A note on the impact of time-series length on the variability of the rate of population growth from the Cooke (2009) model

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ABSTRACT
The relationship between the variation in the rate of increase and time for nine of the scenarios considered by Cooke (2009) is investigated. This variation declines with increases to the length of the period over which it is computed, irrespective of the measure used to quantify variation.

KEYWORDS: MSYR, VARIATION; SIMULATION

INTRODUCTION AND METHODS

The Scientific Committee of the International Whaling Commission is conducting a review of the range of MSYR values to include in simulation trials when selecting among variants of the Revised Management Procedure (RMP). The 3rd Intersessional Workshop on the review of MSYR (IWC, 2010) recommended that the environmental variability population model of Cooke (2009) be used to determine the predicted relationship between the length of series and the estimated level of variability in the population rate of increase for the "standard" scenarios.

This note implements that recommendation. Table 1 lists the scenarios considered. The scenarios in table 1 are a subset of those in Cooke (2009), restricted to factors which should impact the distribution for the rate of increase. Projections are undertaken for 2,000 years from a population initially close to zero (10^{-80}) [so that the impact of density-dependence is negligible] and the following two statistics computed after 10, 20, 50 and 100 years for each replicate: (a) the rate of increase [defined as the slope of the linear relationship between log-abundance and time] and (b) the coefficient of variation of the rate of increase. The distributions for these two statistics (across 400 replicate projections) are summarised by the standard deviation of the 400 rates of increase, and the median across replicates of the standard deviation for the rate of increase for each replicate.

RESULTS AND DISCUSSION

Figures 1 and 2 summarize the two summary statistics for the nine "standard" scenarios in table 1. The variability in the rate of increase declines with time, irrespective of how variability is measured, although the variability for some of the individual replicates increases (results not shown). As noted by Punt and Allison (2010), the level of variability in population growth rate decreases with increasing values for q (and hence MSYR) and is larger when the extent of environmental variation and the auto-correlation in environmental variation is greater (table 1; Figures 1 and 2).

The values for the extent of variation in Figures 1 and 2 relate to variation in the true rate of increase because observation error has been ignored. As such, the

variation in Figure 2 is smaller than would be expected had the standard deviation of the rate of increase been computed using data typical of those obtained from field measurements.

REFERENCES

Cooke, J.G. 2009. Further analyses of the effects of environmental variability on the estimation of MSY rates. Paper SC/61/RMP13 presented to the IWC Scientific Committee, June 2008. (unpublished). 10pp.

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Table 1
Summary of the scenarios considered in this paper (see Cooke (2009) for the definitions for the symbols)

Case	r_{max}	z	q	**σ**	**ρ**	**MSYR**	**MSYL**
B1	0.1	2.39	0.1	0.5	0.5	0.011	0.509
B2	0.1	2.39	0.4	0.5	0.5	0.039	0.538
B3	0.1	2.39	0.9	0.5	0.5	0.067	0.589
M1	0.1	2.39	0.1	0.5	0.9	0.011	0.509
M2	0.1	2.39	0.4	0.5	0.9	0.039	0.538
M3	0.1	2.39	0.9	0.5	0.9	0.067	0.589
N1	0.1	2.39	0.1	1	0.9	0.011	0.509
N2	0.1	2.39	0.4	1	0.9	0.039	0.538
N3	0.1	2.39	0.9	1	0.9	0.067	0.589

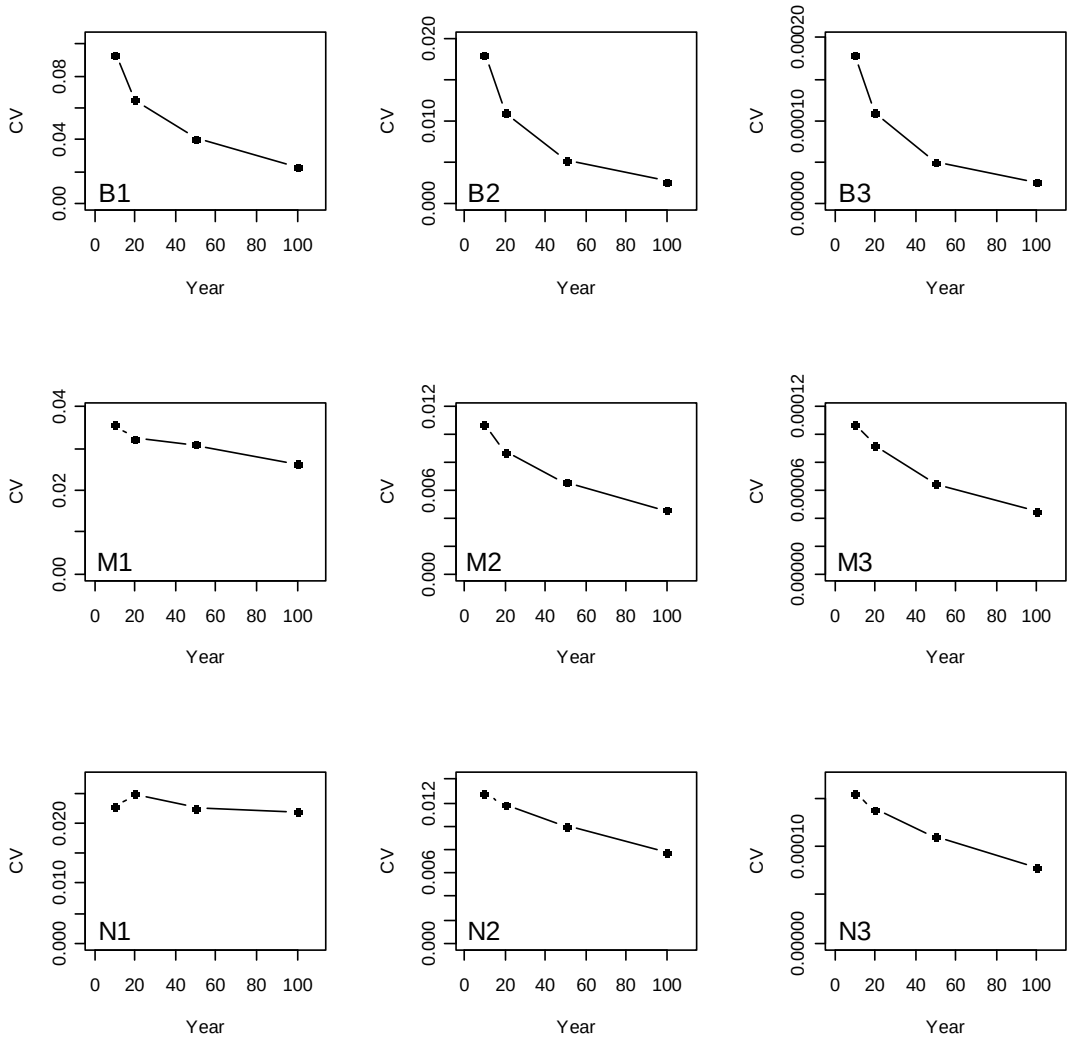

Figure 1. Coefficient of variation of the rate of increase for the nine scenarios as a function of time.

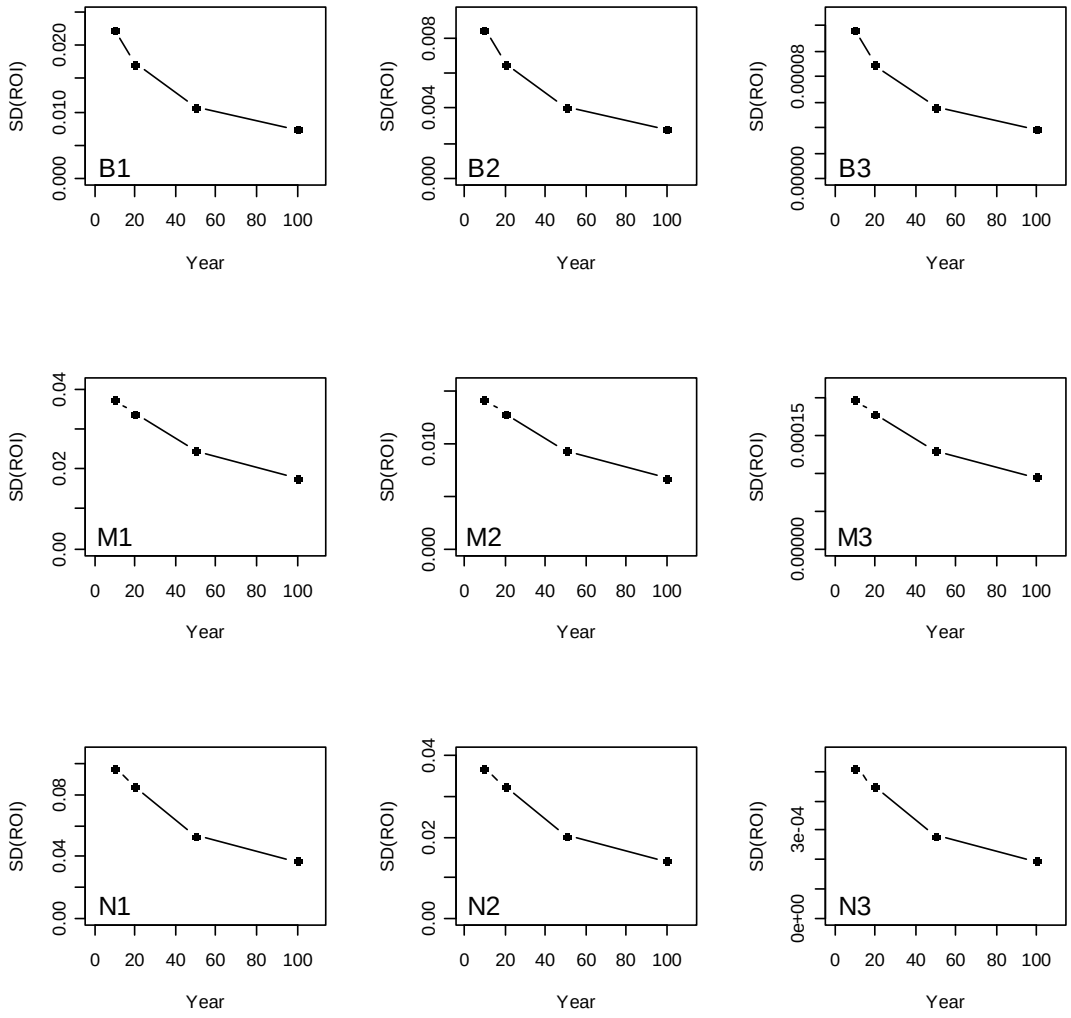

Figure 2. Median across replicates of the standard deviation of the rate of increase for the nine scenarios as a function of time.