

Further results and sensitivity tests for the Reference-case abalone spatial- and age-structured assessment model for Zones A, B, C and D

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SUMMARY

This paper reports on results for the Reference-case model (when the updated and extrapolated “old” CPUE series is used in the model fitting procedure) that were requested as well as results for two sensitivity tests. Details of the Reference-case model are provided in Brandão and Butterworth (2009). The Reference-case model using the stratified Zone B FIAS series estimates a pristine spawning biomass, B_0^{sp} (in tonnes) of 10 069, 5 917, 7 465 and 10 567 for Zones A, B, C and D respectively. Under the revised policing efficiency, these values are 18 785, 6 008, 7 419 and 9 024. The 2010 (inshore+offshore) spawning biomasses of abalone in Zones A, B, C and D are estimated at ca. 29 %, 25 %, 6% and 11 % respectively of their pre-exploitation levels for the sensitivity test that uses the stratified Zone B FIAS series and at ca. 36%, 29%, 6% and 16% if the revised policing efficiency trends are used. In essence use of the stratified Zone B FIAS series has little effect on results; however for the revised policing efficiency the estimates for the current status of Zone A particularly, and also Zones B and D, are improved.

INTRODUCTION

This document provides **selected** results from fitting the abalone spatial- and age-structured production model (ASPM) to Zones/Subareas A, B, CNP, CP and D in combination (hereafter referred to as the “combined ABCD model”) using updated 2008 and new 2009 data for some of the model inputs. The full details of the spatial- and age-structured production model are provided in Appendices 1 and 2 of Brandão and Butterworth (2009).

Spawning biomass projections for the Reference-case model (when the updated and extrapolated “old” CPUE series is used in the model fitting procedure) described in Brandão and Butterworth (2009) are reproduced in this paper, but now also to include projections under the assumption of zero poaching (and commercial catch) in the future. Model predicted poaching numbers and biomass are also reproduced here.

Two sensitivity tests have been performed, both for the Reference-case model (when the updated and extrapolated “old” CPUE series is used in the model fitting procedure), which for the remainder of the paper will be simply referred to as the Reference-case model. These two sensitivity tests are:

- a) The Reference-case model, except the revised (Pedro Goosen) policing efficiency series is used.
- b) The Reference-case model, except the FIAS abundance indices for Zone B have been modified to treat station 11 as a separate substratum (Table 1).

RESULTS

A summary of results for the two sensitivity tests are provided in Table 2. For comparison, the results for the Reference-case model are also given.

Parameter estimates

The Reference-case model using the stratified Zone B FIAS series estimates a pristine spawning biomass, B_0^{sp} (in tonnes) of 10 069, 5 917, 7 465 and 10 567 for Zones A, B, C and D respectively. Under the revised policing efficiency, these values are 18 785, 6 008, 7 419 and 9 024. The 2010 (inshore+offshore) spawning biomasses of abalone in Zones A, B, C and D are estimated at ca. 29 %, 25 %, 6% and 11 % respectively of their pre-exploitation levels for the sensitivity test that uses the stratified Zone B FIAS series and at ca. 36%, 29%, 6% and 16% if the revised policing efficiency trends are used.

Biomass trajectories and projections

Figure 1 shows the Reference-case total (inshore + offshore) spawning biomass trajectories for Zones A to D. Note that the 20-yr projections shown (indicated by vertical bar) represent scenarios under which future poaching levels are assumed to remain at the current estimated level (average of 2008 and 2009) and future commercial catches are set to zero. Projections under the scenario of future zero poaching and zero commercial catches are also shown. Figure 2 shows these projections but for Zones A+B combined and Zones C+D combined, as well as for all Zones combined.

Figures 3 and 4 shows the comparison of spawning biomass projections between the Reference-case model and the two sensitivity tests.

Poaching estimates

Figure 5 shows the Reference-case model estimates of the numbers and corresponding biomass of abalone that is assumed poached for Zones A+B combined and Zones C+D combined. Figure 6 shows these results for all Zones combined.

Figures 7 and 8 show the comparison of model estimates for the Reference-case model and the two sensitivity tests of the numbers and corresponding biomass of abalone that is assumed poached in the combined Zones A and B and the combined Zones C and D as well as all Zones combined.

CONCLUSIONS

There is little difference in the results between the Reference-case model and the sensitivity test that uses the stratified Zone B FIAS series (this is not surprising as the stratified series does not differ greatly from the original – see Figure 9). Under the revised policing efficiency, the status of the resource is estimated to be better for all Zones, except for Zone

C where this remains the same. The model estimated number of poached abalone is higher for Zones A and B, but lower for Zones C and D for the revised policing efficiency sensitivity test.

REFERENCES

- Brandão, A. and Butterworth, D.S. 2009. Results for the Reference-case abalone spatial- and age-structured model for Zones A, B, C and D in 2009. Marine and Coastal Management document: MCM/2009/OCT/SWG-AB/08.
- Plagányi, É. 2008. Reference-case 2008 assessment model for abalone in Zones A, B, C and D. Marine and Coastal Management document: MCM/2008/NOV/SWG-AB/21.

Table 1. FIAS-based indices of abundance for Zones B and for Zone B stratified for station 11. In years where no additional sampling took place in station 11, a common CV was assumed which was derived from the 2008 additional sampling at station 11. Abundance estimates are expressed as the mean number \bar{x} (and associated standard error) of abalone per 60 m², calculated by averaging over the indicated number of 30m x 2m transects. As only half of the transects in Zone B were sampled in each of the years 1999 and 2000, the average of the density and standard error values (shown in brackets in italics) in these two years are assumed for each of these years, with a 0.5 weighting being assigned in each case.

Year	B	B stratified
1995	35.7	35.7
1996	41.1	40.89
1997	34	33
1998	31	30.23
1999	15.8 (25.88)	15.6 (25.34)
2000	36.0 (25.88)	36.0 (25.34)
2001	44.9	43.62
2002	-	-
2003	23.85	22.35
2004	4.7	4.65
2005	18.80	17.46
2006	10.29	8.49
2007	6.16	5.98
2008	6.50	5.27
<u>Standard error</u>		
1995	13.4	13.45
1996	13	13.11
1997	12.4	7.97
1998	10.5	9.34
1999	3.3 (4.18)	3.43 (3.88)
2000	5.1 (4.18)	5.09 (3.88)
2001	17.4	11.88
2002	-	-
2003	16.69	7.72
2004	1.34	1.26
2005	14.80	6.64
2006	7.99	3.04
2007	1.69	1.24
2008	1.81	1.06

Table 2. Summary of some key model results when using the Reference-case assessment model when the updated and extrapolated “old” CPUE is used in the model fitting procedure and for two sensitivity tests.

Parameter	Reference case	Revised policing	FIAS for Zone B stratified
$B(2010)^{sp}/B(0)^{sp}$ (Zone A)	0.290	0.358	0.290
$B(2010)^{sp}/B(0)^{sp}$ (Zone B)	0.258	0.292	0.254
$B(2010)^{sp}/B(0)^{sp}$ (Zone C)	0.059	0.059	0.060
$B(2010)^{sp}/B(0)^{sp}$ (Zone D)	0.113	0.164	0.114
$B(0)^{sp}$ (Zone A)	9 876	18 785	10 069
$B(0)^{sp}$ (Zone B)	5 902	6 008	5 917
$B(0)^{sp}$ (Zone C)	7 462	7 419	7 465
$B(0)^{sp}$ (Zone D)	10 439	9 024	10 567
$B(2009)^{sp}$ (Zone A)	3 036	6 976	3 091
$B(2009)^{sp}$ (Zone B)	1 534	1 743	1 518
$B(2009)^{sp}$ (Zone C)	634	484	638
$B(2009)^{sp}$ (Zone D)	1 317	1 612	1 349

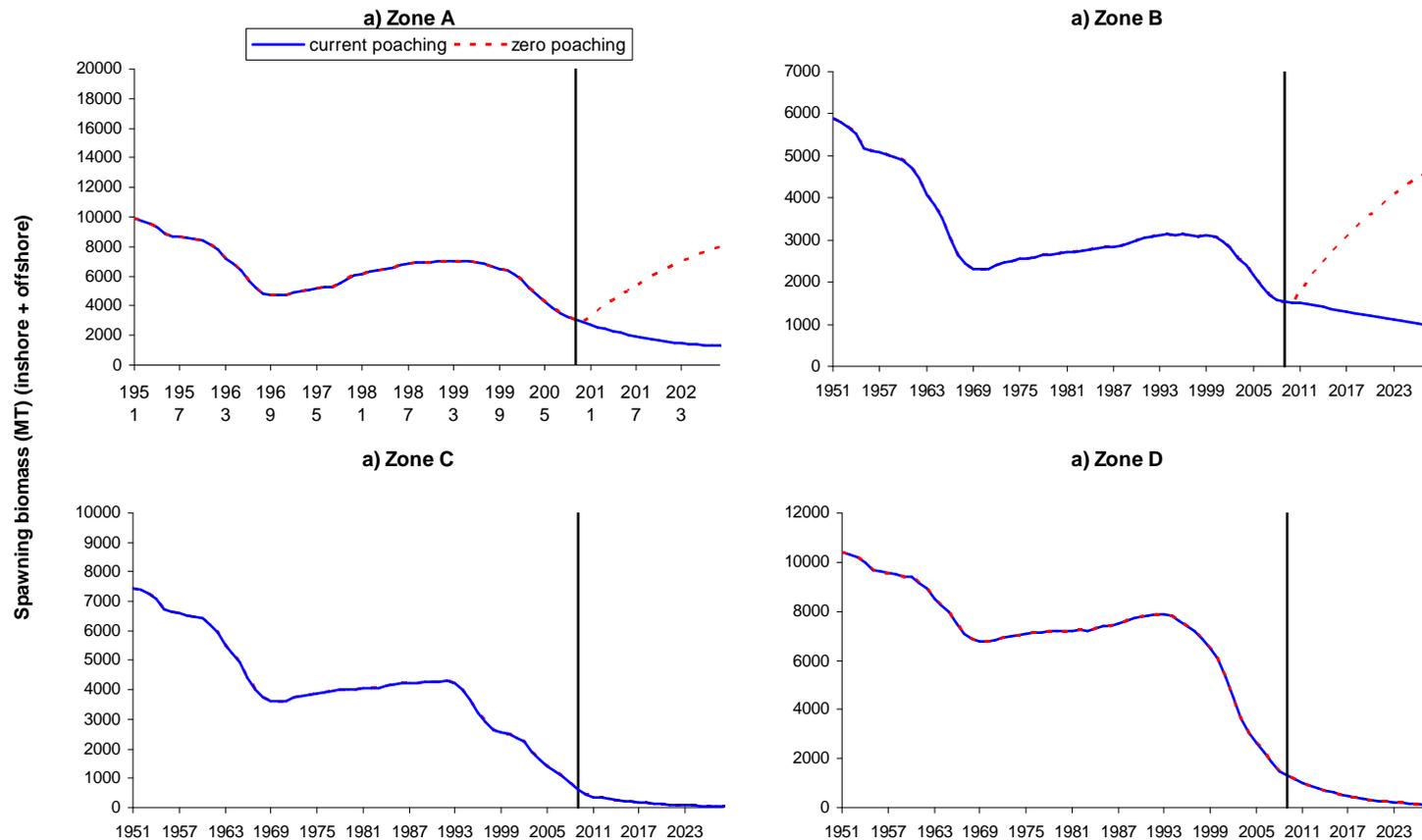


Figure 1. Reference-case combined ABCD model (when the updated and extrapolated “old” CPUE series is used in the model fitting procedure) total (inshore + offshore) spawning biomass trajectories shown for Zones A to D. Note that the 20-yr projections shown (whose start is indicated by the vertical bar) represent scenarios under which future poaching levels are assumed to remain at the current estimated level (average of 2008 and 2009) and future commercial catches are set to zero. The dashed lines represent projections under the assumption that future poaching as well as commercial catches are zero; for C and D these results are indistinguishable from the projections including poaching.

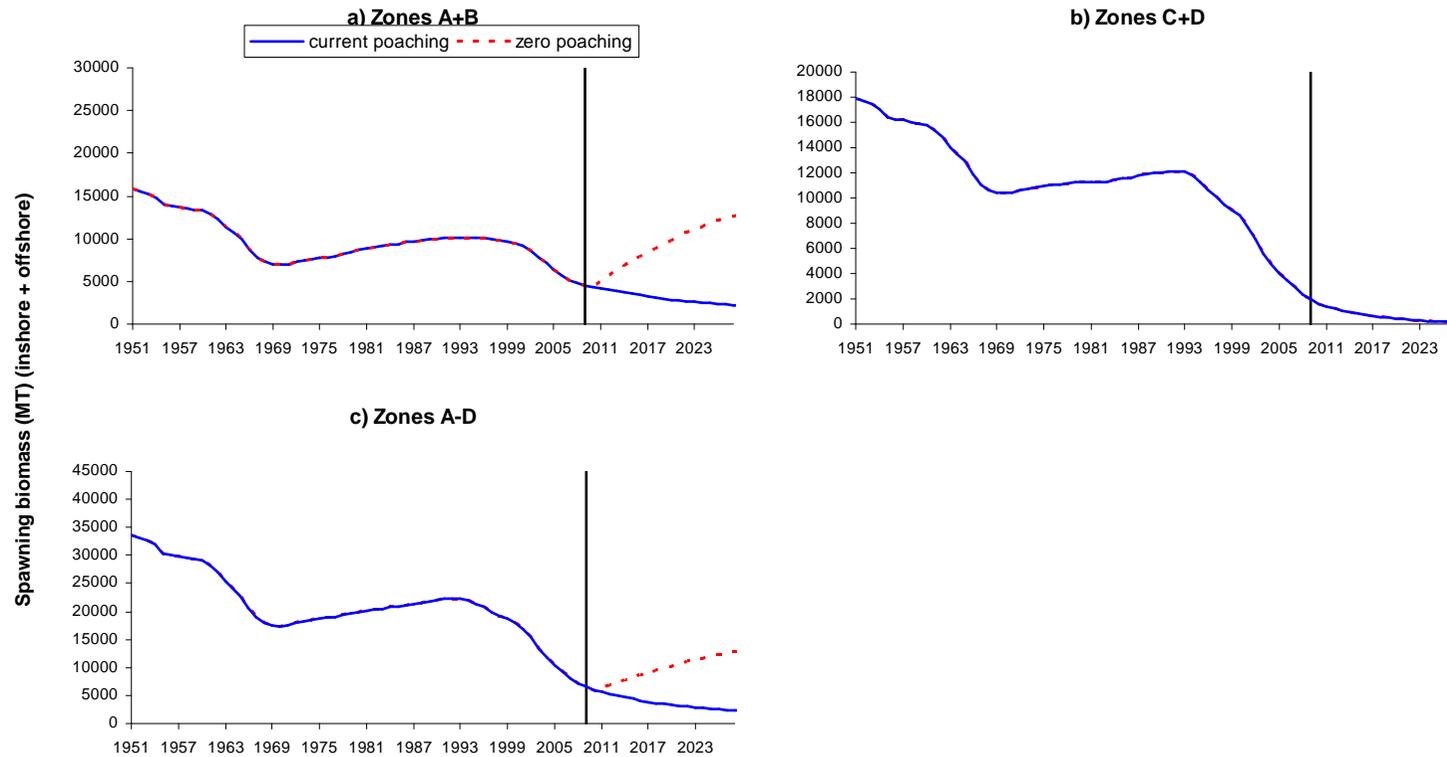


Figure 2. Reference-case combined ABCD model (when the updated and extrapolated “old” CPUE series is used in the model fitting procedure) total (inshore + offshore) spawning biomass trajectories shown for combined Zones A+B and Zones C+D, as well as for all Zones combined. Note that the 20-yr projections shown (whose start is indicated by the vertical bar) represent scenarios under which future poaching levels are assumed to remain at the current estimated level (average of 2008 and 2009) and future commercial catches are set to zero. The dashed lines represent projections under the assumption that future poaching as well as commercial catches are zero; for C+D these results are indistinguishable from the projections including poaching.

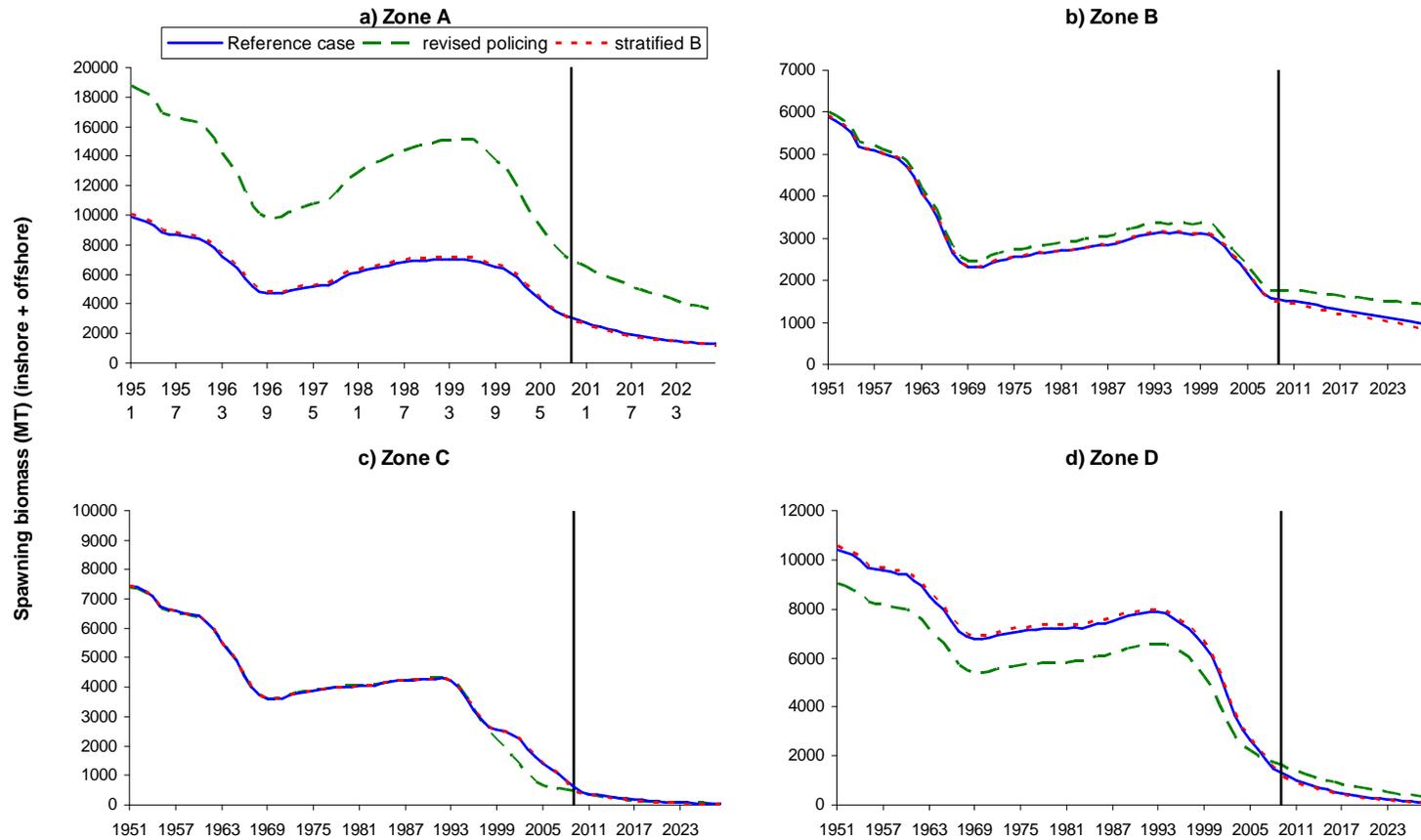


Figure 3. Comparison of the Reference-case and two sensitivity tests for the combined ABCD model (when the updated and extrapolated “old” CPUE series is used in the model fitting procedure) total (inshore + offshore) spawning biomass trajectories shown for Zones A to D. Note that the 20-yr projections shown (whose start is indicated by the vertical bar) represent scenarios under which future poaching levels are assumed to remain at the current estimated level (average of 2008 and 2009) and future commercial catches are set to zero.

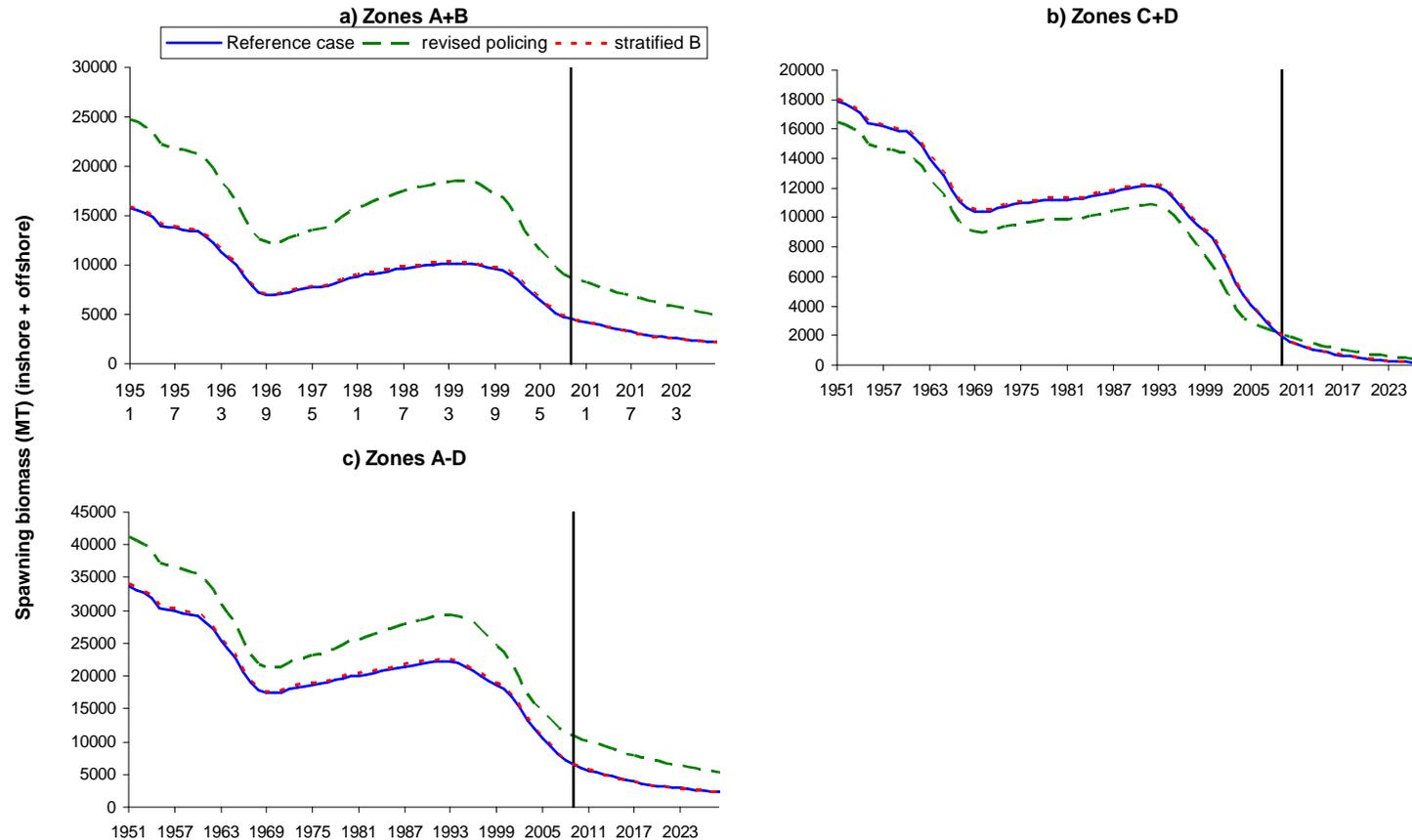


Figure 4. Comparison of the Reference-case and two sensitivity tests for the combined ABCD model (when the updated and extrapolated “old” CPUE series is used in the model fitting procedure) total (inshore + offshore) spawning biomass trajectories shown for combined Zones A+B and Zones C+D, as well as for all Zones combined. Note that the 20-yr projections shown (whose start is indicated by the vertical bar) represent scenarios under which future poaching levels are assumed to remain at the current estimated level (average of 2008 and 2009) and future commercial catches are set to zero.

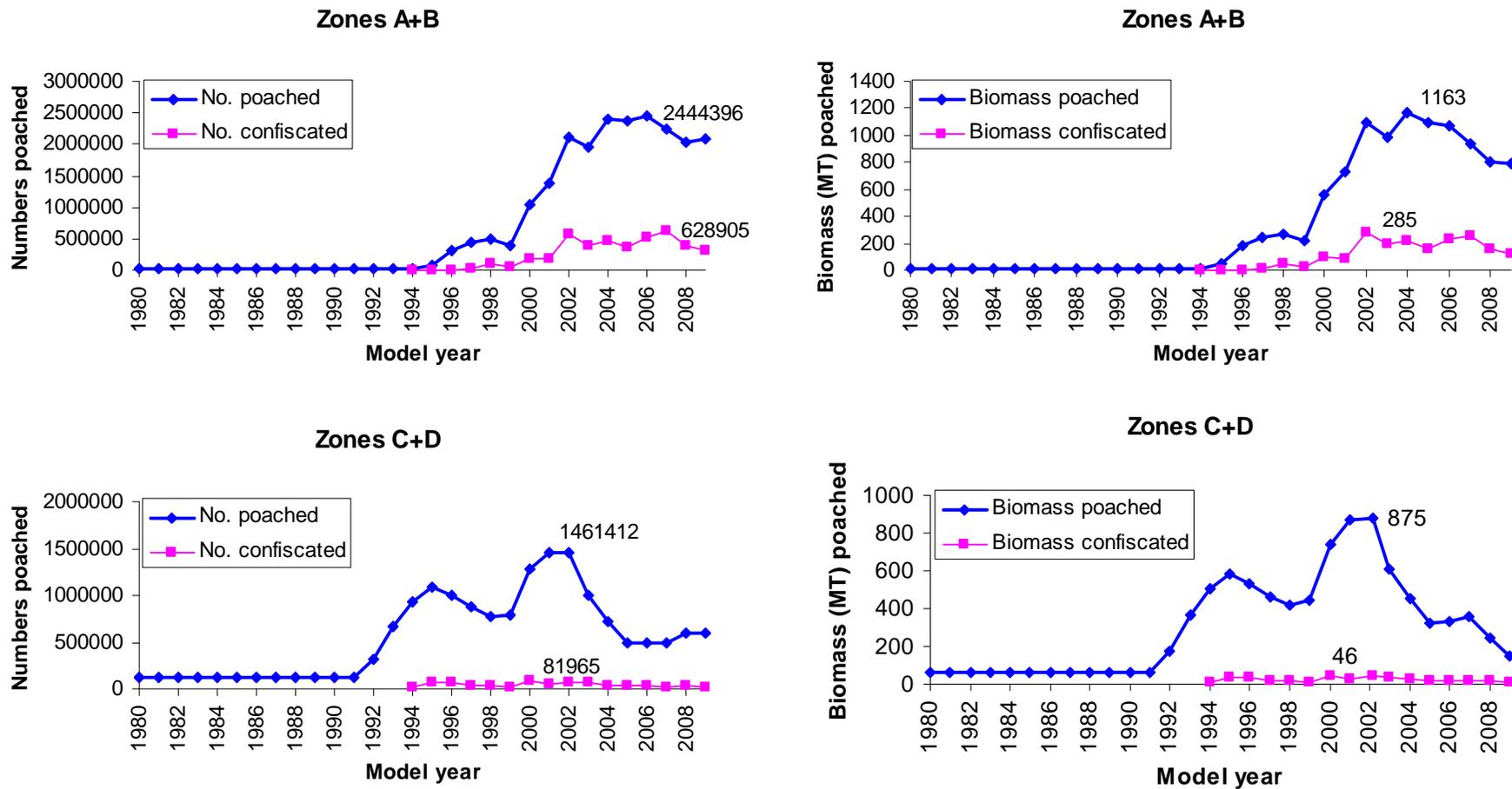


Figure 5. Comparison of model-predicted numbers (on the left hand side) and biomass (MT) (on the right hand side) of abalone poached for the combined Zones A+B and Zones C+D with “observed” numbers confiscated (after allocating confiscated abalone from the Unknown category to each of Zones A-D). The numerical value (units are numbers on the left side plots and MT on the right) corresponding to selected points on the graph is given. Results are for the Reference-case model (when the updated and extrapolated “old” CPUE series is used in the model fitting procedure).

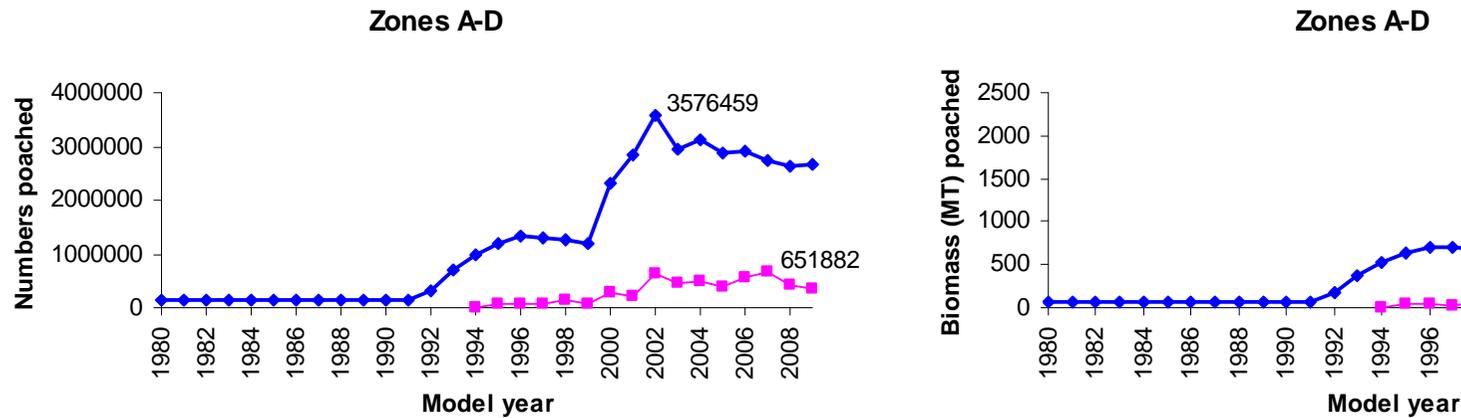


Figure 6. Comparison of model-predicted numbers (on the left hand side) and biomass (MT) (on the right hand side) of abalone poached for all Zones combined with “observed” numbers confiscated (after allocating confiscated abalone from the Unknown category to each of Zones A-D). The numerical value (units are numbers the left side plots and MT on the right) corresponding to selected points on the graph is given. Results are for the Reference-case model (when the updated and extrapolated “old” CPUE series is used in the model fitting procedure).

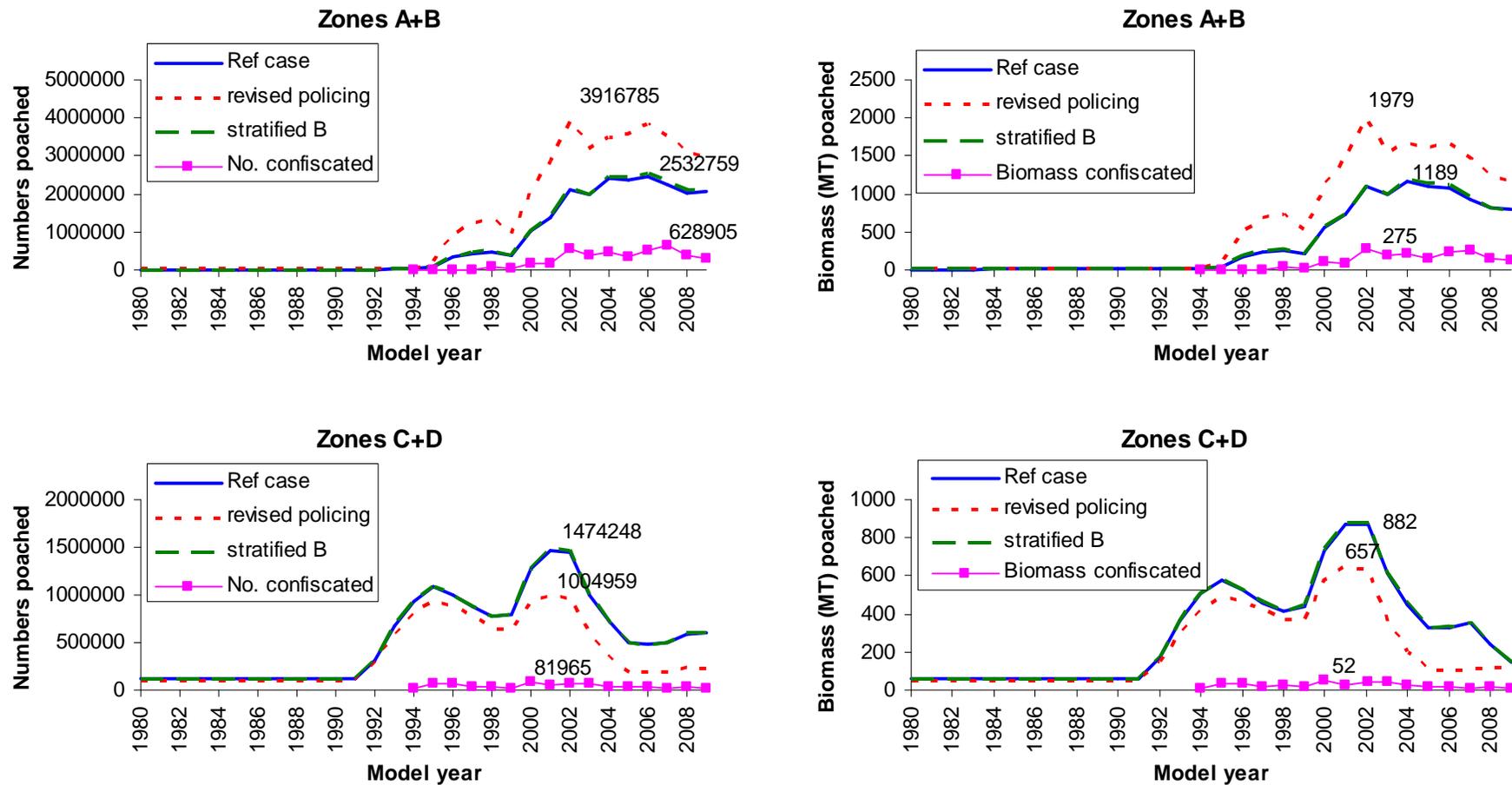


Figure 7. Comparison of model-predicted numbers (on the left hand side) and biomass (MT) (on the right hand side) of abalone poached for the combined Zones A+B and Zones C+D with “observed” numbers confiscated (after allocating confiscated abalone from the Unknown category to each of Zones A-D). The numerical value (units are numbers the left side plots and MT on the right) corresponding to selected points on the graph is given. Results are for the Reference-case model (when the updated and extrapolated “old” CPUE series is used in the model fitting procedure) and two sensitivity tests.

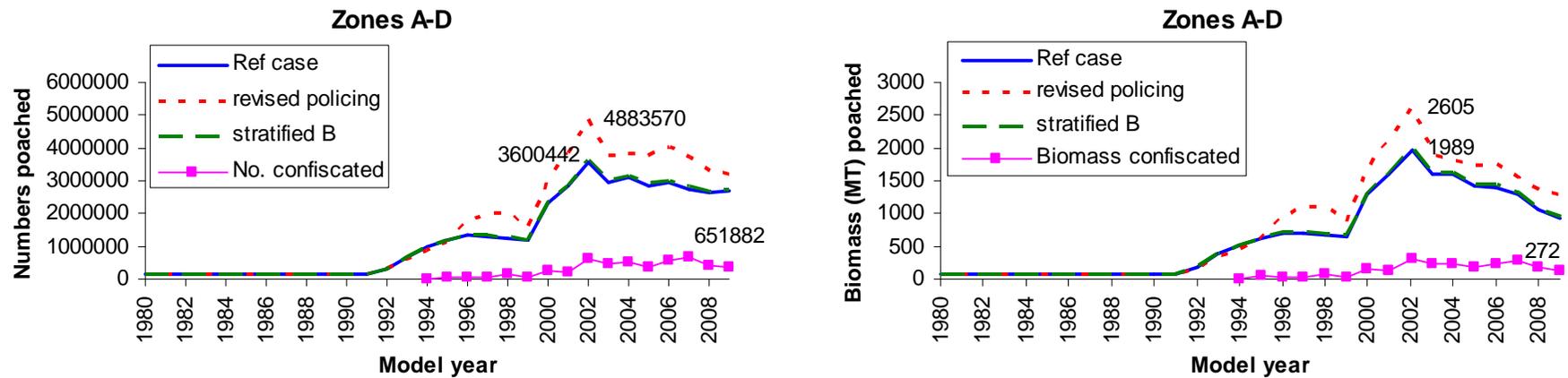


Figure 8. Comparison of model-predicted numbers (on the left hand side) and biomass (MT) (on the right hand side) of abalone poached for all Zones combined with “observed” numbers confiscated (after allocating confiscated abalone from the Unknown category to each of Zones A-D). The numerical value (units are numbers the left side plots and MT on the right) corresponding to selected points on the graph is given. Results are for the Reference-case model (when the updated and extrapolated “old” CPUE series is used in the model fitting procedure) and two sensitivity tests.

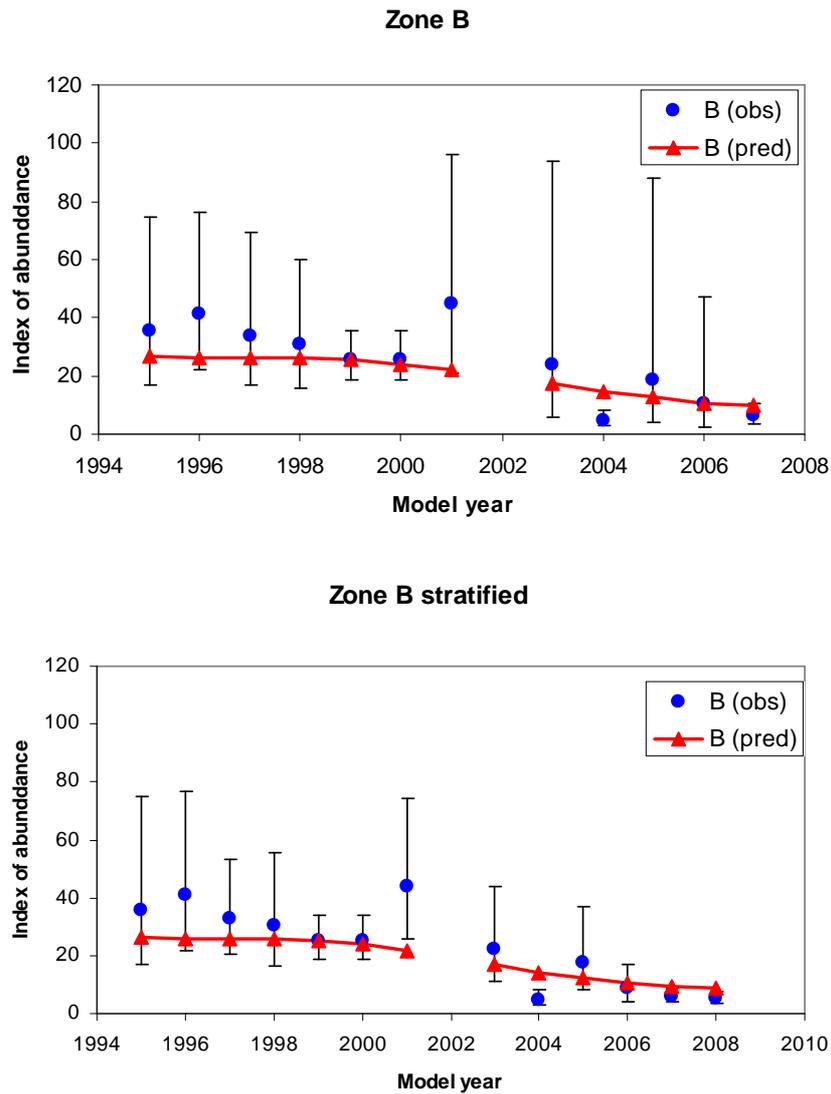


Figure 9. Comparison of model-predicted (for the Reference-case combined ABCD model) and observed FIAS trends for Zone B (top) and for the sensitivity test that uses the stratified Zone B FIAS series (bottom). Note that 95% confidence intervals have been computed as $\text{estimate} \cdot \exp(\pm 1.96 \cdot \text{CV})$.