Comparing year-average prevalence-at-length and abundance-at-length plots for western and southern sardine following exclusion of data from the presumed "mixing zone"

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Introduction

Length frequency distributions, prevalence-at-length and abundance-at-length plots of infection of western and southern sardine shown in Figure 6 (and below) in van der Lingen and Mushanganyisi (2015) represent composite plots for all data collected during Pelagic Biomass Surveys conducted each year 2010-2014. This analysis gives observations from each individual fish equal weighting, and standard error bars for the composite abundance-at-length plot are derived using the numbers of fish sampled per length class during all years combined.

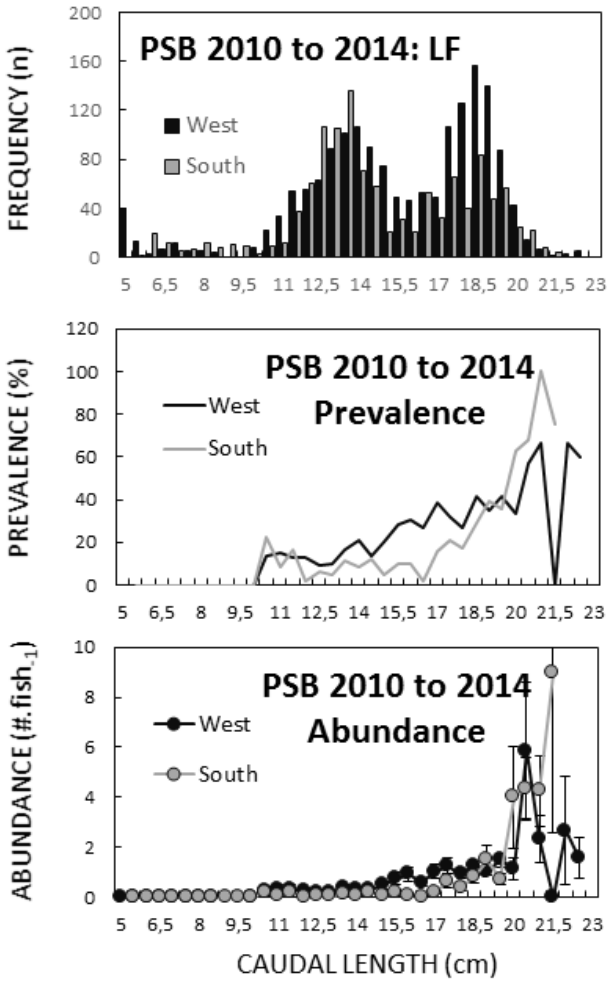

Figure 1: Composite length frequency distributions (n; upper), prevalence of infection by caudal length class (centre) and mean parasite abundance by caudal length class (lower; standard error bars are shown) for western and southern sardine sampled during the 2010 to 2014 Pelagic Biomass Surveys (note that standard error bars for the composite abundance plot are derived using the numbers of fish samples per length class).

Annual prevalence-at-length plots of infection of western and southern sardine are shown in Figure 2, and year-averaged values per 0.5 cm length class have been derived by calculating averages from values obtained for each survey (*i.e*. surveys were equally weighted) and are also shown in Figure 2 (with a zoom in the area of interest).

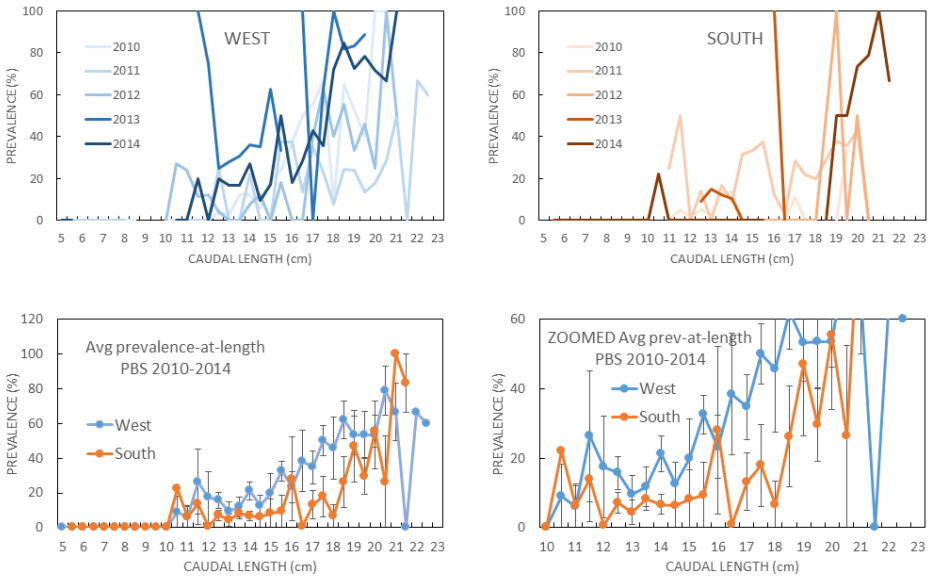

Figure 2: Annual prevalence-at-length (upper panel) and year-averaged prevalence-at-length (lower panel; standard error bars are shown with n being the number of years for which data for that length class were available) for western and southern sardine sampled during the 2010 to 2014 Pelagic Biomass Surveys.

Average prevalence-at-length is higher for western sardine than for southern sardine over virtually the entire length range from 10 cm CL upwards, except for fish >21 cm CL but sample sizes are small for these large fish. The standard error bars overlap for much of the size range, except for fish of 16.5 to 18.5 cm CL.

Annual abundance-at-length plots of infection of western and southern sardine are shown in Figure 3, and year-averaged values per 0.5 cm length class have been derived by calculating averages from values obtained for each survey (*i.e*. surveys were equally weighted) and are also shown in Figure 3 (with a zoom in the area of interest). Abundance-at-length is higher for western sardine than for southern sardine over the length range up to 18.5 cm CL; above this size averages fluctuate markedly and do not appear to be different between fish from the two stocks, although this may also be an artefact of small sample sizes as indicted by the large standard error bars for larger fish.

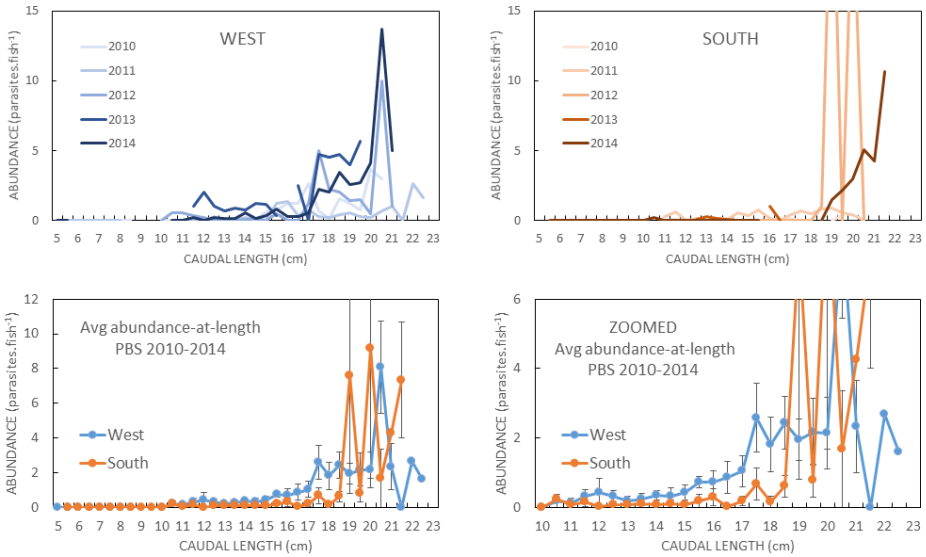

Figure 3: Annual abundance-at-length (upper panel) and year-averaged abundance-at-length (lower panel; standard error bars are shown with n being the number of years for which data for that length class were available) for western and southern sardine sampled during the 2010 to 2014 Pelagic Biomass Surveys.

These year-averaged plots shown in Figs 2 and 3 were derived using all data collected during PSB surveys and assigning sardine into western or southern stocks using Cape Agulhas (20°E) as the dividing line. In discussion at the 2015 ISAW, questions have arisen as to the possible impact that including data from the "mixing zone" between the two stocks may have on the year-averaged plots for southern sardine, given the assumption that movement is from west to south only and uncertainty as to where the stocks are separated in reality. Hence the dataset for the southern stock may include western fish that are just east the 20°E dividing line. To assess this effect, the analyses were redone after excluding all data collected from between 20° and 22°E (i.e. the Central Agulhas Bank; see Figure 1). This reduced the amount of data available for the southern stock (including the loss of all southern data in 2013) but not for the western sardine stock (Table 1).

Table 1: Number of fish (and number of samples) from Pelagic Biomass survey samples examined for "tetracotyle" type metacercarian parasites for western sardine, and for southern sardine defined as (i) east of 20°E and (ii) east of 22°E), 2010-2014.

Year	Western	Southern (east of 20°E)	Southern (east of 22°E)
2010	373 (16)	370 (22)	113 (11)
2011	542 (18)	431 (17)	254 (9)
2012	297 (8)	67 (1)	67 (1)
2013	175 (3)	103 (1)	0
2014	279 (12)	214 (9)	205 (8)
Total	1 666 (57)	1 185 (50)	639 (29)

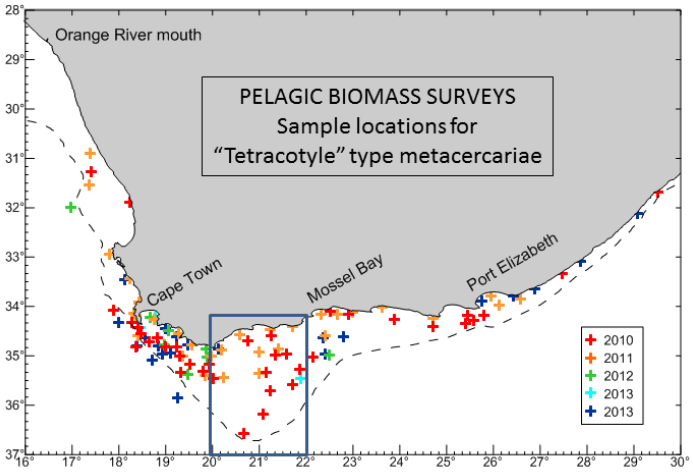

Figure 1: Map showing the location of sardine sampled for TTM from Pelagic Biomass Surveys 2010 to 2014; the blue rectangle indicates the presumed "mixing area" from which data were excluded for the 2nd definition of southern sardine.

Removing data from sampled on the Central Agulhas Bank (20-22°E) does result in changes in the year-averaged prevalence-at-length for southern stock sardine: prevalence levels are reduced for fish of 10.5 to 13.5 cm CL but increased for fish of 14.0 to 15.5 cm CL (Fig. 4), but not dissimilar for fish >16 cm CL. Changing the definition of southern sardine by excluding data from 20-22°E did not result in marked changes in the year-averaged abundance-at-length.

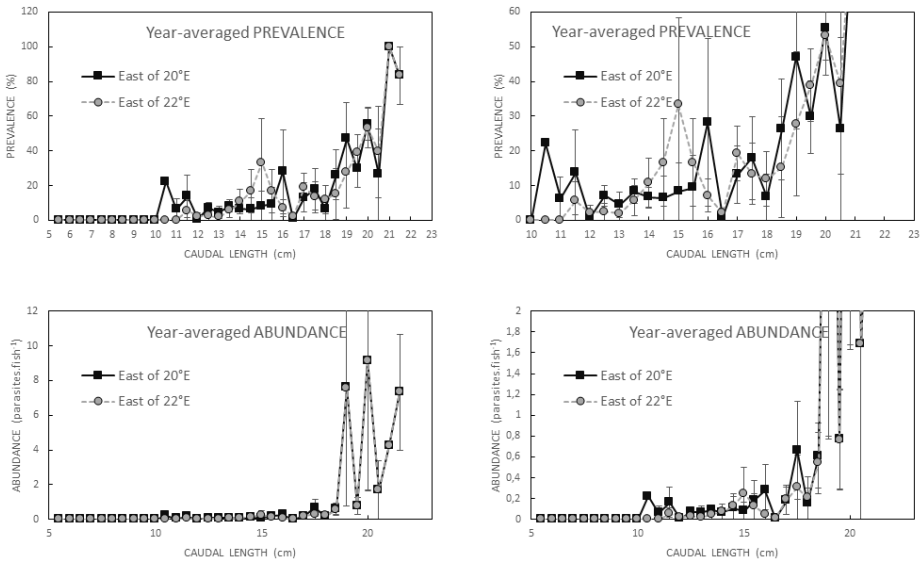

Figure 4: Year-averaged prevalence-at-length (upper panel) and year-averaged abundance-at-length (lower panel) for southern sardine sampled during the 2010 to 2014 Pelagic Biomass Surveys either defined as (i) fish east of 20°E or as (ii) fish east of 22°E. Standard error bars are shown with n being the number of years for which data for that length class were available.

Prevalence-at-length for western and southern (calculated using data from east of 22°E only) sardine are shown in Figure 5; prevalence in western fish is higher than in southern fish for all length classes except for fish of 14.5 and 15.0 cm, and for fish >21.0 cm.

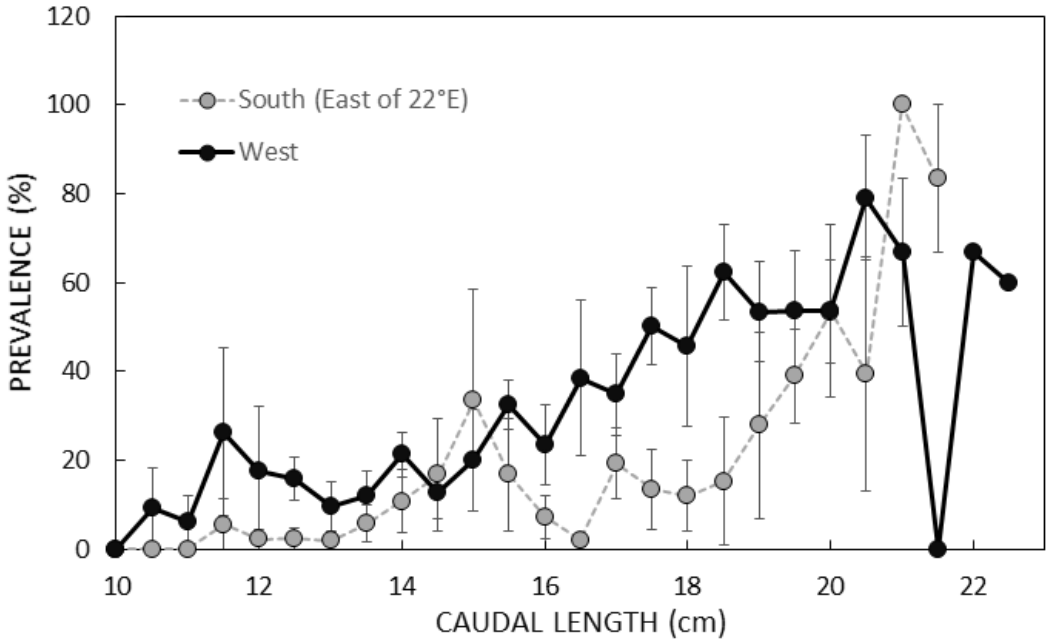

Figure 5: Year-averaged prevalence-at-length for western and southern (using samples east of 22°E only) sardine sampled during the 2010 to 2014 Pelagic Biomass Surveys (standard error bars are shown with n being the number of years for which data for that length class were available).