

**VARIANTS OF GLM-STANDARDISED LOBSTER CPUE FOR
TRISTAN DA CUNHA FOR THE 1997-2009 PERIOD**

S.J. Johnston, A. Brandão, and D.S. Butterworth.

MARAM
Department of Mathematics and Applied Mathematics
University of Cape Town
Rondebosch, 7701

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ABSTRACT

Powerboat CPUE data for Tristan island are more limited (in terms of the associated data collected that might provide co-variates for a GLM-standardisation exercise) than the longline CPUE data for the outer three islands. Thus for the four GLM variants applied here to the Tristan powerboat CPUE data, only year and month have been used as fixed effect co-variates.. All four GLM variants show similar CPUE trends. After a steady increase over the 1994-2006 period, the standardised CPUE indices show drops over the following two seasons, with an increase for the most recent 2009 season.

INTRODUCTION

Johnston and Butterworth (2010) presented a GLM-standardised CPUE series for the Tristan powerboat CPUE where the CPUE was expressed as catch per fishing hour. Here we extend this GLM analysis to include three further GLM variants for which the quantity of gear (numbers of traps and of hoopnets) deployed is also taken into account.

The powerboat CPUE database for Tristan contains information at a trip level of the following:

- Year
- Month
- Number of traps
- Number of hoops
- Hours fished
- Total catch (in kgs)

In Johnston and Butterworth (2010) GLM1 was developed for which the CPUE is

taken as equal to
$$CPUE = \frac{\text{catch}}{\text{hours fished}} \text{ kg/hour}$$

Here we produced three further GLM variants (GLM2, GLM3 and GLM4) where the

catch is taken equal to
$$CPUE = \frac{\text{catch}}{(\text{number gear})(\text{hours fished})} \text{ kg/hour/gear}$$

where the number of gear is either:

GLM2 $\text{number of gear} = \text{traps} + \text{hoopnets}$

GLM3 $\text{number of gear} = \text{traps} + (0.5) \cdot \text{hoopnets}$

GLM4 $\text{number of gear} = \text{traps} + (0.25) \cdot \text{hoopnets}$

to allow for different possible values for the relative efficiency of the two types of gear. As the catch taken is not disaggregated by gear, it is not possible to estimate this relative efficiency directly, though James Glass (pers. comm) advises that hoopnets are less efficient than traps, so that GLM2 would be based on some overestimation of effective effort.

METHODOLOGY

The GLM model used here is given by:

$$\ln(CPUE + \delta) = \mu + \alpha_{\text{year}} + \beta_{\text{month}} \quad (1)$$

where:

C	is the catch in kg,
E	is the effort in hours fished on its own or multiplied by the number of gear,
μ	is the intercept,
α_{year}	is a factor with 16 levels associated with year (i.e. the Season-Years: 1994-2009),
β_{month}	is a factor with levels associated with the fishing month (1-12), and
δ	is taken to be 2.2769 kg/hour for GLM1, 0.6096 kg/hour/gear for GLM2, 0.9300 kg/hour/gear for GLM3 and 1.2640 kg/hour/gear for GLM3 (about 10% of the nominal average values in each case).

For Tristan Island the CPUE has been standardised on the month of *September*. Further, as no *area*year* interactions are included, the standardised CPUE series is obtained from:

$$CPUE_{\text{year}} = \exp(\mu + \alpha_{\text{year}} + \beta_{\text{September}}) - \delta \quad (2)$$

RESULTS

Table 1 provides standardised CPUE values derived from the four GLM variants considered. For comparison, the nominal CPUE values are also reported. Figure 1 compares the nominal CPUE with the standardised CPUE series for each GLM variant where both series have been renormalised for comparative purposes. Figure 2 compares the standardised CPUE series for all four GLM variants. Figure 3 shows the month effects for GLM3.

DISCUSSION

There is only a slight difference between GLM1 (where effort is assumed equal to hours fished only) and GLM2-4 (where effort is assumed equal to the hours fished and the number of gear deployed). The standardised GLM series for GLM2-4 are virtually insensitive to assumptions made regarding the relative trap:hoopnet efficiency. All four GLM variants show similar CPUE trends. After a steady increase over the 1994-2006 period, the standardised CPUE indices show drops over the following two seasons, with an increase for the most recent 2009 season.

Since GLM1 fails to utilise information on the quantity of gear deployed, one of GLM2-4 would seem as preferable selection for use in assessments. Given the insensitivity of results to different choices for relative gear efficiency, the choice made between the three options shown is not critical. In these circumstances, the GLM3 standardised CPUE series shown in Table 1 is put forward as an appropriate choice upon which to base assessment of the resource, given that there are reasons to suspect bias in the effort measure used for GLM2.

REFERENCES

Johnston, S.J., Brandao, A. and D.S. Butterworth. 2010. GLMM- and GLM-standardised lobster CPUE from the Tristan da Cunha group of islands for the 1997-2008 period. MARAM/Tristan/2010/May/04.

Table 2d: Standardised powerboat CPUE series for **Tristan** Island using four GLM model variants detailed in the text. The number of data records for each Season-Year (N) is provided, along with the adjusted nominal CPUE series for each variant for comparison.

Season-Year	N	Nominal CPUE				Standardised CPUE			
Season-Year	N	GLM1 (kg/hour)	GLM2 (kg/hour/gear)	GLM3 (kg/hour/gear)	GLM4 (kg/hour/gear)	GLM1 (kg/hour)	GLM2 (kg/hour/gear)	GLM3 (kg/hour/gear)	GLM4 (kg/hour/gear)
1994	107	8.22	0.19	0.29	0.41	7.95	0.20	0.31	0.43
1995	1253	7.56	0.16	0.25	0.33	7.48	0.18	0.28	0.37
1996	1222	8.49	0.19	0.28	0.37	8.20	0.20	0.30	0.40
1997	772	13.97	0.30	0.45	0.60	13.06	0.31	0.47	0.62
1998	502	19.84	0.43	0.65	0.87	16.39	0.37	0.56	0.75
1999	338	30.48	0.63	0.96	1.30	21.86	0.49	0.74	1.00
2000	324	32.44	0.67	1.02	1.38	27.76	0.62	0.93	1.26
2001	334	32.39	0.71	1.11	1.55	25.40	0.61	0.96	1.34
2002	335	33.20	0.95	1.40	1.84	28.71	0.89	1.31	1.72
2003	382	30.30	1.12	1.68	2.23	25.96	1.01	1.50	2.00
2004	385	34.56	1.15	1.73	2.30	32.92	1.12	1.68	2.24
2005	339	44.38	1.53	2.31	3.10	43.58	1.44	2.18	2.94
2006	284	65.05	1.81	2.83	3.94	56.56	1.63	2.54	3.55
2007	310	54.39	1.51	2.36	3.30	45.12	1.33	2.08	2.90
2008	456	34.34	0.96	1.50	2.08	27.07	0.81	1.24	1.75
2009	281	41.96	1.17	1.82	2.54	39.40	1.10	1.72	2.40

Figure 1: Comparative plot of the nominal and GLM standardised powerboat CPUE series for **Tristan** Island. Both series have been renormalised to a mean of 1 for easier comparison of trends.

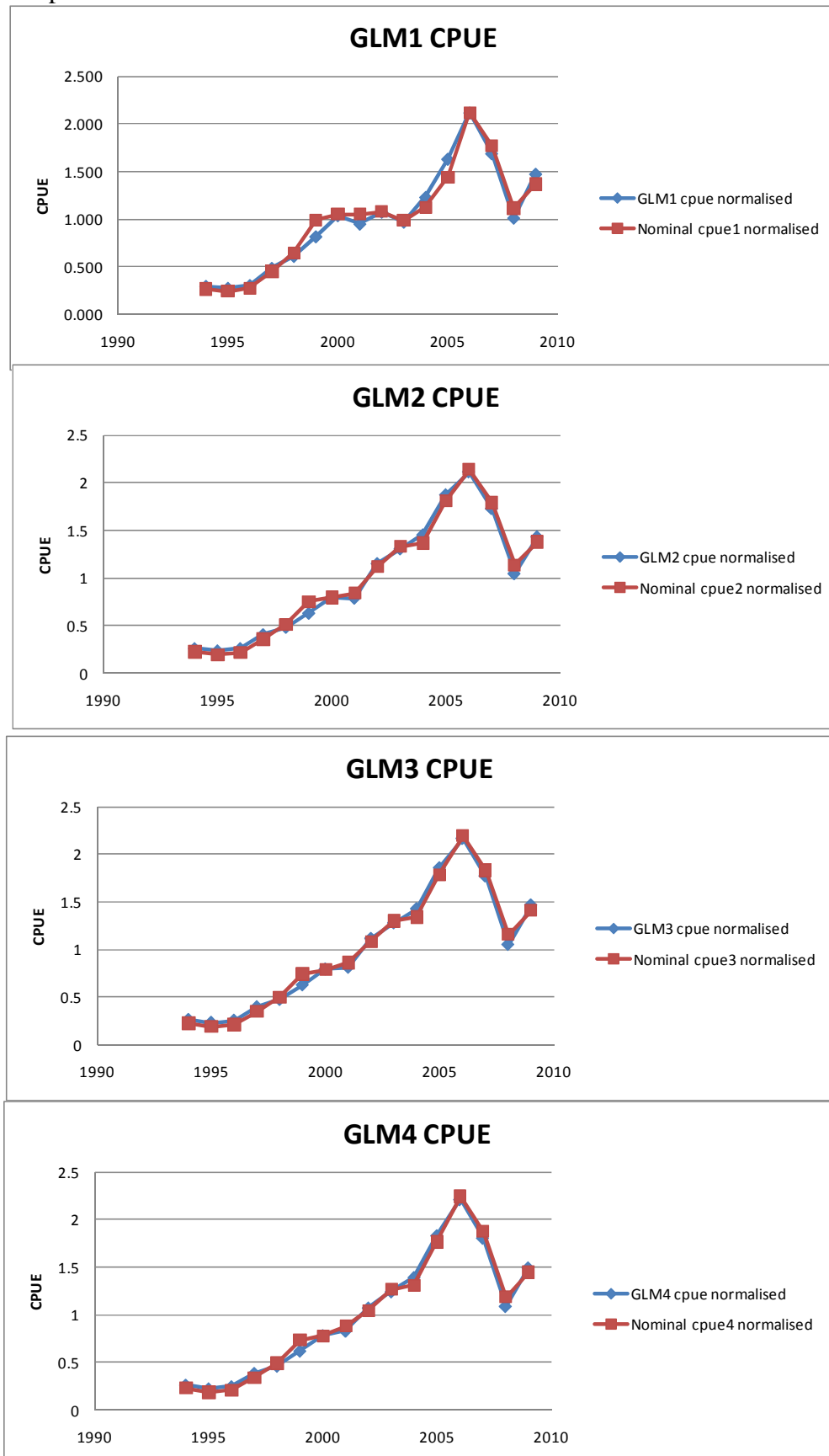


Figure 2: Comparative plot of the four variants of GLM standardised powerboat CPUE series for **Tristan** Island. All series have been renormalised to a mean of 1 for easier comparison of trends.

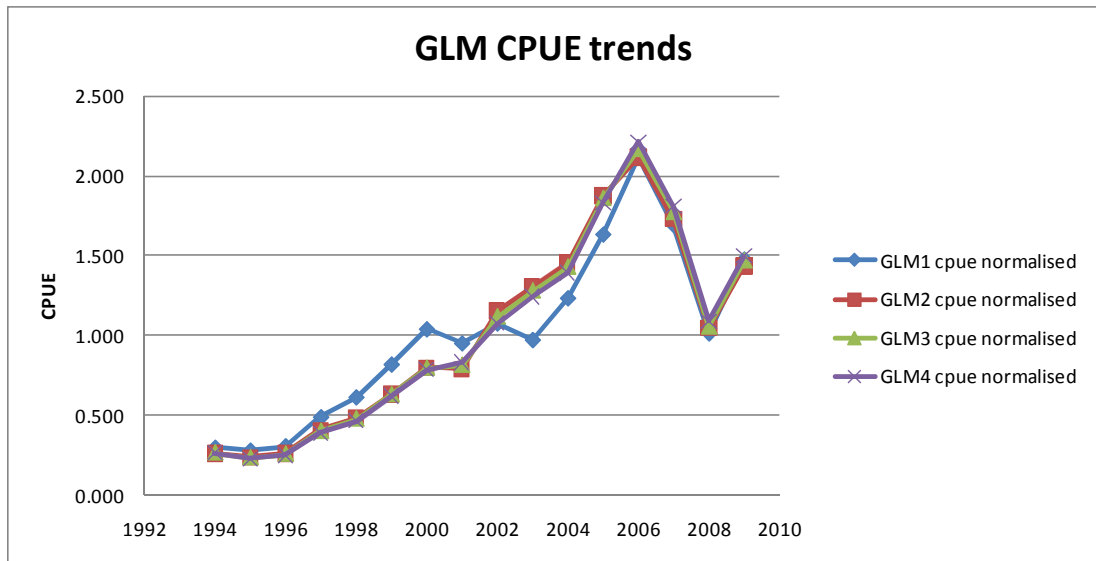


Figure 3: GLM3 month effects for the **Tristan** Island.

