International review of some aspects of the Island Closure Experiment

Document List

Primary documents

1. FISHERIES/2020/DEC/SWG-PEL/REVIEW/01 – International review of some aspects of the Island Closure Experiment. Terms of Reference and Organisation Details.

2. FISHERIES/2020/DEC/SWG-PEL/REVIEW/02 – This document list.

3. FISHERIES/2020/DEC/SWG-PEL/REVIEW/03 – Question Q1: Summary Document.
This document combines pertinent comments and responses contained in various documents submitted to the Small pelagic Working Group during the course of 2020 that are associated with Question Q1.

4. FISHERIES/2020/DEC/SWG-PEL/REVIEW/04 – Question Q2: Summary Document.
This document combines pertinent comments and responses contained in various documents submitted to the Small pelagic Working Group during the course of 2020 that are associated with Question Q2.

5. FISHERIES/2020/DEC/SWG-PEL/REVIEW/05 – Question Q3: Summary Document.
This document combines pertinent comments and responses contained in various documents submitted to the Small pelagic Working Group during the course of 2020 that are associated with Question Q3.

Background documents

1. FISHERIES/2020/DEC/SWG-PEL/REVIEW/06 – Question Q4: Summary Document.
Note that g*iven the large amount of additional material that this question would require the Panel to review in order to answer this question, and the delay in getting material to the Panel members, they have recommended that this question not form part of the ToR for this review. In the interests of transparency and for the benefit of others who have not seen these summarised arguments, this document will be retained for background purposes.*

Pertinent SWG-PEL AND MARAM/IWS documents referred to in Q1-Q3 summary documents
(Chronological order, *summaries are included where provided in the original document***)**

2015

Penguin Island Closure Task Team (M.O. Bergh, D.S. Butterworth, K.L. Cochrane (chair), T.L. Morris, R.B. Sherley and H. Winker). 2015. Specifications for operating models to evaluate bias in estimation methods in accordance with recommendation A.1 of the 2014 International Review Panel. MARAM/IWS/DEC15/PengD/P1. Pp. 1-10.

Penguin Island Closure Task Team (MO Bergh, DS Butterworth, KL Cochrane (chair), TL Morris, RB Sherley, H Winker). 2015. Consolidated analyses produced in implementation of the approaches described in document MARAM/IWS/DEC15/PengD/P1. MARAM/IWS/DEC15/PengD/P2. Pp. 1-40.

Dunn A, Haddon M, Parma AM and Punt AE. 2015. INTERNATIONAL REVIEW PANEL REPORT FOR THE 2015 INTERNATIONAL FISHERIES STOCK ASSESSMENT WORKSHOP 30 November–4 December 2015, UCT. MARAM/IWS/DEC15/General/8.

2016

Ross-Gillespie A, Butterworth DS. 2016. Penguin power analyses using the approach recommended by the international panel: methods and results. FISHERIES/2016/NOV/SWG-PEL/ Peng/01. Pp. 1–31. Also referenced as MARAM/IWS/DEC16/Peng Clos/P1.
The panel report for the 2015 International Stock Assessment Workshop (IWS) provided a detailed outline of the penguin power analysis procedure which it recommended. Over the course of the last year, this procedure has nevertheless needed to be refined in consultation at times with two of the panel members, and with reference to the Penguin Task Team (PTT). This document provides the details of the refined methods and the data used, and also the results for the set of runs prioritised by the PTT in implementing the panel's recommendation.

Butterworth DS. 2016. On the use of aggregated vs individual data in assessment models. MARAM/IWS/DEC16/Peng Clos/P3. Pp.1-6
The conventional two-step process in fisheries assessments, whereby data are first aggregated to provide typically annual values before those are input to the assessment model, is compared to a single-step process where the individual data are input directly to the assessment model. The key point at issue is whether or not the latter process would provide estimates of key parameters that are (and are reliably estimated to be) more precise in circumstances where there is non-independence in the individual data. Arguments are offered that this non-independence does not introduce bias into estimates of precision for the aggregated case when observation error variance in the data is much less than process error variance in the assessment model. The utility of the random effects approach for addressing non-independence through working with individual data in a single-step process is queried; this is because of uncertainty about the bias in estimates of precision that may arise because of a lack of knowledge in most situations whether the structure assumed for the random effects will adequately account for the actual (and usually unknown) sources of non-independence in the data. Some aspects of the issue are illustrated by quantitative examples

Sherley RB. 2016. Additional analysis suggested in response to differences in variance estimates between Sherley (2016) and Ross-Gillespie & Butterworth (2016). Document: MARAM/IWS/DEC16/Peng Clos/P4. Pp. 1-3.

Dunn A, Haddon M, Parma AM and Punt AE. 2016. INTERNATIONAL REVIEW PANEL REPORT FOR THE 2016 INTERNATIONAL FISHERIES STOCK ASSESSMENT WORKSHOP 28 November–2 December 2016, UCT. MARAM/IWS/DEC16/General/7.

2019

Ross-Gillespie A, Butterworth DS. 2019. Updated GLMM results for the South Coast penguin colony foraging data. Document: FISHERIES/2019/NOV/SWG-PEL/27rev also referenced as MARAM/IWS/2019/PENG/P2. Pp. 1-12.
Applies the current DEA Pelagic Working Group standard fixed effects model approach to estimate the effects on penguins of fishing in the neighbourhood of the Bird and St Croix islands, based on annual averages of penguin response variables from foraging data.

Ross-Gillespie A, Butterworth DS. 2019. Results for GLMM analyses of the South Coast penguin colony chick condition data. Document: FISHERIES/2019/NOV/SWG-PEL/33 also referenced as MARAM/IWS/2019/PENG/P3. Pp. 1-5.
Applies the current DEA Pelagic Working Group standard fixed effects model approach to estimate the effects on penguins of fishing in the neighbourhood of the Bird and St Croix islands, based on annual averages of penguin response variables from **chick condition** *data.*

Sherley RB, Barham BJ, Barham PJ, Campbell KJ, Crawford RJM, de Blocq A, Grigg J, Le Guen C, Hagen C, Makhado AB, McInnes A, Meyer A, Morris T, Pichegru L, Steinfurth A, Upfold L, van Onselen M, Visagie J, Weller F, Winker H. 2019. A Bayesian approach to understand the overall effect of purse-seine fishing closures around African penguin colonies. Document: FISHERIES/2019/NOV/SWG-PEL/32rev) also referenced as MARAM/IWS/2019/PENG/P4.
A Bayesian approach based on models using individual penguin response variable data to estimate the effects on penguins of fishing in the neighbourhood of the island colonies from response variables measured during island closure experiments.

Butterworth, D. S. & Ross-Gillespie, A. (2019) Is pseudo-replication biasing results from analyses from the island closure experiment which model individual penguin responses directly? Document: MARAM/IWS/2019/PENG/P5. Pp. 1–10.
A simple simulation study is used to investigate the impact of possible pseudo-replication arising from the use of individual penguin observations, in contrast to annually aggregated measures, in analyses of the island closure experiment which attempt to estimate the possible effect on penguins of closure of the neighbourhood of these islands to pelagic fishing. Unlike the case for estimators based on annually aggregated inputs, those based on the use of individual observations are found to lead to possibly substantially negatively biased estimates of the standard errors of the parameter that reflects the effect on penguins of these closures. This means that past results concerning the statistical significance and probabilities that island closures impact penguins from analyses based on individual observations need to be reconsidered. Previous analyses using this approach should ideally be repeated based on year-aggregated inputs, and future analyses need to avoid repeating this earlier approach.

Sherley RB, Winker H. 2019. Some observations on comparisons of fitting to the annual means and the observation-level data for the cases in MARAM/IWS/DEC19/Peng/P4 that support a positive effect of the island closures experiment on African penguins. Department of Environment, Forestry and Fisheries Report: MARAM/IWS/2019/PENG/WP3. Pp. 1–5.
Over the course of the 12 years of the Island Closures (Feasibility Study) Experiment, Butterworth and colleagues have argued repeatedly that it is preferable to fit to annual means rather than fit to disaggregated data at the level at which the observations were collected (e.g. from individual birds or nests) and use mixed models with random effect structures that account for hierarchical sources of variation implicit to the sampling design (e.g. Butterworth & Ross-Gillespie 2019). Together with others, I have refuted this each time (e.g. Winker & Sherley 2019) as it is not consistent with modern approaches in either fisheries or ecological science (e.g. Hilborn and Liermann, 1998; Gelman and Hill, 2007; Pinheiro and Bates, 2009; Zuur et al., 2009; Thorson and Minto, 2014). Nevertheless, here I consider whether results from using the annual means remain consistent with the findings in Sherley et al. (2019, MARAM/IWS/DEC19/Peng/P4) for two cases that support a positive effect of the island closures experiment.

Die DJ, Punt AE, Tiedemann R, Waples R and Wilberg MJ. 2019. International Review Panel Report for the 2019 International Fisheries Stock Assessment Workshop, 2–5 December 2019, UCT. Document MARAM/IWS/2019/General/5.

2020

Butterworth D.S. 2020. On estimates of the impact of fishing from analyses of the island closure experiment which model individual penguin responses directly. Department of Environment, Forestry and Fisheries Report: FISHERIES/2020/JAN/SWG-PEL/08. Pp. 1-5.
Empirical comparative results available, and consideration of a limiting case, are used to inform on aspects of the use of estimates from individual data-based approaches on the impact of fishing when conducted near penguin colonies.

Ross-Gillespie A, Butterworth DS. 2020. Updated implementation of the Algorithm recommended by the Panel for the 2016 International Stock Assessment Workshop for assessing whether or not to continue with the penguin island closure experiment. Department of Environment, Forestry and Fisheries Report: FISHERIES/2020/JAN/SWG-PEL/09rev. Pp. 1–17.
The analysis conducted late in 2016 to apply the algorithm recommended by the international Panel to evaluate the results of the island closure experiment is extended to include the further data now available, as well as to incorporate results further response variables for which data have been provided, making for a total of seven variables in all. For Dassen Island, all the response variables except for chick survival give little to no indication of a biologically meaningful negative impact of fishing on the penguin population. For Robben Island, two of the data sets (chick condition and fledging success) provide evidence for a meaningful negative impact of fishing; the other response variables give little indication of such an impact. For all the variables not currently reflecting such an impact (except for chick survival at Robben island), at least an additional 20 years' data would be required before there is an 80% probability of detecting such an impact, if it is indeed present.

Sherley RB. 2020. Revisiting the key results in MARAM/IWS/2019/PENG/P4 in light of the 2019 Panel recommendations. Report: FISHERIES/2020/JUL/SWG-PEL/53rev. Pp. 1–27.
Here, I have refit the three key models in MARAM/IWS/2019/PENG/P4 (Sherley et al. 2019) using model selection, model averaging and best-practise guidelines (Zuur et al. 2009) to choose the best fitting random effect structure (as recommended by Die et al. 2019). I have also updated the chick survival analysis for the Western Cape island pair (Robben Island and Dassen Island) to include the most recent data, so all analyses now span 11 years from 2008 to 2018. Based on the best fitting models, Chick Condition at Robben Island improved by 23% (Highest Posterior Density Interval, HPDI: −5–51%) when purse-seine fishing was banned around the island. Although the 95% HPDI overlapped zero for this effect, 96% of the posterior samples were positive. There was also weak evidence for a Closure effect at Dassen Island, with 85% of all the posterior estimates being positive. Four models were well supported for the Eastern Cape Maximum Distance dataset; based on the model averaged results, the penguins foraged 28% (HPDI: 14–44%) closer to St. Croix Island during 'Closed' years. Finally, based on the best fitting model, Chick Survival increased by 10% (HPDI: 6–15%) at Robben Island and 11% (HPDI: 5–16%) at Dassen Island during 'Closed' years, relative to 'Open' years. By updating the Overall Closure Effect, I found there is 3 times more evidence for a positive Closure effect than for no effect at present. Further consideration of whether it is sensible to include 'Island' in the random component of these models is warranted. Nevertheless, the inference about the effect of the fishing closures is now stronger than reported in Sherley et al. (2019). Moreover, the results presented here, in Sherley et al. (2019), and in the recent update of the MARAM power analysis (Ross-Gillespie and Butterworth 2020) broadly agree that biologically meaningful effects of fishing around African penguin breeding colonies are apparent on variables (e.g. chick survival) that impact the demographic process.

Butterworth D.S. 2020. A response to Sherley: FISHERIES/2020/JUL/SWG-PEL/53REV. Department of Environment, Forestry and Fisheries Report: FISHERIES/2020/AUG/SWG-PEL/82. Pp. 1–38.
Sherley's document below, as it states, provides a response (in commendable detail) to some suggestions made by the 2019 International Review Panel regarding the selection of random effects structures for models to estimate the closure effect from the island closure experiment which Sherley and colleagues have submitted previously. That goes to the question of how best such models might

remove the effects of non-independence (or pseudo-replication) in the individual measurement data they use to prevent their providing negatively biased estimates of the standard errors of these closure effects.
However, the document fails to address the more basic question of whether, even if perhaps such removal may be achieved, the use of such individual data can provide improved (lower standard error) estimates of such precision compared to those based on annually aggregated values of the corresponding response variables. This is the issue raised, for example, in the last section of FISHERIES/2020/JAN/SWG-PEL/08, where a limiting case example is used to suggest that this may not be so.

Sherley RB. 2020. Some comments on FISHERIES/2020/JAN/SWG-PEL/08. Department of Environment, Forestry and Fisheries Report: FISHERIES/2020/AUG/SWG-PEL/83. Pp. 1–5.

Bergh M. 2020. Comments on "Revisiting the key results in MARAM/IWS/2019/PENG/P4 in light of the 2019 Panel recommendations (FISHERIES/2020/JUL/SWG-PEL/53REV) by Richard B. Sherley". Department of Environment, Forestry and Fisheries Report: FISHERIES/2020/AUG/SWG-PEL/84. Pp. 1–4.

Sherley RB. 2020. A response to Butterworth: FISHERIES/2020/AUG/SWG-PEL/82. Department of Environment, Forestry and Fisheries Report: FISHERIES/2020/SEP/SWG-PEL/85. Pp. 1–23.

Sherley RB. 2020. Some observations on comparisons of fitting to the annually aggregated and the individual data, this time using JAGS and for the cases considered in FISHERIES/2020/JUL/SWG-PEL/53REV. Department of Environment, Forestry and Fisheries Report: FISHERIES/2020/SEP/SWG-PEL/86. Pp. 1–4.

Sherley RB. 2020. A reply to Bergh: FISHERIES/2020/AUG/SWG-PEL/84. Department of Environment, Forestry and Fisheries Report: FISHERIES/2020/SEP/SWG-PEL/87. Pp. 1–18.

Sherley RB. 2020. Model selection results for the remaining penguin metrics that can currently be fitted using an individual data approach. Report: FISHERIES/2020/SEP/SWG-PEL/89.

de Moor CL. 2020a. A simple summary of the penguin island closure analysis. Department of Environment, Forestry and Fisheries Report: FISHERIES/2020/SEP/SWG-PEL/95. Pp. 1-7.
This document attempts to summarise in 'lay-mans' terms the results currently available from two different sets of analyses about the penguin island closure experiment to assist SWG-PEL participants in management and potentially further analysis/experiment recommendations.

Butterworth D.S. 2020. Summary comments on analyses of the island closure experiment. Department of Environment, Forestry and Fisheries Report: FISHERIES/2020/SEP/SWG-PEL/96rev. Pp. 1–5.
Based on a summary of issues raised in recently submitted documents, the conclusion is drawn that existing analyses based on annually-aggregated data are fully acceptable for consideration in developing management recommendations regarding possible future island closures., but that those based on individual data are not. The reason for this last statement is that results based on a methodology which an unchallenged proof has shown to be flawed are necessarily considered to be unreliable. It is also suggested that sufficient analyses of existing data using the estimation model of the 2016 Panel Algorithm are available to allow for proceeding towards formulation of recommendations. However, discussion is first needed on the response variables to be considered, reconciliation of apparent conflicts amongst some of these, and the criteria/considerations to be taken into account in developing those recommendations. In future, an important prerequisite will be a re-emphasis of the need to follow agreed protocols when engaged in a comparative analysis exercise such as this.

Bergh M. 2020. Summary comments on the Penguin Island Closure Experiment. Department of Environment, Forestry and Fisheries Report: FISHERIES/2020/SEP/SWG-PEL/99. Pp. 1-2.

de Moor CL. 2020. A proposal for future penguin island closures. Department of Environment, Forestry and Fisheries Report FISHERIES/2020/OCT/SWG-PEL/102. Pp. 1-3.
A proposal for moving forward from the penguin island closure experiment conducted between 2008-2020 is presented, suggesting that Robben and St. Croix Islands can now be closed for an "extended period" from 2021, that the current experiment be continued around Dassen Island in the short-term while further understanding of the current 'counter-intuitive' results is obtained and that Bird Island be opened for an "extended period" from 2021.

Butterworth D.S. 2020. A proposal for a basis to consider future island closures, taking account especially of the current results from the island closure experiment. Department of Environment, Forestry and Fisheries Report FISHERIES/2020/OCT/SWG-PEL/103. Pp. 1-5.
This document provides proposals for a basis to consider future island closures, first taking account of the results to date for estimates of the impact of closure parameter δ from the island closure experiment obtained using the 2016 Panel algorithm. A pragmatic approach is adopted, given difficulties arising from outstanding matters of interpretation of the input data, which require further discussion. In essence, based only on the indications (which currently remain unclear) of whether or not biologically meaningful effects of closure on the penguin populations concerned have been demonstrated, suggestions are made to open Dassen island, to increase the relative frequency of closures at Robben island, and to maintain the current experimental closure schedule at St Croix and Bird islands with a possible increase in closure frequency at the former and decrease at the latter. In this situation, with important aspects of uncertainty still remaining concerning whether and to what extent closures might benefit penguins, final decisions will need to be based on trade-offs. These need to be quantified to the extent possible; they relate to the potential benefits to the penguins and the losses to the fishing industry in terms of financial returns and employment under different future closure proposals. The PWG will need to provide a summary of those benefits and losses, and some suggestions are made in that regard. Furthermore, continuation of the experiment in some form so as to better estimate closure impact parameter values obviously requires continuation of monitoring of at least some of the penguin response variables considered to date at all four islands; hence, plans to do so need to be confirmed.

Makhado A, McInnes A, Hagen C, Sherley R, Waller L, Pichegru L, Shannon L, Shaw K, Olds A, Ludynia K, Jarre A, Crawford R, Barham P, Masotla M, Carpenter-Kling T, Stassen M. 2020. Recommendations for island closures around African Penguin colonies. Department of Environment, Forestry and Fisheries Report: FISHERIES/2020/OCT/SWG-PEL/105REV. Pp. 1-8.
Results of the island closure experiment for African Penguins continue to be debated although they are scheduled to inform fisheries management recommendations by the end of 2020. Despite technical statistical issues around different modelling approaches, the most recent set of results that has followed due diligence in terms of meeting external review processes demonstrates 2 – 3 times more evidence for positive effects of fishing closures on breeding penguins than no effects. Based on these results we strongly recommend that closures be implemented around the 6 largest colonies which make up approximately 90% of the African Penguin breeding population in South Africa. Lack of action in implementing sustainable management interventions will not only have dire consequences for Africa's only penguin species but will also affect the socio-economic benefits that this species provides. Moreover, a failure to implement an effective ecosystem approach to fisheries management within the Benguela Upwelling System will not only influence the status of African Penguins but will also have an impact on other top predators that utilise this system (some of which also have significant commercial and eco-tourism value) and the health of this ecosystem more broadly.

Butterworth D.S. 2020. A Response to FISHERIES/2020/JUL/SWG-PEL/102. Department of Environment, Forestry and Fisheries Report: FISHERIES/2020/OCT/SWG-PEL/110. Pp. 1-6.

Comments in the form of embellishments and caveats are added to the information and suggestions provided in PEL/102. The relative power of alternative future closure patterns should be evaluated by simulation before any choice might be made. Clarification of what future monitoring data are planned to be collected is important. Discussion to clarify different hypotheses on the manner in which closure impacts penguins is required, as this is pertinent to assessing the possible impact of recent MPA declarations on analyses of the impact of closures. In summarizing results for decision makers, benefits for and costs to both penguins and industries need to be quantified; this exercise will need to distinguish (possibly defensibly differing) expert judgements from individual preferences regarding risk, as eventual decisions related to the latter are the responsibility of the decision maker.

Butterworth D.S. 2020. Response to FISHERIES/2020/JUL/SWG-PEL/105. Department of Environment, Forestry and Fisheries Report: FISHERIES/2020/OCT/SWG-PEL/111. Pp. 1-13.
Comments are offered on many of the assertions made in PEL/105. A key overall concern is the absence of clear explanations/evidence for the reasons for the decline in the penguin population. Even if (presently contested) estimates of a beneficial impact for penguins of closure around the vicinity of penguin colonies were to be accepted, such closures are nevertheless projected to have relatively little impact on arresting this decline. Assertions of poor ecosystem health and implications of an excessive negative impact of pelagic fishing on the ecosystem are questioned. Ultimately decisions about island closures require decision makers to be presented with summarised costs for and benefits to penguins and the industries involved; existing industry cost analyses offer rather different perspectives on this, and most require critical review before they might be used to contribute to such summaries.

Bergh M. 2020. Comments on FISHERIES/2020/SEP/SWG-PEL/105REV, "Recommendations for island closures around African Penguin colonies". Department of Environment, Forestry and Fisheries Report: FISHERIES/2020/OCT/SWG-PEL/113. Pp. 1-11.

Sherley RB. 2020. Refitting the Western Cape chick survival model excluding the 8% of chicks not monitored from hatching does not change the inference about the effect of the island closures. Department of Environment, Forestry and Fisheries Report: FISHERIES/2020/NOV/SWG-PEL/117rev. Pp. 1–5.