

2009 Stock Assessment Report for SESSF species assessed by SlopeRAG

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Introduction

General Approach

The Harvest Strategy Framework for the SESSF that is the basis for calculations of RBCs was largely unchanged in 2009. There is a target reference point of 48% of unfished spawning biomass or B_{48} as the default proxy for B_{MEY} that applies for the calculation of RBCs for Tier 1 species. For this harvest control rule the inflection point in the control rule, between the limit of B_{20} and the target of B_{48} , has been set at 35% of unfished biomass. Previous modifications made to the Tier 3 and Tier 4 rules to overcome some problems with them and make them more consistent with Tier 1 were applied again in 2009. The changes to the Harvest Strategy Framework have now largely been tested by management strategy evaluation and the current framework has been shown to be consistent with, and meeting the requirements of, the Commonwealth Harvest Strategy Policy (Wayte 2009).

The target reference point of 48% of unfished spawning biomass is the default economic target reference point for B_{MEY} . As before, SlopeRAG did not feel able to provide meaningful comment on the appropriateness of this as a target for any of the species it has considered. This is due to a combination of a lack of economic information available to it and a lack of economic expertise within the group. Previously, concern had been expressed about the ability to determine appropriate economic targets for individual species in a multi-species and multi-method fishery, and about the likelihood that any estimate of B_{MEY} would be very sensitive to inter-annual or within season changes in such things as market prices or fuel prices.

Estimates of total catches and discards used in assessments are detailed in Klaer (2009a). Standardised catch rates used in all assessments are detailed in Haddon (2009a) and figures from this report are used in the species summaries presented here.

Tier 1 Harvest Control Rule

Wherever possible, quantitative assessments for Tier 1 species have been implemented using the Stock Synthesis version 3 (SS3) package. The use of SS3 (or its predecessor SS2) for assessments in the SESSF is becoming the standard. The advantages of using this package include

- It is well-tested and flexible
- Provides a uniform approach to stock assessment for all SEF species
- Standard outputs will allow RAG members to more easily understand assessments
- Calculation of RBCs is incorporated into the software
- A standard approach allows stock assessment scientists to more easily understand (and therefore assist with or review) other assessments
- Excellent output software allows rapid model testing and development.

No species assessed by SlopeRAG were upgraded to Tier 1 from other tier levels in 2009, but there have been continued efforts on developing a Tier 1 assessment for western gemfish by BRS, and work was initiated on a Tier 1 assessment for mirror dory. The assessments for pink ling and silver warehou were moved from SS2 to SS3 in 2009. The assessment model for blue grenadier model is still in the process of being moved to Stock Synthesis. An updated assessment was not required for blue grenadier this year because of AFMA's decision to set a multi-year TAC for this species.

The default target reference point for the Tier 1 Harvest Control Rule for 2009 has again been set at B_{48} (the spawning biomass equal to 48% of unfished levels), the default proxy for B_{MEY} as specified in the Commonwealth Harvest Strategy Policy. The default limit reference point has also remained at B_{20} . The target level of fishing mortality is therefore F_{48} , the level that would lead to a spawning biomass of B_{48} if applied over the long term.

The break-point in the trajectory of fishing mortality between the limit and target was set at B_{35} last year based on an analysis for a range of SESSF species. Below this level of biomass, the level of fishing mortality will be set according to the old 20:40:40 rule. At biomasses above this level, but below the target, fishing mortality will be set at F_{48} .

Tier 3 Harvest Control Rule

The revised and improved version of the Tier 3 HCR that was developed, tested and adopted last year was applied again in 2009. The new rule overcomes problems with the previous rule by extending the period used for calculating recent catches and matching it with the years over which mortality is calculated, by incorporating a selectivity function into the calculations, and by incorporating targets

and limits into a new control rule that are more consistent with those used for Tier 1. The results for the Tier 3 analyses are provided in Klaer 2009b.

A decision is needed on whether a cap on the RBC for Tier 3 species should be introduced similar to that applied under the Tier 4 HCR.

Tier 4 Harvest Control Rule

The revised and improved version of the Tier 4 HCR that was developed, tested and adopted last year was applied again in 2009. The new rule overcomes problems with the previous rule by incorporating targets and limits into a new control rule to make it more consistent with those used for Tier 1. Results for Tier 4 analyses are provided in Haddon (2009b) and tables and figures from this report have been used in these species summaries.

Meta-Rules

In addition to the above harvest control rules, two of the three meta-rules introduced last year are to be applied again this year, according to the agreed TAC setting process.

The meta-rule that will not be applied this year is the one introduced in 2008 to reduce the impact of the new Tier 3 and Tier 4 harvest control rules by limiting the change due to the new rules to a maximum of 25% of the TAC.

The second meta-rule was proposed to deal with the lag in the assessment cycle. A rule was developed that allowed adjustment of the TAC upward or downward depending on whether recent standardised CPUE levels were above or below previous values. After trialling this rule for selected species last year it was agreed that it will now be applied to all species.

The third meta-rule was proposed to explicitly introduce more precaution in TAC setting under the Tier 3 and Tier 4 harvest control rules. It was proposed that RBCs be discounted by 5% for Tier 3 species and 15% for Tier 4 species. These discounts are the default ones that are to be applied, but the RAGs were requested to examine the need for their application on a species by species basis.

Previously agreed rules regarding the deductions of catches in other jurisdictions and discards, and limiting changes in TACs to between 10% and 50% were again agreed to be implemented.

The exception to this occurred for western gemfish for which there were catches also taken in the GAB trawl fishery. Last year if the expected catch in the GAB had been deducted from the RBC it would have produced a zero RBC for the other areas of the SESSF. It is assumed that there is a single stock that is shared between the GAB trawl fishery and other fleets in the SESSF but nevertheless, the RAG again agreed that the application of this rule was not a sensible outcome and recommended that expected GAB catches not be subtracted off the RBCs when calculating the TAC.

AFMA will apply the above meta-rules to the RBC in developing their TAC advice to the MAC and Commission. The RAG has provided advice on whether there was justification for not applying discount factors to the Tier 3 and Tier 4 analyses. The RAG has also provided on whether the carryover of undercatch/overcatch was appropriate for each species.

2009 Stock Assessment Report for Blue eye trevalla *Hyperoglyphe antarctica*

RAG undertaking the assessment: SlopeRAG

Stock structure:

A single stock is assumed as there is no strong evidence of structuring within SESSF. Recent genetic studies found no evidence of structuring within the area of the SESSF. Otolith microchemistry (including both elemental and stable isotope analyses) has suggested some stock structuring, principally between the East Coast Deepwater and New Zealand regions (which appeared to form one group) and the rest of Australia's SESSF, and further suggested that areas off NSW could be an important site for mixing.

Biological indicators

Biological productivity: Low

Trophic level: 2?

Associated species: blue grenadier, silver warehou, ling

Percentage of otter trawl catch targeted: primarily by-product (Klaer 39%)

Suggested environmental drivers: Water temperature

Recent catch history:

	2004	2005	2006	2007 ¹	2008 ¹	2009 ¹
Agreed TAC (Global)	621	621	560	560	560	560
Actual TAC (Global)	743	679	618	573	610	604
Trawl catch (SEF2 Comm.)	84	43	67	39	34	
Trawl Catch (SEF2 State)	0	0	0	0	0	
Non-trawl catch (SAN2)	567	451	494	536	339	
% actual TAC	88	73	91	100	61	
Estimated discards (SET)	0	0	0	0	0	
% Discards (SET)	0	0	0	0	0	
Estimated discards (NT)	1	0	0	0	0	
% Discards (NT)	<1	0	<1	0	0	
Trawl catch (GAB-logbook)	2	8	12	1	<1	
State catch	64	56	43	51	36	
Total catch	719	557	616	627	408	

¹ 2007 TACs are for the 12 months to December 2007. 2008 & 2009 TACs are for the new fishing year (May to April)

[Abbreviations – SEF2: landed weights as recorded in the landings records of trawlers; SAN2: landed weights as recorded in the landings records of the non-trawl sector; SET: south-east trawl sector; NT: non-trawl sector; GAB- Great Australian Bight trawl sector]

From 1998 to 2001, blue eye trevalla trawl and non-trawl catches were managed under a global agreed TAC of 630 t (530 t non-trawl, 100 t trawl sector). From 2001, up to 10% of the non-trawl quota was transferable to the trawl sector annually. Also from 2001, a bycatch trip limit and a 60 t total catch limit were introduced on the Lord Howe Rise, and the Cascade Plateau was closed to the non-trawl sector.

Synopsis of the 2008 fishery

The landed catch for the 2008 calendar year was 373 t. At the end of the quota year (April 2009) the landed catch was 435 t which represented 71% of the actual TAC. Discarding of blue eye trevalla is not an issue for either the trawl or the non-trawl sectors.

Industry reported that the distribution of fishing effort by the line sector around the fishery continues to be influenced by interactions with killer whales. This had previously produced a shift in effort from eastern Tasmania to around Kangaroo Island. Industry noted that when killer whales are found to have taken fish off long lines, fishers move their gear to different areas. The impacts of this depredation are reported to be significant at times but the details have not been recorded in logbooks so its effect on CPUE indices cannot be quantified.

In some years (e.g. 2005) the majority of the blue eye trevalla caught in longline fishery are less than 70 cm noting that size at maturity is greater than 70 cm. The absence of large fish in catch in many

years is a result of the combination of fish behaviour (fish migrating onto and off fishing grounds) and fishers targeting size classes that will maximise the value of the catch.

Industry had reported that 2006/07 was the best fishing year for blue-eye since quota had been introduced, with excellent catch rates observed. It was also reported last year that three of the main auto-longline vessels had stopped targeting blue-eye early due to the limited quota.

2009 assessment:

Blue eye trevalla were assessed as a Tier 4 species last year after detailed examination of the available size and age composition data. This showed substantial annual, seasonal and spatial variation in the size and age composition of the catch. Industry had also reported that the seasonal movement of fish and differences in the depth distribution of fish of different sizes contributed to this variation. As a result, SlopeRAG was not confident that the data available provided a consistent or robust basis for the estimation of mortality which was a prerequisite for applying the previously used Tier 3 harvest control rule.

Tier 4

The CPUE series selected last year for use in the Tier 4 assessment was a combination of data from drop-lines and longlines, but excluding records from fishing on the Cascade Plateau and seamounts. The time series of catch data were combined using the unit of catch per shot. Last year an inspection of the distribution of the log of the catches was used as a basis for deciding that the two gear types could be sensibly combined. This was further examined this year by inspecting plots of the distributions of the log of the catch rates (Figure 1) which showed similar distributions albeit with higher catch rates from droplines.

The same time series was used again this year with the same reference period (1997-2006) and regarded blue eye to be fully fished by this period. Catch rates were relatively stable during this period and at a level that industry considered to be reasonable. SlopeRAG considered that there was no indication that catches during this period were unsustainable.

The CPUE series from the trawl sector has not been considered to be informative because blue eye has shifted from a target to a bycatch species for this sector and is now responsible for only a small proportion of the total catch. Nevertheless, a comparison of the two time series shows that they follow a similar trend during the years when they overlap (Figure 2).

There had been a suggestion that the CPUE series for blue eye trevalla should take account of targeting for ling in the same way that the ling CPUE series accounts for blue eye trevalla fishing. The approach used for ling is to classify shots that catch more blue eye trevalla than ling as targeted blue eye trevalla shots and to exclude them. An inspection of a scatter plot of the catches of ling and blue eye trevalla in individual shots, however, showed no clear separation between shots catching one or the other species suggesting that a classification based on the most abundant species in the catch would be an arbitrary one. This criterion was therefore not adopted for filtering of data to use in the CPUE standardisation for blue eye trevalla.

Recommended Tier Level

Tier 4.

RBC Calculations

The RBC calculated using the autolongline and dropline data was 536 t (Table 1, Figure 4) before any allowance for discards, State catches, discount factor or recent CPUE adjustment. The average CPUE over the last four years is lower than the average from the reference period producing a scaling factor less than 1 and an RBC that is below the average catch over this period (667t).

Additional Comments from the RAG

This year some industry members reported some level of concern about trends in the fishery. The fishery is now largely confined to the 'hot-spots' and the information coming from these areas is not reflective of what used to be a broader fishery. Some of what used to be 'hot-spots' (e.g. off the south coast of Tasmania) are also not producing as well as they used to and fish are not as spread out on diverse areas as they used to be. Most of the main areas of concentration were still producing fish but there was a noticeable difference from the early years of the fishery. Some 'residential' fish used to be found spread out along the shelf, but their numbers have now declined. This view was initially raised by the line sector but was supported by the trawl sector who also reported that blue eye were not as

prevalent as in the past, and that they were now needing less quota to cover what was essentially a by-catch for them.

It was also pointed out that one of the main areas of trawl catches of blue eye trevalla in the summer (near Gull Island) has now been made part of one of the MPAs off eastern Tasmania.

Discount factor

Whereas last year industry members strongly expressed the view that that the assessment for this species does not warrant the application of any RBC discount factor given the stable history of the fishery, this year there was agreement by SlopeRAG that the discount factor should apply. The change in sentiment was in response to the view that there was less stability than had been previously seen, and in recognition that even with a discount factor the TAC is likely to be above recent catch levels.

Overcatch/undercatch

The issue of overcatch and undercatch of quota was discussed and it was agreed that a figure of 10% should apply to blue eye trevalla. The assessment indicated that the CPUE was close to target levels and allowing carryover of un-caught quota would not pose any risk to the stock.

Tables and Figures

See also BRS report (Hobsbawn 2009 p41).

Table 1. Tier 4 RBC calculations for blue eye trevalla based on AutoLongLine combined with Dropline. C^* (average reference catch (t)) and $CPUE_{targ}$ (target reference CPUE level) are calculated over the period 1997-2006, $CPUE_{Lim}$ (limit reference CPUE) is 40% of the target $C_{max} = 1.25 C^*$ and $CPUE$ is the average standardised CPUE over the last four years (2005-2008). Scaling factor is the adjustment to C^* used to calculate the RBC (t). The RBC calculation does not account for predicted discards, predicted State catches, discount factor or recent CPUE adjustment.

1st Reference Year	1997
2nd Reference Year	2006
C^*	666.609
C_{max}	833.261
$CPUE_{targ}$	1.0129
$CPUE_{Lim}$	0.4052
CPUE	0.8942
Scaling Factor	0.8047
Wt_Discard	0.001
Wt_State	
RBC	536.403

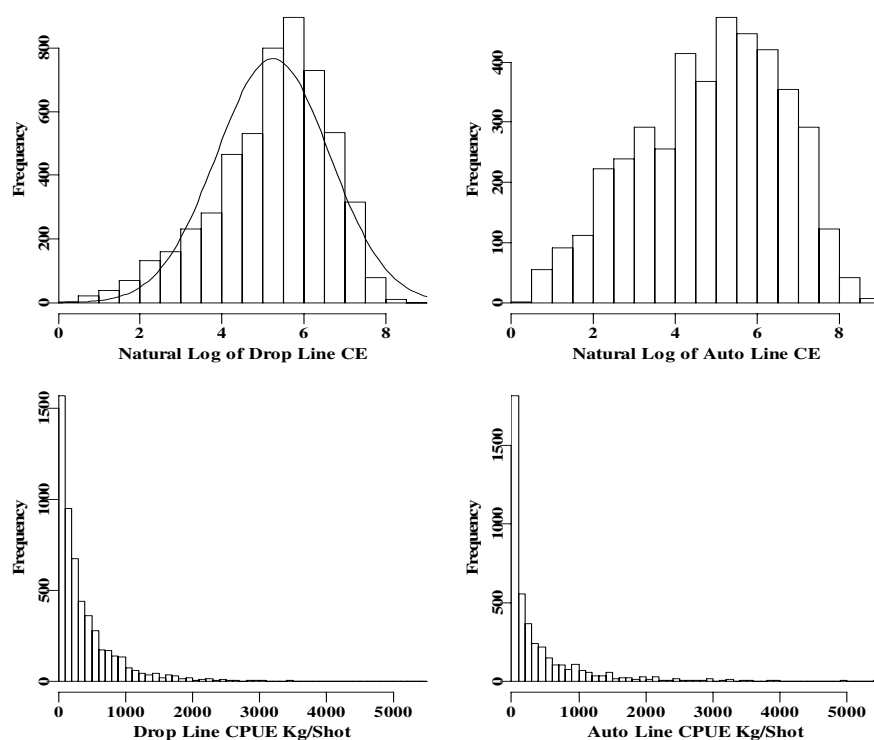


Figure 1. Comparison of the catch rates (both log-transformed and as kg per shot) for drop line (left hand graphs) and for auto-line (right hand graphs). The mean catch rate of blue eye for drop line was 188 kg/shot while for autolining it was 130 kg/shot. (from Haddon, 2009a).

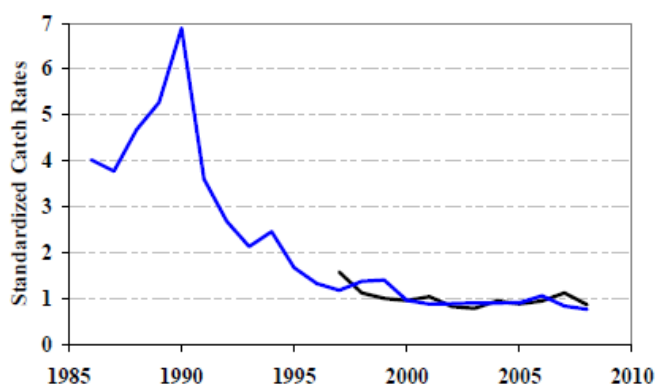


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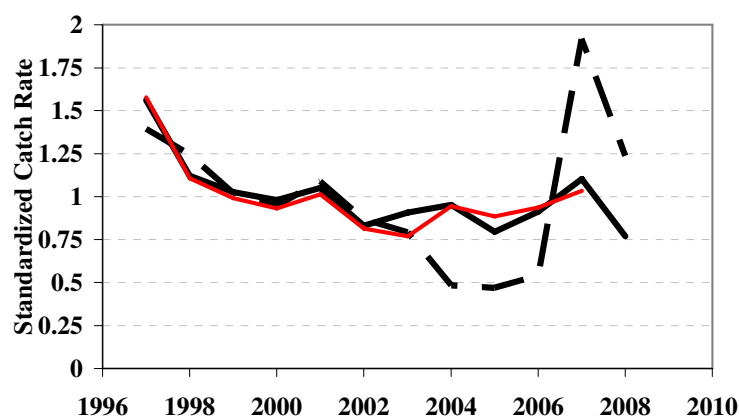


Figure 3. Blue eye reported from depths between 200 and 600 m, zones 10-50, 83-85. The graph is the standardized catch rates, with the dashed line representing the geometric mean and the solid line representing the optimum model. Catch rates have been essentially flat since 1998. The red line is last year's (2008) analysis (the GAB catches were not included last year). The graph standardizes catch rates relative to the mean of the standardized catch rates. (from Haddon, 2009a).

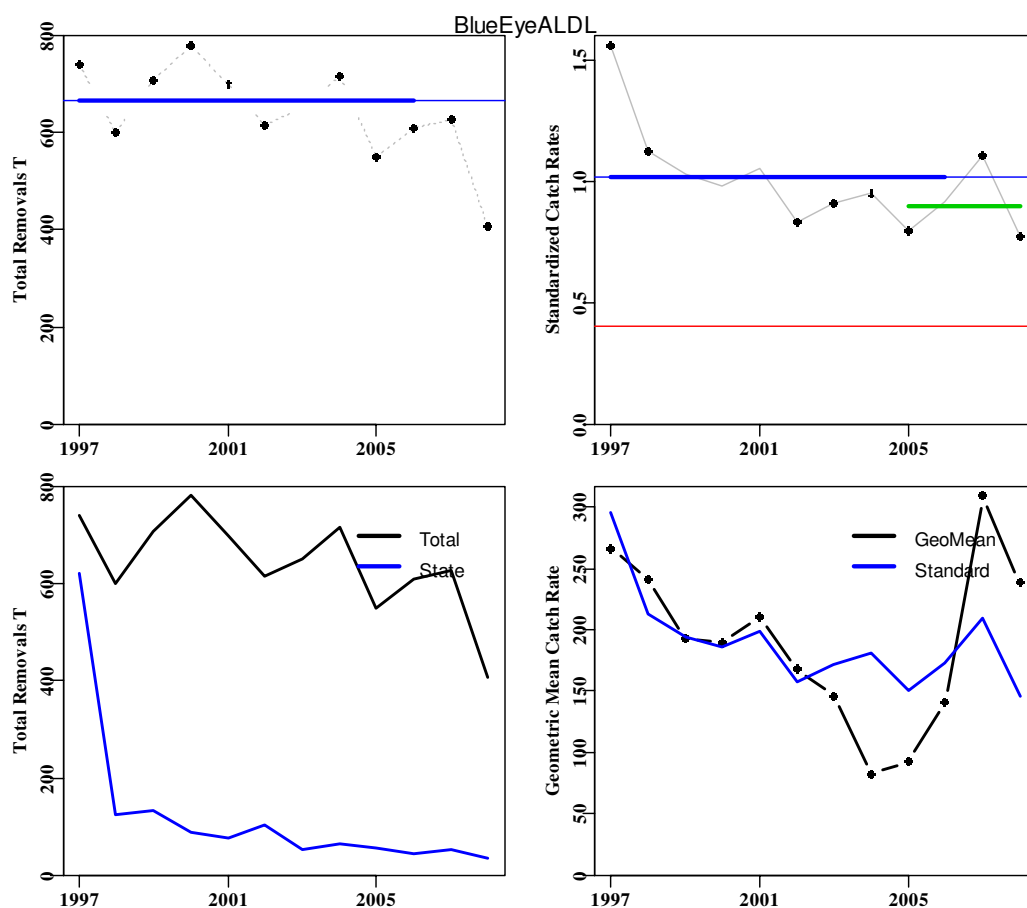


Figure 4. Blue Eye Trevalla. Top left is the total removals with the fine line illustrating the target catch. Top right represents the standardized catch rates with the upper fine line representing the target catch rate and the lower line the limit catch rate. Thickened lines represents the reference period for catches, catch rates, and the recent average catch rate (green) (from Haddon, 2009b).

2009 Stock Assessment Report for Blue grenadier *Macruronus novaezelandiae*

RAG undertaking the assessment: SlopeRAG

Stock structure

A recently completed stock structure study using otolith chemistry and otolith shape (Hamer *et al.* 2009) has provided evidence that there is more than one stock of blue grenadier being fished within the SESSF. Specifically, the otolith indicators provided support for separate stocks of blue grenadier being fished by the Great Australian Bight Trawl and Commonwealth Trawl Sectors of the SESSF. They also indicated that blue grenadier from the western Tasmanian and eastern Bass Strait regions of the CTS were unlikely to be part of one highly mixed south eastern Australian stock. The implications of these findings for the assessment have not yet been fully examined.

Biological indicators

Biological productivity: Medium
 Trophic level: 4
 Associated species: silver warehou, ling
 Percentage of otter trawl catch targeted: 89 %
 Suggested environmental drivers: Not examined

Recent catch history

	2004	2005	2006	2007 ²	2008 ²	2009 ²
Agreed TAC (Global)	6,428	4,819	3,730	3,530 ²	4,368	4,700
Actual TAC (Global)	7,000	5,000 ¹	3,730	3,599 ²	4,228	4,851
Trawl catch (SEF2 Comm.)	6,392	4,283	3,710	3,376	3,931	
Trawl Catch (SEF2 State)	0	0	0	4		
Non-trawl catch (SAN2)	10	10	11	8	6	
% actual TAC	91	86	100	94	93	
Estimated discards	27	527	247	224	268	
% Discards nsp (sp)	1 (0)	27 (2)	17 (0)	N/A	1	
State catch	0	0	0	4	0	
Total catch	6,575	5,108	4,069	3,693	3,937	

nsp – non-spawning fishery; sp – spawning fishery

¹The global agreed TAC in 2005 was 5,000 t with a voluntary industry reduction to 4, 200 t.

² 2007 TACs are for the 12 months to December 2007. 2008 & 2009 TACs are for the new fishing year (May to April)

Synopsis of 2009 fishery

There are two defined sub-fisheries: the spawning and non-spawning fisheries. The catch in the non-spawning fishery was 1,224 t in the 2008 calendar year up slightly on the 2007 catch. The catch from the spawning fishery was 2,806 t in 2008, a substantial increase from the 1,729 t caught in 2007. At the end of the quota year (April 2009) the landed catch was 3,817 t which represented 90% of the actual TAC.

The level of discarding has declined to low levels in 2007 and 2008 due to a combination of the increase in size of individuals in the strong 2003 and 2004 cohorts, that had been the main ones discarded, and the progressive uptake of more selective trawl gear, with the adoption of larger diamond meshes or rotated mesh panels in codends. Nevertheless, a new cohort is also evident in the age composition data and in the mode in the length-frequency for discards of fish between 40 and 50 cm TL.

The west coast spawning sub-fishery followed a similar pattern in 2008 as in 2007: good size catches were taken from the start of the fishing season and on most days thereafter with a trend towards larger catches as the season progressed (Ryan and Kloser 2009). Fishing effort was initially widely distributed but tended to contract to the Pieman canyon and the grounds north as the season progressed. This is presumably because school marks were less substantial and persistent in the early part of the season but more stable and substantial as time progressed. (Ryan and Kloser 2009).

A maximum snapshot biomass for the 2008 season of 24,450 tonnes (survey CV 0.22) was obtained from the 2008 survey of the west coast spawning aggregation and included in the 2003-2008 time series index. This index represents a minimum bound of the spawning stock as it does not include fish outside schools or fish turnover on the grounds (Ryan and Kloser 2009).

The spawning aggregation of blue grenadier discovered off the east coast of Tasmania in 2007 was again observed in 2008 and 2009. Although there has been evidence of blue grenadier spawning off the east coast before (through the presence of larvae) an aggregation of spawning fish had not been previously recorded. Samples from this spawning aggregation have been collected and were included in the recently completed study that examined the relationship between blue grenadier populations in the GAB and the SESSF. This concluded that, although the age composition of fish from this aggregation exhibits the same sequence of strong and weak year classes found in the other parts of the SESSF, there is evidence that it forms a separate stock.

2009 Assessment

There was no update or projection of the Tier 1 assessment in 2009 because a three year TAC was set in 2008. The RAG confined its work to examining key indicators to assess whether there had been any developments that were of concern. Indicators examined were the results of standardized CPUE, the acoustic biomass survey, and the size and age composition data.

The standardised CPUE for the spawning sub-fishery, based on catch rates from the factory vessels, is not considered to be a useful index of abundance because the vessels target concentrations of fish and the size of catches is limited to suit vessel processing capacity. The standardized CPUE in the non-spawning fishery increased slightly to a similar level to that in 2006 (Figure 5).

The 2008 biomass survey was less than half the (very imprecise) estimate from 2007, and is also lower than the estimate for 2006 (Figure 6). It was of a similar magnitude to that obtained in the first survey in 2003.

Both the size and age composition data indicate that a new relatively strong cohort that is starting to enter the fishery (see BRS report – Hobsbawn 2009 p14). This confirms early reports last year of a stronger 2006 cohort.

Recommended Tier Level

Tier 1.

RBC Calculations

No new RBC calculations were undertaken in 2009.

Additional Comments from the RAG

SlopeRAG agreed that the indicators available all point to a stable or increasing biomass in the spawning fishery. There was no concern expressed that catches up to the agreed TAC would constitute any threat to blue grenadier stocks.

Acoustic-optic experiments have been conducted in 2008 to measure target strength of individual blue grenadier with concurrent optical images giving estimates of length, orientation and species identity. Final analysis of these results are supportive of the earlier Australian estimates of target strength that had previously been used in the base case analyses and referred to as the 'low model'. The low model therefore will remain the preferred model when the assessment is updated, being both more consistent with the available data and the more risk averse strategy.

Overcatch/undercatch

SlopeRAG agreed that a 10% overcatch/undercatch allowance was suitable for blue grenadier.

Research needs, future assessments

These were not updated in 2009.

The extent and impact of the uptake of larger mesh sizes should be examined to assess its affect on gear selectivity and on discard rates.

SlopeRAG again supported the investigation of options to undertake an acoustic ‘snapshot’ survey of the spawning aggregation on the east coast. It was noted, though, that the effect of incorporating data on this aggregation into the assessment model is difficult to predict.

The potential benefits of moving the assessment to SS3 were noted, particularly the ability to get better fits to the CPUE series and data on age composition. Incorporating seasonality into the model was also suggested as a way to get better fits to the data.

Figures

See also BRS report (Hobsbawn 2009 p 13)

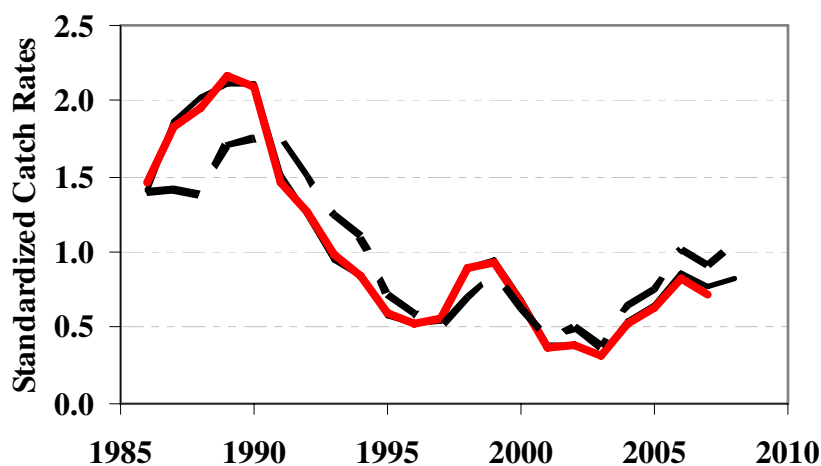


Figure 5. Blue Grenadier reported from the non-spawning fishery in depths 0 to 1,000 m. The dashed black line represents the geometric mean catch rate and the solid black line the standardized catch rates. The fine red line (to 2007) represents last year's analysis. The graph standardizes catch rates relative to the mean of the standardized catch rates.

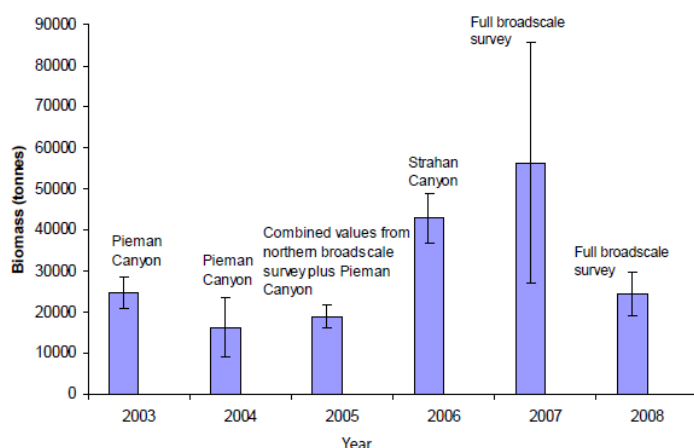


Figure 6. Maximum biomass estimates for the 2003 to 2008 survey years using. Survey regions are noted. Error bars are ± 1 S.D. of the survey sampling error.

2009 Stock Assessment Report for Blue warehou *Seriolella brama*

RAG undertaking the assessment: SlopeRAG

Stock structure

Two stocks east and west Bass Strait, but single TAC.

Biological indicators

Biological productivity: Moderate

Trophic level: 2

Associated species: silver warehou, morwong, flathead

Percentage of otter trawl catch targeted: 63 %

Suggested environmental drivers: cold water, also associated with their prey source - salps

Recent catch history

East and West combined

	2004	2005	2006	2007 ¹	2008 ¹	2009 ¹
Agreed TAC (Global)	300	300	650	288	365	183
Actual TAC (Global)	297	300	661	338	381	214
Trawl catch (SEF2 Comm.)	260	311	425	195	156	
Trawl Catch (SEF2 State)	0	0	0	0		
Non-trawl catch (SAN2)	2	1	1	1	1	
% actual TAC	88	104	64	58	41	
Estimated discards	381	274	273	3	27	
% Discards	51	47	38	1 ²	12	
Trawl catch (GAB-logbook)	5	6	5	8	4	
State catch	31	17	26	25	0	
Total catch	680	609	730	224	194	

East

	2004	2005	2006	2007 ¹	2008 ¹
Trawl catch (SEF2 Comm.)	64	25	32	21	
Trawl Catch (SEF2 State)	0	0	0	0	
Non-trawl catch (SAN2)	0.9	0.8	0.6	<1	
Estimated discards	62	18	4	na	
% Discards	33	46	13	0	
State catch	31	17	26	25	
Total catch	158	61	63	46	

West	2004	2005	2006	2007 ¹	2008 ¹
Trawl catch (SEF2 Comm.)	198	286	393	174	
Trawl Catch (SEF2 State)	0	0	0	0	
Non-trawl catch (SAN2)	0.8	0.5	0.3	<1	
Estimated discards	320	256	270	0.026	
% Discards	57	47	40		
State catch	0	0	0	0	
Total catch	519	543	663	174	

¹ 2007 TACs are for the 12 months to December 2007. 2008 & 2009 TACs are for the new fishing year (May to April)

² The estimated discard rate for 2007 (1.3%) is uncertain owing to very low sample sizes.

Synopsis of 2008 fishery

The landings during the 2008 calendar year were 196 t of which 19% was taken in the east. This catch was up slightly on the 2007 catch of 174 t. The landed catch in the east continues to be a low fraction of historical values, while the landed catch in the west during 2008 is even lower than that for 2007 which was the lowest since 1989. This is again attributable in no small part to the TAC for 2007 of 219 t (both stocks). The standardized catch-rates for both stocks continued to be low in 2008 (Figure 7 and Figure 8).

At the end of the quota year (April 2009) the landed catch was 161 t which represented 42% of the actual TAC.

Discard rates had fallen from 46% in 2005 to 13% in 2006 in the east, but a much smaller drop (from 47% to 40%) was recorded in the west. In 2008 the overall estimated discard rate was 12% but it was reported that this estimate may be biased low because of an unwillingness of some industry members to follow their normal discarding practices when carrying an AFMA observer. Active avoidance of blue warehou in the east due to limited quota had previously reported as one reason why the discard rate had fallen. Discarding was mostly smaller fish (less than 30cm) in 2008 as the result of high-grading (see Hobsbawn 2009 p44).

2009 Assessment

There were some concerns about the accuracy of data on State catches (both recent and historical) and an agreement that this required further investigation as it may impact on the assessment.

The assessment remained as a Tier 4. Age compositions were dominated by 2 year old fish in both the east and west but these distributions are inconsistent with the size composition data and may be unrepresentative of the catch.

Recommended Tier Level

Tier 4

RBC Calculations

The target catch rate was selected as the average standardised catch rate for 1986-1995 and the limit catch rate at 40% of this target.

RBCs for both eastern and western stocks remain at zero as standardized catch rates are below the limit reference points.

Additional Comments from the RAG

The RAG noted again its concern that the CPUE is not a good index of abundance while the TAC is so low and industry attempts to avoid catching the species. The need for a fishery-independent survey to obtain an improved index was again raised, but it was also noted that it will be difficult even for such a survey to achieve this aim given the schooling nature of the species.

Discount factor

The TAC is set at a level that is intended to allow landing of incidental catches. SlopeRAG did not discuss the discount factor for blue warehou. The RAG chair was of the view that the discount factor does not apply to a 'bycatch' TAC. AFMA or SESSFRAG may have a different opinion.

Overcatch/undercatch

SlopeRAG considered that there should be no allowance for undercatch for blue warehou given that the analysis suggests the standardized catch rates are below the limit reference points and AFMA will set a TAC at a level to allow incidental catches only. SlopeRAG also considered that overcatch should be managed within the limits set by the 'determined amount' for small quantities of catch above an operator's quota.

Other comments previously reported from the RAG that are still relevant:

1. Limited quota availability has been reported to affect the extent of targeting and hence catch rates.
2. Market factors were also reported as reducing catch rates.
3. There was an acknowledgment by the RAG that blue warehou exhibit considerable variation in availability that affects catches, catch rates and variability in catch rates.
4. There is inconsistency between calculated RBCs and industry perceptions of stock status. Industry have argued that previously high discard rates were an indication of a much larger stock size than is suggested by the TAC.
5. Many observed shifts in catches and changes in CPUE could be attributed to transfers of quota from operators in the east to those in the west.
6. It was more difficult for fishers to locate spawning areas as these were not in consistent over time and there had been a large reductions in the number of operators.

Research needs, future assessments

These were not updated in 2009.

- a) Consideration should be given to including sex-structure into the population dynamics model. Although the length-frequency data are not sex-specific, much of the recent ageing data include the sex of the animal.
- b) The fishery catches are very low at present. This leads to lower sample sizes for length-frequency and further concern regarding the validity of catch-rates as indices of abundance.
- c) Consideration should be given to evaluating objective methods for detecting resource recovery. Such methods may also be of value for several of the other species in the SESSF (e.g. eastern gemfish).
- d) There is a need to collect additional length-frequency data for the Tasmanian component of the fishery (owing to the present size of this sector relative to the rest of the fishery in the east).
- e) The impact of the catches from northwestern Tasmania coming from the western rather than the eastern stock should be examined. Such an examination requires information on the length-composition of the catches from northwestern Tasmania.
- f) In principle, the ages obtained from reading of whole (rather than sectioned) otoliths should be included in the assessment.
- g) Consideration should be given to estimating selectivity patterns for various time-blocks (particularly for the western stock).
- h) The approach used to derive the standardized indices of abundance based on the logbook data ignores zero catches (and particularly trends in zero catches).

Tables and Figures

See also BRS report (Hobsbawn 2009 p 43)

Table 2. RBC calculations for Blue Warehou East. C^* and $CPUE_{targ}$ relate to the period 1986-1995, $CPUE_{Lim}$ is 40% of the target, $C_{max} = 1.25 C^*$, and is the average catch rate over the last four years. The RBC calculation does not account for predicted discards of predicted State catches or recent CPUE adjustments.

1 st Reference Year	1986
2 nd Reference Year	1995
C^*	961.698
C_{max}	1,202.122
$CPUE_{targ}$	1.8202
$CPUE_{Lim}$	0.7281
$\overline{CPUE}$	0.1690
Scaling Factor	0.0000
%Wt_Discard	10.708
RBC	0.000

Table 3. RBC calculations for Blue Warehou West (Zones 40-50). C^* and $CPUE_{targ}$ relate to the period 1986-1995, $CPUE_{Lim}$ is 40% of the target, $C_{max} = 1.25 C^*$, and is the average catch rate over the last four years. The RBC calculation does not account for predicted discards of predicted State catches or recent CPUE adjustments.

1 st Reference Year	1986
2 nd Reference Year	1995
C^*	762.974
C_{max}	953.717
$CPUE_{targ}$	1.7298
$CPUE_{Lim}$	0.6919
$\overline{CPUE}$	0.4844
Scaling Factor	0.0000
%Wt_Discard	11.771
RBC	0.000

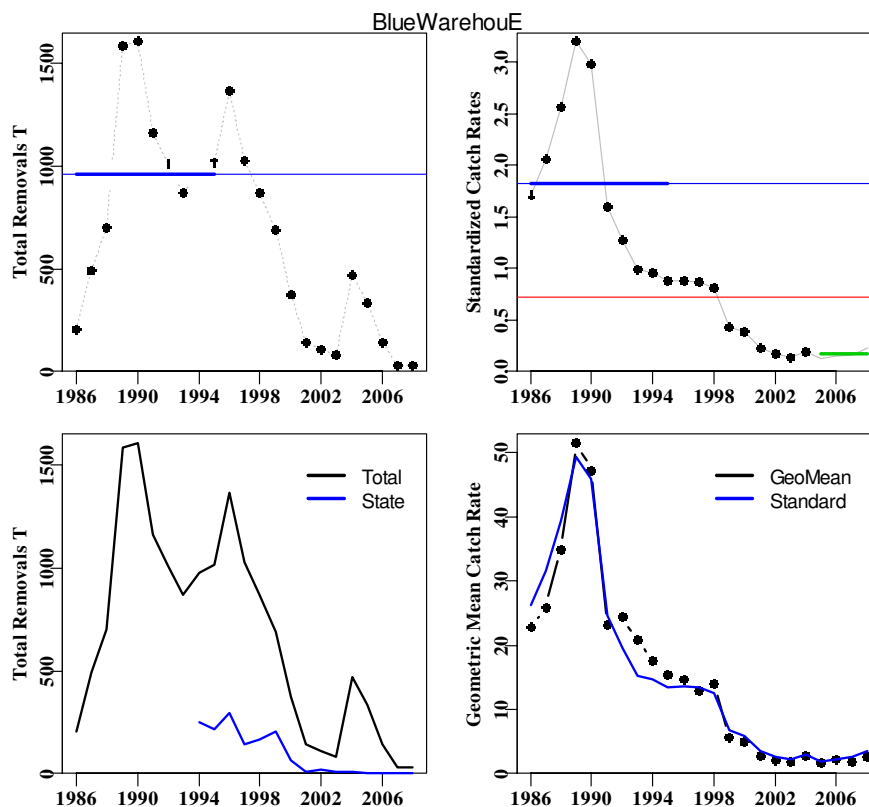


Figure 7. Blue Warehouse zones 10 - 30. Top left is the total removals with the fine line illustrating the target catch. Top right represents the standardized catch rates with the upper fine line representing the target catch rate and the lower line the limit catch rate. Thickened lines represents the reference period for catches, catch rates, and the recent average catch rate (green) (from Haddon, 2009b).

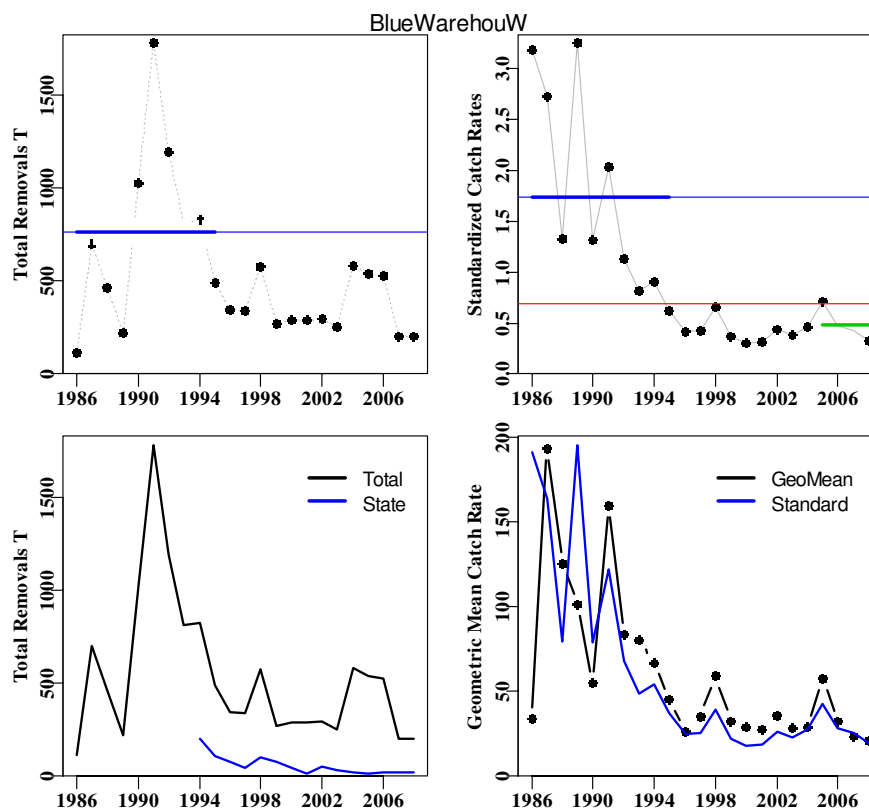


Figure 8. Blue Warehouse zones 40 - 50. Top left is the total removals with the fine line illustrating the target catch. Top right represents the standardized catch rates with the upper fine line representing the target catch rate and the lower line the limit catch rate. Thickened lines represents the reference period for catches, catch rates, and the recent average catch rate (green) (from Haddon, 2009b).

2009 Stock Assessment Report for Western gemfish *Rexea solandri*

RAG undertaking the assessment: SlopeRAG

Stock structure

One stock is assumed across the areas fished by south east trawl and non-trawl sectors and the GAB trawl sector.

Biological indicators

Biological productivity: Medium

Trophic level: 4

Associated species: blue grenadier, ling, mirror dory, silver warehou

Percentage of otter trawl catch targeted: Not examined

Suggested environmental drivers: Not examined, Leeuwin current

Recent catch history

	2004	2005	2006	2007 ¹	2008 ¹	2009 ¹
Agreed TAC (Global)	300	300	167	167	167	125
Actual TAC (Global)	322	327	190	173	179	135
Trawl catch (SEF2 Comm.)	146	157	126	91	76	
Trawl Catch (SEF2 State)	0	0	0	0	0	
Non-trawl catch (SAN2)	4	6	28	9	11	
% actual TAC	47	50	81	58	49	
Estimated discards	9	2	0.6	35	<1	
% Discards	6	1	<1	26	3	
Trawl catch (GAB-logbook)	378	268	339	361	105	
State catch ²	0	0	0	0	0	
Total catch	429	370	399	515	193	

¹ 2007 TACs are for the 12 months to December 2007. 2008 & 2009 TACs are for the new fishing year (May to April)

² All state catches of gemfish are attributed to eastern gemfish.

Synopsis of 2008 fishery

No significant changes to the SESSF component were reported. The landed catch for the 2008 calendar year was 86 t. At the end of the quota year (April 2009) the landed catch was 99 t which represented 55% of the actual TAC. Landings in the GABTS were 105 t which is substantially below recent catch levels for this sector. This reduction is largely due to the departure of the largest catching vessel from the fishery but was also the result of the impact of the economics of the fishery. The previous export market had been affected by a stronger Australian dollar and reduced demand. The domestic market could only accept limited volumes before the price was adversely affected. This kept individual target catches small, particularly in the GAB, to maximise the returns per kg. Industry had previously expressed the view that these market constraints meant that catches were not a good indicator of the size of the available resource. Because of these constraints, and the better returns available from fishing for deepwater flathead and Bight redfish, industry also indicated that western gemfish are now not the subject of much targeted fishing in GABTS. Western gemfish have largely been a byproduct species of fishing for blue grenadier for the SETF for a number of years.

Discards rates in 2008 obtained from observers were estimated to be highly variable across the fishery. In the GABTS most fish were discarded (82%) but in the SETS discard rates were only 3.1%. The reasons for this large difference are unknown. Discards were mostly comprised of fish less than 50 cm TL (Hobsbawn 2009).

2009 Assessment

Work to develop a Tier 1 quantitative assessment of western gemfish using SS2, which was started in 2008, is still being completed, now under the RUSS project that is being undertaken by BRS. This assessment is intended to cover the full area of the fishery, including the GAB.

Length frequency distributions have been quite variable from year to year. In several years there has been evidence, in the presence of larger numbers of small fish, of strong cohorts of fish entering the fishery (but mainly discarded). However, in the past there has been no clear progression of these

“cohorts” in subsequent years. It is unclear whether this variability is inherent in the fishery or is a reflection of unrepresentative sampling. This variability has contributed to the difficulties in developing a coherent integrated assessment model.

Standardised catch rates of western gemfish (for the SETF) remain at much lower levels than recorded in the late 1980s and for the past seven years have also remained below the relatively stable levels recorded from 1992 to 2001 (Figure 9).

Industry members had previously expressed concern that the departure of two major fishers for western gemfish (who operated out of Beachport) would have reduced future fleet-wide estimates of CPUE and had also reduced recent catches. The vessel factor in the standardization process should, however, account for such a possible effect

As a result of the problems with developing a Tier 1 assessment (which would also prevent the application of Tier 3 harvest control rule), SlopeRAG agreed to assess western gemfish using the Tier 4 harvest control rule in 2008.

The GABRAG has previously requested that a joint assessment of western gemfish be undertaken and SlopeRAG has agreed to do so. This is a logical step under the assumption of a single shared stock and is what is being attempted with the SS2 model that is under development.

The application of a joint Tier 4 assessment, however, is problematic in part because of the different management arrangements for the two sectors (one being under a TAC and the other not). There is also the issue of whether GAB catches should be subtracted from any RBC that is calculated. Last year SlopeRAG proposed, and the MAC and AFMA agreed, that this would not be done for western gemfish. The same process was again proposed by SlopeRAG this year and the Tier 4 RBC is based on the CPUE series calculated from trawl shots in zones 40 and 50 only.

GAB industry expressed the view that applying a Tier 4 assessment based on CPUE was a flawed approach for Western gemfish as they are a migratory species and their local abundance varies annually in response to the (poorly known) factors that affect this behaviour. The changes in targeting by the fleets, and the sporadic catches that have resulted, were also considered to be factors that would degrade the usefulness of CPUE as an index of abundance, anywhere in their range.

Nevertheless, the RAG noted that standardized CPUE in the SETF had been quite stable during the chosen reference period. The large drop in CPUE early in the time series was considered unusual given the relatively low catches taken during this period (a maximum of 269 t in 1986).

Recommended Tier Level

Tier 4

RBC Calculations

The RBC calculated using the CPUE from zones 40 and 50 was 102 t (Table 4).

Additional Comments from the RAG

The RAG considered that it was very important to improve the quantity and quality of data collected for western gemfish, to improve the current assessment. The arrangements now in place for deepwater sharks, where fishers landed a sample of their catch which was then transported free to the market for researchers to measure and record, was proposed as a good model to examine for western gemfish where catches may be similarly sporadic and hence easily missed by onboard or port-based observers.

Discount factor

It was argued that there is no need to apply the discount factor to the TAC for western gemfish the SETF for a number of reasons:

- the stability seen in the recent CPUE,
- the fishery only impacts the extreme eastern end of the range of the stock,
- there will probably be a Tier 1 assessment available next year that will provide greater certainty to the assessment, and

It was also noted that catches in the GAB of 250 to 350 t between over four successive years had produced no discernible impact on CPUE in the SETF, suggesting that a catch of about 100 t in the SETF was not a risky undertaking. Catches in the GABTF have also fallen by over 100 t and are likely to remain at these lower levels for the next 12 months at least.

Against these arguments were the points that the preliminary Tier 1 assessment is suggesting the stock to be depleted, and the experience of the sudden collapse of the eastern gemfish fishery. On this last issue the potentially large impact that managing a relatively minor but depleted species can have on the rest of the fishery was highlighted.

Last year SlopeRAG considered that there were no indicators that suggested any cause for concern with stocks of western gemfish. There have been no substantial changes in any of these indicators.

On balance, SlopeRAG suggested that the discount factor should not apply to western gemfish.

Overcatch/undercatch

SlopeRAG considered that 10% overcatch/undercatch should be allowed for western gemfish.

Research needs, future assessments

There is a need to improved the collections of basic biological information on western gemfish and continue to monitor the size and age composition. Increased monitoring of GAB catches is required.

The RAG supported efforts to continue to develop a joint Tier 1 assessment.

Tables and Figures

See also BRS report (Hobsbawn 2009 p39).

Table 4. RBC calculations for Western Gemfish. C^* and $CPUE_{targ}$ relate to the period 1992-2001, $CPUE_{Lim}$ is 40% of the target, $C_{max} = 1.25 C^*$, and is the average catch rate over the last four years. The RBC calculation does not account for predicted discards of predicted State catches or recent CPUE adjustments. Only catches from zones 40 and 50 included.

1 st Reference Year	1992
2 nd Reference Year	2001
C^*	204.039
C_{max}	255.049
$CPUE_{targ}$	0.821
$CPUE_{Lim}$	0.3284
$\overline{CPUE}$	0.5746
Scaling Factor	0.4998
%Wt_Discard	2.628
RBC	101.973

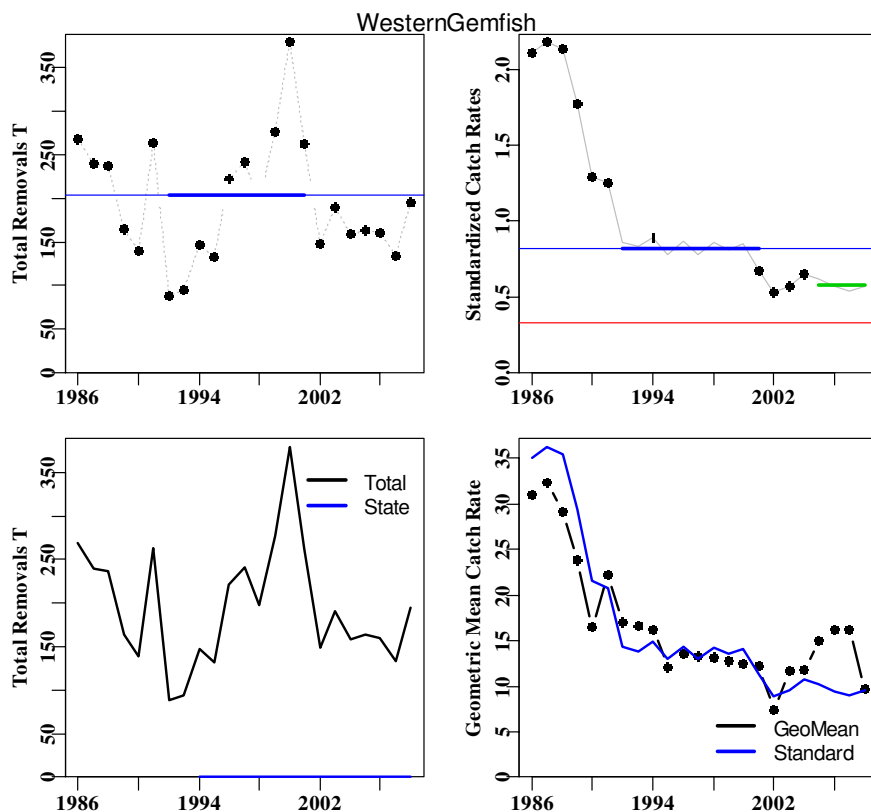


Figure 9. Western Gemfish. Top left is the total removals with the fine line illustrating the target catch. Top right represents the standardized catch rates with the upper fine line representing the target catch rate and the lower line the limit catch rate. Thickened lines represents the reference period for catches, catch rates, and the recent average catch rate (green) (from Haddon, 2009b).

2009 Stock Assessment Report for Pink ling *Genypterus blacodes*

RAG undertaking the assessment: SlopeRAG

Stock structure

SlopeRAG has agreed on the importance of separate assessments for east and west stocks, but there is a single TAC.

No evidence has been presented to SlopeRAG that there is a separate stock of pink ling in the GAB. Therefore, catches in the GAB have also been included in the assessment on the assumption that pink ling in the GAB are part of the western stock.

There has been evidence and reports of serial depletion of local populations of ling, particularly in the west, suggesting a limited amount of movement of fish between fishing areas. There is also the possibility that populations of ling in the west comprise more than one stock, but this has not yet been investigated.

Biological indicators

Biological productivity: Medium

Trophic level: 4

Associated species: silver warehou, blue grenadier, ocean perch, mirror dory

Percentage of otter trawl catch targeted: 57%

Suggested environmental drivers: No

Recent catch history

East and West combined (see Table 5 for breakdown east and west).

	2004	2005	2006	2007 ¹	2008 ¹	2009 ¹
Agreed TAC (Global)	1,800	1,400	1,200	1,200	1,080	800
Actual TAC (Global)	2,001	1,400	1,194	1,201	1,165	853
Trawl catch (SEF2 Comm.)	904	756	729	649	706	
Trawl Catch (SEF2 State)	0	0	0	0	0	
Non-trawl catch (SAN2)	850	644	455	339	444	
% actual TAC	88	100	99	82	99	
Estimated discards (SET)	1	2	3	3	3	
% Discards (SET)	<1	<1	<1	<1	<1	
Estimated discards (NT)	1	1	0	0	0	
% Discards (NT)	<1	<1	<1	<1	0	
Trawl catch (GAB-logbook)	32	46	30	15	2	
State catch	12	15	14	23	0	
Total catch	1,796	1,459	1,229	1,034	1,182	

¹ 2007 TACs are for the 12 months to December 2007. 2008 & 2009 TACs are for the new fishing year (May to April)

Since 2000 there has been a substantial transfer of quota from the trawl to the non-trawl sector which industry states has impacted the fishing pattern of the trawlers, particularly in the east. Quota in the trawl sector is now often used to cover bycatch rather than for targeted shots.

Synopsis of 2008 fishery

Industry had reported in 2007 that improved catches were positive signs indicating increasing abundance of stocks of ling in the east. These observations were reiterated again in 2008 by industry who expressed a belief that stocks in both the east and west were continuing to improve.

The total landed catch for the 2008 calendar year was 1,186 t (up from 1,015 t in 2007). It included 755 t from the east (up from 511 t in 2007) which comprised 480 t from the trawl and 274 from non-trawl sectors, and 432 t from the west (down from 520 t in 2007) which comprised 262 t from trawl and 169 t from non-trawl sectors (Figure 10, Table 5 and Table 6). At the end of the quota year (April 2009) the landed catch was 1,108 t which represented 95% of the actual TAC. In the past there had been under-catching of the quota which industry reported was due to the unavailability of quota at a price that fishers were willing to pay.

Standardized CPUE for the trawl sector has risen in the east (Figure 11), the third year in the last four that it has risen. In the west standardized CPUE has also risen for the third consecutive year (Figure 12).

There has been no issue of discarding of ling observed in the past but there were insufficient trips monitored in 2008 to obtain a valid estimate of the discard rate in 2008. The value for 2007 (3 t) was therefore used as the best estimate in the base case. Industry again reported that the reduced TACs in recent years have created the incentive to high grade and to discard smaller and lower value ling, and that such high grading was likely to increase if TACs were cut further. Higher values of discarding (5% for 2008 and 15% for 2009) were therefore run as a sensitivity scenario. These values were based on anecdotal information obtained by SETFIA from some of its members.

Industry reported that the reduction in ling quota in recent years, combined with a significant quantity of uncaught quota not being made available for lease, had resulted in changes in fishing behaviour in both the trawl and non-trawl sectors. Industry considered that trawl catches since 2000 have been increasingly been a bycatch species, particularly in the east. This has led to trawl fishers in particular adapting their fishing practices to reduce the catch of ling by avoiding the canyons and gutters from which higher catches of ling could be taken. These changes would not necessarily be evident in log book records because it would not be necessary to significantly change the areas or depths that were fished.

Industry have previously reported that mandatory gear modifications introduced in 2006 have also reduced the catch of ling less than 60 cm total length.

2009 Assessment

The 2009 assessment for pink ling is reported in Taylor (2009) and the tables, figures and much of the text below have been extracted from that report. The 2009 assessment model has been run in version 3 of Stock Synthesis (SS3). It assumes separate stocks in the east and west of the fishery. As done previously, the assessment includes estimates of female and male growth parameters and of natural mortality.

This latest assessment differs from that produced last year in that it

1. Includes data from the fishery in 2008.
2. Includes catch data from SA and the GAB.
3. Uses a CPUE standardisation that includes a depth factor.
4. Estimates recent recruitment only up to 2005 in the east and 2004 in the west (based on the size at 50% recruitment from the selectivity curves and the corresponding average age from the relevant growth curves).
5. Incorporates a separate estimate of catchability for the trawl fleet in the east after 2000 to allow for the reported, but undocumented, changes to fishing practices by trawlers there since 2000. These changes are attributed to the shift of a significant proportion of the TAC and catch to the longline sector with a consequent decrease in targeted fishing for ling by trawlers.

The change to the year up to which recruits were estimated was made on the basis that ling younger than the age at 50% recruitment would not be well represented in the data and therefore would not be well estimated. Last year the cut-off was 3 years before the latest assessment for both the east and the west. Initially, this cut-off was estimated as being 5 years for both east and west from an inspection of the selectivity and growth curves. A more detailed subsequent examination of the actual data, however, reduced the lag to the values given.

The change in fishing practices (5) was dealt with in the model last year by allowing selectivity to be different after 2000. After discussion this year among the assessment scientists and the RAG, however, it was decided that this change in fishing practices was better represented in the model by allowing catchability to change after 2000. The transfer of quota to the non-trawl sector was considered to be more gradual and to have had a lesser impact on the trawl fishery in the west and therefore a break in catchability was not considered to be warranted for the western CPUE trawl series. Very little difference was found in 2008 in the fits to the trawl CPUE series between the 2007 model and the 2008 base case of the 3-block model for the west.

There is evidence of the reported change in fishing practices in the 56% decline in the CPUE in the east over three years after 1999 (Figure 13). This drop is far faster than any expected stock reduction and happened at the same time as the catches by trawlers in the east declined from 1,209 t in 1999 to 529 t in 2002. It was agreed by the RAG that, while allowing for a break in catchability in the CPUE time series was the most appropriate way to account for the reported change in fisher behaviour since 2000 in the short term, a more detailed examination of the data for individual vessels was a more satisfactory way to examine the actual changes that have occurred. This examination should take place prior to the next assessment update. Industry reported that the effects of the reduced quota were uneven among vessels, with some being severely restricted and others not so. A preliminary examination of the data confirmed that catch rates of some vessels at least were apparently unaffected. A more detailed examination of these data would allow any effect to be incorporated into the CPUE standardisation process, which would avoid some of the undesirable aspects of using a break in catchability.

Industry had reported the change to the behaviour of trawlers in past years, but were only included in the assessment through the usual CPUE standardisation process. This should have accounted for major changes the depths fished or the areas in which fishing occurred, but could not have accounted for the more subtle changes to fishing practices that have been reported. Previously, the depth distributions of ling shots was examined over the period 1998-2005 and there was no evidence of a major shift in the depth at which most effort that caught ling was expended.

The dome shaped selectivity patterns for the eastern trawl fishery and survey (Kapala) are very pronounced. While trawl catches predominated, this would have allowed a partial refuge in size for larger ling, but this refuge is increasingly removed as non-trawl catches increase.

The base case assessment shows a good fit to the size and age composition data, with the exception that a stronger cohort from 2001 to 2004 that is evident in the length-frequency distributions for the east is not well fitted by the model.

The spawning biomass at the start of 2009 is estimated to be 36% of the virgin spawning biomass in the east (up from 28% last year) and 49% in the west (up from 33% last year) (Figure 15). Projections to the start of 2010 (used for RBC calculations) are for a depletion of 37% in the east and 49% in the west (Table 9). Longer-term projections of spawning biomass suggest that the biomass will gradually rebuild in the east and remain stable at around target levels in the west. These projections assume average levels of recruitment in the future that are higher than have been estimated for the last 5 years in the east and the last 9 years in the west (Figure 16).

The latest assessment is much more optimistic than the assessment in 2008 for the eastern stock which was also more optimistic than the assessment in 2007. The latest assessment is also more optimistic than the 2008 assessment for the western stock and is closer to the assessment from 2007 for this stock.

Sensitivity tests

A range of sensitivity tests were conducted to examine the effect of changing various assumptions, data inputs, parameters estimated, and the weighting assigned to different data series. These were undertaken for an early version of the base case that estimated recruitment up to only 2003. The new accepted base-case model estimated recruits up to 2005 in the east and 2004 in the west but there was insufficient time to rerun these sensitivities after the RAG decided on its revised base case (Table 7). The following comments are based on the sensitivities run on the earlier base case model but are considered to be reliable for describing the extent and direction of the effects of the different sensitivities.

For the east, there are two scenarios produce depletion estimates below the limit reference point of 20%, but the high negative log likelihoods associated with these scenarios indicate that they do not fit the other data series at all well. These involve halving the CV on (increasing the weight given to) the CPUE series for trawl and non-trawl.

Among all the other scenarios examined for the east the range in estimated depletion is from 29% to 55% with corresponding RBCs of 509 t to 1,310 t. The most pessimistic of these scenarios corresponds to there being no change in catchability, which highlights the importance of resolving this question. More optimistic projections are associated with higher natural mortality, doubling the CV on (giving less weight to) the non-trawl CPUE, doubling the weighting on the length-frequency data, and

using the higher estimate of discard rates for 2008 and 2009. Note that while this last scenario was more optimistic in terms of biomass depletion, the RBC was lower because the estimate of unfished biomass had also decreased. As was seen last year, increasing weighting on the length data increased the estimated biomass, whereas increased weighting on the age-length data decreased it. The less optimistic scenarios are associated with a lower natural mortality, estimating recruitment up to 2005 (which has in fact become the base case), and using a change in selectivity after 2000 instead of allowing catchability to change (the base case scenario from last year). Thus the assessment (like all such models) is again sensitive to the level of natural mortality, but this is estimated within the model.

The assessment for the western stock shows less sensitivity than does the eastern stock to the modelled scenarios; the range of depletions estimated is 42% to 64%. The most optimistic scenario is associated occurs when catchability is allowed to change in 2000 (as it does in the base case for the east). Other optimistic scenarios are when natural mortality is increased and when sigmaR is reduced (more weight is given to the estimates of recruitment). The more pessimistic scenarios occur when there is less weight given to the length-frequency data, halving the CV on (giving more weight to) the non-trawl CPUE, and estimating recruitment up until 2005. Note that the final base case brought forward the year up to which recruitment was estimated to 2004, which was also slightly more pessimistic. As for the eastern zone, increasing weighting on the length data increased the estimated biomass, whereas increased weighting on the age-length data decreased it.

Recommended Tier Level

Tier 1.

RBC Calculations

The RBC for 2009 using the 20:35:48 Tier 1 rule is 1,469t (656t from the east and 813t from the west). Projections again suggest a long term sustainable yield of over 1,600 tonnes under the 20:35:48 rule.

Additional Comments from the RAG

The outputs from the assessment were accepted by the RAG, and the group expressed its appreciation of the efforts of the assessment scientist to incorporate all the factors considered important in the model.

The RAG (including industry members) had some reservations about the large increase in RBC that the assessment is producing, but noted that any increase would be limited by the meta-rule that allows a maximum increase of 50%.

Industry members have also previously expressed the view that the western stock could not sustain higher catches than the eastern stock. The new base case, unlike the assessment last year, estimates that the long-term RBC in the west is slightly higher than in the east. Industry members were, however, generally comfortable with this on the basis that the area from which this catch could be taken included the area of the GAB that is open to the non-trawl sector.

The importance of a more detailed investigation of the changes in fishing practices in the east around 2000 was emphasised, as allowing catchability to change has a substantial impact on the assessment. The available data and industry knowledge should be used to better describe and document the nature of these changes and determine the best way to represent them in the assessment model.

Overcatch/undercatch

The RAG was of the view that a 10% allowance for overcatch/undercatch was acceptable for pink ling.

Research needs, future assessments

There is only indirect evidence of the reported changes in fishing practices that are the basis for the change in catchability in the east in 2000 that is now part of the base case. Additional work to describe and quantify the nature of these changes is needed, including whether any change is best modelled the way it is done presently (via catchability) or better done through additional factors in the CPUE standardisation or other approaches.

** SlopeRAG again proposed that that a dedicated workshop be held to investigate this for pink ling in particular, but the approach and findings could have relevance to other SESSF quota species. Such

a workshop might also help develop formal guidelines for use if similar breaks in time series are proposed for other SESSF species.

Stock structure remains uncertain, but within the SESSF there is evidence of separate stocks east and west. The previous studies on stock structure didn't include samples from the GAB and the relationship of ling in the GAB to those in the SESSF area needs to be determined. Samples from the Campbell Plateau in New Zealand could also be informative.

Other areas that would benefit from additional data and further research include:

- improve the consistency of fishery dependent data collected, in particular from areas of the GAB and from the non-trawl sector in the west,
- develop a project proposal to investigate the role of refuges for ling,
- check against New Zealand information to determine the usefulness of trawl CPUE as an indicator of abundance,
- develop a reference level for age or size structure, and
- improve estimates of size at maturity and review the information available on fecundity.

Tables and Figures

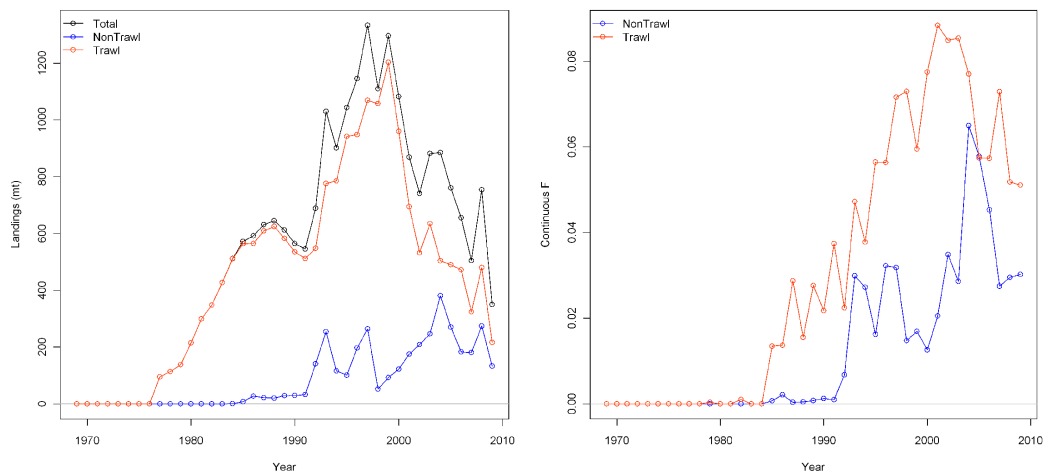


Figure 10. Landed catch for the period 1977 – 2008 for the Eastern Zone (left, black (upper) is total catch) and the Western Zone. For both zones red (middle on left, upper on right) is trawl catch and blue (lower) is non trawl catch. Some discards are included for 1998 – 2008.

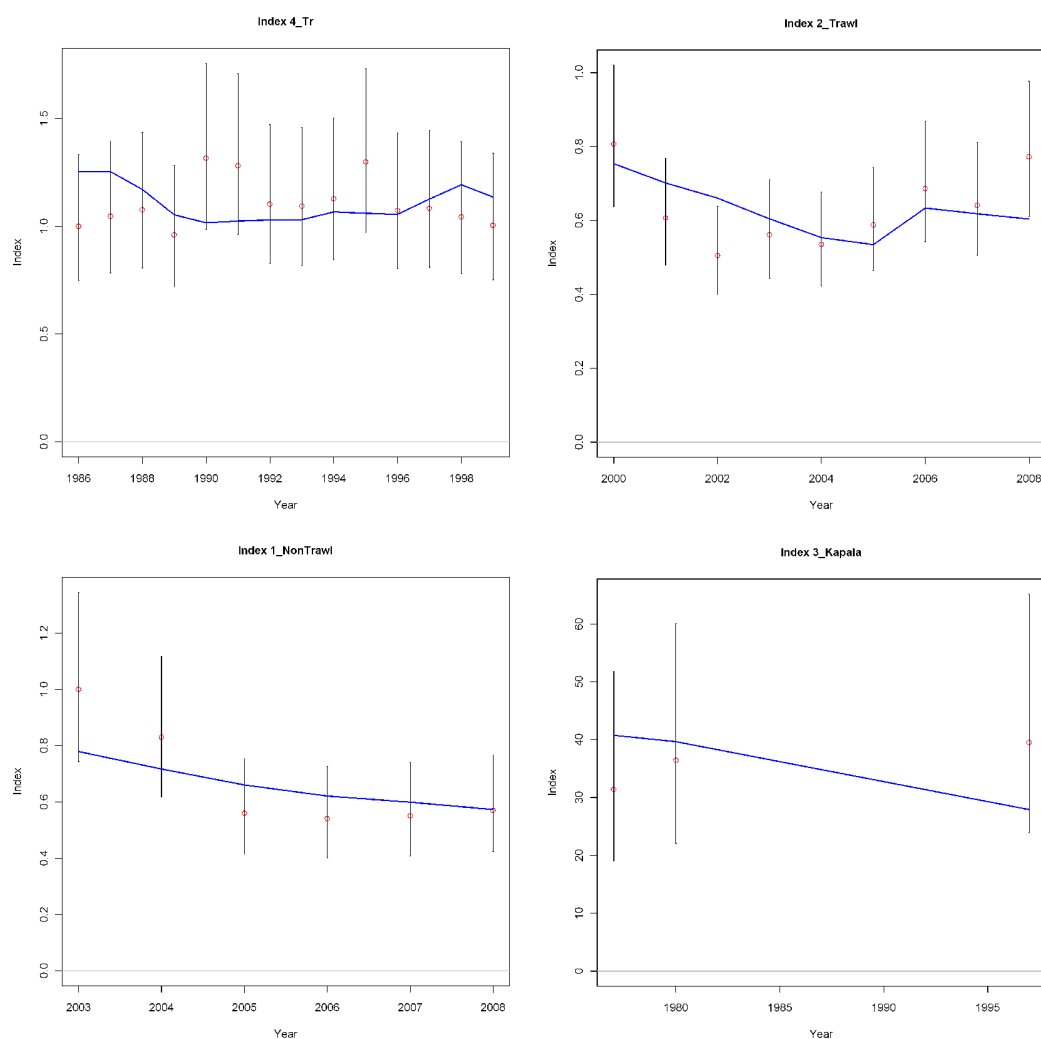


Figure 11. Observed and estimated catch rates for trawl (upper), non-trawl (lower left) and Kapala (lower right) for the Eastern Zone. The trawl series is plotted separately for the periods 1986-1999 and 2000-2008 to reflect the break in catchability that the base case now uses.

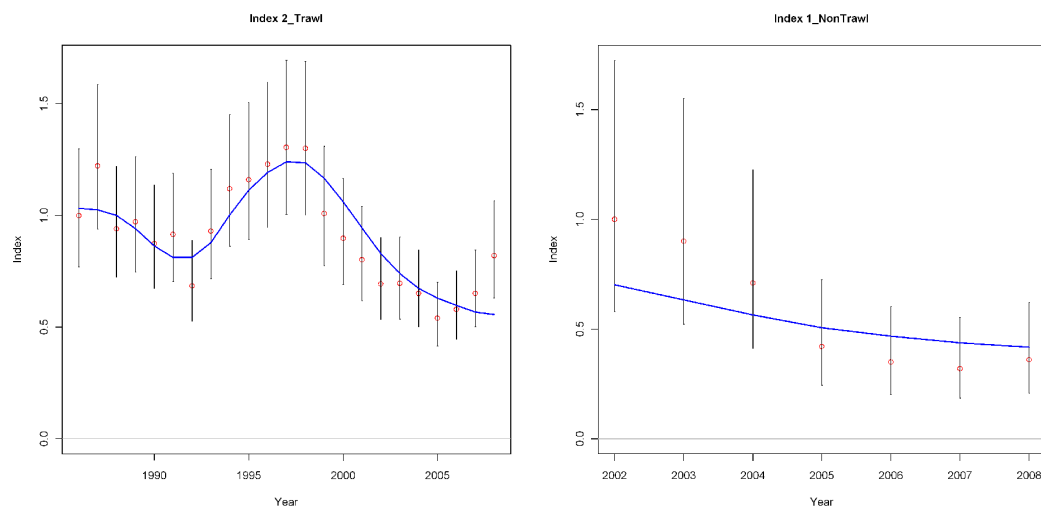


Figure 12. Observed and estimated catch rates for trawl (upper) and non-trawl (lower) in the Western Zone

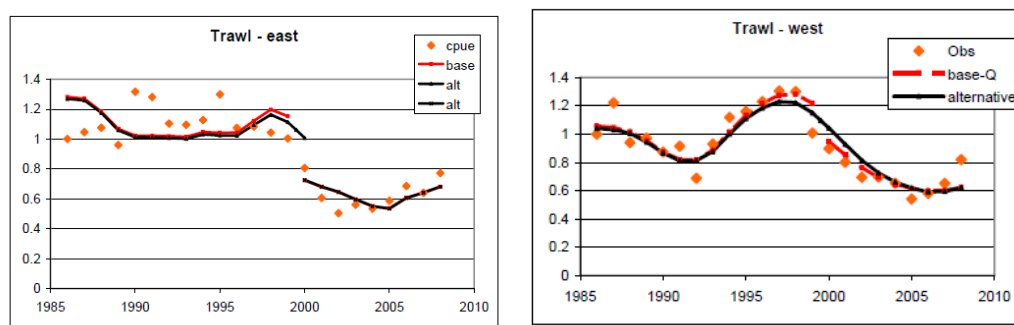


Figure 13. Comparison of trawl CPUE for the base case and the alternative case for the Eastern Zone (left) and the Western Zone (right).

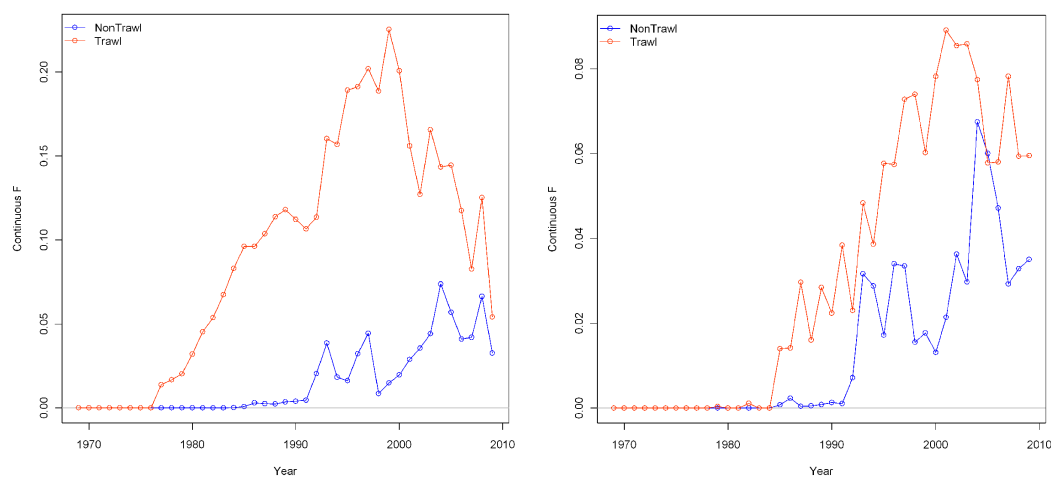


Figure 14. Harvest rate by gear type for the Eastern zone (left) and Western Zone (right). The harvest rate for trawl is red (upper) and for non-trawl is blue (lower)

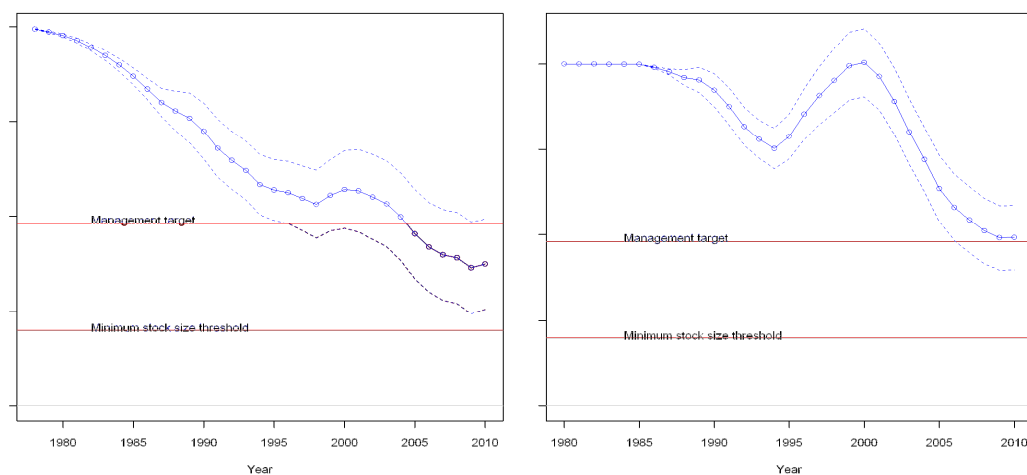


Figure 15. Trajectory of spawning biomass depletion and confidence interval relative to the target and limit reference points for the eastern zone (left) and western zone (right).

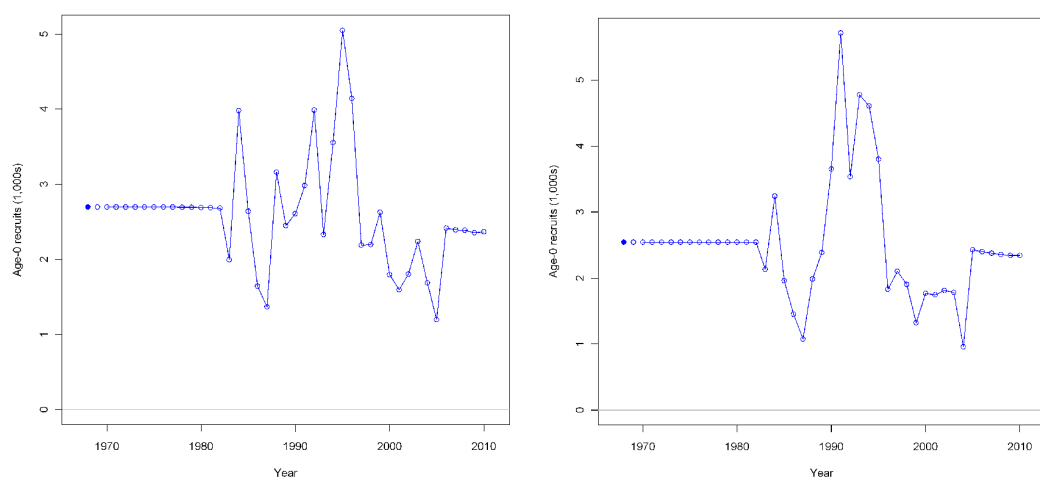


Figure 16. Annual recruitment for the Eastern Zone (left) and Western Zone (right).

Table 5. Pink ling. Reported catches (1977 to 2008) and estimated discards (1998-2006) for each zone and gear by origin (State or Commonwealth). (from Taylor 2009).

Year	Victoria				Tasmania				NSW		Discards				Commonwealth				Total catch (modelled)				
	East		West		East		West		East		East		West		East		West		East		West		Total
	Tr	NT	Tr	NT	Tr	NT	Tr	NT	Trawl	NT	Tr	NT	Tr	NT	Trawl	NT	Trawl	NT	Trawl	NT	Trawl	NT	
1977									95										95	0	0	0	95
1978									114										114	0	0	0	114
1979	1	0	3	0					136										138	0	3	0	140
1980	0	0	0	0					215										215	0	0	0	215
1981	0	0	0	0					299										299	0	0	0	299
1982	8	0	9	0					340										348	0	9	0	357
1983	8	0	0	0					419										427	0	0	0	427
1984	4	1	0	0					507										511	1	0	0	513
1985																			564	8	116	8	695
1986	1	9	0	4	18	18	3								561	0	116	0	565	27	116	23	730
1987	10	18	0	0	4	4	2								597	0	241	0	609	22	241	4	876
1988	28	15	0	0	5	5	7								590	0	127	0	625	20	127	5	777
1989	33	22	0	2	7	7	2								548	0	212	0	583	29	212	8	832
1990	17	20	0	2	10	10	3								515	0	153	0	535	30	153	12	729
1991	20	26	0	1	7	7	4								488	0	247	0	512	33	247	9	801
1992	36	114	3	0	27	58	2								510	0	145	1	548	141	148	59	896
1993	67	177	8	1	76	249	2								707	1	329	1	776	254	337	251	1,618
1994	42	33	0	0	83	228	3								740	1	307	1	785	116	307	229	1,437
1995	39	81	0	0	20	143	2								901	0	509	0	942	101	509	144	1,697
1996	36	102	0	2	94	300	6								906	1	543	2	948	197	543	304	1,992
1997		GAB			119	107	29								1,040	145	716	209	1,069	264	716	316	2,365
1998		13			1	1	48			25	17				984	51	695	152	1,057	52	725	153	1,987
1999		14			1	1	49			7	4				1,147	92	553	178	1,203	93	557	179	2,032
2000		2	0		0	0	18			6	5				936	121	653	131	960	122	658	131	1,872
2001		11	0		0	0	8			3	3				683	175	664	201	694	175	667	202	1,738
2002		0	0		0	0	15			3	0	3	0		514	208	559	314	532	209	562	314	1,617
2003		16	0		0	0	8			0	0	0	0		626	246	503	231	635	247	504	232	1,617
2004		38	61		0	0	12			1	0	1	0		491	381	413	470	504	381	414	470	1,769
2005		52	77		0	0	21			1	1	1	1		469	270	288	375	490	270	289	375	1,425
2006		34	133		0	0	15			2	0	0	0		454	183	275	272	472	183	275	272	1,203
2007		18	86		0	0	23			3					298	181	352	158	324	181	352	158	1,015
2008		1	122		0	0	32			3					445	274	262	169	480	274	262	169	1,186
2009 (assumed)															217	133	273	177	217	133	273	177	800

Table 6. Pink ling. Catch summary from SEF1 (1985-2007) and GN01 (1997-2007) by calendar year, fishing method and zone (East = 10-NSW; 20- E.Vic; 30- E.TAS. West = 40-W.Tas; 50-E.Vic/SA; 60-BassStr; 80-GAB). (from Taylor 2009).

Year	Records	Catch (t) by zone							Catch (t)			Total
		10	20	30	40	50	60	80	East	West		
SEF1												
1985	1,994	103	30	1	47	29	0		134	76	210	
1986	7,888	372	185	3	52	63	1	0	559	116	675	
1987	7,065	325	214	3	160	56	3	1	542	220	762	
1988	6,598	251	210	4	54	43	3	16	464	116	580	
1989	7,090	235	237	9	139	46	2	7	481	193	674	
1990	6,079	216	276	12	101	49	2	7	504	159	663	
1991	6,710	196	226	31	101	104	1	2	453	208	660	
1992	6,063	222	175	6	40	63	5	1	403	109	512	
1993	8,469	314	272	21	130	118	35	1	607	283	891	
1994	9,729	386	212	31	134	115	11	1	629	261	890	
1995	11,744	426	303	37	215	217	2	1	766	434	1,200	
1996	11,864	344	378	43	241	216	1	2	764	460	1,224	
1997	13,526	396	391	60	343	240	1	8	847	591	1,439	
1998	12,334	433	357	29	355	210	1	11	819	577	1,396	
1999	13,470	427	451	49	247	188	2	11	927	448	1,375	
2000	14,016	316	394	38	345	172	3	2	748	523	1,271	
2001	13,483	161	315	65	377	141	1	8	541	527	1,068	
2002	12,954	137	233	40	313	131	1	0	410	446	855	
2003	12,978	149	326	35	283	111	2	13	511	410	921	
2004	12,015	91	298	33	151	169	2	33	423	356	779	
2005	10,961	108	263	48	119	90	2	46	419	257	677	
2006	8,392	100	266	37	132	82	1	30	403	245	648	
2007	6,960	50	181	35	229	66	1	16	265	311	576	
2008	5,986	35	269	45	144	59	1	1	349	205	554	
GN01												
1997		0	98	1	91	3	50	0	100	145	245	
1998		0	39	8	79	1	61	0	47	142	189	
1999		0	79	13	101	4	75	0	93	180	273	
2000		0	80	32	50	3	67	0	112	121	233	
2001		1	30	119	131	2	39	0	150	173	323	
2002		0	50	139	253	16	16	0	189	285	475	
2003		0	119	104	193	12	4	0	222	209	431	
2004		0	218	101	271	72	1	51	320	395	715	
2005		0	177	43	142	101	0	62	220	306	526	
2006		0	145	25	89	38	1	123	170	252	422	
2007		0	121	38	60	3	1	75	159	139	298	
2008		0	163	66	35	3	2	102	229	142	371	

Note: These catches are from SEF1 and GN01, hence they differ from the catches in Table 1 which are based on SEF2 and SAN2.

These catches are scaled to the SEF2 and SAN2 totals to get total catch by region for modelling.

Zone 10 NSW; 20 E Vic; 30 E Tas; 40 W Tas; 50 E Vic / SA; 60 BS; 80 GAB

Table 7. Pink ling. Biomass estimates, depletion and RBC for the east: base case and alternative case with a range of sensitivity scenarios. (from Taylor 2009).

	-LN(L)	Female SpBio	SpBio 2,009	B2009/B0	20:35:48 rule 2,010 2,029	
East						
Base (split Q, rec 2005)	2,518	6,779	2,468	0.36	656	810
estimate recruits to 2004	2,522	7,072	2,773	0.39	784	863
estimate recruits to 2006	2,517	6,640	2,391	0.36	590	784
Alternative (split Q, 2003)	2,492	7,088	3,149	0.44	902	898
Halve weighting on LF data	2,283	6,905	2,772	0.40	797	848
Double weighting on LF data	2,894	7,251	3,506	0.48	985	930
Reduce weight on age-len data	1,874	7,760	3,687	0.48	1,008	961
Double weight on age-len	4,436	6,770	2,712	0.40	765	817
Halve CV on NT CPUE	28,833	12,062	947	0.08	0	443
Double CV on NT CPUE	2,485	7,592	3,588	0.47	975	934
Halve CV on trawl CPUE	10,731	5,439	819	0.15	0	838
Double CV on trawl CPUE	2,492	7,088	3,149	0.44	902	898
M=0.2	2,509	8,117	2,878	0.35	634	738
M=0.3	2,498	7,478	4,123	0.55	1,310	1,133
h=0.65	2,493	7,332	3,179	0.43	831	847
h=0.85	2,491	6,909	3,133	0.45	960	938
reduce sigmaR	2,492	7,088	3,149	0.44	902	898
increase sigmaR	2,492	7,088	3,149	0.44	902	898
drop 2000 from trawl cpue	2,487	7,500	3,476	0.46	952	923
break Q in 2000	2,492	7,000	3,039	0.43	877	886
estimate recruits to 2004	2,489	6,839	2,746	0.40	793	858
estimate recruits to 2005	2,482	6,826	2,594	0.38	684	815
discards in 2008,2009	2,492	7,090	3,382	0.48	897	895
no split (nil)	2,422	6,205	1,821	0.29	509	751
extra selectivity 2000-5	2,412	6,319	2,111	0.33	667	793
Alternative (split sel, 2003)	2,480	6,919	2,938	0.42	856	877

Table 8. Pink ling. Biomass estimates, depletion and RBC for the west: base case and alternative case with a range of sensitivity scenarios. (from Taylor 2009).

	-LN(L)	Female SpBio	SpBio 2,009 B2009/B0		20:35:48 rule 2,010 2,029	
West						
Base (const Q, rec 2004)	2,447	6,351	3,121	0.49	813	818
estimate recruits to 2003	2,452	6,722	3,526	0.52	967	883
estimate recruits to 2005	2,445	6,043	2,916	0.48	687	763
Alternative (const Q, 2003)	2,456	6,687	3,539	0.53	958	870
Halve weighting on LF data	2,319	4,802	2,037	0.42	642	683
Double weighting on LF data	2,709	7,542	4,194	0.56	1,099	963
Halve weight on age-len data	1,433	7,840	4,380	0.56	1,147	1,000
Double weight on age-len data	4,578	5,577	2,731	0.49	784	752
Halve CV on NT CPUE	2,466	5,914	2,817	0.48	780	763
Double CV on NT CPUE	2,453	6,886	3,729	0.54	1,006	898
Halve CV on trawl CPUE						
Double CV on trawl CPUE	2,446	6,271	3,231	0.52	897	830
M=0.2	2,465	6,266	2,885	0.46	640	652
M=0.3	2,468	7,462	4,452	0.60	1,641	1,336
h=0.65	2,456	6,788	3,576	0.53	878	801
h=0.85	2,456	6,613	3,514	0.53	1,025	928
reduce sigmaR	2,479	6,509	3,782	0.58	1,001	853
increase sigmaR	2,465	14,423	7,271	0.50	2,252	2,060
5 x wt on 2001-2005 age-len	2,680	7,025	3,711	0.53	970	886
2.5 x wt on 2001-2005 age-len	2,992	8,209	4,581	0.56	1,088	968
estimate recruits to 2004	2,453	6,404	3,208	0.50	829	819
estimate recruits to 2005	2,451	6,146	3,031	0.49	721	774
Alternative (split Q) case	2,459	8,630	5,483	0.64	1,421	1,137

Table 9. Pink ling. Spawning biomass, current and projected depletion and RBC under the 20:35:48 rule for the new base cases. Note: Depletion is the start of year value. (from Taylor 2009).

Year	East			West			Total
	SpB	B/B0	RBC (t)	SpB	B/B0	RBC (t)	RBC (t)
1965	7,088			8,631			
2006	2,836	0.42		3,685	0.58		
2007	2,698	0.40		3,453	0.54		
2008	2,645	0.39		3,248	0.51		
2009	2,468	0.36		3,121	0.49		
2010	2,536	0.37	656	3,125	0.49	813	1,469
2011	2,586	0.38	685	3,073	0.48	814	1,499
2012	2,678	0.40	709	3,058	0.48	816	1,525
2013	2,771	0.41	728	3,054	0.48	817	1,545
2014	2,849	0.42	743	3,053	0.48	818	1,560
2015	2,913	0.43	754	3,052	0.48	818	1,572
2016	2,967	0.44	764	3,052	0.48	818	1,582
2017	3,012	0.44	772	3,052	0.48	818	1,590
2018	3,050	0.45	779	3,052	0.48	818	1,597
2019	3,083	0.45	785	3,051	0.48	818	1,603
2020	3,111	0.46	790	3,051	0.48	818	1,608
2021	3,134	0.46	794	3,051	0.48	818	1,612
2022	3,154	0.47	798	3,051	0.48	818	1,615
2023	3,170	0.47	801	3,050	0.48	818	1,618
2024	3,184	0.47	803	3,050	0.48	818	1,621
2025	3,196	0.47	805	3,050	0.48	818	1,623
2026	3,205	0.47	807	3,050	0.48	818	1,624
2027	3,213	0.47	808	3,050	0.48	818	1,626
2028	3,220	0.48	809	3,050	0.48	818	1,627
2029	3,226	0.48	810	3,050	0.48	818	1,628

Table 10. Pink ling. Spawning biomass, current and projected depletion and RBC under the 20:35:48 rule for the alternative cases (East-split Q, West- single Q, 2003 recruit). Note: Depletion is the start of year value. (from Taylor 2009).

Year	East			West			Total
	SpB	B/B0	RBC (t)	SpB	B/B0	RBC (t)	RBC (t)
1965	7,088			6,688			
2006	3,151	0.44		3,792	0.57		
2007	3,039	0.43		3,563	0.53		
2008	3,102	0.44		3,473	0.52		
2009	3,149	0.44		3,539	0.53		
2010	3,401	0.48	902	3,668	0.55	958	1,860
2011	3,423	0.48	902	3,590	0.54	941	1,844
2012	3,425	0.48	900	3,519	0.53	926	1,826
2013	3,418	0.48	899	3,456	0.52	914	1,813
2014	3,410	0.48	898	3,406	0.51	906	1,804
2015	3,406	0.48	898	3,369	0.50	899	1,797
2016	3,405	0.48	898	3,341	0.50	894	1,792
2017	3,404	0.48	898	3,318	0.50	890	1,788
2018	3,404	0.48	898	3,300	0.49	886	1,784
2019	3,404	0.48	898	3,285	0.49	883	1,781
2020	3,404	0.48	898	3,272	0.49	880	1,779
2021	3,403	0.48	898	3,262	0.49	878	1,777
2022	3,403	0.48	898	3,253	0.49	876	1,775
2023	3,403	0.48	898	3,246	0.49	875	1,773
2024	3,403	0.48	898	3,240	0.48	874	1,772
2025	3,403	0.48	898	3,235	0.48	873	1,771
2026	3,403	0.48	898	3,231	0.48	872	1,770
2027	3,403	0.48	898	3,227	0.48	871	1,770
2028	3,403	0.48	898	3,225	0.48	871	1,769
2029	3,403	0.48	898	3,222	0.48	870	1,768

2009 Stock Assessment Report for Mirror dory *Zenopsis nebulosus*

RAG undertaking the assessment: SlopeRAG

Stock structure

Uncertain - probably separate stocks east and west of Bass Strait, but a single stock currently assumed for assessment purposes.

Biological indicators

Biological productivity: High

Trophic level: 3

Associated species: eastern gemfish - depleted, ling, redfish, ocean perch

Percentage of otter trawl catch targeted: 13 % (1985-2004, includes earlier gemfish fishery)

Suggested environmental drivers: Yes but not defined

Recent catch history

	2004	2005	2006	2007 ¹	2008 ¹	2009 ¹
Agreed TAC (Global)	640	700	634	634	634	718
Actual TAC (Global)	562	736	686	669	689	761
Trawl catch (SEF2 Comm.)	522	590	405	307	442	
Trawl Catch (SEF2 State)	0	0	0	0	0	
Non-trawl catch (SAN2)	<1	0	0	0	0	
% actual TAC	93	80	59	46	64	
Estimated discards (SET)	170	53	27	<1	88	
% Discards (SET)	16	7	13	<1	16	
Estimated discards (NT)	0	0	0	0	0	
% Discards (NT)	0	0	0	0	0	
Trawl catch (GAB-logbook)	9	3	5	2	<1	
State catch	95	70	85	26	22	
Total catch	795	717	521	333	464	

¹ 2007 TACs are for the 12 months to December 2007. 2008 & 2009 TACs are for the new fishing year (May to April)

Synopsis of 2008 fishery

The landed catch declined 442t (of which about 85% was taken in the east) for the 2008 calendar year, up from the 307t caught in the 2007 calendar year. At the end of the quota year (April 2009) the landed catch was 430t which represented 62% of the actual TAC. The State catch was again reduced and comprised 5% of the total landings in 2008.

Industry members reported no particular issues with catches of mirror dory this year but have previously noted that the total catch has been limited by the low quota for eastern gemfish which are caught at similar depths. The ready availability of, and good prices for, flathead has also been proposed as a reason for fishers not chasing mirror dory. The depth distribution of the mirror dory catch was tightly constrained to the 300-550m depth band, with a smaller proportion of the catch coming from shallower depths than in previous years.

Discarding of small fish as a result of high-grading has been an issue for mirror dory. The estimate of discards for 2008 was 16%. Industry had reported last year that there were a lot of small fish around and expected that discarding levels would be high in 2008 but the recorded discard rate is comparable with levels recorded in 2003, 2004 and 2006. The length frequency distributions show that mirror dory of 25-35 cm were mostly discarded but do not clearly indicate a strong cohort of younger fish.

2009 Assessment

An exploration of the data available for mirror dory has been undertaken (Thomson and Fay 2009) as a prelude to the development of a Tier 1 assessment in SS3. This has identified some previously unknown potential issues with the representativeness of the sampling of mirror dory. Some text from the summary of this report is quoted below.

"There appear to be differences in the data with respect to sex, with males representing less than 25% of the sexed aged sample. The male sample is smaller and younger than the female sample, with a scarcity of older males. Observed differences by sex may be a result of the low sample size, but also could reflect gender-specific values for one or more of natural mortality, availability to fishing gear, and growth."

"Length composition data appears to have adequate coverage from 1998 onwards for both port-based and onboard sampling, although there are some years for which the monthly and spatial coverage of the sampling are lacking. In general, size composition data are consistent between the port and onboard data, with variability in recruitment strength and cohort progression being evident."

The data in Thomson and Fay (2009) also confirmed industry reports that fish caught in the eastern zones are generally smaller than those caught in the west. "The mean size of fish in both port and onboard samples is smaller in the eastern zones than in the west, although the port sampling suggests the presence of fish of comparable size to those in western zones off East Tasmania."

SlopeRAG was advised that a discrepancy had emerged between the yield-per-recruit parts of the Tier 3 assessment model and the maximum age of 11 years indicated in the ageing data. In the east, the Tier 3 assessment indicated that recent F levels are well below target levels, whether the assessment used the size or age data (Figure 17). In the west, however, the analysis using the size composition data indicated that recent F levels are also below target levels, but the analysis with the age composition data indicated that recent F levels are well above limit levels.

This indicated that there were issues with the estimates of either the growth parameters or natural mortality in the assessment. Additional and more representative sampling of the age and size composition of the catch should help resolve this issue. Thomson and Fay (2009) also confirmed that obtaining more recent and representative sampling of the age composition of the catch is a high priority if the species is to be assessed using either a Tier 1 or Tier 3 approach.

An additional problem noted with the Tier 3 approach was that it uses a combined growth model for both sexes, but there are major growth differences between males and females. There may also be different growth rates east and west which are also not accounted for by the Tier 3 assessment. It is uncertain what effect this has on the assessment outputs. An appropriately structured SS3 model would be able to account for these differences.

SlopeRAG also examined the results of the Tier 4 assessment for mirror dory, partly because of the concerns about the Tier 3 assessment but also because the BRS now used the Tier 4 assessments for Tier 3 species to determine whether they were overfished or not. SlopeRAG first examined catches and catch rates for the default reference period of 1984-1996 and decided that, although catch rates were declining over the latter part of this period, there were no compelling reasons not to use it as the reference period. Mirror dory were also regarded as likely to be fully fished by this time given the length of time that they had been part of the fishery prior to 1984. The Tier 4 assessment (Figure 18 and Table 11) indicated that the CPUE was increasing and that recent average CPUE was close to the target levels and so under Tier 4 mirror dory would not be considered overfished. Since 2001, annual landings have averaged over 600 t yet CPUE has substantially increased over this time. This suggests that the average catch during the Tier 4 reference period of 487 t is a conservative catch level.

Recommended Tier Level

Tier 3.

RBC Calculations

The RBC estimated for mirror dory was 1,196 t by the Tier 3 harvest control rule, compared with the previous RBC of 906 t last year and the recent TAC of 634 t.

The RBC estimated from the Tier 4 assessment was 381 t.

Additional Comments from the RAG

SlopeRAG was not comfortable with the increase in RBC indicated by the latest Tier 3 assessment given the issues raised with this assessment (particularly the source of the ageing samples) and that the suggested RBC is well above all historical catch levels. It was noted that the current form of the Tier 3 harvest control rule does not have a cap on the maximum catch allowed like the Tier 4 assessment does and agreed that such a cap was probably warranted.

There were, however, no indicators that suggested a need to reduce catches as would be needed if the Tier 4 assessment was used to calculate the RBC.

SlopeRAG recommended that the current TAC for mirror dory be maintained for one year while efforts are made to develop a Tier 1 assessment or the issues with the Tier 3 assessment are resolved.

Given the generally positive indicators, maintaining the current TAC was not considered to be a risk to the stock of mirror dory, and there is a good chance that the assessment issues can be quickly resolved if new data on age composition become available.

Discount factor

SlopeRAG considered that, if the TAC is maintained at current levels instead of increasing as the Tier 3 assessment indicates, the application of an additional discount factor is not warranted.

Overcatch/undercatch

SlopeRAG considered that the application of the default 10% level for overcatch and undercatch was reasonable for mirror dory in the current circumstances.

Research needs, future assessments

There is an urgent need to update the estimates of the age composition of the catch and to ensure that samples for size and age are obtained for both the eastern and western parts of the fishery and are representative of the catch.

Further investigation of stock structure for mirror dory is also a priority, particularly whether there are separate stocks east and west of Bass Strait.

Tables and Figures

See also BRS report (Hobsbawn 2009 p 23).

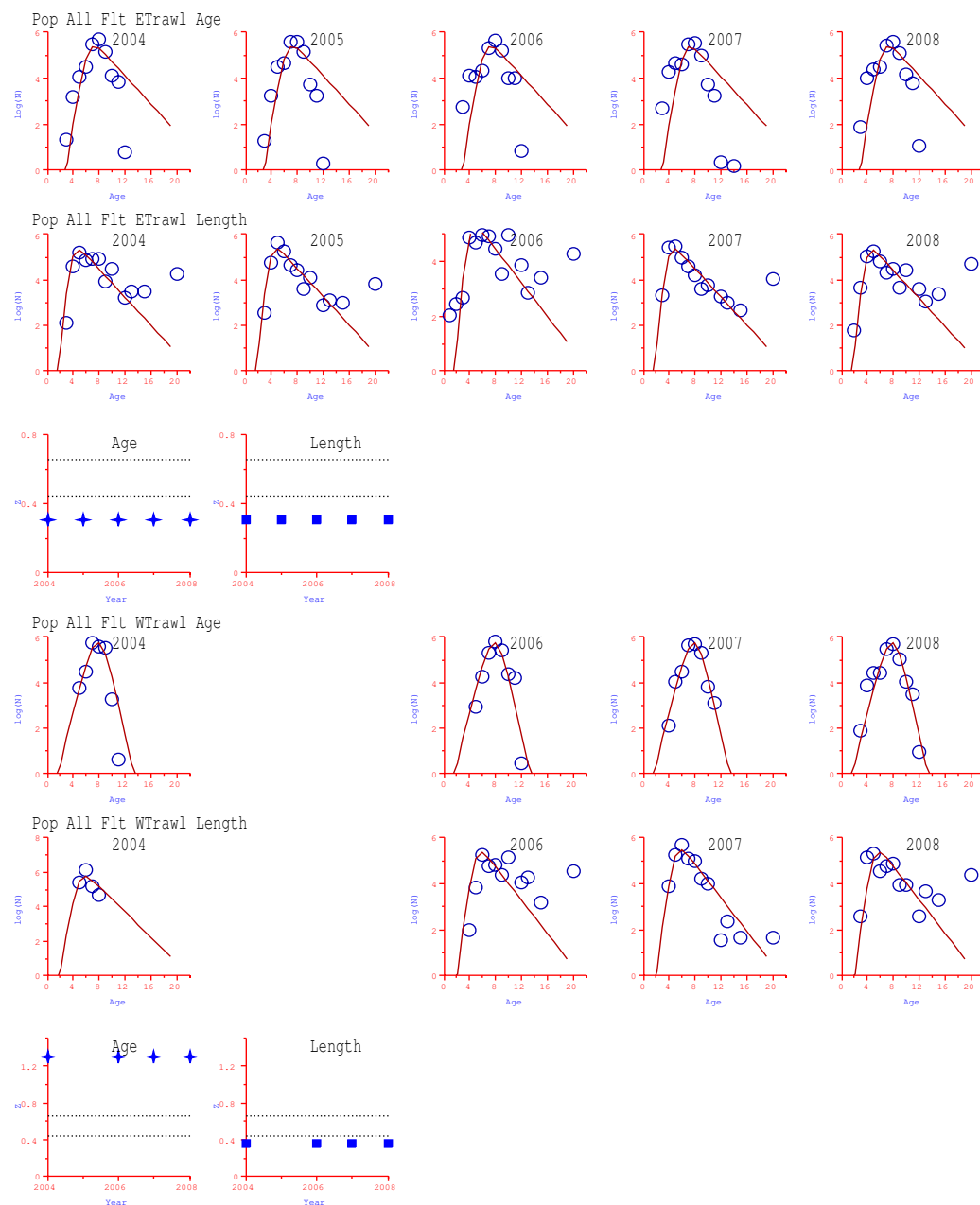


Figure 17. Mirror dory catch curve results from the Tier 3 analysis. (from Klaer 2009)

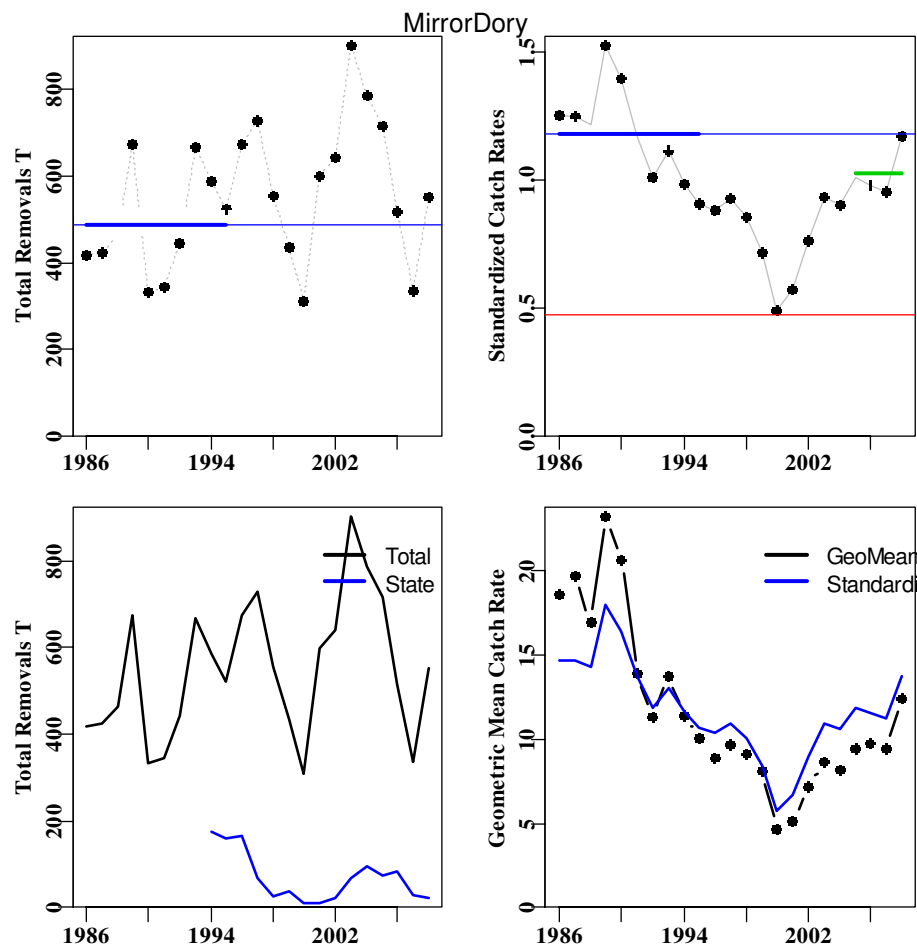


Figure 18. Mirror Dory. Top left is the total removals with the fine line illustrating the target catch. Top right represents the standardized catch rates with the upper fine line representing the target catch rate and the lower line the limit catch rate. Thickened lines represents the reference period for catches, catch rates, and the recent average catch rate (green) (from Haddon, 2009b).

Table 11. RBC calculations for Mirror Dory. C^* and $CPUE_{targ}$ relate to the period 1986-1995, $CPUE_{Lim}$ is 40% of the target, $C_{max} = 1.25 C^*$, and is the average catch rate over the last four years. The RBC calculation does not account for predicted discards of predicted State catches or recent CPUE adjustments.

1 st Reference Year	1986
2 nd Reference Year	1995
C^*	487.406
C_{max}	609.258
$CPUE_{targ}$	1.1838
$CPUE_{Lim}$	0.4735
$\overline{CPUE}$	1.0294
Scaling Factor	0.7826
Wt_Discard	9.696
RBC	381.448

2009 Stock Assessment Report for Ocean perch *Helicolenus spp.*

RAG undertaking the assessment: SlopeRAG

Stock structure

Uncertain but there is probably an east/west structuring of stocks. A single TAC is set for the two distinct species: the inshore species *H. percoides*, also known as coral cod, and the offshore species *H. barathri*).

Biological indicators

Biological productivity: Low
 Trophic level: 4
 Associated species: ling, royal red prawn, blue grenadier
 Percentage of otter trawl catch targeted: 10%
 Suggested environmental drivers: Not examined

Recent catch history

Inshore and offshore spp combined.

	2004	2005	2006	2007 ¹	2008 ¹	2009 ¹
Agreed TAC (Global)	500	500	500	417	500	400
Actual TAC (Global)	538	542	540	438	546	446
Trawl catch (SEF2 Comm.)	277	273	184	173	183	
Trawl Catch (SEF2 State)	0	0	0	0	0	
Non-trawl catch (SAN2)	66	35	56	34	38	
% actual TAC	64	57	44	47	42	
Estimated discards (SET)	41	17	21	24	27	
% Discards (SET)	10	9	16	10	7 ²	
Estimated discards (NT)	2	0	<1	0	0	
% Discards (NT)	2	0	<1	0	0	
Trawl catch (GAB-logbook)	19	30	34	16	8	
State catch ²	20	15	19	10	17	
Total catch	425	369	305	241	238	

¹ 2007 TACs are for the 12 months to Dec 2007. 2008 & 2009 TACs are for the new fishing year (May to April)

² 7% for the offshore *H. barathri*., 29% for the inshore *H. percoides*.

³ Most of the State catches are *H. barathri* but they include an unknown proportion of *H. percoides*.

H. barathri have comprised a significant catch by NSW trawlers since the continental slope fishery developed in the late 1960s and early 1970s. On average *H. barathri* are larger than the inshore ocean perch *H. percoides*, and the offshore form has comprised the majority of landings by the trawl fishery. Small quantities of offshore ocean perch are also taken by dropline off NSW. Annual landings off NSW have varied between 200 and 400 t since the 1970s (Rowling 2008).

Offshore ocean perch live to at least 62 years old but in the east most fish in the catch are now between 6 and 13 years of age and in the west they are between 6 and 20 years of age but with significant numbers of fish between 20 and 50 years old. It is likely that the difference in age structure reflects the higher fishing pressure in the eastern regions of the SEF, and is indicative of there being separate stocks in the two areas. Most of offshore ocean perch discarded in the eastern region consist of fish less than 10 years old.

Synopsis of 2008 fishery

The landed catch for the 2008 calendar year was 210 t for offshore ocean perch and 27 t for inshore ocean perch. At the end of the quota year (April 2009) the landed catch was 231 t (for both species) which represented 42% of the actual TAC. This continued lower catches have been attributed in part to the decline in fishing effort off NSW.

Discard rates had increased from 9% in 2005 to 16% in 2006 and in 2008 were estimated to be 29% for the inshore species and 7% for the offshore species.

The auto-longline sector takes a minor component of the total catch of the offshore species. This had been expected to increase but after peaking at 66 t in 2004 the catch by this sector has since been between 29 t and 46 t. It has been reported that the catch by this sector was from different areas than the catch taken by trawlers.

Ocean perch is generally regarded as a bycatch species but there has been some limited targeting.

No comments were received on the 2008 fishery to suggest that there have been any significant changes in the fishery for ocean perch.

2009 Assessment

Interpretation of landed catch rates has been confounded by the inclusion of two species and by the high discard rates particularly for the inshore species. This year SlopeRAG decided that it should base its advice on separate analyses of the inshore and offshore species. It was concerned that having a combined analysis could mask adverse trends, particularly for the inshore species, and that a depleted inshore species could adversely impact on industry's ability to target other species. The RBC was therefore to be the sum of the RBCs calculated separately for the two species. It was acknowledged that this will most likely make little difference to the final RBC, because the inshore species comprises a small proportion of the catch, but it was felt that it was important to be seen to be monitoring the status of both species independently.

Virtually all the ocean perch catch is taken between depths of 100-650 m. Although the precise depth distributions of each species are unknown, and the species caught are not recorded in logbooks, a 250m depth criterion has been used to separate the catches of the two species. After further discussion of the issue and inspection of the depth distribution of the catches, it was agreed to change this and to use 300 m as the basis for classifying catches.

SlopeRAG agreed that both species of ocean perch should be assessed as Tier 4 species again this year using the default period of 1986-1995 as the reference period for calculation of the target CPUE level and the reference catch level (Figure 19). Both species were to be regarded as having been fully fished by the period.

Inspection of the catch series for ocean perch identified some potential double counting of catches over several years before 1994 with fishers reporting the same catches to NSW and AFMA. It was not possible to fully resolve this issue during the RAG meeting but it was agreed that the relevant parties should consult out of session to review and revise the catch series and that this revised catch series should be used as a basis for the Tier 4 assessment. This work has been completed and the revised catch series has been used as the basis of the RBC calculations reported here. The data series of reported catches therefore differ from those previously used. The changes include splitting the reported landings between Offshore and Inshore Ocean perch relative to the Commonwealth log book catches for the two depth ranges. This increased the total catches reported, but these data are now considered to be the best available information on Ocean Perch catches.

It had been suggested that ocean perch may be able to be elevated to a Tier 3 species this year, but this has not yet been accomplished and there will need to be careful consideration on how to take account of the two species and the east/west differences in age structure.

Recommended Tier Level

Tier 4

RBC Calculations

The RBC calculated was 244 t comprising 25 t for the inshore species and 219 t for the offshore species.

Additional Comments from the RAG

There were no additional comments from the RAG on the assessment for ocean perch but RAG members had not seen the new Tier 4 assessment prior to the completion of this draft document.

The RAG requested that the two species be examined separately in part to allow examination of the

status of each individual species. The Tier 4 analyses indicate that both species are above the limit reference points although both require some rebuilding to achieve target levels. The inshore species shows the greater level of depletion in the past but CPUE has been increasing in four of the past five years. CPUE for the offshore species has been relatively stable for the past 14 years but at a level that is below the Tier 4 target.

Discount factor

SlopeRAG considers that the 15% discount factor be applied to ocean perch. Although the catch and catch rates have been stable or increasing the truncated size and age compositions in the east are an indication that the fishery has had a substantial impact on the stock. It is noted, however, that a 15% reduction in the TAC is unlikely to reduce catches which have historically been well below the TAC.

Overcatch/undercatch

SlopeRAG considered that a 10% allowance for overcatch/undercatch was acceptable for ocean perch.

Tables and Figures

See also BRS report (Hobsbawn 2009 p 27)

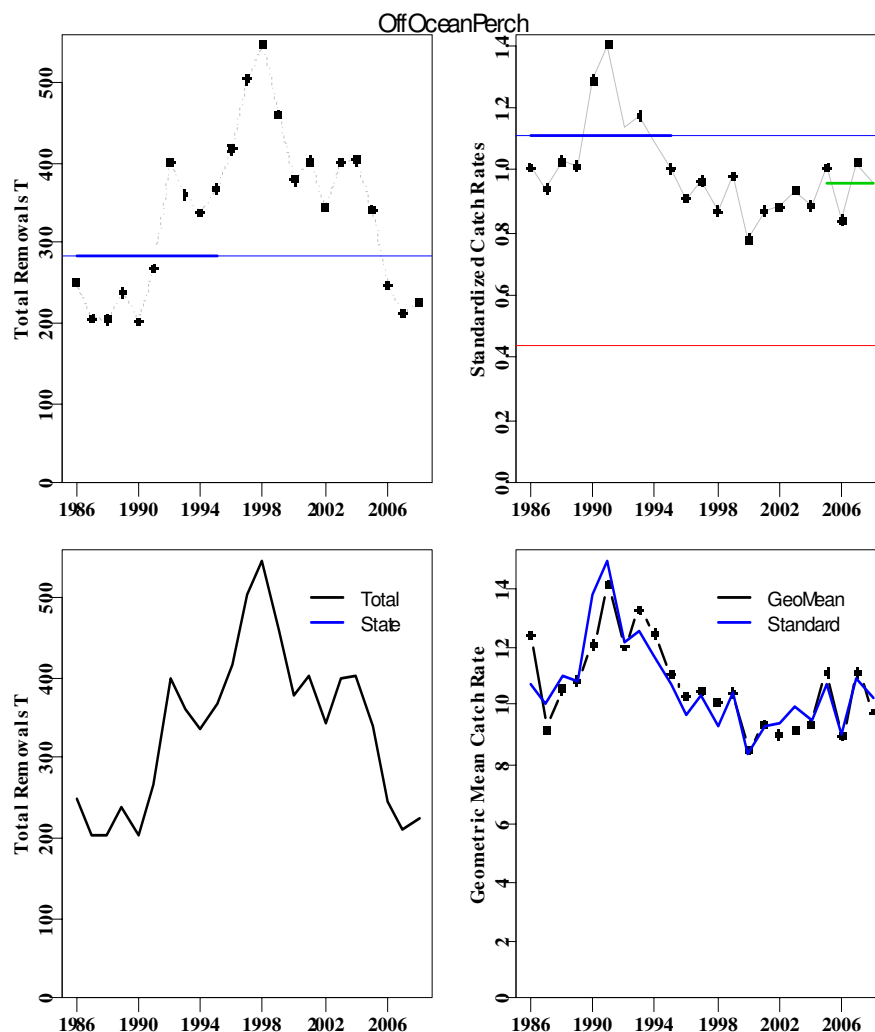


Figure 19. RBC calculation. Offshore Ocean Perch. Top left is the total removals with the fine line illustrating the target catch. Top right represents the standardized catch rates with the upper fine line representing the target catch rate and the lower line the limit catch rate. Thickened lines represents the reference period for catches, catch rates, and the recent average catch rate (green) (from Haddon, 2009b).

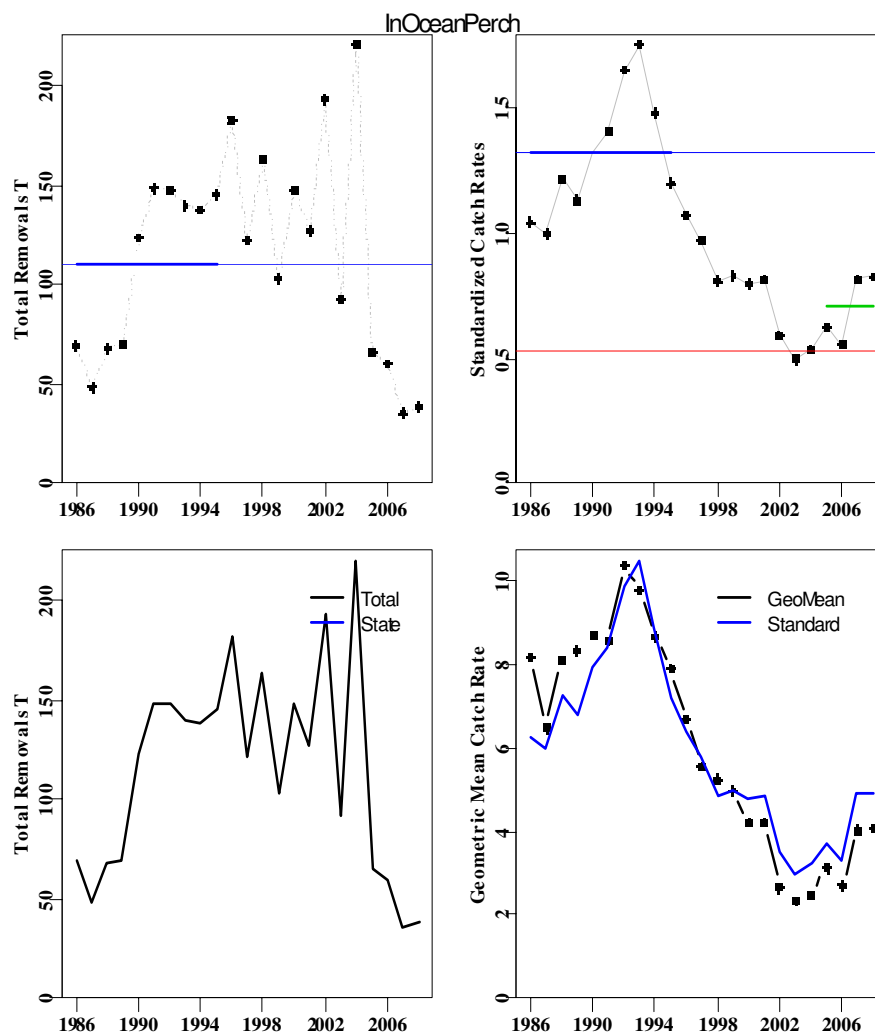


Figure 20. RBC calculation. Inshore Ocean Perch. Top left is the total removals with the fine line illustrating the target catch. Top right represents the standardized catch rates with the upper fine line representing the target catch rate and the lower line the limit catch rate. Thickened lines represents the reference period for catches, catch rates, and the recent average catch rate (green) (from Haddon, 2009b).

Table 12. RBC calculations for Offshore Ocean Perch. C^* and $CPUE_{targ}$ relate to the period 1986-1995, $CPUE_{Lim}$ is 40% of the target, $C_{max} = 1.25 C^*$, and is the average catch rate over the last four years. The RBC calculation does not account for predicted discards of predicted State catches, the discount factor or recent CPUE adjustments.

1 st Reference Year	1986
2 nd Reference Year	1995
C^*	283.202
C_{max}	354.003
$CPUE_{targ}$	1.1087
$CPUE_{Lim}$	0.4435
$\overline{CPUE}$	0.9589
Scaling Factor	0.7747
%Wt_Discard	7.684
RBC	219.41

Table 13. RBC calculations for Inshore Ocean Perch. C^* and $CPUE_{targ}$ relate to the period 1986-1995, $CPUE_{Lim}$ is 40% of the target, $C_{max} = 1.25 C^*$, and is the average catch rate over the last four years. The RBC calculation does not account for predicted discards of predicted State catches, the discount factor or recent CPUE adjustments.

1 st Reference Year	1986
2 nd Reference Year	1995
C^*	109.802
C_{max}	137.253
$CPUE_{targ}$	1.323
$CPUE_{Lim}$	0.5292
$\overline{CPUE}$	0.7089
Scaling Factor	0.2264
%Wt_Discard	25.717
RBC	24.858

2009 Stock Assessment Report for Ribaldo *Mora moro*

RAG undertaking the assessment: SlopeRAG

Stock structure

One stock of ribaldo is assumed for the SESSF.

Biological indicators

Biological productivity: Medium/Low?

Trophic level: Not examined

Associated species: ling

Percentage of otter trawl catch targeted: Not examined

Suggested environmental drivers: Not examined

Recent catch history

	2004	2005	2006	2007 ¹	2008 ¹	2009 ¹
Agreed TAC (Global)		100	165	165	165	165
Actual TAC (Global)		100	165	165	189	178
Trawl catch (SEF2 Comm.) ²	97	53	44	25	26	
Trawl Catch (SEF2 State)	0	0	0	0	0	
Non-trawl catch (SAN2)	103	52	73	36	71	
% actual TAC		105	71	37	51	
Estimated discards (SET)	15	21	3	5	5	
% Discards (SET)	14	28	6	16	³	
Estimated discards (NT)	1	1	<1	0	0	
% Discards (NT)	<1	1	<1	0	0	
Trawl catch (GAB-logbook)	8	21	23	29	<1	
State catch	<1	<1	0	0	0	
Total catch	220	142	138	66	97	

¹ 2007 TACs are for the 12 months to Dec 2007. 2008 & 2009 TACs are for the new fishing year (May to April).

² Catches of ribaldo have been inconsistently reported in SEF1 and SEF2 returns. A combination of the two data sources is reported here.

³. No reliable estimate of discards available for 2008.

The early catches of ribaldo were considered to be largely as a bycatch of fishing for orange roughy but has been increasingly targeted. Up to 2000 most of the catch has been taken at depths of more than 700m. Since then there has been a gradual shift to catches from depths of less than 600m and the depth distribution of the catch has become bimodal.

Synopsis of 2008 fishery

The landed catch has declined from a peak of 180 t in 2004 to 74 t for the 2008 calendar year, down slightly from the 2007 catch of 77 t as a result of a decline in landings from the trawl sector (Figure 21). At the end of the quota year (April 2009) the landed catch was 115 t which represented 61% of the actual TAC. Industry reported that one factor in TAC not being caught in 2008 was that there had been a lack of trawl effort targeting other species found at the depths ribaldo was often caught (orange roughy and deepwater sharks). Since 2006 there has been a marked shift to shallower water in the depth distribution of the catch of ribaldo (Hobsbawn 2009 p 11).

Last year it was reported that the ribald catch was down because it was a good year for blue eye for the non-trawl sector and that these are a preferable species. Catching ribaldo requires a setting gear close to the bottom whereas for blue eye the gear are off the bottom. Very small catches were now taken from depths below 700m in 2007 due to the closure to trawling below this depth.

Discard rates had decreased from a high of 28% in 2005 to 6% in 2006. Discards make up approximately 10.58 % of the catch over the 1998-2007 period. There were too few observed shots in the trawl sector to obtain an estimate of discards in both 2007 and 2008. In the GAB trawl fishery the discard rate was estimated to have been 5% in 2007.

Industry reported in 2008 that a lot of small fish had been evident in catches, mainly south of Eden, NSW and that when the economic value of ribaldo is low industry tend to move out of these fishing grounds where the fish congregate. There is some evidence in the length-frequency distributions of more smaller fish being caught in 2006 but there were too few data in 2007 to reliably assess the recent size composition of the catch. In 2008 the size distribution included more large fish than had been recorded in earlier years.

2009 Assessment

Ribaldo had been assessed as a Tier 3 species up until 2008. In 2008 SlopeRAG was advised, however, that under the new Tier 3 harvest control rule, it was necessary for the period used for the calculation of the current level of fishing mortality firstly, to be the same as used for the calculation of current catch, and secondly, for all the age classes included to have been exposed to this fishing mortality from the age at first recruitment. The age composition data available indicated that ribaldo live to over 50 years old and were not fully recruited to the fishery until about 17 years old. Catches had only been above very low levels for less than 10 years meaning that abundance of most age classes in the fishery have been subject to fishing for only a part of their life. Their relative abundance therefore would not provide a good estimate of the current level of fishing mortality, and the Tier 3 harvest control rule should not be applied.

Accordingly, SlopeRAG examined data on CPUE as the basis for a Tier 4 assessment. Standardised CPUE for the trawl sector shows a consistent decline from the late 1980s until 2007 with a slight increase in 2008 (Figure 22). The early and largest part of this decline, however, corresponds to a period when catches were less than 50t and the stock would have been only lightly exploited. The period of high catches between 2002 and 2004 (Figure 22) was reported to be when there was pressure to build catch history in anticipation of the introduction of TACs for ribaldo.

In 2008 members of SlopeRAG considered that there is no period in this time series that would represent an appropriate reference period for Tier 4 harvest control rule to be applied.

In 2009 SlopeRAG also were concerned with the best way to account for the fact that large areas from which ribaldo were previously caught were now closed to fishing. Options considered included removing all data from these areas from the CPUE series, as is done for some other species. It was noted that adopting this method would imply that there was minimal movement between closed and open areas. SlopeRAG was not aware of any information on movement rates for ribaldo to assess whether such an assumption is warranted.

Nevertheless, SlopeRAG examined the results from the updated Tier 4 assessment.

Recommended Tier Level

None of the current tier levels are now considered applicable to ribaldo.

RBC Calculations

In line with the approach used for other SESSF species, calculations had been done using the period from 1995-2004 as the reference period (when catches first approached 100t) and considering the stock to be lightly exploited at this time. This analysis produced an RBC of 160 t (Table 14) which is substantially less than the 2008 RBC of 210 t but close to the current TAC of 165 t.

Additional Comments from the RAG

SlopeRAG had previously expressed the view that the combination of changes in the history of the fishery for ribaldo mentioned above meant that SlopeRAG did not have confidence that the standardised CPUE series from trawling reflected changes in abundance. As this is the primary assumption behind the Tier 4 harvest control rule the RAG did not support its application as a basis for calculating the RBC.

Instead, a continuation of the current TAC of 165 t was proposed while awaiting further guidance on the best way to undertake a Tier 4 analysis for this species (in particular how to account for the introduction of areas that are closed to trawling on the CPUE series).

There were also concerns expressed about the best way to deal with the catches from a relatively unexploited species in what becomes the reference period for a Tier 4 species.

Discount factor

SlopeRAG considered the uncertainty surrounding the calculation of a sustainable catch meant that it would be appropriate to apply the default 15% discount for Tier 4 species.

Overcatch/undercatch

The default 10% overcatch and undercatch values were considered to be appropriate for ribaldo.

Research needs, future assessments

Guidance is needed about the best way to account for the potential impact of closed areas on CPUE for ribaldo and the level of protection afforded by such areas.

Improved estimates of *M* would be provided by additional estimates of the age composition of a ribaldo population that has not been subjected to significant fishing pressure. More information on the basic biology of ribaldo and representative samples of the age and length composition will also be essential for an eventual progression to a Tier 3 assessment. Such information, however, will not be able to be incorporated into a Tier 3 assessment for a number of years.

Tables and Figures

See also BRS report (Hobsbawn 2009 p 11)

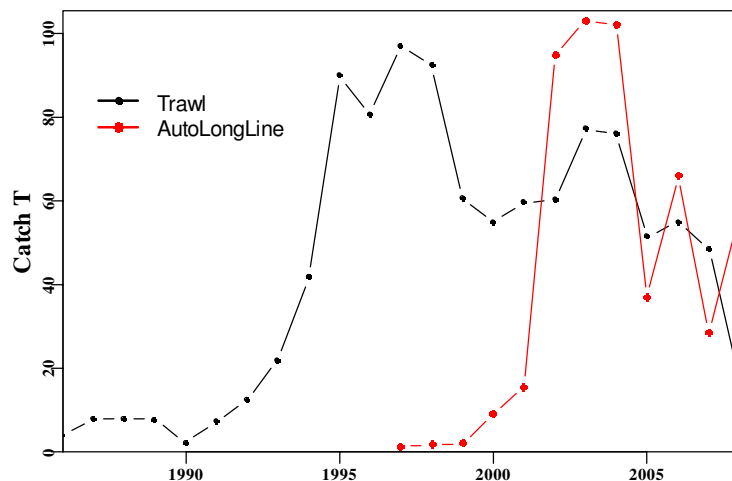


Figure 21. Ribaldo, all zones 10-50, plus the GAB and north of Barrenjoey. Catches by the two main methods, trawl and AutoLongLine. As with trawling, most catches by AutoLongLine are taken in zones 20-50.

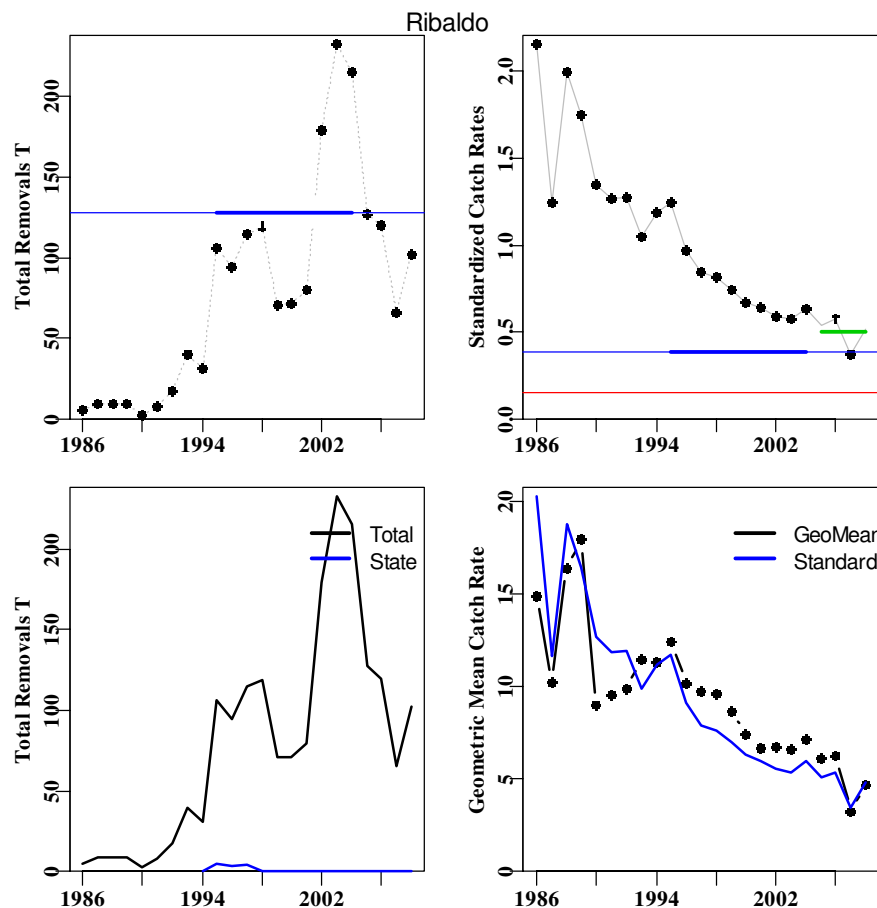


Figure 22. Ribaldo. Top left is the total removals with the fine line illustrating the target catch. Top right represents the standardized catch rates with the upper fine line representing the target catch rate and the lower line the limit catch rate. Thickened lines represents the reference period for catches, catch rates, and the recent average catch rate (green) (from Haddon, 2009b).

Table 14. RBC calculations for Ribaldo. C^* and $CPUE_{\text{targ}}$ relate to the period 1995-2004, $CPUE_{\text{Lim}}$ is 40% of the target, $C_{\text{max}} = 1.25 C^*$, and is the average catch rate over the last four years. The RBC calculation does not account for predicted discards of predicted State catches, discount factor or recent CPUE adjustments.

1 st Reference Year	1995
2 nd Reference Year	2004
C^*	128.306
C_{max}	160.383
$CPUE_{\text{targ}}$	0.3862
$CPUE_{\text{Lim}}$	0.1545
$\overline{CPUE}$	0.5010
Scaling Factor	1.4955
%Wt_Discard	5.946
RBC	160.383

2009 Stock Assessment Report for Silver warehou *Seriolella punctata*

RAG undertaking the assessment: SlopeRAG

Stock structure

A study has been completed on the stock structure of silver warehou using genetics (mtDNA), morphology, otolith shape and otolith microchemistry. Results did not indicate the presence of separate stocks east and west of Bass Strait although there were indications of some structuring around Tasmania. This study together with other information suggests that silver warehou should be considered as a single stock in the area of the SESSF.

Biological indicators

Biological productivity: Medium

Trophic level: 2

Associated species: blue grenadier, ling, blue warehou

Percentage of otter trawl catch targeted: 56%

Suggested environmental drivers: Not examined

Recent catch history

	2004	2005	2006	2007 ¹	2008 ¹	2009 ¹
Agreed TAC (Global)	4,039	4,400	4,400	3,227	3,227	3,000
Actual TAC (Global)	4,478	4,400	4,775	3,227	3,603	3,249
Trawl catch (SEF2 Comm.)	3,311	2,908	2,362	2,004	1,522	
Trawl Catch (SEF2 State)	<1	0	0	0	0	
Non-trawl catch (SAN2)	<1	<1	<1	<1	<1	
% actual TAC	74	66	49	62	42	
Estimated discards (SET)	1,183	435	96	171	47	
% Discards (SET)	21	6	4	8	3	
Estimated discards (NT)	0	0	0	0	0	
% Discards (NT)	0	0	0	0	0	
Trawl catch (GAB-logbook)	13	33	70	19	3	
State catch	4	4	2	4	<1	
Total catch	4,510	3,378	2,532	2,187	1,523	

¹ 2007 TACs are for the 12 months to Dec 2007. 2008 & 2009 TACs are for the new fishing year (May to April).

Synopsis of 2008 fishery

The catch increased to over 4,000 t in 2003, but has since declined and was lower in 2008 than 2007 which was the lowest since 1993. The previous increases were largely due to catches taken on the west coast of Tasmania associated with the blue grenadier spawning fishery. The percentage of the TAC caught ranged between 61% and 77% between 2002 and 2005 but fell to 49% in 2006. The landed catch at the end of the 2008/09 fishing year was 1,545 t which represented 43% of the actual TAC.

Industry members again reiterated that marketing of the species remains a problem and that the species provides a relatively low economic return, which has also been impacted by the high value of the Australian dollar. These factors were considered to be responsible for the failure of the TAC to be caught and also, in part, responsible for the relatively high levels of discarding in the past. Industry had previously expressed its belief in the robust condition of the stock, but AFMA reported that they received some expressions of concern about the status of silver warehou from some industry members.

Discard levels have fallen from 21% in 2004 to 4% in 2006, had risen to 8% in 2007, and had fallen again to 3% in 2008. Industry have previously expressed concern that the marketing issues had affected targeting practises and therefore the CPUE series and the estimated strength of recent

recruitment. They have also expressed concern that the departure from the fishery of the most historically important catching vessels would also bias downwards fleet-wide estimates of CPUE.

2009 Assessment

In response to the expressions of concern about the status of silver warehou, SlopeRAG had requested that a full update of the assessment be undertaken this year. This was undertaken by CSIRO and a report on the updated assessment provided to SlopeRAG at their November meeting (Tuck and Fay 2009). The figures, tables and most of the text below describing the results of the assessment are drawn from that report.

This assessment used data up to 31 December 2008. The last full assessment was presented in Tuck and Punt (2007). In 2008, a basic update was performed by including landings data from 2007/08, with all other data, except for natural mortality which has been increased to 0.3yr⁻¹ from 0.25yr⁻¹, remaining the same as that in Tuck and Punt (2007). The 2009 assessment updates all data inputs (such as landings, discards, catch rates, length and age data), has been transferred from SS2 to SS3 and the data have been moved to a calendar year (previously they were grouped on a 'biological year' of May to April) to ensure data from 2008 are complete. Estimation of recruitment residuals has been limited to those cohorts for which length-composition data are available and hence estimated only until 2004. Other changes are the catch data have been updated to reflect total landings (not just logbook catches), including annual calendar year state data, and the weighting on the length frequency and the conditional age-at-length data have been altered in line with current agreed practice.

The fits to the catch rate indices (Figure 23) are very good and substantially better than those of previous assessments (Thomson, 2002a; Taylor and Smith, 2004; Tuck and Punt, 2007; Tuck, 2008).

When re-tuning the silver warehou assessment, the data series showed a clear conflict between (i) the length and cpue data, and (ii) the age data that requires further investigation. In the meantime, the RAG adopted a base-case model that maintained the data weighting on ages at the fixed value of $\lambda = 0.25$.

The spawning stock biomass in 2009 is estimated to be 44.3% of virgin stock biomass under the base-case parameter set (i.e. 2009 spawning biomass relative to virgin spawning biomass). The stock declined slowly from the beginning of the fishery in 1980, before a sharp decline in the late-1980s corresponding to an increase in catch (Figure 24). The recovery in the late-1990s was driven by the high 1993 and 1994 recruitments (Figure 25). After this, the stock declined due to several poor recruitments before a moderate increase following recruitments in 1999 and 2001.

Sensitivities

Sensitivities of the outputs to a range of options for input parameters or data weightings produce estimates of biomass depletion that ranged from 40% to 55%, 2010 RBCs that ranged from 1,838 to 3,853 t and long term RBCs that ranged from 2,147 to 3,394 t (Table 15). These extremes are mostly associated with lower and higher estimates of natural mortality than are used in the base case. The base case value ($M = 0.30 \text{ y}^{-1}$) was selected by the RAG in 2007 based on an examination of likelihood profiles for this parameter (Tuck and Punt 2007).

Recommended Tier Level

Tier 1

RBC Calculations

Projections of future RBCs and levels of depletion are shown in Table 16 and Figure 27.

The accepted base-case assessment estimates that the 2010 spawning stock biomass will be 47.9% of virgin stock biomass. The RBC from the base-case model for 2010 is 2,660 t for the 20:35:48 harvest control rule, with a long-term yield of 2,664 t. In comparison, last year's assessment estimated the 2008/09 and 2009/10 depletions to be 53% and 46% respectively, with corresponding RBCs of 2,488 t and 2,320 t, with a long-term yield of 2,282.

Additional Comments from the RAG

SlopeRAG concluded that the assessment provided little evidence for any concerns about the status of silver warehou.

Industry members reported that there had been periods in 2002 and 2003 when a large proportion of the TAC had been taken by factory vessels but that this was no longer the case. They were concerned that their departure would have reduced the fleet-wide CPUE but it was pointed out that the CPUE standardisation process should take this into account.

SlopeRAG has previously expressed confidence in the Tier 1 assessment and the calculated RBC. No other qualifying comments were made by the RAG this year and the proposed RBC was accepted.

Overcatch/undercatch

SlopeRAG considered that 10% overcatch/undercatch should be allowed for silver warehou.

Research needs, future assessments

Future development of the stock assessment for silver warehou should include a more in depth exploration of the raw data (e.g. spatial and temporal aspects of sampling), and potential changes in selectivity and growth (Tuck and Fay 2009).

Previously identified research needs:

- Further analyses of the catch and effort data need to be undertaken to better account for the impact of depth, area, season, and interactions with other species (particularly blue grenadier), by fleet.
- Additional sensitivity analyses including; treatment of CPUE, leaving out data from early years, and changing weights.
- Determine how discards as a function of fish length as well as catch could be modelled in future projection for each fleets.
- Further work on stock structure and spatial dynamics to clarify apparent differences around Tasmania.

Tables and Figures

See also BRS report (Hobsbawn 2009 p 47)

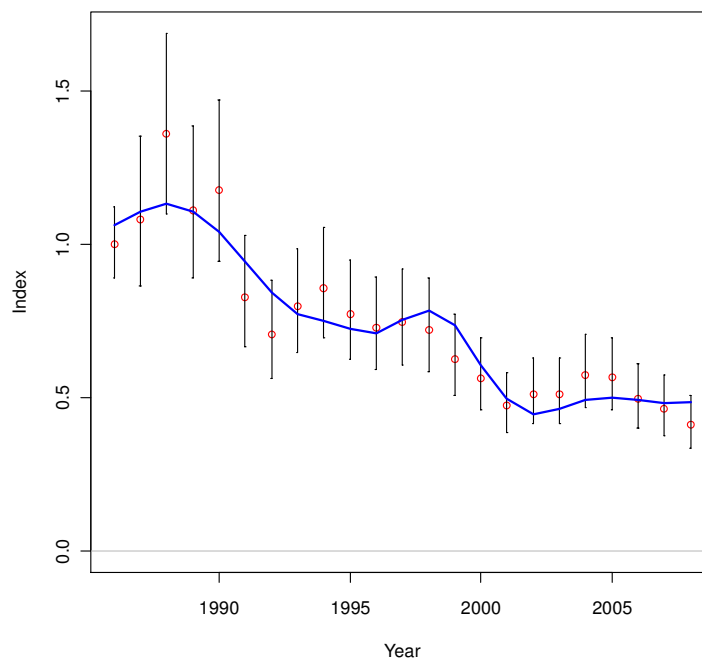


Figure 23. Observed (solid dots) and model-predicted (lines) catch-rates versus year for silver warehou. The vertical lines indicate approximate 95% confidence intervals for the data. (from Tuck and Fay 2009)

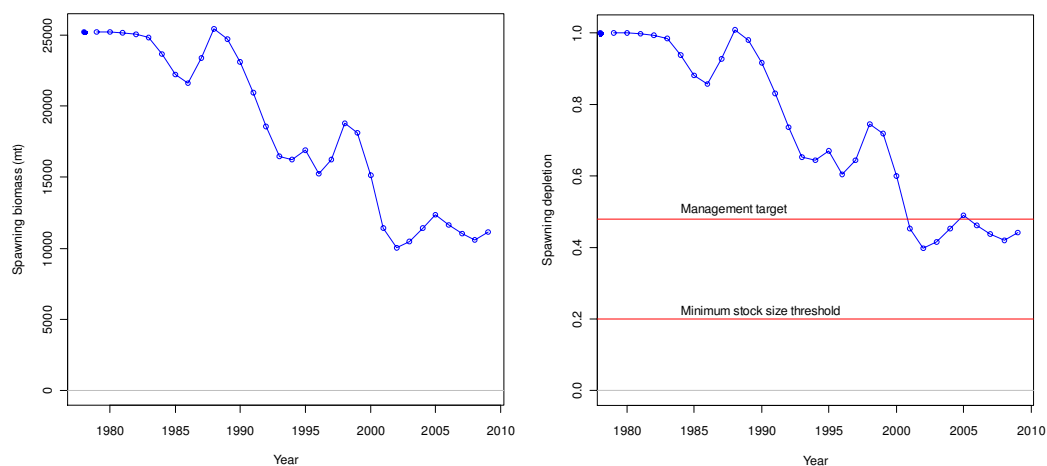


Figure 24. Silver warehou. The time-trajectories of total spawning biomass, and spawning biomass depletion corresponding to the MPD estimates under the base-case model. (from Tuck and Fay 2009)

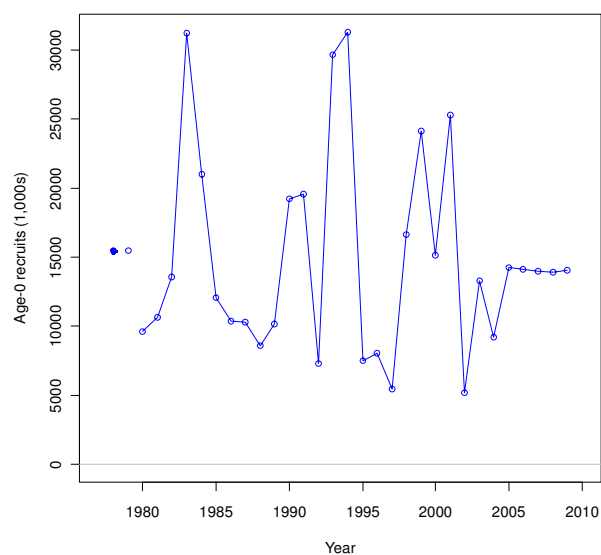


Figure 25. Silver warehou. The time-trajectory of recruitment for the base-case analysis. (from Tuck and Fay 2009)

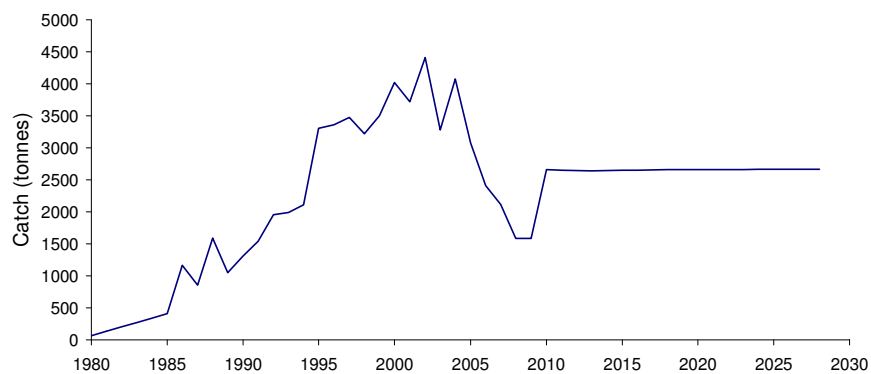


Figure 26. The projection of catch and RBCs under the 20:35:48 rule for silver warehou. (from Tuck and Fay 2009)

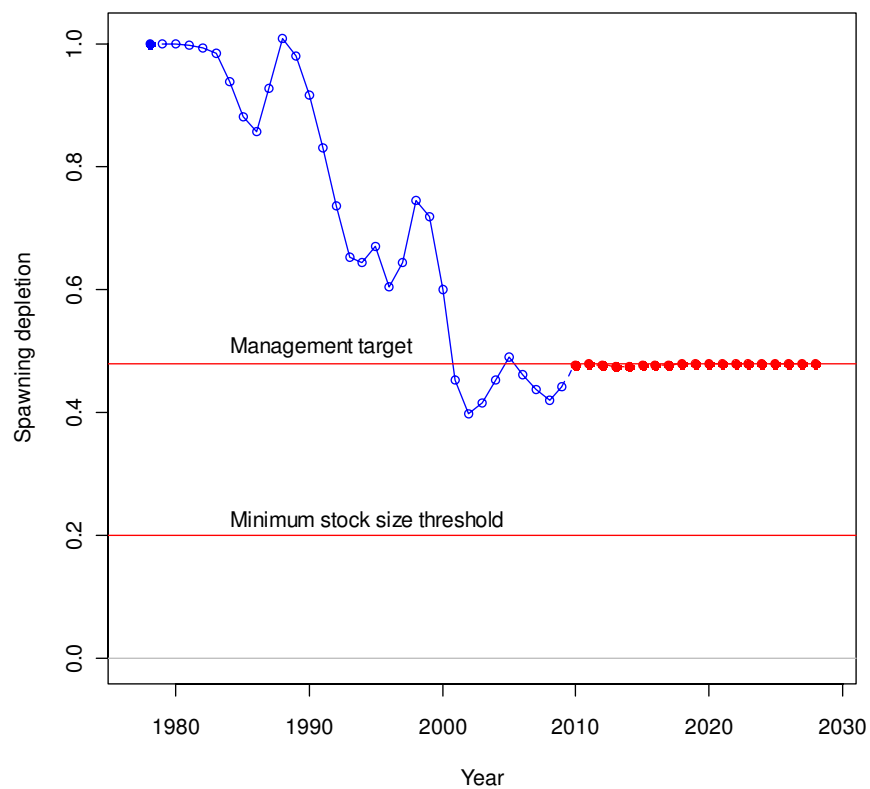


Figure 27. The relative spawning biomass assuming catches follow the RBC under the 20:35:48 rule for silver warehou as estimated by the model (blue line up to 2009) and predicted from 2010 onwards (red line). (from Tuck and Fay 2009)

Table 15. Summary of results for the base-case analysis and sensitivities for silver warehou. (from Tuck and Fay 2009)

Model	20:35:48 harvest strategy					
	-ln L	SB ₀	SB ₂₀₁₀	SB ₂₀₁₀ /SB ₀	2010 RBC (t)	Long term RBC (t)
Base-case ($M=0.30$, $h=0.75$, $\lambda=0.25$, $\sigma_R = 0.52$)	1,128	25,193	12,055	0.479	2,660	2,664
$M=0.25$	1,134	24,712	10,029	0.406	1,838	2,147
$M=0.35$	1,126	26,984	14,803	0.549	3,853	3,394
$\sigma_R = 0.42$	1,134	24,525	11,925	0.486	2,629	2,594
$\sigma_R = 0.62$	1,125	26,113	12,269	0.469	2,710	2,761
$h = 0.85$	1,128	24,771	12,213	0.493	2,908	2,831
$h = 0.65$	1,128	25,784	11,860	0.460	2,366	2,459
Halve weight on lengths	951	25,297	11,475	0.454	2,496	2,620
Double weight on lengths	1,436	2,6156	13,561	0.518	2,972	2,762
Last Recruit Est 2006 (tuned)	1,121	25,905	13,221	0.510	2,939	2,731
Increase age weight $\lambda=1.0$ (tuned)	3,159	30,741	12,217	0.397	2,635	3,108

Table 16. Silver warehou. Summary of the annual RBCs and corresponding depletion for the base-case analysis under the 20:35:48 harvest control rule. (from Tuck and Fay 2009)

	20:35:48	
	RBC (t)	Depletion
2009	1,582	0.443
2010	2,660	0.479
2011	2,653	0.479
2012	2,647	0.477
2013	2,644	0.476
2014	2,645	0.476
2015	2,649	0.477
2016	2,653	0.478
2017	2,656	0.478
2018	2,658	0.479
2019	2,660	0.479
2020	2,661	0.479
2021	2,662	0.479
2022	2,662	0.480
2023	2,663	0.480
2024	2,663	0.480
2025	2,663	0.480
2026	2,664	0.480
2027	2,664	0.480
2028	2,664	0.480

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