A description of parasite data (2010-2015) used to condition the sardine two mixing stock Operating Model

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Introduction

Significant spatial differences in infection of sardine around the South African coast by a digenean “tetracotyle” type metacercarian (TTM) parasite have supported the hypothesis of multiple sardine stocks off South Africa (van der Lingen et al., 2015; Weston et al., 2015), and panel reports from the 2013, 2014 and 2015 International Stock Assessment Workshops recommended that data on the presence of parasites by length should be included in sardine assessments (Smith et al., 2013; Dunn et al., 2014, 2015).

Data on parasite infection levels have been collected during Pelagic Biomass Surveys conducted each spring (late-October to early-December) from 2010 to 2015, and parasite-prevalence-at-length are presently used in assessments (de Moor et al., accepted). This paper documents that parasite data. Initial results on parasite-infection intensity-at-length patterns (i.e. infected fish only) for putative western and southern sardine stocks (or components) to the west and east of Cape Agulhas are also presented. These data may be useful as indicators of residence time of sardine in the parasite endemic area, hypothesized to be to the west of Cape Agulhas, only, and might be included in future assessments.

Data collection

Sardine for TTM parasite analysis were collected from midwater trawl catches taken during Pelagic Biomass Surveys conducted each spring (late-October to early-December) from 2010 to 2015 (Fig. 1). A total of 3 532 fish have been examined for the 6-year period, comprising 1 947 sardine from 65 samples and 1 585 from 59 samples to the west and east of Cape Agulhas, respectively (Table 1). Sampling has

not been balanced between years, with poorer coverage in 2012 and 2013 and particularly off the South Coast.

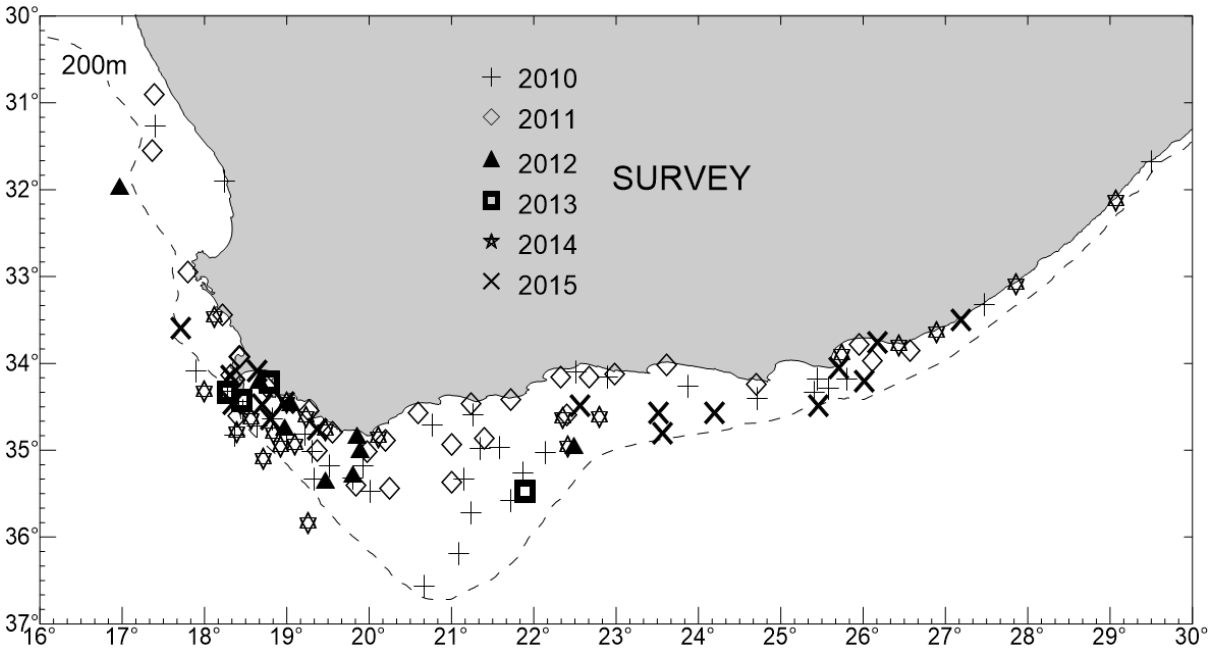

Figure 1: Sample locations of sardine collected for TTM parasite analysis during Pelagic Biomass Surveys by year, 2010-2015.

Table 1: Numbers of sardine examined for TTM parasites (and number of samples in brackets) collected during Pelagic Biomass Surveys by putative stock and in total, 2010-2015; numbers are also shown for southern stock samples collected to the east of 22°E only.

Year	Western	Southern all	Southern east of 22°E	Total all	Total W+S>22°E
2010	373 (16)	370 (22)	257 (11)	743 (38)	630 (27)
2011	542 (18)	431 (17)	254 (9)	973 (35)	796 (27)
2012	297 (8)	67 (1)	67 (1)	364 (9)	364 (9)
2013	175 (3)	103 (1)	0 (0)	278 (4)	175 (3)
2014	279 (12)	214 (9)	205 (8)	493 (21)	484 (20)
2015	281 (8)	400 (9)	400 (9)	681 (17)	681 (17)
Total	**1 947 (65)**	**1 585 (59)**	**1 183 (38)**	**3 532 (124)**	**3 130 (103)**

Sardine were processed in the laboratory and the catch date and location, caudal length (CL, to the nearest mm) and total number of parasites found in both eyes of

each fish were recorded. Fish were assigned to a 0.5cm CL class, and annual, coast-specific length frequency distributions and TTM parasite infection prevalence-at-length (prevalence per length class) were derived.

Results

Average prevalence-at-length curves (average of annual values where n = the number of years for which an observation for that length class was made) were then calculated separately for sardine to the west and east of Cape Agulhas. Following Dunn et al. (2015) South Coast data from the area between 20° and 22°E were not included in the base case sardine assessment model in order to exclude age-1 animals that may be from the west coast. Combined length frequency distributions and average (for the period 2010-2015) TTM parasite prevalence-at-length plots for sardine to the west and east of Cape Agulhas (excluding the area between 20° and 22°E) are shown in Figure 2 and annual length frequency distributions and prevalence-at-length plots are shown in de Moor et al. (accepted; MARAM/IWS/2016/Sardine/P1).

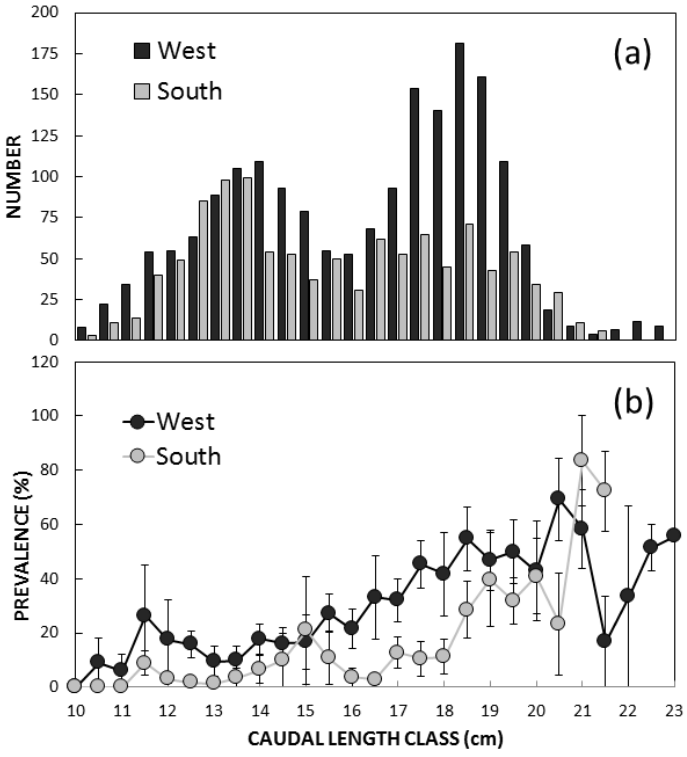

Figure 2: (a) Combined length frequency distributions (numbers of fish) and (b) average (across years) TTM parasite infection prevalence-at-length for sardine of 10-23 cm CL from the putative western stock (or component; West - samples collected to the west of Cape Agulhas) and Southern stock (or component; South - samples collected to the east of Cape Agulhas and excluding the area between 20° and 22°E), 2010-2015. Standard error bars where n = number of annual observations per length class are shown in (b).

Average prevalence of infection increases with length for sardine to both the west and the east of Cape Agulhas, but prevalence-at-length levels are generally higher in sardine from the West Coast than the South (>22°E) Coast for lengths of 10.0-18.5 cm CL. Prevalence-at-length averages are closer for larger fish although remain generally higher for fish from the West Coast but higher error around mean values for sardine >20cm CL and possibly due to smaller sample sizes at these lengths confounds interpretation.

Average prevalence-at-length plots for all sardine sampled to the east of Cape Agulhas and those sampled east of 22°E are compared in Figure 3. Smaller fish (10.5-13.5 cm CL) mostly show higher prevalence values when all data are used, as do fish of 16.0 cm, whereas fish of 14.5-15.5 cm CL show lower prevalence values when all data are used.

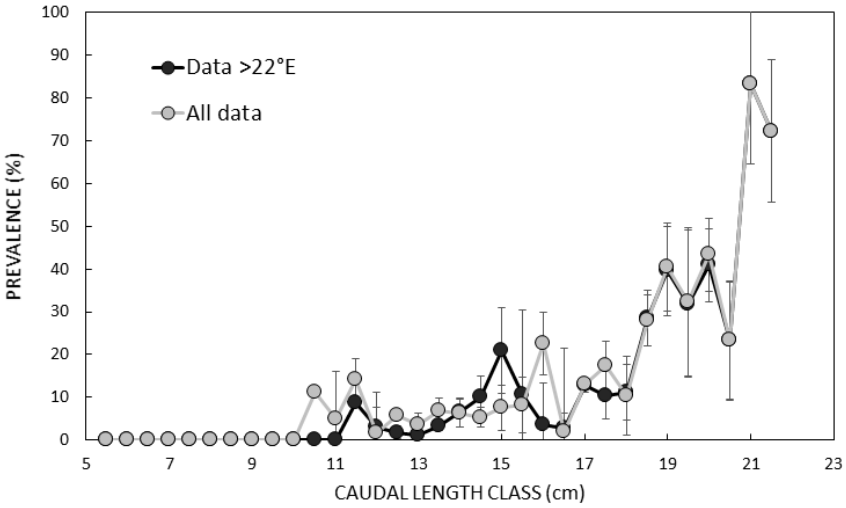

Figure 3: Comparison of average (across years) TTM parasite infection prevalence-at-length plots for sardine of 5-21.5 cm CL from the east of Cape Agulhas (All data) and from sardine collected to the east of 22°E (Data >22°E), 2010-2015. Standard error bars where n = number of annual observations per length class are shown for both.

Length frequency distributions, scatterplots of the number of parasites against fish caudal length and average (across years) TTM parasite infection intensity-at-length for sardine of 10-23 cm CL from the putative western and southern (all data east of Cape Agulhas) stocks (or components) for all infected fish sampled over the period 2010-2015, are shown in Figure 4. Over the size range 10.5-18.0 cm CL sardine from the west had consistently but not substantially higher average infection

intensities (1.7-3.5 parasites.infected fish^{-1}) than did those from the south (1.0-2.8 parasites.infected fish^{-1}). Average infection-at-length was relatively stable or increased only slightly with length for fish from both coasts of 10.5-17.0 cm CL, but increased in fish >17.0 cm CL. Average values for fish of >20cm CL have large standard errors and more samples of large fish are needed.

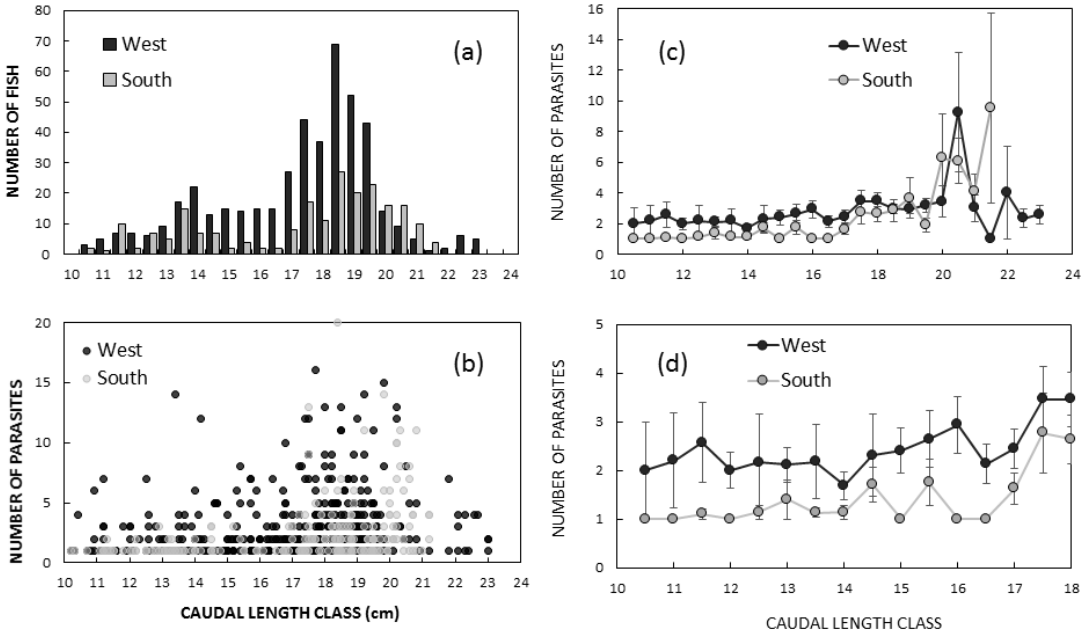

Figure 4: (a) Combined length frequency distributions (numbers of fish), (b) scatterplots of parasite number against fish size (note that data where parasite number exceeds 20 (24-48 parasites.infected fish^{-1}) are not shown for six fish, 2 from the west and 4 from the south), (c) average (across years) TTM parasite infection-at-length for sardine of 10-23 cm CL from the putative western stock (or component; West - samples collected to the west of Cape Agulhas) and Southern stock (or component; South - samples collected to the east of Cape Agulhas including the area between 20° and 22°E), and (d) average infection-at-length for sardine of 10.5-18.0 cm CL, 2010-2015. Standard error bars where n = number of annual observations per length class are shown in (c) and (d).

References

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