

Explanation of how the authors addressed NMFS reviewer comments on the draft manuscript, *Mitigating seabird bycatch during hauling by pelagic longline vessels*.

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Addressing Comments provided by Keith Bigelow

1. Keith suggested reporting whether there was an effect on seabird haul captures of the factor of vessels that opted to employ the combination of methods with side setting vs. stern setting. Paragraph 6 of the Introduction describes the factors of these two combinations of bird mitigation methods likely to affect haul captures. We added a paragraph to Discussion section 4.6 to address this question, which begins with: "A factor for the two alternative regulatory-defined combinations of seabird..."
2. Introduction, changed 'In the order of' to 'On the order of'.
3. Introduction, we reviewed the current seabird regulations (NMFS, 2011), determined the regulatory definition of night setting (starting one hour after local sunset and finishing one hour before local sunrise), and added this information.
4. Last paragraph of the Introduction, Keith suggested adding 'shallow set' in describing the global implications of the findings. We did not add this as the findings on ways to avoid seabird captures during hauling are applicable to pelagic longline fisheries regardless of the depth at which the gear soaks.
5. In response to Keith's comment, we have added to Methods Section 2.2 on the proportion of seabirds hauled alive, the observer data recording protocol for what constitutes an "alive" and "dead" seabird (from p. 54 of NMFS, 2010).
6. We modified the text of Section 2.4 to clarify that seabirds observed coming up on the gear from the gear soak were assumed to have been captured during the set.
7. Section 2.7, in describing the covariate leader length, Keith points out that different rules apply for lead length for shallow-set vessels that opt to side- vs stern-set. We have described the regulations in the introduction, and discuss this in section 4.6, covered under our response to Keith's first comment.
8. Section 2.8, we confirmed the NMFS (2004) regulatory definitions for deep- and shallow-setting, where a deep set must have ≥ 15 hooks per basket, ≥ 20 m long floatlines and no use of lightsticks, and a shallow-set employs gear not meeting the definition of a deep set, plus required use of 18/0 or larger 10⁰ offset circle hooks, and mackerel-type bait.
9. We corrected a typo in section 3.3, where we now report that the total number of records with information available both on (i) whether the bird was observed captured during the haul or coming up on the gear from the soak, and (ii) the condition (alive vs. dead) upon retrieval was 230 records.
10. Table 1, we corrected an error, re the total number of unique vessels in the sample was $n=49$, now consistent with the text in Section 3.5 (using permit number, not vessel name).
11. Section 3.6, last sentence of the first paragraph, we deleted 'significantly' from the sentence, as there was no statistical test or variance comparison between the GAM and GAMM.
12. We use the same y-axis scale in panels A-J in Fig. 4. However, the dimensions of Panels D and G enable the panel to be the same size as the other plots, but still uses the same scale (i.e., the response of 0.5 in one panel is the same as in all the others). While it would be easier to visualize the relative contribution of each variable in explaining model variability if the dimension size of each panel were consistent, using different dimension for all panels was necessary in order to fit the entire figure within each panel.
13. Section 4.3, we replaced the word 'Effective' with 'Additional'.

14. To improve clarity and consistency with the manner of presenting the findings in the Results section, we revised the text in the Discussion section on the condition of birds observed caught during hauling vs. coming up on the gear from the soak (now included in Section 4.1).
15. To address an inquiry of whether the inclusion of random effects in the GAMM or the use of the mixed component resulted in the reported improvement over the GAM, we explain in the Methods that the GAMM employed trip-specific heterogeneity as a random, mixed effect (random intercepts only) to account for the sampling structure of the data set - to account for mixed effects from multiple measurements on the same sampling unit of repeated longline trips by individual vessels. And we explain in section 4.6 that, " Results from the AIC and log-likelihood test support the inference that the GAMM would account for more of the deviance than the equivalent GAM (Table 2), indicating that inclusion of random effects in the model was an improvement."
16. We revised the manuscript (abstract, Results 3.6, Discussion 4.6 and 4.8) to correctly report the findings that covariates haul duration and branchline length did not have significant effects in the seabird haul catch rate model. These variables improved model fit and therefore were retained in the model and in Fig. 4.
17. We reduced the length of the Discussion in response to Keith's suggestion. This included reducing the length of discussion in Section 4.5 of the effect of the covariates haul duration and branchline length, which were found to not have significant effects on the live seabird standardized catch model. We shortened section 4.7 on cryptic sources of mortality, but decided not to eliminate the section as the data collection protocols employed by observers of this fishery, which count observed pre-catch escapements as captures, and do not estimate or attempt to account for pre-catch, post-release and other cryptic sources of seabird removals, likely has a significant effect on estimates of the proportion of seabirds that are caught during setting vs. hauling, and estimates of mortality rates from the different interactions. We also decided not to eliminate the discussion in section 4.7 of potential additional methods for reducing seabird haul bycatch in the fishery; we recognize that the level of seabird mortality in the fishery likely poses no risk to population viability or hinders plans for population rebuilding, but see broader benefits of the fishery undertaking commercially viable steps to nearly eliminate bird interactions, as explained in the Introduction. We however do not present these alternative methods with capacity to reduce haul bycatch as recommended regulatory measures, and instead present them as potentially viable methods for consideration by management authorities and the catch sector.

Addressing comments provided by Cleo Small

1. Cleo suggested explaining the effect of stern vs. side-setting on seabird haul captures. The response is captured in bullet no. 1 under the explanation of how we addressed Keith's comments.
2. Cleo commented that, "in the New Zealand fishery I understand that when swordfish are caught they tend to react to the presence of the boat on hauling and hence drag other lines (and unused baits) to the surface," and asked, "Is there any evidence that this happens in this fishery?" In the 4th paragraph of section 2.8, we summarize findings from our review of the observer comment fields in the observer database of the causes of branchlines to drag astern during hauling. One of the main causes observed was branchlines tangling with each other and with the mainline, but we did not identify comments recorded by observers indicating that swordfish, or other species, routinely drag lines to the surface.
3. Cleo commented that, "The finding that discarding on the opposite side of the boat had no effect on reducing albatross captures and may in fact increase densities of birds around the boat which is shown to increase capture rates is a strong reason for discarding to be

abandoned in the fishery.” We discuss these findings in section 4.6. We explain here that there was an extremely small sample size of hauls where discarding did not occur, which is why we did not analyze the data to determine if vessel discarding offal and spent bait during hauling is correlated with higher seabird densities relative to vessels not discarding during hauling. During hauling in this fishery, it is our understanding that there is almost always some spent bait and offal going overboard. It might be impractical to completely eliminate these discharges, and currently there is a lack of evidence in this fishery to support the hypothesis that discarding biomass during hauling increases seabird bycatch. I understand that CCAMLR prohibits discarding during hauling in demersal longline fisheries in the Southern Ocean; I have not come across information on the basis for this rule. If there is empirical evidence on the effect of offal discarding during hauling from other fisheries, this would potentially provide a basis for NMFS to consider changing the current requirement for “strategic offal discards” in the Hawaii fisheries.

4. Abstract, we changed the case of the first letter of the word in a sentence following a colon to lower case.
5. In response to a comment asking for clarification of the sample size of the effect of side vs. stern setting on haul catch rates, we have added augmented explanation of this in the Introduction and Discussion, as explained in a response to Keith’s first comment. And, we added to Discussion section 4.5 the subset of the total records that placed hooks within 1m of the hook.
6. In the Introduction, 6th paragraph, Cleo commented that we should provide an explanation as to why we identified the subset of the gear and methods included in current regulations as likely to have an effect on haul seabird bycatch. We have listed citations to relevant references that provide this information, and provide this explanation in the Methods section 2.7 and Discussion section 4.5 (paragraph beginning “Several variables”), and decided not to repeat that information in the Introduction. And, to address a comment about why hauling at night was not also identified, we have added the time of day of hauling in this list.
7. We revised the first sentence of Methods Section 2.1, flagged by Cleo as requiring clarification.
8. We added to Methods Section 2.7 that the variable spatial distribution of effort was included in the model via the use of vessel position latitude and longitude at the beginning of the haul.
9. Cleo suggested that we explain in the Methods Section 2.7, where we describe the model covariate haul duration, that haul start time had low variability. We declined to do so, as we already discuss in Section 4.5 how we explored the inclusion of the time of day of initiating hauling as a model covariate, and that this variable had low variability during the study period. We decided that the discussion of this variable is better placed in the Discussion section than in the Methods section.
10. We decided not to include in Table 1 or in the Results section the proportion of vessels that used weighed swivels on branchlines or the distance of weights from the hook, as there are numerous additional variables that were hypothesized to have a significant effect on seabird haul bycatch, too many to include in the table, and we provide these summary statistics in the text, and do not want to repeat this information in the Table.
11. In response to a comment to clarify the difference in summary statistics reported in Results Section 3.1, we reordered the 2nd and 3rd sentences. One sentence presents the percent of the total 517 birds captured during the full period that were alive, while the 2nd sentence presents the mean of the nine annual percentages of total birds caught that were alive in that year.
12. Cleo commented that, although based on the odds ratio test a significantly higher proportion of Laysan albatrosses were caught alive vs. dead relative to black-footed albatrosses, that perhaps because the time series of the sample was only through the last 4 years and

because the percent caught alive looks very similar for the two species, perhaps this difference is not very meaningful. The study period for this component was 2004-2012 – see Fig. 1 and the relevant Methods section. The time series is sufficient, but the sample size for black-footed albatross captures was small. Given the finding of a significant difference, and qualitatively analyzing Fig. 1 which shows that in every year of the sample this difference was consistent, the findings are sound and useful to report. Cleo further inquired if prior to 2009 the bycatch mitigation measures for the set weren't effective for black-footed albatross – we do not see any evidence to support this.

13. In response to Cleo's comment, we revised Results section 3.3 – as explained in the response to Keith's comment bullet number 9.
14. In the Results section and elsewhere we now correctly report that there were 49 unique vessels included in the study period (based on permit number, and not vessel name, as the latter can change over time).
15. Cleo inquired if the 3 categories of vessels (high, average and low nominal live seabird catch rates) could be explained based on vessel side vs. stern setting. As explained previously, and now clarified in the manuscript text, an observer record that a vessel was side setting in most records did not reliably indicate if the vessel was employing all of the regulatory required measures associated with that combination of bird bycatch avoidance methods. Of the variables associated with the regulatory requirements that influence haul interactions, identified in the Introduction, there are several other variables that the findings here show have a larger effect on haul catch rate, including albatross density near the vessel and year. We explain in other bullets how we address the comments related to assessing the effect of regulatory definitions of side- vs. stern-setting.
16. Cleo inquired how the Results section 3.5 finding that both the high and low category vessels could have significantly higher values for month, year, swivel weight and leader length. These results are presented as relative to the records of the medium category group, and not comparing high and low category records.
17. Cleo commented on the unexpected result that the standardized live seabird catch rate significantly increased as the weight of swivels increased from 65g – we discuss this finding in section 4.5. Cleo further commented that Fig 4f shows decreasing live seabird catch rate with increasing weight from 40-60g, but this trend was not significant. The width of confidence bands provides an indication of relative sample sizes. The model explicitly account for other included factors and covariates, and as explained in the Methods section, each variable is conditioned on the other 10 factors and covariates. As we explain in the Discussion, almost all records had weights $\geq 45g$ and thus weight amount is not an indicator of whether a set was conducted from the side vs. stern per the regulatory definition.
18. We improved the clarity of part of the Results section 3.6 presenting findings shown in Fig. 4l of the effect of the factor vessel high/medium/low categories of nominal live seabird catch rate.
19. In reviewing Discussion section 4.1, Cleo commented that the results of the proportion of albatrosses hauled alive prior to 2009 was substantially different from the proportion post 2009. This is not correct. From 2004 to 2009, 73% (204 of 279) of caught albatrosses were alive, and from 2009-2013 78% (184 of 236) were alive.
20. Cleo pointed out that in Section 4.5 we identify the three variables that showed the highest effect in the standardized live seabird catch rate model, but in the Results we identify the top 4 variables, and should make these consistent. We modified the results to identify the top 3.
21. Discussion Section 4.5, we revised the text discussing the variable haul duration to improve clarity and address a comment from another reviewer.
22. Discussion Section 4.5, we corrected an error to correctly report that an increase in swivel weight above 65g significantly increased the standardized live seabird haul catch rate, and that this finding was inconsistent with the hypothesized effect of this variable.

23. Discussion Section 4.5, we added a paragraph to explain the effect on haul seabird captures, and included in this paragraph the additional summary statistics on swivel weights that almost all vessels conventionally used swivel weights >45g (only 15 of 11,385 records had swivel weights <45g), discussed in more detail in the response to Keith's 1st comment.
24. Fixed a typo, changing "outliner" to "outlier".
25. As addressed previously, we have added text in the Discussion on the effect of vessels selecting to employ the combination of methods with the regulatory definitions of side- vs. stern-setting.
26. Cleo suggested including a better transition in Discussion Section 4.5, with the paragraph beginning, "Several variables not included...". The discussion earlier in this section interprets the effects of the variables included in the model. The paragraph in question begins discussion on variables that were considered but not included in the model, and we feel that this introductory sentence of this paragraph provides a clear transition from the first to 2nd half of the section.
27. Discussion Section 4.7, we reworded the first sentence to improve clarity.
28. Cleo suggested that in the Discussion Section on next steps, that we couch the description of the methods identified for reducing haul bycatch as specific recommendations for changes to practice in the fishery. We decided not to implement this recommendation – it is our view the study findings are best presented objectively to identify alternatives that management authorities and the capture sector can consider for potential regulatory amendment or voluntary uptake. The Introduction and in our response to Keith's 17th comment present an argument for the fishery to pursue minimizing seabird bycatch as low as practical.

Addressing Comments provided by Kim Rivera

1. To address Kim's comment, in the final paragraph of the Introduction we reference an ACAP report, which identifies research to reduce seabird bycatch during hauling in pelagic longline fisheries as a priority.
2. We combined two discussion sections – on the finding of the proportion of caught birds that were alive, and the finding on the condition of birds observed being caught during the haul vs. during the set, enabling a clearer explanation of the likely condition of a bird that is captured during these two fishing operations.
3. In the Discussion Section Next Steps, we added text to identify that additional method of refraining from discarding as a possible way to reduce seabird captures during both hauling and setting.