Preliminary Standardisation of CPUE series for Rock Lobster from Inaccessible Island

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Introduction

The CPUE series between 2000 and 2005 was standardized using the General Linear Model approach. This effectively accounts for extraneous factors that have influenced the catch rate, allowing the CPUE to be used as a more reliable index of population abundance.

Areas

Fishing effort was allocated to one of 10 areas, corresponding to the eight compass directions around the island, plus the Bank (see Map). Area 10 represents a narrow band around the entire perimeter of the island accessed only by the Powerboats.

Models fitted and results

Six models were fitted to the CPUE series. CPUE was estimated using the Retained Catch only, with Effort measured by the Number of Traps Hauled. The variables used in each model are listed in Table 1.

The most comprehensive model (Model 6) can be represented by the equation:

$$\ln(CPUE + \delta) = \alpha_{YEAR} + \beta_{MONTH} + \gamma_{AREA} + \lambda_{FISHING} + \varphi_{VESSEL} + (\alpha\beta)_{AREA*YEAR}$$

where δ is 10% of the mean CPUE and the overall mean $\mu = 0$. Models 1 to 5 are subsets of Model 6.

All models predict similar rates of increase in abundance over time for the resource as a whole (Table 1 and Figure 1), although with notable differences for different areas (Figure 4). In particular Area 10, in which the Powerboats operate, shows a negative trend (although this is heavily influenced by the high 2000 value for this area).

Table 1. Models fitted to the data (with fit measured by the Adj. R-squared) alongside the changes in abundance that they predict. Fishing Year is the calender year during which fishing took place. Type of Fishing distinguishes between Longline and Powerboat fishing techniques.

Model	Variables	Adj. R-squared	Proportional change in abundance per year
1	Fishing Year	0.171	0.161
2	Fishing Year + Fishing Month	0.198	0.182
3	Fishing Year + Fishing Month + Area	0.237	0.183
4	Fishing Year + Fishing Month + Area + Type of Fishing	0.240	0.180
5	Fishing Year + Fishing Month + Area + Type of Fishing + Vessel	0.242	0.178
6	Fishing Year + Fishing Month + Area + Type of Fishing + Vessel + Area*Fishing Year	0.293	-
	Area 1	-	0.255
	Area 2	-	0.125
	Area 3	-	0.154
	Area 4	-	0.173
	Area 5	-	0.172
	Area 6	-	0.068
	Area 7	-	0.191
	Area 8	-	0.238
	Area 9	-	0.201
	Area 10	-	-0.089
	Average across areas (standard deviation)	-	0.149(0.099)

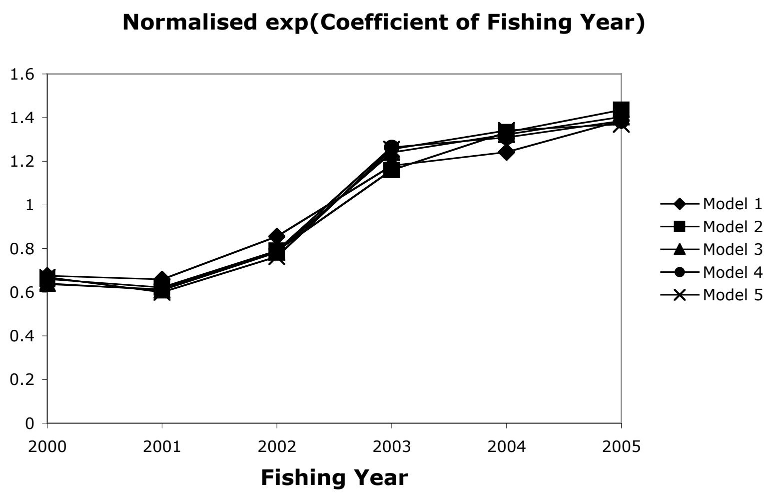

Figure 1. Plot showing the normalised relationship between $\exp[\alpha_{YEAR}]$ (equivalent to CPUE + δ averaged across Month, Area, Type of Fishing and Vessel) and Fishing Year.

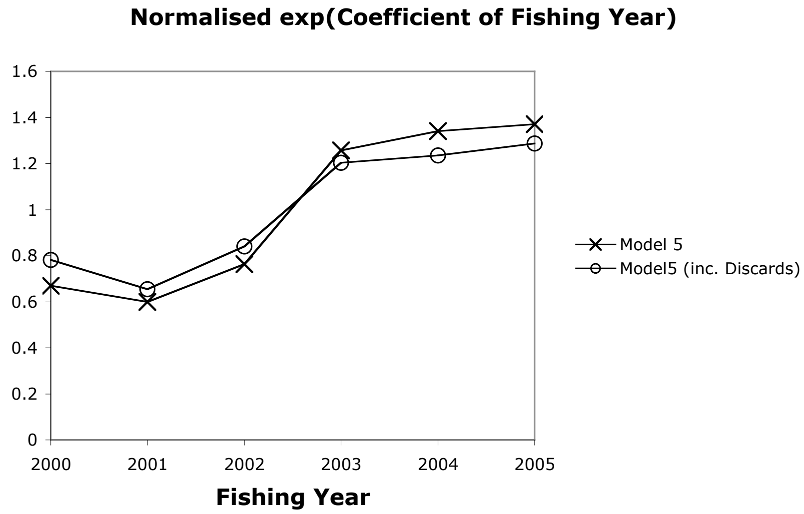

Figure 2. Plot showing the normalised relationship between $\exp[\alpha_{YEAR}]$ and Fishing Year for Model 5. CPUE was estimated using the Retained Catch only (as for Figure 1) and Retained Catch + Discards. When the discarded catch was included, the Adj. R-squared value increased from 0.242 to 0.292, and the annual proportional change in abundance dropped from 0.178 to 0.136.

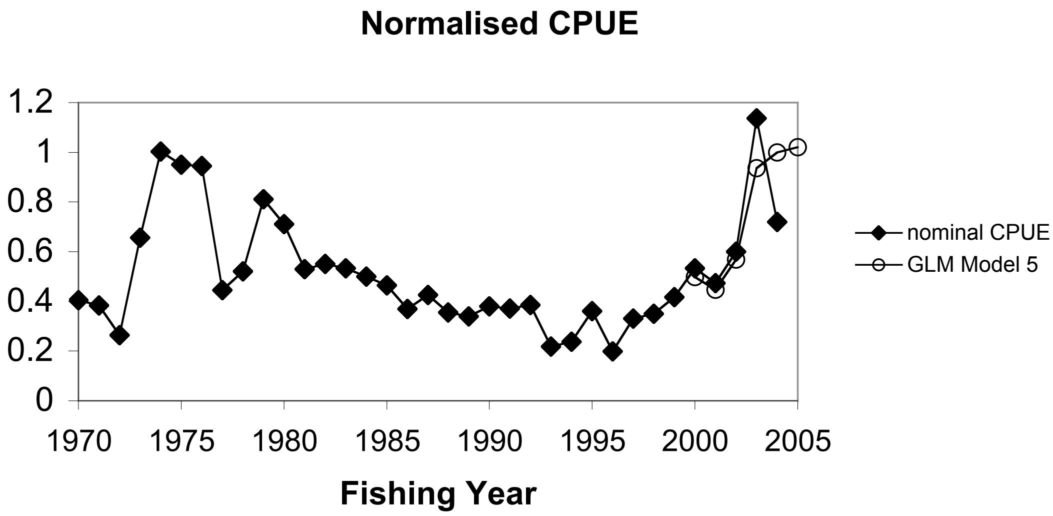

Figure 3. Comparison of the nominal (uncorrected) CPUE series as used in previous assessments, with that standardised by the General Linear Model (GLM). Both series have been normalised to the same average over the period of overlap (2000 – 2004).

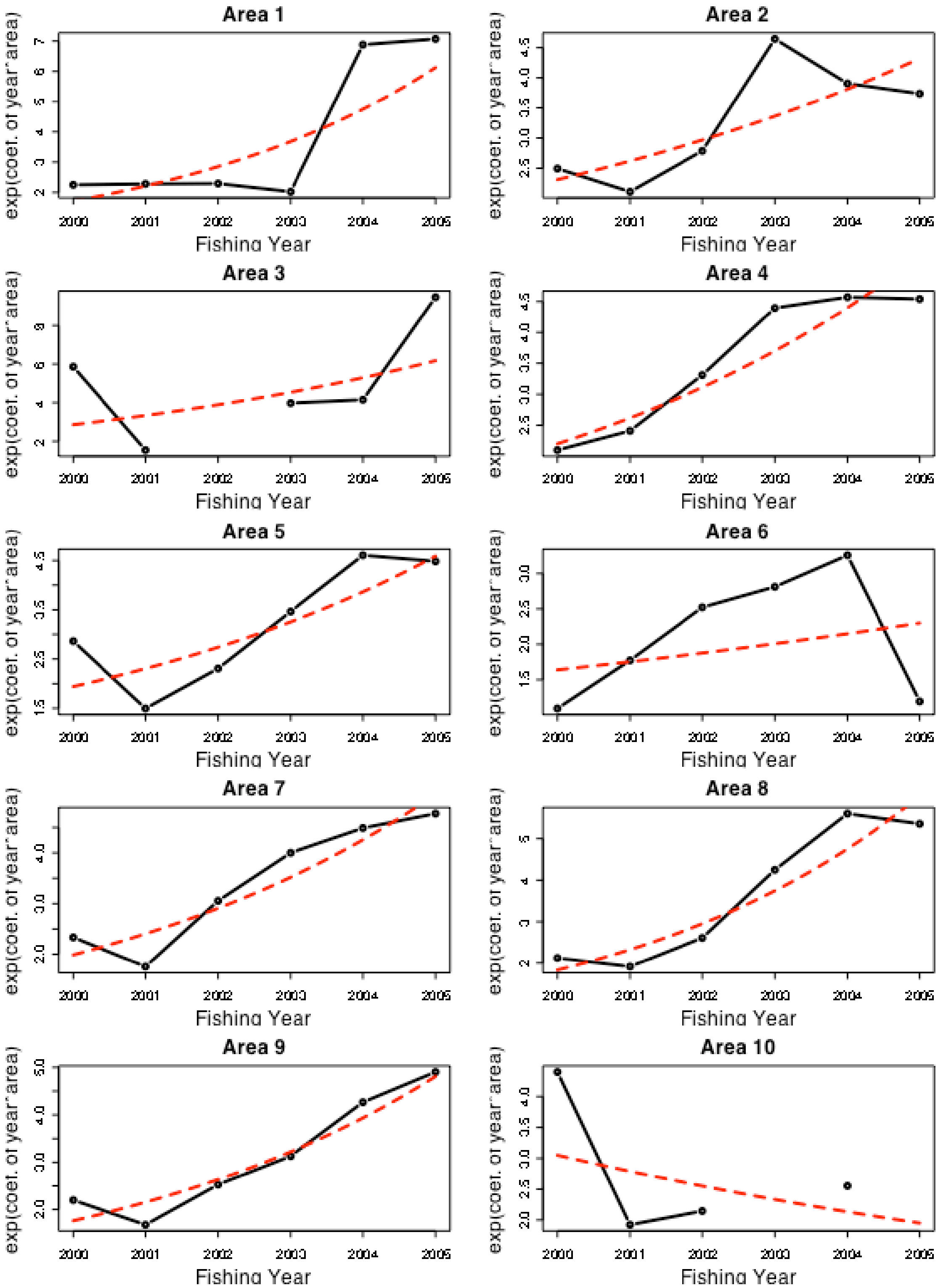

Figure 4. Plots showing the relationship between $\exp\left[\alpha_{YEAR} + \gamma_{AREA} + (\alpha\gamma)_{AREA*YEAR}\right]$ and Fishing Year for each Area. The dashed curve represents a log-linear regression between the two variables, giving an estimated trend in abundance for each Area.

Concluding remarks

Figure 1 shows there to be an increase in the catch rate between 2000 and 2005. The similarity between Models illustrates that the GLM standardisation (Models 2 to 6) makes little difference to the nominal trend shown by the raw data provided (Model 1).

Of concern is that even this nominal trend differs quite considerably from that being used for assessments at present (Figure 3). A further concern is some marked differences in trends for different areas (Figure 4). These trends need to be weighted by the ocean surface areas for the regions to which they correspond in developing an abundance index for the island as a whole.

Data for years from 1997 to 2000 have been received and are now being encoded to allow the analysis to be repeated for a longer time series.