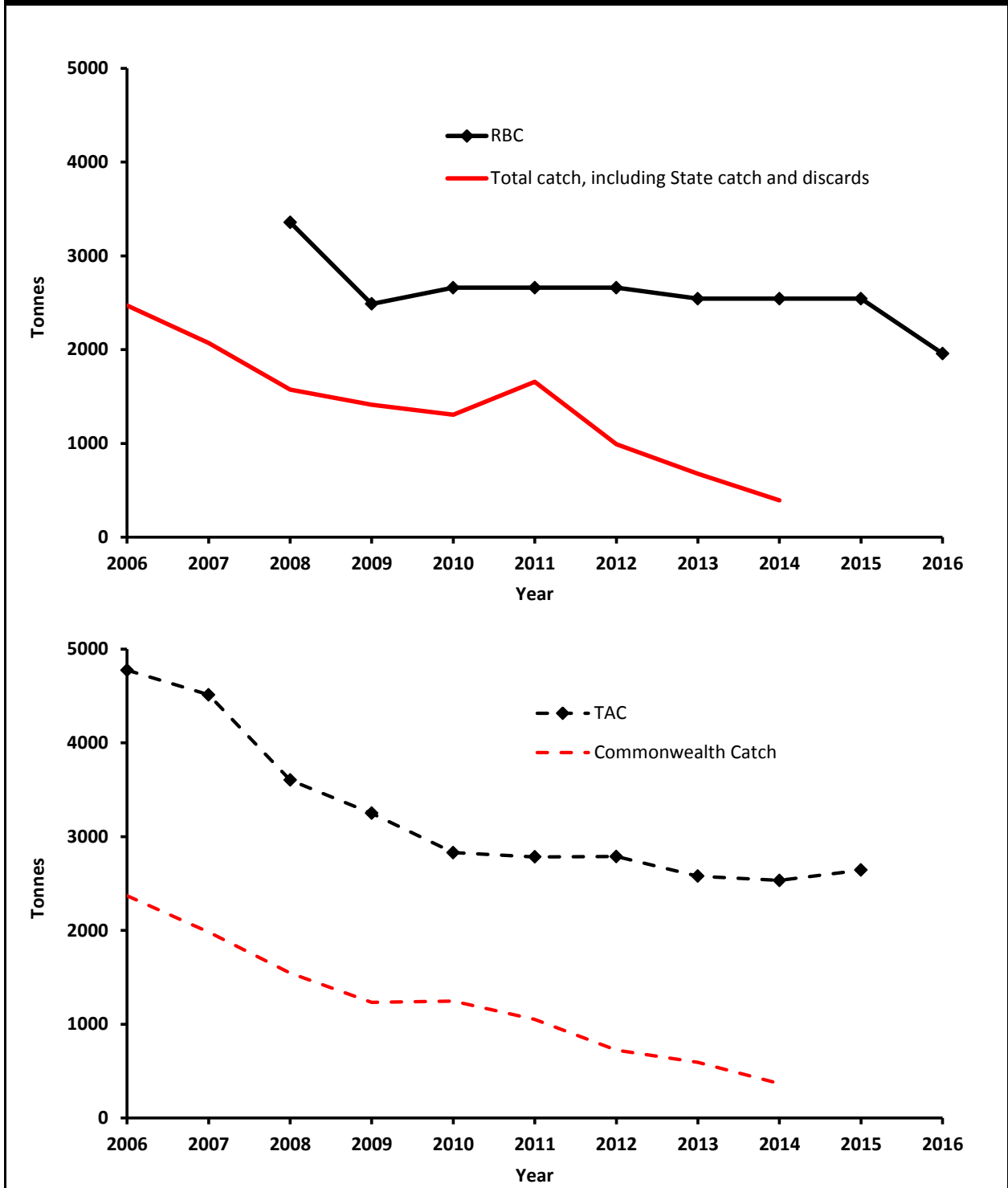
| | |
|--|--|
| Significant changes to data inputs | 3 years of new data were added: catch; CPUE; length and age data to 2014 the ageing error matrix was updated. |
| Comments on data | N/A |
| Implications for companion species/TEPs/multi-species fisheries | Nil |



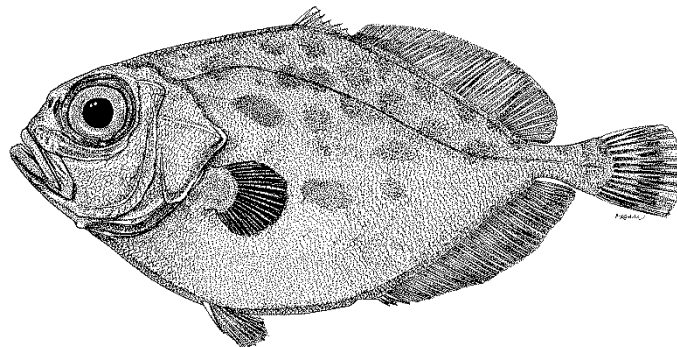
| Research | | |
|---------------------------|--|---|
| Research allowance | 0 t | |
| | <input type="checkbox"/> Included in TAC | <input type="checkbox"/> In addition to TAC |



Catch trends – Silver warehou
 (RBC and total catch are calendar year; TAC and Commonwealth catch are fishing season)



Smooth oreodory (*Pseudocyttus maculatus*) – Non-Cascade Plateau



Assessed by SlopeRAG in 2015. Species summary updated in 2015.

| Stock status summary | | |
|--|---|---|
| Stock structure | Little is known about the stock structure of smooth oreodory. For assessment and management purposes they are treated as a single unit of stock through the SESSF excluding the Cascade Plateau and South Tasman Rise. | |
| Stock status against reference points and trend | <p>Smooth oreodory were assessed using a Tier 5 depletion based stock reduction analysis (DBSRA) for the first time in 2015.</p> <p>DBSRA is used to search for the level of yield (RBC) that would lead to a yield equivalent to a target depletion of 48 per cent of unfished biomass while maintaining the probability of the spawning biomass remaining above 20 per cent of unfished biomass above 0.9.</p> <p>Biomass trend: When last assessed, the CPUE was variable but with a slight positive trend. Low catch and effort levels since 2009 have precluded any updates.</p> | |
| ABARES most recent assessment (2015) | Biomass: Not overfished | Fishing mortality: Not subject to overfishing |
| GVP figures (2013 - 14 fishing season) | GVP | % fishery GVP |
| | <\$0.1 million | <0.2 per cent |
| Recommended Biological Catch 2016/17 | <p>N/A.</p> <p>MYTAC – The RAG recommended a MYTAC of 90 t</p> | |
| Overcatch/undercatch | 10 per cent undercatch | |
| | 10 per cent overcatch | |

| | |
|---|--|
| Probability of recommended biological catch (RBC) (or other levels of catch) causing a decline below limit reference <u>under proposed management</u> <u>Species that follow a HS rule that has been MSE tested will have a “very unlikely” score in this section (i.e. $P < 10\%$).</u> | RBC recommendation = < 10 percent |
| | Alternative Catch Scenarios = N/A |

| Assessment Year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|--------------------------------------|-------------------------|-------------------------|----------------|----------------|----------------|----------------|----------------|
| Tier /rollover /MYTAC | Tier 4 | Tier 4 | Not assessed | Not assessed | Not assessed | Not assessed | Tier 5 |
| Stock Status | CPUE higher than target | CPUE higher than target | Not assessed | Not assessed | Not assessed | Not assessed | N/A* |
| Fishing Year | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
| RBC | 106 | 50 | Not assessed | Not assessed | Not assessed | Not assessed | 90 |
| Agreed TAC | 45 | 45 | 23 | 23 | 23 | 23 | |
| Actual TAC after overs/unders | 48 | 49 | 27 | 24 | 25 | 25 | |
| % TAC caught | 0 | 3 | 3 | 0 | 3 | | |

*Tier 5 assessment does not estimate stock status.

| Tier Level & Discounts | |
|--|---|
| Tier Level | Tier 5 |
| Discount factor | 0 per cent. The discount factor was not applied due to this method of calculating the RBC is extremely conservative and in combination with large trawl closures provides sufficient protection to the smooth oreodory stock. The RAG recommended that a discount factor is not applied. NB There is no specific Tier 5 discount factor in the SESSF HSF. |
| Is a multi-year TAC in place? | <input type="checkbox"/> Yes (in place this season) <input checked="" type="checkbox"/> No |
| Is a multi-year TAC recommended? (please provide a clear indication on whether the multi-year | <input checked="" type="checkbox"/> Yes (recommended for future seasons) 3 year MYTAC of 90 t. <input type="checkbox"/> No |



| | | |
|---|----|--|
| recommendation is a RBC (e.g. based on Tier 1 model output) or TAC (e.g. a roll-over of catch) | | |
| Breakout rules for multi-year TAC | No | |
| Have breakout rules been triggered? | No | |

| Assessment | |
|---|---|
| Stock indicator trends | Unknown due to low effort and catches |
| RAG comments | <p>Smooth oreodory are an aggregating bycatch species taken when fishing for orange roughy and the catch rate may not be a reliable index of abundance..</p> <p>Smooth oreodory are spatially structured and the model assumes some homogeneity that may not be a reliable estimation of stock distribution.</p> <p>The RAG agreed that a target depletion of 48 per cent of B_0 is needed to be consistent with the SESSF Harvest Strategy Framework.</p> <p>The RBC is extremely conservative as 90 per cent of the smooth oreodory catch was taken from waters that are now closed.</p> <p>The previous TAC of 23 t was arbitrary and was set when the deepwater area of the fishery was closed to protect orange roughy. The RAG noted that under the large change limiting rule the maximum the TAC could be is 34.5 t. The RAG agreed that there are no sustainability issues in not applying the large change limiting rule in this instance.</p> |
| Key model technical assumptions/parameters | <p>The requirements for DBSRA are:</p> <ul style="list-style-type: none"> • catch time series; ideally from the start of the fishery • a simple model of the dynamics of the fishery. <p>Plausible values are also required for:</p> <ul style="list-style-type: none"> • the natural Mortality Rate: M, <i>model input 0.05</i> • the ratio of FMSY to the Natural Mortality: $FMSY/M$, <i>model input 0.8</i> • the most productive stock depletion level: $BMSY/B_0$, <i>model input 0.4</i> • the age at maturity: <i>model input 15</i> • the final depletion level, <i>model input 0.48</i> |
| Changes to model structure/assumptions | Tier 5 (DBSRA) used to assess this species superseding the |



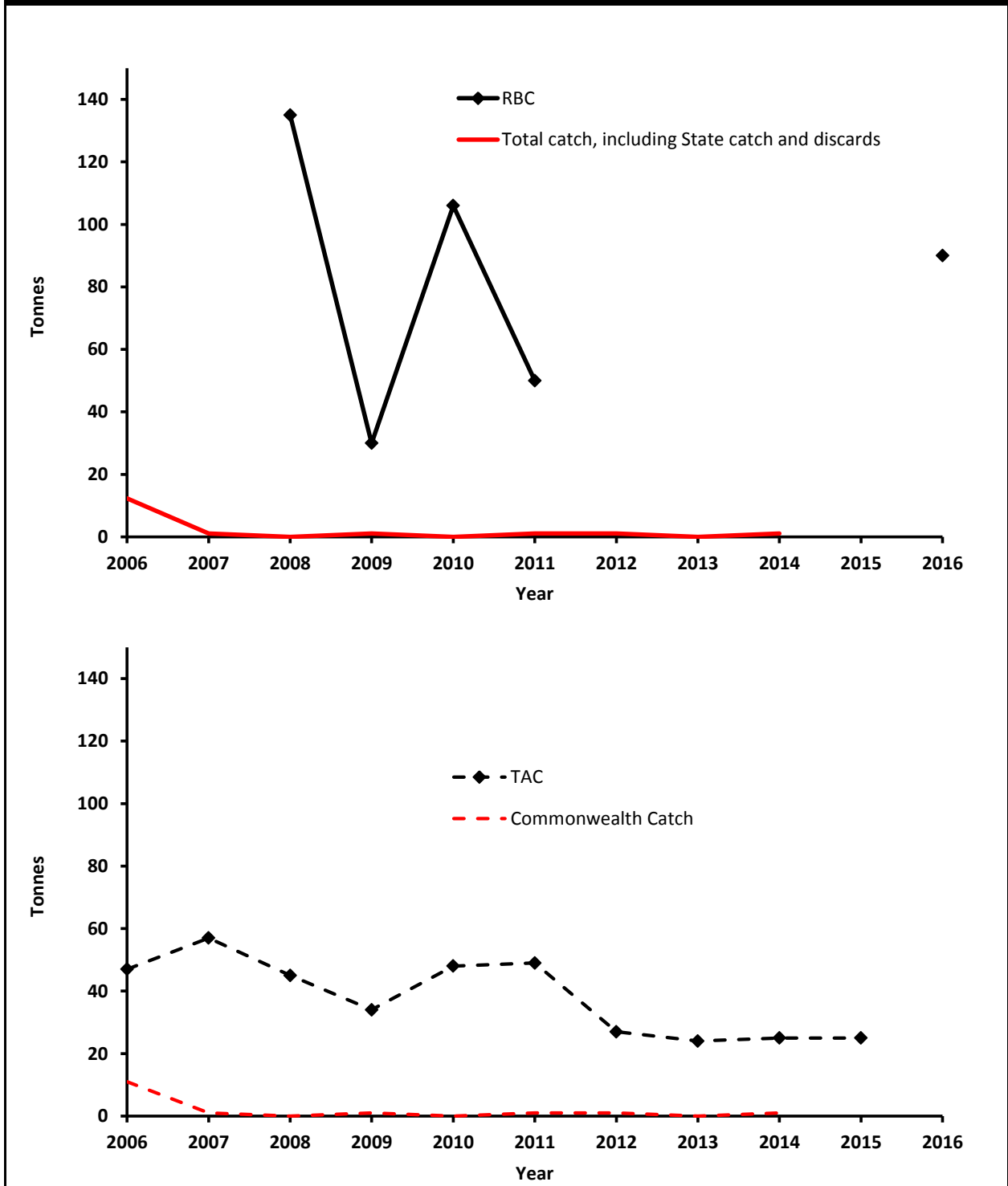
| | |
|--|---|
| | previous Tier 4 assessment. |
| Significant changes to data inputs | N/A |
| Comments on data | There is only a short time series of data when these fish were caught in any quantity. |
| Implications for companion species/TEPs/multi-species fisheries | Smooth oreodory is a bycatch when targeting orange roughly. The previous TAC of 23 t constrained catches of orange roughly in the Pedra Branca area of the southern orange roughly zone. An increase in TAC should reduce/remove this constraint. |

| Tier 4 CPUE series (2010) | |
|----------------------------------|---|
| Standardized Catch Rates | Smooth oreodory is an aggregating species and CPUE is not a reliable abundance index for aggregating species DBSRA does not use catch rates in the assessment. |

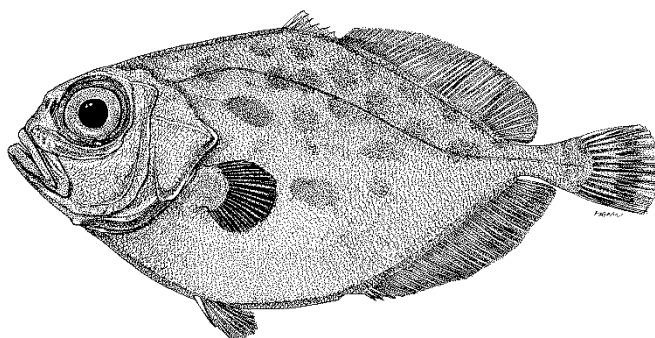
| Research | | |
|---------------------------|--|---|
| Research allowance | 0 t | |
| | <input type="checkbox"/> Included in TAC | <input type="checkbox"/> In addition to TAC |



**Catch trends – Smooth oreodory – non-Cascade
(RBC and total catch are calendar year; TAC and Commonwealth catch are fishing season)**



Smooth oreodory – Cascade Plateau (*Pseudocyttus maculatus*)



Assessed by SlopeRAG in 2009, reviewed in 2015.

| Stock status summary | | | | | | | | | | |
|--|--|--|--|-------------|---------------|--------|--------------|--------|---------------|--------|
| Stock structure | Stock structure of Smooth oreodory is unknown. For assessment and management purposes the Cascade Plateau is regarded as a separate stock. | | | | | | | | | |
| Stock status against reference points and trend | <p>Tier 4 species use CPUE targets as a proxy of biomass targets.</p> <p>The Tier 4 target reference point is the level of CPUE assumed to produce a spawning biomass of 48 per cent of unfished levels.</p> <p>The limit reference point is the level of CPUE assumed to produce a spawning biomass of 20 per cent of unfished levels.</p> <p>Stock status: The most recent assessment (a Tier 4 assessment in 2010 using data up to 2009) concluded that the CPUE-based biomass proxy was above the target reference point. Low catch and effort levels since 2009 have precluded any updates to the Tier 4 assessment.</p> <table border="1" data-bbox="730 1509 1299 1664"> <thead> <tr> <th></th> <th>CPUE</th> </tr> </thead> <tbody> <tr> <td>Target</td> <td>0.4989</td> </tr> <tr> <td>Limit</td> <td>0.1996</td> </tr> <tr> <td>Recent</td> <td>1.3575</td> </tr> </tbody> </table> <p>Biomass trend: When last assessed, CPUE had been extremely variable and the fluctuations were considered to be not indicative of changes in stock status.</p> | | | CPUE | Target | 0.4989 | Limit | 0.1996 | Recent | 1.3575 |
| | CPUE | | | | | | | | | |
| Target | 0.4989 | | | | | | | | | |
| Limit | 0.1996 | | | | | | | | | |
| Recent | 1.3575 | | | | | | | | | |
| ABARES most recent assessment (2015) | Biomass: Not overfished | Fishing mortality: Not subject to overfishing | | | | | | | | |
| GVP figures (2013 - 14 fishing season) | GVP | % fishery GVP | | | | | | | | |
| | N/A | N/A | | | | | | | | |



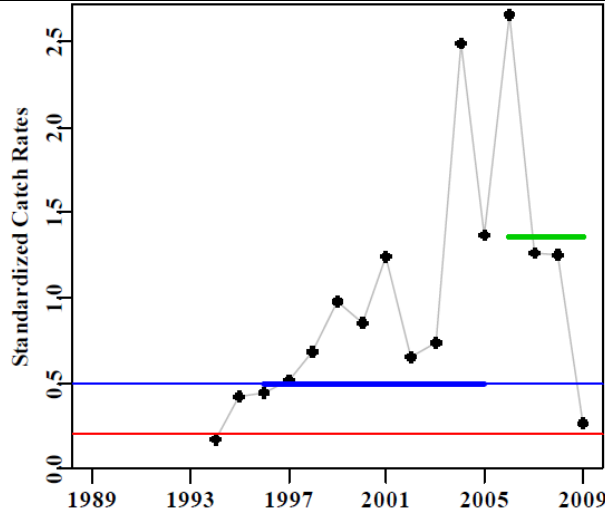
| | |
|---|---|
| Recommended Biological Catch 2014-15 | Catches of Smooth Oreos are now so low on the Cascade Plateau that the catch rate and Tier 4 analyses are unlikely to be valid. |
| Overcatch/undercatch | 10 per cent undercatch 10 per cent overcatch |
| Probability of recommended biological catch (RBC) (or other levels of catch) causing a decline below limit reference <u>under proposed management</u> <u>Species that follow a HS rule that has been MSE tested will have a “very unlikely” score in this section (i.e. $P < 10\%$).</u> | RBC recommendation = See above. MYTAC 150 t |
| | Alternative Catch Scenarios = N/A |

| Assessment Year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|--------------------------------------|-------------------------|-------------------------|----------------|----------------|----------------|----------------|----------------|
| Tier /rollover /MYTAC | Tier 4 | Tier 4 | Not assessed | Not assessed | Not assessed | Not assessed | Not assessed |
| Stock Status | CPUE higher than target | CPUE higher than target | Not assessed | Not assessed | Not assessed | Not assessed | Not assessed |
| Fishing Year | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
| RBC | 247 | 771 | Not estimated | Not estimated | Not estimated | Not estimated | Not estimated |
| Agreed TAC | 150 | 150 | 150 | 150 | 150 | 150 | 150 |
| Actual TAC after overs/unders | 160 | 165 | 165 | 165 | 161 | 165 | |
| % TAC caught | 2 | 0 | 0 | 0 | 0 | | |



Tier 4 CPUE series (2010)

**Standardize
d Catch
Rates**



Smooth Oreo (Cascade) standardized catch rates from the most recent Tier 4 assessment completed (2010) with the upper fine line representing the target catch rate and the lower line the limit catch rate. Thickened lines represents the reference period for catches, catch rates, and the recent average catch rate

Research

Research allowance

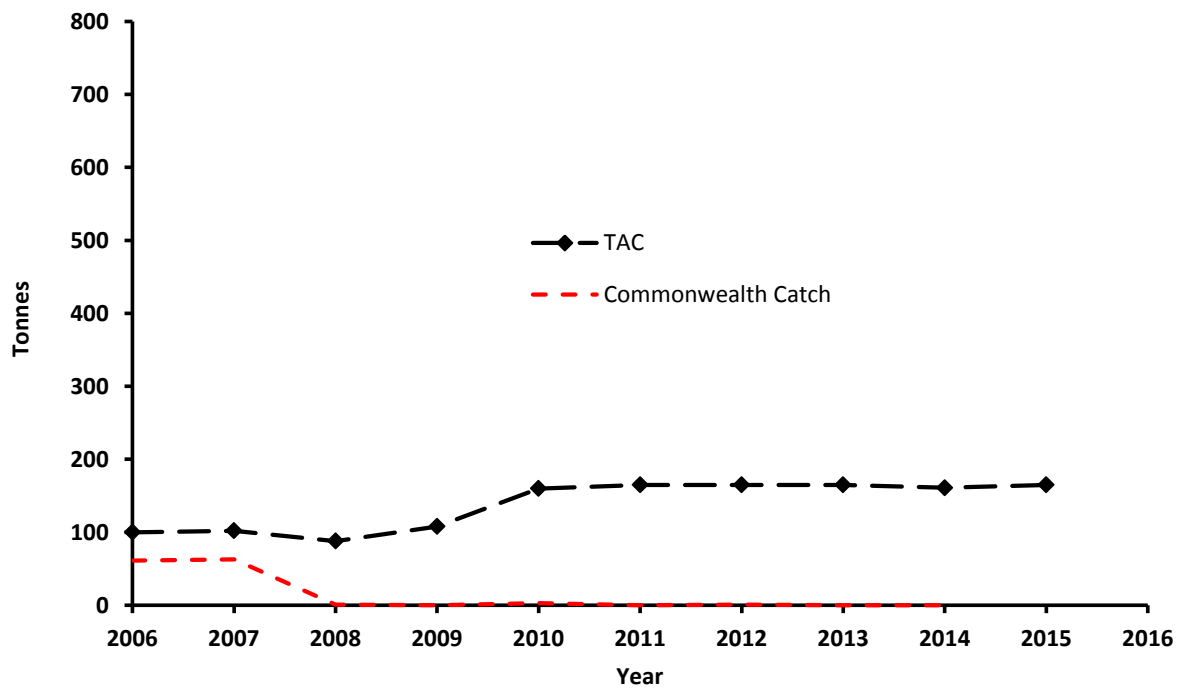
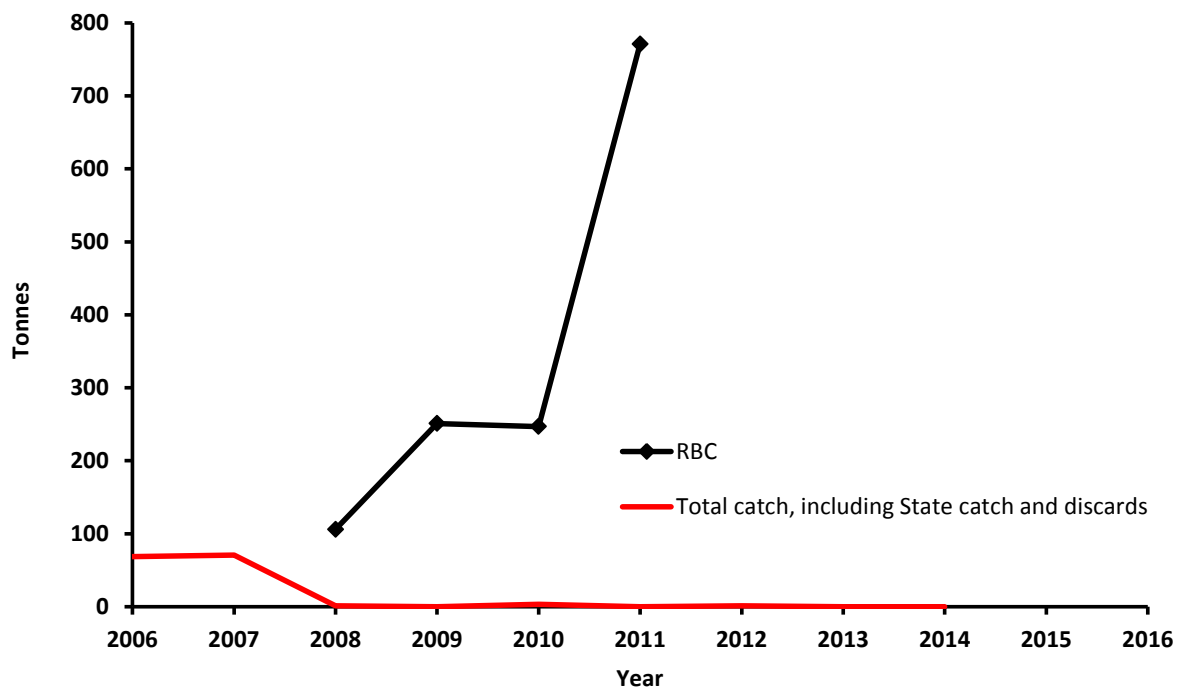
0 t

Included in TAC

In addition to TAC



Catch trends – Smooth oreodory - Cascade
 (RBC and total catch are calendar year; TAC and Commonwealth catch are fishing season)



Glossary

Biological reference points – quantitative values, often stated in terms of fishing mortality or stock size, that summarise either a desired state for the stock (a target) or a state of the stock that should be avoided (a threshold).

Biomass – the total weight of all the fish in a stock or a component of a stock.

B_{LIM} (biomass limit reference point) – the point beyond which the risk to the stock is regarded as unacceptably high.

B_{MEY} (biomass at maximum economic yield) – average biomass corresponding to maximum economic yield.

B_{MSY} (biomass at maximum sustainable yield) – average biomass corresponding to maximum sustainable yield.

B_{TARG} (target biomass) – the desired biomass of the stock.

B_0 (mean equilibrium unfished biomass) – average biomass level if fishing had not occurred.

Catch-per-unit effort (CPUE) – the number or biomass of fish caught as by a unit of fishing effort. Often used as a measure of fish abundance.

C_{TARG} (Catch target) – the target catch level.

CE_{LIM} (CPUE limit reference point) – the point below which CPUE is too low and can indicate stock depletion.

CE_{TARG} (CPUE target) – the target CPUE rate.

Confidence interval – also called the confidence bound, a range of values within which the true value most likely lies.

F (fishing mortality) – the instantaneous rate of fish deaths due to fishing a designated component of the fish stock.

F_{LIM} (fishing mortality limit reference point) – the point above which the removal rate from the stock is too high.

F_{MEY} (fishing mortality at maximum economic yield) – the fishing mortality rate that corresponds to maximum economic yield.

F_{MSY} (fishing mortality maximum sustainable yield) – the fishing mortality rate that achieves maximum sustainable yield.

F_{TARG} (fishing mortality target) – the target fishing mortality target rate.

Index of abundance – numerical value used to demonstrate the trend in relative abundance over time.

Markov Chain Monte Carlo (MCMC) – an approach to estimate uncertainty in a statistical model by beginning with a final model and shifting its associated parameter values slightly to recalculate the model's goodness of fit thousands or millions of times.

Maximum economic yield (MEY) – the sustainable catch level for a commercial fishery that allows net economic returns to be maximised. For most practical discount rates and fishing costs, MEY implies that the equilibrium stock of fish is larger than that associated with maximum sustainable yield (MSY). In this sense, MEY is more environmentally conservative than MSY and should, in principle, help protect the fishery from unfavourable environmental impacts that could diminish the fish population.



Maximum sustainable yield (MSY) – the maximum average annual catch that can be removed from a stock over an indefinite period under prevailing environmental conditions.

Mortality – deaths from all causes (usually expressed as a rate or as the proportion of the stock dying each year).

Overfished – a fish stock with a biomass below the biomass limit reference point. ‘Not overfished’ implies that the stock is not below the threshold.

Overfishing, subject to – a stock that is experiencing too much fishing, and the removal rate from the stock is unsustainable. Also:

- Fishing mortality (F) exceeds the limit reference point (F_{LIM}). When stock levels are at or above B_{MSY} , F_{MSY} will be the default level for F_{LIM} .
- Fishing mortality in excess of F_{LIM} will not be defined as overfishing if a formal ‘fish down’ or similar strategy is in place for a stock and the stock remains above the target level (B_{TARG}).
- When the stock is less than B_{MSY} but greater than B_{LIM} , F_{LIM} will decrease in proportion to the level of biomass relative to B_{MSY} .
- At these stock levels, fishing mortality in excess of the target reference point (F_{TARG}) but less than F_{LIM} may also be defined as overfishing, depending on the harvest strategy in place and/or recent trends in biomass levels.
- Any fishing mortality will be defined as overfishing if the stock level is below B_{LIM} , unless fishing mortality is below the level that will allow the stock to recover within a period of 10 years plus one mean generation or three times the mean generation time, whichever is less.

Spawning stock biomass (SB) – the total weight of all adult (reproductively mature) individuals in a population. Also called spawning biomass.

SB_{MSY} – Spawning or ‘adult’ equilibrium biomass at maximum sustainable yield.

Stock assessment – an evaluation of the past, present and future status of the stock that includes a range of life history characteristics for a species, such as the geographical boundaries of the population and the stock; information on age, growth, natural mortality, sexual maturity and reproduction, feeding habits and habitat preferences; and the fisheries pressures affecting the species.



Guide to completing species assessment forms

This template is prepared to present RAG considerations to inform the AFMA Commission in setting Total Allowable Catches.

Who should complete this form?

RAGs should work together to complete this form as a group. One form should be completed for each species or basket quota species.

How to complete this form

Instructions on what to include in each section are provided in the form itself. Greater clarification has been provided for particular items and can be accessed by following the endnotes provided. RAGs should delete the endnotes in the form prior to submitting it to the Commission.

Briefly summarise the current assumptions regarding stock structure and distribution.

¹ Report the most likely stock status against reference points using the base case for the assessment. Trend should be in terms of stock size and fishing intensity.

¹ Provide assessments of biomass and fishing mortality using the most recent Fishery Status Reports by the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES). Complete this section by:

1. using the dropdown lists to select an assessment option
2. insert status with cell colour. Note if species is under a rebuilding strategy.

¹ Taken from most recent ABARES report.

¹ Potentially useful indicators might include:

- change in distribution of catch or effort by method
- non standardised CPUE
- standardised CPUE
- size, age composition and recruitment (if available)

Write 'N/A' if not required.

¹ Use dot points to list the main data inputs for the assessment. In particular, note any *significant* changes to the inputs. For example, simple updates to catch and effort do not need to be noted.

¹ Include main data outputs (eg model calculated discards or productivity) and any data not used.

¹ Provide any RAG recommendations on companion or other species that will be affected, or will influence, the ability of a TAC to meet an RBC for this species.

¹ This section can only be completed for Tier 1 species as stock projections are not completed for Tier 3 and Tier 4 species. Delete this section if not required.

¹ This section should be used to report any available information on likely future trends in biomass or related variables under the current (or a range of) catch levels over a period of approximately 3-5 years following the year of the last assessment.



¹ Research allowance is allocated when there is a specific research proposal available for the RAG to consider. In most cases the Research Allowance will come off the RBC during TAC calculations. Write '0' if a research allowance has not been allocated.

¹ THIS CHART SHOULD ALLOW READERS OF THE SPECIES SUMMARY TO RAPIDLY SEE CATCHES, RBC AND TAC OVER THE RECENT PAST (5-10 YEARS).

