

**COMMENTS/QUERIES ON “STARVING SEABIRDS:
UNPROFITABLE FORAGING ...” BY GREMILLET *ET AL.***

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Note: Referencing in this document is to line numbers in the recent Gremillet *et al.* paper in Marine Biology.

While the Gremillet *et al.* paper introduces an interesting new approach and results, the fundamental question raised is whether these justify the conclusions which it draws.

- 1) (33-39): The paper draws a VERY strong conclusion, which consequently merits rigorous review as regards its justification: “Based on this evidence, we advocate a revision of regional fishing quotas for small pelagic fish and discussion of the possibility of an experimental cessation of purse-seine fishing activities off the west coast of South Africa. These measures are needed for the ecological and socio-economic persistence of the broader southern Benguela upwelling system.”
- 2) (9-10): The opening statement made is that: “Fisheries are often accused of starving vulnerable seabirds, yet evidence for this claim is scarce.” Notably, this implies that without the evidence in this paper, the management recommendations it makes have little justification.
- 3) (46-47): Pauly *et al.* (1998) – this “fishing down the food web paper” is quoted to justify the preceding statement – why so, given that this analysis has subsequently (in 2010) been comprehensively falsified by Trevor Branch and colleagues (Nature 468, 431–435).
- 4) (69): While shorter term indices may indeed be desirable, how can they be used with confidence before validation against the quantities of interest in analyses that take account of the extents of associated bias and precision?
- 5) (110-115): “despite the fact that the purse-seine fishery targets scarce fish stocks ... it still has a total [annual] catch (TAC) of >600 000 tonnes based on the abundance of fish throughout South African shelf waters” – how is this consistent with the fact that most of this abundance, for the greater part of the year, reflects anchovy on the west coast, which has since the turn of the century been a record levels averaging some 3-4 times those in the 1980s and 1990s?
- 6) (122-124): “80% of the fish are caught west of Cape Agulhas, whereas 80% of the fish biomass is found east of Cape Agulhas” – the senior author of the paper cited for this statement has confirmed that the paper does not report this; in any case the statement is not correct, and furthermore such comparisons need to take account of the annual patterns in fish distribution, particularly as most of the catch is juvenile anchovy taken at a time (autumn) when nearly all the dominant recruit component of the anchovy biomass is on the west coast; greater proportions of the pelagic fish biomass occurring further east relate more to the time of November spawner biomass surveys.

- 7) (137-142): “Cape gannets do not perform adaptive mass loss during the breeding season; they rather keep steady body masses” – what are the precision of the mean estimate of the associated trend and its annual variation, and how do these compare to the implied mass loss rate for some birds in Fig. 2? (See also 16) below.) Table 2 of the paper cited would seem to suggest that this trend is not particularly precisely determined.
- 8) (158): Results relate only to October – is there any information on how representative this is of the situation in other pertinent months?
- 9) (170): The birds measured were each fitted with three data loggers – is there any information on the extent to which this might have impacted their feeding efficiency?
- 10) (223): +/- figures are given for various estimates – what are these? – single standard errors or related to 95% confidence intervals? See also line 257 which refers to confidence intervals without giving the associated percentage.
- 11) (229): The temperatures of ingested food are assumed known with high precision (15+/- 1°C). Is this realistic given the wide range of offshore extent of foraging indicated in Fig. 3? Note that this assumption has a potentially large impact on the estimates and error bars shown in Fig. 2.
- 12) (268-270): Which species were weighted in what way (noting the wide range of species mentioned in lines 323-326)?
- 13) (Fig.1): The caption refers to average values of indices of reproductive success but then states that error bars correspond to standard deviations – is that a typo for standard errors? Although the trends indicated are statistically significant, are their extents biologically meaningful? The plots of Figure A at the end of this document compare these condition indices to November survey pelagic fish biomass estimates for the area to the west of Agulhas – there is a clear negative correlation, which is hardly consistent with the hypothesis that fishing has a negative impact on gannet reproductive success.
- 14) (318): A prey item of over 1 kg in a stomach of a bird weighing some 2.5 kg– is this a typo and/or an indication of poor precision of the method used to estimate these weights?
- 15) (324-326): Five prey species are mentioned, with anchovy (which constitutes the bulk of the west coast pelagic fish catch) notably absent. Only two of the species mentioned make substantial contributions to the catch by the pelagic fishery. What proportions of the diet do sardine and redeye comprise as indicated by these data?
- 16) (338-339): “eight of 11 birds spent more energy than they gathered” – this is a small sample, reflecting a result not significantly different from parity at the 5% level. This result also needs to be interpreted in the context of the response to 6) above. Furthermore the positive/negative results correlate exactly (Fig. 3) with whether or not the birds travelled east of Cape Point, so that conclusions are strongly dependent on whether the sample of birds studied reflect a random selection from the population with regard to propensity or otherwise to forage to such longer distances from the colony – is there a basis to justify this assumption?

- 17) (432): “Monte Carlo simulations” – how were these specified (as their results will depend on that)?
- 18) (446-447): “from the late 1990s reduced the abundance of small pelagic fish off the west coast despite sustained, high primary productivity” – but anchovy increased and then stayed at much higher biomasses over this period; sardine also grew to a peak in the early 2000s, though subsequently declined.
- 19) (490-492): “this small pelagic fishery is still managed using a single stock approach” – this comment is supported by citing a 2006 paper; it thus omits to mention that over recent years, pending further analysis of the implications of possible multiple sardine stocks, limits have been placed on the proportions of sardine TAC which may be taken east and west of Cape Agulhas.
- 20) (495-497): “whose management as a single stock leads to the over-exploitation and virtual collapse of the west coast stock” – the paper cited as the basis for this statement, though raising concerns, does not draw this conclusion.
- 21) (502-506): In referring to Cury *et al.* (2011), no account is taken of reservations and implications to be drawn therefrom listed in FISHERIES/2015/JUL/SWG-PEL/24.
- 22) (507-510): What is proposed has already been done – see 19) above.
- 23) (547-548) “since most of the profit flows into white-owned businesses” – the reference cited to support this statement does not make it; the major company involved has for the second successive year been listed as the most transformed of any on the Johannesburg Stock Exchange.

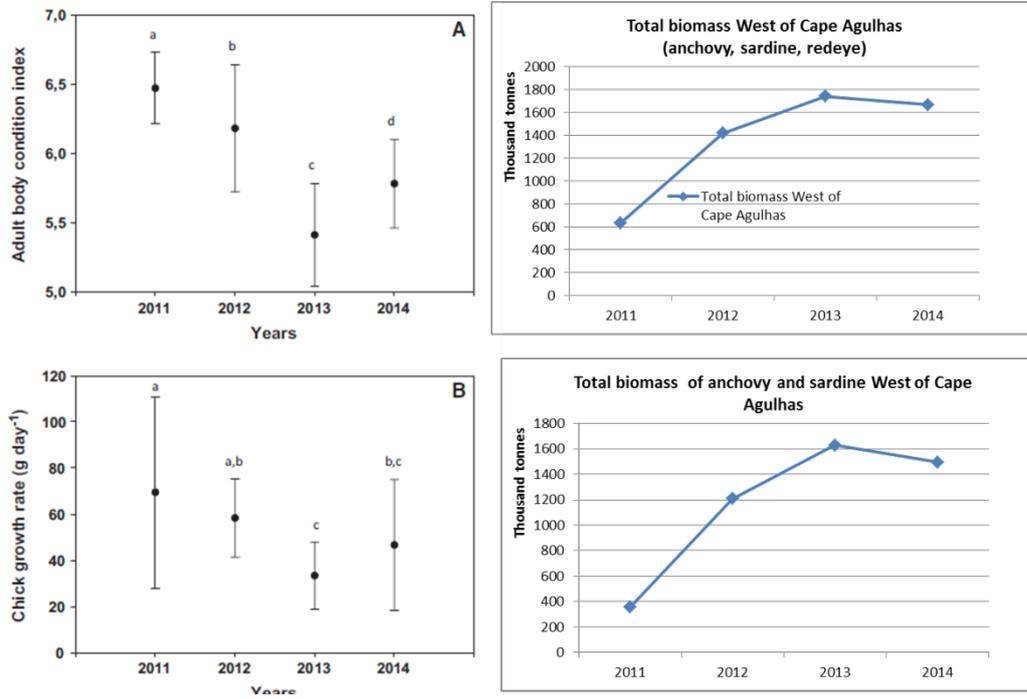


Figure A: A comparison of the plots of Fig. 1 of Gremillet *et al.* on breeding gannet body condition and chick growth rates with results for biomass west of Agulhas from the November spawner biomass surveys.