List of key questions for the panel regarding sardine, together with brief summaries of the documents provided

Following primarily the work by Teske *et al*. (2021) (MARAM/IWS/2022/Sardine/P2), the previously modelled stock structure of South African sardine requires modification. A new Operating Model of the sardine resource is thus being developed, with an MSE planned for 2023. The key questions relating to sardine are as follows:

1) What are the most important features of this new stock structure model to explore going forward?

A brief description of each document is provided in red italics.

Primary papers

MARAM/IWS/2022/Sardine/P1: List of key questions for the panel regarding sardine, together with brief summaries of the documents provided.

MARAM/IWS/2022/Sardine/P2: Teske PR, Emami-Khoyi A, Golla TR, Sandoval-Castillo J, Lamont T, Chiazzari B, McQuaid CD, Beheregaray LB, van der Lingen CD. 2021. The sardine run in southeastern Africa is a mass migration into an ecological trap.

Genomic and transcriptomic data are used to identify two 'stocks': cool temperate (Atlantic Ocean) and warm temperate (Indian Ocean) sardine, with sardine participating in the Sardine Run off the east coast including cool temperate sardine. This document provided the primary foundation for the difference in stock structure described in P2 from the previous stock structure (BG2). Note, in particular, Figure 3 with near only warm temperate sardine found off the south coast. Given the presence of hybrid sardine (a mixture of cool and warm temperate sardine) participating in the Sardine Run, hybrid sardine have been proposed by the SWG-PEL to behave as cool temperate sardine for modelling purposes – the preference being to model two population components rather than three.

MARAM/IWS/2022/Sardine/P3: de Moor CL, van der Lingen CD and Teske PR. 2022. A new hypothesis for South African sardine stock structure.

A minor update from FISHERIES/2022/MAY/SWG-PEL/11. The new sardine stock structure hypothesis is conceptualised following newly available genomic and transcriptomic research. The hypothesis consists of two primary components: (i) some fish of Atlantic Ocean origin (cool temperate sardine) actively move eastward to take part in the Sardine Run on the East Coast; and (ii) some spawning products of Indian Ocean origin (warm temperate sardine) are passively transported to the West Coast for a period of time before returning to the South Coast as adults. This document provides some necessary background to P4 and the key question.

MARAM/IWS/2022/Sardine/P4: de Moor CL. 2022. An initial simple model of the revised stock structure hypothesis for South African sardine.

A brief model description (model equations provided in the appendix) of the model used to initially explore fitting the revised stock structure hypothesis to the data. As this is an initial step, commercial data are not yet included. The model provides a reasonable fit to the data and passes two 'red face tests': checking the annual west to south/east movement of Cool Temperate Sardine compared to Warm Temperate Sardine and the annual 'success' of recruitment on the west coast of Cool Temperate Sardine compared to Warm Temperate Sardine. Following steps are suggested, particularly including an informative prior on passive movement of spawning products from the south to the west coast, an informative prior on the length at which survey selectivity is 50% and alternative growth curves. This document provides some necessary information for the key question.

Background documents

MARAM/IWS/2022/Sardine/BG1: Coetzee JC, de Moor CL, van der Lingen CD and Butterworth DS. 2022. A summary of the sardine (and anchovy) fishery.

A summary document providing an overview of the sardine resource and fishery, and a brief description of the data available, together with past assessments and management of the fishery.

MARAM/IWS/2022/Sardine/BG2: Butterworth DS, van der Lingen CD, Coetzee J and de Moor CL. 2016. The present agreed hypothesis for South African sardine stock structure.

The conceptual framework for the two-mixing-component hypothesis for sardine used previously.

MARAM/IWS/2022/Sardine/BG3: de Moor CL, Butterworth DS and van der Lingen CD. 2017. The quantitative use of parasite data in multistock modelling of South African sardine (*Sardinops sagax*).

Details of the model of the previous two-mixing-component hypothesis for sardine, used as the Operating Model when developing OMP-18.

MARAM/IWS/2022/Sardine/BG4: de Moor CL. 2021. Updated assessment of the South African sardine resource using data from 1984-2020.

A recent assessment of the sardine resource, based on the previous stock structure hypothesis. This document is an extension of FISHERIES/2021/APR/SWG-PEL/23. The assessments used for management recommendations in 2021 and 2022 were not conditioned on the parasite prevalence-at-length data (i.e. model (i) in this document).

MARAM/IWS/2022/Sardine/BG5: van der Lingen CD. 2022. A synthesis of studies of South African sardine population structure.

A synthesis of studies which have been used to examine the stock structure of South African sardine. For potential reference when discussing the new stock structure hypothesis.