

A new hypothesis for South African sardine stock structure

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forestry, fisheries
& the environment

Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA



Ecological Genomics & Wildlife Conservation

Sardine Stock Structure Hypotheses

- Single stock
- Two “stocks” -> two “components”
-> mixing clarified
- Updated two component hypothesis

This is the ‘conceptual framework’

One “stock” in the sense of a biological unit that is reproductively isolated, but spatial structure within that “stock”

Previous Hypothesis

MARAM/IWS/2022/Sardine/BG2

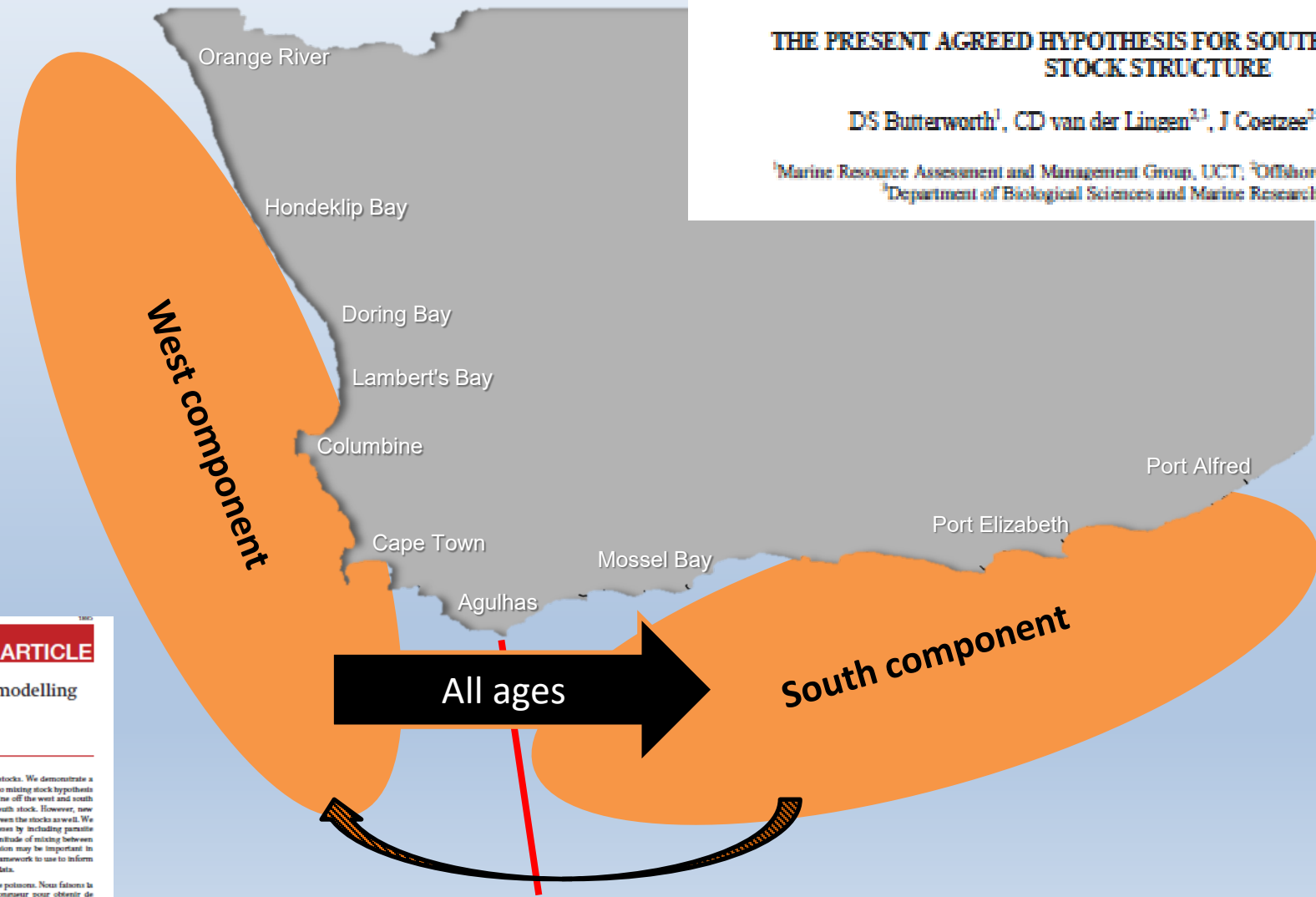
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THE PRESENT AGREED HYPOTHESIS FOR SOUTH AFRICAN SARDINE STOCK STRUCTURE

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MARAM/IWS/2022/Sardine/BG3

NRC Research Press **ARTICLE**

The quantitative use of parasite data in multistock modelling of South African sardine (*Sardinops sagax*)¹
 Carryn L. de Moor, Douglas S. Butterworth, and Carl D. van der Lingen

Abstract: Differences in parasite infection have previously been used to distinguish between fish stocks. We demonstrate a novel use of parasite prevalence-by-length data to inform quantitatively on stock mixing. An initial two mixing stock hypothesis proved consistent with biological and survey data, suggesting that there are different stocks of sardine off the west and south coasts of South Africa. That hypothesis assumed that only recruits moved from the west to the south stock. However, new "retroactive" type mark-recapture parasite tagging data indicate a need to allow older fish to move between the stocks as well. We demonstrate extension of bio-tagging to inform on the plausibility of population structure hypotheses by including parasite prevalence-by-length data in the model's likelihood. Our method enables the estimation of the magnitude of mixing between semi-discrete stocks, providing more precise estimates of annual movement. Such improved precision may be important in better informing future movement hypotheses and thereby management. Our research provides a framework to use to inform quantitatively on stock structure and movement hypotheses for other fish species with bio-tagging data.

Résumé : Des variations de l'infection de parasites ont déjà été utilisées pour distinguer des stocks de poissons. Nous faisons la démonstration d'un nouvel usage des données de prévalence de parasites en fonction de la longueur pour obtenir de l'information quantitative sur le mélange de stocks. L'hypothèse initiale du mélange de deux stocks concorde avec les données biologiques et d'échantillonnage, ce qui porte à croire qu'il y a des stocks de sardines distincts au large des côtes ouest et sud de l'Afrique du Sud. Cette hypothèse supposait que seuls des recrues se déplaçaient du stock de l'ouest au stock du sud. Cependant, de nouvelles données de type balisage rétroactif de parasites indiquent un besoin de permettre aux poissons plus âgés de se déplacer entre les stocks. Nous démontrons l'extension du balisage de parasites pour informer sur la plausibilité des hypothèses de structure de population en incluant les données de prévalence de parasites par longueur dans la vraisemblance du modèle. Notre méthode permet d'estimer la magnitude du mélange entre des stocks semi-discrets, fournissant des estimations plus précises du mouvement annuel. Une telle précision améliorée peut être importante pour mieux informer les hypothèses de mouvement futures et ainsi la gestion. Notre recherche fournit un cadre pour utiliser quantitativement les données de balisage de parasites pour d'autres espèces de poissons.

Genomic/Transcriptomic Research

Cool Temperate Sardine (CTS)

Warm Temperate Sardine (WTS)

Mixed origin

Preferential waters

South Coast – almost solely WTS

West Coast – predominantly CTS,
also WTS & mixed

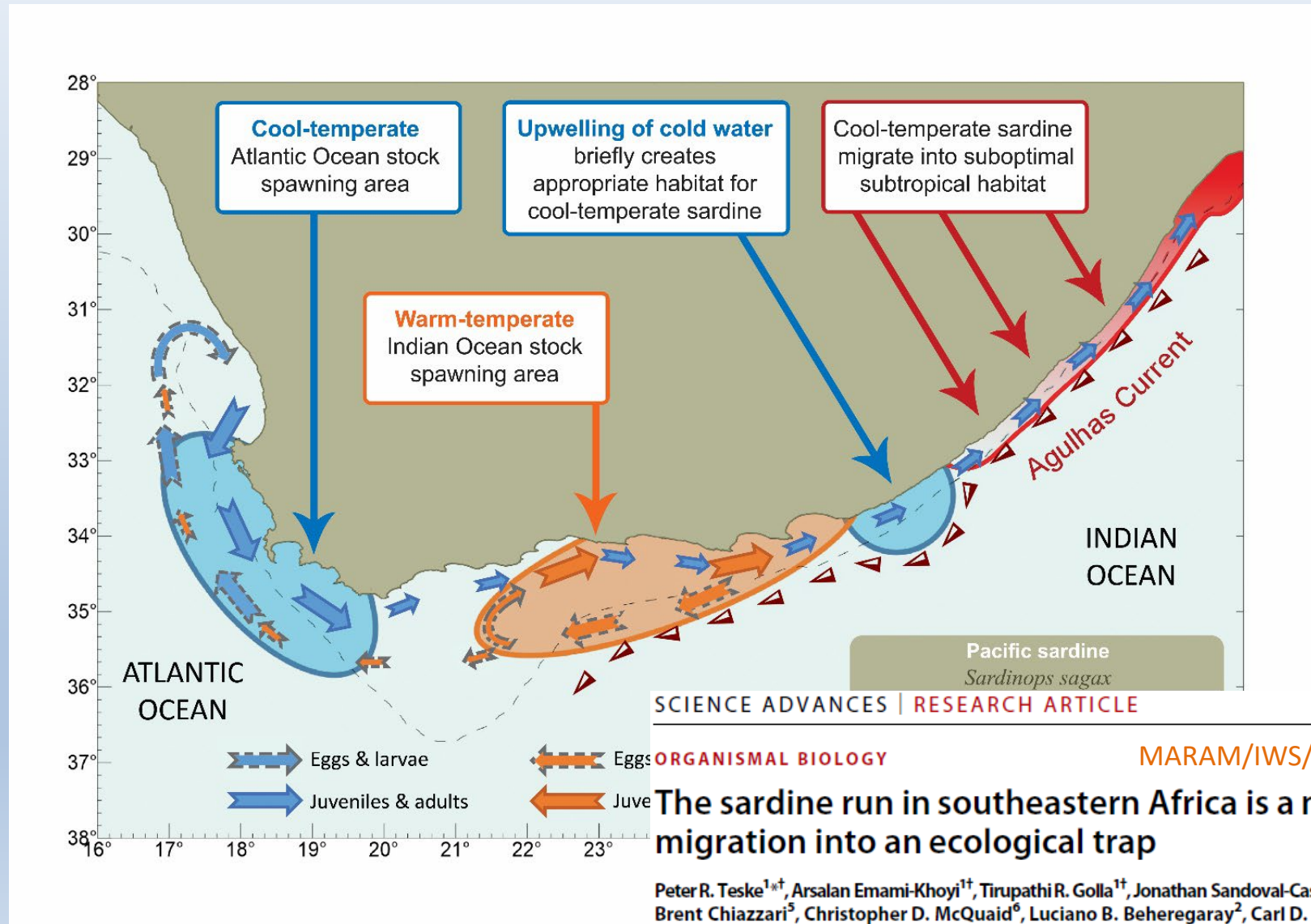
Passive SC->WC movement of
WTS spawning products

Active WC->SC return of WTS

Active WC -> SC -> EC
movement of CTS

Some surviving CTS may move
back to SE coast after sardine

run (within/outside management boundary?)



Basic Model Structure

Management area:
west of Port Alfred

Keep track of 5 'types'
of fish

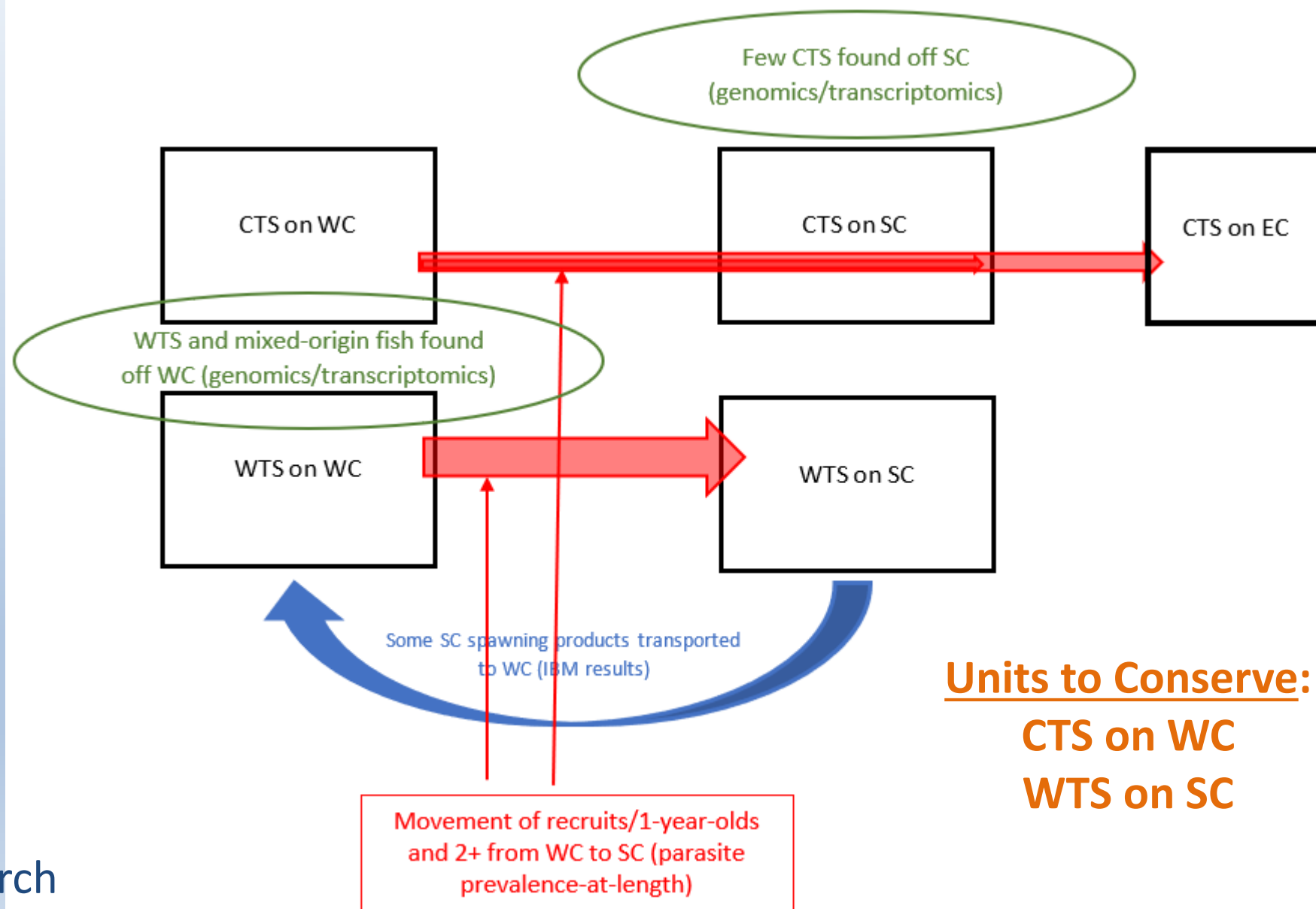
Mixed-origin fish on
WC assumed to behave
like CTS

Key uncertainties:

- Extent of passive SC->WC movement
- Timing of active return of WTS from WC->SC
- 'Behaviour' of mixed-origin fish

See Table 1 for details

See text for supporting research



Key Differences

- West Component fish move to and become 'like' South Component fish - but Teske et al. (2021) found almost no CTS on south coast
- WTS off the west coast return back to the more favourable south coast waters
- Spawning products from South Component contribute to West Component recruitment
- WTS spawning products that move (passively) to the west coast, retain their 'genetic heritage'

Summary

- This is the conceptual framework
- Two components found on two (three) coasts
- For now, mixed-origin fish on the west coast are assumed to behave like CTS
- Next step – fit ‘simple’ model to key data