

**SUMMARY OF ISSUES PERTINENT TO A DECISION ON POSSIBLE  
ADJUSTMENT OF THE MAXIMUM DIRECTED SARDINE CATCH ALLOWANCE  
WEST OF AGULHAS FOR 2016**

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**Note:** Percentage figures given relate to the maximum proportion of the current directed sardine TAC to be taken west of Agulhas, which is 45.6% (corresponding to the average biomass proportion WoCA observed during the past two November surveys [=35.6%] plus the 10% leeway allowance) in terms of the present “gentlemen’s agreement”, corresponding to 29 114 tons.

- 1) **Hydrodynamic model** – Rather work with proportion of biomass effectively contributing to recruitment in the west, than with the proportion of biomass west of Agulhas (all computations based on November survey results)

35.6% → 52.8%      (49% increase based on survey data)

Note that the current maximum allowance for the West Coast is based on a 10% increase to this 35.6% figure.

2) **10% allowance on proportion of biomass west of Agulhas**

- i) 10% considered to have been allowed primarily because original testing of the rule used in the “Gentleman’s agreement” indicated the rule resulted in proportions of catch in the west lower than actual proportions historically taken by the industry, and the 10% allowed for some flexibility in case the rule was ‘a step too far’ for the industry to attain during the short term ‘warm-up period’ – it is now considered unnecessary to adjust (i.e add 10%) given that the change in 1) reduces this past discrepancy

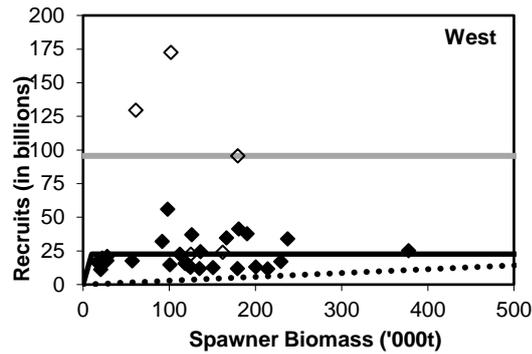
52.8% → 52.8%      (no further increase in proportional west allocation)

- ii) 10% considered to have been allowed primarily because of survey estimation uncertainty – then this would be considered appropriate to apply to change under 1)

52.8% → 62.8%

3) **Current west spawning biomass is very low**

- i)  $B_{sp\text{west}}(2015) = 72\ 000\text{t}$  with  $K_{sp} = 706\ 000\text{t}$  so that  $B_{sp}/K_{sp} = 0.10$
- ii) The new hockey-stick S/R relationship indicates that unlike before, recruitment starts to decline only for  $B_{sp\text{west}}$  below the rather low level of 7 000t



iii) Nevertheless the values for the lowest three  $B_{sp}$  west points in Fig 3 are all below the asymptotic level.

- 4) **The 2016 recruitment estimate is poor** (possibly a consequence of the low November 2015 biomass estimate in the west).

This recruitment estimate of 0.811 billion fish is the lowest measured since 1988 and far below the long-term median recruitment estimate of 7.38 billion.

- 5) **ER/M and F/M for the west coast sardine stock appears low compared to values evident for other sardine stocks when showing an increasing trend**

- i) ER/M is 40% lower and F/M 38% lower than the median for such other stocks.
- ii) Projected ERs for 2016 for sardine on the west coast are higher than ERs corresponding to past increasing west stock biomass, indicating a lower chance of increase during 2016 given the projected ERs.

- 6) **The updated risk analysis**

ER values reported in the table consider directed sardine Jan-Dec catch only.

- 7) **The June 2016 survey provides a basis to update the estimate of 1+ biomass in Nov 2015 (biomass-based model)**

Biomass in thousand tons of 131.7 -> 147 (12% west allocation proportional increase; ER values reported based on Jan+ catches only)

- 8) **The June 2016 survey provides a basis to update the estimate of 1+ biomass in Nov 2015 (age-based projection model)**

Biomass in thousand tons of 140.1 -> 162.1 (23% west allocation proportional increase); ER values reported based on both Nov-Oct and Jan-Dec catches

- 9) **Projection from Nov 2015 to Nov 2016 (age-based projection model)**

33 500t caught west of Cape Agulhas will result in an exploitation rate of over 0.38, substantially higher than that of the recent past and higher than those shown by point 5) above; ER values reported based on both Nov-Oct and Jan-Dec catches

#### 10) Potential financial losses to industry

- i) Some 10 000 tons of directed TAC not caught if available on west but not on south coast  
Loss R 190 million
- ii) Some 10 000 tons of directed TAC caught on south coast instead of west coast and trucked to west coast factories  
Loss R 11 million

#### A) Pertinent further information still to come

- i) Fits to stock recruit curves (*later this year*)  
Do these indicate any preference between models which take account of spawners east of Agulhas making more or less contribution to recruitment in the west?
- ii) Update on hydrodynamics model (*next year*)  
Will enable improved computations of effect 1) above

#### B) General/Longer Term

- There is clear evidence that there are at least two “biological” (“demographically distinct”) sardine stocks off South Africa. However the key point at issue here concerns recruitment from the westernmost of such stocks, for which the core question is to what extent spawners east of Agulhas contribute to recruitment on the west coast.
- Views on this are inferentially based at this time, informed particularly by the hydrodynamics model.
- Reservations exist: evolutionary effects might see egg and larval behaviour more geared to achieve movement west than suggested by the inert particle assumption of the hydrodynamics model; the poor recruitment evident on the South Coast (including from westernmost stock animals on that coast) is unexpected, raising questions.
- Alternatively, the poor productivity of fish on the south coast (irrespective of their origin) might be expected because of the lower primary and secondary productivity in that area and potentially higher predation on early life stages by other small pelagic and demersal species. Additionally, extensive HAB outbreaks on the south coast in recent years and their apparent negative impact on sardine condition, and hence reproductive output, may also be a contributing factor.

- The only possibility for direct confirmation of current inferences would be via parent-offspring close-kin mark-recapture genetics, but costs would be in the tens of millions of Rands for genotyping the sample sizes required.
- Is there movement across the Agulhas “boundary” during the year sufficient to invalidate decisions based on the distribution indicated by the November survey? An initial examination based on the distribution of 1+ sardine found during the recruitment survey did not support this contention. A full examination would however require extensive surveying.
- The average biomass west of Cape Agulhas over the most recent 5 years is ~70% of what it was in the years (91-94) prior to the rapid growth in the sardine population that led to peak years of biomass in the early 2000s. The 1991-94 biomass is the risk level below which we did not want to drop under a one-stock scenario. Considering the whole population, the average biomass over the most recent 5 years is similar to this risk level and the biomass in November 2015 was just 28% of this risk level (at the joint posterior mode)