Results of abalone projections for Zones A and B

A. Brandão and D.S. Butterworth
Marine Resource Assessment & Management Group (MARAM)
Department of Mathematics and Applied Mathematics

University of Cape Town

Rondebosch 7701, Cape Town

January 2010

ABSTRACT

Projections for the spawning biomass of the abalone resource in Zones A and B for various future poaching levels and commercial catch scenarios are presented.

INTRODUCTION

This paper presents results of projections for the abalone resource in terms of spawning biomass in Zones A and B using the Reference-case model presented in Brandão and Butterworth (2009). Projections are shown for several scenarios for the assumed level of poaching and the commercial catch taken in the future. One sensitivity test that takes into account the possibility of an Allee effect occurring is also presented.

METHODOLGY

Projections for the abalone resource in Zones A and B are investigated for different assumed levels of future poaching and commercial catches. The scenarios considered are:

1. Assuming that the current poaching level (taken as the average of the last two years' estimates of poaching amounts) remains constant in the future while the level of the annual commercial catch is varied.
2. Assuming an annual 10 percent reduction in the level of poaching in each year in the future and an annual commercial catch of 50 tons in the first three years which increases to 100 tons thereafter.
3. Assuming several percentage reductions in the level of poaching in each year in the future and an annual commercial catch of 50 tons in the first three years, thereafter increased (if possible) by an amount that would allow the resource to recover to 0.4 of its pre-exploitation value at the end of a specified period.
4. Assuming an annual 15 percent reduction in the poaching in each year, which ceases when poaching is reduced to 40% of the current level, and a constant annual commercial catch of 50 tons in the future.

This paper also investigates the percentage reduction in the poaching levels that would be necessary to obtain a depletion level in ten years which is the same as at present,

while several options for constant commercial catches are assumed in the future. A sensitivity test that takes into account the possibility of an Allee effect is also investigated.

RESULTS

Depletion values for projections for Zones A and B under the current poaching level and various levels of assumed annual commercial catches are given in Table 1 and Figure 1. Table 2 shows the percentage reduction in the poaching level that would be necessary if the commercial catches in Table 1 are taken in the future and the level of depletion of the abalone resource is the same in 10 years as it is at present.

Figure 2 shows projections for the scenario that assumes that future poaching levels will decrease by 10% each year, while there is an initial commercial catch of 50 tons for the first 3 years which increases to 100 tons thereafter.

Depletion values for projections for Zones A and B after 10, 15 and 20 years under the scenario of a 50 tons commercial catch for the first three years, increased (if possible) thereafter by an amount that would allow the resource to recover to 0.4 of its pre-exploitation value at the end of the period considered, and for alternative annual percentage reductions in the poaching level each year are shown in Table 3. A 15% reduction in the poaching level each year is necessary for an increase in the commercial catches to be possible after three years if a 15 year recovery period is considered. With a 10% reduction in the poaching level each year, a 20 year recovery period needs to be considered for the possibility of an increase in the commercial catches after three years.

If a 15% reduction in poaching levels each year is not attainable and the reduction in poaching cannot get this below 40% of the current level, and a constant annual commercial catch of 50 tons in taken in the future, the resource is not able to recover to 0.4 of its pre-exploitation level. For Zone A, the depletion value in 15 years would be the same as at present, while for Zone B there is a slight recovery from the present value.

Figure 4 shows the effect on the spawning biomass (as a proportion of the pre-exploitation value) if the possibility of an Allee effect is taken into account. The Allee effect has a much higher impact in Zone B as the abalone in this zone is estimated to be at a lower depletion value than in Zone A. Figure 5 shows the projections for Zones A and B with and without an Allee effect for the scenario that assumes future poaching levels will decrease by 15% each year, and a constant annual commercial catch of 50 tons is taken in the future. For Zone B, with an Allee effect the resource does not recover and continues to decline. For Zone A, even with an Allee effect, the abalone resource does recover (however at a slower rate than without an Allee effect) for the assumed poaching reduction and commercial catch.

REFERENCE

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.

Table 1. Summary of depletion B_{sp}/K_{sp} values for projections for Zones A and B under the current poaching level (given as the average of the last two years of estimated poaching) and various levels of assumed commercial catches. For comparison depletion values are also given for the scenario of zero poaching and zero commercial catches in the future.

Commercial catch level	Current (2009)	2012	2014	2018
Zone A				
0 tons (0 poaching)	0.307	0.365	0.442	0.573
0 tons	0.307	0.261	0.233	0.185
50 tons	0.307	0.252	0.217	0.158
100 tons	0.307	0.243	0.201	0.130
150 tons	0.307	0.235	0.185	0.102
200 tons	0.307	0.226	0.169	0.075
Zone B				
0 tons (0 poaching)	0.260	0.340	0.419	0.551
0 tons	0.260	0.251	0.238	0.213
50 tons	0.260	0.236	0.211	0.167
100 tons	0.260	0.221	0.184	0.120
150 tons	0.260	0.206	0.157	–
200 tons	0.260	0.191	0.130	–

Table 2. The percentage reduction in poaching levels necessary to obtain a depletion level in 10 years that is the same as at present given various constant annual commercial catches assumed in the future.

Commercial catch level	**% poaching reduction**
Zone A	
0 tons	40%
50 tons	45%
100 tons	53%
150 tons	63%
200 tons	65%
Zone B	
0 tons	20%
50 tons	28%
100 tons	45%
150 tons	55%
200 tons	73%

Table 3. Depletion B_{sp}/K_{sp} values for projections for Zones A and B after 10, 15 and 20 years under the scenario of a 50 tons commercial catch for the first three years, increased (if possible) thereafter by an amount that would allow the resource to recover to 0.4 of its pre-exploitation value at the end of the period considered. Three alternative annual percentage reductions in the poaching level each year are considered.

Commercial catch level	Zone A			Zone B		
	10 years	15 years	20 years	10 years	15 years	20 years
Current poaching						
no future increase	0.145	0.107	0.080	0.157	0.105	0.058
5% poaching reduction						
no future increase	0.219	0.232	0.273	0.230	0.257	0.308
10% poaching reduction						
no future increase	0.289	0.366	0.468	0.292	0.372	0.472
15% poaching reduction						
no future increase	0.348	0.460	0.580	0.342	0.451	0.565
Increase of 80t in Zone A and 40t in Zone B	0.311	0.400	0.502	0.311	0.400	0.498
15% poaching reduction until 40% of current						
no future increase	0.297	0.310	0.321	0.299	0.326	0.351

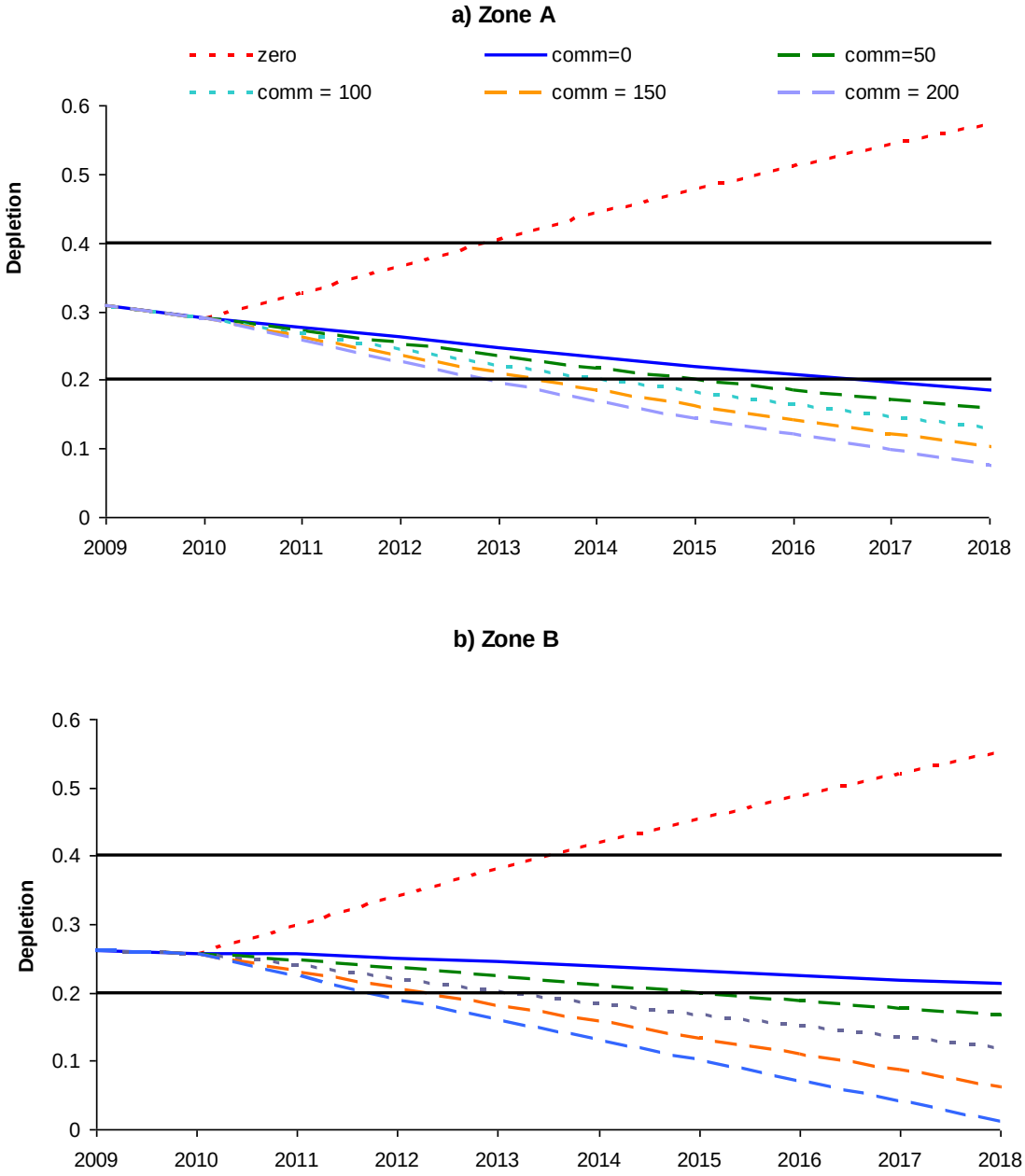

Figure 1. Total spawning biomass projections (inshore and offshore combined shown as a proportion of the pre-exploitation level) for a) Zone A and b) Zone B when using the Reference-case model. Projections are shown under the assumption that future poaching as well as commercial catches are zero, as well as under the current poaching level and various commercial future catches. The horizontal lines represent depletion levels of 0.2 and 0.4.

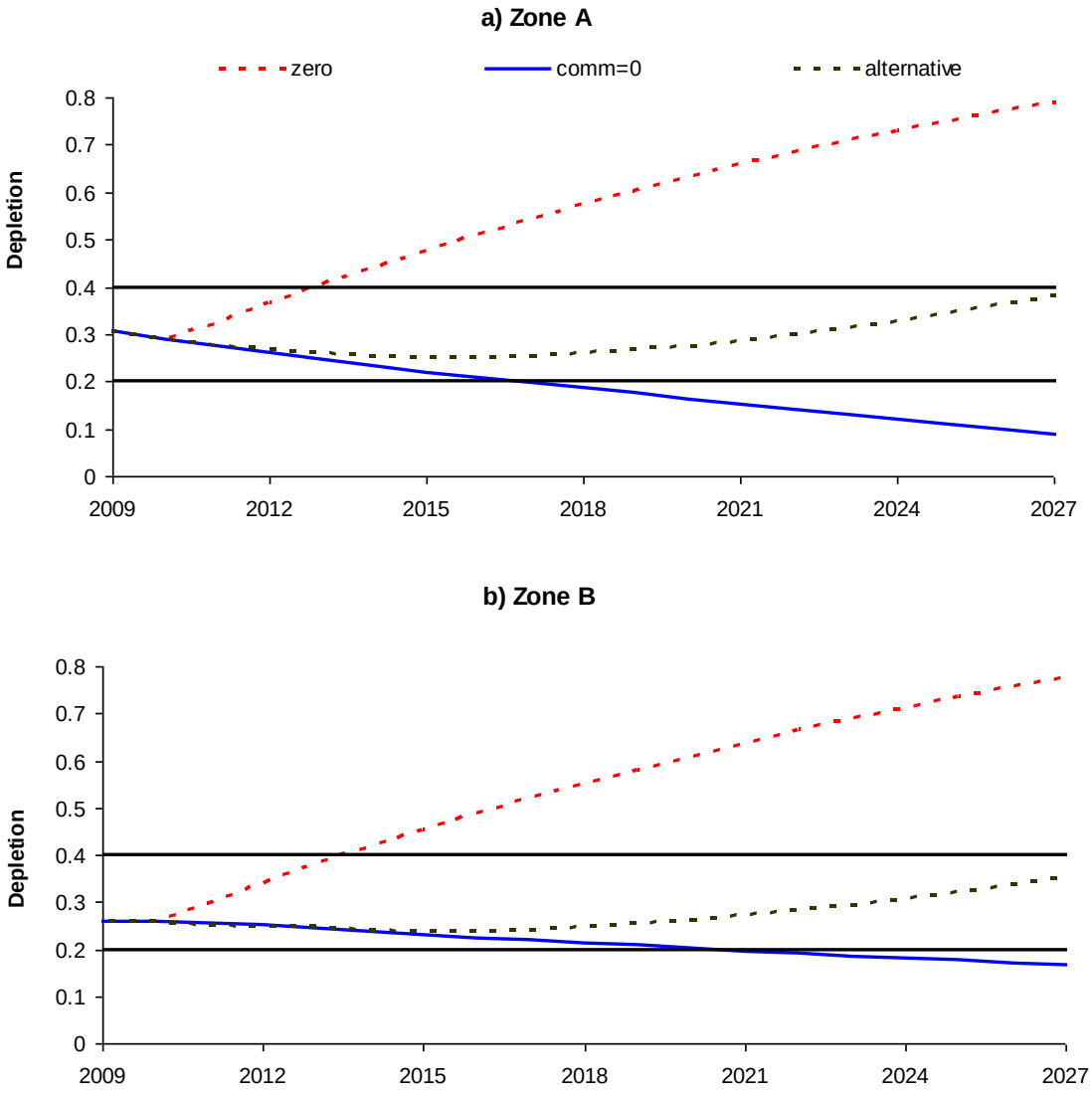

Figure 2. Total spawning biomass projections (inshore and offshore combined shown as a proportion of the pre-exploitation level) for a) Zone A and b) Zone B when using the Reference-case model. Projections are shown for an alternative scenario that assumes that future poaching levels will decrease by 10% each year, while there is an initial commercial catch of 50 tons for the first 3 years which increases to 100 tons thereafter. For comparison, projections are given under the assumption that future poaching as well as commercial catches are zero, as well as under the current poaching level and a zero commercial future catch. The horizontal lines represent depletion levels of 0.2 and 0.4.

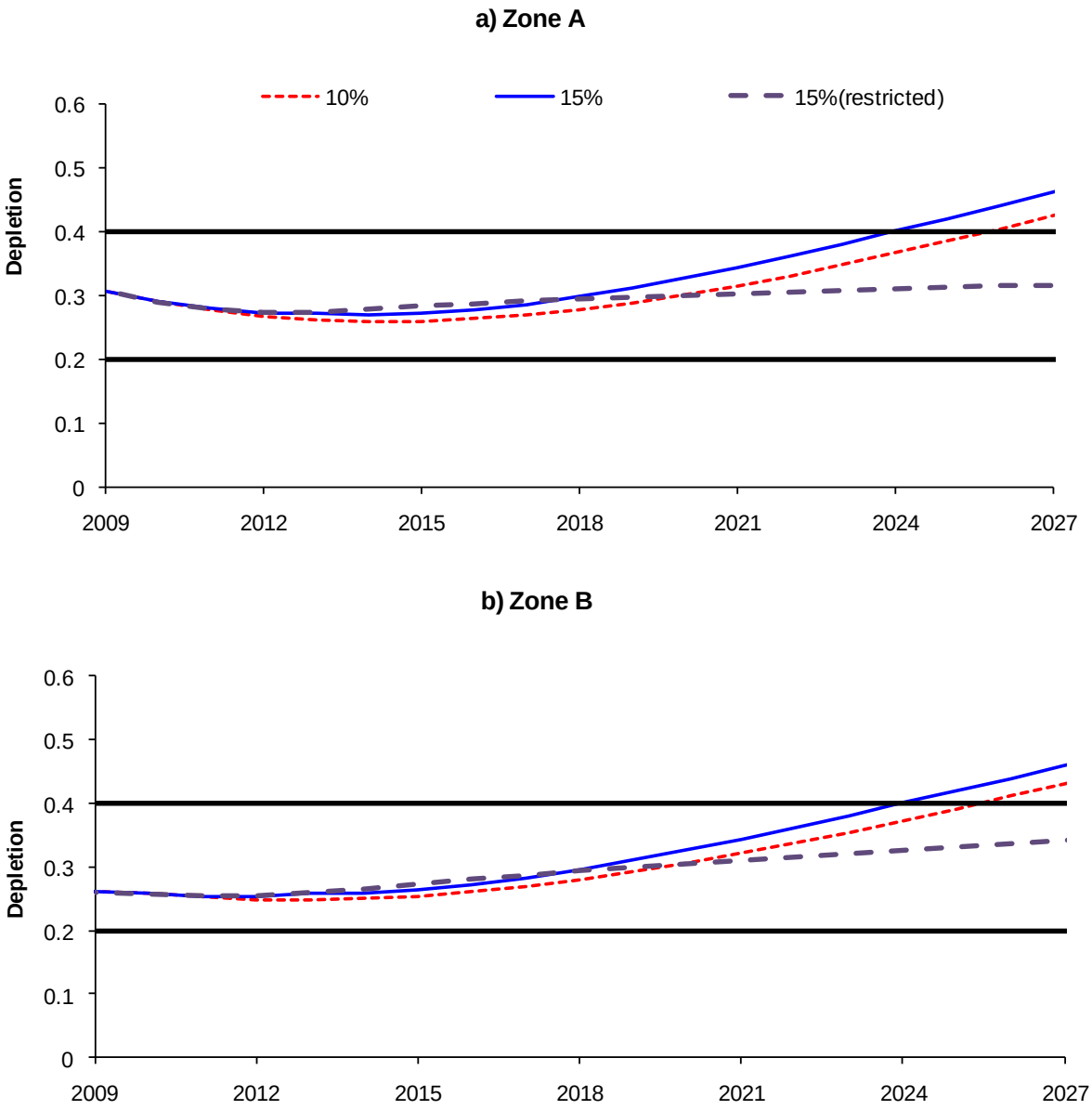

Figure 3. Total spawning biomass projections (inshore and offshore combined shown as a proportion of the pre-exploitation level) for a) Zone A and b) Zone B when using the Reference-case model. Projections are shown for a scenario that assumes that future poaching levels will decrease by 10% each year and there is a constant annual commercial catch of 50 tons in the future. An alternative scenario assumes that future poaching levels will decrease by 15% each year, while there is an initial commercial catch of 50 tons for the first 3 years which increases thereafter by 80 tons in Zone A and 40 tons in Zone B. Another scenario assumes that future poaching levels will decrease by 15% per year, but the reduction ceases once poaching has dropped to 40% of current levels, and there is a constant annual commercial catch of 50 tons in the future. The horizontal lines represent depletion levels of 0.2 and 0.4.

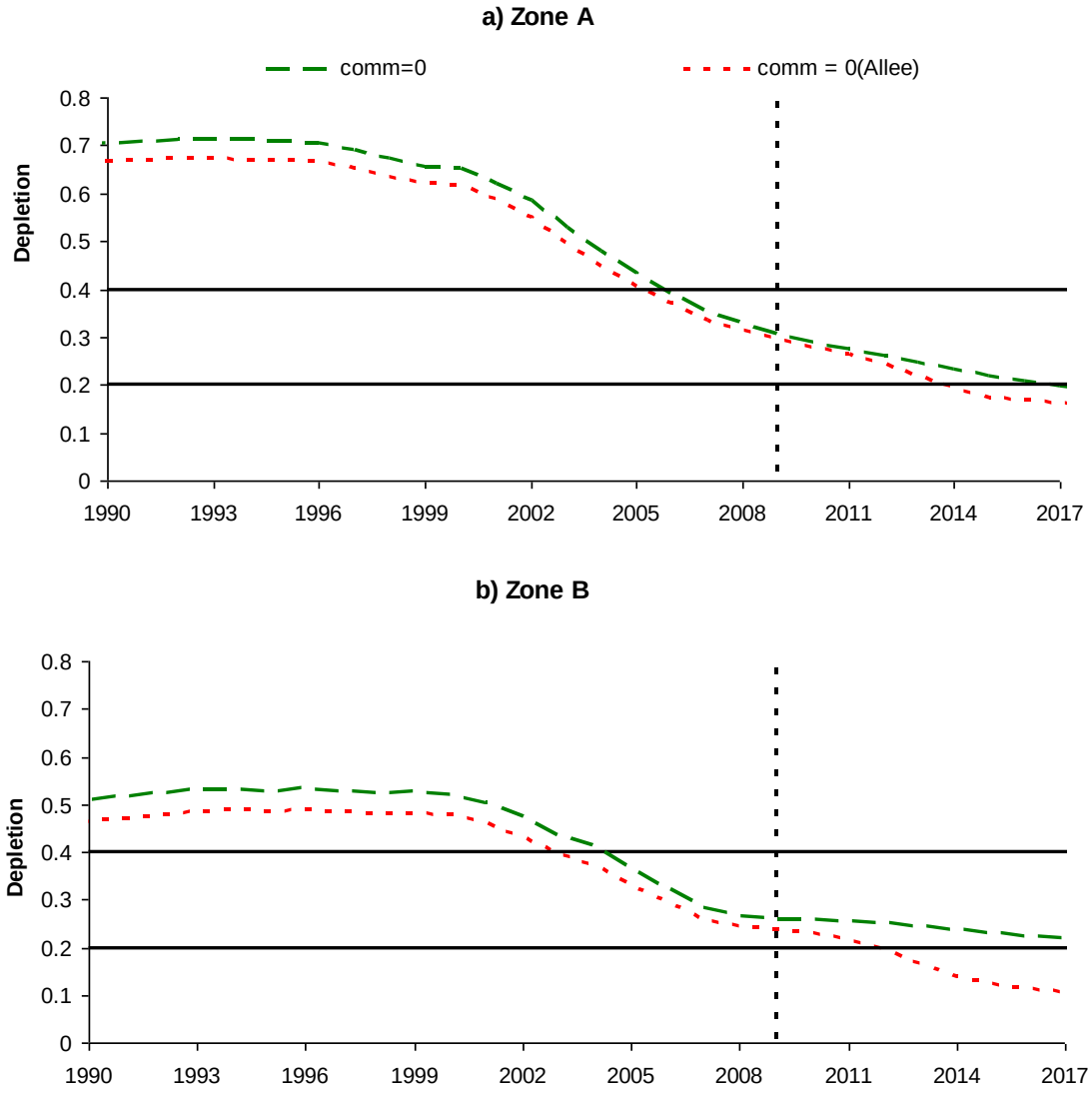

Figure 4. Total spawning biomass projections (inshore and offshore combined shown as a proportion of the pre-exploitation level) for a) Zone A and b) Zone B with and without an Allee effect. Projections are shown for a scenario that assumes the current poaching levels and no commercial catch in the future. The horizontal lines represent depletion levels of 0.2 and 0.4 and the vertical line shows the start of the projections.

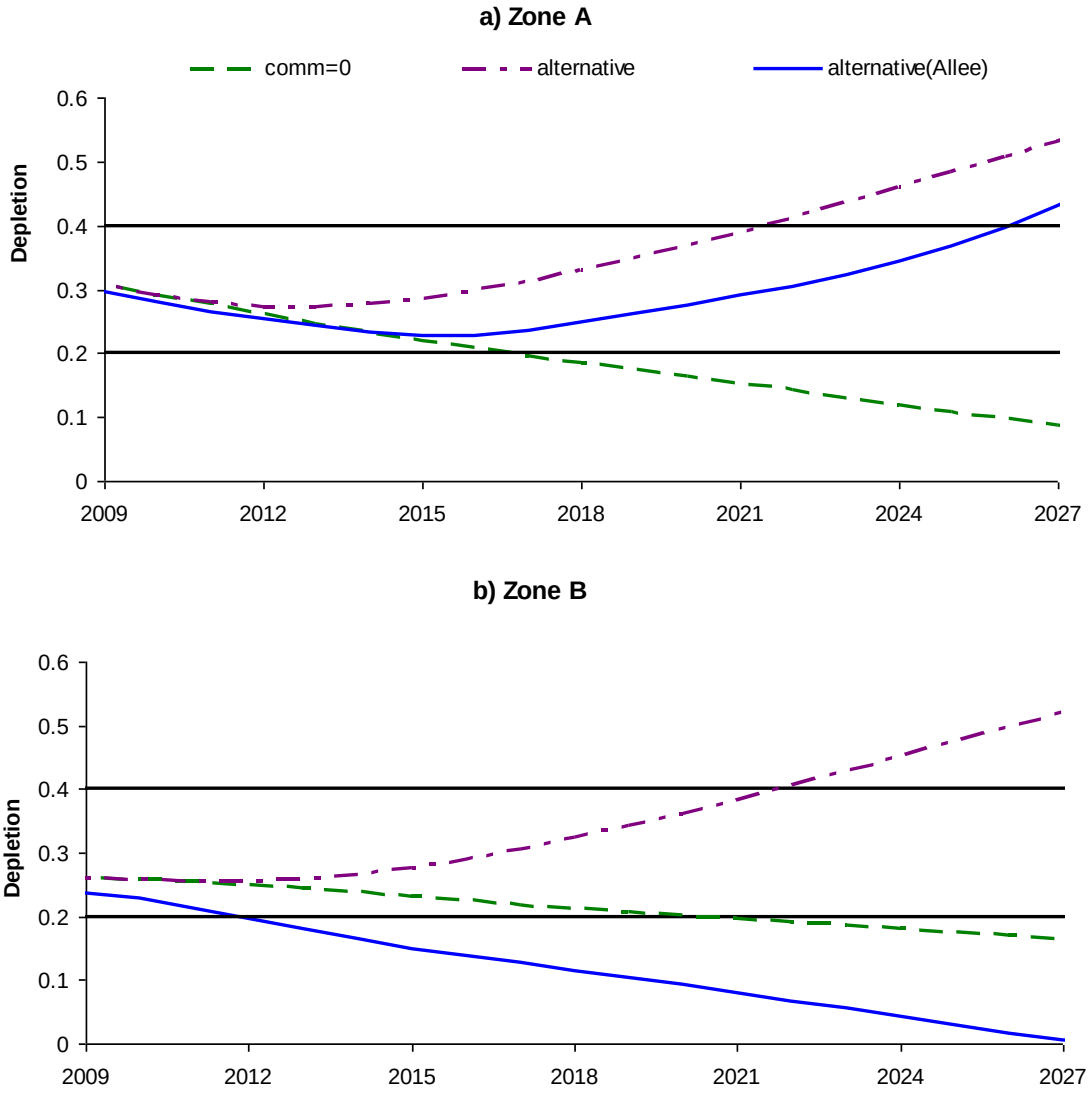

Figure 5. Total spawning biomass projections (inshore and offshore combined shown as a proportion of the pre-exploitation level) for a) Zone A and b) Zone B with and without an Allee effect. Projections are shown for the scenario that assumes future poaching levels will decrease by 15% each year, and a constant annual commercial catch of 50 tons is taken in the future. For comparison, projections for the scenario (without an Allee effect) of current poaching levels and no commercial catch in the future are also shown. The horizontal lines represent depletion levels of 0.2 and 0.4.