Increasing prevalence of infection with increasing fish size for southern stock sardine is not a model artefact

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Introduction

Updated results from GLM analyses of three indices of infection of sardine by a digenean "tetracotyle" type metacercarian parasite using data collected from commercial catch samples taken over the period 2011 to 2013 were presented at the SWG(PEL) meeting held on 29/04/2014 (van der Lingen *et al*. 2014). Significant differences in the prevalence of infection, mean infection intensity and mean parasite abundance between sardine from the western stock and those from the southern stock have convincingly corroborated the multistock hypothesis for this species. However, concern has been raised (both at the last and at previous meetings where sardine parasite data were discussed) regarding the fits of these models that show an increase in the prevalence of infection with increasing fish size for sardine from the southern stock, specifically whether the fits are a consequence of the functional relationship (a logistic curve) assumed for prevalence of infection with length or a genuine reflection of the available data. A request that the raw data of prevalence by length class and the associated binomial error bars be plotted on top of the model outputs was made and these are provided in this document.

Methods

The mean prevalence of infection was calculated separately for each 1 cm CL-class of sardine from each stock for each year, and the associated binomial standard errors calculated using the equation $se = \sqrt{(pq)/n}$, where p is the observed mean probability of infection-at-length, $q = (1-p)$, and n is the number of observations for that particular length class of a given stock in a given year.

Results

Observed mean prevalence of infection by length class and the associated binomial error bars are plotted on top of the GLM outputs of predicted infection-at-length for sardine from the western and southern stocks for the period 2011-2013 and are shown in Fig. 1. For sardine from the southern stock in all three years and for those from the western stock in 2011 and 2013 the raw data clearly indicate that prevalence of infection increases with increasing fish size. The exception to this pattern is shown by sardine from the western stock in 2012, where the prevalence of infection was high and relatively stable for the entire size range of fish observed.
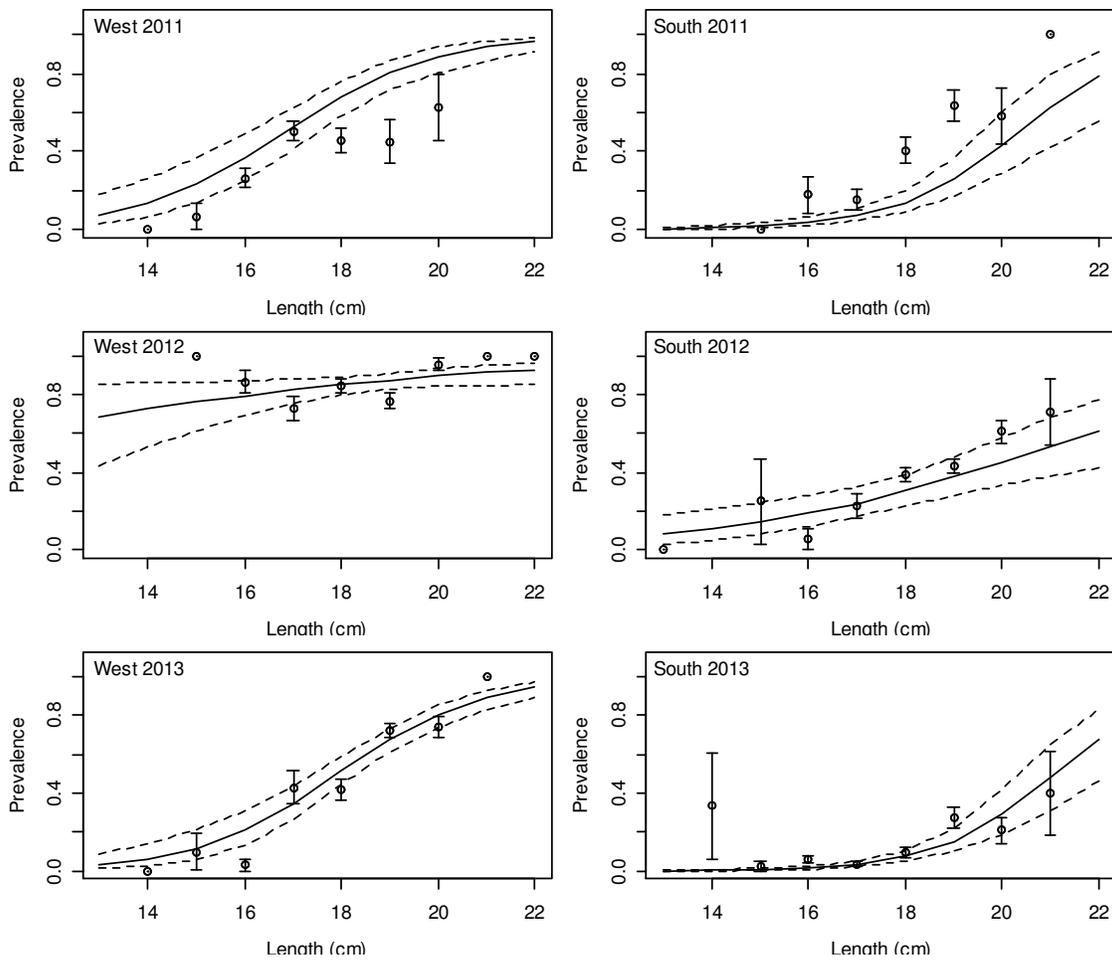
Figure 1: Outputs from the updated prevalence of infection GLM showing predicted prevalence (proportion; solid lines with 95% confidence limits shown as dashed lines) by CL for each stock during each year. Open circles denote the mean observed prevalence of infection-at-CL by year and stock with binomial standard error bars shown.

The predicted prevalence of infection-at-length accurately tracks observations of infection-at-length for sardine from both the western and the southern stock in both 2012 and 2013, but is less accurate for fish from both stocks in 2011 where predicted prevalence of infection is somewhat higher than observations for larger western sardine and somewhat lower than observations for larger southern sardine. Despite this reduced fit for the 2011 data, the reasonably close match between predicted and observed prevalence of infection-at-length for sardine from both the western and the southern stocks indicates that a logistic curve is an appropriate functional relationship to use for this analysis.

References

van der Lingen, C.D., Weston, L.F., Reed, C.C., Hendricks, M. and H. Winker. (2014). Updated GLM analyses of parasite data corroborate the sardine multi-stock hypothesis. FISHERIES/2014/APR/SWG-PEL/27, 4p.