

Projections of the west coast rock lobster resource under different poaching and future catch scenarios

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Summary

This document provides the projections of the west coast rock lobster resource under different poaching and future catch scenarios.

This document reports the current projections for the west coast rock lobster resource, using the recently updated 2018 assessments for each super-area as the underlying operating models (OMs). Catch quantities are in MT and refer to whole mass.

Assumptions made for the projections

First, note that the projections are all deterministic (this was for reasons of time).

Estimation and projection of recruitment

Recruitment is modelled as for the previous assessments and projections: historically recruitment is assumed to change linearly between a set of estimated recruitment values over time. Thus, past recruitments are estimated for each super-area for the years indicated by the following list of parameters:

- R1910, R1920, R1950, R1970, R1975, R1980, R1985, R1990, R1995, R1998, R2001, R2004, R2007 and R2010, where furthermore
- R2010 is a new additional recruitment parameter estimated in the model fit given the further years of data now available,
- the R2007 and 2010 values are constrained by a penalty added to the $-\ln L$ based on the geometric mean as follows:

$$\begin{aligned} pen1 &= \frac{1}{2} \frac{(\ln R_{2007} - \ln \bar{R})^2}{\sigma_R^2} && \text{and} \\ pen2 &= \frac{1}{2} \frac{(\ln R_{2010} - \ln \bar{R})^2}{\sigma_R^2} && \text{where} \end{aligned}$$

$$\sigma_R^2 = \frac{\sum_{y=1975}^{y=2010} (\ln R_y - \ln \bar{R})^2}{9}$$

and finally

- all recruitments are constrained to be less than R1910.

Then for the (deterministic) projections:

- R2013+ values are set equal to the geometric mean (\bar{R}) of the R1975, R1980, R1985, R1990, R1995, R1998, R2001, R2004, R2007 and 2010 estimated values for the super-area in question.

Note that values assumed for recruitment after 2010 do not affect the assessment results shown (because of the time taken for lobsters to grow to a size that impacts the indices fitted in the assessment), but do impact future projections. Figure 1 shows the Base Case recruitment values for each super-area.

A concern which might need to be addressed in future is that this framework makes no allowance for any stock recruitment relationships. Figure 2 shows plots of recruitment against egg production for each super-area.

Future Somatic growth rate

- Future somatic growth (2018+) is set at the arithmetic average value of the 1989-2017 values.

Poaching Scenarios used in these projections

In 2018, a WCRL Task Team examined all the current information regarding poaching – both absolute (from TRAFFIC sources) and trend information from compliance and TRAFFIC sources of data.

MARAM/IWS/2018/WCRL/P1 provides details of the TT recommendations. Table 1 sets out the values associated with the three 2018 poaching scenarios (a Base case and two sensitivities) recently agreed by the WCRL SWG. Figure 3 shows these three poaching scenarios.

Future catches

The proportional (legal) catch split per super-area is virtually as was assumed for the 2016 projections (see Table 2). Note that the legal catches refer to the allocations to offshore, inshore, interim relief (now changing to “small scale”) and recreational sectors combined.

Projections are extended to 2030 rather than to 2021 only as in the past (so as to show the effect of transients resulting from recent recruitment variations, especially for super-area A8+), because 2021 is now so near. The catches (both legal and poaching), recruitment and somatic growth are all assumed to remain unchanged from 2018 onwards, except for changes to the legal catches between 2018 and 2019 in many of the examples shown.

Results

Results are developed around the option corresponding to the WCRL SWG’s preferred recommendation, which was for a 2-(equal)-step reduction in the TAC value for the 2017 season to a value for the 2019 season which, continued thereafter, would secure a “7%

recovery". That recovery was defined in terms of the B75m biomass in 2025 relative to its 2006 value which has served in the past as the baseline to which to relate the extent of recovery projected. Note that this projected 2025 biomass still remains very low relative to 1910 (some 2.3%).

Table 3 lists the various alternatives for future catches for which results are reported, while Table 4 shows these split by super-area. Table 5 shows B75m biomass values relative to those in 2006, both at present (2018) and as projected for 2025 under the various alternative future catches. Finally, Table 6 shows projection results by super-area for the baseline future overall TAC preferred by the WCRL SWG, but divided differently amongst the super-areas compared to the 2016 season split.

Figure 4 compares the baseline TAC projection result for B75m for the whole resource (i.e. all super-areas combined) with those for different time-invariant (legal) catches (including zero, i.e. a fishery closure), as well as for an absence of both legal and poaching catches (which reflects a bound for the fastest recovery possible).

Figure 5 shows the sensitivity of the baseline projection to alternative historical poaching scenarios, whilst Figure 6 shows this for alternative choices for the extent of recovery sought by 2025. Figure 7 shows the consequences of a 1-step rather than a 2-step TAC reduction approach to achieve the same 7% recovery by 2025.

Finally, Figure 8 shows the baseline projections disaggregated by super-area, together with those projections under the changed distribution of the TAC compared to 2016 as advocated by the WCRL SWG (see final column of Table 6).

Table 1: Poaching amounts (MT) for the whole resource for the Base Case and two sensitivity scenarios.

	Base Case	Sensitivity 1	Sensitivity 2
1950	0	0	0
1985	348	516	271
1990	402	601	312
2000	556	785	432
2008	678	826	527
2012	900	900	700
2014	1350	1050	1050
2015	1546	1115	1202
2017+	1521	1107	1183

Table 2: The super-area proportional splits of future catches (MT) – taken from the splits reported for 2016.

	A12	A34	A56	A7	A8+
2016 proportional split of CC	0.024	0.118	0.079	0.118	0.661

Table 3: Annual TAC values (MT) for the total resource for the various projections (future poaching continues at the current BC poaching level). The WCRL SWG preferred selection is shown in this and following tables in **bold**.

Management Objective		Total 2018	Total 2019+
TAC that flattens at the B(2006) level by 2030	0% recovery (maximum sustainable catches)	1174	424
B(2025/2006)=1.07	7% recovery	1084	244
B(2025/2006)=1.10	10% recovery	1034	144
TAC = zero	13% recovery (maximum possible)	0	0
TAC and poaching zero	Maximum possible recovery if poaching ceased	0	0
CC=0		0	0
CC=1000		1000	1000
CC=1924		1924	1924
1-step 7% recovery		350	350
2-step 7% recovery SEN1 poaching		1084	244
2-step 7% recovery SEN2 poaching		1084	244

Table 4: Annual TAC values (MT) for each Super-area for different projection scenarios.

Management Objective	A12 2018/2019+	A34 2018/2019+	A56 2018/2019+	A7 2018/2019+	A8 2018/2019+
B(2025/2006)=1.07 i.e.7% recovery	26/6	128/29	86/19	128/29	717/161
TAC that flattens at B(2006) level by 2030 (0% recovery)	28/10	139/50	93/35	139/50	776/80
B(2025/2006)=1.10 ie 10% recovery	25/4	122/7	82/11	122/17	683/99
TAC = zero ie 13% recovery (maximum possible)	0/0	0/0	0/0	0/0	0/0
TAC and poaching zero	0/0	0/0	0/0	0/0	0/0
CC=0	0/0	0/0	0/0	0/0	0/0
CC=1000	24/24	118/118	79/79	118/118	661/661
CC=1924	46/46	227/227	152/152	227/227	1272/1272
1-step 7% recovery	8/8	41/41	28/28	41/41	231/231
2-step 7% recovery SEN1 poaching	26/6	128/29	86/19	128/29	717/161
2-step 7% recovery SEN2 poaching	26/6	128/29	86/19	128/29	717/161

Table 5: B75m(2018)/B75m(2006) and B75m(2025)/B75m(2006) ratios for the projections presented in Figures 4-7.

	B75m(2018)/B75m(2006)	B75m(2025)/B75m(2006)
2-step 7% recovery	0.821	1.07
CC=0	0.821	1.13
CC=1000	0.821	0.95
CC=1924	0.821	0.58
CC=0 and poaching zero	0.821	1.50
2-step 7% recovery SEN1	0.823	1.32
2-step 7% recovery SEN2	0.722	0.73
TAC that flattens at B(2006) level by 2030 (0% recovery)	0.821	1.07
B(2025/2006)=1.10 i.e. 10% recovery	0.821	1.10
TAC = zero i.e. 13% recovery (maximum possible)	0.821	1.13
1-step 7% recovery	0.821	1.07

Table 6: **2 year step** down options – **B75m(2025/2006)** summary statistics for different super-area TAC proportion splits for the “**7% recovery**” option. Results corresponding to a TAC distribution change are shown in **red**. The option in the final column was recommended by the WCRL SWG.

B75m (2025/2006)	B(2025/2006) =1.07 TAC=1084/244 MT Current super-area TAC proportions	B(2025/2006)=1.07 10% shift from A8+ to A34	B(2025/2006)=1.07 10% shift from A8+ to A7	B(2025/2006)=1.07 5% shift from A8+ to A34 and 5% shift from A8+ to A7	B(2025/2006)=1.07 10% shift from A8+ to A34 and 10% shift from A8+ to A7
A1+2	0.925	0.925	0.925	0.925	0.925
A3+4	0.948	0.919	0.948	0.934	0.903
A5+6	2.698	2.698	2.698	2.698	2.698
A7	0.930	0.930	0.879	0.904	0.878
A8	0.873	0.889	0.889	0.889	0.909
Total	1.071	1.071	1.071	1.071	1.067

Figure 1: The 2018 assessment recruitment estimates under the Base case poaching scenario for each super-area. The left plots show the full 1910+ period, whilst the right plots show the 1975+ estimates only. The vertical arrow shows the start of the projection period.



Figure 2: Plots of recruitment (R) relative to pristine (1910) against egg production (Eggs) relative to pristine for the years for which recruitment is estimated.

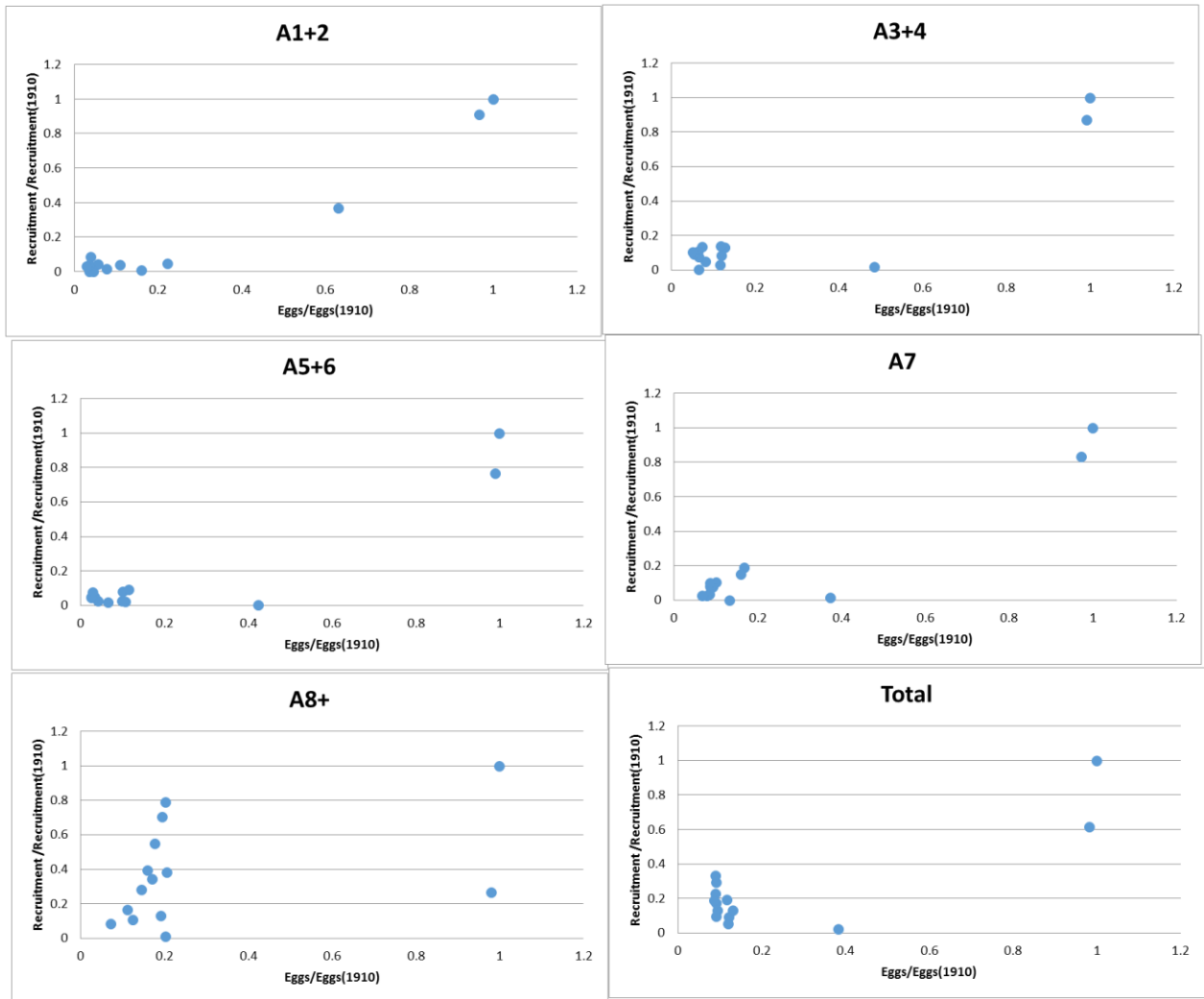


Figure 3: The three poaching scenarios considered in this document.

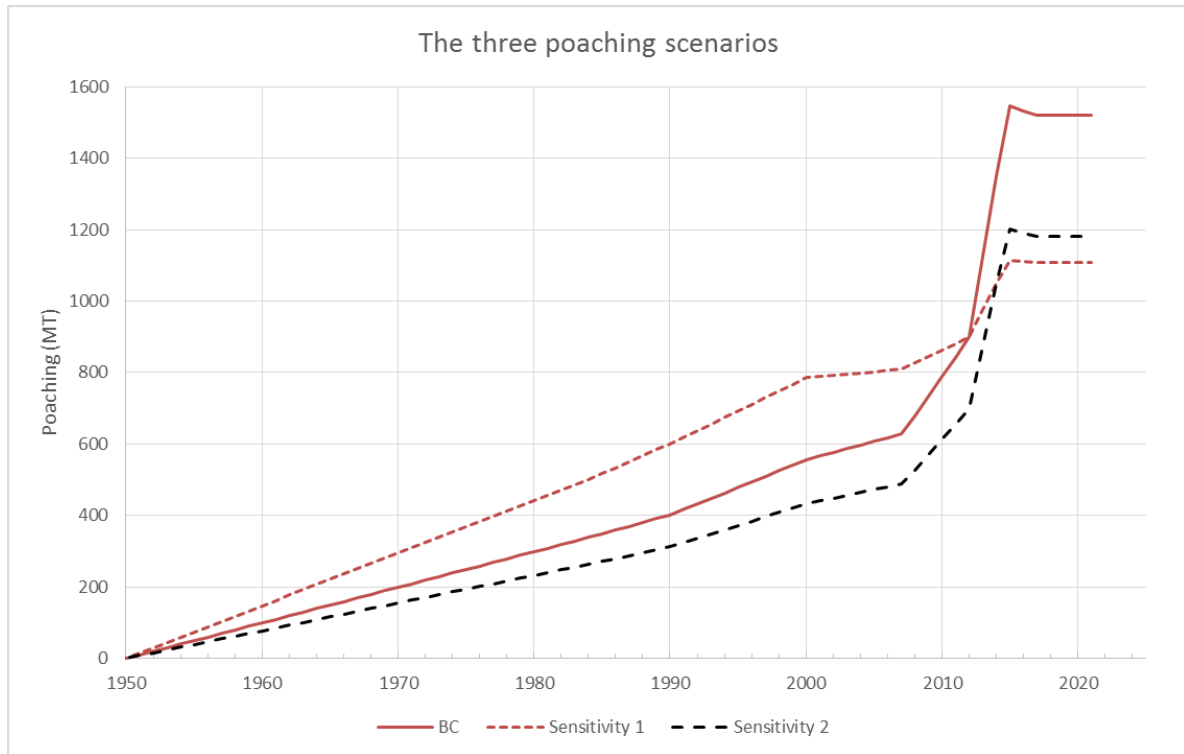


Figure 4: Baseline 2-step 7% recovery compared with zero, 1000 MT, and 1924 MT constant catch (CC) trajectories (1924 corresponds to the TAC over 2015 to 2017) as well as zero commercial catch AND zero poaching for 2018+. Here and below the horizontal green dashed line is the 2006 baseline compared to which percentage recovery is quoted, and the vertical line shows that year (2018) from which projections commence.

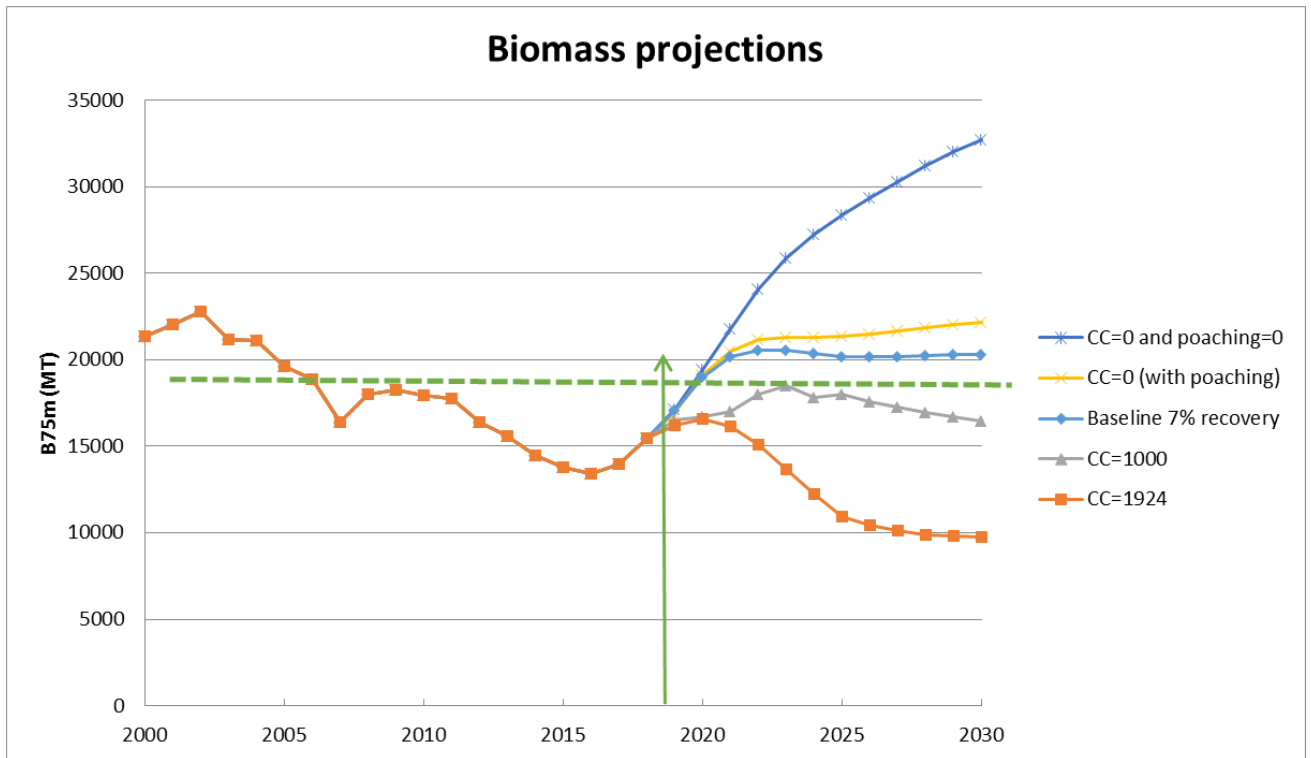


Figure 5: Baseline 2-step 7% recovery compared with 2 alternate poaching scenarios – SEN1 and SEN2. Note that the dashed green line corresponds to the Base case assessment, not to either sensitivity.

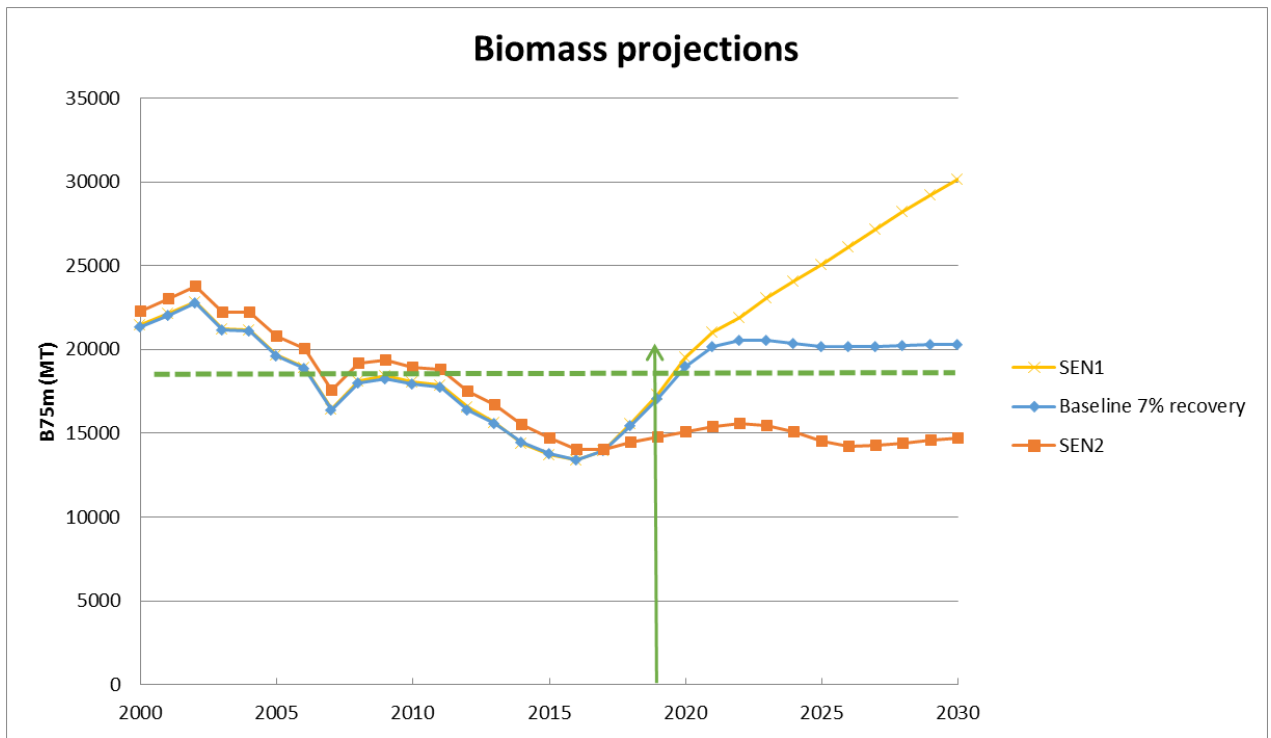


Figure 6: Baseline 2-step 7% recovery compared with 0% recovery, 10% recovery and 13% recovery (all 2-step). 13% is the “maximum possible” (zero commercial catch, but unchanged poaching).

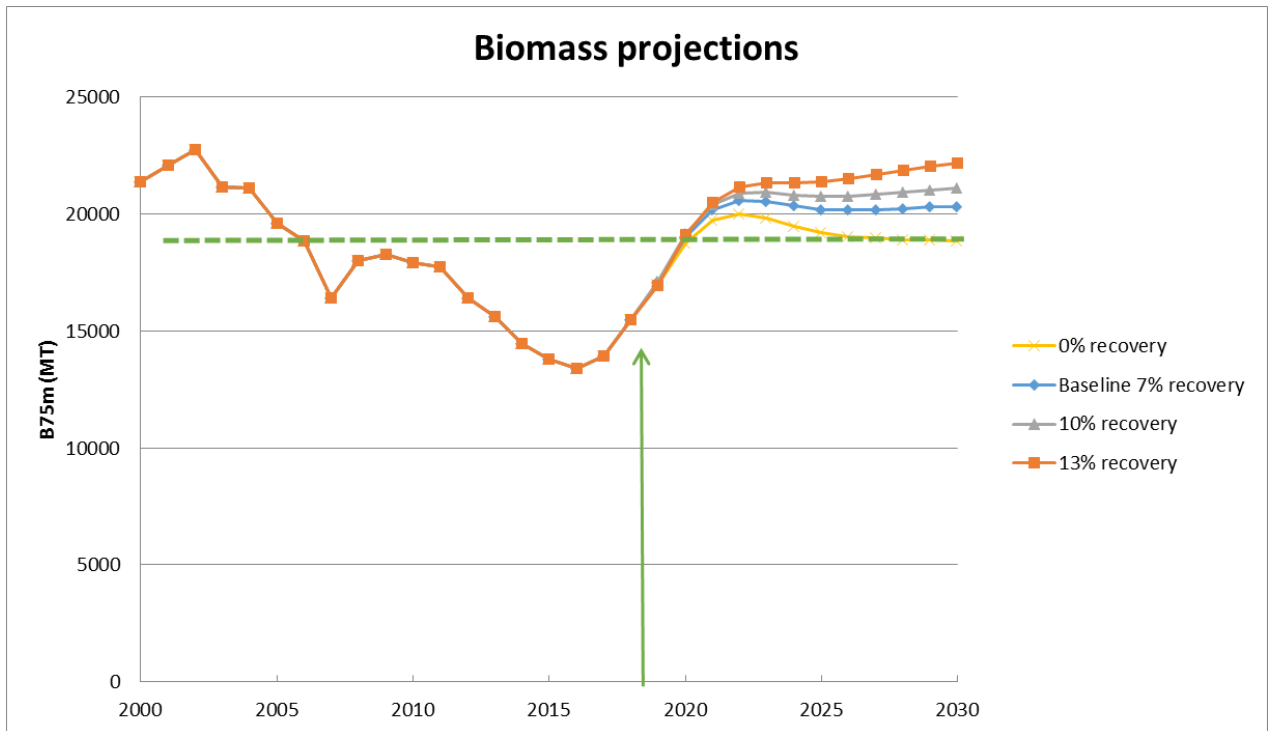


Figure 7: Baseline 2-step 7% recovery compared with 1-step 7% recovery option.

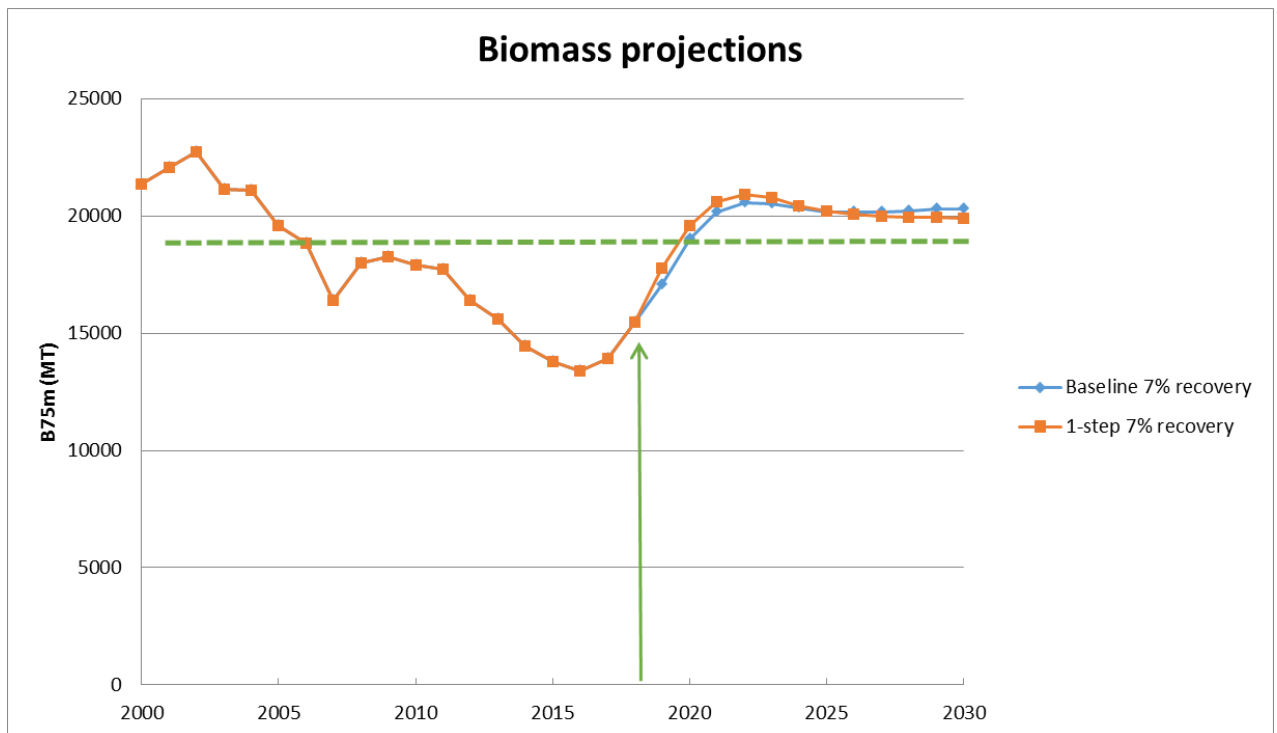


Figure 8: Baseline 2-step 7% recovery shown for each super-area and the whole resource. The solid black lines on these plots for A3+4, A7 and A8+ show the results of shifting 10% of the A8+ TAC to each of A3+4 and A7.

