Sensitivity of the west coast rock lobster length-based stock assessment to a consistently higher somatic growth rate

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Introduction

A recent study by Dubula *et al*. (2005) on the effect of tagging on the subsequent growth rate of rock lobsters has shown that there may be an appreciable reduction in the growth rate of male rock lobsters as a result of tagging. The amount of somatic growth reduction that might be occurring is of the order 2-3 mm per annum. A key question then to consider is what implications this might have for the sustainable productivity from the resource.

Methods

The RC1 area-aggregated model is re-fitted assuming that all male (70mm+) lobsters grow 2mm more than currently estimated (for all years 1870-2015). Ten-year replacement yields (RY) are also estimated and reported. Future somatic growth is fixed, assumed first to be the average of the 1968-2004 values, and then the average of the 1989-2004 values.

Results

Table 1 compares the results of the reference case RC1 model, and the corresponding model which assumes a higher somatic growth rate. Figure 1 compares future projections of B75 (biomass > 75mm) for the resource between the reference case model and the model which assumes consistently higher somatic growth rates. These projections are repeated for two assumptions regarding future somatic growth rate:

- i) future somatic growth rate is the average of all available data (1968-2004)
- ii) future somatic growth rate is the average of the 1989-2004 data (1989 was the year in which the somatic growth initially dropped from previously higher levels)

Three levels of future constant catch (CC) are explored: 2000 MT, 3000 MT and 4000 MT.

Discussion

Table 1 shows that the RC model is able to fit the data somewhat better (-lnL = -57.57 compared to -45.92) than in the case where somatic growth is assumed to be 2mm more for all male lobsters. Both models estimate current biomass to be around 0.04-0.06, and egg production to be around 0.18-0.19 of pristine levels. The “higher somatic growth” model estimates a lower ten-year replacement yield (5654 MT) than the RC model (7045 MT). If the scenario where future somatic growth is given by the 1989-2004 rather than the 1968-2004 average is considered, these replacement yield values become 2667 MT and 3083 MT respectively.

From Figure 1, it is clear how sensitive future projections are to the assumption for future somatic growth rate. Figure 1 also shows that for scenario where this future somatic growth rate is equal to the 1968-2004 average, the RC model is more optimistic in terms of resource productivity and trends than the model which assumes somatic growth rate has been consistently higher. Somewhat surprisingly, however, the direct of this difference is reversed when the future somatic growth rate is set at the lower level of the 1989-2004 average.

Reference

Dubula, O., Groenveld, J.C., Santos, J., van Zyl, D.L., Brouwer, S.L., van den Heever, N., and S.C. McCue. 2005. Effects of tag-related injuries and timing of tagging on growth of rock lobster, *Jasus lalandii*. Fisheries Research 74:1-10.

Table 1: Comparative contributions to the –ln$L$ value, sigma values, biomass and egg production estimates for the area-aggregated assessments.

Model	**RC**	**Higher somatic growth**
Female survivorship	0.91	0.91
R_{1870}	7.61 x 10^8	4.93 x 10^8
R_{1920}	0.84	0.78
R_{1950}	0.27	0.27
R_{1970}	0.12	0.11
R_{1975}	0.34	0.35
R_{1980}	0.09	0.14
R_{1985}	0.29	0.22
R_{1990}	0.36	0.31
R_{1995}	0.27	0.24
Trap CPUE σ	0.164	0.157
Hoop CPUE σ	0.205	0.190
FIMS CPUE σ	0.312	0.316
Male Trap Size σ	0.166	0.274
Female Trap Size σ	0.135	0.136
Male Hoop Size σ	0.173	0.238
Female Hoop Size σ	0.310	0.314
Male FIMS Size σ	0.072	0.084
Female FIMS Size σ	0.159	0.166
Male Sublegal size σ	0.146	0.168
Female Sublegal size σ	0.120	0.126
Trap F% σ	0.019	0.020
Hoop F% σ	0.064	0.066
FIMS F% σ	0.038	0.040
Trap CPUE –*lnL*	-31.35	-32.36
Hoop CPUE –*lnL*	-26.04	-27.90
FIMS CPUE –*lnL*	-8.65	-8.48
Male Trap Size –*lnL*	-18.25	52.58
Female Trap Size –*lnL*	6.46	7.36
Male Hoop Size –*lnL*	19.68	52.43
Female Hoop Size –*lnL*	57.36	58.48
Male FIMS Size –*lnL*	-90.74	-75.92
Female FIMS Size –*lnL*	-20.52	-18.07
Male Sublegal size –*lnL*	-7.07	-2.44
Female Sublegal size –*lnL*	-17.92	-16.07
Trap F% -*lnL*	3.87	4.12
Hoop F% -*lnL*	8.77	9.51
FIMS F% -*lnL*	2.93	3.36
Total –*lnL* (excl. LLF_R)	**-57.57**	**-45.92**
B_{75}(2002)	34 843	24 978
B_{75}(2005)	31 912	22 962
$B_{75}(2002)/B_{75}(1870)$	0.06	0.04
$B_{75}(2005)/B_{75}(1870)$	0.06	0.04
Egg (2002)/Egg (1870)	0.19	0.18
Egg (2005)/Egg (1870)	0.19	0.18
RY (ave growth 68-04)	7045	5654
RY (ave growth 89-04)	2667	3083

Figure 1: Biomass (*B*75) trajectories for two models (RC model and the higher somatic growth model).The top two plots are for the assumption future somatic growth is the 1968-2004 average, and the bottom two for the assumption that future somatic growth is the 1989-2004 average.