Revisiting the Zone B abalone assessment

Éva Plagányi

Marine Resource Assessment and Management Group (MARAM),

Department of Maths and Applied Maths, UCT

SUMMARY

Poaching confiscation data, standardised as confiscations per unit of policing effort (CPUPE), are used to obtain base-case estimates of the trend in poaching over time in each of Zones A-D. Based on this approach, the assessment analyses have assumed that the amount of poaching in Zone B has decreased substantially in recent years (Fig. 1, Table 1). Given that this assumption may be in error, an analysis was done to test the sensitivity of model results to this assumption and to test whether a better fit to the available data would be obtained if it is assumed instead that the recent trend in poaching in Zone B has been constant rather than steeply declining (Fig. 1). This additional sensitivity was motivated partly because of concerns related to the fit of the model to the Zone B data (the model arguably providing a more optimistic picture of resource trends) (Figs 2-3).

Fig. 4 shows spawning biomass trajectories for Zone B when using the model version which assumes constant recent poaching. The 10-yr projections shown represent scenarios under which future poaching levels are assumed to remain at the recent estimated level (average of 2004 and 2005) and future commercial catches remain constant at the current level. The plot illustrates that the resource is predicted to continue a steep decline under all scenarios except when commercial catches are reduced to zero and future poaching levels are assumed equal to half the current level.

From Table 1 it is evident that the "Constant Recent Poaching" model provides a significantly better fit to the data. It also suggests that the resource in Zone B is much more depleted (current depletion = 0.12 i.e. spawning biomass is estimated to be 12% of the pristine spawning biomass level) compared to the Reference Case 2006 model (current depletion = 0.32). Given the dramatic improvement in model fit which results when changing the input assumption regarding the trend in poaching in Zone B, this suggests that this aspect should be carefully re-examined. Note that the sensitivity scenario shown here was deliberately an extreme case and intermediate scenarios can and will be presented in further analyses.

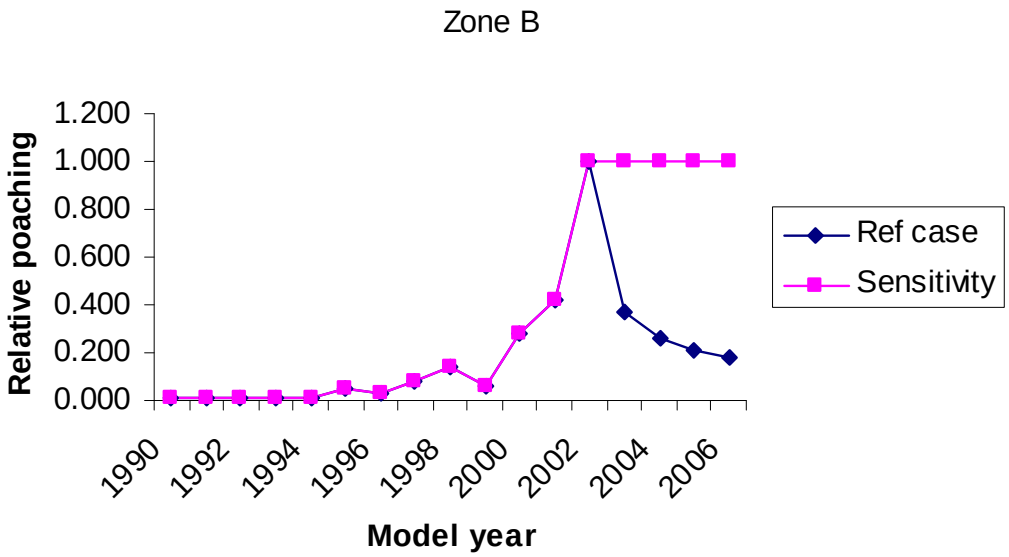


Fig. 1. Comparison of Reference model assumption of the trend in poaching in Zone B (based on the relative numbers of confiscated abalone known to have been poached from Zone B and after correcting for differences in policing efficieny) compared to the alternative assumption tested here such that the level of poaching in recent years is assumed to have remained approximately constant.

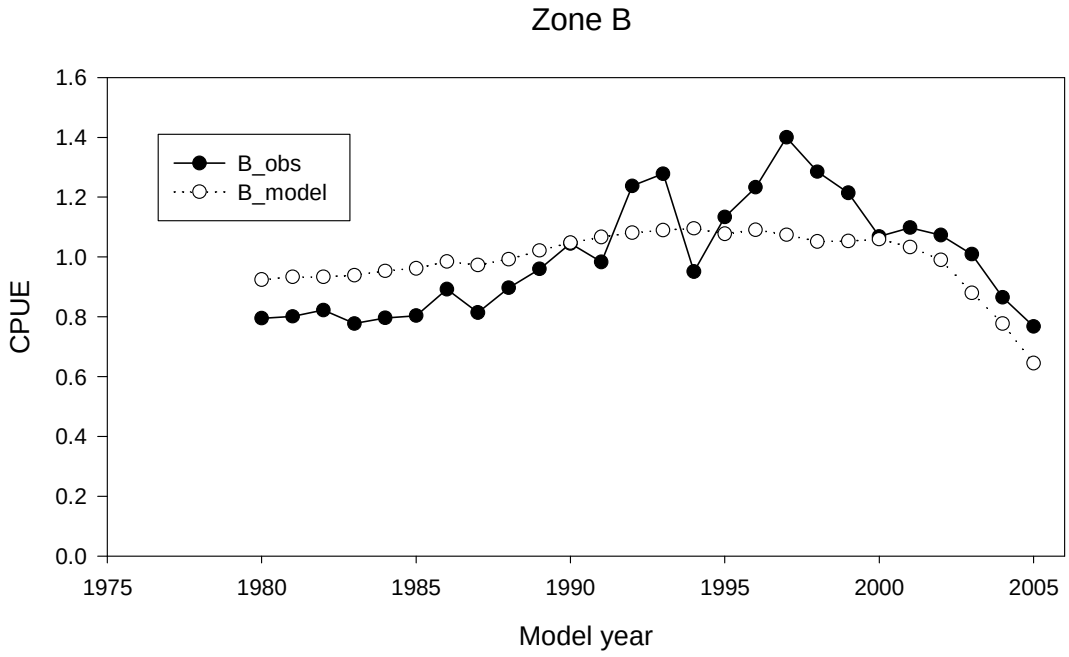
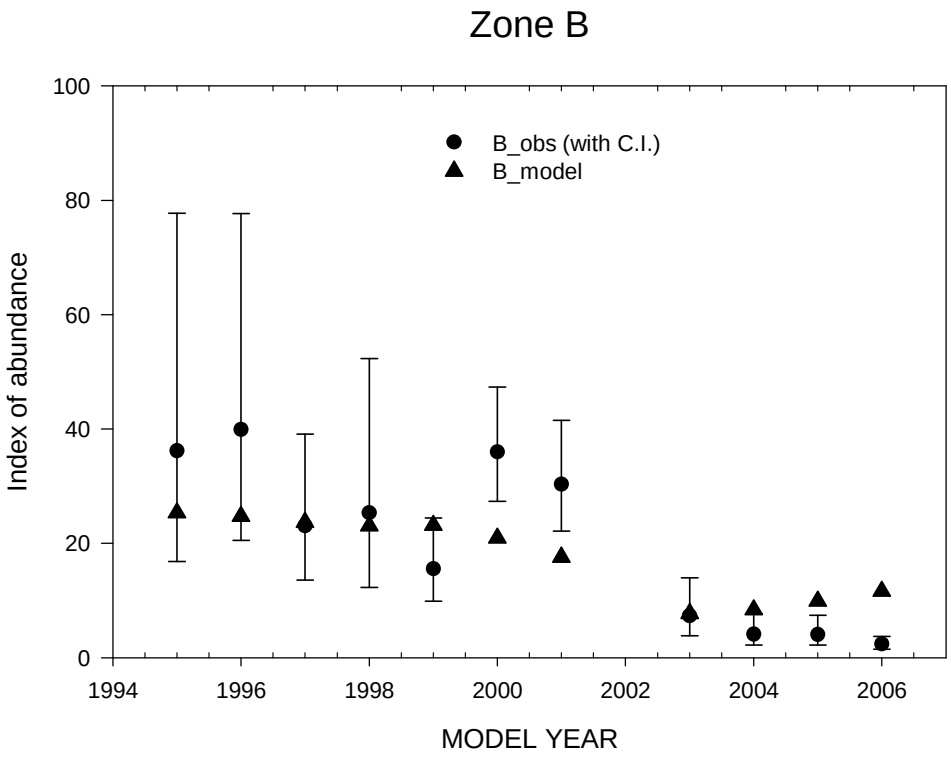


Fig. 2. Comparisons between the standardised CPUE and model-predicted CPUE values for Zone B for the model version which assumes a constant recent level of poaching.

REFERENCE CASE (2006) MODEL:



MODEL WITH CONSTANT RECENT POACHING ASSUMPTION:

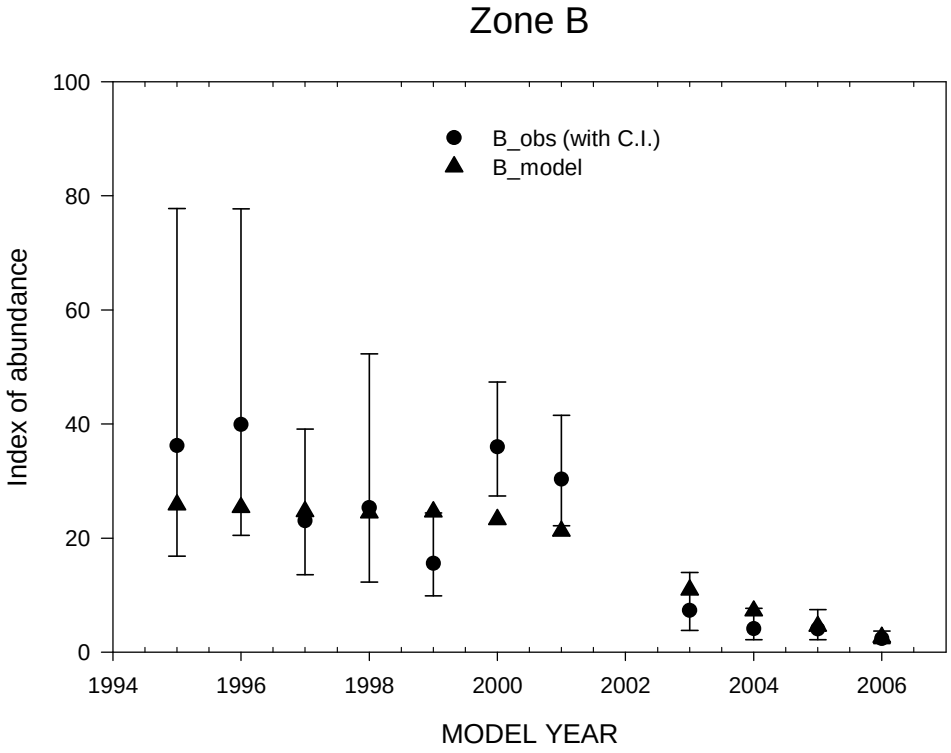


Fig. 3. Comparison of model-predicted and observed FIAS trends for Zone B when using Reference Case model version (top) and Constant Recent Poaching model version (bottom). Note that 95% confidence intervals have been computed as estimate*exp(±1.96*CV).

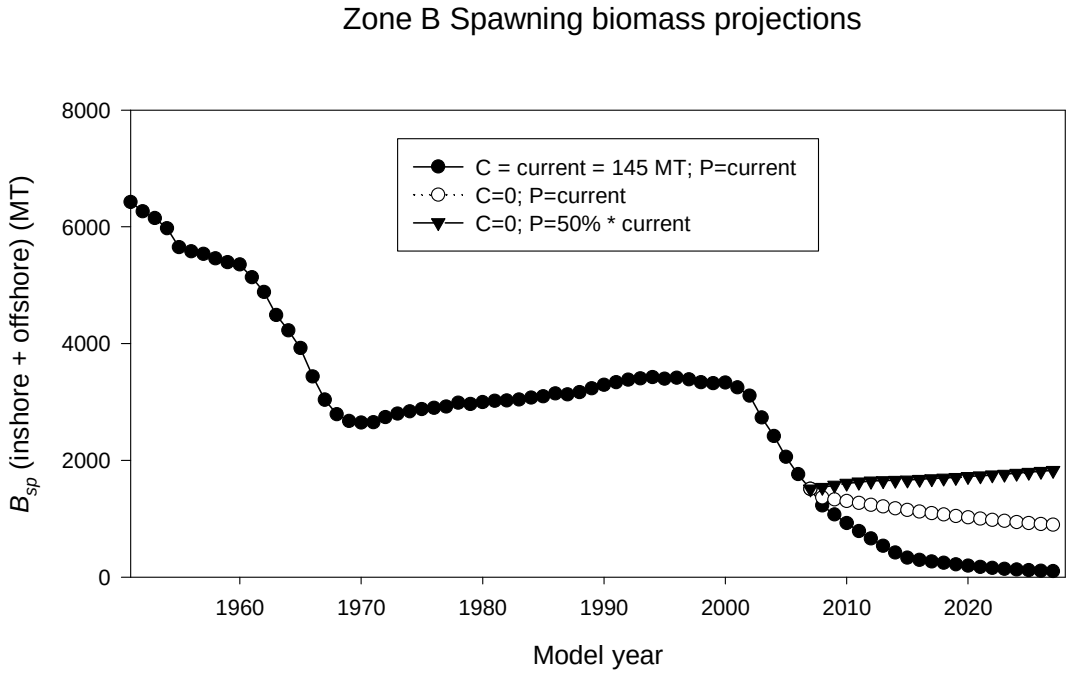


Fig. 4. Spawning biomass trajectory shown for Zone B when using the model version which assumes constant recent poaching. Note that the 10-yr projections shown represent scenarios under which future poaching levels are assumed to remain at the recent estimated level (average of 2004 and 2005) and future commercial catches remain constant at the current level.

Table 1. Best fit estimates under a) the Constant recent poaching model investigated here and b) the 2006 Reference Case model, of the pre-exploitation spawning biomass B_0^{sp} (or *K*) for the "poached" CP and "nonpoached" CNP areas of Zone C, and for each of Zones A, B and D, the estimated natural mortality estimates M_a, the inshore-offshore migration parameters ρ (yr^{-1}), the proportions of recruitment in each subarea that occur inshore versus offshore r_I, and the poaching maximum CP_{max} (i.t.o. NUMBERS). The CP_{max} estimates are also shown in terms of biomass and the years to which these estimates apply are given in the row below. Minimum values of the negative of the log-likelihood function are also shown. The estimated selectivity parameters are shown for the commercial sector (CS), recreational sector (RS), poaching sector (PS), FIAS (FS) and the old 1980's survey (OS).

Model	a) Change in poa trend for Zone B					b) Model used for recommendations				
No. parameters			30					30		
Zone	**A**	**B**	**CNP**	**CP**	**D**	**A**	**B**	**CNP**	**CP**	**D**
Ave confiscation %	10%	16%	18%		6%	9%	29%	19%		6%
B(0) ^{sp}	11255	6424	2214	4829	13482	13230	6886	2176	4955	15212
ρ	0.000658	0.000658	0.000658	0.000329	0.000658	0.00073	0.00073	0.00073	0.000365	0.00073
r^I	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Cpmax (no.)	3060720	1.02E+06		646022	831407	3374270	1.67E+06		625714	928328
Cpmax (MT)	932	484		332	521	1038	767		324	580
Cpmax (YEAR)	2004	2002		1995	2002	2004	2002		1995	2002
Cmult (Zone A)	1.50					1.50				
Ppoach			0.62					0.61		
M_0			0.311					0.306		
M_{15}			0.123					0.119		
ν (steepness of recruitment failure)			0.2293					0.2308		
Mmax (Recruitment failure scale parameter|)			499.997					499.997		
a(CS)			8.9994					8.99952		
a(RS)			8.99002					9.00611		
a(PS)			4.99472					4.99544		
a(FS)			6.26801					7.03203		
a(OS)			5.44003					5.58427		
a(IS)			-					-		
μ(CS)			0.001081					0.001341		
μ(RS)			0.00102					0.001039		
μ(PS)			7.2E-05					5.06E-05		
μ(FS)			0.00122					0.001441		
μ(OS)			0.0007					0.000908		
μ(IS)			-					-		
δ(CS)			498.866					501.305		
δ(RS)			3.25381					3.10266		
δ(PS)			506.879					502.034		
δ(FS)			1.05759					0.908818		
δ(OS)			0.682486					0.695788		
δ(IS)			-					-		

Continued overleaf..

	A	B	CNP	CP	D	A	B	CNP	CP	D
-*ln* L CPUE	-28.120	-38.161	-43.678	-44.508	-31.049	-30.066	-31.642	-44.013	-43.689	-30.563
-*ln* L FIAS	-6.225	-4.837	-6.737	7.924	-2.284	-6.078	11.776	-6.973	7.786	-2.276
-*ln* L age CS	-14.289	-19.148	-7.320	-10.711	-11.457	-14.053	-19.504	-7.411	-10.519	-11.384
-*ln* L age RS	-1.571	-8.177	-7.179	-0.098	-8.560	-1.556	-8.200	-7.119	-0.108	-8.519
-*ln* L age PS	-4.072	-2.133		-2.125	-3.695	-4.093	-1.623		-2.102	-3.761
-*ln* L age FIAS	-4.584	-7.113	-3.774	-0.247	-5.585	-3.310	-7.283	-3.604	-0.202	-5.937
-*ln* L age OS inshore	-2.669	-1.159		-1.390	-1.260	-2.379	-1.146		-1.450	-1.368
-*ln* Lage OS offsh.	-3.004	-1.244		-1.180	-2.393	-2.926	-1.152		-1.193	-2.446
-*ln* L age IS insh+offsh.		-0.663	-0.526				-0.676	-0.521		
-*ln* L zone subtotal	-64.534	-82.636	-121.549		-66.284	-64.462	-59.450	-121.118		-66.254
-*ln* L TOTAL			-335.003					-311.283		
σ CPUE	0.206	0.140	0.108	0.066	0.184	0.191	0.180	0.106	0.068	0.187
σ age CS	0.089	0.067	0.118	0.093	0.097	0.091	0.066	0.118	0.094	0.097
σ age RS	0.117	0.056	0.058	0.177	0.062	0.118	0.056	0.058	0.174	0.062
σ age PS	0.090	0.142		0.146	0.099	0.090	0.153		0.146	0.098
σ age FIAS	0.081	0.087	0.095	0.136	0.083	0.103	0.086	0.098	0.138	0.079
σ OS insh.	0.052	0.058		0.048	0.055	0.060	0.059		0.045	0.050
σ OS offsh.	0.049	0.061		0.062	0.023	0.050	0.065		0.061	0.022
σ IS		0.055	0.092				0.054	0.093		
q CPUE	0.000222	0.000585	0.003004	0.0009	0.000176	0.000188	0.000551	0.003058	0.000903	0.000159
Confiscation percentage			Zone C					Zone C		
$\%Co/Po_{1994}$		0.18	0.07		0.03		0.11	0.07		0.02
$\%Co/Po_{1995}$		0.22	0.08		0.03		0.14	0.09		0.03
$\%Co/Po_{1996}$		0.11	0.04		0.02		0.07	0.04		0.01
$\%Co/Po_{1997}$	0.04	0.16	0.06		0.02	0.04	0.10	0.06		0.02
$\%Co/Po_{1998}$	0.04	0.16	0.06		0.02	0.04	0.10	0.06		0.02
$\%Co/Po_{1999}$	0.08	0.31	0.12		0.04	0.07	0.19	0.12		0.04
$\%Co/Po_{2000}$	0.07	0.28	0.11		0.04	0.06	0.17	0.11		0.03
$\%Co/Po_{2001}$	0.07	0.29	0.11		0.04	0.07	0.18	0.12		0.04
$\%Co/Po_{2002}$	0.11	0.17	0.17		0.06	0.10	0.28	0.18		0.06
$\%Co/Po_{2003}$	0.08	0.08	0.12		0.04	0.07	0.19	0.13		0.04
$\%Co/Po_{2004}$	0.10	0.08	0.15		0.05	0.09	0.24	0.16		0.05
$\%Co/Po_{2005}$	0.11	0.16	0.33		0.12	0.10	0.50	0.35		0.11
Ave prop over last 5 yrs	**0.10**	**0.16**	**0.18**		**0.06**	**0.09**	**0.29**	**0.19**		**0.06**
Mean CS Fishing mortality	0.03	0.29	0.13	0.13	0.03	0.03	0.12	0.13	0.13	0.02
Catches	1159.4	169	6.860335			902.4	169	5.33975		
Ccomm(2005)	8	145	4	4	8	8	145	4	4	8
Cpoa(2005)	379.6	347.7	2.8	2.3	427.0	423.0	114.9	2.6	2.3	359.7
Catch total (2005) MT	387.6	492.7	6.8	6.3	435.0	431.0	259.9	6.6	6.3	367.7

DEPLETION STATISTICS:

	A	B	CNP	CP	D	A	B	CNP	CP	D
Depletion comp. yr	1986/87	1982		1981	1983	1986/87	1982		1981	1983
Insh OBS	0.33	0.67		0.33	0.36	0.33	0.67		0.33	0.36
Insh PRED	0.85	0.59		0.49	0.80	0.87	0.62		0.49	0.82
Offsh OBS	0.20	0.54		0.24	0.50	0.20	0.54		0.24	0.50
Offsh PRED	0.73	0.36		0.30	0.68	0.75	0.38		0.29	0.70
Depletion statistics										
$B^{sp}(2005)/K$ (Insh. + Offsh)	0.35	0.27	0.13	0.10	0.29	0.38	0.32	0.14	0.11	0.31
$B^{sp}(2005)/K$ (Insh.)	0.11	0.14	0.00	0.00	0.07	0.12	0.25	0.00	0.00	0.06
$B^{sp}(2005)/K$ (Offsh.)	0.57	0.40	0.26	0.30	0.51	0.60	0.39	0.26	0.30	0.52
$B^{total}(2005)/K$	0.39	0.32	0.12	0.10	0.27	0.42	0.37	0.13	0.10	0.29
$B^{commercial}(2005)/K$	0.33	0.24	0.15	0.12	0.34	0.37	0.26	0.16	0.12	0.35
FIAS N_{2005}/N_{1951}	0.09	0.07	0.00	0.00	0.00	0.09	0.31	0.00	0.00	0.00
Projections	A	B	CNP	CP	D	A	B	CNP	CP	D
Ccomm(2006)	8.0	145.0	4.0	4.0	8.0	8.0	145.0	4.0	4.0	8.0
Cpoa(2006) (NUMBERS)	1492100	1021500	66205	81923	505496	1644960	326542	60004	80795	564424
Cpoa(2006) (MT)	520	367.8	24.9	10.4	363	579	121.6	22.7	10.4	345
Catch total (2006) MT	528.3	512.8	28.9	14.4	370.8	587.1	266.6	26.7	14.4	352.8
$B^{sp}(2010)/K$	0.27	0.12	0.07	0.06	0.16	0.30	0.32	0.08	0.07	0.18
$B^{sp}(2025)/K$	0.16	0.02	0.00	0.00	0.02	0.17	0.32	0.00	0.01	0.03
$B^{sp}(2025)/Bsp(2005)$	0.77	0.45	0.55	0.57	0.53	0.78	1.00	0.57	0.58	0.56
$B^{sp}(2025)/Bsp(2005)$	0.46	0.06	0.00	0.04	0.07	0.46	0.99	0.01	0.05	0.09