

## An initial proposal for future island closures based on the closure experiment results

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### Summary

This document motivates initial proposals for future island closures based on the results to date for estimates of the impact of closure parameter  $\delta$  from the island closure experiment using the 2016 Panel algorithm. A pragmatic approach is adopted, given difficulties arising from outstanding matters of interpretation which require further discussion. In essence, the initial recommendation is to open Dassen island, to increase the relative frequency of closures at Robben island, and to maintain the current experimental closure schedule at St Croix and Bird islands with a possible increase in closure frequency at the former and decrease at the latter.

### On the basis for a proposal

In principle, given the agreed decision criteria offered by the Panel, the basis to interpret the results from the application of the 2016 Panel algorithm to the island closure experiment results should be straightforward: in simple terms, check for point estimates of the closure impact parameter  $\delta$  amongst the response variables (only those which are able to be linked directly to penguin demographics) that are less than -0.1.

Only two variables (see also Figure 1) meet this criterion – chick survival and fledging success (though these are available for Robben and Dassen islands only). Dassen meets the criterion for chick survival and Robben for fledging success (and is close to doing so for chick survival). However, as discussed in FISHERIES/2020/JAN/SWG-PEL/96, this inference is confounded by two other aspects related to these data: a reverse result for  $\delta$  for fledging success at Dassen which is (in simple terms) in the reverse direction and near statistically significantly different at the 10% level from that for the chick survival rate, and certain unexpected features of the survival data analyses which indicate a need for these first to be more closely examined.

Considering the results for Robben and Dassen in Figure 1 as a whole, two features are evident:

- a) the generally wide confidence intervals; but nevertheless
- b) a clear pattern of estimates of a positive impact (if any) from closure being for the most part notably less for Dassen than for Robben island.

Addressing the situation for the Eastern Cape colonies – St Croix and Bird islands – is the more difficult because of a fewer number of response variables. Results are available for chick condition and foraging data only, and are subject to various reservations:

- a) the estimates based on chick condition are very imprecise;
- b) the three different measures (length, duration and max length) for foraging data are not independent;
- c) for max length, if the assumption of proportionality of the extent of change in this response variable to any related change in penguin population growth rate is met, the  $< -0.1$  criterion for a meaningful impact is well met for St Croix; but maximum length is of questionable reliability because it does not, by its nature, provide a robust statistic; and
- d) while viewed overall these foraging data statistics suggest that a positive effect from closure is more likely than a negative one, the reverse holds for Robben and Dassen islands; this raises

the more general question of whether these particular response variables do actually provide a reliable indication of the direction, let alone the magnitude, of any impact.

### Initial proposals

The difficulties in interpretation noted above make it, as yet, impossible to apply some single reliable quantitative overall criterion as the basis for an initial proposal. Hence a pragmatic approach is suggested at this stage.

1) *Proposals are limited to the four islands involved in the experiment*

Results across the islands in the experiment are too variable from island to island to allow inferences to be drawn that could be considered to apply with reasonable reliability to all other islands.

2) *Monitoring data should continue to be collected at all four islands*

The proposals that follow are not such that would preclude continued improvements of estimates of  $\delta$ .

3) *Dassen island should be open*

Figure 1, together with the points made above, indicate that there is hardly any evidence for a meaningful impact of closure assisting penguin reproductive success at this island, and consequently continuation of the socio-economic losses to the industry that would arise from further closures there cannot be justified. This proposal should be linked to consideration of the proposal to bring the “16 mile beach” closure in this region to an end.

4) *The relative proportion of closed to open years at Robben island should be increased*

The weight of evidence at Robben island is towards there being some positive benefits for penguins of closures (though the associated magnitudes of those benefits in terms of penguin population growth rate are not very large). The experiment should though still continue to try to resolve existing uncertainties further, but with an increase the frequency of closures in the light of results to date. An important consideration in this regard is that the population model analysis of Robinson *et al.* (2015)<sup>1</sup>, which indicated no relationship between penguin reproductive success and anchovy recruitment at Robben island; this effectively argues against the case for closure there.

5) *The current experiment at St Croix island should continue unchanged, but with a possible increase in the proportion of closed to open years*

The foraging-based results for St Croix island argue for an increase in the closure frequency there, but given the relatively poor overall reliability of this response variable (see reasons given above), and the poor precision of the estimate from the chick condition data, such an increase has to be weighed against the socio-economic implications for the fishery.

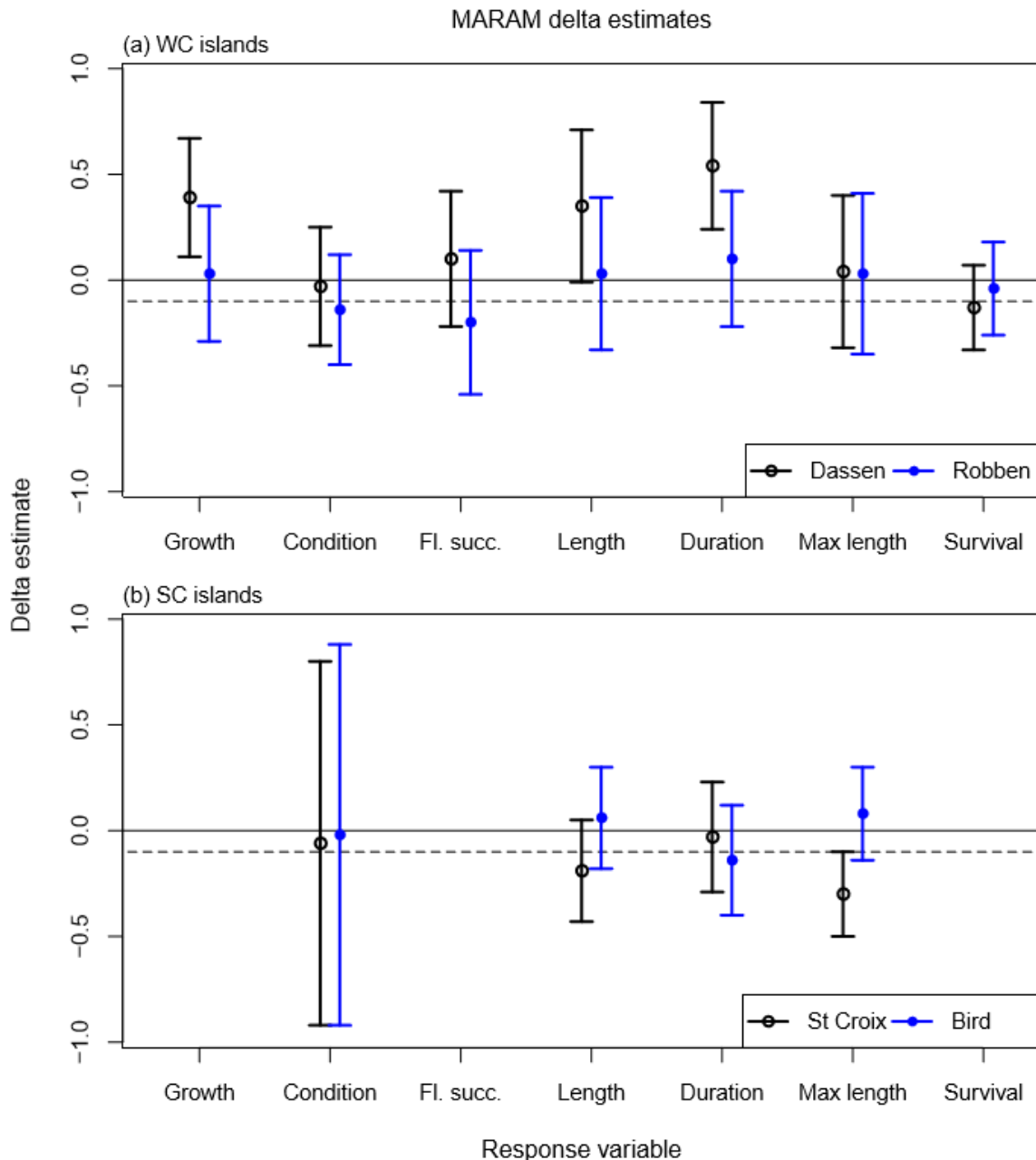
6) *The current experiment at Bird island should continue unchanged, but with a possible decrease in the proportion of closed to open years*

Any evidence for an impact of fishing at Bird island is notably weaker than at St Croix. For the same reasons as given there, consideration should be given to a decrease in the closure frequency there.

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<sup>1</sup> ICES JMS 72 (2015) 1822-1833

- 7) The three-years on, three-years off experimental closure pattern should be reviewed. This constituted no more than a compromise as part of a package agreed at the 2010 Panel meeting to get the experiment underway. The biological mechanisms and motivation for multiple-year aspect have never been laid out clearly. Unless, at minimum, analyses of the existing data show empirical evidence supporting that multi-year closures result in greater beneficial impacts, this should be dropped as a pattern requirement.



**Figure 1:** Zeh plots of the  $\delta$  estimates and rough 95% confidence intervals are shown for (a) Robben and Dassen islands (from FISHERIES/2020/JAN/SWG-PEL/09rev) and for (b) St Croix and Bird islands (from MARAM/IWS/2019/PENG/P2 for the foraging data and from FISHERIES/2019/NOV/SWG-PEL/33 for the chick condition data), for a range of response variables for the aggregated data approach applied in MARAM analyses. This Figure has been kindly provided by A. Ross-Gillespie.