Updated 2021 Inaccessible island assessments

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Summary

This paper provides updated assessments of the rock lobster resource at Inaccessible island. This assessment includes updated data from the commercial fishery and biomass surveys. Data from the 2020 season are not included as they are not yet available. The assessments were last updated in 2018. These updated assessment models will function as the underlying baseline operating models in the development of new 2021 OMP for Inaccessible for setting annual TACs. The updated assessment estimates current spawning biomass to be 85% of their pristine level.

KEY WORDS: Inaccessible island, *Jasus tristani*, stock assessment

Introduction

The age-structured population model used for these assessments are described fully in Johnston and Butterworth (2013). These assessments were last updated in 2018 (Johnston and Butterworth 2018). The updated 2021 assessments include the following data:

1) Standardised longline CPUE data for 1997-**2019** (Johnston 2020). Note this GLMM takes the length of fishing trip information into account.
2) Biomass survey CPUE data (2006-**2019**, with data for 2008 absent because there was no survey that year).
3) Catch-at-length data from the onboard observers (males and females separate) (1997-**2019**).
4) Catch-at-length data from the biomass survey (males and females separate) (2006-**2019**, with 2008 data absent).
5) Discard % (1997-**2019**).

Data to 2017 only were available for the previous 2018 assessment. Data from the 2020 season are not included as they are not yet available.

Impact of the OLIVA on Inaccessible

The impact that the OLIVA had on the resource at Inaccessible is modelled by assuming a 35% once off mortality of lobsters aged 1, 2 and 3 years during the 2011 season, as previously considered the most reasonable assumption[1]. There has been no indication in the CPUE data as yet of any negative impact of the OLIVA event. A sensitivity model is run for which it is assumed that no extra juvenile mortality occurred in 2011 due to the OLIVA event for comparison purposes.

Value of F_{2009}

The previous 2018 assessment assumed a value of fishing proportion in 2009, F_{2009}, of 0.30. Here the appropriateness of this value is re-considered. Figure 1a plots the total –lnL values for a range of F_{2009}. From this plot it is clear that assuming an F_{2009}=0.3 remains defensible, hence the 2021 RC model assumes F_{2009}=0.3, although given the fairly flat –lnL curve for larger values, sensitivity of this value to larger values is explored.

Value of natural mortality *M*

Natural mortality estimates for lobster species around the world obtained from the RAM legacy database have an average value of M=0.17. For the South African west coast rock lobster *Jasus lalandii*, adult M is assumed to be 0.10. The previous 2018 assessment assumed a value of M=0.2. Here the appropriateness of this value is re-considered. Figure 1b plots the total –lnL values for a range of M (ranging from 0.05 to 0.35. From this plot it is clear that assuming an M=0.2 remains defensible, hence the 2021 RC model assumes M=0.2, although sensitivity of this value to larger (0.3) and smaller (0.1) values is explored.

Sensitivity models

Results are run initially for the same set of assumptions assumed in 2018. Table 1 reports these Reference case model assumptions. A series of sensitivity models are then run to explore the sensitivity of the assessment results to these assumptions. These are:

Sen1: h prior mean = 0.90

Sen2: h prior mean = 0.80

Sen3: h prior mean = 0.70

Sen3b: h prior mean = 0.50

Sen4a: M=0.1

Sen4b: M=0.3

Sen5: d = 0.2

[1] Cape Town Workshop held 16-18 November 2011.

Sen6: F(2009)=0.4

Sen7: F(2009)=0.5

Sen 8: No once-off mortality of lobsters aged 1,2, and 3 years during the 2011 due to OLIVA event.

Results and Discussion

Updated Inaccessible assessment

Table 2a reports the Inaccessible 2021 updated assessment results, and provides the 2018 assessment results for comparison. Current spawning biomass is estimated to be 85%K – a very healthy level (and similar to the previous 2018 assessment). Sen8 the model where no OLIVA induced mortality is assumed, produces a slightly better fit to the data overall and a more optimistic current spawning biomass (89%K compared with 85%K for the RC).

Figure 2a shows various results for the updated RC inaccessible assessment. From Figure 2a, it is evident that the fits to the CPUE data remain good. Figure 2b shows comparative model fits to the CPUE and Biomass survey data as well as spawning biomass trends for the RC model (with OLIVA effect) and the model (Sen8) which assumes no OLIVA effect in 2011. There is virtually no visual difference in the model fits to the data (although the model with no OLIVA effects does fit the overall data better – see Table 2a). There is some difference in the 2011+ spawning biomass trends, with the RC being slightly more pessimistic (due to the OLIVA effect) – although by 2020 the estimates are near identical.

The model continues to underestimate the discard proportion. This current underestimation is not seen as an immediate major concern because the manner in which these data are collected – fairly rough onboard estimates of amounts discarded – which means that they are probably not very accurate.

The RC fits to both the longline and biomass survey catch-at-length data are good in terms of aggregates over years (Figures 3a and b), but some residual patterns do remain at the annual level (Figures 5a and b). The recent exploitable biomass trend is decreasing slightly with the spawning biomass trend remaining level (Figure 2a).

Sensitivity tests

Table 3b reports the results of the various sensitivity tests. The estimates of current spawning biomass relative to *K* are insensitive to *h*, *M*, and *d* (discard rate) values. Sen6 (F_{2009}=0.4) and Sen7 (F_{2009}=0.5) estimate lower current abundance estimates (76%K and 73% K respectively).

References

Johnston, S.J. and Butterworth, D.S. 2013. The age structured population modeling approach for the assessment of the rock lobster resources at the Tristan da Cunha group of islands. MARAM/Tristan/2013/Mar/07. 15pp.

Johnston, S.J. and Butterworth, D.S. 2018. Updated 2018 rock lobster assessments for Inaccessible and Gough islands. MARAM/Tristan/2018/JUL/08.

Johnston, S.J. 2020. Further GLM analyses of Nightingale, Inaccessible and Gough CPUE data to incorporate trip length data MARAM/Tristan/2018/NOV/15.

Table 1: Reference case model assumptions.

	Inaccessible
M natural mortality	0.2
Mean of the prior on *h* (the steepness SR parameter)	0.95
d (discard mortality rate)	0.1
F(2009) (harvest proportion in 2009)	0.3

Table 2: Inaccessible updated 2021 assessment results (last column). The 2018 assessment results are reported in the first column to allow comparison. The shaded values are fixed on input. Values in parentheses are estimated σ values.

	2018 **assessment**	**2021** **assessment**	**2021** **Assessment With NO OLIVA induced mortality in 2011 (Sen7)**
# parameters	**84**	**90**	**90**
K	1662	1659	1580
h	0.92	0.95	0.97
M	0.2	0.2	0.2
d (discard mortality rate)	0.1	0.1	0.1
σ_{length}	0.2	0.2	0.2
F_{2009} fixed at	0.3	0.3	0.3
θ	0.342	0.342	0.369
-lnL total	-	-24.94	-26.33
-lnL CPUE T	-	-19.36	-19.05
-lnL CPUE longline	-	-8.88 (0.185)	-9.10 (0.176)
-lnL CPUE Survey Leg1	-	-10.48 (0.251)	-9.95 (0.266)
-lnL CAL T	-	-185.34	-190.16
-lnL CAL onboard observer	-	-81.55 (0.060)	-91.86 (0.060)
-lnL CAL Survey Leg 1	-	-95.78 (0.071)	-98.30 (0.071)
SR1 pen	-	3.83	2.64
-lnL discard	-	4.59	4.54
Bsp(1990)/Ksp	0.32	0.31	0.34
Bsp(2018)/Ksp	0.86	0.84	0.91
Bsp(2020)/Ksp	-	0.85	0.89
Bexp(2017) (Bexp(2017)/Bexp(1990))	630 (3.24)	669 (3.29)	656 (3.27)
Bexp (2019) (Bexp(2019)/Bexp(1990))	-	591 (3.05)	581 (2.89)
Program	Inac18.tpl, .rep	Inac21.tpl	Inac21n.tpl

Table 3b: Inaccessible 2021 assessment sensitivity model results. Fixed parameter values are in shaded block. Values in red are those altered from the RC.

	RC	**Sen1 Fix *h*=0.90**	**Sen2 Fix *h*=0.80**	**Sen3 Fix *h*=0.70**	**Sen3b Fix *h*=0.50**	**Sen4a *M*=0.1**	**Sen4b *M*=0.3**	**Sen5 *d*=0.2**	**Sen6 F_{2009}=0.4**	**Sen7 F_{2009}=0.5**
K	**1659**	1666	1692	1468	1468	1777	1602	1663	1329	1044
h	**0.95**	0.90	0.80	0.70	0.50	0.95	0.96	0.95	0.53	0.95
M	**0.2**	0.2	0.2	0.2	0.2	**0.1**	**0.3**	0.2	0.2	0.2
h prior mean	**0.95**	**0.90 fixed**	**0.80 fixed**	**0.70 fixed**	**0.50 fixed**	0.95	0.95	0.95	0.95	0.95
d (discard mortality rate)	**0.1**	0.1	0.1	0.1	0.1	0.1	0.1	**0.2**	0.1	0.1
F_{2009} fixed at	**0.3**	0.3	0.3	0.3	0.3	0.3	0.3	0.3	**0.4**	**0.5**
θ	**0.342**	0.341	0.342	0.321	0.321	0.306	0.378	0.348	0.350	0.417
-lnL total	**-24.94**	-24.91	-24.62	10.38	599.75	-24.36	-25.07	-25.05	-22.43	-26.08
-lnL CPUE T	**-19.36**	-19.43	-19.58	-18.74	-17.83	-19.59	-19.24	-19.38	-19.63	-19.31
-lnL CPUE longline	**-8.88 (0.185)**	-8.96 (0.100)	-9.13 (0.175)	-8.52 (0.197)	-8.42 (0.201)	-9.11 (0.175)	-8.61 (0.194)	-8.88 (0.184)	-9.48 (0.162)	-8.83 (0.186)
-lnL CPUE Survey Leg1	**-20.48 (0.251)**	-10.48 (0.251)	-10.45 (0.251)	-10.21 (0.243)	-9.40 (0.265)	-10.47 (0.251)	-10.62 (0.289)	-10.50 (0.251)	-10.16 (0.261)	-10.48 (0.254)
-lnL CAL T	**-185.34**	-184.70	-183.198	-86.86	-77.80	-178.94	-190.83	-185.85	-172.88	-190.21
-lnL CAL onboard observer	**-81.55 (0.060)**	-89.21 (0.060)	-88.36 (0.060)	-43.70 (0.065)	-38.89 (0.066)	-82.86 (0.061)	-95.94 (0.067)	-89.74 (0.060)	-80.39 (0.061)	-91.30 (0.060)
-lnL CAL Survey Leg 1	**-95.78 (0.071)**	-95.49 (0.072)	-94.83 (0.072)	-43.16 (0.090)	-38.92 (0.091)	-96.09 (0.072)	-94.89 (0.072)	-96.11 (0.072)	-92.49 (0.075)	-98.91 (0.071)
SR1 pen	**3.83**	3.81	3.78	1.96	1.96	3.76	4.01	3.81	3.27	3.62
-lnL discard	**4.59**	4.56	4.55	4.89	4.39	4.47	4.71	4.55	4.63	4.59
Bsp(1990)/Ksp	**0.31**	0.31	0.32	0.30	0.30	0.28	0.35	0.32	0.32	0.39
Bsp(2018)/Ksp	**0.84**	0.84	0.82	0.76	0.70	0.83	0.86	0.84	0.73	0.83
Bsp(2020)/Ksp	**0.85**	0.85	0.84	0.85	0.79	0.85	0.85	0.85	0.76	0.73
Bexp(2017) (Bexp(2017)/Bexp(1990))	**669 (3.29)**	638 (3.27)	637 (3.18)	481 (2.82)	436 (2.56)	635 (3.63)	649 (3.02)	639 (3.20)	422 (2.57)	368 (2.45)
Bexp (2019) (Bexp(2019)/Bexp(1990))	**591 (3.05)**	592 (3.03)	592 (2.96)	536 (3.14)	491 (2.88)	594 (3.39)	594 (2.77)	592 (2.96)	399 (2.42)	335 (2.23)
Programs	**Gough21.tpl**	Is1.tp	Is2.tpl	Is3.tpl	Is3b.tpl	Is4.tpl	Is4b.tpl	Is5.tpl	Is6.tpl	Is7.tpl

Figure 1a: -lnL (total) for a range of fixed F_{2009} values. The red vertical line indicates best fit to the data (lowest –lnL value). RC value is 0.30.

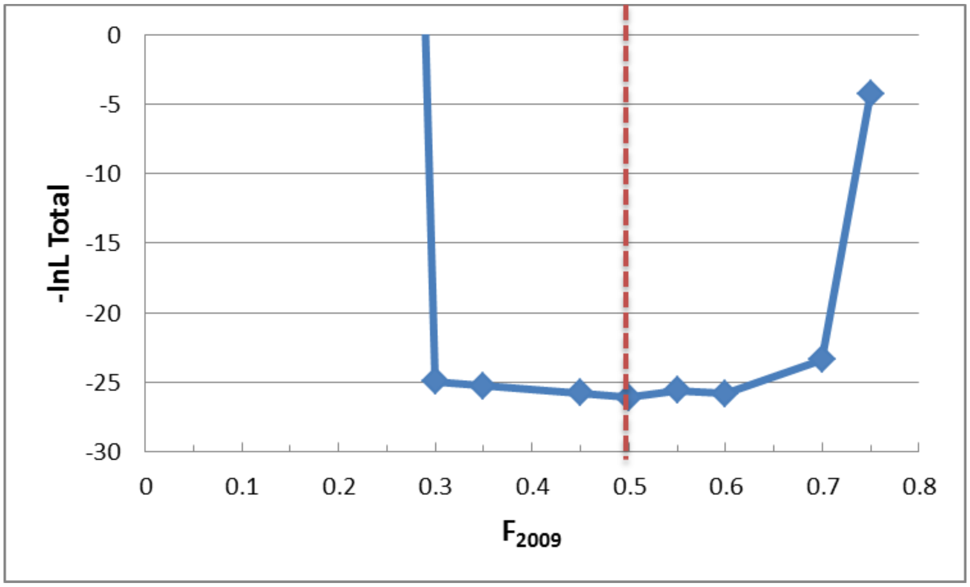


Figure 1b: -lnL (total) for a range of fixed natural mortality M values. The red vertical line indicates best fit to the data (lowest –lnL value). RC value is 0.2.

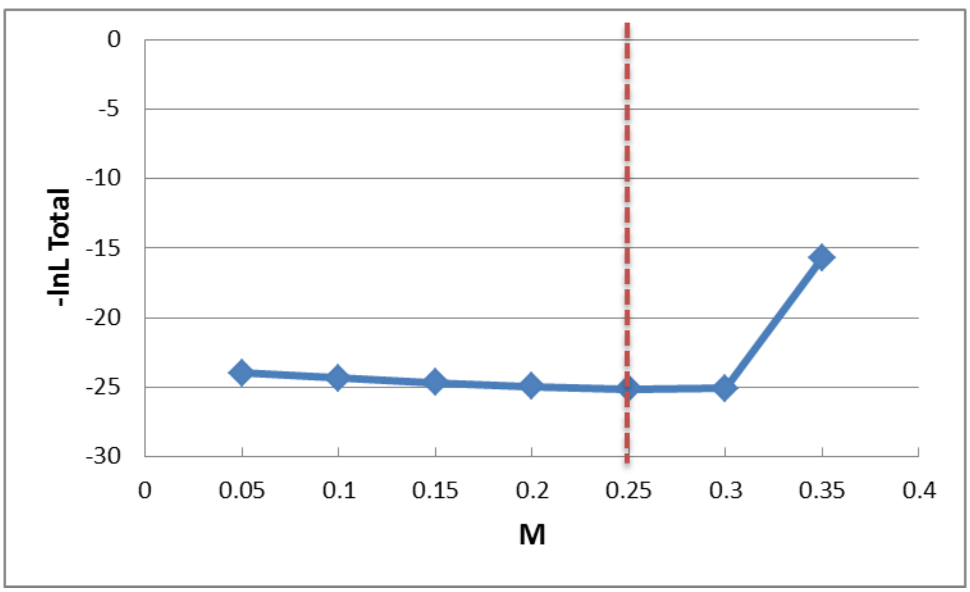


Figure 2a: Inaccessible 2021 assessment results.

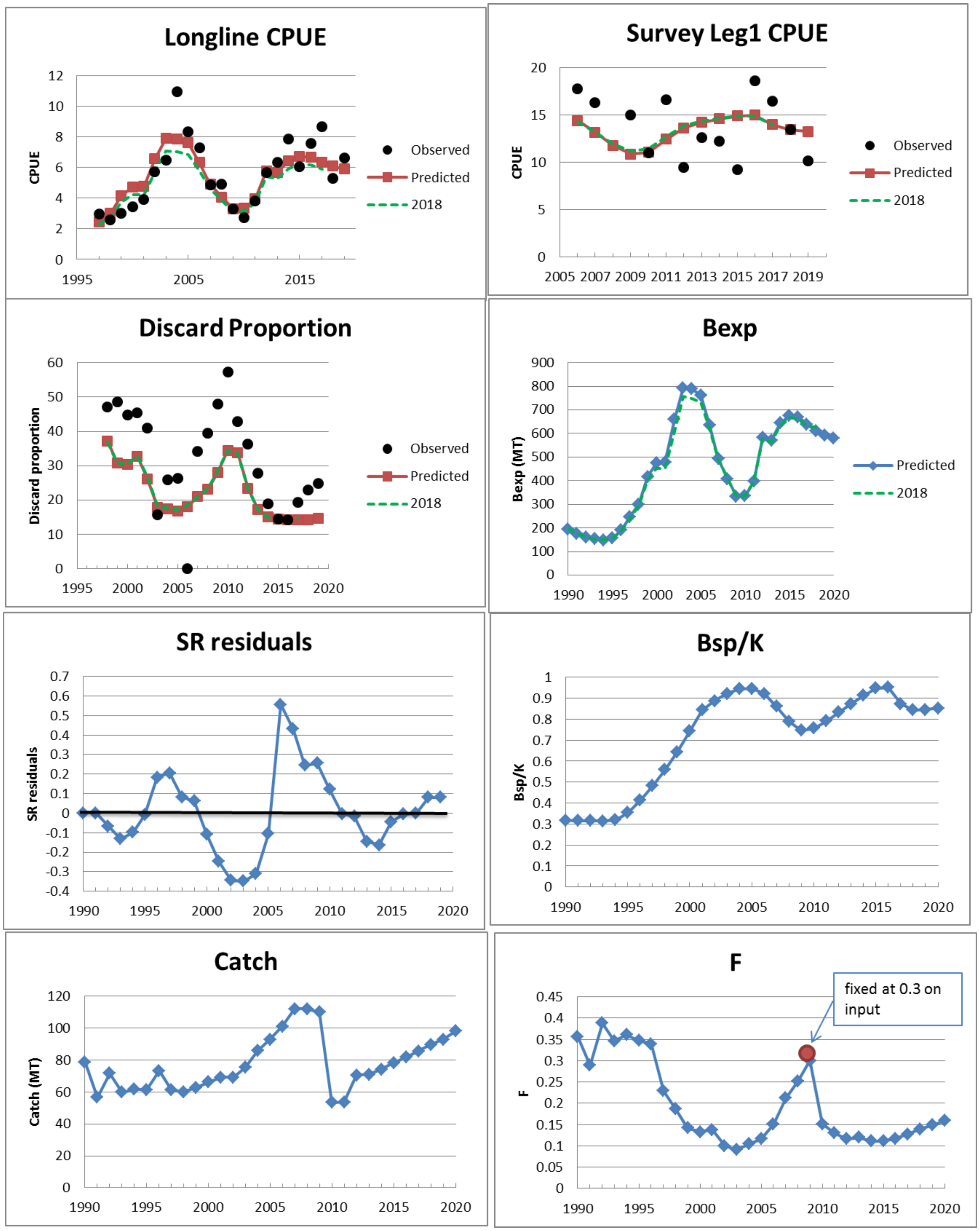
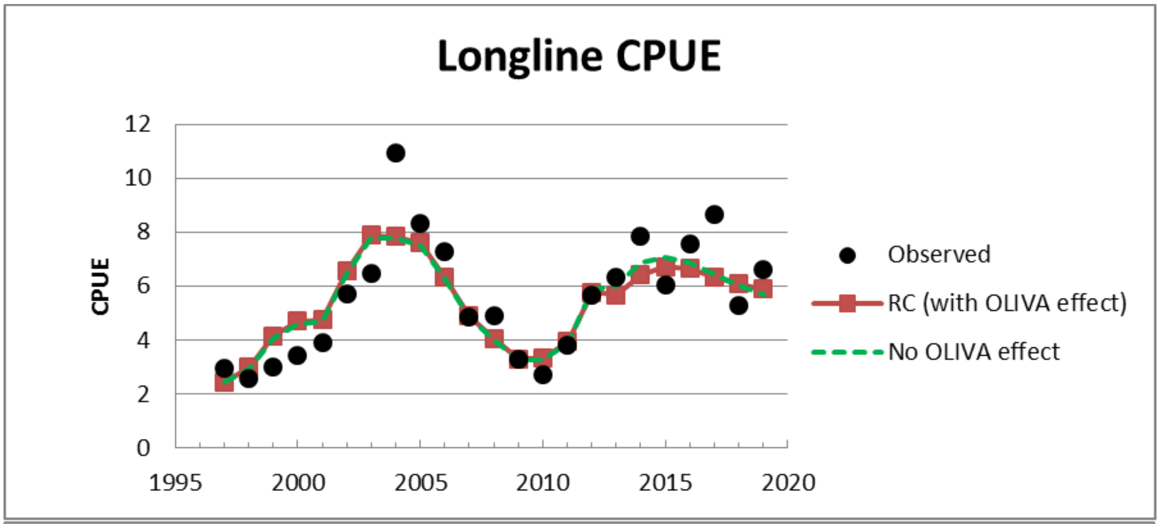
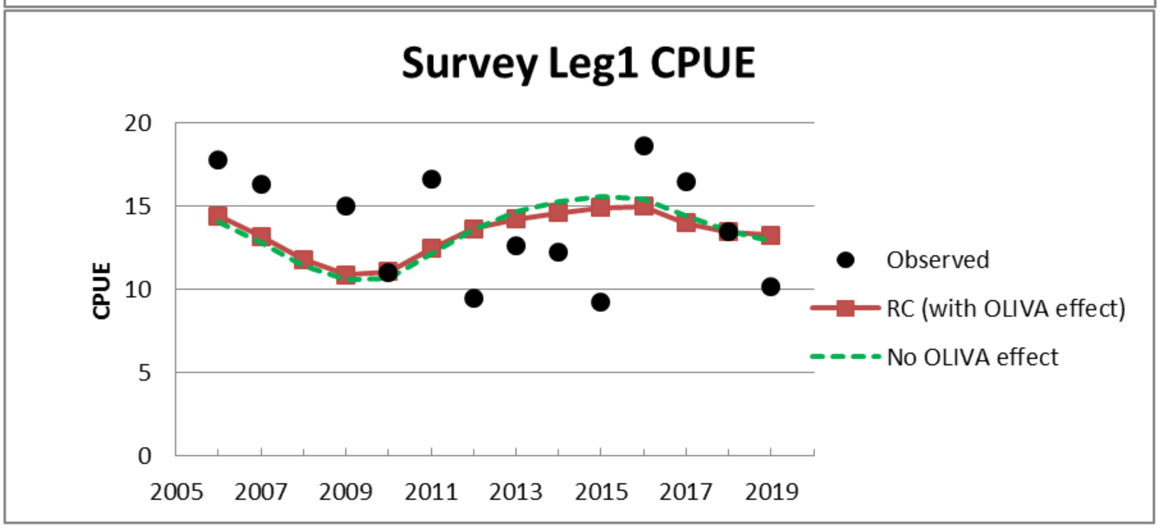


Figure 2b: Comparisons between the RC (with OLIVA effect) and the model which assumes no OLIVA effect in 2011.





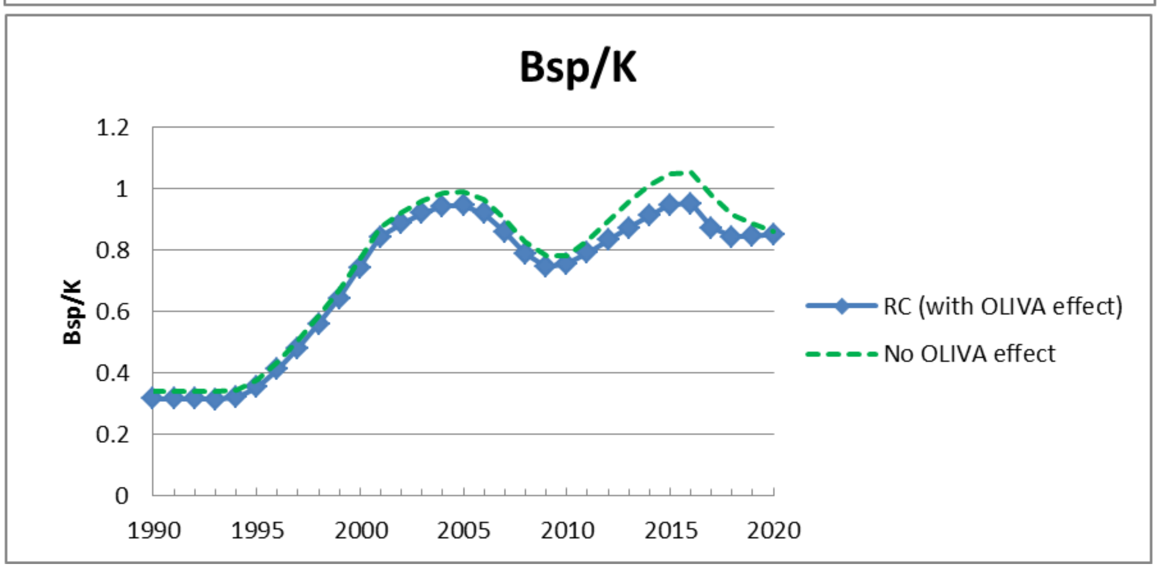
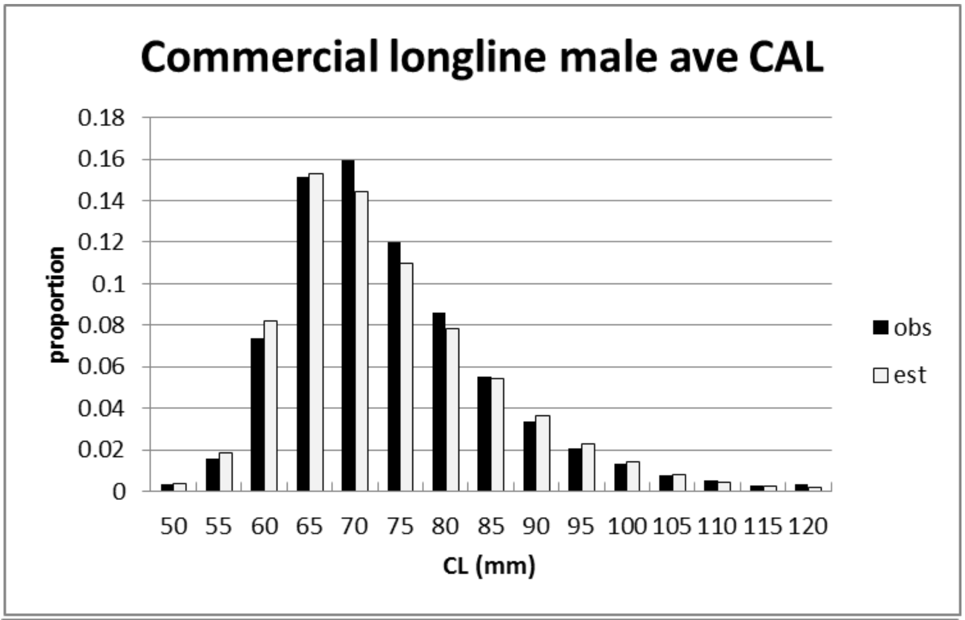


Figure 3a: Inaccessible RC commercial longline CAL fits averaged over years.



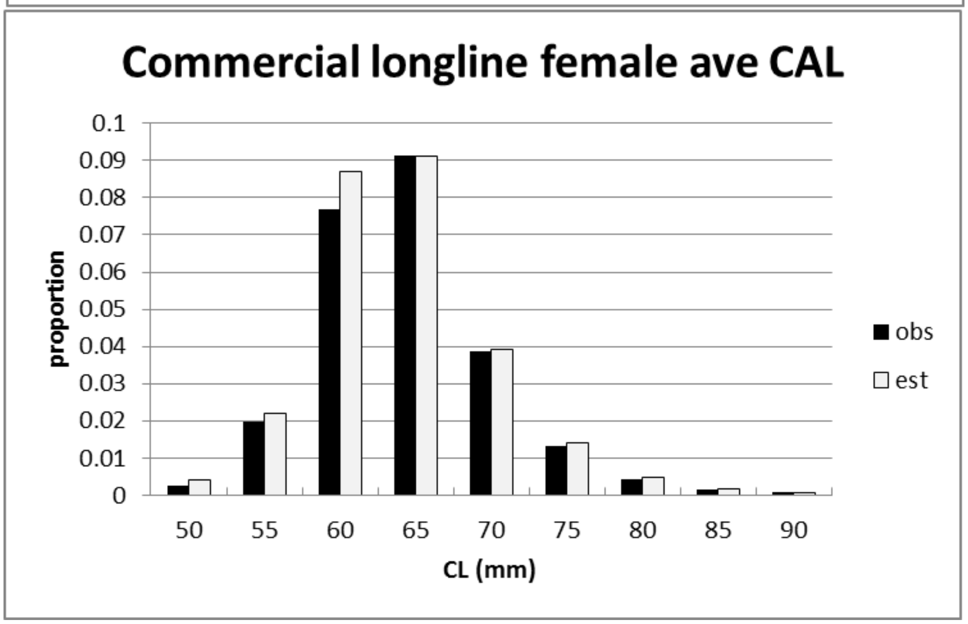
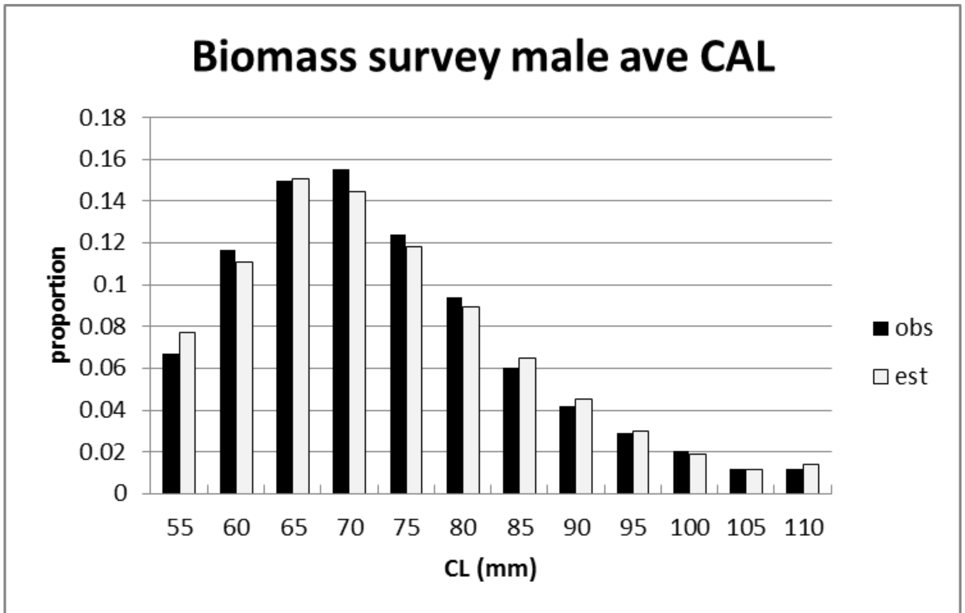


Figure 3b: Inaccessible RC biomass survey CAL fits averaged over years.



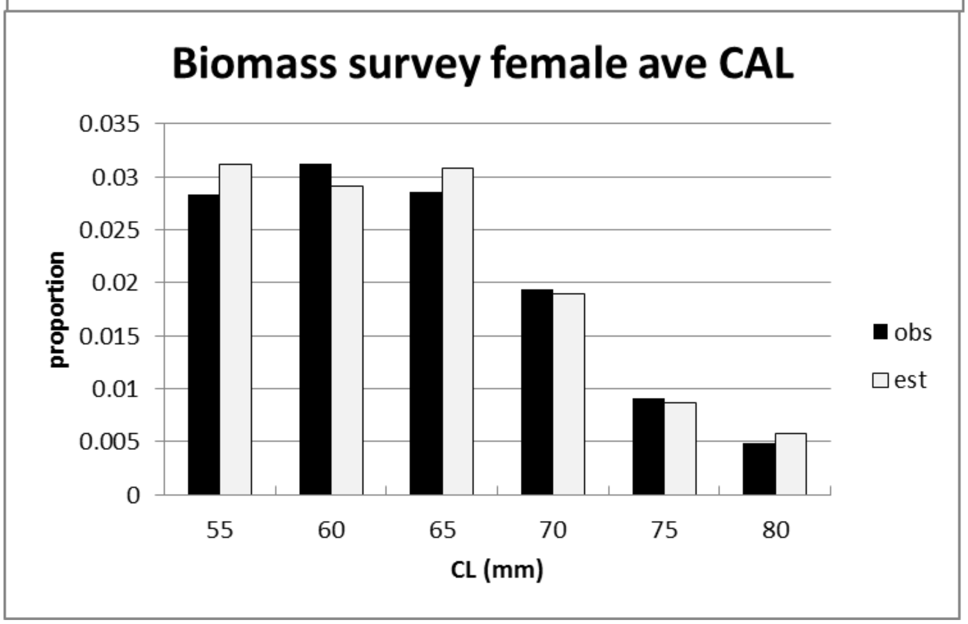


Figure 4a: Inaccessible RC selectivity functions.

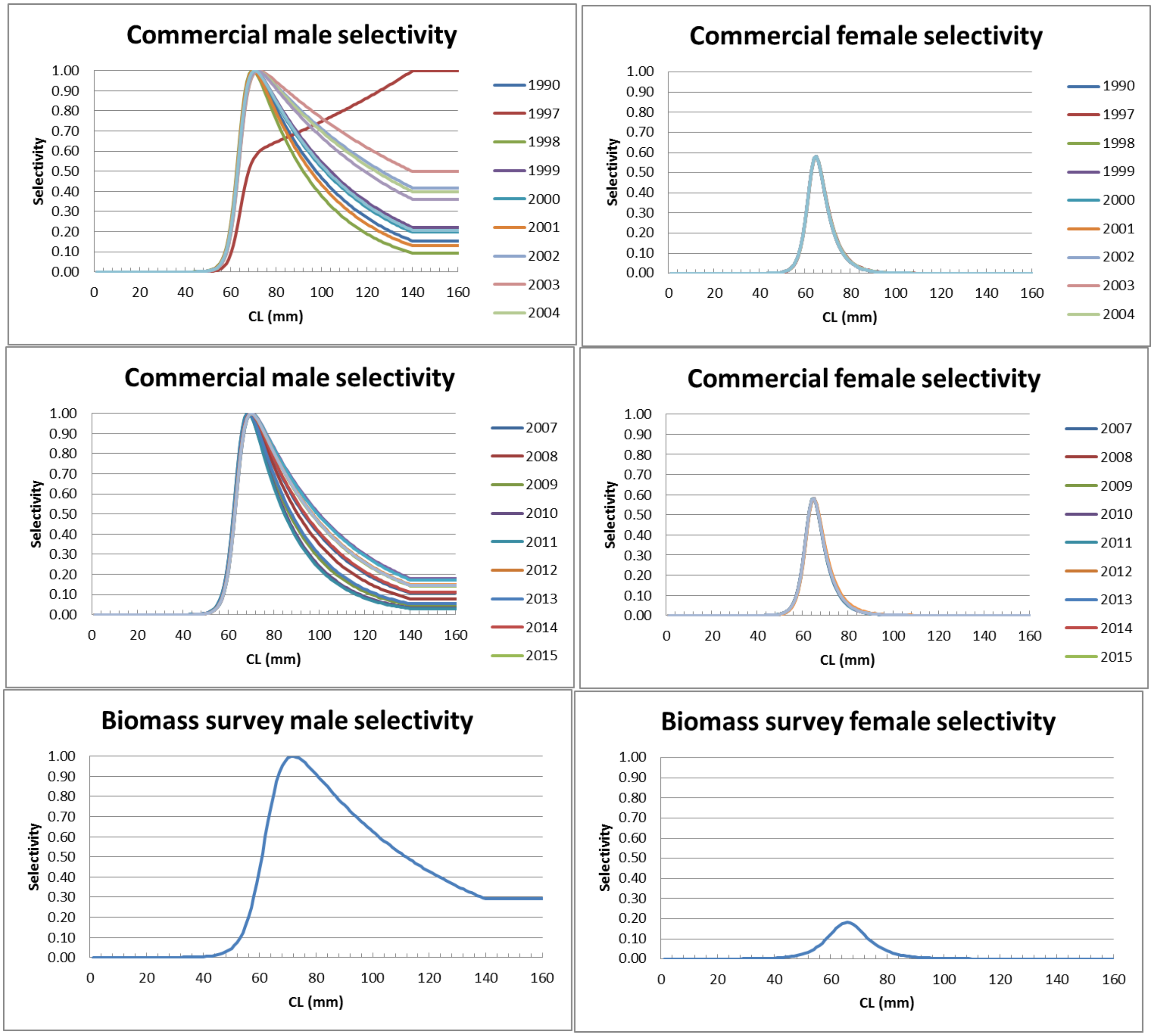


Figure 4b: Inaccessible RC estimated μ residuals (used for selectivity function variability).

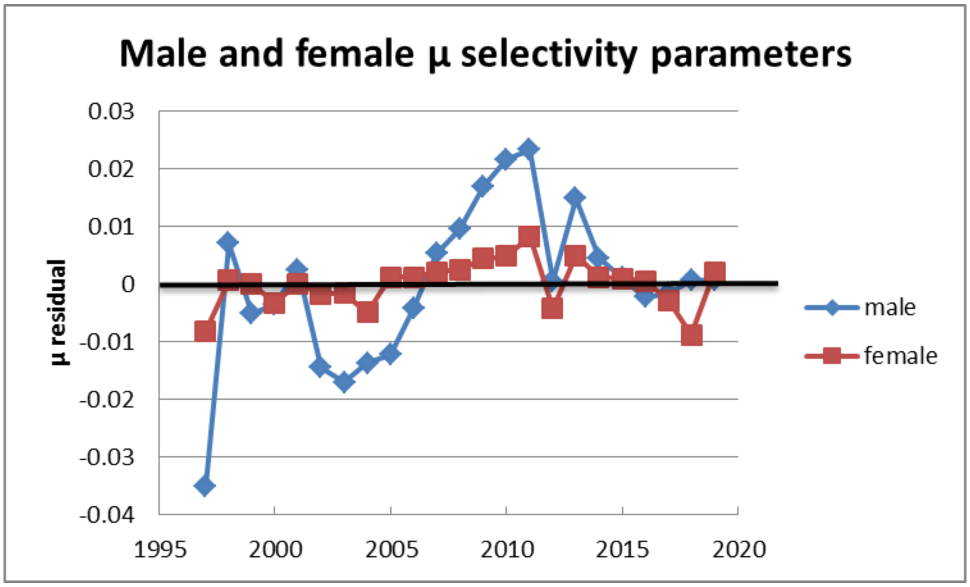


Figure 5a: Inaccessible RC standardised commercial longline CAL residuals. The dark bubbles reflect positive and the light bubbles negative residuals, with the bubble radii proportional to the magnitudes of the residuals.

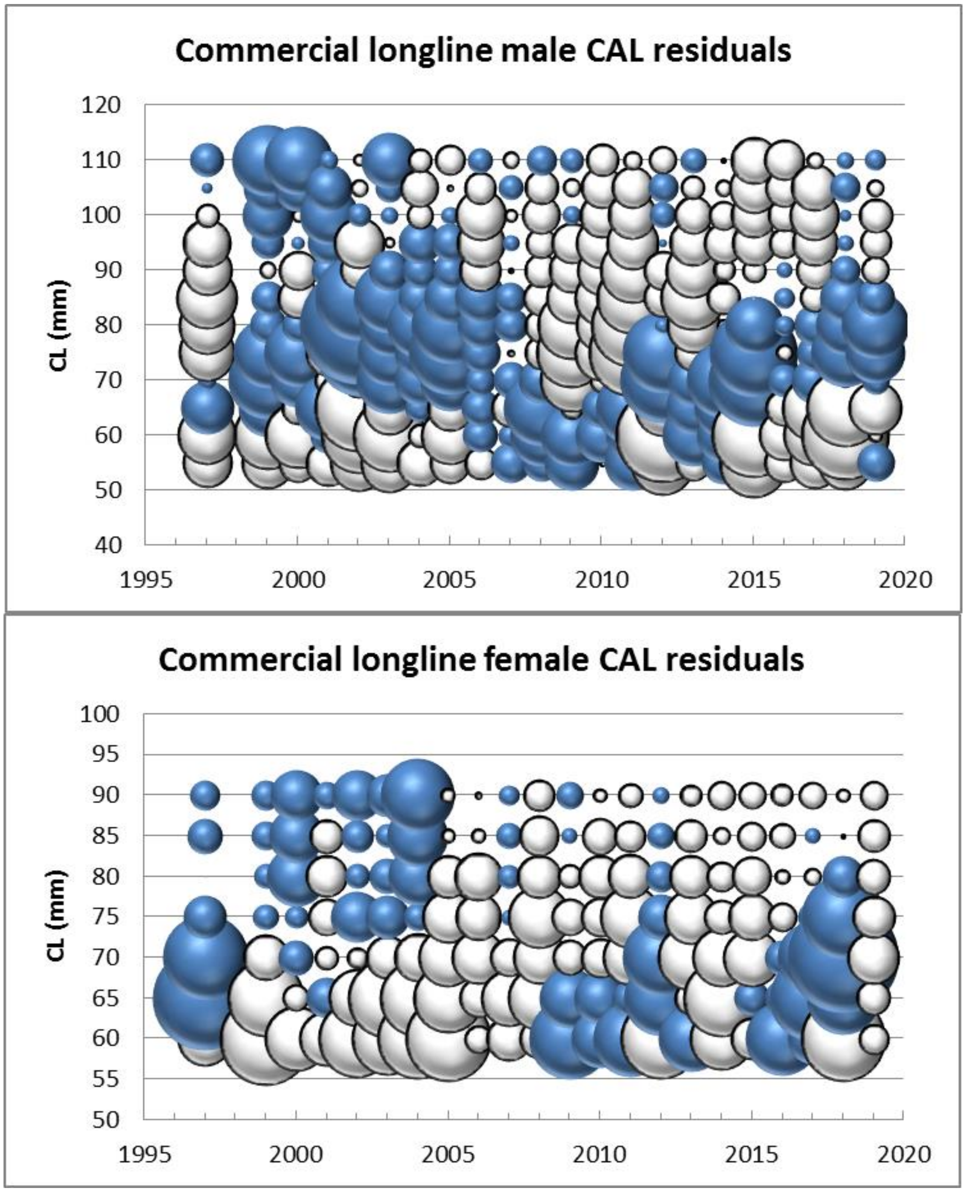


Figure 5b: Inaccessible RC standardised biomass survey CAL residuals. The dark bubbles reflect positive and the light bubbles negative residuals, with the bubble radii proportional to the magnitudes of the residuals.