Initial exploration of oscillations in the projections of exploitable biomass

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Summary

The Reference Case model RS02 (Ricker stock-recruitment relationship with central year of catch shift at 1958) is projected forwards 100 years under the rules of OMP2014 (TAC cap of 150 00t with no change in *b*) for 100 simulations and sine curves are fit to the resulting trajectories. For 70% of the simulations, a sine curve could readily be fit and the median period of the oscillations was found to be 21 with a 90% probability interval of (18, 30).

Background

Comments have been made at previous DWG meetings that hake seems to show oscillatory projections in abundance. This would not be expected directly from the form of the equations usually used to model the dynamics, but might be an emergent property for some reason.

This document seeks to establish whether that is the case by considering 100-year projections of the existing Reference Case OM under OMP-2014 to see whether these provide evidence oscillatory behaviour.

Results and Discussion

Figure 1a and b illustrate exploitable biomass trajectories from the 100 simulations and the fits of a sine curve to each simulation. Figure 2 plots histograms of the amplitude and period of the oscillations estimated by fitting the sine curves.

While the method of fitting the sine curves could still be refined (i.e. efforts made to fit curves to the 30% for which the estimated sine curve was essentially a monotonic curve through the oscillations), this initial exploration suggest that most of these projected exploitable biomass trajectories (for both species combined) do exhibit oscillatory behaviour with a period centred on about 20 years. There is not much evidence that the amplitude of the oscillations follow a set pattern.

Probably the mechanism for this is the occasional appearance of strong and of weak year-classes, which introduce auto-correlation into the abundance series as these year-classes work their way through the population, and that this gives an appearance of regular sinusoidal behaviour over time.

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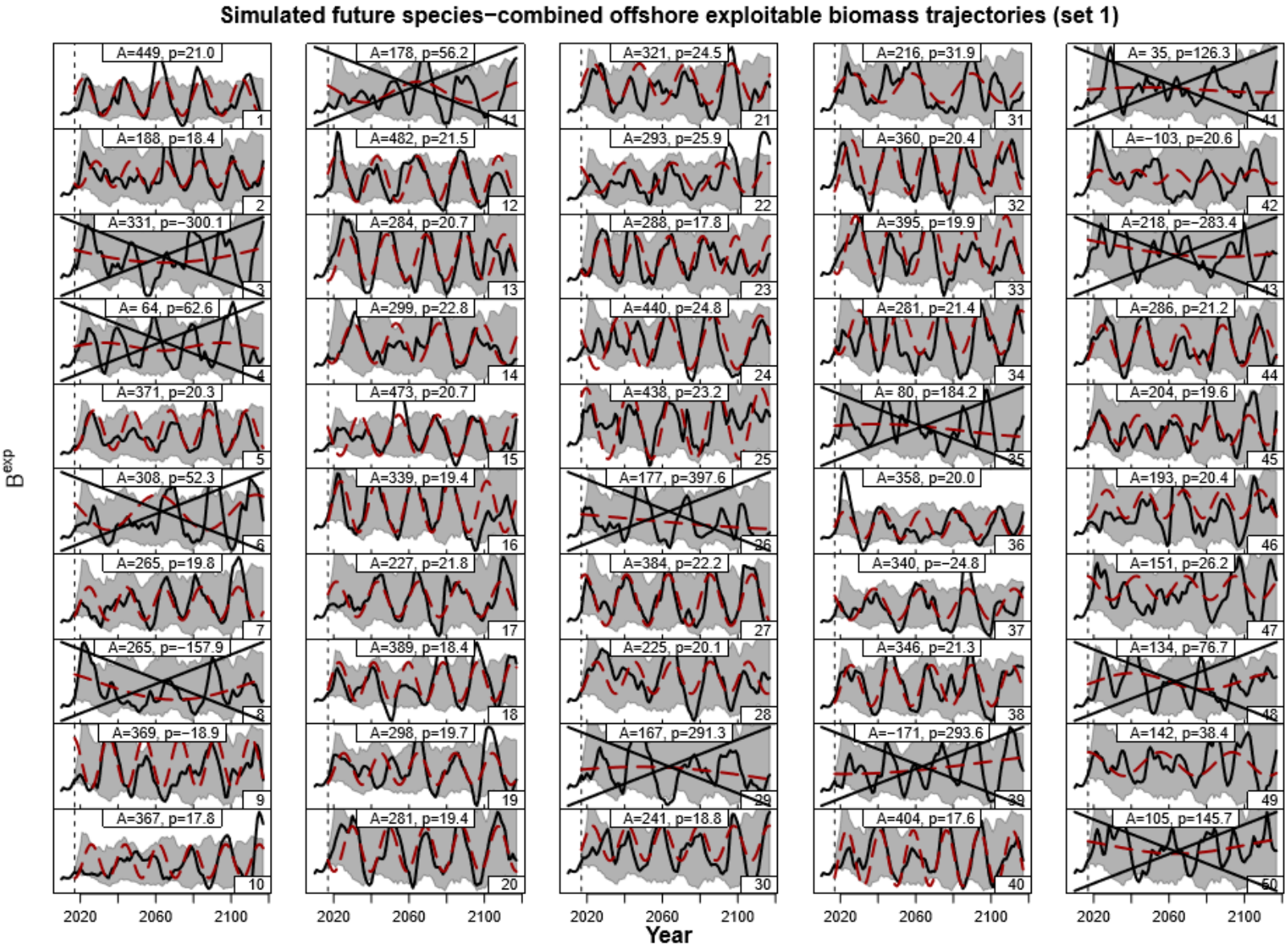

Figure 1a: The first 50 simulated B^{exp} trajectories are shown in black, with the fitted sine curves in red. The grey shaded area shows the 90% probability envelope of the 100 simulations. The estimated amplitude (A) and period (p) are reported for each simulation. Simulations where the fit of the sine curve yielded a period of more than 50 years have been excluded (as indicated by the Xs).

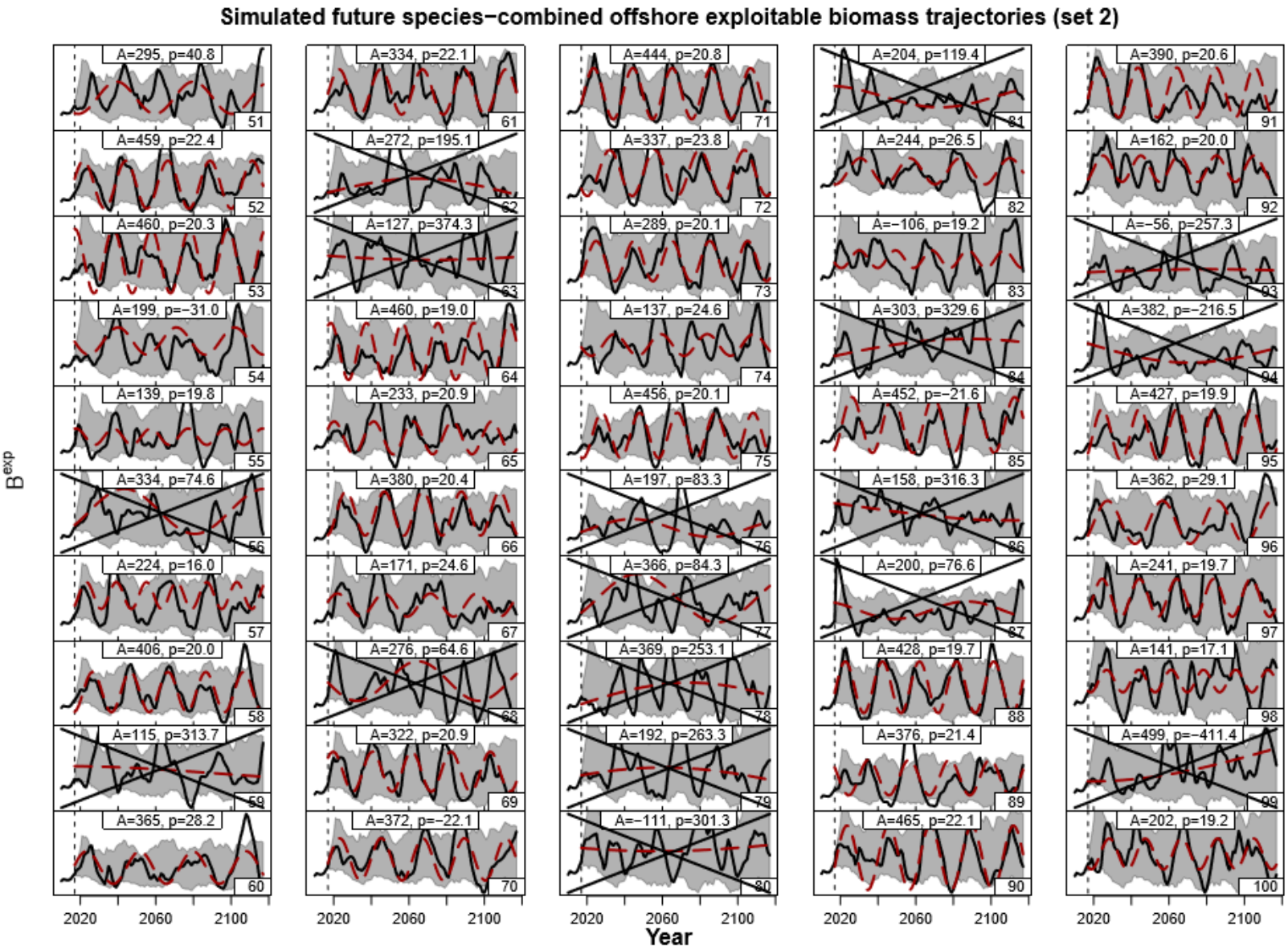

Figure 1b: The second 50 simulated B^{exp} trajectories.

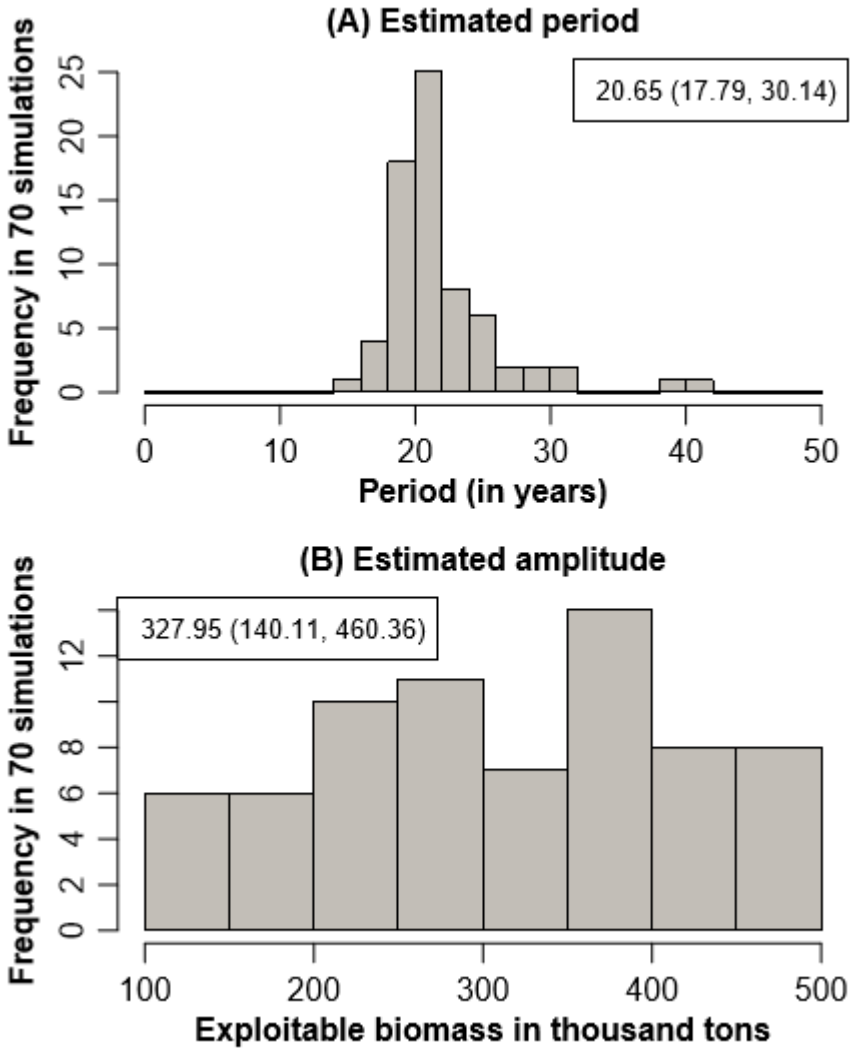

Figure 2: Histograms of the estimated period and amplitude of the oscillations. The medians and 90% probability intervals are listed in the legends.