



Summary of the GLM used to standardise abalone catch-per-unit-effort data for Zones A-D over the period 1980-2006

Éva Plagányi and Charlie Edwards

Department of Mathematics and Applied Mathematics, University of Cape Town,

Rondebosch 7701

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INTRODUCTION

The General Linear Model (GLM) approach used last year is here updated for use in standardising the commercial abalone CPUE time series (1980 – 2006) of abalone for the influence of other factors on the CPUE apart from resource abundance. The raw data were supplied by A. Mackenzie (MCM).

The explanatory variables included in the GLM are as in previous years. The same is true for the interaction terms in the model. The purpose of refitting a GLM to the abalone data is to update the results of Plaganyi (2006) using the data available for the 2006 Model year (October 2005 – September 2006). The method described by Plaganyi (2006) has been replicated as far as possible.

DATA INCLUDED IN THE MODEL

DATA: Catch data (as kg whole mass), and effort data (as total duration of dives in minutes for each day dived) are available for the period 1980 to 2006. Additional information in the database pertains to the dates, the divers, and the areas and zones that were dived.

MODEL YEAR: A standard Model year y that is taken to run from October of year $y-1$ to September of year y . The CPUE data are analysed for Model years 1980 to 2006.

ZONES/SUBAREAS: All data for zones A, B, C and D are included in this analysis, with Zone C split into a “nonpoached” (CNP) and “poached” (CP) subarea.

SEASONS: Because of a strong seasonal effect on the distribution of effort through the year, dates in the database were used to group the 12 months into four seasons, *viz.* 1) January-March, 2) April-June, 3) July-September, 4) October-December.

FISHER CODE: Includes both the entitlement holders coded in the database as well as "divers". The code numbers were carefully checked and revised last year (see Edwards *et al.* 2006). Some 92 recent divers not yet allocated a code were given a temporary code of 555 for the purposes of this analysis.

Following the removal of outliers (approximately 1% of total) based upon observations with large residuals (> 6 std deviations) in an initial GLM fit, a total of 40 267 data points remained for the analysis. A breakdown of the numbers of data entries used in the GLM analysis is given in Table 1.

THE MODEL

The GLM model applied is given by:

$$\ln(CPUE) = \mu + \alpha_{year} + \beta_{season} + \varphi_{fisher} + \gamma_{zone} + \eta_{year \times season} + \delta_{year \times zone} + \varepsilon \quad (1)$$

where:

$CPUE$ is in kg/min,

μ is the intercept,

$year$ is a categorical variable associated with the year (i.e. abundance) effect (1980–2005),

$season$ is a categorical variable associated with the season effect (1 = Jan-Mar; 2 = Apr-Jun; 3 = Jul-Sep; 4 = Oct-Dec),

$fisher$ is a categorical variable associated with the fisher code (1–555),

$zone$ is a categorical variable associated with the different zones/subareas (A, B, CP, CNP and D),

$year \times season$ is the interaction between years and seasons,

$year \times zone$ is the interaction between years and zones/subareas, and

ε is the error term, that is assumed to follow a normal distribution.

RESULTS OF THE GLM MODEL IMPLEMENTATION

Following an initial GLM fit, the residuals were examined to check, in particular, for evidence of heteroscedasticity. As in previous years, there was evidence of larger residuals associated with lower effort and with the largest effort category. To account for this heteroscedasticity, the model was refit to the data using the iterative, inverse-weighting procedure applied last year, in which reduced weight is given to the data points with the largest variance in the model. To replicate this method, weighting factors were calculated by grouping the data into 11 effort categories, and estimating the mean variance of the residuals (the ε 's) in each category, such that category 1 represents effort of <50 minutes dive duration, category 2 is 50-100 minutes and so on (Fig. 1). The weighting factors are simply the inverse of the variance for each category. The residuals were iteratively re-weighted until the model converged. Cook's distance measure was used to identify points that are potentially influential due to their location in x -space (Montgomery and Peck 1992). No such points (with $D_i > 1$) were identified after the second model iteration.

A summary of the model results is presented in Table 2 and the full set of parameter estimates listed in Appendix 1. Approximately 33% of the total variation is explained by the model. The nominal and standardised CPUE indices are shown in Table 3, and Figs. 2 a-e show graphical comparisons of the same. Note that in the plots, the nominal and the standardised values have been divided by the mean value for their respective series.

DISCUSSION

The updated standardised CPUE series described in this manuscript is similar to that used last year except that another season's data have been added. The number of contributory data points available for Zone C for recent Model years is very small due to the small quota allocated in recent years. The GLM-standardised CPUE series presented in Table 3 will be used in the current 2007 abalone assessment. As discussed previously, it is advisable to investigate the implications of alternative error structure models such as the negative

binomial. Future work may take this into account but it is considered unlikely that it will have any major effect on results.

Given that the historic CPUE data have been reworked to divide Zone C into turfs C1 and C2 instead of subareas CNP and CP (these do not correspond exactly to C1 and C2), it is advisable in future to use C1 and C2 in the GLM instead. However, this has not been done here because it simultaneously requires reworking all the other Zone C data in a similar fashion. The GLM has been applied at the zonal scale rather than the TURF scale because there are currently insufficient data to run the model with separate data for each TURF. In Figure 3 the nominal CPUE data have been plotted per TURF and the trends in each zone compared, suggesting that the trends per TURF are very similar historically. In future it will become increasingly important to analyse CPUE and other data at the scale of TURFS.

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LITERATURE CITED

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Appendix 1. GLM parameter estimates

Parameter	B	Std. Error	t	Sig.	Parameter	B	Std. Error	t	Sig.
Intercept	-0.165	0.309	-0.533	0.594	[DIVER=151]	0.234	0.113	2.078	0.038
[YEAR=1980.00]	1.055	0.074	14.187	0.000	[DIVER=152]	-0.103	0.308	-0.334	0.739
[YEAR=1981.00]	0.484	0.312	1.550	0.121	[DIVER=153]	-0.045	0.192	-0.236	0.813
[YEAR=1982.00]	0.480	0.307	1.563	0.118	[DIVER=155]	0.192	0.102	1.887	0.059
[YEAR=1983.00]	0.154	0.308	0.499	0.618	[DIVER=156]	0.115	0.123	0.933	0.351
[YEAR=1984.00]	0.251	0.326	0.772	0.440	[DIVER=157]	-0.010	0.127	-0.078	0.938
[YEAR=1985.00]	0.190	0.307	0.620	0.536	[DIVER=158]	0.322	0.167	1.929	0.054
[YEAR=1986.00]	0.449	0.308	1.459	0.145	[DIVER=160]	0.164	0.076	2.139	0.032
[YEAR=1987.00]	0.449	0.307	1.461	0.144	[DIVER=161]	0.208	0.192	1.084	0.278
[YEAR=1988.00]	0.664	0.308	2.159	0.031	[DIVER=162]	0.243	0.067	3.606	0.000
[YEAR=1989.00]	0.447	0.307	1.457	0.145	[DIVER=164]	0.171	0.067	2.561	0.010
[YEAR=1990.00]	0.787	0.308	2.559	0.011	[DIVER=165]	0.189	0.076	2.484	0.013
[YEAR=1991.00]	0.749	0.307	2.438	0.015	[DIVER=166]	-0.072	0.157	-0.460	0.645
[YEAR=1992.00]	0.725	0.308	2.358	0.018	[DIVER=167]	0.161	0.080	2.002	0.045
[YEAR=1993.00]	1.213	0.309	3.925	0.000	[DIVER=168]	-0.062	0.134	-0.464	0.643
[YEAR=1994.00]	1.068	0.307	3.473	0.001	[DIVER=169]	0.048	0.133	0.361	0.718
[YEAR=1995.00]	0.870	0.307	2.832	0.005	[DIVER=171]	-0.240	0.095	-2.541	0.011
[YEAR=1996.00]	0.986	0.308	3.202	0.001	[DIVER=172]	0.241	0.077	3.154	0.002
[YEAR=1997.00]	0.943	0.307	3.069	0.002	[DIVER=174]	0.109	0.071	1.523	0.128
[YEAR=1998.00]	0.672	0.312	2.158	0.031	[DIVER=176]	0.455	0.576	0.791	0.429
[YEAR=1999.00]	0.706	0.310	2.281	0.023	[DIVER=177]	0.058	0.118	0.489	0.625
[YEAR=2000.00]	0.665	0.308	2.156	0.031	[DIVER=178]	0.157	0.428	0.366	0.714
[YEAR=2001.00]	0.373	0.312	1.197	0.231	[DIVER=179]	0.187	0.068	2.762	0.006
[YEAR=2002.00]	0.531	0.312	1.702	0.089	[DIVER=180]	0.251	0.185	1.359	0.174
[YEAR=2003.00]	-0.054	0.324	-0.165	0.869	[DIVER=181]	0.094	0.080	1.187	0.235
[YEAR=2004.00]	-0.191	0.343	-0.557	0.577	[DIVER=182]	-0.009	0.080	-0.108	0.914
[YEAR=2005.00]	-0.158	0.102	-1.542	0.123	[DIVER=183]	0.275	0.157	1.752	0.080
[YEAR=2006.00]	0.000	.	.	.	[DIVER=184]	-0.537	0.217	-2.470	0.014
[SEASON=1]	-0.217	0.299	-0.726	0.468	[DIVER=186]	0.183	0.307	0.597	0.550
[SEASON=2]	-0.452	0.299	-1.510	0.131	[DIVER=188]	0.191	0.243	0.787	0.431
[SEASON=3]	-0.512	0.300	-1.708	0.088	[DIVER=189]	0.146	0.166	0.877	0.380
[SEASON=4]	0.000	.	.	.	[DIVER=191]	0.383	0.414	0.926	0.355
[ZONE=A]	0.414	0.097	4.287	0.000	[DIVER=192]	0.172	0.084	2.045	0.041
[ZONE=B]	0.392	0.065	6.013	0.000	[DIVER=193]	0.842	0.412	2.044	0.041
[ZONE=CNP]	-0.204	0.072	-2.846	0.004	[DIVER=196]	-0.095	0.302	-0.316	0.752
[ZONE=CP]	-0.624	0.165	-3.784	0.000	[DIVER=198]	-0.009	0.121	-0.076	0.939
[ZONE=D]	0.000	.	.	.	[DIVER=199]	0.149	0.118	1.265	0.206
[DIVER=1]	0.165	0.060	2.775	0.006	[DIVER=200]	-0.413	0.443	-0.933	0.351
[DIVER=2]	0.174	0.061	2.881	0.004	[DIVER=201]	0.096	0.125	0.773	0.439
[DIVER=3]	0.189	0.065	2.889	0.004	[DIVER=202]	0.052	0.138	0.378	0.705
[DIVER=4]	0.224	0.072	3.098	0.002	[DIVER=203]	0.502	0.247	2.032	0.042
[DIVER=5]	0.210	0.062	3.386	0.001	[DIVER=207]	0.271	0.081	3.340	0.001
[DIVER=6]	0.216	0.060	3.615	0.000	[DIVER=208]	0.243	0.142	1.712	0.087
[DIVER=7]	0.205	0.059	3.447	0.001	[DIVER=209]	0.176	0.070	2.511	0.012
[DIVER=8]	0.144	0.059	2.444	0.015	[DIVER=210]	0.131	0.122	1.069	0.285
[DIVER=9]	0.170	0.059	2.861	0.004	[DIVER=211]	-0.150	0.412	-0.365	0.715
[DIVER=10]	0.140	0.060	2.350	0.019	[DIVER=212]	0.268	0.146	1.833	0.067
[DIVER=11]	0.183	0.059	3.093	0.002	[DIVER=213]	0.157	0.074	2.109	0.035
[DIVER=12]	0.423	0.412	1.028	0.304	[DIVER=214]	0.324	0.150	2.155	0.031
[DIVER=13]	0.165	0.060	2.724	0.006	[DIVER=215]	0.355	0.268	1.321	0.187
[DIVER=14]	0.154	0.060	2.568	0.010	[DIVER=217]	0.196	0.076	2.595	0.009
[DIVER=15]	0.249	0.060	4.160	0.000	[DIVER=218]	0.254	0.103	2.452	0.014
[DIVER=16]	0.234	0.060	3.878	0.000	[DIVER=219]	0.206	0.148	1.393	0.164
[DIVER=17]	0.189	0.059	3.184	0.001	[DIVER=220]	0.368	0.305	1.206	0.228
[DIVER=18]	0.174	0.060	2.910	0.004	[DIVER=221]	0.163	0.150	1.085	0.278
[DIVER=19]	0.147	0.060	2.446	0.014	[DIVER=223]	-0.018	0.081	-0.223	0.823
[DIVER=20]	0.228	0.062	3.647	0.000	[DIVER=226]	0.154	0.064	2.392	0.017
[DIVER=21]	0.217	0.060	3.639	0.000	[DIVER=227]	0.835	0.216	3.864	0.000
[DIVER=22]	0.151	0.059	2.533	0.011	[DIVER=229]	-0.211	0.295	-0.717	0.473
[DIVER=23]	0.150	0.060	2.519	0.012	[DIVER=230]	0.243	0.145	1.678	0.093
[DIVER=24]	0.150	0.060	2.511	0.012	[DIVER=231]	0.509	0.346	1.471	0.141
[DIVER=25]	0.161	0.059	2.717	0.007	[DIVER=232]	-0.386	0.151	-2.547	0.011
[DIVER=26]	0.172	0.059	2.903	0.004	[DIVER=234]	0.045	0.412	0.110	0.912
[DIVER=27]	0.181	0.061	2.953	0.003	[DIVER=236]	0.724	0.412	1.756	0.079
[DIVER=28]	0.243	0.067	3.622	0.000	[DIVER=237]	0.371	0.294	1.262	0.207
[DIVER=29]	0.180	0.059	3.055	0.002	[DIVER=238]	0.145	0.295	0.492	0.623
[DIVER=30]	0.254	0.065	3.876	0.000	[DIVER=240]	-0.077	0.414	-0.186	0.853
[DIVER=31]	0.129	0.063	2.065	0.039	[DIVER=241]	-0.208	0.104	-1.987	0.047
[DIVER=32]	0.217	0.060	3.623	0.000	[DIVER=242]	0.268	0.296	0.905	0.365
[DIVER=33]	0.090	0.064	1.403	0.161	[DIVER=243]	0.077	0.073	1.065	0.287
[DIVER=34]	0.178	0.060	2.980	0.003	[DIVER=244]	-0.033	0.220	-0.150	0.881
[DIVER=35]	0.108	0.061	1.760	0.078	[DIVER=245]	0.232	0.162	1.430	0.153
[DIVER=36]	0.189	0.059	3.174	0.002	[DIVER=246]	0.140	0.116	1.208	0.227

Parameter	B	Std. Error	t	Sig.	Parameter	B	Std. Error	t	Sig.
[DIVER=37]	0.188	0.060	3.160	0.002	[DIVER=247]	-0.137	0.195	-0.704	0.482
[DIVER=38]	0.206	0.060	3.422	0.001	[DIVER=248]	0.054	0.113	0.481	0.630
[DIVER=39]	0.176	0.059	2.960	0.003	[DIVER=249]	0.196	0.180	1.089	0.276
[DIVER=40]	0.157	0.059	2.648	0.008	[DIVER=250]	-0.143	0.150	-0.955	0.340
[DIVER=41]	0.193	0.060	3.217	0.001	[DIVER=251]	0.263	0.160	1.638	0.101
[DIVER=42]	0.180	0.060	2.975	0.003	[DIVER=252]	0.095	0.124	0.765	0.444
[DIVER=43]	0.137	0.060	2.298	0.022	[DIVER=253]	-0.061	0.243	-0.251	0.801
[DIVER=44]	0.083	0.061	1.363	0.173	[DIVER=254]	0.065	0.106	0.611	0.541
[DIVER=45]	0.174	0.060	2.922	0.003	[DIVER=256]	0.146	0.297	0.491	0.623
[DIVER=46]	-0.358	0.161	-2.219	0.027	[DIVER=257]	0.043	0.150	0.289	0.773
[DIVER=47]	0.171	0.059	2.874	0.004	[DIVER=258]	-0.211	0.414	-0.510	0.610
[DIVER=48]	0.246	0.071	3.465	0.001	[DIVER=259]	-0.138	0.100	-1.374	0.170
[DIVER=49]	0.162	0.059	2.724	0.006	[DIVER=260]	0.333	0.117	2.854	0.004
[DIVER=50]	0.131	0.063	2.087	0.037	[DIVER=262]	-0.062	0.135	-0.458	0.647
[DIVER=51]	0.169	0.059	2.838	0.005	[DIVER=263]	0.070	0.195	0.359	0.720
[DIVER=52]	0.161	0.060	2.692	0.007	[DIVER=264]	0.370	0.167	2.219	0.027
[DIVER=53]	0.130	0.061	2.136	0.033	[DIVER=265]	0.272	0.177	1.532	0.126
[DIVER=54]	0.027	0.109	0.247	0.805	[DIVER=266]	0.194	0.148	1.313	0.189
[DIVER=55]	0.211	0.059	3.542	0.000	[DIVER=267]	0.353	0.214	1.650	0.099
[DIVER=56]	0.164	0.066	2.475	0.013	[DIVER=268]	0.365	0.192	1.901	0.057
[DIVER=57]	0.200	0.065	3.065	0.002	[DIVER=269]	-0.086	0.179	-0.482	0.630
[DIVER=58]	0.196	0.063	3.130	0.002	[DIVER=270]	0.114	0.195	0.582	0.561
[DIVER=59]	0.195	0.060	3.244	0.001	[DIVER=271]	0.402	0.157	2.560	0.010
[DIVER=60]	0.146	0.064	2.286	0.022	[DIVER=272]	0.243	0.144	1.690	0.091
[DIVER=61]	0.180	0.079	2.275	0.023	[DIVER=273]	-0.271	0.169	-1.604	0.109
[DIVER=62]	0.148	0.059	2.495	0.013	[DIVER=274]	0.160	0.094	1.698	0.090
[DIVER=63]	0.171	0.063	2.718	0.007	[DIVER=275]	0.390	0.196	1.984	0.047
[DIVER=64]	0.160	0.060	2.660	0.008	[DIVER=276]	0.529	0.195	2.718	0.007
[DIVER=65]	0.252	0.068	3.715	0.000	[DIVER=277]	0.172	0.193	0.888	0.375
[DIVER=66]	0.195	0.073	2.671	0.008	[DIVER=279]	0.070	0.165	0.425	0.671
[DIVER=67]	0.093	0.063	1.467	0.142	[DIVER=280]	-0.226	0.193	-1.169	0.242
[DIVER=68]	0.204	0.065	3.124	0.002	[DIVER=281]	0.135	0.150	0.901	0.368
[DIVER=69]	0.236	0.085	2.783	0.005	[DIVER=282]	-0.008	0.155	-0.051	0.960
[DIVER=70]	0.159	0.079	2.012	0.044	[DIVER=283]	0.238	0.144	1.649	0.099
[DIVER=71]	0.261	0.076	3.447	0.001	[DIVER=284]	0.146	0.136	1.069	0.285
[DIVER=72]	0.200	0.063	3.165	0.002	[DIVER=285]	0.071	0.127	0.560	0.576
[DIVER=73]	0.133	0.066	2.023	0.043	[DIVER=286]	0.188	0.131	1.432	0.152
[DIVER=74]	0.159	0.077	2.076	0.038	[DIVER=287]	0.194	0.149	1.304	0.192
[DIVER=75]	0.134	0.070	1.931	0.053	[DIVER=288]	0.411	0.157	2.619	0.009
[DIVER=76]	0.223	0.087	2.549	0.011	[DIVER=289]	-0.139	0.114	-1.224	0.221
[DIVER=77]	0.270	0.079	3.432	0.001	[DIVER=290]	-0.092	0.137	-0.676	0.499
[DIVER=78]	0.199	0.082	2.422	0.015	[DIVER=291]	0.199	0.146	1.364	0.173
[DIVER=79]	0.119	0.072	1.666	0.096	[DIVER=292]	0.005	0.134	0.037	0.970
[DIVER=80]	0.136	0.062	2.179	0.029	[DIVER=293]	-0.312	0.127	-2.462	0.014
[DIVER=81]	0.077	0.070	1.096	0.273	[DIVER=294]	-0.376	0.142	-2.657	0.008
[DIVER=82]	-0.052	0.156	-0.331	0.740	[DIVER=295]	0.187	0.149	1.254	0.210
[DIVER=84]	-0.065	0.117	-0.555	0.579	[DIVER=296]	0.062	0.143	0.436	0.663
[DIVER=86]	0.032	0.116	0.279	0.780	[DIVER=297]	0.014	0.157	0.091	0.927
[DIVER=88]	0.104	0.133	0.777	0.437	[DIVER=298]	0.155	0.137	1.132	0.258
[DIVER=90]	-0.225	0.430	-0.522	0.602	[DIVER=299]	0.355	0.129	2.744	0.006
[DIVER=91]	0.234	0.092	2.537	0.011	[DIVER=300]	0.308	0.125	2.458	0.014
[DIVER=92]	0.259	0.134	1.930	0.054	[DIVER=301]	0.040	0.194	0.208	0.835
[DIVER=93]	0.244	0.081	2.994	0.003	[DIVER=302]	0.478	0.414	1.155	0.248
[DIVER=94]	-0.392	0.186	-2.111	0.035	[DIVER=303]	-0.267	0.124	-2.153	0.031
[DIVER=95]	0.193	0.157	1.235	0.217	[DIVER=304]	0.379	0.112	3.375	0.001
[DIVER=96]	0.046	0.130	0.356	0.722	[DIVER=305]	-0.078	0.156	-0.503	0.615
[DIVER=97]	-0.079	0.412	-0.192	0.848	[DIVER=306]	0.666	0.413	1.614	0.106
[DIVER=98]	0.159	0.082	1.931	0.053	[DIVER=307]	0.083	0.139	0.598	0.550
[DIVER=99]	0.059	0.098	0.596	0.551	[DIVER=308]	0.253	0.086	2.945	0.003
[DIVER=100]	0.102	0.101	1.002	0.316	[DIVER=309]	0.275	0.166	1.656	0.098
[DIVER=101]	-0.030	0.084	-0.359	0.720	[DIVER=310]	-0.037	0.166	-0.223	0.824
[DIVER=103]	0.181	0.068	2.674	0.007	[DIVER=311]	-0.107	0.180	-0.594	0.552
[DIVER=104]	0.092	0.192	0.482	0.630	[DIVER=312]	-0.032	0.119	-0.272	0.786
[DIVER=105]	0.037	0.160	0.234	0.815	[DIVER=313]	-0.006	0.154	-0.038	0.970
[DIVER=106]	0.181	0.103	1.750	0.080	[DIVER=314]	0.246	0.155	1.584	0.113
[DIVER=108]	-0.213	0.215	-0.990	0.322	[DIVER=315]	0.356	0.157	2.263	0.024
[DIVER=109]	0.200	0.163	1.230	0.219	[DIVER=316]	0.181	0.152	1.194	0.232
[DIVER=110]	0.009	0.138	0.068	0.946	[DIVER=317]	0.374	0.179	2.091	0.037
[DIVER=111]	0.020	0.194	0.102	0.919	[DIVER=318]	-0.158	0.144	-1.095	0.273
[DIVER=113]	0.134	0.075	1.800	0.072	[DIVER=319]	0.002	0.149	0.014	0.989
[DIVER=114]	-0.164	0.243	-0.672	0.501	[DIVER=320]	0.200	0.160	1.245	0.213
[DIVER=115]	0.064	0.105	0.613	0.540	[DIVER=321]	0.310	0.167	1.860	0.063
[DIVER=116]	0.075	0.079	0.949	0.343	[DIVER=322]	-0.115	0.149	-0.774	0.439

Parameter	B	Std. Error	t	Sig.	Parameter	B	Std. Error	t	Sig.
[DIVER=117]	0.222	0.104	2.139	0.032	[DIVER=323]	0.107	0.156	0.685	0.493
[DIVER=118]	0.488	0.161	3.030	0.002	[DIVER=324]	0.050	0.148	0.336	0.737
[DIVER=119]	0.138	0.412	0.335	0.737	[DIVER=325]	0.107	0.160	0.669	0.504
[DIVER=120]	0.261	0.104	2.512	0.012	[DIVER=326]	-0.199	0.168	-1.189	0.234
[DIVER=121]	0.121	0.137	0.882	0.378	[DIVER=327]	0.220	0.111	1.980	0.048
[DIVER=122]	0.266	0.083	3.215	0.001	[DIVER=328]	0.156	0.137	1.135	0.256
[DIVER=123]	0.086	0.158	0.541	0.588	[DIVER=329]	0.140	0.120	1.163	0.245
[DIVER=124]	0.103	0.076	1.353	0.176	[DIVER=331]	0.220	0.178	1.240	0.215
[DIVER=126]	0.099	0.338	0.293	0.769	[DIVER=332]	0.097	0.143	0.681	0.496
[DIVER=127]	-0.139	0.140	-0.991	0.322	[DIVER=333]	0.094	0.134	0.703	0.482
[DIVER=128]	0.119	0.096	1.240	0.215	[DIVER=334]	0.236	0.193	1.221	0.222
[DIVER=129]	0.140	0.132	1.058	0.290	[DIVER=335]	0.278	0.137	2.032	0.042
[DIVER=130]	0.134	0.067	1.995	0.046	[DIVER=336]	0.088	0.139	0.635	0.525
[DIVER=131]	-0.078	0.228	-0.343	0.731	[DIVER=337]	-0.190	0.149	-1.271	0.204
[DIVER=132]	0.055	0.118	0.463	0.644	[DIVER=338]	0.160	0.149	1.075	0.282
[DIVER=133]	0.101	0.067	1.494	0.135	[DIVER=339]	0.061	0.118	0.518	0.605
[DIVER=134]	0.298	0.116	2.572	0.010	[DIVER=340]	0.094	0.116	0.816	0.414
[DIVER=135]	-0.181	0.412	-0.439	0.661	[DIVER=341]	0.244	0.149	1.640	0.101
[DIVER=136]	0.335	0.117	2.868	0.004	[DIVER=342]	0.116	0.134	0.872	0.383
[DIVER=137]	0.133	0.066	2.023	0.043	[DIVER=343]	-0.120	0.215	-0.557	0.578
[DIVER=138]	-0.073	0.099	-0.730	0.465	[DIVER=344]	0.206	0.109	1.895	0.058
[DIVER=139]	-0.018	0.110	-0.168	0.867	[DIVER=345]	0.083	0.157	0.528	0.598
[DIVER=140]	0.342	0.414	0.827	0.408	[DIVER=346]	-0.542	0.157	-3.445	0.001
[DIVER=141]	0.355	0.428	0.830	0.407	[DIVER=347]	0.142	0.129	1.099	0.272
[DIVER=143]	0.303	0.189	1.606	0.108	[DIVER=348]	0.111	0.185	0.600	0.548
[DIVER=145]	0.088	0.088	1.006	0.314	[DIVER=349]	0.143	0.128	1.117	0.264
[DIVER=146]	0.092	0.077	1.191	0.234	[DIVER=350]	0.130	0.148	0.876	0.381
[DIVER=148]	0.330	0.132	2.500	0.012	[DIVER=351]	0.176	0.184	0.958	0.338
[DIVER=149]	0.163	0.113	1.450	0.147	[DIVER=352]	-0.134	0.124	-1.076	0.282
[DIVER=150]	0.131	0.072	1.817	0.069	[DIVER=353]	0.268	0.125	2.148	0.032
[DIVER=370]	0.156	0.166	0.941	0.347	[DIVER=354]	0.080	0.126	0.634	0.526
[DIVER=371]	0.247	0.139	1.781	0.075	[DIVER=355]	0.159	0.126	1.269	0.204
[DIVER=373]	-0.172	0.165	-1.044	0.297	[DIVER=356]	0.127	0.192	0.661	0.508
[DIVER=374]	0.010	0.151	0.066	0.947	[DIVER=357]	-0.118	0.134	-0.876	0.381
[DIVER=375]	0.352	0.159	2.214	0.027	[DIVER=358]	0.245	0.149	1.651	0.099
[DIVER=376]	0.502	0.187	2.683	0.007	[DIVER=359]	0.341	0.156	2.183	0.029
[DIVER=377]	0.030	0.102	0.296	0.767	[DIVER=360]	0.011	0.145	0.078	0.938
[DIVER=378]	0.025	0.216	0.114	0.909	[DIVER=361]	0.129	0.124	1.036	0.300
[DIVER=379]	0.431	0.205	2.108	0.035	[DIVER=362]	-0.070	0.193	-0.361	0.718
[DIVER=382]	0.010	0.137	0.074	0.941	[DIVER=363]	0.356	0.145	2.460	0.014
[DIVER=389]	-0.185	0.412	-0.449	0.653	[DIVER=364]	0.234	0.127	1.837	0.066
[DIVER=391]	-0.042	0.412	-0.103	0.918	[DIVER=365]	0.278	0.140	1.987	0.047
[DIVER=410]	0.049	0.199	0.247	0.805	[DIVER=366]	-0.137	0.129	-1.066	0.287
[DIVER=413]	0.105	0.177	0.594	0.552	[DIVER=367]	0.121	0.110	1.100	0.272
[DIVER=414]	0.131	0.177	0.740	0.459					
[DIVER=415]	0.430	0.137	3.131	0.002					
[DIVER=419]	0.110	0.085	1.291	0.197					
[DIVER=555]	0.000	.	.	.					

Parameter	B	Std. Error	t	Sig.	Parameter	B	Std. Error	t	Sig.
[YEAR=1980.00] * [SEASON=1]	-0.414	0.043	-9.575	0.000	[YEAR=1982.]	-0.191	0.102	-1.876	0.061
[YEAR=1980.00] * [SEASON=2]	-0.195	0.047	-4.175	0.000	[YEAR=1982.]	-0.381	0.070	-5.476	0.000
[YEAR=1980.00] * [SEASON=3]	0.000	.	.	.	[YEAR=1982.]	0.122	0.084	1.449	0.147
[YEAR=1981.00] * [SEASON=1]	0.109	0.306	0.357	0.721	[YEAR=1982.]	0.518	0.167	3.104	0.002
[YEAR=1981.00] * [SEASON=2]	0.340	0.306	1.110	0.267	[YEAR=1982.]	0.000	.	.	.
[YEAR=1981.00] * [SEASON=3]	0.356	0.307	1.160	0.246	[YEAR=1983.]	-0.067	0.102	-0.655	0.513
[YEAR=1981.00] * [SEASON=4]	0.000	.	.	.	[YEAR=1983.]	-0.274	0.071	-3.836	0.000
[YEAR=1982.00] * [SEASON=1]	0.070	0.301	0.232	0.816	[YEAR=1983.]	0.314	0.083	3.764	0.000
[YEAR=1982.00] * [SEASON=2]	0.267	0.301	0.887	0.375	[YEAR=1983.]	0.677	0.168	4.039	0.000
[YEAR=1982.00] * [SEASON=3]	0.365	0.302	1.210	0.226	[YEAR=1983.]	0.000	.	.	.
[YEAR=1982.00] * [SEASON=4]	0.000	.	.	.	[YEAR=1984.]	-0.096	0.102	-0.936	0.349
[YEAR=1983.00] * [SEASON=1]	0.301	0.302	0.997	0.319	[YEAR=1984.]	-0.326	0.071	-4.606	0.000
[YEAR=1983.00] * [SEASON=2]	0.477	0.302	1.580	0.114	[YEAR=1984.]	0.231	0.079	2.936	0.003
[YEAR=1983.00] * [SEASON=3]	0.556	0.302	1.837	0.066	[YEAR=1984.]	0.578	0.168	3.443	0.001
[YEAR=1983.00] * [SEASON=4]	0.000	.	.	.	[YEAR=1984.]	0.000	.	.	.
[YEAR=1984.00] * [SEASON=1]	0.313	0.320	0.980	0.327	[YEAR=1985.]	-0.163	0.101	-1.611	0.107
[YEAR=1984.00] * [SEASON=2]	0.512	0.320	1.601	0.109	[YEAR=1985.]	-0.351	0.070	-5.052	0.000
[YEAR=1984.00] * [SEASON=3]	0.586	0.321	1.828	0.068	[YEAR=1985.]	0.144	0.081	1.778	0.075
[YEAR=1984.00] * [SEASON=4]	0.000	.	.	.	[YEAR=1985.]	0.618	0.167	3.695	0.000
[YEAR=1985.00] * [SEASON=1]	0.408	0.301	1.357	0.175	[YEAR=1985.]	0.000	.	.	.
[YEAR=1985.00] * [SEASON=2]	0.575	0.301	1.906	0.057	[YEAR=1986.]	-0.178	0.105	-1.696	0.090
[YEAR=1985.00] * [SEASON=3]	0.674	0.302	2.230	0.026	[YEAR=1986.]	-0.302	0.076	-3.970	0.000
[YEAR=1985.00] * [SEASON=4]	0.000	.	.	.	[YEAR=1986.]	0.233	0.084	2.768	0.006
[YEAR=1986.00] * [SEASON=1]	0.103	0.300	0.343	0.731	[YEAR=1986.]	0.762	0.169	4.499	0.000
[YEAR=1986.00] * [SEASON=2]	0.387	0.300	1.288	0.198	[YEAR=1986.]	0.000	.	.	.
[YEAR=1986.00] * [SEASON=3]	0.462	0.304	1.519	0.129	[YEAR=1987.]	-0.116	0.105	-1.108	0.268
[YEAR=1986.00] * [SEASON=4]	0.000	.	.	.	[YEAR=1987.]	-0.340	0.076	-4.444	0.000
[YEAR=1987.00] * [SEASON=1]	0.124	0.300	0.412	0.680	[YEAR=1987.]	0.270	0.090	2.995	0.003
[YEAR=1987.00] * [SEASON=2]	0.347	0.301	1.154	0.248	[YEAR=1987.]	0.633	0.170	3.731	0.000
[YEAR=1987.00] * [SEASON=3]	0.308	0.336	0.918	0.359	[YEAR=1987.]	0.000	.	.	.
[YEAR=1987.00] * [SEASON=4]	0.000	.	.	.	[YEAR=1988.]	-0.258	0.105	-2.468	0.014
[YEAR=1988.00] * [SEASON=1]	0.090	0.300	0.300	0.764	[YEAR=1988.]	-0.419	0.077	-5.460	0.000
[YEAR=1988.00] * [SEASON=2]	0.316	0.301	1.051	0.293	[YEAR=1988.]	0.137	0.091	1.503	0.133
[YEAR=1988.00] * [SEASON=3]	0.161	0.315	0.512	0.609	[YEAR=1988.]	0.531	0.170	3.131	0.002
[YEAR=1988.00] * [SEASON=4]	0.000	.	.	.	[YEAR=1988.]	0.000	.	.	.
[YEAR=1989.00] * [SEASON=1]	0.121	0.300	0.405	0.686	[YEAR=1989.]	-0.152	0.103	-1.472	0.141
[YEAR=1989.00] * [SEASON=2]	0.398	0.301	1.322	0.186	[YEAR=1989.]	-0.246	0.075	-3.282	0.001
[YEAR=1989.00] * [SEASON=3]	0.000	.	.	.	[YEAR=1989.]	0.323	0.091	3.571	0.000
[YEAR=1989.00] * [SEASON=4]	0.192	0.300	0.639	0.523	[YEAR=1989.]	0.706	0.169	4.179	0.000
[YEAR=1990.00] * [SEASON=1]	0.168	0.320	0.523	0.601	[YEAR=1989.]	0.000	.	.	.
[YEAR=1990.00] * [SEASON=2]	0.049	0.300	0.165	0.869	[YEAR=1990.]	-0.378	0.106	-3.578	0.000
[YEAR=1990.00] * [SEASON=3]	0.054	0.301	0.179	0.858	[YEAR=1990.]	-0.411	0.078	-5.270	0.000
[YEAR=1990.00] * [SEASON=4]	0.088	0.305	0.289	0.773	[YEAR=1990.]	0.186	0.089	2.075	0.038
[YEAR=1991.00] * [SEASON=1]	0.147	0.301	0.489	0.625	[YEAR=1990.]	0.455	0.170	2.672	0.008
[YEAR=1991.00] * [SEASON=2]	0.197	0.312	0.632	0.527	[YEAR=1990.]	0.000	.	.	.
[YEAR=1991.00] * [SEASON=3]	0.370	0.304	1.218	0.223	[YEAR=1991.]	-0.190	0.106	-1.792	0.073
[YEAR=1991.00] * [SEASON=4]	0.000	.	.	.	[YEAR=1991.]	-0.327	0.077	-4.253	0.000
[YEAR=1992.00] * [SEASON=1]	0.014	0.302	0.045	0.964	[YEAR=1991.]	0.204	0.087	2.348	0.019
[YEAR=1992.00] * [SEASON=2]	0.030	0.313	0.094	0.925	[YEAR=1991.]	0.517	0.170	3.046	0.002
[YEAR=1992.00] * [SEASON=3]	0.000	.	.	.	[YEAR=1991.]	0.000	.	.	.
[YEAR=1992.00] * [SEASON=4]	0.000	.	.	.	[YEAR=1992.]	-0.193	0.105	-1.832	0.067
[YEAR=1993.00] * [SEASON=1]	0.030	0.301	0.098	0.922	[YEAR=1992.]	-0.253	0.079	-3.217	0.001
[YEAR=1993.00] * [SEASON=2]	0.102	0.307	0.332	0.740	[YEAR=1992.]	0.171	0.092	1.861	0.063
[YEAR=1993.00] * [SEASON=3]	-0.440	0.306	-1.436	0.151	[YEAR=1992.]	0.567	0.171	3.323	0.001
[YEAR=1993.00] * [SEASON=4]	0.000	.	.	.	[YEAR=1992.]	0.000	.	.	.
[YEAR=1994.00] * [SEASON=1]	-0.067	0.301	-0.222	0.824	[YEAR=1993.]	-0.600	0.111	-5.413	0.000
[YEAR=1994.00] * [SEASON=2]	0.124	0.302	0.411	0.681	[YEAR=1993.]	-0.577	0.086	-6.727	0.000
[YEAR=1994.00] * [SEASON=3]	0.213	0.313	0.681	0.496	[YEAR=1993.]	-0.446	0.099	-4.524	0.000
[YEAR=1994.00] * [SEASON=4]	0.000	.	.	.	[YEAR=1993.]	0.206	0.176	1.173	0.241
[YEAR=1995.00] * [SEASON=1]	0.058	0.301	0.194	0.846	[YEAR=1993.]	0.000	.	.	.
[YEAR=1995.00] * [SEASON=2]	0.096	0.303	0.315	0.752	[YEAR=1994.]	-0.424	0.107	-3.964	0.000
[YEAR=1995.00] * [SEASON=3]	-0.073	0.305	-0.239	0.811	[YEAR=1994.]	-0.611	0.078	-7.861	0.000
[YEAR=1995.00] * [SEASON=4]	0.000	.	.	.	[YEAR=1994.]	-0.087	0.090	-0.968	0.333
[YEAR=1996.00] * [SEASON=1]	0.094	0.302	0.312	0.755	[YEAR=1994.]	0.384	0.171	2.243	0.025
[YEAR=1996.00] * [SEASON=2]	0.227	0.305	0.745	0.457	[YEAR=1994.]	0.000	.	.	.
[YEAR=1996.00] * [SEASON=3]	0.474	0.302	1.571	0.116	[YEAR=1995.]	-0.334	0.105	-3.184	0.001
[YEAR=1996.00] * [SEASON=4]	0.000	.	.	.	[YEAR=1995.]	-0.366	0.078	-4.713	0.000
[YEAR=1997.00] * [SEASON=1]	0.515	0.305	1.688	0.091	[YEAR=1995.]	0.038	0.089	0.425	0.671
[YEAR=1997.00] * [SEASON=2]	0.660	0.305	2.163	0.031	[YEAR=1995.]	0.444	0.171	2.595	0.009
[YEAR=1997.00] * [SEASON=3]	0.721	0.305	2.362	0.018	[YEAR=1995.]	0.000	.	.	.
[YEAR=1997.00] * [SEASON=4]	0.000	.	.	.	[YEAR=1996.]	-0.405	0.103	-3.929	0.000
[YEAR=1998.00] * [SEASON=1]	0.000	.	.	.	[YEAR=1996.]	-0.423	0.075	-5.618	0.000

[YEAR=1999.00] * [SEASON=4]	0.000	.	.	.	[YEAR=1997.]	-0.532	0.103	-5.140	0.000
[YEAR=2000.00] * [SEASON=1]	0.039	0.302	0.129	0.897	[YEAR=1997.]	-0.382	0.077	-4.951	0.000
[YEAR=2000.00] * [SEASON=2]	0.084	0.302	0.279	0.780	[YEAR=1997.]	-0.486	0.084	-5.790	0.000
[YEAR=2000.00] * [SEASON=3]	-0.098	0.310	-0.317	0.751	[YEAR=1997.]	-0.154	0.174	-0.885	0.376
[YEAR=2000.00] * [SEASON=4]	0.000	.	.	.	[YEAR=1997.]	0.000	.	.	.
[YEAR=2001.00] * [SEASON=1]	0.257	0.304	0.846	0.398	[YEAR=1998.]	-0.532	0.102	-5.218	0.000
[YEAR=2001.00] * [SEASON=2]	0.255	0.305	0.835	0.404	[YEAR=1998.]	-0.498	0.073	-6.804	0.000
[YEAR=2001.00] * [SEASON=3]	0.518	0.330	1.569	0.117	[YEAR=1998.]	-0.370	0.086	-4.305	0.000
[YEAR=2001.00] * [SEASON=4]	0.000	.	.	.	[YEAR=1998.]	-0.187	0.177	-1.061	0.289
[YEAR=2002.00] * [SEASON=1]	-0.014	0.303	-0.046	0.963	[YEAR=1998.]	0.000	.	.	.
[YEAR=2002.00] * [SEASON=2]	0.036	0.304	0.117	0.907	[YEAR=1999.]	-0.382	0.102	-3.751	0.000
[YEAR=2002.00] * [SEASON=3]	-0.194	0.307	-0.630	0.529	[YEAR=1999.]	-0.249	0.072	-3.435	0.001
[YEAR=2002.00] * [SEASON=4]	0.000	.	.	.	[YEAR=1999.]	0.033	0.095	0.351	0.725
[YEAR=2003.00] * [SEASON=1]	0.101	0.304	0.334	0.738	[YEAR=1999.]	0.000	.	.	.
[YEAR=2003.00] * [SEASON=2]	0.149	0.305	0.488	0.626	[YEAR=1999.]	0.000	.	.	.
[YEAR=2003.00] * [SEASON=3]	0.113	0.310	0.363	0.716	[YEAR=2000.]	-0.142	0.102	-1.393	0.164
[YEAR=2003.00] * [SEASON=4]	0.000	.	.	.	[YEAR=2000.]	-0.165	0.075	-2.190	0.029
[YEAR=2004.00] * [SEASON=1]	0.553	0.336	1.648	0.099	[YEAR=2000.]	0.518	0.134	3.875	0.000
[YEAR=2004.00] * [SEASON=2]	0.306	0.334	0.916	0.360	[YEAR=2000.]	0.000	.	.	.
[YEAR=2004.00] * [SEASON=3]	0.284	0.334	0.848	0.396	[YEAR=2001.]	-0.087	0.106	-0.823	0.411
[YEAR=2004.00] * [SEASON=4]	0.000	.	.	.	[YEAR=2001.]	-0.175	0.080	-2.179	0.029
[YEAR=2005.00] * [SEASON=1]	0.159	0.051	3.098	0.002	[YEAR=2001.]	0.000	.	.	.
[YEAR=2005.00] * [SEASON=2]	0.110	0.055	2.016	0.044	[YEAR=2002.]	0.067	0.109	0.612	0.540
[YEAR=2005.00] * [SEASON=3]	0.000	.	.	.	[YEAR=2002.]	-0.061	0.085	-0.716	0.474
[YEAR=2006.00] * [SEASON=1]	0.000	.	.	.	[YEAR=2002.]	0.319	0.097	3.301	0.001
[YEAR=2006.00] * [SEASON=2]	0.000	.	.	.	[YEAR=2002.]	0.000	.	.	.
[YEAR=2006.00] * [SEASON=3]	0.000	.	.	.	[YEAR=2003.]	0.329	0.139	2.363	0.018
[YEAR=2006.00] * [SEASON=4]	0.000	.	.	.	[YEAR=2003.]	0.334	0.126	2.657	0.008
[YEAR=1980.00] * [ZONE=A]	-0.149	0.102	-1.463	0.144	[YEAR=2003.]	0.358	0.138	2.587	0.010
[YEAR=1980.00] * [ZONE=B]	-0.550	0.070	-7.845	0.000	[YEAR=2003.]	0.000	.	.	.
[YEAR=1980.00] * [ZONE=CNP]	-0.030	0.089	-0.334	0.739	[YEAR=2004.]	0.354	0.118	3.001	0.003
[YEAR=1980.00] * [ZONE=CP]	0.392	0.167	2.355	0.019	[YEAR=2004.]	0.117	0.086	1.369	0.171
[YEAR=1980.00] * [ZONE=D]	0.000	.	.	.	[YEAR=2004.]	0.096	0.096	1.003	0.316
[YEAR=1981.00] * [ZONE=A]	-0.039	0.104	-0.380	0.704	[YEAR=2004.]	0.000	.	.	.
[YEAR=1981.00] * [ZONE=B]	-0.428	0.071	-6.034	0.000	[YEAR=2005.]	0.062	0.131	0.470	0.638
[YEAR=1981.00] * [ZONE=CNP]	0.106	0.082	1.295	0.195	[YEAR=2005.]	0.124	0.097	1.269	0.204
[YEAR=1981.00] * [ZONE=CP]	0.468	0.167	2.800	0.005	[YEAR=2005.]	0.175	0.106	1.653	0.098
[YEAR=1981.00] * [ZONE=D]	0.000	.	.	.	[YEAR=2005.]	0.000	.	.	.
					[YEAR=2006.]	0.000	.	.	.
					[YEAR=2006.]	0.000	.	.	.
					[YEAR=2006.]	0.000	.	.	.
					[YEAR=2006.]	0.000	.	.	.

Table 1. The number of data entries per Zone used in the GLM analysis to standardise the commercial CPUE series. Note the small number of entries in Zone C during the 1999 and 2000 fishing seasons. Zone CNP was closed during the 2001 fishing season and Zone CP during both the 2001, 2002 and 2003 fishing seasons as indicated by the absence of data for these years. Model years are defined as the period October to September. Note values shown in italics indicate sample sizes which were too small to be included in the analysis. The second table shows the abalone catch per zone (in MT).

Model year	A	B	CNP	CP	D
1980	257	555	73	754	535
1981	192	578	147	622	383
1982	311	610	109	594	608
1983	327	691	144	466	302
1984	334	701	303	366	373
1985	360	620	158	366	583
1986	340	765	222	446	205
1987	446	586	106	494	144
1988	457	434	96	498	147
1989	448	414	91	504	184
1990	527	410	139	458	140
1991	447	404	161	544	167
1992	349	302	98	398	142
1993	299	239	110	336	75
1994	347	290	160	288	162
1995	441	238	138	334	171
1996	514	324	413	460	206
1997	771	249	258	117	197
1998	634	509	225	75	331
1999	725	429	57	8	306
2000	456	335	24	2	315
2001	400	291	1		135
2002	290	229	103	2	96
2003	415	128	54		26
2004	101	576	158	6	69
2005	63	599	170	4	56
2006	42	672	171		48
2007		340	1		

Model year	A	B	CNP	CP	D
1980	144.2	173.6	17.1	162.3	183.8
1981	111.0	173.8	38.5	140.7	127.3
1982	144.8	186.6	26.7	131.1	191.1
1983	158.5	200.5	37.0	105.4	78.4
1984	165.2	205.1	82.6	95.4	101.0
1985	136.8	176.4	41.6	98.7	153.8
1986	132.0	229.4	57.3	120.6	50.3
1987	171.8	166.1	29.7	126.4	45.2
1988	194.9	138.7	26.2	139.5	49.2
1989	190.9	137.3	28.6	134.8	51.0
1990	199.2	142.4	40.3	116.6	46.3
1991	182.9	138.0	41.0	119.0	49.6
1992	184.1	147.5	30.3	113.9	56.3
1993	179.2	152.1	31.9	105.2	53.7
1994	174.0	150.0	44.1	91.2	92.5
1995	210.8	152.3	39.1	84.7	90.2
1996	204.1	146.8	64.6	61.3	89.9
1997	196.8	145.9	36.7	16.1	92.6
1998	162.4	148.4	24.3	7.6	108.5
1999	191.5	155.5	11.3	1.0	103.8
2000	179.6	139.7	3.6	0.2	100.1
2001	156.5	113.4	0.2	0.0	34.1
2002	112.6	84.6	30.0	0.5	19.0
2003	119.5	36.5	5.1	0.0	1.4
2004	31.9	149.8	8.6	0.3	10.9
2005	10.1	140.3	8.6	0.2	8.5
2006	7.6	137.9	8.1	0.0	7.2
2007	0.0	52.4	0.029	0.0	0.0

Table 2. Results of the GLM analysis (using SPSS 11.0) showing the variables included in the model and some corresponding model statistics. A Type III Sum of Squares (equivalent to Yates' weighted-sum-of-means technique) was used. The variables are abbreviated as follows: YEAR = Model year (Oct to Sept.) (1980-2006), SEASON = season (Jan-Mar = 1; Apr-Jun = 2; Jul-Sep = 3; Oct-Dec =4), ZONE = zone/subarea (A,B,CNP,CP,D), DIVER = diver number/entitlement holder.

Tests of Between-Subjects Effects^b

Dependent Variable: LNCPUE

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3773.286 ^a	548	6.886	35.152	.000
Intercept	214.537	1	214.537	1095.253	.000
YEAR	271.503	26	10.442	53.311	.000
SEASON	71.938	3	23.979	122.419	.000
ZONE	360.205	4	90.051	459.728	.000
DIVER	137.262	346	.397	2.025	.000
YEAR * SEASON	221.736	73	3.037	15.507	.000
YEAR * ZONE	347.243	96	3.617	18.466	.000
Error	7778.760	39712	.196		
Total	22978.657	40261			
Corrected Total	11552.046	40260			

a. R Squared = .327 (Adjusted R Squared = .317)

b. Weighted Least Squares Regression - Weighted by WT_CAT

Table 3. Nominal and standardised commercial CPUE series for abalone for model years (October to September) 1980 to 2005 and Zones A, B, C (shown separately for subareas CNP and CP) and D. Both the nominal and the standardised values have been divided by the mean value of the respective series. Data are plotted in Figs. 2 a-e.

	<u>Nominal CPUE</u>				
	A	B	CNP	CP	D
1980	1.026	0.738	0.875	0.841	0.908
1981	1.000	0.740	0.899	0.834	0.834
1982	0.878	0.749	0.884	0.834	0.804
1983	0.866	0.730	0.941	0.875	0.724
1984	0.940	0.780	0.960	0.891	0.797
1985	0.880	0.789	0.922	0.965	0.810
1986	0.977	0.877	1.025	1.104	0.771
1987	1.006	0.843	1.137	1.057	0.869
1988	1.078	0.926	1.188	1.149	1.035
1989	0.985	0.941	1.157	1.116	0.895
1990	1.130	1.148	1.422	1.215	1.247
1991	1.129	1.187	1.225	1.099	1.233
1992	1.246	1.249	1.267	1.231	1.165
1993	1.352	1.475	1.092	1.290	1.911
1994	1.283	1.283	1.210	1.321	1.711
1995	1.194	1.383	1.256	1.131	1.469
1996	1.174	1.307	0.976	0.914	1.441
1997	1.117	1.390	0.902	0.722	1.499
1998	1.167	1.276	0.997	0.739	1.550
1999	0.966	1.092	0.984	0.673	1.020
2000	1.006	1.093	1.111		0.952
2001	0.994	1.021			0.842
2002	1.006	1.046	1.224		0.761
2003	0.816	0.997	0.804		0.484
2004	0.763	0.730	0.559		0.444
2005	0.496	0.656	0.511		0.393
2006	0.523	0.554			0.434
	<u>Standardised CPUE</u>				
	A	B	CNP	CP	D
1980	1.089	0.803	0.893	0.888	1.014
1981	1.134	0.846	0.955	0.894	0.947
1982	0.947	0.861	0.941	0.912	0.919
1983	0.905	0.810	0.964	0.904	0.777
1984	0.989	0.865	0.998	0.920	0.873
1985	0.925	0.844	0.915	0.959	0.874
1986	0.990	0.962	1.086	1.201	0.949
1987	1.008	0.888	1.079	1.011	0.909
1988	1.029	0.964	1.111	1.074	1.069
1989	1.021	1.023	1.196	1.143	0.954
1990	1.085	1.156	1.387	1.184	1.271
1991	1.092	1.048	1.177	1.050	1.059
1992	1.211	1.256	1.268	1.229	1.179
1993	1.198	1.350	1.016	1.272	1.751
1994	1.049	0.958	1.068	1.116	1.285
1995	1.088	1.159	1.147	1.123	1.219
1996	1.085	1.174	0.963	0.953	1.306
1997	1.095	1.401	0.834	0.758	1.496
1998	1.099	1.253	0.940	0.736	1.502
1999	0.969	1.218	1.068	0.673	1.139
2000	1.010	1.086	1.421		0.934
2001	1.024	1.033			0.897
2002	1.036	1.003	0.970		0.778
2003	0.858	0.949	0.642		0.495
2004	0.932	0.809	0.523		0.525
2005	0.536	0.627	0.436		0.404
2006	0.595	0.655			0.477

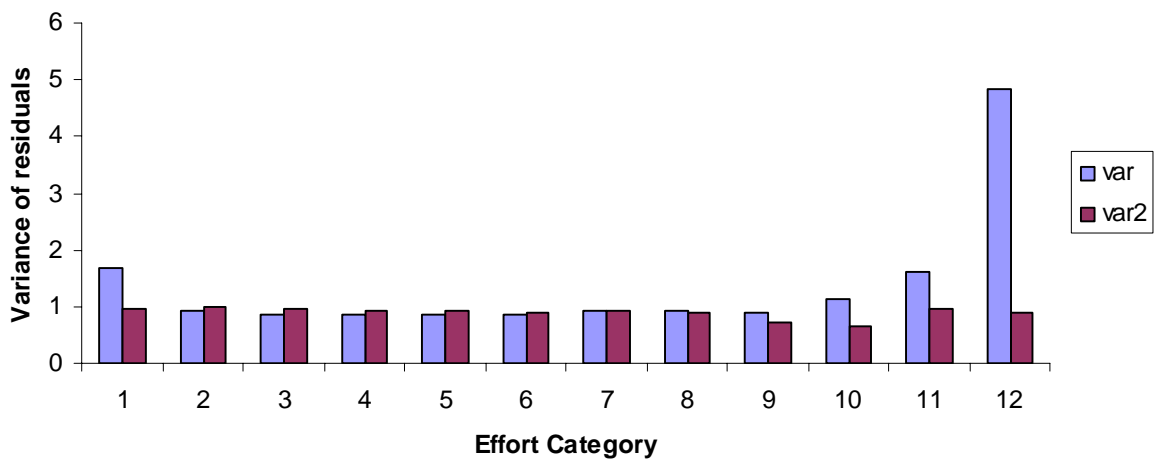


Fig. 1. Plot of the average variance of the residuals (corresponding to an initial GLM fit of the data) versus effort category (50 minutes interval). To take account of this heteroscedasticity, a weighted GLM was developed as described in the text, with the final (homoscedastic) pattern of residuals shown alongside (series var 2).

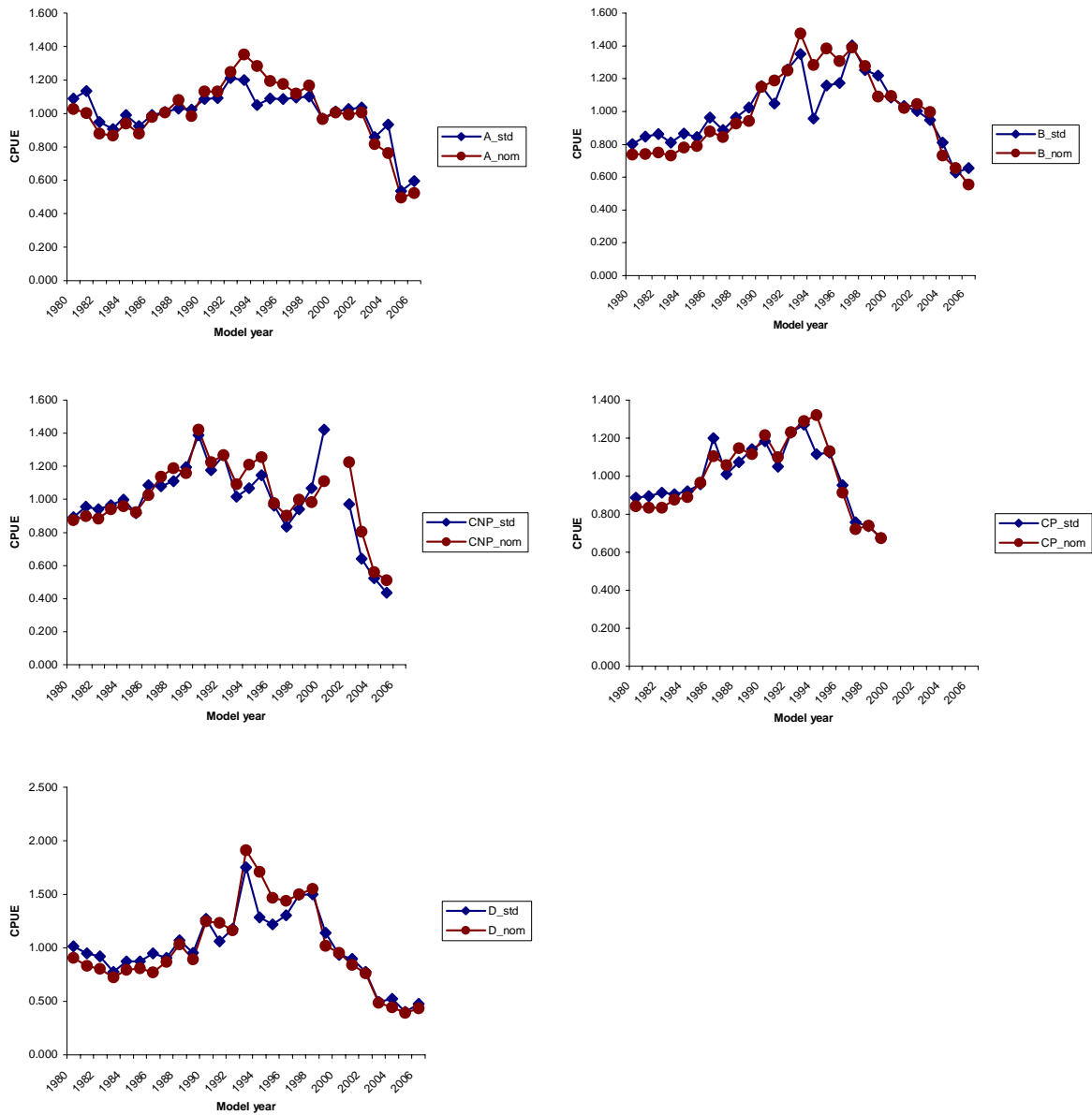


Fig. 2a-e. Comparisons between the nominal and GLM-standardised catch-per-unit-effort (CPUE) trends for zones A, B, CNP, CP and D. For ease of viewing, both the nominal and the standardised values have been divided by the mean value of the respective series. Values are derived from an iterative effort weighted GLM (see text).

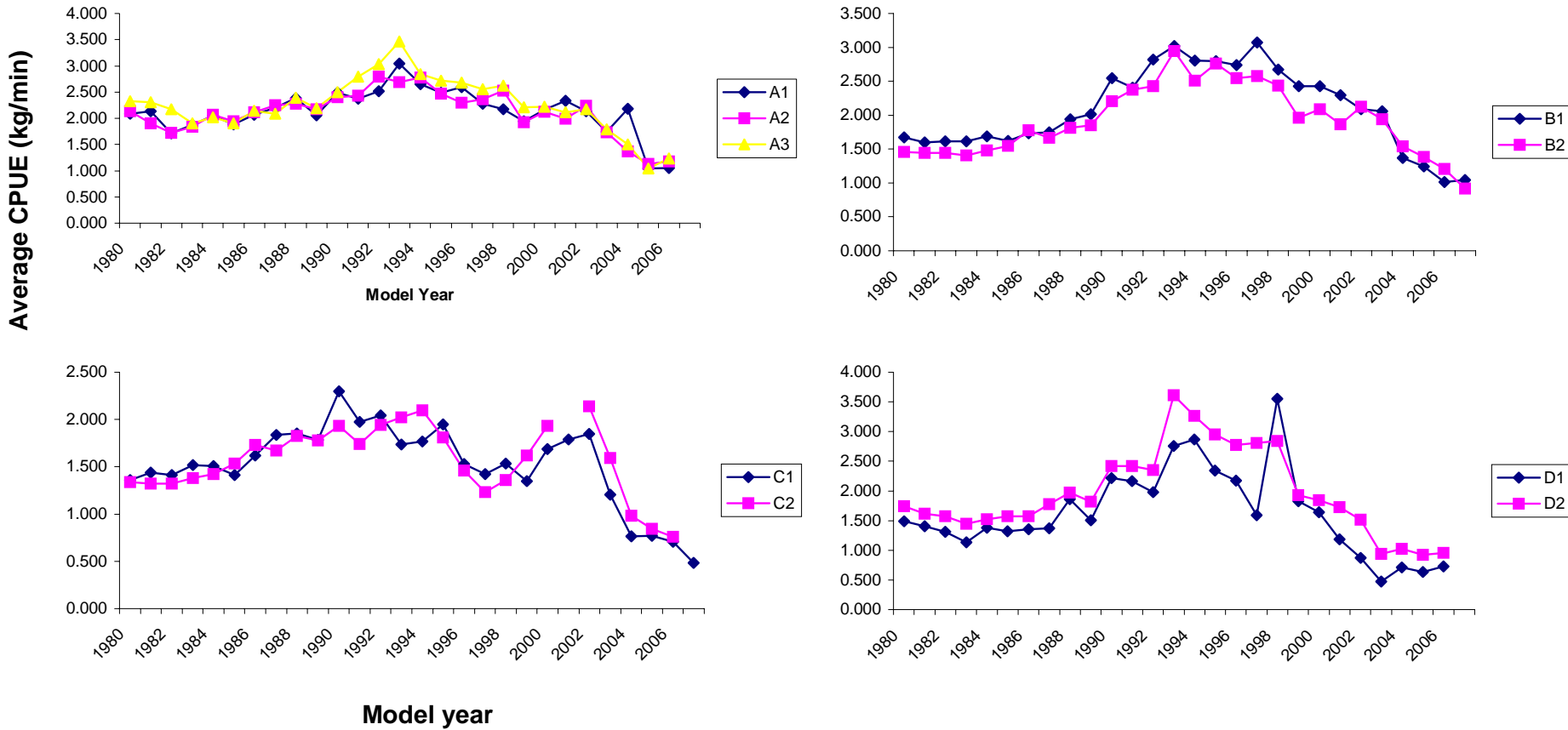


Fig. 3. Plots of the nominal CPUE data shown for TURFS.