Key Issues for Discussion Regarding Prioritisation of Future Sardine Research

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This document lists some key issues for discussion by the panel regarding prioritisation of future sardine research.

1) The use of parasite data

What would be the best approach to the use of the available parasite data in determining movement of sardine between the west and south stocks? (Also see the 2013 panel's recommendation C.4)

The current sardine assessment, evaluated by the panel in 2013, used data up to November 2011. Parasite data are available for 2010 – 2013. Data from 2014 is anticipated in early 2015, although the sample size is expected to be small, and the coverage not wide, with most samples from the Gansbaai area for "western fish" and Mossel Bay area for "southern fish". The metrics currently available by coast are

i) Prevalence-by-length of parasites
ii) Infection intensity-by-length of infected fish only
iii) Parasite abundance-by-length (average number of parasites per fish for all fish, including those not infected)

All three metrics increase with length for sardine from both the west and the south coast but at different rates, with these indices generally being higher at length for western fish compared to southern fish (van der Lingen and Hendricks 2014; Weston et al in press).

The 2015 assessment will be based on data up to November 2014. It is thus anticipated that the prevalence and infection intensity will be used as a form of tagging data to tune movement parameters for the latter part of the time series in the next assessment. The parasite prevalence-by-length and abundance-by-length are not independent sources of data as the latter is equal to the proportion infected-by-length multiplied by the infection intensity-by-length

The model will thus need to track the movement of fish on the south coast that originated from the west coast as follows:
"West stock" – sardine originating from and remaining on the west coast
"South stock" – sardine originating from and remaining on the south coast
"South from west stock" – sardine originating from the west coast, but now part of the south stock.
The reason for distinguishing the last two, which otherwise do not differ in behaviour, is the need to be able to work out the proportion of south stock fish that originated from the west (i.e. may have the parasite), while the "original south stock" fish will be modelled not to have parasites. That way proportions of sardine in the south/west that have parasites can be predicted.
The stock recruitment relationship for the south stock will be based on the effective SSB of both the "south" and "south from west" stocks, but recruitment will be modelled to the "south" stock only.

It is anticipated that such "tagging data" could help distinguish between the alternative "D" (Varied adult movement) hypotheses of de Moor et al. (2014b).

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2) Stock recruitment relationships

What would be the best approach to estimate stock recruitment relationships for sardine? (See also the 2013 panel's recommendation C.5.3)

It is anticipated that the development of the 2015 assessment will include testing the impact of including and excluding the estimation of a stock recruitment relationship. If stock recruitment relationships are fit after the minimisation of the assessment, the chosen relationships would not influence the assessment output – which is arguably appropriate in a situation where as the form of relationship is so uncertain - and alternative hypotheses such as assuming recruitment is dependent on the total (west+south) spawning biomass could easily be explored. However, fitting such relationships to the assessment outputs is problematic, because covariance effects would not be properly taken into account and relationships would need to be fit for each draw of parameters from the posterior distributions – this is a potentially time consuming computing process.

The 2013 panel recommended that a hypothesis of a single stock recruitment relationship be tested with total west+south recruitment being dependent on total west+south spawning biomass. The authors are hesitant that the model will be able to distinguish between the annual proportions of total recruitment "settling" to the west and the south coast areas in addition to the annual proportions of recruits [and likely older sardine too] moving from the west to south stocks.

3) Alternative hypotheses of sardine stock structure

Can any currently considered alternative hypotheses of sardine stock structure be excluded at this stage and are there any alternatives we have missed? Is it possible, given current results, to prioritise which hypotheses should be pursued first?

de Moor et al. (2014b) give some initial results of alternative hypotheses currently considered possible.

In terms of the further work on the alternative "A" hypothesis (effective spawning biomass), ideally, the analysis by Miller et al. (2006) should be updated, particularly with revised a nursery area for the south coast, as the original area selected is now considered not to have covered the full nursery area; however this would be a long-term project. In this regard we note that Kone et al. 2013 used the IBM configuration of Miller et al. (2006) but with a coupled hydrodynamic-biogeochemical model to simulate diatom and copepod abundance, and showed that food dynamics and availability was important in determining spatial and temporal patterns of anchovy recruitment success. A similar study could be conducted for sardine using recent hydrodynamic models coupled to biogeochemical models, which would provide a more realistic basis for IBM simulations of sardine spawning patterns and enable the impact of prey distribution fields to be assessed, but no person/project has yet expressed interest in this work.

4) November survey data

Can the panel provide advice and prioritisation of the use suggested below of the November survey data in the 2015 sardine assessment? (See also the 2013 panel's recommendation C.5.2)

We have identified three areas in which the use of the November survey data in the model should be updated.

a) It is anticipated that the 2015 assessment will be tuned to November survey proportion-at-length data (in line with the former assessment), but that sardine weights-at-length will be used instead of weights-at-age. Previously age 0 sardine were assumed to contribute nothing to the biomass surveyed. The annual weights-at-length will be informed by the assumed weight-at-length relationship, modified by the overall average fish weight of each survey.

Following this change, the model should be able to more accurately predict the "total biomass" surveyed.

b) A variant of the 2015 assessment will be conducted under the assumption that there are two cohorts of recruitment to the south stock, one in November and one in May, where the latter will be assumed not to form part of the May survey estimate of recruit abundance, but which will contribute to the November survey estimate of total biomass. A "total annual recruitment" will be modelled relating to spawning biomass with a stock-recruitment relationship, and, in the absence of further data, the proportion of this annual recruitment occurring in November and May will likely be assumed to remain constant over all years. Note this is in contrast to the 2013 panel's recommendation of a time-varying proportion of recruitment in November v May, because there are no data which allow this variation to be estimated.

c) If the November survey biomass is to be split into an age 0 and 1+ abundance, two methods could potentially be used. Annual cut-off lengths for the November survey will need to be derived (the cut-off lengths differ from <12cm to <17cm over the past 27 years of May surveys). However, initial investigations showed the choice of cut-off length to be highly influential (de Moor et al. 2014a). A quantitative analysis of the November survey length frequencies by stratum may assist in differentiating between winter spawned recruits, assuming they are spawned and remain on the south coast, from the summer spawned recruits, the majority of which appear to be spawned further to the west. This differentiation may further assist in determining annual cut-off lengths.

Alternatively, the proportion of age 0 sardine in each November survey estimate of abundance could potentially be calculated using a similar method as de Moor et al. (2013) used to determine the proportion of 1-year-old anchovy in the November surveys.

The re-calculation of CVs for both age 0 and 1+ survey estimates of abundance would then be required, as well as a re-calibration of pre-1998 survey data (Coetzee et al. 2008, de Moor et al. 2008). This would be a long-term project and not possible in time for the 2015 assessment.

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