IN THE HIGH COURT OF SOUTH AFRICA
GAUTENG DIVISION, PRETORIA

Case No: 2024-029857

In the matter between:

BIRDLIFE SOUTH AFRICA	First Applicant
SOUTH AFRICAN FOUNDATION FOR THE CONSERVATION OF COASTAL BIRDS	Second Applicant
and	
THE MINISTER OF FORESTRY, FISHERIES AND THE ENVIRONMENT	First Respondent
THE DEPUTY DIRECTOR-GENERAL: FISHERIES MANAGEMENT, DEPARTMENT OF FORESTRY, FISHERIES AND THE ENVIRONMENT	Second Respondent
THE DEPUTY DIRECTOR-GENERAL: OCEANS AND COASTS, DEPARTMENT OF FORESTRY, FISHERIES AND THE ENVIRONMENT	Third Respondent
THE SOUTH AFRICAN PELAGIC FISHING INDUSTRY ASSOCIATION	Fourth Respondent
EASTERN CAPE PELAGIC ASSOCIATION	Fifth Respondent

FOURTH AND FIFTH RESPONDENTS' EXPERT AFFIDAVIT OF DR MICHAEL OLAF BERGH

I, the undersigned

DR MICHAEL OLAF BERGH

do hereby make oath and state that:

1. I am employed as the Chief Technical Officer at OLSPS Marine. We specialise in the development of quantitative fisheries management tools.

2. The facts stated in this affidavit are true and correct and fall within my personal knowledge unless otherwise apparent from the context.

3. Where convenient, I use terms as defined in the Industry Respondents' answering affidavit.

INTRODUCTION

4. OLSPS Marine has, since 2017, been providing on-going services to the South African Pelagic Fishing Industry Association (**"SAPFIA"**), dealing with all scientific aspects of small pelagic resources in South Africa, including measures to conserve the African penguin.

5. I assisted and represented SAPFIA in the deliberations of the International Review Panel regarding Fishing Closures adjacent to South Africa's African penguin breeding colonies and declines in penguin population (as well as during

MGB

the Consultative Advisory Forum and Extended Task Team deliberations before that).

6. This expert affidavit accompanies the Industry Respondents' answering affidavit.

7. I first set out my qualifications and relevant experience.

8. I then provide an overall summary.

9. Thereafter, I:-

    9.1 give estimates of both the benefits to penguins and the economic costs of island closures;

    9.2 respond to the expert affidavit of Weideman ("AM5") ("Weideman") under the following headings:

        9.3.1 general methodological aspects;

        9.3.2 application of Weideman's trade-off mechanism to specific islands;

        9..3.3 comment on the Applicants' proposed closures, per island, as set out in the founding affidavit;

        9.3.4 island closures where there are already Marine Protected Areas in place.

MQ3

QUALIFICATIONS AND RELEVANT EXPERIENCE

10. My qualifications and relevant experience are set out in my curriculum vitae, attached marked "**MOB 1**". I have a Ph.D. from the University of Cape Town (Department of Applied Mathematics) and decades of experience in quantitative marine resource assessment analyses. I attend all scientific meetings convened by the South African government to develop management advice for South African small pelagic and demersal stocks. I lead a technical team which is involved in the stock assessments of the main target species, and in the provision of advice regarding the development of management strategies for these species. I advise and liaise with the South African fishing industry through their associations and develop alternative harvesting strategies and approaches where appropriate in consultation with these bodies. I am also involved in various aspects of the inter-relationship between small pelagic stocks and seabird populations, with a particular focus on the African penguin. Together with my team, I have authored numerous technical submissions to scientific committee meetings.

SUMMARY

11. This affidavit comments on the scientific basis for the Applicants' proposed closures as outlined in the founding affidavit and Weideman. It also provides estimates of the differential in **costs to the pelagic fishing industry** and the **benefits to penguins** between the Interim Closures and the Applicants' proposed closures.

12. The main theoretical elements that Weideman offers in support of the Applicants' proposed closures are:

12.1 The methods applied to delineate the mIBA-ARS closure options.

12.2 The 'penguin utility score' metric used to quantify the benefits of closures to the penguin population.

12.3 The methods used to estimate the costs to the industry, the economy and job numbers of different closure options.

12.4 A specific interpretation of what the Panel purportedly recommended about the mIBA-ARS method, the benefit to penguins, the way to use the OBM results to assess costs, and how to carry out trade-offs to determine the optimal closure area.

12.5 The relative scaling assumed for costs to industry and benefits to penguins.

12.6 The specific set of closure options selected for weighing-up costs and benefits, and for providing the basis for a trade-off relationship between costs and benefits.

12.7 The appropriate way to draw the trade-off curve describing the trade-off relationship between costs and benefits.

13. I have very serious difficulties with the Applicants' approach to each of those theoretical elements. The Applicants' underlying rationales and methods are subjective and incomplete, such that they would not pass any reasonably objective and independent scientific assessment. Specifically:

13.1 No cogent description of the methods used to delineate the UD90 and mIBA-ARS closure area have been provided by Weideman and her supporting documents, and no clear demonstration of the reliability of the methods adopted to determine the value of the key smoothing parameter h has been provided. No responses have been provided to technical documents highlighting potential problems with the use of h (a critical smoothing parameter used in the delineation of the UD90 and mIBA-ARS areas) values that are too large, and the potential excessive size of the resultant closure area. Access to the relevant penguin telemetry data and computer code has been denied by the Applicants, making it impossible to verify the reliability of the methods and the final results. The dive data validation of the mIBA-ARS areas recommended by Panel prior to the adoption of any mIBA-ARS results has not been made available to the scientific processes held under the auspices of DFFE or any other forum that I am aware of.

13.2 The problems raised above with the delineation mIBA-ARS areas undermines the acceptability of the 'penguin utility score' metric used to quantify the benefits of closures to the penguin population, since this is just a ratio of a penguin utility index for mIBA-ARS's calculated at two different penguin utilisation levels, one at ~50% (I am uncertain as to the exact value used) and another at 90%.

13.3 The Panel recommended that the OBM results could be used in a relative sense, but this then suggests that the relative scale of costs at different islands should be related in the same relative scales as are estimated by the OBM. Instead, Weideman assigns a cost of 1 to UD90 for all islands regardless of the large variation in costs across these islands. This is arbitrary and/or subjective and it is clear that conformity with the relative scaling of costs across different islands would have resulted in materially different optimal closed areas.

13.4 The Panel expressed a clear preference for areas delineated according to the mIBA-ARS method, but must have implied selection from a suite of such mIBA-ARS options for each island. The Applicants avail themselves of only one mIBA-ARS option (apart from UD90 which is not a possible optimal closed area) out of a set which include closure options determined by very different approaches. Thus, a final optimal closed area selected by this method might be a non-mIBA-ARS closure option, in conflict therefore with the Panel's recommendation and preference. The Applicants also claim that the Panel set out a clear specification of how to carry out the cost/benefit trade-offs. In reality, and from a review of their wording, it is clear that the Panel was not prescriptive about any of the details and only made some suggestions about a possible approach.

13.5 The shape of the trade-off relationship between costs and benefits is a key determinant of the final optimal closure area. Weideman does not appear to have applied recognisable statistical methods to draw these curves. From inspection of graphs presented in Weideman, her trade-off curves contain unexplained features which are arbitrary or subjective, such that it is very likely that another independent analyst would arrive at a different curve and hence a different optimal closed area.

13.6 In addition, in some cases the Applicants' proposed closures are not consistent with the trade-off methodology described and proposed in Weideman. An important example of this is that, although for Dassen Island Figure 5 of Weideman shows that, depending on species, the CAF or DFFE closure options are closer to the optimal closed area than the Applicants' proposed mIBA-ARS closure option, she (and hence the Applicants) recommend the mIBA-ARS closure.

13.7 A key theme in the Applicants' case is that the benefits conferred to penguins by the Interim Closures is "meaningless" or negligible. I estimate the following costs and penguin benefit differentials between the Interim Closures and the Applicants' proposed closures:

14. **Direct costs to the pelagic fishing industry:** The direct cost to the industry of the Applicants' proposed closures is **114% greater** (i.e. more than double) than those of the Interim Closures (direct costs to the industry of Interim Closures: close to ZAR 89,000,000 per annum; Applicants' proposed closures: close to ZAR 190,000,000 per annum).

15. **Benefits to penguins:** I estimate that the benefit to penguins of the Interim Closures is 29 to 62 breeding pairs per annum, and for the Applicants' proposed closures 50 to 106 breeding pairs per annum (which is less than double). While a number of assumptions must be made to estimate these benefits to penguins, the broad indication that the benefits to penguins from the Interim Closures are

substantial **in relation to those from the Applicants' proposed island closures** is inescapable.

16. For the reasons given in the Industry Respondents' answering affidavit, and in my response to Weideman, it is not possible at this stage for a scientifically defensible trade-off decision consistent with the recommendations in the Panel report to be made.

ESTIMATES OF BENEFITS TO PENGUINS AND ECONOMIC COSTS OF ISLAND CLOSURES

17. Mike Copeland of SAPFIA and I were the authors of the SAPFIA comments on the Panel report which were submitted to the DFFE in November last year.[1] Appendix A to the SAPFIA comments[2] summarised SAPFIA's estimates of the cost of island closures to the fishing industry and to the economy, subject to the specified caveats and limitations and the need for further research to be undertaken.

18. In the light of this court application, I have undertaken further analysis (in so far as is possible at this stage without all the research and tasks in the Panel report having been completed) of benefits to penguins and the economic costs, both to the pelagic fishing industry and to the broader economy, of island closures. This further analysis is set out below.

[1] "AM 76" record pp. 868 – 887.

[2] Record pp. 878 – 882.

58411999-2
Sutgenty

MCB

Benefits to penguins from island closures

19. Appendix A, section 6.1 of the SAPFIA comments gave an analysis of benefit to penguins from island closures.[3]

20. Based on the results of the ICE at Dassen and Robben Islands, the Panel report noted that the benefit to penguins of island closures is between 0.71% and 1.51% of the population. It is of importance to appreciate that these estimates of between 0.71% and 1.51% are based only on penguin benefits estimated for Dassen and Robben Islands where fishing is predominantly for anchovy. In assessing the benefits to penguins at the other four sites (Stony Point, Dyer Island, St Croix Island, Bird Island) where directed sardine is a very important and frequently the dominant species caught, extensive and uncertain extrapolations must be made. Thus, the amount of information available to support these estimates of benefits to penguins at all six breeding sites is very limited.

21. The Panel's estimates of benefits to penguins of between 0.71% and 1.51% of the population omitted all foraging data. These foraging data when included in the analyses results in a lesser benefit than the range of 0.71% and 1.51%, and, also, they suggest that the effect of island closures is in the opposite direction in some cases, i.e. a disbenefit from closures for penguins.

[3] "AM 76" record p.878.

22. Note that benefits 'to penguins' expressed as 'breeding pairs per annum' are the number of penguins that, **save for the implementation of island closures**, would otherwise have died.

23. I have now conducted further analyses which are more fine-grained, with estimates by island[4].

24. Based on:

- Penguin counts at breeding sites from Makhado et al (2021),[5]
- Assigning no benefit to penguins at Bird Island Algoa Bay (because there is very little fishing there (see the founding affidavit paragraph 179),

the range of benefits to the penguin population is as given in Table 1 below, for the comparison of the ICE 20 km closures at all six breeding sites listed, with no closures at these six breeding sites.

4 SAPFIA comments , Appendix A, provides a high level estimate of the benefits of 36 to 76 breeding pairs. These were produced by applying the Panel's 0.71% or 1.51% to a rough population size of 10000 breeding pairs, and then dividing by half given that the ICE was in effect half of the time over the period 2008 to 2021. The value of 36 to 76 is therefore the additional benefit to be achieved in comparison to the period of the ICE. Here, a more fine scale analysis is carried out using (i) the best estimates of each of the six colony sizes, (ii) applying 0.71% or 1.5% to each of these quanta except for Bird Island where no benefit is assumed, and then summing the benefits across all six sites. The comparison (i.e. the additional 50 to 106 breeding pairs) is now between having all the ICE 20 km closures in effect, vs no closures in effect.

5 Makhado, A.B., Masotla, M.J., Dyer, B.M., Upfold L., and Crawford, R.J.M. 2021. African penguins face extinction. Recent trends in numbers breeding in South AFrica. Department of Forestry, Fisheries and Environment, Cape Town 8000, South Africa FISHERIES/2021/JUL/SWG-PEL/45.

Table 1. The number of additional breeding pairs per annum in the event that closures are implemented at all six breeding sites listed, compared to no closures at these breeding sites.

Not relative to ICE					
	Number of breeding pairs in 2021 (Makhado et al, 2021)	Panel Lower Estimate	Panel Upper Estimates	# additional breeding pairs p.a. for Panel lower estimate.	# additional breeding pairs p.a. for Panel upper estimate.
Dassen Island	1806	0.71	1.51	12.82	27.27
Robben Island	1007	0.71	1.51	7.15	15.21
Stoney Point	1623	0.71	1.51	11.52	24.51
Dyer Island	1069	0.71	1.51	7.59	16.14
St Croix Island	1543	0.71	1.51	10.96	23.30
Bird Island Algoa Bay	1853	0.00	0.00	0.00	0.00
Additional Breeding Pairs				50.0	106.4

25. For this comparison the benefits are therefore **50** to **106 pairs per annum**.

26. However, the ICE experiment was in effect between 2008 and 2021 and this has involved some ICE 20 km closures according to the schedule in Table 2.

27. This shows that three out of five sites would have had the benefit of closure from 2011 to 2021. Therefore, if one were to express the benefit to the population of closures at the five sites above (six to start with, but then excluding Bird Island, Algoa Bay), but assigning only 50% of the benefit to Dassen, Robben and St Croix Islands, then the additional benefit relative to the trend over the period of ICE would be 35 to 74 breeding pairs. This is summarised in Table 3 below.

Table 2. The schedule of island closures implemented during the ICE – the Island Closure Experiment (x = closed; for 2021, seasonal closures were applied whereby Dassen Island was closed in the first and fourth quarters (x—x) and St Croix island was closed in the second and third quarters (-xx-). .

Island	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
	Feasibility study							Island Closure Experiment						
Dassen	x	x					x	x	x				x	x--x
Robben				x	x	x				x	x	x		
St Croix		x	x	x				x	x	x				-XX-
Bird					x	x	x				x	x	x	

Table 3. The number of additional breeding pairs per annum in the event that closures are implemented at all six breeding sites listed, compared to the situation where Dassen, Robben and St Croix Islands are closed 50% of the time as was the case in the ICE experimental period.

Relative to ICE					
	Number of breeding pairs in 2021 (Makhado et al, 2021)	Panel Lower Estimate	Panel Upper Estimates	# additional breeding pairs p.a. for Panel lower estimate.	# additional breeding pairs p.a. for Panel upper estimate.
Dassen Island	1806	0.36	0.76	6.41	13.64
Robben Island	1007	0.36	0.76	3.57	7.60
Stoney Point	1623	0.71	1.51	11.52	24.51
Dyer Island	1069	0.71	1.51	7.59	16.14
St Croix Island	1543	0.36	0.76	5.48	11.65
Bird Island Algoa Bay	1853	0.00	0.00	0.00	0.00
Additional Breeding Pairs				34.6	73.5

28. For this comparison the benefits are therefore between **35** and **74 breeding pairs per annum**.

29. **Benefits due to Interim Closures:** It is not possible at this stage to reliably estimate the benefits to penguins derived from closure options that differ from the ICE 20 km closures used during the ICE (Island Closure Experiment). The best that is possible is to calculate these benefits using the following two metrics, (i) the areal extent of these closures in relation to the ICE 20 km closures, or (ii) the penguin utility score[6] of these closures in relation to that of the ICE 20 km closures. If we assume (i), i.e. that the benefits to penguins is pro rata to the areal extent of the Interim Closures, then we get reduced benefits to penguins of between either 25 and 54 pairs per annum if we make no provision for the outer area at Dyer Island i.t.o. benefits to penguins (~ 50% of the ICE 20 km closures), or 29 and 62 pairs per annum (~ 60% of the benefits from the ICE 20 km closures) if we assign 42% of the outer area at Dyer Island as closed and hence

[6] Weideman defines the penguin utility index in paragraph 21.1 of Weideman as "a measure of the estimated number of individual penguins that regularly forage in a particular cell on a grid which we overlay onto penguin foraging data. One cell measures 0.5 km2 in extent and the grid system allows us to more accurately identify the use of space by African Penguins around a particular colony". My understanding is that the penguin utility **score** is the penguin utility index for a candidate closed area divided by the penguin utility index for the area denoted as 'UD90'.

benefitting penguins. 42% is the catch % made by vessels larger than 26 m in the area between Cape Point and Cape Agulhas (based on pelagic catch data for the period 2011 to 2021). These calculations are summarised below in Table 4.

Table 4. Comparing the benefits from the ICE 20 km closures with those for the Interim Closures, pro rata to area, and where the top panel of the table ignores benefits from the Outer Area at Dyer Island and the lower panel assigns 42% of the Outer Area as equivalent to complete closure.

Not relative to ICE, no provision for benefit from Dyer Outer Area								
	Number of breeding pairs in 2021 (Makhado et al, 2021)	Panel Lower Estimate	Panel Upper Estimates	# additional breeding pairs p.a. for Panel lower estimate.	# additional breeding pairs p.a. for Panel upper estimate.	Interim Area as % of ICE 20 km	# additional breeding pairs p.a. for Panel lower estimate.	# additional breeding pairs p.a. for Panel upper estimate.
Dassen Island	1806	0.71	1.51	12.82	27.27	0.8803	11.29	24.01
Robben Island	1007	0.71	1.51	7.15	15.21	0.2636	1.88	4.01
Stoney Point	1625	0.71	1.51	11.52	24.51	0.0961	1.11	2.85
Dyer Island	1069	0.71	1.51	7.59	18.14	0.2949	2.24	4.76
St Croix Island	1543	0.71	1.51	10.96	23.30	0.7989	8.75	18.61
Bird Island Algoa Bay	1853	0.00	0.00	0.00	0.00	0.8215	0.00	0.00
Additional Breeding Pairs				50.0	106.4		25	54
Not relative to ICE, 42% provision for benefit from Dyer Outer Area ito km^2								
	Number of breeding pairs in 2021 (Makhado et al, 2021)	Panel Lower Estimate	Panel Upper Estimates	# additional breeding pairs p.a. for Panel lower estimate.	# additional breeding pairs p.a. for Panel upper estimate.	Interim Area as % of ICE 20 km	# additional breeding pairs p.a. for Panel lower estimate.	# additional breeding pairs p.a. for Panel upper estimate.
Dassen Island	1806	0.71	1.51	12.82	27.27	0.8803	11.29	24.01
Robben Island	1007	0.71	1.51	7.15	15.21	0.2636	1.88	4.01
Stoney Point	1625	0.71	1.51	11.52	24.51	0.0961	1.11	2.85
Dyer Island	1069	0.71	1.51	7.59	18.14	0.7093	6.07	12.90
St Croix Island	1543	0.71	1.51	10.96	23.30	0.7989	8.75	18.61
Bird Island Algoa Bay	1859	0.00	0.00	0.00	0.00	0.8215	0.00	0.00
Additional Breeding Pairs				50.0	106.4		29	62

30. **Benefits due to the Applicants' proposed closures:** As for the Interim Closures, it is not possible at this stage to reliably estimate the benefits to penguins derived from other closure options that were not part of the ICE. The best that is possible is to calculate these benefits pro rata to two possible metrics, (i) the areal extent of these closures in relation to the ICE 20 km closures, or (ii) the penguin utility score of these closures in relation to that of the ICE 20 km closures. In Weideman, Figures 1, 2,5,7,9,11 and 13 plot the penguin utility scores for the ICE 20 km closures and for the Applicants' proposed island closures. These can be roughly read from the graphs, making the application of method (ii) possible albeit only roughly given that the actual values underlying

the graphs were not available to me. The calculations are summarised in the Table 5 below and they show that the overall benefits from the Applicants' proposed island closures and those for the ICE 20 km closures **are virtually identical**.

Table 5. Comparing the benefits to penguins from the ICE 20 km closures with those from the Applicants' proposed island closures.

		% Benefit		Benefit i.t.o. breeding pairs p.a. from ICE 20 km closures		Penguin utility scores from Weideman Figures		Ratio of penguin utility scores	Benefit from applicants proposed island closures	
	Breeding pairs 2021	Panel Low	Panel High	Panel Low	Panel High	X: ICE 20 km	Y: Applicants proposed island closures	Y/X	Panel Low	Panel High
Dassen	1806	0.71	1.51	12.82	27.27	0.90	0.82	0.91	11.68	24.85
Robben	1007	0.71	1.51	7.15	15.21	0.95	0.82	0.86	6.17	13.12
Stony	1623	0.71	1.51	11.52	24.51	0.93	0.88	0.95	10.90	23.19
Dyer	1069	0.71	1.51	7.59	16.14	0.70	0.76	1.09	8.24	17.53
St Croix	1543	0.71	1.51	10.96	23.30	0.63	0.75	1.19	13.04	27.74
Bird	1853	0.00	0.00	0.00	0.00	0.90	0.90	1.00	0.00	0.00
				50.0408	106.4248			Total	50.0404	106.4239

31. To summarise, I estimate that the benefits to the penguin population per annum from the ICE 20 km closures and using the ICE (Island Closure Experiment) estimates recommended by the Panel are between 50 and 106 breeding pairs per annum. Then, if one uses only the portion of the Interim Closure areas that overlap with the ICE 20 km closures, assumes that benefits are pro rata to area, and one assigns 42% of the Outer area at Dyer Island as closed in view of the resultant reduced catches there, the benefits to penguins from the Interim Closures are between 29 and 62 breeding pairs per annum. Finally, the benefits to penguins from the Applicants' proposed closures are related to those of the ICE 20 km closure using the respective penguin utility scores of the two sets of closures, and this analysis shows no difference in the overall benefit at the two sets of closure, viz. both are estimated to achieve a benefit of between 50 and 106 breeding pairs per annum.

<u>The economic costs to the pelagic fishing industry and to the economy</u>

32. Appendix A, section 6.2, of the SAPFIA comments gave an analysis of economic costs to the pelagic fishing industry and to the economy using the OBM.[7]

33. In the SAPFIA comments, SAPFIA noted the Panel's following comments:

    33.1 Section 7.2, bullet 2: The OBM and SAM are appropriate methods for estimating costs to the fishery but their results should be considered primarily in a relative sense (section 4.4) and as measures of short-run impacts.

    33.2 Section 7.2, bullet 3: The OBM likely overestimates the loss in catches due to closures, to an unquantified extent, given its assumptions related to the set of opportunities that are available to replace catches in closures, particularly those considered "irreplaceable" because all of the catch on a given day occurred inside a closure (section 3.2; Appendix E).

34. In the SAPFIA comments, SAPFIA further noted that it was engaging in further work to investigate and improve the OBM, including the search behaviour of the pelagic fleet and irreplaceability of the catch.

7 "AM 76" record pp.878 – 882.

35. I have undertaken further analysis using the OBM, whilst acknowledging that additional work is required which has not yet been done (and which will still take some time to do).

36. The catch and economic losses were calculated using the Opportunity Based Model (OBM) for the following six island closure options:

- The ICE 20 km closures
- The CAF closure options
- The mIBA-ARS closure proposals (as submitted to the Panel by McInnes et al)[8]
- The DFFE 2021 closure proposals
- The Interim Closures
- The Applicants' proposed closures.

37. The OBM developed by OLSPS Marine works by reviewing historic catches within proposed closed areas and, if an alternative catch took place outside this area on that day, replacing the catch 'within' by a selection from the set of 'outside' catches. If there is no catch 'outside' then the catch 'within' is 'irreplaceable', viz. deemed to be lost. Even if all the 'inside' catches are replaceable, because the replacement catches 'outside' could be higher than

8 McInnes, A.M., Weideman, E., Waller, L., Sherley, R., Pichegru, L., Ludynia, K., Hagen, C., Smith, C., Barham, P., Kock, A., Carpenter-Kling, T. 2023a. Purse-seine fisheries closure configurations for African Penguin conservation: methods and considerations for optimal closure designs: Report to Expert Review Panel on African Penguins and Island Closures. Date submitted: 15 May 2023 ("**McInnes *et al* 2023a**").

those 'inside', the aggregate catch after replacement could be larger, implying a catch gain, or expressed differently, a negative lost catch[9]. There are different results possible from the OBM depending on the use of different settings in the model, viz.:

- The historical dataset used – for the results in the SAPFIA comments the catch data for 2011 to 2020 were used.
- How catches made outside prospective closed areas are selected to replace a catch inside a prospective closed area – the SAPFIA comments used the median of the available outside catch opportunities.
- How often an outside catch can be used to replace an inside catch – the SAPFIA comments used five times.
- Whether alternative catches could only be on the same day or whether they include catches from earlier or later days as well – the SAPFIA comments uses same day catches only.
- How outside catches should be prioritised by area on the west coast – the SAPFIA comments used a version of the OBM in which outside catches to replace inside catches at Dassen or Robben would first be sought between Cape Columbine and Cape point, then north of Cape Columbine, and then finally between Cape Point and the 19°E line of longitude.

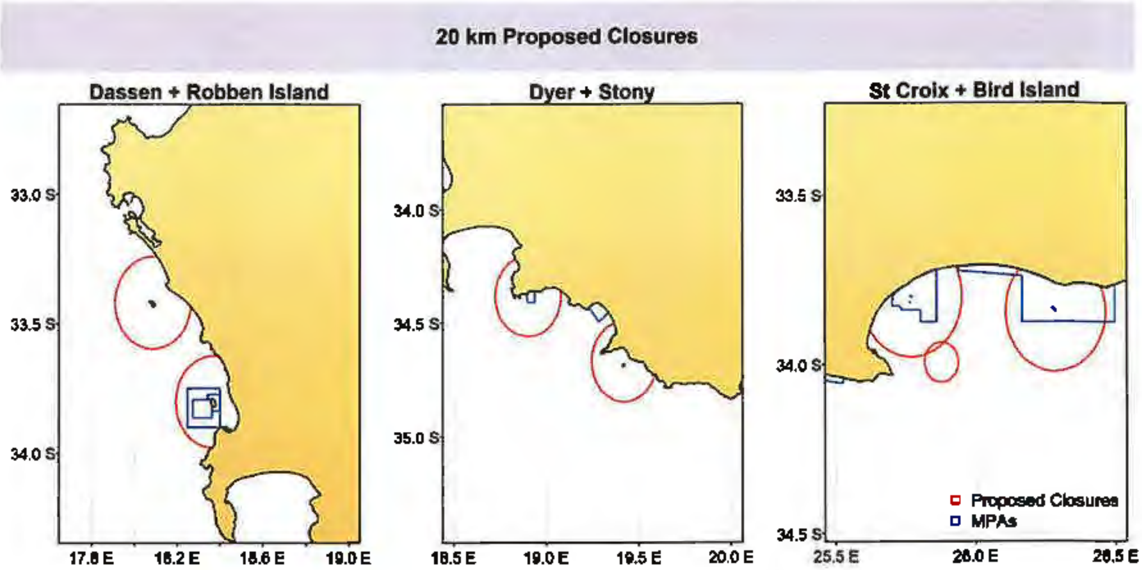
[9] Although a negative lost catch is possible and does occur in my calculations it tends to only emerge for small components of the catch such as for sardine bycatch which was not the main economic driver of catches, and in general the industry would likely already have taken advantage of such possibilities in the course of fishing without a closure present.

- Aspects of the way that the multispecies nature of the fishery are handled – the SAPFIA comments used an OBM which allows for switching between targeting anchovy and redeye, but if fishers were aiming for sardine on the 'inside', they could not switch to another species.

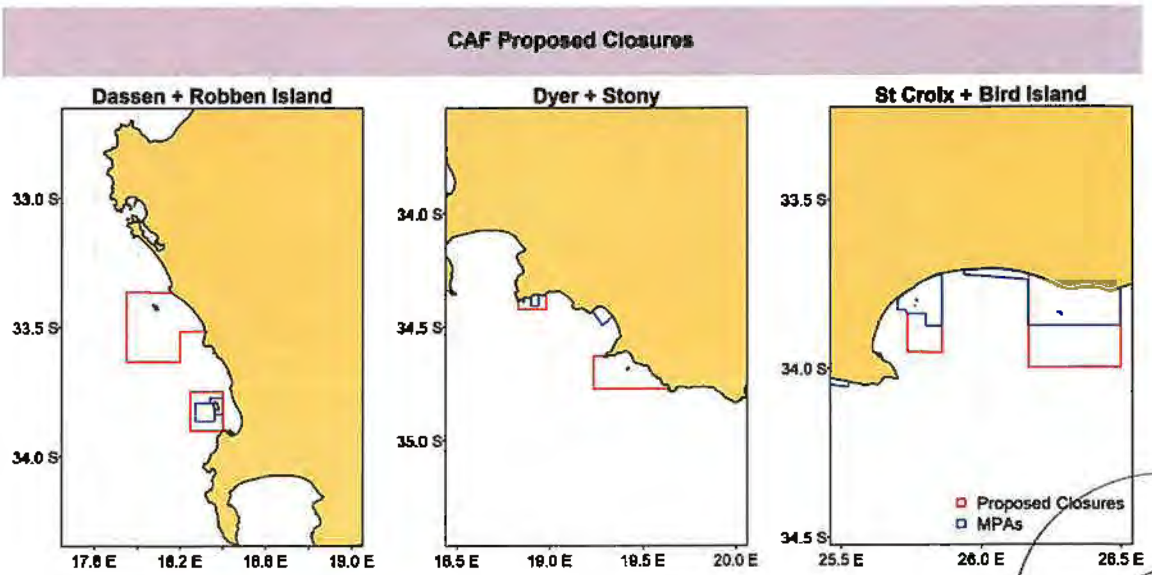
- In the SAPFIA comments an upper catch limit is imposed when selecting an 'outside' catch which is the maximum in the historical record for the vessel for a given target species for that year.

38. The OBM produces estimates of the loss of catch as a result of different island closures. This direct loss can be converted to a value by multiplication by the unit value of product. This reflects the "direct" lost value per annum.

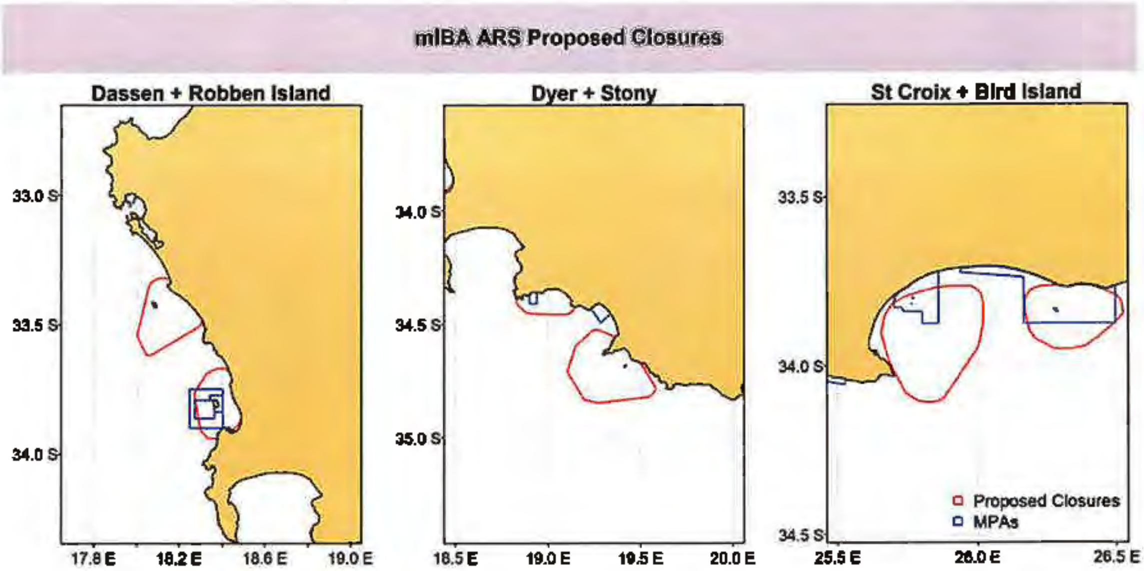
39. Maps of six closure options are given in Figure 1(ICE), Figure 2(CAF), Figure (mIBA-ARS as submitted to the Panel by McInnes et al), Figure 4 (DFFE 2021), Figure 5 (Interim Closures) and Figure 6 (the Applicants' proposed closures, being a combination of mIBA-ARS (as calculated by the Applicants), DFFE 2021 and ICE 20 km depending on island).



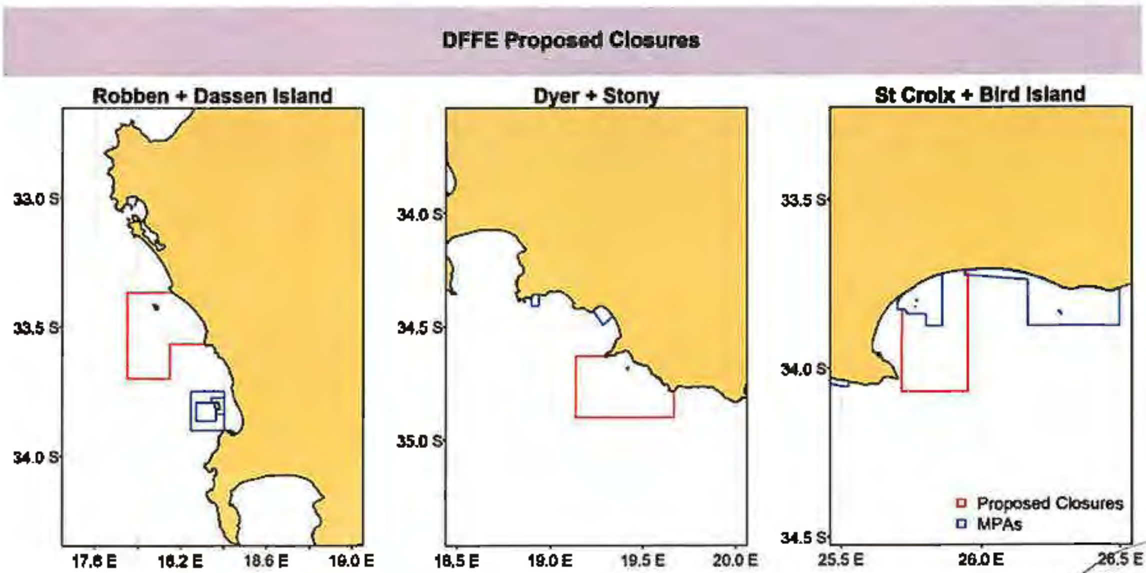
40. Figure 1. The ICE 20 km closure options. For the two western islands and the two islands in Algoa Bay, this shows the extent of the 20km closure areas, plus the closure around Riy Bank that was in place during the ICE. For completeness this has been extended to include Stony Point and Dyer Island as well, even though these two sites were not included in the ICE. Note that the areas shown in blue are MPAs and the ICE closures are in red.



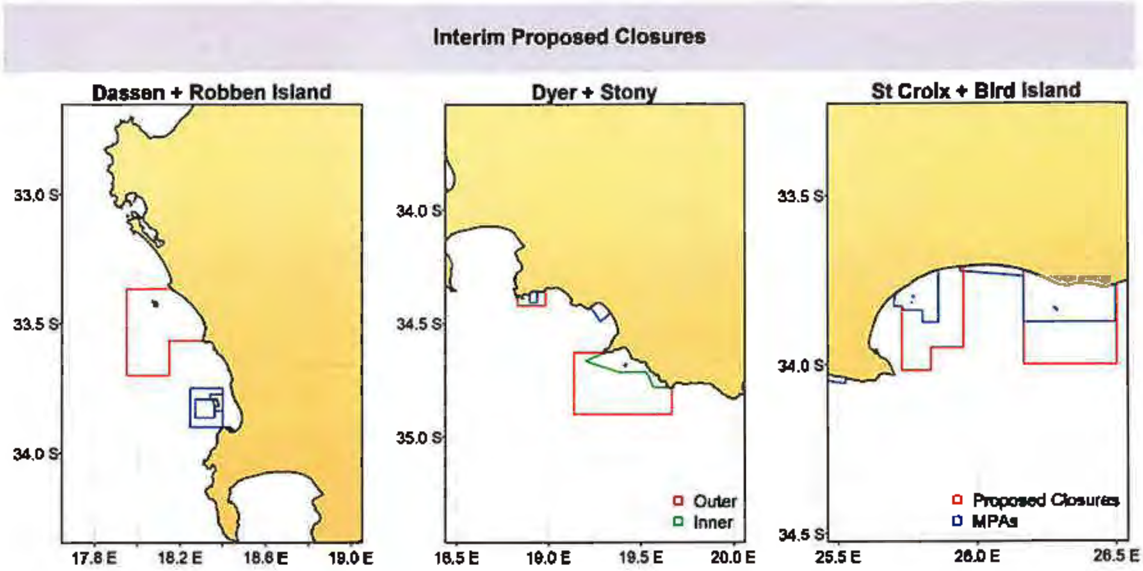
41. Figure 2. CAF recommendations on closure options that were sent to the Minister at the conclusion of the CAF process (see CAF, 2022). Here the MPAs are in blue and the CAF areas are in red.



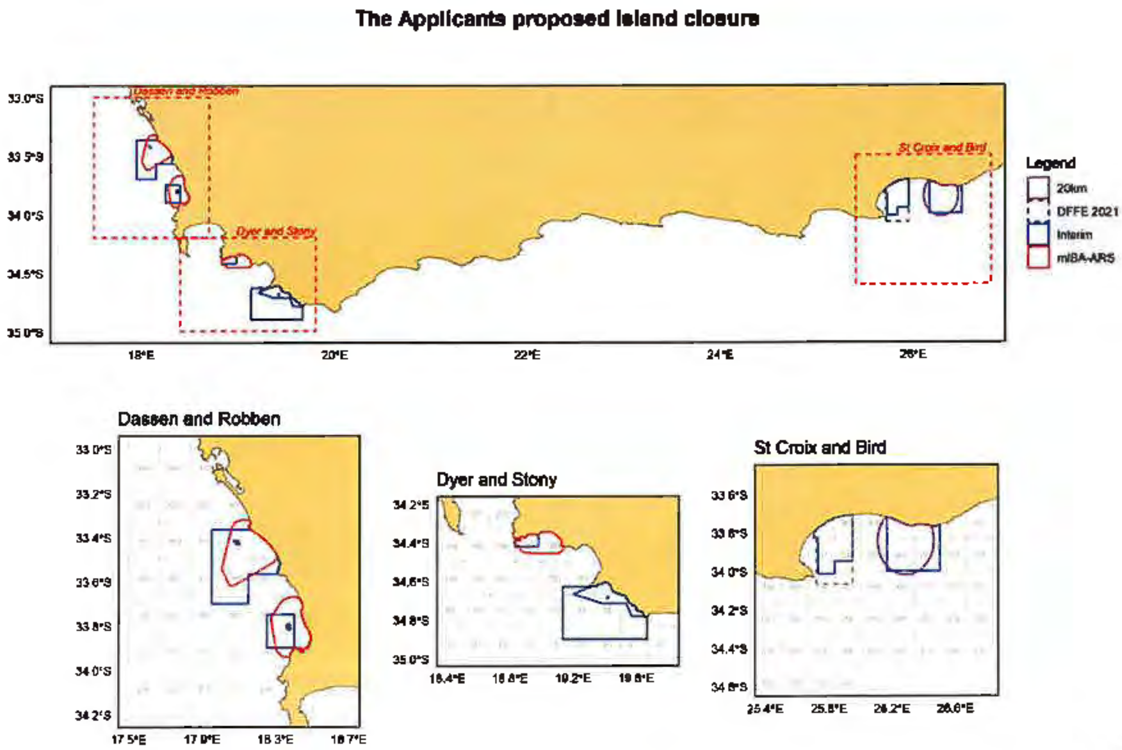
42. Figure 3. The mIBA-ARS closure options (see McInnes et al, 2023a).



43. Figure 4. The DFFE 2021 closure options.



44. Figure 5. These are the Interim Closures as per the January 2024 Permit Conditions.



45. Figure 6. These are the Applicants' proposed closures. They are mIBA-ARS for Dassen Island, Robben Island and Stony Point, the DFFE 2021 closures at Dyer and St Croix Islands, and the ICE 20 km closure at Bird Island Algoa Bay. These are those indicated as the Applicants' proposed closures in the above map.

46. The catch and economic cost implications of the different closure options were calculated using the same Opportunity Based Model (OBM) as was used in the SAPFIA comments. There are different results possible from the OBM depending on the selection of different options in the model. The options used in this analysis and those used in the SAPFIA comments are as follows:

- The historical dataset used was *2011 to 2019*,
- A *random* selection of prospective outside catches to replace catch inside the closed area,
- An outside catch can be re-used up to a *maximum of five times,*
- Only prospective outside catches on the *same day* were used,
- Opportunity catches for catches inside proposed closures at Dassen or Robben would be first sought between Cape Columbine and Cape point, then north of Cape Columbine, and then finally between Cape Point and 19°E longitude.
- *Switching* between targeting anchovy and redeye was allowed, but if fishers were going for sardine on the 'inside', they could not switch to another species.

- An *upper catch limit* is imposed when selecting an 'outside' catch. For these results it is the maximum set catch in the historical record for the boat for a given target species for that year.

47. This model gave an estimate of the average annual total lost catch per targeted species (anchovy, sardine, redeye and sardine bycatch). The average annual catch losses associated with specific closure options by species or type of catch are given below in units of metric tons (MT) in Table 6 (ICE closures), Table 7 (CAF closures), Table 8 (mIBA-ARS closures), Table 9 (DFFE 2021 closures) Table 10 (Interim Closures) and Table 11 (Applicants' proposed island closures).

Table 6. Catch losses associated with the ICE closure options, figures are presented in metric tons (MT)[10] per annum.

	Dassen	Robben	Dyer	-	Stony	St Croix	Bird	Riy	Total (MT)
ANCHOVY	3216.7	1133.7	8604.5	-	310.6	18.2	0.0	3.1	13286.9
BYPIL	108.2	60.1	209.6	-	49.8	0.3	0.0	0.1	428.1
DIRPIL	89.3	37.9	1062.8	-	1049.6	1756.4	19.0	45.1	4060.1
REDEYE	169.1	44.2	829.3	-	162.4	2.7	0.0	0.2	1207.9
Total (MT)	3583.3	1276.0	10706.2	-	1572.4	1777.6	19.1	48.5	19031.5

Table 7. Catch losses associated with the CAF closure options, figures are presented in metric tons (MT) per annum.

	Dassen	Robben	Dyer	-	Stony	St Croix	Bird	-	Total (MT)
ANCHOVY	370.76	-61.03	855.06	-	-33.83	0.21	0.00	-	1131.19
BYPIL	47.67	-16.48	14.70	-	-0.33	0.14	0.00	-	45.70
DIRPIL	87.91	-3.46	137.78	-	8.82	421.06	34.84	-	686.94
REDEYE	69.26	23.62	55.75	-	-0.24	-0.16	0.04	-	148.27
Total (MT)	575.6	-57.3	1063.3	-	-25.6	421.3	34.9	-	2012.1

Table 8. Catch losses associated with the mIBA-ARS closure options, figures are presented in metric tons (MT) per annum.

	Dassen	Robben	Dyer	-	Stony	St Croix	Bird	-	Total (MT)

[10] The terms tons, tonnes, MT or metric tons all refer to units of 1000 kg of fish. Hence 15 MT is equivalent to 15 tons and to 15 tonnes and to 15000 kilograms.

ANCHOVY	2013.7	808.6	13628.7	-	284.0	1.4	0.0	-	16736.4
BYPIL	70.7	55.2	341.8	-	19.5	3.2	0.0	-	490.4
DIRPIL	78.7	4.8	4604.6	-	952.6	1708.9	32.5	-	7382.2
REDEYE	155.3	88.8	1213.7	-	88.8	3.1	0.0	-	1549.7
Total (MT)	2318.5	957.4	19788.8	-	1344.9	1716.6	32.5	-	26158.6

Table 9. Catch losses associated with the DFFE closure options, figures are presented in metric tons (MT) per annum.

	Dassen	Robben	Dyer	-	-	St Croix	Bird	-	Total (MT)
ANCHOVY	60.8	-46.5	5014.4	-	-	1.2	0.0	-	5029.8
BYPIL	32.2	-8.0	163.9	-	-	0.2	0.0	-	188.4
DIRPIL	113.9	-1.6	2160.9	-	-	1203.4	19.8	-	3496.4
REDEYE	71.7	36.3	576.9	-	-	2.6	0.0	-	687.4
Total (MT)	278.5	-19.8	7916.1	-	-	1207.4	19.8	-	9402.1

Table 10. Catch losses associated with the Interim Closures, figures are presented in metric tons (MT) per annum.

	Dassen	Robben	Dyer	Dyer inside	Stony	St Croix	Bird	-	Total (MT)
ANCHOVY	49.8	-21.5	1311.7	84.8	-26.9	1.2	0.0	-	1399.2
BYPIL	39.8	-13.8	70.9	0.1	-0.5	0.1	0.0	-	96.6
DIRPIL	114.1	-4.6	1476.9	38.5	8.6	976.7	35.1	-	2645.4
REDEYE	75.9	42.5	103.3	6.5	-0.1	0.8	0.0	-	229.0
Total (MT)	279.6	2.7	2962.8	129.9	-18.8	978.9	35.1	-	4370.1

Table 11. Catch losses associated with the Applicants' proposed island closures, figures are presented in metric tons per annum.

	Dassen	Robben	Dyer	-	Stony	St Croix	Bird	-	Total (MT)
ANCHOVY	2003.0	873.7	5117.7	-	139.6	1.2	0.0	-	8135.3
BYPIL	68.2	59.6	166.8	-	24.6	0.2	0.0	-	319.4
DIRPIL	84.6	3.4	2162.2	-	625.1	1194.6	42.7	-	4112.7
REDEYE	147.0	122.4	585.8	-	81.8	2.6	0.0	-	939.7
Total (MT)	2302.8	1059.2	8032.5	-	871.2	1198.7	42.8	-	13507.1

48. From these estimates of average annual lost catches, the financial loss was calculated using the following prices (Mike Copeland pers. comm. November 2023):

- R28,566 per metric ton for sardine,
- R7,706 per metric ton of industrial fish (anchovy, redeye and sardine bycatch).

49. These prices are those used in the SAPFIA comments and may have changed since then, but they were used because they are consistent with the SAPFIA comments. These are average direct losses per annum incurred by the small pelagic fishing industry and are presented in Table 12 (first column of numbers in that table).

50. Furthermore, revenue that is lost in the fishing industry has a potential ripple effect throughout the South African economy. The extent of such secondary effects are studied by Statistics South Africa who make available updated matrices which capture how and to what extent revenue in the fishing industry impacts the rest of the economy. SAPFIA enlisted the services of an economics consulting group Urban-Econ to estimate how much the loss of revenue in the small pelagic fishing industry reduces economic activity in the South African economy. Their estimates were that the losses to the economy as a whole were 2.86 times the losses to the small pelagic fishing industry.

51. Therefore, in order to extrapolate the direct losses incurred by the small pelagic fishing industry to the broader economy, a multiplier effect of 2.86 (based on the work of Urban-Econ, 2023[11]) has been applied to provide an estimate of the total lost revenue to the economy. These estimates are given as the second column of numbers in Table 12.

Table 12. The calculated economic losses from the OBM catch losses presented in Tables above, where the annual economic losses are calculated from catch losses using the prices per ton of sardine and industrial fish given in the text, and the economic losses to the South African economy were calculated using a multiplier of 2.86 developed by Urban-Econ (2023).

Closure Option	Annual Economic losses to the Small Pelagic Fishing Industry	Annual Losses to the South African economy (Multiplier = 2.86)
ICE	ZAR 230,977,518	ZAR 660,595,703
CAF	ZAR 29,834,753	ZAR 85,327,394
mIBA ARS	ZAR 355,570,625	ZAR 1,016,931,988
DFFE 2021	ZAR 145,387,384	ZAR 415,807,918
Interim Closures	ZAR 88,859,113	ZAR 254,137,062
Applicants' proposed island closures	ZAR 189,877,010	ZAR 543,048,248
Applicants' proposed island closures **divided by** Interim Closures	2.14	2.14
Applicants' proposed island closures **% larger than** Interim Closures	114%	114%

Discussion and conclusions

52. For the six island closure options, the direct cost of the Interim Closures to the pelagic fishing industry are ZAR 89,000,000, and for the Applicants' proposed closures the costs are ZAR 190,000,000 – these are 114% larger than those for the Interim Closures, **viz. more than double**.

53. Based on Punt et al (2023) (the Panel report) [12] and the above analysis, the benefits for penguins from ICE closures ranges between 50 and 106 breeding

[11] Urban Econ, 2023. The Pelagic Fishing Industry: Socio-Economic Impact Assessment May 2023. Urban-Econ Development Economists.

[12] Punt, A.E., Furness, R.W., Parma, A.M., Plagányi-Lloyd, E., Sanchirico, J.N., Trathan, P.N. July 2023. Report of the International Review Panel regarding fishing closures adjacent to South Africa's African Penguin breeding colonies and declines in the penguin population. Department of Forestry, Fisheries and the Environment (DFFE). ISBN: 978-0-621-51331-8.

pairs per annum[13]. The benefits of the Interim Closures are 29 to 62 breeding pairs per annum[14], while the benefit for the Applicants' proposed closures is virtually identical to those for the ICE 20 km closures, i.e. between 50 and 106 breeding pairs per annum. The additional benefits to penguins of the Applicants' proposed closures is therefore less than double those conferred by the Interim Closures. The broad indication that the benefits to penguins from the Interim Closures are substantial in relation to the Applicants' proposed closures is inescapable. It is relevant as well that these benefits are small when compared to the absolute rate of decline in the penguin population which is in the order of 800 breeding pairs per annum (the estimate differs depending on how one calculates that rate of decline – e.g. the period over which one views the trend, and whether colony specific or aggregated population level calculations are used, but in general the results will all be in the ball park of about 800).

54. It is noted that neither the Founding Affidavit nor Weideman compares the costs and benefits between the Interim Closures and the Applicants' proposed closures.

55. Based on Urban Econ (2023) the loss of jobs is 4.18 jobs for every R 1 million of direct loss to the fishing industry. Using this value, the number of jobs lost varies, depending on the closure option. For the Interim Closures the estimated number of jobs lost is 371 and for the Applicants' proposed closures it is 794 jobs lost, 114% greater.

[13] For the comparison between ICE 20 km closures at all six breeding sites, and no closures at all. That the are two values quoted is due to the Panel's low and high estimates of 0.71% and 1.51% for penguins.

[14] Using a pro-rata to area approximation described earlier in this affidavit, and assigning 42% of the outer area at Dyer Island as equivalent to complete closure.

WEIDEMAN: GENERAL METHODOLOGICAL ASPECTS

56. I have read Weideman carefully, and respond to it below.

The application of the mIBA-ARS method by Weideman to delineate island closures

57. Weideman has determined two areas for "purposes of discussing delineations", namely a "full foraging range" for a particular African penguin colony (which she refers to as UD90) and a "core" foraging range (which she refers to as mIBA-ARS).[15] UD90 and mIBA-ARS are both understood by me to be the result of the application of the Area Restricted Search methods to discriminate between foraging and other activity, but they differ in regard to how much of the total foraging area they encompass, UD90 being, ostensibly, 90% of that area and mIBA-ARS, ostensibly, a lesser % of in the order of 50% (I am uncertain of the exact percentage used).

58. There are fundamental difficulties with Weideman's purported delineations of both UD90 and mIBA-ARS. These difficulties are common to both UD90 and to mIBA-ARS since they differ only in the proportion of the foraging area that they encompass. Comments which follow in relation to mIBA-ARS are therefore relevant to UD90 as well.

59. A mIBA-ARS area is a marine important bird area (mIBA) whose delineation has been determined using the application of the ARS method. ARS is an acronym for Area Restricted Search and necessarily incorporates a numerical calculation

[15] Weideman "AM5" paragraphs 11.1 – 11.2 record pp. 175 – 176.

whose aim is to identify and specify areas where penguins forage, to the exclusion of other activities, e.g. transiting.

60. Weideman creates the impression that her determination of the mIBA-ARS (and UD90) is in accordance with the mIBA-ARS method as "endorsed by the Panel" and that there is no scientific dispute about the method. For the reasons given below, that is not correct.

Dive data validation requirement by the Panel

61. The Panel "recommended that further validation of mIBA-ARSs should occur (this means that to be consistent with the Panel's recommendations it is essential to use dive data in the calculation of the mIBA-ARS areas), in particular using dive data that provide objective identification of foraging locations, rather than commuting (or travelling) locations". That is, the Panel recommended that the use of dive data are essential to reliably determine ARS-based closed areas. To my knowledge this 'dive data based' validation of mIBA-ARS area closure options has not been carried out. I am uncertain as to whether this is because such dive data are not available, or whether such dive data as are available are insufficient for such validation, or whether such data are sufficient and the necessary analyses are feasible and have simply not been carried out to date. To my knowledge no technical document outlining such a dive data based validation is available, and therefore there are to my knowledge no available dive data validated mIBA-ARS based area delineations that could be used in cost/benefit trade-offs to determined island closures consistent with the Panel's recommendations.

Problems with and uncertainties in the mIBA-ARS method including the determination of the smoothing parameter h

62. The scale of the area encompassed by mIBA-ARS is very sensitive to the value of the smoothing parameter h used in the application of the method 'mIBA-ARS'. There is no cogent explanation given by Weideman or in her supporting references for the basis of the choice of h for calculating the mIBA-ARS delineations. It is thus not possible to ascertain the reliability and robustness of the values of h used and hence of the resulting areal delineations.

63. Consequently, the submissions by McInnes et al (2023a,b[16]) and Weideman have **not** demonstrated that the methods and associated mIBA-ARS's (a) reliably distinguish between foraging and transiting behaviour and (b) provide reliable estimates of the smoothing parameter h (also discussed below). Therefore, the mIBA-ARS methods and results which they provide are inappropriate for implementation.

64. Furthermore, the methods used by Weideman for determining either mIBA-ARS or UD90 are not clearly specified. This amongst other factors (see below) makes it very difficult to independently verify the reliability of the final results.

65. ARS necessarily incorporates a numerical calculation whose aim is to identify and specify areas where penguins forage, to the exclusion of other activities, e.g. transiting.

---

[16] McInnes, A.M., Weideman, E., Waller, L., Pichegru, L., Sherley, R., Smith, C., Ludynia, K., Carpenter-Kling, T., Hagen, C., Barham, P., Stander, N., and Shannon, L. 2023b. The potential for interim purse-seine fisheries restrictions to alleviate resource competition around African Penguin colonies: assessment based on International Review Panel Report recommendations. 17 October 2023 ("AM62" at record pp 752 – 763) (referred to in the Industry Respondents' answering affidavit as the Conservation Sector Group Assessment).

66. The method described as 'ARS' in the literature usually also includes some objective basis for determining the value of the smoothing parameter h. In Dias et al (2018) the performance of the ARS method ("test") for determining h is compared to that of a separate cross validation method[17]. The results show that (Dias et al, 2018) "The *h-value* resulting from the ARS test was never the optimum value" – see Table 2 of Dias et al (2018).

67. Dias et al (2018) also note that the nature of penguin telemetry data makes it difficult to identify penguin behaviour during a foraging trip using ARS. They state "However, PTT-Argos-based location data from penguins are often unsuitable for ARS estimation since trips and, therefore, within-trip behaviors cannot be readily identified, due to the typically variable and often low-accuracy (and infrequent) positions."[18]

68. Some of the scientific literature, at least, therefore finds what Weideman calls the ARS method to be an unreliable basis for the determination of the penguin core foraging area and the smoothing parameter.

69. The values of h underlying the mIBA-ARS areas in Weideman are based on the median of the log variance of the first passage time. There is no clear and

[17] "The tests were carried out using the *test sample*, and the *validation sample* was then used to measure the quality of the final result of each set of values (*h-value*, UD% and PT). The quality was quantified by analyzing the relationship between the percentage of location data in the *validation sample* that were included inside the candidate IBA site (*inclusion*) and the area of the IBA (Supporting information Figure S2.4 in Appendix S2). The optimum set of parameter values was chosen as the one resulting in the point that minimized the size of the IBA while maximizing the *inclusion* (i.e., the point reaching the asymptote of IBA area-*inclusion* curve and identified as the first parameter combinetion resulting in <5% variation in *inclusion*; Supporting information Figure S2.4). Finally, we tested the correlation between the optimum values of *h-value* and UD% across the different datasets and the maximum distance travelled from the colony (average of the individuals in each dataset)" – Dias et al (2018).

[18] Carpenter-Kling et al (2022) Table 1 suggests that three different telemetry devices have been used, PTT, Catlog and GPS-GSM, and although the Dias et al (2018) comment specifically relates to PTT, one assumes it applies to all telemetry data including the Catlog and GPS-GSM devices.

accessible explanation in Weideman or in the literature referenced by Weideman as to why h should be based on such a criterion. It is essential that Weideman minimally provides a simple explanation of how her ARS method has been used to exclude penguin telemetry points because they are judged as linked to non-foraging activity and also provides a simple explanation of why the smoothing parameter h should be related to the median of the log of the variance of the first passage time, before considering acceptance of her results as the basis of major management decisions on closed areas. Horton and Bergh (2023)[19] shows that the spatial scale of mIBA-ARS areas are very sensitive to the value of h that is used[20][21]. As with any quantitative estimates based on data subject to uncertainty, common practice is to report (i) the best estimates of h, and (ii) their uncertainties at the time of reporting the mIBA-ARS delineations themselves. Weideman and McInnes et al (2023a) report neither (i) nor (ii), while McInnes et al (2023b) only reports (i).

70. Butterworth and Ross-Gillespie (2023)[22] present numerical examples which show that the kernel smoothing approach can inflate the size of mIBAs in excess of the actual foraging ranges for penguins in provisioning their chicks –

---

[19] Horton, M. and M.O. Bergh. 2023. Recalculation of MIBAs using different values of the kernel density smoothing parameter h. Document FP/PANEL/WP/07 presented to the Panel in May 2023.

[20] Lascalles et al (2016) similarly notes that "To estimate density, KDE assumes an area of influence around each point (the smoothing factor h). The results of KDE are extremely sensitive to this value, which must be defined a priori. However, despite considerable debate (Worton, 1989; Wand & Jones, 1995), there is no consensus and values are frequently set arbitrarily. To assign smoothing factors to GPS and PTT data in a justifiable and consistent way, we employ a novel approach based on area-restricted search behaviour (ARS – e.g. Weimerskirch et al., 2007), assessed via First Passage Time (FPT) analysis, to determine the spatial scales individuals interact with different aspects of the environment (Suryan et al., 2006). We used the average ARS exhibited across all trips within a data group (Fig. 4) to define the h value – see Appendix S1."

[21] Beal et al (2021) similarly notes that "setting the 'h' or smoothing parameter is an all-important step, as the results of KDE are highly sensitive to this value; a small parameter value could result in disjointed kernels surrounding each tracking location ('under-smoothing', e.g., Fig. S1A), whereas a large value may result in over-estimated space use areas for each animal ('over-smoothing', e.g., Fig. S1C)."

[22] Doug Butterworth and Andrea Ross-Gillespie. 2023. Reservations about the current MIBA evaluations. FP/Panel/WP/02 MARAM/PENG/2023/JUNE/P4.

particularly when the value of h selected is too large. This document has been available for almost a year without BLSA offering any counter-arguments in response to its arguments and results.

71. One must conclude therefore that the scientific literature considers that the choice of h, a critical determinant of the mIBA-ARS is not a settled matter, and at present involves a degree of arbitrariness.

72. In relation to the reliability of the estimates of h, usual scientific practice would be to demonstrate the implications of uncertainty in h by presenting results for the sensitivity of the final closure results across the range of uncertainty in and/or for a range of values of h determined using different methods. Such results have not been reported in Weideman, while McInnes et al (2023a) shows the impact only of the application of the central ARS estimates compared to the application of h=7 km taken from Dias et al (2028).

BLSA's refusal to make the underlying computer code and penguin telemetry data available

73. Since the Panel report was issued, neither the underlying computer code, nor the associated penguin telemetry data used, have been made available by BLSA to all participants in the scientific and management deliberations held under the auspices of DFFE, aside from the period 1 May 2023 to 1 July 2023 during which these were provided to OLSPS Marine in terms of a data sharing agreement for purposes of the Panel process.

74. Thereafter, even after the Panel report was issued, McInnes refused requests for access to the penguin telemetry data and the computer code used for their analyses.

75. It is standard in many marine resource management deliberations and fora around the world (for example the International Whaling Commission Scientific Committee[23]) that the data upon which management-related proposals are based are made publicly available to allow for independent cross-checking and potential falsification (a core tenet of the scientific method). There has been insufficient access to these data to independently verify the reliability of the mIBA-ARS results (as well as those for UD90) referenced in Weideman paragraph 11.2.

Conclusion regarding the mIBA-ARS areas

76. It is evident therefore that the numerical robustness and reliability of the mIBA-ARS's (and UD90s) presented by Weideman and McInnes et al (2023a,b) have not been established. In addition, they have not been validated using dive data, a key requirement for their use as recommended by the Panel, and therefore they cannot be used as the basis of trade-off curves for determining the optimal closed area. The mIBA-ARS areas calculated and put forward in Weideman first need to be validated by dive data and then by further numerical work which establishes that the methods applied are robust[24].

[23] International Whaling Commission. 2004. Report of the Scientific Committee. Annex T, Report of the Data Availability Working Group. *J. Cetacean Res. Manage.* 6 (Suppl.): 406-408

[24] Here 'robust' means that the bias and precision of the estimates lies within scientifically reasonable limits.

The trade-off mechanism applied by Weideman

77. Contrary to what Weideman asserts in paragraph 12, the Panel did not provide a "clear mechanism" for identifying optimal closed areas. This is evident from their use of the wording "some aspects" and "could form" in the following excerpt from their Executive Summary (page 8 bullet point 5):[25]

> "The trade-off among closure options is a policy decision related to conservation, economic and social goals and objectives for South Africa. This report outlines **some aspects** that **could form** part of a decision-making framework to identify the closure options that will provide the best outcomes for penguins given some level of cost to the fishing industry".
>
> and their statements in section 4.4 which use terminology such as "One way", "could demonstrate" and "one approach", viz.:
>
> "**One way** to explore the trade-off between expected benefits to penguins and impacts on fishing is via trade-off plots (see, Hilborn et al. (2021) and Halpern et al. (2013) for examples of trade-off analyses)".
>
> "A trade-off curve (e.g., Figure 4.3) **could demonstrate**..."
>
> "**One approach** (if curves such as those in Figure 4.6 can be created) is to find the point at which the change in penguin benefits (by increasing closures) matches the change in costs to society".

78. There are a number of difficulties with Weideman's application of a trade-off mechanism.

79. Nowhere in Weideman is it explained how the trade-off curves in Figures 1,2,5,7,9,11,13 of Weideman have been constructed. The standard scientific approach would be to specify the function of the curve, and estimate the function parameters by a minimisation procedure, but this does not seem to have been done. The shape of this

[25] Record p.323.

curve is a key determinant of the 'balance point' that is referred to in Weideman. Therefore, the basis for any optimal closed area determined by this method is as unclear and unsupported as the specific trade-off curve upon which it is based.

80. The telemetry data referenced have not been made generally available to all parties involved in the scientific and management deliberations held under the auspices of the DFFE. There was also no description of the telemetry dataset used with respect to the years included, the number of tracks and other important aspects. Consequently, I have not been able to verify the correctness of all calculations as is a standard scientific requirement.

81. Apart from Figures 9[26] (record p.194) and 11 (record p.196) which show the penguin utility scores and not the economic costs associated with the Interim Closures, the trade-off considerations in Weideman do not include the Interim Closures which are currently in place (as per the permit conditions of January 2024.) This is a glaring omission. These Interim Closures are represented by the blue outlined areas below (see Figure 7, taken from the 2024 sardine permit conditions), where the areas in red outline are the mIBA-ARS closure options. The second map (see Figure 8) shows the Interim Closures in relation to the Weideman closure proposals (mIBA-ARS at Dassen Island, Robben Island and Stony Point, DFFE 2021 at Dyer and St Croix Islands and the ICE 20 km closure at Bird Island Algoa Bay):

[26] Figure 9 shows Weideman's trade-off curves for Dyer Island. It represents the penguin utility score as a vertical dashed line. The Interim Closure at Dyer Island involves complete closure to all pelagic fishing within an inner area of 255 km^2 (OLSPS Marine Calculations) located within a larger area of 1039.1 + 255.2 = 1294.3 km^2 in which pelagic fishing by vessels greater than 26 metres in length is excluded.

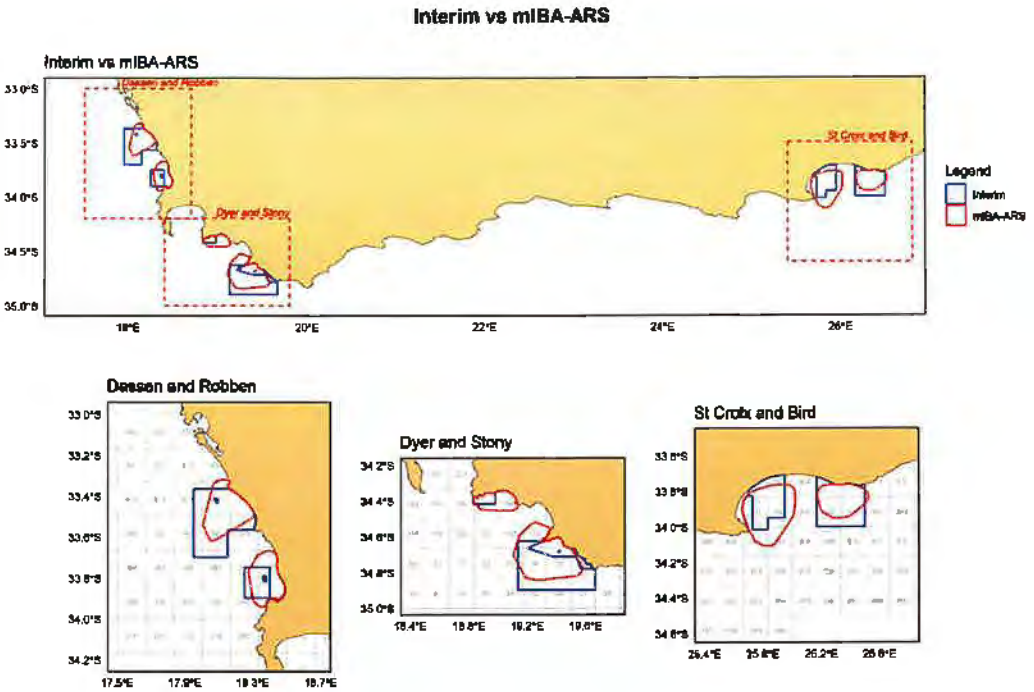


Figure 7. Map showing the mIBA-ARS in relation to the Interim Closures.

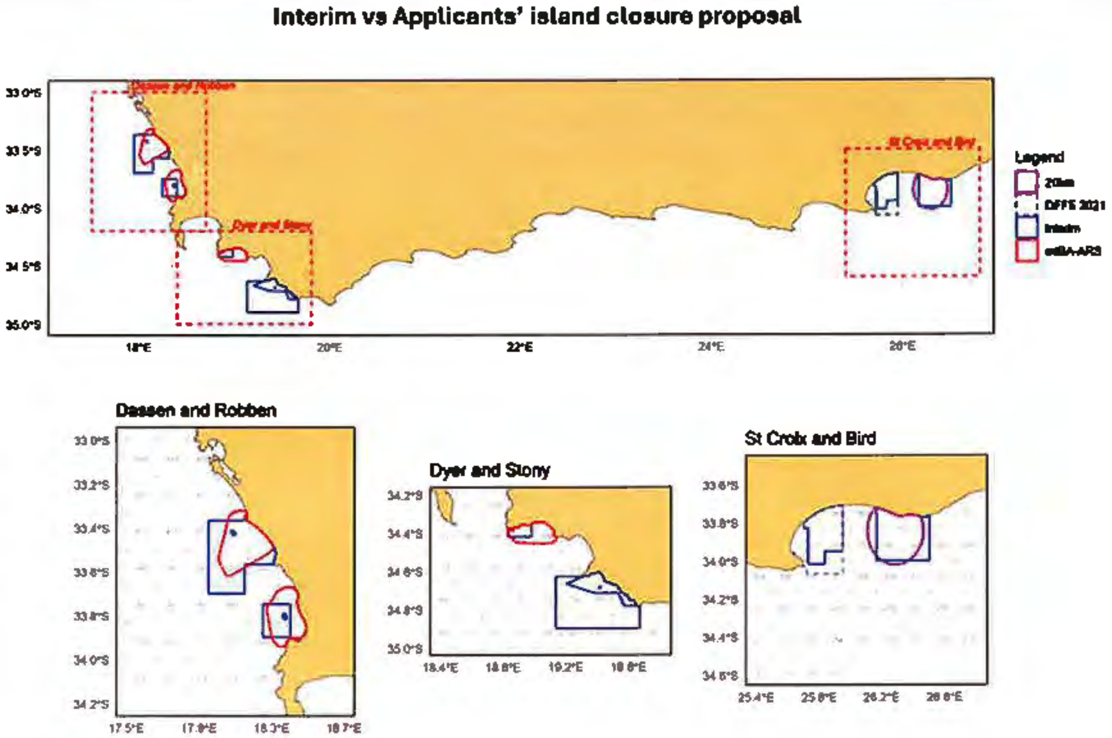


Figure 8. Map showing the Applicants' proposed closures in relation to the Interim Closures. For Dyer Island the Interim Closure for the outer area is identical to the DFFE 2021 closure which is the Applicants' proposed closure at Dyer Island.

Implications of using area as a proxy for benefit to penguins

82. Without access to the penguin telemetry data it is not possible to calculate the penguin utility scores for the Interim Closures. However, since the delineations of the Interim, ICE 20 km and DFFE 2021 Closures are known, their areas can be calculated and compared to those of the Applicants' proposed closures and the mIBA-ARS areas. Such a comparison provides an indication of the relative scale of the Interim Closures in relation to the Applicants' proposed closures, which must bear some relation to the relative scales of the benefits to penguins. These comparisons are given in the table below Table 13:

Table 13. Sea area of various closure options, and the Interim Closure areas expressed as a percentage of either the mIBA-ARS or the Applicants' proposed closures.

Site	ICE (20 km) km^2 (OLSPS Marine)	mIBA-ARS km^2 (OLSPS Marine)	DFFE (2021) km^2	Applicants' proposed island closed areas	Interim Closure km^2	>26 m exclusion area	Interim/ mIBA-ARS	Interim/ Applicants' proposed island closed areas
Dassen	897.56	*549.27*	941	549.27	941		171%	171%
Robben	744.84	*418.62*	227	418.62	227		54%	54%
Stony	686.66	*269.71*	20	269.71	83		31%	31%
Dyer	652.73	1003.76	*1294.3*	1294.3	255.3	1039.1	25%	20%
St Croix	618.28	951.79	*809*	809	580		61%	72%
Bird	*831.27*	536.38	458	831.27	837		156%	101%
Total	4431.34	3729.53	3749.3	4172.17	2923.3		78%	70%

83. This table shows that the sum of the areas of all Interim Closures is 78% of the sum of the areas of all the mIBA-ARS closures, and 70% of the sum of the areas of all the Applicants' proposed closures. A different calculation can be carried out to determine what the area of overlap is between the Applicants' proposed island closures and the Interim Closures, and the same for the mIBA-ARS areas. This is summarised below in Table 14 and Table 15.

Table 14. The overlap between the Interim Closures and the Applicants' proposed closures, expressed as a percentage of the Applicants' proposed closures. With regard to the Outer Area at Dyer Island which excludes fishing

by vessels larger then 26 m, the first panel does not include any of the Outer Area and the second panel includes 42% of that Outer Area, in recognition that 42% of the catch in the vicinity of Dassen Island is due to vessels larger than 26 metres.

No allowance for closure of Outer Area at Dyer Island: Interim Overlap as % of Applicants' proposed island closures					
Island	**Applicants' proposed island closures**	**Interim (km2)**	**Interim vessels > 26 m**	**Overlap (km2)**	**Overlap as percentage of Applicants' proposed island closures**
Dassen	549.3	941.1		504.4	92%
Robben	418.6	227.3		177.2	42%
Dyer	1294.3	255.3	1039	255.3	20%
Stony	269.7	84		81.7	30%
StCroix	809.2	579.8		579.8	72%
Bird	831.3	836.8		693.6	83%
Total	**4172.4**	**2924.3**		**2292**	**55%**
Average					**57%**

42% allowance for closure of Outer Area at Dyer Island: Interim Overlap as % of Applicants' proposed island closures					
Island	**Applicants' proposed island closures**	**Interim (km2)**	**Interim vessels > 26 m**	**Overlap (km2)**	**Overlap as percentage of Applicants' proposed island closures**
Dassen	549.3	941.1		504.4	92%
Robben	418.6	227.3		177.2	42%
Dyer	1294.3	255.3	436.4	691.68	53%
Stony	269.7	84		81.7	30%
StCroix	809.2	579.8		579.8	72%
Bird	831.3	836.8		693.6	83%
Total	**4172.4**	**2924.3**		**2728.38**	**65%**
Average					**62%**

Table 15. The overlap between the Interim Closures and the mIBA-ARS areas, expressed as a percentage of the mIBA-ARS areas. With regard to the Outer Area at Dyer Island which excludes fishing by vessels larger than 26 m, the first panel does not include any of the Outer Area and the second panel includes 42% of that Outer Area, in recognition that 42% of the catch in the vicinity of Dassen Island is due to vessels larger than 26 metres.

No allowance for closure of Outer Area at Dyer Island: Interim Overlap as % of mIBA-ARS					
Island	**mIBA ARS (km2)**	**Interim (km2)**	**Interim vessels >26 m**	**Overlap (km2)**	**Overlap as % of mIBA ARS**
Dassen	549.3	941.1		504.4	92%
Robben	418.6	227.3		177.2	42%
Dyer	1003.8	255.3	1039	209.6	21%
Stony	269.7	84		81.7	30%
StCroix	951.8	579.8		475	50%
Bird	536.4	836.8		526.6	98%
Total	**3729.6**	**2924.3**		**1974.5**	**53%**
Average					**56%**

42% allowance for closure of Outer Area at Dyer Island: Interim Overlap as % of mIBA-ARS					
Island	**mIBA ARS (km2)**	**Interim (km2)**	**Interim vessels >26 m**	**Overlap (km2)**	**Overlap as % of mIBA ARS**
Dassen	549.3	941.1		504.4	92%
Robben	418.6	227.3		177.2	42%
Dyer	1003.8	255.3	436.4	552.6	55%
Stony	269.7	84		81.7	30%
StCroix	951.8	579.8		475	50%
Bird	536.4	836.8		526.6	98%
Total	**3729.6**	**2924.3**		**2317.5**	**62%**
Average					**61%**

84. Table 14 shows that the sum of the overlap of the Applicants' proposed closures and Interim Closures is 55% of the sum of all Applicants' proposed closure areas without recognition of any benefit from the Outer Area at Dyer Island. When 42% of the Outer Area at Dyer Island is assumed to be closed, then this value of 55% increases to 65%.

85. Within the limitation of using area as a proxy for benefit to penguins, I conclude from the above that the Interim Closures may confer 65% of the benefit to

penguins that would be conferred by the Applicants' proposed closures if they were to be implemented.

86. Table 15 shows that the sum of the overlap of the mIBA-ARS areas and the Interim Closures is 53% of the sum of all mIBA-ARS areas. When 42% of the Outer Area at Dyer Island is assumed to be closed, then this value of 53% increases to 62%.

87. Note that by considering only the area from the Interim Closures that **overlap** with the Applicants' proposed closed area as conferring a benefit to penguin, I am being conservative because there are areas encompassed by the Interim Closures which are not encompassed by the Applicants' proposed closed areas which are nevertheless foraging areas for penguins.

88. The use of area as a proxy for calculating the benefit to penguins for Interim Closure is a conservative approach. This is so because the concentration of penguin foraging activity closer to islands is such that the Interim Closures may encompass a greater percentage of the foraging activity than of the sea area. This is apparently the case given the table below which shows areas and penguin utility scores for the six breeding sites and for the ICE 20 km, mIBA-ARS and DFFE 2021 closure options. Also shown in the table are, for each site, the ratio of the smallest to the largest areas, and the corresponding ratio of the penguin utility scores read roughly from Weideman's Figures 1,2,3,5,7,9,11,13. In all instances the penguin utility score ratio is much larger than the corresponding ratio for area. So, for example, whereas for Dassen Island the mIBA-ARS area is 61% of the DFFE 2021 closure option, the mIBA-ARS penguin utility score is

91% of that for the DFFE 2021 closure option. This illustrates that smaller areas confer greater penguin benefits than their area ratios suggest, hence the use of area as a pro rata basis to infer benefits to penguins from Interim Closures compared to the Applicants' proposed closures understates the benefits conferred by the Interim Closures in relation to those of the Applicants' proposed closures.

Table 16. Areas and penguin utility scores for the ICE 20 km, mIBA-ARS and DFFE 2021 closure options. The ratios of smallest to largest areas are in all cases smaller than the corresponding ratios of the penguin utility scores read from the graphs in Weideman.

Site	ICE (20 km) km^2	mIBA-ARS km^2	DFFE (2021) km^2	Smallest/Largest Area	Penguin Utility Score Ratio
Dassen	897.56	549.27	941.00	0.61	0.91
Robben	744.84	418.62	227.00	0.30	0.42
Stony	686.66	269.71	20.00	0.03	0.11
Dyer	652.73	1003.76	1294.30	0.50	0.92
St Croix	618.28	951.79	809.00	0.65	0.72
Bird	831.27	536.38	458.00	0.55	0.72

Site	ICE (20 km) km^2 Penguin Utility Score (Weideman)	mIBA-ARS km^2 Penguin Utility Score (Weideman)	DFFE (2021) Penguin Utility Score (Weideman)	Smallest/Largest Area
Dassen	0.90	0.82	0.90	0.91
Robben	0.95	0.82	0.40	0.42
Stony	0.93	0.88	0.10	0.11
Dyer	0.70	0.80	0.76	0.92
St Croix	0.63	0.88	0.75	0.72
Bird	0.90	0.88	0.65	0.72

89. The feature relating areas and benefits to penguins referenced immediately above, which concludes that the use of areas is conservative is also reflected in the following figure from the Panel's report. In this figure at the red or blue dots a reduction in area closed results in a lesser relative reduction in the benefit to penguins:

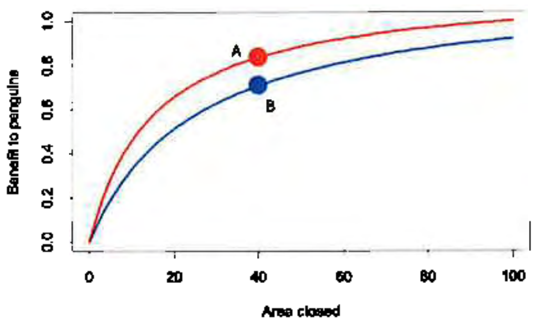


Figure 9. An excerpt from the Panel report page 36: "Figure 4.3: Illustrative relationships between benefits to penguins for optimally selected and simple closures given the amount of area closed (upper panel) and between area closed and fishing costs (lower panel). See text for explanations of curves A and B".

The trade-off mechanism allegedly specified by the Panel

90. In paragraph 14 Weideman sets out what she refers to as a set of parameters (her paragraphs 14.1 to 14.7) established by the Panel which define the relevant trade-off mechanism. However, the sub-paragraphs do not fully specify a trade-off mechanism. Specifically, they:

90.1 Do not specify which closure options should be plotted on a trade-off curve, the mathematical equation for the curve that should be drawn, or exactly how the curve should be calculated.

90.2 Do not identify the general type of closed area that should be considered in the trade-off. At present there are regions/areas/shapes that emanate from a range of different considerations. (It would be more appropriate to use a series of shapes that differ by varying only a single parameter. Such shapes would then have the same basic characteristic but a different areal extent which differs only from others by changing a single parameter. This would then allow for differentiation of the curve with respect to that parameter to determine the optimal closed area).

90.3 Do not provide a basis for determine the relative scale of fishing costs versus penguin benefits. Different such scales lead to a different location of the optimal closed area. Therefore, the relative scaling of fishing costs versus benefits to penguins, which at present has not been determined in any deliberative manner in any forum where interested parties have been able to provide inputs, is a key but undetermined determinant of the 'balance point' referred to in Weideman.

91. Para 14.1: This sub-paragraph and the introductory paragraph Para 14 read that "14. The Panel established a set of parameters which define the relevant trade-off mechanism. These are: 14.1. A trade-off mechanism is **ideal** if it "minimizes societal costs and maximizes benefit to penguins; however, an optimal solution (or acceptable 'balance') between competing objectives is not simply obtained by closing 50 percent of *any given area*". Weideman has inserted the word **ideal** (my emphasis added) before the quote. The exact wording was "*It is desirable to identify a solution that minimizes societal costs and maximizes benefits to penguins; however, an optimal solution (or acceptable "balance") between competing objectives is not simply obtained by closing 50 percent of any given area.*". This further confirms that the Panel was not prescriptive about the particular trade-off mechanism that should be used.

92. Para 14.2: The paragraph states that one of the parameters of a trade-off calculation specified by the Panel is "It is possible to identify the trade-off between "expected benefits to penguins and impacts on fishing" using trade-off curves which plot closure options as points on a graph measuring the relationship

between a particular closure area / delineation and (1) benefits to penguins, on the one hand, and (2) costs to fisheries on the other". I do not dispute that this is possible, but it should be mentioned and understood that the curves that could reliably provide a basis for a trade-off require much more input than is mentioned in or which follows after this paragraph. Just three requirements not mentioned are:

92.1 an objective method for 'drawing' such curves,

92.2 specification of which closure option can validly be depicted on such a curve for purposes of determining an optimal closed area, and

92.3 how fishing costs and benefits to penguins are to be scaled relative to each other in order that the trade-off is reflecting costs and benefits in comparable 'currency'.

93. Weideman does not explain how the curves are drawn, and looking at the various figures given in her Figures 1,2,5,7,9,11 and 13, the impression is that different people acting independently would likely draw rather different curves and obtain different optimal closed areas.

94. Para 14.3: This is a paragraph which explains how one would identify the location of the optimal closed area on the trade-off curve based on the Panel report page 36, Bullet 3, which states that "***One approach*** *(if curves such as those in Figure 4.6 can be created) is to find the point at which the change in penguin benefits (by increasing closures) matches the change in costs to society*". The Panel's use of the words "**One approach**..." in this excerpt from their report highlights that the Panel is not prescribing a specific method or mechanism for carrying out a trade-off calculation.

95. Para 14.5: This paragraph of Weideman's emphasises that the costs estimated by the OBM should for now be used in a relative sense consistent with the Panel's recommendation that OBM costs can be compared "in a relative sense..." (see page 46 of the Panel report). This however has implications for the vertical axis scaling of the trade-off graphs in Figures 1,2,5,7,9,11,13 of Weideman which should differ relatively according to the different costs for these different islands estimated by the OBM. Weideman has not made this adjustment since in every graph of Figures 1,2,5,7,9,11,13 she has given the cost to the industry a value of 1 at UD90 corresponding to a value of the penguin utility score of 1 at UD90. These scales should differ relatively as given by the OBM estimates.

Representing benefits to African penguins and costs to fisheries on a trade-off curve

96. Para 15 of Weideman states that "Central to the trade-off mechanism was the ability to represent the benefits to African Penguins and costs to the fishing industry on a graph for each colony; for each catch type (of anchovy, sardine, bycatch sardine and redeye) and for each delineation option considered by the Panel, namely:" I note that consistent with this Weideman has plotted trade-offs in her Figures 2,5,7,9,11 and 13 for different islands and different species. However, while the Panel mentions the need for sectoral considerations in computing trade-offs, it seems premature at this stage to conclude that species-specific trade-offs should be considered. This substantially and unnecessarily complicates the consideration of trade-offs. Indeed, such considerations or some other split has not yet been discussed amongst any of the parties involved, so

that Weideman's approach set out in paragraph 15 to split by species (anchovy, sardine or redeye)/type of catch (directed or bycatch), is premature.

97. In respect of the island closure options referenced by Weideman in paragraphs 15.1 to 15.6 (she lists and considers the following six closure options: UD90, DFFE 2021, ICE 20 km, CAF, Industry 2023, mIBA-ARS for purposes of trade-off calculations) the set of closure options evaluated should have included the Interim Closures in force as of January 2024. Yet, these have not been included.[27] From Weideman it is therefore not possible to locate these Interim Closures on the Weideman trade-off plots for all islands and hence to express, in Weideman's terms, the penguin benefits derived from the Interim Closures for all islands.

98. There is no reason given for why the Interim Closures are not represented on Weideman's graphs/ trade off curves. I showed, in responding above to Weideman paragraph 3.2, that the area encompassed by the Interim Closures which overlaps with the mIBA-ARS and the Applicants' proposed closures is 65% of the Applicants' proposed closures. This is a substantial proportion, and hence in assessing the rationality of the Minister's decision it is important to quantify the benefit of the Interim Closures to penguins.

99. The relative scaling of penguin benefits to fishery costs implicit in Figures 1,2,5,7,9,11,13 is that the costs incurred by UD90 are equivalent to the benefits to penguins at UD90, so that they are each accorded a value of 1 at the UD90

[27] Although Figures 9 (Dyer Island) and 11 (Bird Island) do represent the penguin utility scores for the Interim Closures the costs reported for these in the SAPFIA comments are not included so the trade-off implications are not represented. The estimated losses of the Interim Closures for Dyer and Bird given in the SAPFIA comments are around ZAR 249,000,000 and ZAR 928 000.

closure option. This is an arbitrary scaling which, together with the curve that is drawn connecting all points, determines the location of the optimal closed area. In essence however, the optimal closed area is arbitrary to the extent that the relative scaling is arbitrary. Further discussion and deliberation of this matter based on further improvements to the OBM are necessary to achieve an acceptable relative scaling for these trade-off graphs.

100. Figures 1,2,5,7,9,11,13 show curves drawn through the points representing the six closure options considered in Weideman's affidavit. It is relevant to the objectivity or otherwise of the approach that is taken by Weideman that the curve that is drawn will differ depending on which closed area options are included in the figure, and hence the optimal closed area will be determined to considerable degree by the specific closure options that are plotted[28]. This underscores (a) that some criterion needs to be applied to select closure options for preparing such graphs and trade-off curves and (b) that the curves as drawn in Weideman are subjective to the extent (at least) that the set of closure options selected was not based on an objective criterion. The Panel did not address this issue but it is clearly critical. An example might be that only closure options drawn from a family of mIBA-ARS areas should form the permissible set of points on the graph, constructed perhaps by varying the value of the UD%. Were that the case, then it is likely that the exact shape of the trade-off curve will not change dramatically dependent on the inclusion of more or fewer closure options for different values

[28] For some graphs- i.e., Figure 5 - the curve is perfectly drawn through most of the closure options, but then for some reason some points to the left of the curve (in this instance ARS and 20km) are omitted. This particular curve likely is decisive for which closure option is selected as the optimal closed area.

of UD%'s. Such a mechanism and any other mechanism for that matter, should be the subject of further research and deliberations amongst all parties.

Weideman's explanation of the trade-off curves, and the determination of the optimal closure area, using Stony Point as an example

101. In paragraphs 14 – 25 Weideman outlines her trade-off mechanism and its basic elements, using Stony Point as an example to illustrate how the method works. The following sections give my general comments on this method as applied by Weideman.

Placing penguin benefits and fishing costs on a graph

102. Paragraph 21 of Weideman states that a "penguin utility index" is plotted on the horizontal-axis. Actually, all graphs plot a 'penguin utility score" on their horizontal-axis which I assume is the "penguin utility index" of a closure option divided by the "penguin utility index" of UD90.

103. Paragraph 21.1 provides a description of how the penguin utility index is calculated but it is not possible from this description to follow the method clearly nor to understand how foraging is distinguished from other penguin activities such as transiting. I would not, based on this description, be able to repeat the calculations given the available telemetry data for penguins. I cannot therefore verify the meaning or reliability of the penguin utility index which has been used in Weideman.

104. What are plotted in Figures 1,2,3,5,7,9,11 are not costs and benefits per se, but rather fishing costs expressed as a proportion of the costs incurred at the UD90

closure option and the penguin benefits envisaged expressed as a proportion of those envisaged at the UD90 closure option. This means that the costs and benefits at UD90 have the same value, viz. 1. **<u>There is no basis for such an assumption.</u>** Here, as with the drawing of the trade-off curves, a different person may arrive at a different initial approach to scaling costs relative to benefits. Just two alternative *examples* are:

104.1 One job lost by the South African economy is equivalent to five penguin pairs saved.

104.2 1 % of annual revenue in the fishery (per annum) is equivalent to 1% of the penguin population (per annum).

105. These two examples will produce markedly different trade-off curves and markedly different optimal closed areas because analysts who believe the first equivalence between jobs lost and penguins saved will favour different island closure options than those who believe the second equivalence. Other examples are easily created to highlight that this is a general result.[29]

106. Paragraph 22 suggests that the costs at UD90 are equivalent to the penguin benefits at UD90, since they have both been assigned a value of 1. However, I have highlighted that this is an arbitrary scaling of costs vs benefits and that different analysts could easily arrive at very different conclusions. This

[29] Consider island closure options A and B: For A the benefits are 25 penguins gained and 100 jobs lost, and for B the benefits are 35 penguins gained and 165 jobs lost. An analyst who believes that one job lost is equivalent to 5 penguins saved will favour situation A because the profit in terms of penguins for A (25-100/5 = 5 penguins) is larger than for B (35-165/5 = 2 penguins). An analyst who believes (2), viz. that one job lost is equivalent to 12 penguins saved, will favour closure option B because the profit in terms of penguins for B (35-165/12 = 21 penguins) is larger than for A (25-100/12 = 17 penguins).

underscores the need to carry out more research to establish a firmer basis for the relative scaling of costs to benefits.

107. In regard to the scaling in paragraph 23, on Figure 1 an optimal closed area is denoted by the yellow dot. Given the scaling of costs vs benefits selected (costs = benefits at UD90) this must lie where the curve has a 45 degree slope. The point where this curve has a 45 degree slope will depend on the shape of the curve, which in turn is determined by how the curve is drawn[30]. No information is provided about how the curve was drawn and, as stated previously, the nature of the curve is influenced by which closure options are selected for the plot. Since the final result is a consequence of the following three arbitrary choices:

1 – the closure options chosen for plotting,

2 – the relative scaling of costs and benefits,

3 – the manner in which the curve is drawn

it cannot form the basis for a final decision about island closures.

108. In response to paragraph 23.1.2: the figure referenced does not address the costs and benefits associated with the Interim Closures. Since the application seeks relief to review and set aside the Minister's decision about Interim Closures, this is a key omission because it precludes any assessment of the merits of the Interim Closures, restricting arguments to those in favour of an alternative closed area, which I have argued is contingent on a number of

[30] I am using the term 'drawn' to cover a range of mathematical and/or statistical methods that could be used to construct an equation describing the curve which can then be presented on a plot such as Figures 1,2,3,5,7,9,11 using its value across a range of x-axis values.

subjective or arbitrary choices (see earlier comments), and not by reference to the trade-off implications of the Interim Closures.

109. With regard to the vertical-axis in Figure 1 and 2 reflecting "estimated fishery catch loss":

109.1 Para 23.2.1: The use of different trade-off figures for different species substantially complicates the determination of an optimal closed area. This complexity is not adequately addressed in Weideman. It is fortuitous that optimality lies close to mIBA-ARS for all four species in the case of Stony Point, but this is not the case at all the other five penguin breeding sites. Just one aspect of the complexity referenced is that the economic losses due to different species caught differs, in some cases markedly. For consistency with the Panel's support for using the OBM costs estimates in a relative sense, the vertical-axis scales for different species should be set in accordance with these different costs. At present they are all set equal to 1, which cannot be correct and which biases the determination of the optimal closed area.

109.2 Para 23.2.2: The method that was used to fit a curve through the points on Figure 1, and the functional form of this curve is not given. Given only the task of fitting some convex curve through the points in Figure 1, different analysts will obtain different curves that satisfy this broad requirement. There is a need to specify the method used, and the functional form adopted, so that its merits can be assessed in pursuit of a suitably objective and scientifically defensible approach. This has not been done. This leads to the conclusion that in its present form the trade-off curve, and the optimal closed area selected are arbitrary.

Fitting a trade-off curve and identifying the "optimal closed area"

110. I note that although Stony Point is used for illustrative purposes, the example is also the basis for Weideman's recommendation to close the mIBA-ARS area around Stony Point.

111. Para 25.1 of Weideman refers to a graph, Figure 1 of Weideman, showing the trade-off curve of costs vs benefits for anchovy at Stony Point. This curve indicates by a yellow dot the point on the curve where the slope is 45 degrees. This graph also shows that the green dot for mIBA-ARS is very close to the yellow dot, closer than the markers for any of the other closure options. I note that the same is the case for Figure 2 which shows the trade-off for directed sardine. Based on this I agree with Weideman's conclusion in paragraph 25.1 that the Stony Point trade-off curve for anchovy indicates an optimal closed area coinciding with the green dot representing the mIBA-ARS closure option, if one takes as a given the assumptions and approaches in Weideman. **However, the meaning and relevance of this optimal closed area is very limited because**:

111.1 For the reasons given above, the basis for the determination of the mIBA-ARS area for Stony Point is unclear (see my responses to Weideman paragraphs 11.1, 11.2, 13, 13.1, 24).

111.2 The points represented on the plot in Figures 1 and 2 are partly responsible for the shape of the trade-off curve, and the curve will change if one or more of these points are omitted or if some other new points are included. This is a shortcoming because the selection of the points that are plotted is either arbitrary and/or because they were (selected from only) those for which information was available.

111.3 The scaling of costs and benefits in Figures 1 and 2 is subjective because there are other possible scalings which would likely be selected by other independent analysts.

111.4 The methods used to draw the trade-off curve through the points that have been selected are not specified, and it is clear that other independent analysts would, within the framework that has been stated, produce different shapes/curves.

111.5 Changes to (i) the choice of which closure options to plot, (ii) how to scale fishing costs relative to penguin benefit, (iii) how the "trade-off" curve is drawn, and hence their application by another independent analyst will change the optimal closed area.

112. Paragraph 25.2: Sentence 1 is a verbal description of Figure 1 which does not change my reservations expressed in paragraphs 111.1 – 111.4 above. The conclusion stated in Sentence 2 ("*Because the green dot is closer to "1" on the x-axis it is a closure option which provides greater benefit to African Penguins than the closure options represented by the dark blue diamond and pink triangle*") is subject to the reliability of the mIBA-ARS determination. Sentence 3 is a correct interpretation of Figure 1 ("*This means that for a relatively small increase in cost to the fishing industry, the mIBA-ARS closure is likely to provide*

significantly greater benefits to African Penguins than the DFFE 2021 and CAF closures."), but its correctness more broadly is subject to the reservations.

113. Paragraph 25.3 provides a verbal explanation as to why the yellow dot in Figures 1 and 2 is an optimal closure area instead of the points for mIBA-ARS or UD90 which provide greater benefit for penguin. The essence of the explanation is that despite the larger benefits for penguins at UD90 and mIBA-ARS, the economic costs are much greater and hence optimality lies rather at the yellow dot. I agree with the general principle that is outlined in this description, but that the specific location of the yellow dot is optimal is nevertheless arbitrary and/or subjective for a number of reasons expressed earlier in this affidavit including the following:

113.1 a number of methodological choices made in the delineation of the mIBA-ARS which are questioned in a number of early responses in this affidavit,

113.2 the selection of which points to represent on the figure which is somewhat arbitrary,

113.3 the scalings accorded to costs and benefits which is somewhat arbitrary, and

113.4 the particular method, as yet unspecified, that was used to draw a convex curve through the points.

114. Paragraph 25.4 notes that for all species (anchovy, directed sardine, redeye and bycatch sardine) the trade-off curves for Stony Point imply optimality (i.e. a yellow dot) which is closer to mIBA-ARS than to any of the other six closure options.

Again I agree with this interpretation of the curves but I reiterate that the reason for this is a series of semi-arbitrary decisions and the application at times of unspecified numerical methods (see point i – iv in 'Response to Weideman Paragraph 25.3). Further interrogation of the methods is needed before such a closure option can be regarded as a reliable trade-off between costs and benefits.

115. Paragraph 25.5 makes the same point as 25.4 and my comment in that case is applicable again.

116. Paragraph 25.6: "We are then able to represent this on a map showing the spatial impacts of the preferred closure relative to the other closure options (as shown in Figure 3 below). We are also able to identify a single closure option as the most appropriate closure delineation for purposes of inclusion in small-scale pelagic purse-seine fishing permit conditions...". The first sentence here draws the reader's attention to spatial features of closures. In response, and in the absence of the dive data validation work recommended by the Panel, I caution against drawing any conclusions based (apparently purely) on the graphical display of penguin foraging tracks and prospective closed areas. The second sentence attracts a similar response to my response in relation to 25.3, 25.4, and 25.5, but this sentence takes it a step further and claims that the areas can be specified as closed in the permit conditions for small pelagic purse seine fishing. This proposal is premature since it would first need to be evaluated and verified as scientifically acceptable and it would not be judged to be acceptable following such scrutiny.

WEIDEMAN: APPLICATION OF THE TRADE-OFF MECHANISM TO SPECIFIC ISLANDS

Weideman: Dassen Island

117. Clause 26.1 of Weideman refers to a figure, Figure 5 which shows a trade-off curve drawn through cost/benefit points for the six closure options. The way that the curve is drawn is unusual since its construction appears to ignore the points for mIBA-ARS and ICE 20 km for species anchovy and redeye. Were the curve to be estimated using a standard statistical approach, it would have passed close to the points in such a manner that some points lie above and some below the curve. That this is not the case again raises a question about how this curve is drawn and also about its objectivity. It is unclear why the curve that is drawn on Figure 5 (record p.188) does not pass closer to the mIBA-ARS point or the 20 km point. Clearly a convex shape cannot pass through all points; this is a standard issue that is resolved in statistical approaches to curve fitting. Weideman does not explain how this issue was addressed, and the impression given is that this has been dealt with in an arbitrary and/or subjective manner. Of high importance however, I note that based on Figure 5 (record p.188), and consistent with her stated method, Weideman should have recommended the CAF option or the DFFE option for Dassen Island, since for all species shown in Figure 5 the CAF closure option or the DFFE options (species dependent) are closer to the yellow dot than for the mIBA-ARS closure option. Despite this, in paragraph 31, Weideman recommends the mIBA-ARS closure option. This amounts to Weideman repudiating her own method.

118. The conclusion in paragraph 27 that the costs to industry start to increase close to the blue diamond, is the result of the somewhat arbitrary assumptions (i) to (iv) she makes; see my response to Weideman paragraph 25.3. However, any discussion of the blue diamond is secondary to the main message from Figure 5 that for Dassen Island, for the curve as drawn, the preferred closure option is either 'CAF' (red triangle) of DFFE 2021 (blue diamond) depending on the species: anchovy (DFFE 2021), directed sardine (CAF) and redeye (DFFE 2021), **and not mIBA-ARS (green dot).**

119. In Para 28 Weideman argues against the application of the DFFE 2021 or CAF closure options for Dassen Island, despite the fact that her identification of the location of the optimal yellow dot is closer to DFFE 2021 or CAF depending on the species caught. I reiterate my response to Weideman paragraph 25.3, but now in the context of Dassen Island instead of Stony Point. In short, this is that the reason that the specific location of the yellow dot is indicated to be optimal is subjective (and will therefore not withstand scientific scrutiny) for a number of reasons expressed repeatedly in this affidavit (viz. problems delineating mIBA-ARS, which points are selected for trade-off evaluations, the relative scaling of costs and benefits, how the trade-off curve has been drawn).

120. All of these reservations are still applicable to the section of the Weideman affidavit dealing with Dassen Island. Paragraph 28 introduces a new criterion into the method of recommending closures which causes the Applicant's preferred option to differ from the point (the CAF option or DFFE 2022, species dependent) closest to the yellow dot. In the case of Dassen Island this criterion is that any preferred option should include '8% of the northern portion of the preferred

foraging area'. This is a subjective departure from the trade-off framework proposed elsewhere by Weideman. This again highlights the need to address the subjectivity mentioned in my response to Weideman Paragraph 25.3.

121. Paragraph 29 is an argument against adopting the DFFE 2021 closure option for Dassen Island because it does not include a northern portion of the penguin foraging area. In response I note that it is clear that within the framework for trade-off proposed by Weideman, the optimal closed area is much closer to 'CAF' or DFFE 2021 (species dependent) than to 'mIBA-ARS'. That she expresses a preference that diverges from the results of the very framework that she has developed and promoted for Stony Point is problematic, since in effect she is repudiating her own proposed method. Another problematic aspect of her arguments in this paragraph is that she bases them on an interpretation of telemetry data which has not been validated by dive data (a key Panel recommendation). Again, such departures from a quantitative framework previously developed and promoted in Weideman, substantiated by a passing reference to unvalidated telemetry data cannot be regarded as sound science to form the basis of a final decision about the optimal closed area.

122. Again but now in paragraph 30, the same criterion about the omission of a northern portion of penguin foraging area is used to modify the optimal trade-off (at CAF or DFFE 2021, species dependent) to bolster support for the mIBA-ARS closure option at Dassen Island. The paragraph suggests that fishing in the northern area will have an impact on the availability of prey to the south. It is not in dispute that fishing will reduce somewhat the amount of fish available to predators such as penguins. However, the question of the quantitative impact of

this is critical[31], and one expects that the proposed trade-off mechanisms would in theory cater for this. If this is not the case, then the framework defended elsewhere by Weideman cannot be viewed as a defensible basis for decisions on island closures.

123. Paragraph 31 is a more or less bland statement of support for the mIBA-ARS closure option at Dassen Island based on a qualitative argument about the importance of the northern portion of penguin foraging areas. Previous comments made here (see immediately above) are applicable to this paragraph. In brief, the preference stated for mIBA-ARS for Dassen Island is a rejection of the framework that was developed earlier and substantiated using Stony Point as an example. It is clear that the Weideman framework supports the 'CAF' or DFFE 2021 closure, and that one of these or, perhaps, their combination should have been Weideman's recommendation consistent with Weideman's framework.

Weideman: Robben Island

124. Para 31.1 says that "Again, we were able to use OBM model outputs for anchovy, directed sardine and redeye only. We could not use bycatch sardine figures from the OBM model as these were erroneous (sometimes eliciting negative results)." It is important in response to emphasise that it is possible that the OBM can produce negative catch loss estimates (in effect a catch gain). The appropriate interpretation of such a result is that the closure will lead to an increase in catch

[31] In relation to this it is relevant that the catches taken are only a small proportion of the biomass that flows southwards and this means that the quantitative impact that they have to reduce the biomass is very small.

for the species under consideration[32]. This is possible and is not an erroneous result. This issue typically arises for species that are minor components of the catch and therefore appears in the results when separating trade-off considerations by species.

125. Paragraph 31.2 refers to Figure 7 which are trade-off curves drawn on a graph together with a plot of the six closure options evaluated by Weideman. The shape of these trade-off curves is puzzling and again raises the question as to how these curves have been drawn or constructed. The curve for anchovy is notably odd since it does not seem to be based on a simple underlying mathematical equation, but rather to involve different components that pass from one point to the next regardless of the shape of the eventual overall curve. The final result appears to be inconsistent with a general statistical preference for parsimony in the mathematical form describing the best fitted curve[33]. Weideman does not report their functional form or how the curves are drawn so there is no basis for accepting their reliability. In Figure 7, for anchovy, the shape of the curve between the mIBA-ARS and the DFFE 2021 point is close to linear. It is not clear why that should be the case. And then between the mIBA-ARS point and the 20 km, the shape reflects strong curvature. Those features that look strange are frequently the same ones that are strong determinants of where

[32] The OBM works by reviewing historic catches within proposed closed areas and, if an alternative catch took place outside this area on that day, replacing the catch 'within' by a selection from the set of

'outside' catches. If there is no catch 'outside' then the catch 'within' is 'irreplaceable', viz. deemed to be lost. If all catches are replaceable, because the replacement catches 'outside' could be higher than those 'inside', the aggregate catch after replacement could be larger, implying a catch gain, or expressed differently, a negative lost catch.

[33] As a further objection to the apparent approach taken by Weideman to draw her curves, overly complex curves such as these risk having more than one point where the slope is 45 degrees, and hence more than one optimal closed area.

MOB

the ("optimal") yellow dot is located on the curve which is a problematic outcome of the way the curve has been drawn.

126. The peculiarities in the trade-off curve mentioned above (the response here to Weideman Paragraph 31.2) are driving the location of the yellow dot. Given that this is a curve fitting exercise, it is very unusual that the curve passes through all 5 points shown in the plot. This violates a number of statistical principles and requirements for curve fitting.

127. I agree with the conclusion in paragraph 33 that Figure 7 as drawn supports that mIBA-ARS is close to optimal and is hence the preferred choice of closure option. However this result overall is highly subjective overall because it depends on points (i) to (iv) in my response to Weideman paragraph 25.3.

128. Paragraph 34 refers to a map (Figure 8) showing a plot of telemetry points and the borders of the closed area options evaluation by Weideman. It is however not appropriate to invoke plots of the telemetry data in apparent qualitative support of the optimal closed area before addressing the dive data validation recommended by the Panel. It remains the case that the result that mIBA-ARS is the optimal closed area in Figure 7 is highly subjective because of points (i) to (iv) in my response to Weideman paragraph 25.3.

Weideman: Dyer Island

129. Paragraph 35 refers to Figure 9 which plots trade-offs for Dyer Island for the four fish species caught. It argues that in the main, the optimal closed area is the DFFE 2021 options (the blue diamond). I do not fault this conclusion for the

curve as drawn, but the result is confounded by the many subjective elements that I have mentioned previously. To focus again on one of these elements, the scaling of the vertical-axis in Figure 9 is inconsistent with its scaling in Figures 5 and 7. The Panel recommended that the existing OBM results can be used in a relative sense, and one assumes that this is applicable when comparing costs across not only closure options, but also across species and across penguin breeding sites. This means that the scaling of the vertical-axis for costs must be appropriately scaled for different species caught and different breeding sites. It cannot be 1 in all the trade-off graphs.

130. In the SAPFIA comments, SAPFIA estimated that 70% of the economic loss due to the mIBA-ARS closures would be those that occur at Dyer Island, a total of ZAR 249 000 000-00. Dassen Island accounts for 5.5% of the economic losses at mIBA-ARS. The following table is the basis for these estimates, and follows from the information provided in Appendix A of the SAPFIA comments.

SPECIES	Dassen	Robben	Dyer	Stony	St Croix	Bird	Total	Value ZAR/MT
ANCHOVY	2013.70	808.60	13628.70	284.00	1.40	0.00	16736.40	ZAR 7,706
RYPIL	70.70	55.20	341.80	19.50	3.20	0.00	490.40	ZAR 7,708
DIRPIL	78.70	4.80	4604.60	952.60	1708.90	32.50	7382.10	ZAR 28,566
REDEYE	155.30	88.80	1213.70	88.80	3.10	0.00	1549.70	ZAR 7,706
Total	2318.50	957.40	19788.80	1344.90	1716.60	32.50	26158.6	
Value of Direct Loss to Pelagic Industry	ZAR 19,507,272	ZAR 7,477,852	ZAR 248,544,449	ZAR 30,235,035	ZAR 48,875,774	ZAR 928,395	ZAR 355,568,778	
% of Cost to Industry by Site	5.5%	2.1%	69.9%	8.5%	13.7%	0.3%	100.0%	

131. The SAPFIA comments did not include estimates of the economic losses at UD90. To illustrate a point only, I take the mIBA-ARS cost ratio Dyer/Dassen to be a proxy for the UD90 cost ratio Dyer/Dassen. From the above table, this ratio is 12.7. Therefore, if, for example, the vertical-axis is correctly scaled for Dassen Island, i.e. there is a cost of 1 at UD90 when the benefit at UD90 is 1 in Figure 5, then following the Panel's recommendation that the OBM results can be treated in relative terms, the vertical-axis value of the graphs in Figure 9 should

5841PP1-2
Sergeant
MB

be 12.7 at UD90 (ignoring for this illustration that the ratios are species dependent) when the benefit to penguins is 1 at UD90. This implies a need to stretch the graphs in Figure 9 vertically by a factor of 12.7, and this will cause the yellow dot shown (which lies where a 45% line touches the curve) to shift to the left to a point where in the current graphs the slope is 1 in 12.7, or a slope of 4.5%, which is an order of magnitude smaller than is shown in Figure 9. This corresponds to a yellow dot substantially to the left of its current location, and highlights the need for consistency in the evaluation of trade-off across different islands with respect to scaling of costs.

132. Paragraph 36 notes that the Interim Closure for Dyer Island is not consistent with DFFE 2021 because of the Inner/Outer Area split regulation regarding vessels larger than 26 m (i.e. no vessel may fish in the Inner Area, and only vessels smaller than 26 m may fish in the Outer Area). Paragraph 36 nevertheless notes that the Outer Area's boundary is aligned with that of the DFFE closure option. These points are further developed in paras 36.1 and 36.2. However, it is notable that Figure 9 for Dyer Island is the first providing a partial graphical representation of the Interim Closure (and this is also seen in Figure 11). It shows by a vertical dashed line the penguin utility score for the Interim Closure, a level of roughly 0.29 (judging by eye). However, this penguin utility score clearly assigns no benefit to the exclusion of vessels larger than 26 m from the Outer Area. This position is at odds with Para 179 of the founding affidavit which seems to imply that the benefit for penguins is related to the amount of catch close to a breeding island, viz.

> "179. The inclusion of this island in closure discussions has always been something of an anomaly. While it is one of the islands with the largest

numbers of breeding pairs and was part of the ICE (which is why it has been included), it is located in an area where very little fishing takes place. It is, therefore, not surprising that a relatively arbitrary closure would not materially affect African Penguin prey access."

133. Only Figures 9 and 11 show a vertical dotted line denoting the penguin utility score for Interim Closures at Dyer Island and St Croix Islands. This is related to the general point made here asking why Weideman did not evaluate results for the Interim Closure. Again it is unclear why the penguin utility score is not shown for the other islands, Dassen, Robben, Stony and Bird. It is reasonable to expect that the penguin utility scores at these islands could be quite large, and it would be important that this is reflected in any deliberations about island closures.

134. Calculations show that for **all** pelagic catches between Cape Point and Cape Agulhas, the mean ratio of catches by vessels >26 m to the total catches by all vessels was **0.42** over the last 10 years. This suggests that excluding vessels >26 m from the larger area at Dyer island would reduce pelagic catches there by about 42%; this must, in terms of the arguments about competition put forward by paragraph 179 of the founding affidavit, imply an additional benefit to penguins.

135. Paragraph 37 states that the Interim Closure at Dyer Island could not be evaluated because no OBM data were available to assess the mixed Inner/Outer Area regulations. These were however made available in SAPFIA (2023, 24 November), so that this is not a valid reason. Weideman concludes by recommending DFFE 2021 as the optimal closed area based on Figure 9.

136. Further in response to paragraph 37: My previous comments (i) to (iv) in respect of paragraph 25.3 referring to the arbitrariness of selecting this as the optimal closed area, and in addition to the failure of the vertical-axis to be consistent with the Panel's recommendations about using the OBM results in a relative sense, are applicable.

Weideman : St Croix Island

137. Paragraph 38, based on Figure 11, concludes that "the best balance between benefits to penguins and costs to industry was the DFFE (2021) closure option". This conclusion is consistent with Figure 11 as drawn. However, my previous comments (i) to (iv) in respect of paragraph 25.3 are relevant to the point that the optimal closed area which is selected is arbitrary since many of the elements underlying Figure 11 are arbitrary (the scale of the vertical-axis, which closure options are evaluated, how the trade-off curve is drawn, how the mIBA-ARS has been calculated etc.). As one example, there is an inconsistency between the scaling of the vertical-axis of Figure 11 with the Panel's recommendations that the OBM results may be used in a relative sense. To take this one step further, the mIBA-ARS costs at St Croix Island are about 2.5 times larger than those at Dassen Island. If one assumes for the purpose of illustration that the costs at Dassen at UD90 are correctly scaled relative to the benefit for penguins, then the vertical scale of Figure 11 needs to be stretched by a factor of 2.5. Inspection of Figure 11 shows that this would shift the yellow dot in the graph to a location close to the CAF point.

Weideman : Bird Island

138. Paragraph 40 argues (a) that the evaluation for Bird Island should focus on directed sardine only, and (b) that the consequence of this and the appropriate interpretation of Figure 13 is that the optimal closure area is the ICE 20 km closure. For (a) it seems safer to plot costs summed over all species, and it is unclear therefore what differences may result. For (b) I agree with this conclusion for the curve as drawn, but my previous comments (response to Weideman Paragraph 38) about the arbitrariness of calculations supporting ICE 20 km refer. Furthermore, given the low cost impacts for closures at Bird Island, consistent scaling of the vertical-axis is required. In the case of Bird Island the costs of mIBA-ARS are less than 10% of those at Dassen Island. Without actually making this adjustment. it is nevertheless evident that this would result in a trade-off point to the right of the yellow dot and the 20 km closure option. I note again my previous point about how the trade-off curve is drawn in Figure 13. It is quite unclear why in this figure the trade-off curve drawn passes directly through the 20km closure point and bypasses the DFFE, mIBA-ARS and CAF points.

139. In response to paragraph 42, I do not agree that application of the trade-off mechanism as stated, i.e. the yellow dot in the curves drawn on Figures 1,2,5,7,9,11,13 leads to the six closures indicated. For Dassen Island the trade-off mechanism described leads to 'CAF' or 'DFFE 2021' (species dependent) and not to 'mIBA-ARS'.

Weideman : conclusion

MOB

140. In paragraph 42 of Weideman she states that a summary of the six closures "resulting from application of the trade-off mechanism" is attached as "EW2". In the concluding paragraph of Weideman 44 she states that she confirms the content of the MIBA method and trade-off mechanism and the expert opinion expressed therein and that she further confirms that the methods and data relied upon are robust, credible and based on methods recognised by Birdlife International and consonant with the trade-off recommended by the Panel.

141. For the reasons given above in my response to Weideman, I do not agree that "EW2" is a summary of the six closures resulting from application of the trade-off mechanism, and I also do not agree that the methods are robust or credible, nor that they are consonant with the trade-off mechanism recommended by the Panel.

FOUNDING AFFIDAVIT: ISLAND CLOSURE PROPOSALS FOR SPECIFIC ISLANDS

Founding affidavit: Dassen Island

142. The Interim Closure is based on the DFFE 2021 proposal. The Applicants seek a closure based on their mIBA-ARS delineation, and contend that "contrary to Panel recommendations" the Interim Closure does not adequately represent the penguin foraging area.

143. The Interim closure at Dassen Island is 941 km2 in extent. The mIBA-ARS proposed in Weideman is 550 km2 in extent.

144. The Interim Closure includes 504.4 km^2 of the mIBA-ARS's 550 km^2 proposed by the Applicants. 504.4 out of 550 km^2 amounts to 91.8%. This means that the Interim Closure at Dassen Island already accounts for 91.8% of the Applicants' proposed island closure there.

145. The penguin utility score for the Interim closure area at Dassen Island has not been determined, but the Interim closure's large areal extent suggests that its penguin utility score would be substantial. In any final trade-off deliberation, the costs of closures would need to be weighed against the benefits to penguins, and it may well be that some compromise is required which would involve keeping certain parts of the mIBA-ARS proposed by the Applicants open for fishing. That the Interim closure excludes a small portion of the Applicants' proposed mIBA-ARS closure area might well be the result of a reasonable trade-off between costs and benefits.

146. The Applicants allege that this Interim Closure is inconsistent with using the best available science to inform environmental management decisions because DFFE 2021 used an outdated method for delineating penguin foraging areas. The Applicants' criticism is however inconsistent with Weideman who proposes DFFE 2021 closures at Dyer and St Croix Islands. The Panel recommended that mIBA-ARS areas should be validated by the use of dive data which has not yet be done. Therefore neither the DFFE 2021 nor the mIBA-ARS area proposals follow the Panel's recommendations.

147. In paragraph 167 of the founding affidavit, the Applicants rely on a qualitative argument pertaining to movement of juvenile anchovies southward between autumn and winter. Anchovy are indeed harvested as they migrate southwards

from recruiting grounds further north. And no doubt fewer anchovy pass certain points on their southward migration than would otherwise be the case in the absence of the fishery. But the proportion of anchovies that are caught in total for the year in all fishing areas combined is about 15% of the biomass available each year. Quantitative rather than the qualitative considerations in paragraph 167 must be the basis for decisions, because amongst other reasons qualitative arguments can lead to non-sequiturs. For example, there will always be fishing to the north of an area that might be closed centred at Dassen Island. Extending closures further and further north to negate the negative impact of fishing to the north of a closed area necessarily leads to closing the entire fishery anywhere north of Dassen Island, but without addressing the cost-benefit trade-off involved.

Founding affidavit: Robben Island

148. The Applicants allege that this Interim closure "is not really a closure at all". That is incorrect.

149. The areal extent of the Interim closure is 227.3 km2 and the areal extent of the Weideman mIBA-ARS proposal is 418.6 km2. The area of overlap is 177.2 km2 which is 42.3% of Weideman's proposed 418.6 km2. The map (record p.96) shows that the blue area (the Interim Closure) overlaps with the dark green area (Core foraging area / mIBA-ARS) to a considerable extent.

150. The Applicants refer to the Interim Closure as being a "mere" 41% of African penguins preferred foraging area and that it covers a "fraction" of the foraging area. Whether it is too small or not should be the subject of an informed and scientifically substantiated quantitative trade-off calculation between costs and

MOB

benefits. My response to Weideman shows that such a trade-off has not and could not have been carried out to date. Further preparatory work is needed including the dive data validation of the mIBA-ARS proposals and further work on the OBM, as well as the use of a numerically logical and robust trade-off calculation procedure.

Founding affidavit: Dyer Island

151. The Interim Closure at Dyer Island closes an area of 255.2 km2 ('Inner Area') to small pelagic fishing and a further 1039.1 km2 ('Outer Area') to fishing by small pelagic vessels larger than 26 m in length. The area proposed for closure in the Weideman affidavit covers 1294.3 km2; and the overlap between this area and the Interim Closures Inner Area is 255.2 km2, which is 19.7% of Weideman's proposed area. Vessels larger than 26 metres in length account for about 42% of catches in the general area of Dassen Island. These vessel exclusions in the 1039.1 km2 'Outer Area' are surely beneficial for penguins, since if the mechanism which drives the negative impact on penguins is the competition between penguins and fishing vessels for fish, it follows that the benefits for penguins must surely be related in some way to the scale of catch by fishing vessels.

152. If one assumes that removing 42% of the catch from the 1039.1 km2 "Outer Area" provides 42% of the benefit to penguins that would result from complete closure, then one could express this benefit as complete closure of 0.42 x 1039.1 = 436.4 km2. This suggests that the effect of the closure arrangement at Dyer Island is equivalent to closing an area of (436.4+255.3) km2, or 691.7 km2, which is 53%

of the Weideman DFFE 2021 closure of 1294.3 km2. This is not insubstantial or inconsequential.

153. Catches by vessels larger than 26 m account for about 42% of catches in the vicinity of Dyer Island, and the logic above when extended suggests that the closure arrangement at Dyer Island may be equivalent to closure of 53% of the DFFE 2021 closed area there.

154. The Applicants' proposal to implement the DFFE 2021 closure at Dyer Island is inconsistent with the case they make that the mIBA-ARS should be adopted, and the Panel recommendation in favour of mIBA-ARS.

Founding affidavit: Stony Point

155. The areal extent of the Interim closure at Stony Point is 84 km2 and the areal extent of the Weideman mIBA-ARS proposal is 269.7 km2. The overlap area is 81.7 km2 which is 30.3% of Weideman's proposed 269.7 km2. Clause 175 states that this "is a closure in name only".

156. The statement that the Interim Closure "cannot possibly help conserve these African Penguins through improving adequate prey availability" is incorrect. The benefits must at least be in proportion to the proportion of the mIBA-ARS that is closed. It seems possible from inspection of the map in paragraph 176 (record p.98) that the Interim Closure encompasses a greater percentage of the penguin foraging area than it does of the mIBA-ARS area. Confirmation of whether this is the case requires further analyses.

Founding affidavit: St Croix

157. The areal extent of the Interim closure at St Croix Island is 579.8 km2 and the areal extent of the Weideman proposal is 809.2 km2. The overlap area is 579.8 km2 which is 71.7% of Weideman's proposed 809.2 km2. The 50% referenced in paragraph 177 is, I presume, the Interim Closure area as a % of the mIBA-ARS. But, Weideman proposes the DFFE 2021 option. Figure 11, paragraph 38 of Weideman argues an optimal trade-off closer to DFFE 2021 than to mIBA-ARS, and shows the following penguin utility scores (reading off the graph crudely):

153.1 Interim Closure (the vertical dashed line): ~0.60

153.2 DFFE 2021: ~0.75

153. mIBA-ARS: ~0.87,

showing that the benefit to penguins from the Interim Closures is about 0.60/0.75 = 80% of that of Weideman's preferred DFFE 2021 closure proposal. Consequently, the statement that "the Interim Closure covers only 50% of African Penguins' preferred foraging area" tells only part of the story and is somewhat misleading.

158. Figure 11 of the Weideman affidavit shows a penguin utility score of about 0.65 for the ICE 20 km closure option (based on crude inspection of Figure 11). Figure 11 also shows a penguin utility score of 0.60 for the Interim Closures. Whether 60% or 65% is sufficient must be "judged" in the context of a trade-off determination. It is entirely possible that the nature of this trade-off (yet to be

considered) is such that 100% protection for penguins is not optimal and that some compromise between economic costs and benefits for penguins must be reached.

Founding affidavit: Bird Island

159. The areal extent of the Interim closure at Bird Island is 836.8 km2 and the areal extent of the Weideman 20 km ICE closure proposal is 831.3 km2. The overlap area is 693.6 km2 which is 83.4% of Weideman's proposed 831.3 km2.

160. Weideman is inconsistent in proposing ICE 20 km at Bird Island. She is also inconsistent with the trade-off procedure she has developed because it is clear from Figure 11 of her affidavit that ICE 20 km is not optimal in her paradigm since the ICE 20 km has a larger cost to industry and a smaller benefit to penguins than options mIBA-ARS and DFFE 2021.

ISLAND CLOSURES WHERE THERE ARE MARINE PROTECTED AREAS IN PLACE

161. The Applicants create the impression that island closures in areas which are already Marine Protected Areas have little benefit to penguins. They are therefore arguing that the benefit comparison which is relevant is the benefit to penguins from the Applicants' proposed closures, minus the benefit that is derived from the MPAs. The estimate made here, viz. that the benefit is between 50 and 106 breeding penguin pairs per annum, is based on the comparison between the situation were the Applicants' proposed closures to be adopted, compared to **no closures at all (viz. no MPAs as well)**. By the Applicants' logic,

had, for illustrative purposes, the mIBA-ARS been declared an MPA in say January of 2024 at Dassen Island, then to now contemplate fishing closures of the mIBA-ARS as a closure would imply no additional benefit to penguins relative to the status quo MPA situation. The benefits derived from MPAs are part of the benefits to penguins that need to be included in the trade-off determination. This is particularly the case for MPAs that were promulgated recently because they would be benefits that can be measured in relation to the trend in the penguin population over a period which predominantly did not have these MPAs in place. In addition there are costs to the industry that are incurred as a result of these MPAs.

162. The following maps show the various MPAs which are pertinent to small pelagic fishing in the context of either the Interim Closures (Figure 10) or the Weideman proposals (Figure 11).

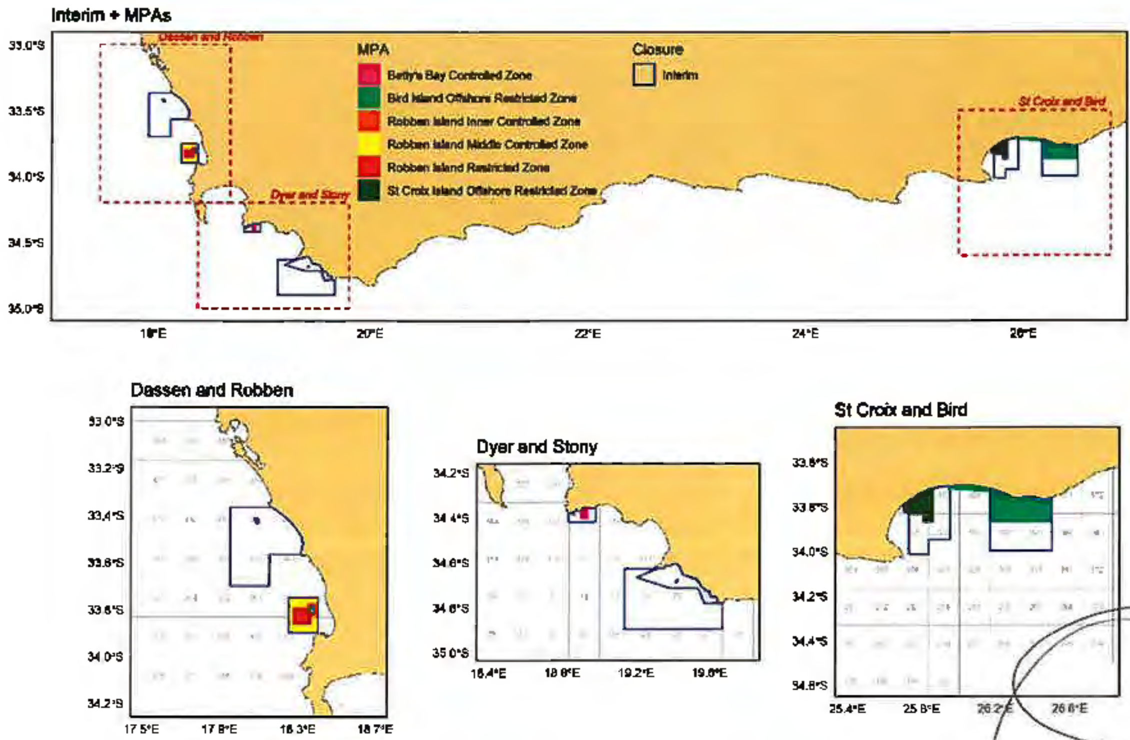


Figure 10. Map of the Interim Closed areas and the MPAs.

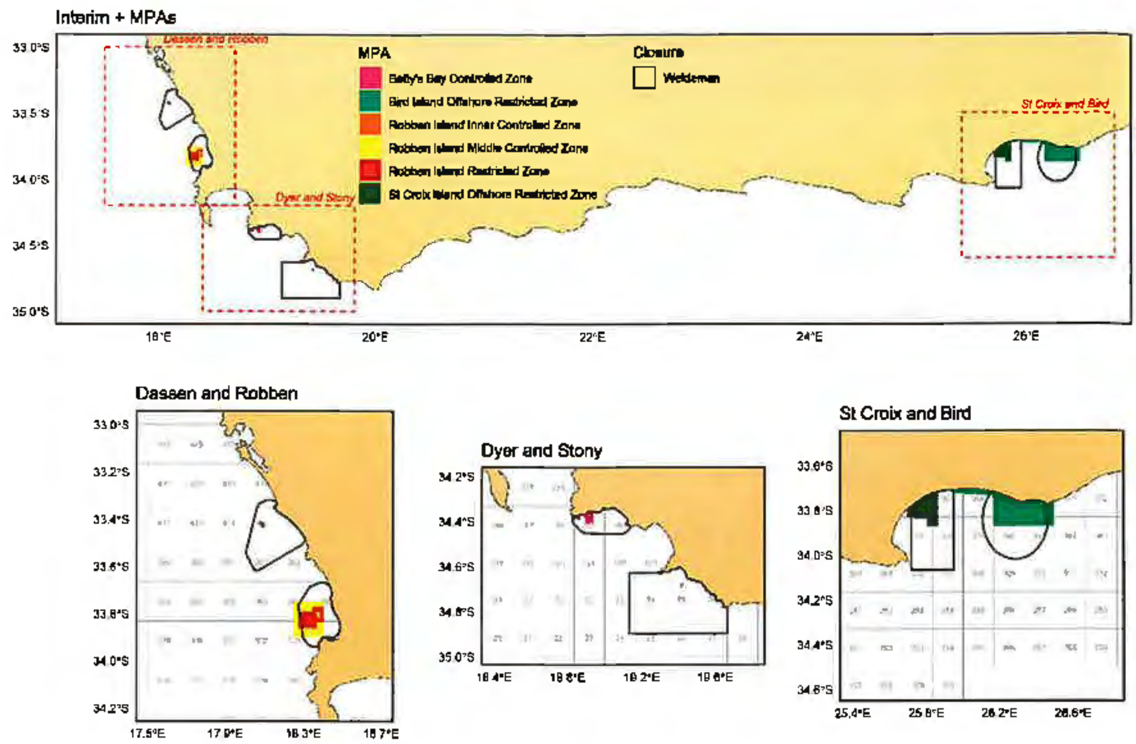


Figure 11. Map of the Applicants' proposed closures and the MPAs.

163. The proclamation dates of these MPAs is relevant to whether they should be part of the benefits to penguins estimated from the ICE.

164. These proclamation dates were:

165. Robben Island: The Robben Island Inner Controlled Zone, the Robben Island Middle Controlled Zone, and the Robben Island Restricted Zone, proclaimed 23 May 2019.

166. Stony Point: The Betty's Bay Controlled Zone, proclaimed in 1981

167. St Croix Island: The St Croix Island Offshore Restricted Zone, proclaimed 23 May 2019

168. Bird Island: The Bird Island Offshore Restricted Zone, proclaimed 23 May 2019

169. Apart from the Betty's Bay Controlled Zone, proclaimed in 1981, the other MPAs were proclaimed on 23 May 2019. The ICE experiment started in 2008 and ran up to 2021, so that the benefits of closures estimated by the ICE include, in the main, any benefits that are contributed by these MPAs, since they were proclaimed close to the end of the ICE experimental period.

170. The selection of the ICE 20 km as the preferred closure option is inconsistent with the Panel's recommendation in favour of mIBA-ARS. It must be the case that the Panel had in mind a set of alternative mIBA-ARS options from which a preference would be developed, but this is not articulated in the Panel's report. Such an approach would avoid the need to opt for non-mIBA-ARS areas as is the case here and in Weideman for Bird Island.

MICHAEL OLAF BERGH

I certify that the above signature is the true signature of the deponent and that he has acknowledged that he knows and understands the contents of this affidavit which affidavit was signed and sworn to before me in my presence at HOUT BAY on this 22 day of August **2024**, in accordance with Government Notice No. R1258 dated 21 July 1972, as amended by Government Notice No R1648 dated 19 August 1977, as further amended by Government Notice No. R1428 dated 11 July 1980, and by Government Notice No R774 of 23 April 1982.

SUID-AFRIKAANSE POLISIEDIENS
HOUT BAY
22 AUG 2024
COMMUNITY SERVICE
SOUTH AFRICAN POLICE SERVICE

COMMISSIONER OF OATHS
FULL NAME: Lucia Sotyantya
DESIGNATION: CST
ADDRESS: M.R Mandela rd

Michael Olaf Bergh: Curriculum Vitae July 2024

Date of Birth: 20 September, 1957. **Place of Birth:** Paarl, Western Cape, South Africa.
Nationality: South African. **Marital status:** Married, Four Children, **Home Language:** English.
Work Address: Silvermine House, Steenberg Office Park, Tokai, 7945, South Africa, Ph: 27 21 – 702 4666. **Cell phone number:** 072 7691326, **Email address:** mike@olsps.com, **Company Website:** www.olsps.com

Education

1979: B.Sc. Chemical Engineering (First Class Hons.), University of Cape Town, South Africa.
1986: Ph.D., University of Cape Town, South Africa (Department of Applied Mathematics). Fisheries stock assessment thesis.

Career Path:

1982 - 1986: Scientific Officer, Marine Biology Research Institute and Department of Applied Mathematics, University of Cape Town (Ph.D. Research).
1986: Senior Scientific Officer, Department of Applied Mathematics, University of Cape Town.
1987: Post-Doctoral Fellow and Associate Specialist, Division of Biological Control, University of California, Berkeley, USA.
1988 - 1989: Post-Doctoral Fellow and Research Associate, Fisheries Research Institute, University of Washington, Seattle, USA.
1989 - 1994: Senior Lecturer in Living Renewable Resource Management, Department of Zoology, University of Cape Town.
1989 – 2012: 50% co-owner of Ocean and Land Resource Assessment Consultants (OLRAC). **Discipline:** Fisheries Management, Quantitative Fisheries Science.
2000 – 2012: 50% co-owner of SPSS-SA (www.spss-sa.com). **Discipline:** Statistics, Data Mining, Predictive Analytics and Mathematical Modelling.
2012 – 2016: 50% co-owner of OLRAC SPS South Africa and OLRAC SPS International (OLRAC SPS is the result of a merger between OLRAC and SPSS-SA). **Discipline:** Fisheries Management, Statistics and Mathematical Modelling.
2017 – 2024: 50% co-owner of OLSPS Solutions and OLSPS Marine (www.olsps.com), significant shareholding of OLSPS Analytics. **Disciplines:** Data Mining, Predictive Analytics, Mathematical Modelling, Fisheries Science, Fisheries Stock Assessments, Multivariate Statistics, Fisheries Management, Statistics and Mathematical Modelling.

Current role and activities

My present position is Technical Director, OLSPS Marine and OLSPS Analytics. I attend all scientific meetings convened by the South African government to develop management advice for South African small pelagic and demersal stocks, and West (***Jasus lallandii***) and South Coast (***Palinurus gilchristi***) rock lobster fisheries. I lead a technical team which is involved in the stock assessments of the main target species, and in the development of management strategies for these species. I advise and liaise with the South African fishing industry through their associations and develop alternative harvesting strategies and approaches where appropriate in consultation with these bodies. I am also involved in various aspects of the inter-relationship between small pelagic stocks and seabird populations, with a particular focus on the African penguin. Each year, together with my team, I authored numerous technical submissions to scientific committee meetings, some of which are highlighted below. Beyond the commitments I have to South African fisheries, each year I take on a number of other ad hoc consulting projects for South African fisheries and for fisheries elsewhere in the world. I have also involved in the development of mathematical models for the management of abalone farming operations. In addition to fisheries, I manage the technical aspects of data mining and predictive analytics projects carried out by OLSPS Analytics, an IBM Business Partner. These business activities are concerned with non-fishing sectors in South Africa and sub-Saharan Africa, including telecommunications, insurance, banking, governmental and educational sectors.

Years of experience:

38 years +

Countries worked, and/or location of projects:

South Africa, Argentina, Namibia, USA, Australia, Botswana, Swaziland, Papua New Guinea, Falklands Island, Scotland

Key contracting fisheries related organisations while employed by OLRAC-SPS and OLSPS Marine

1. **South African Fishing Industry Associations:** The South African Squid Management Industry Association, the South African Patagonian Toothfish Industry Association (SAPTIA), the South Africa Pelagic Fishing Industry Association, the West Coast Rock Lobster Sea Management Association (South Africa), the South Coast Rock Lobster Association (South Africa), the Deep-Sea Trawling Industry Association (South Africa), Consortium of Midwater Horse Mackerel Trawlers, South Africa.
2. **Namibian Fishing Industry Associations:** The Namibian Hake Association, Association of Pelagic Quota Holders of Namibia
3. **Australia:** The South-East Trawl Fishing Association, Australia, the Great Australian Bight Trawl Association, Australia, the Australian Fisheries Management Authority, Canberra, Australia, the West Australian Zone C Rock Lobster Association
4. The Natal Sharks Board (South Africa)
5. The Marine Diamond Mining Association (South Africa)
6. **South African Government:** The Land and Agricultural Policy Centre, The Department of Environmental Affairs and Tourism
7. The GTZ program and the Namibian Government.
8. The BCLME – Benguela Current Large Marine Ecosystem
9. Various private organisations in the fishing industry (South Africa).
10. The Food and Agriculture Organisation (FAO).
11. The Marine Stewardship Council, Southern Africa.
12. **NGO's:** Oceana, Washington D.C. USA, BirdLife South Africa, WWF Mozambique.
13. The African Union IBAR.
14. The National Fisheries Authority, Papua New Guinea.
15. The Falkland Islands Government.
16. The European Maritime and Fisheries Fund

Technical reports over the years number in the several hundred written submissions, varying in length from short 3 or 4 page documents to documents in excess of 100 pages long. Topics include mathematical and statistical modelling, quantitative fisheries stock assessments, fisheries policy studies, ecological impact studies, fisheries development proposals, general fisheries management proposals, experimental designs and analyses. Some pertinent recent **technical reports authored or co-authored by Mike Bergh are:**

- Revised Estimates of Seabird Mortality in the South African Offshore Trawl Fishery: 2006 to 2010. Prepared by OLRAC-SPS and BirdLife South Africa. **Client: The Responsible Fisheries Alliance (RFA).** August 2012. 24 pp.
- Preliminary analysis of toothfish catch, CPUE, size structure and mark-recapture data from SSRUs 48.6A and 48.6G, with comments on the sustainability of different harvest levels. September 2012. Client: **A Private Operator in the Toothfish Fishery**
- An analysis of the economic benefits related to MSC certification of the South African hake trawl fishery. November 2013, 120pp. **Client: The Marine Stewardship Council.**
- South Africa Country Feasibility Study: Fisheries review. 252 pages. By Dr Mike Bergh (Project Leader), Dr Philippe Lallemand, from OLRAC-SPS, Cape Town and Prof Merle Sowman and Dr Serge Raemaekers from EEU, University of Cape Town **June 2014. Client: Oceana, Washington D.C., USA**
- **Final Report:** The economic impact of penguin island closures on the pelagic fishing industry. November 2015. (Original Submission (FISHERIES/2015/OCT/SWG-PEL/36): October 2015), Revised: November 2015 (FISHERIES/2015/NOV/SWG-PEL/40). 102 pp. **Report prepared for the Pelagic Working Group of DAFF, RSA.**
- **A review** and assessment of the economic, social and environmental impact of illegal, unreported and unregulated fishing in Africa. June 2016. **Report prepared for AU-IBAR.** 202 pp. **Report prepared for AU IBAR.**
- Mouat, B., Bergh, M., Shelmerdine, R. L. and K. Leach (2017). Scottish Inshore Fisheries Integrated Data System (SIFIDS): Review and Optimisation of Shellfish Data Collection Strategies for Scottish Inshore Waters. Published by MASTS, 164 pp
- Bergh, M.O., Fourie, A. and N. Joselson. 2016. Modification of the prevailing species, sex, age and size disaggregated hake stock assessment model to incorporate hake cannibalism and inter-species predation.

MOB

OLRAC SPS, Silvermine House, Steenberg Office Park, Tokai 7945. 8 November 2015. Revised 26 November 2015: ADMB vs TMB benchmarking. **FISHERIES/2016/MAR/SWG-DEM/06. Submission to a scientific committee charged with formulating management advice for the South African hake fishery.**

- Economic Study on Major Trends in the Tuna Industry and its Impact on the Seychelles Economy over the 5 Year Period, 2009-2013; prepared for the Indian Ocean Commission as part of the Smartfish programme; in collaboration with Dr Philippe Lallemand from OLSPS Marine, Cape Town. Completed June 2015.
- **The development of a fisheries bioeconomic model** for shrimp and octopus (Aménagement durable des Pêcheries du Sénégal [ADuPeS]); prepared for the Ministry of Fisheries and the Maritime Economy (MPEM), Republic of Senegal, in collaboration with and supporting Dr Philippe Lallemand from OLSPS Marine, Cape Town. Completed April 2017.
- A consultancy to review the past and present foreign fisheries access arrangements in selected member states of the AU from Northern, Eastern and Southern Africa; prepared for the AU IBAR in collaboration with Dr Philippe Lallemand from OLSPS Marine, Cape Town. Completed July 2017.
- A study of the obstacles to the implementation of international fisheries instruments in North African states; prepared for the AU IBAR by Dr Mike Bergh and Willem Malherbe from OLSPS Marine. Completed October 2018.
- Capacity building for fisheries statistical data collection analysis and utilisation of scientific data for informed decision-making in fisheries and aquaculture; prepared for AU IBAR by Drs Mike Bergh and Amos Barkai and Pete Fielding from OLSPS Marine. Completed September 2016.
- **MSC and the PNA:** Applicability and validity of the MSC's "Theory of Change" to the PNA's tuna purse seine fishery, by Mike Bergh, Philippe Lallemand and Pete Fielding. Client: Sharkproject. 136 pages.
- **Abalone farming:** Danger Point Harvesting Optimisation R&D. June 2019. The development of optimised harvesting strategies and software solutions for cohort specific abalone farming. Mike Bergh and Rikus Combrinck. Client: I&J. Includes as well numerous developments concerned with inventory control on an abalone farm.
- **Small pelagics:** Numerous studies on the quantitative management of small pelagic stocks in South African waters. These include extensive checks on the stock assessment ADMB code used by the scientific working group, and technical reports on numerous aspects of the scientific management of these stocks. Work carried out in 2016 - 2024. Collaboration with Albie Fourie.
- **Toothfish:** A review of Falklands Island toothfish stock assessment and management, August 2018. By Mike Bergh, OLSPS Marine (www.olsps.com), Silvermine House, Steenberg Office Park, Tokai 7945, Cape Town, South Africa. Prepared for The Falkland Islands Government. 41 pages.

Publications: 19 in print in the following journals:

- Springer-Verlag, Ecological Studies Series
- Canadian Special Publication of Fisheries and Aquatic Sciences,
- Fisheries Research,
- South African Journal of Marine Science,
- Natural Resource Modelling, Rep. int. Whal. Commn.,
- Theoretical Population Biology,
- Journal of Mathematical Biology,
- Springer-Verlag, Lecture Notes on Coastal and Estuarine Studies,
- Colln scient. Pap. int. Commn SE. Atl. Fish.,
- Int. Symp. Upw. W. Afr., Inst. Inv. Pesq. Barcelona,
- Journal of Plankton Research
- Fisheries Research, special issue on "Fisheries certification and eco-labelling: benefits, challenges and solutions".