

A response to “SC/F15/SP02”

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The NEWREP-A proposal set the lethal sample size for the Antarctic minke whales at 333 animals. This calculation is based on the statistical power analyses to detect a change in the age-at-sexual maturity (ASM, more specifically age-at-50%-maturity, ASM50) over time with appropriate levels of statistical power and the estimation precision of ASM50.

Paper SC/F15/SP02 argued that

- a) the calculation conducted in the NEWREP-A proposal is invalid;
- b) a random effect arising from the spatial and temporal heterogeneity of the JARPA/JARPAII data collection should be taken into account in the generalized linear model for maturity data;
- c) the cohort effect should be dealt with a random effect in the model.

Although a limited time was available since I received the paper, I shall try to clarify the calculation in the NEWREP-A proposal and respond to the arguments above.

Response to a)

A question was posed in SC/F15/SP02 to ask if the age composition is assumed as fixed or randomized vectors in the simulation. The answer is that the age composition in each year in each simulation replica is independently and identically generated by random sampling with replacement from the fixed age composition observed in cohorts of 1980-2000 (Figure 6 of Appendix 13 in the NEWREP-A proposal). So, the scenario assumed in the NEWREP-A is essentially same as “Model 2” in SC/F15/SP02. Note that the statistical power and RRMSE are much less sensitive to the approach of using the observed age composition in the simulation than to the sample size and effect size.

Table 1 in SC/F15/SP02 provided their replicated simulation results. Unfortunately Table 2 in SC/F15/SP02 is not an appropriate comparison because it is an extraction of results from Model 1 in SC/F15/SP02. However, even when looking at the power values for Model 2 in SC/F15/SP02, there are slight difference (see Table A below). The reason behind these differences is not clear for me, but one possible reason is that SC/F15/SP02 tried to read the age frequencies from the Figure 6, which might have provided exactly the same numbers as the original values. Note that the pattern of difference in the power between Model 1 and 2 in SC/F15/SP02 are not consistent over the values of effect size.

Further note that (and this has not been disputed) the power analysis in the NEWREP-A guarantees a significant result (both at the 5% and 1% levels, see Figure A).

Table A. Comparison of results of power.

Effect size	Power in NEWREP-A (Sample size of female age 4-13 animals is 50)	Power for Model 1 in SC/F15/SP02	Power for Model 2 in SC/F15/SP02
0.050	0.410	0.330	0.378
0.075	0.732	0.638	0.662
0.100	0.916	0.876	0.858

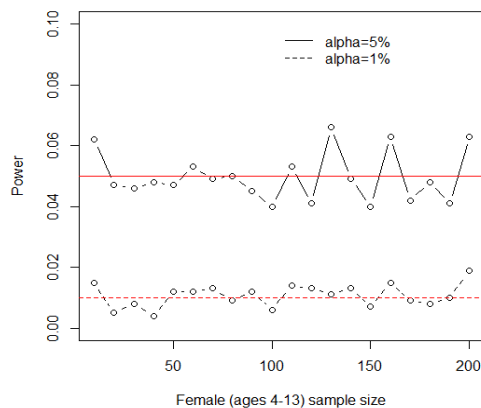


Figure A. The type 1 error against the sample size in the statistical test used in our simulation.

Response to b) and c)

I agree that observation from wildlife tend to have a certain level of over-dispersion attributed to heterogeneity and correlation. This must be the case when the volume of stomach content is observed because the food availability might differ in a spatial manner and that pattern could change over years. HOWEVER, it seems unreasonable to assume randomness in ASM50 with a great extent of variance used in SC/F15/SP02, particularly as this reflects the accumulation of the effects of feeding conditions over a number of years, rather than from one year only.

For example, SC/F15/SP02 drew values of standard deviation (SD) of residuals in the linear regression. The value mentioned in SC/F15/SP02 is 0.822 (correctly 0.816), which is unfortunately calculated from the results in Model1 with data of all the years. Using this value, the authors of SC/F15/SP02 estimated the extent of random effect SD as 0.69. But this is an overly-stated value. As mentioned in Appendix 13 in the NEWREP-A, in some cohorts, there is not enough information to estimate ASM50, and that is why data in some years are deleted in the linear regression (see Figure B2). In “Model 2 (some years deleted)”, which I recommend to use, the SD is calculated as 0.395, and if I allow myself to use the same formula to estimate the random effect SD, it would be almost 0. So, the random effect for the ASM50 is negligible. It is also worth noting that the time series for the age-at-transition (related to the age at sexual maturity) shown in Figure 5 of Appendix 13, NEWREP-A, shows little inter-annual variability, and is quite inconsistent with an argued random effect with a SD of 0.69.

In addition, when quickly using a quasi-likelihood estimating equation, the estimated dispersion is dramatically less than 1 (0.377). This value seems too under-dispersed, which might be due to ignorance of the difference in sample size among years (beta-binomial assumption is more suitable), but this result is again evidence that the over-dispersion in the generalized linear model is negligible.

Conclusion

Given the statistical reasons above, and also given the ecological reason that the ASM does not change randomly but it should case a directional change (decrease, stable, or increase), I consider that the GLMM with a random effect for cohort is not appropriate model for the maturity analyses for the Antarctic minke whales, and therefore the authors statement that the analysis in the NEWREP-A is invalid is not correct.

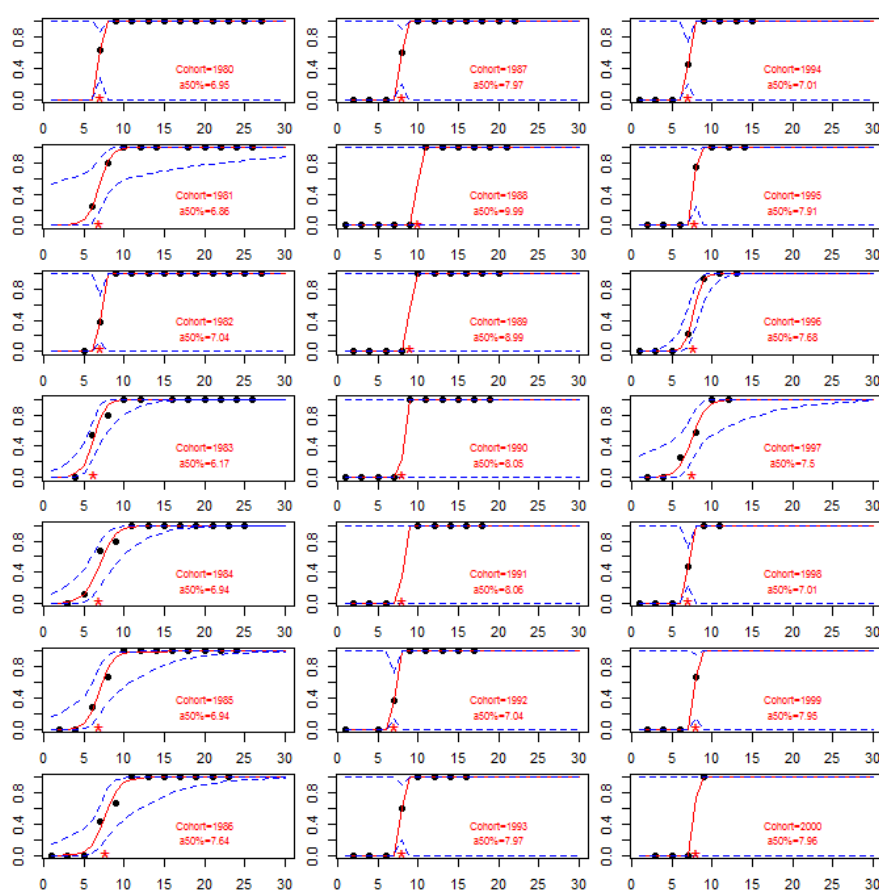


Figure B1. This is same as Figure 1-(a) of Appendix 13 in NEWREP-A. Here this is to show that in some cohorts, there is not enough information to estimate ASM50 and that is why data in some years are deleted in the linear regression. Filled circles are observed maturities against age for Area IV. The red (solid) and blue (shaded) lines are estimated maturity curves and 95% confidence intervals, respectively, based on Model 3 (of Appendix 13, NEWREP-A) with year-specific ASM50 and slope.

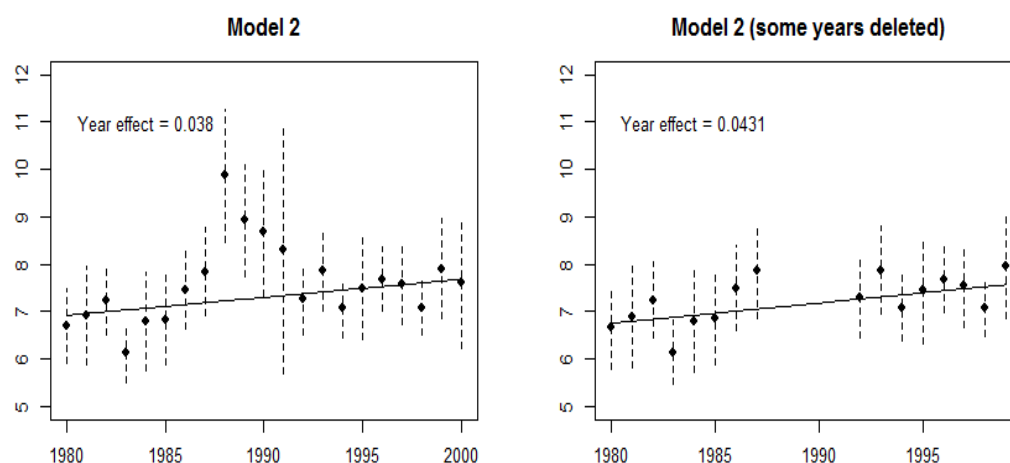


Figure B2. This is same as Figure 3 of Appendix 13 in NEWREP-A. The SD of residuals in the linear regression for “Model 2” and “Model 2 (some years deleted)” are 0.816 and 0.395, respectively.