

**Further results for the standardisation of the CPUE series for toothfish
(*Dissostichus eleginoides*) in the Prince Edward Islands EEZ using finer scale
fishing areas**

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Abstract

Updated standardisation options are presented to account for the change in the vessels operating in the fishery after 2008, and the month effect is investigated as it may provide a useful basis to assist quantify the extent of cetacean depredation.

Introduction

Brandão and Butterworth (2014) presented a revised standardisation of the toothfish CPUE in the Prince Edward Islands (PEI), in which finer scale fishing areas had been incorporated. The results showed a marked decline in abundance after 2008 in contrast to previous CPUE standardisations. Upon further investigation of the data, it was determined that this decrease in abundance was due to the fact that the vessel *Koryo Maru* that had been in operation during this period was replaced by a new vessel with the same name. A distinction between these two vessels had not been made in the previous CPUE standardisation (Brandão and Butterworth, 2013). The GLMM standardisation of the toothfish CPUE by Brandão and Butterworth (2014) was able to estimate vessel factors for these two vessels because two sets were carried out by the old vessel that coincided with sets made by the new vessel in the same year. However because the estimates of these post-2008 vessel effects were based on only two sets, they were too imprecise to be used.

This paper presents results for two of the three options for standardised CPUE series put forward by a task team to address these complications in the toothfish CPUE data. These are:

1. Base case: assume that the two *Koryo Maru* vessels are identical in terms of power (rendered reasonable by the fact that the same skipper operated on both vessels); and
2. Sensitivity test: Use a random effects approach which treats the different powers of all the vessels in the fishery as constrained to have a normal distribution, thus taking account of the fact that the two new (post-2008) vessels' power factors would not differ greatly from those of the other vessels.

This paper also presents results on a GLMM which includes different fixed month effects prior- and post-2000 (the year when cetacean depredation first became noticeable) rather than including the year-month interaction as a random effect, in order to assist determine whether the GLMM month effect might provide a quantitative surrogate for the extent of cetacean depredation.

Results and Discussion

Figure 1 shows the relative abundance indices for toothfish provided by the standardised commercial longline CPUE series for the Prince Edward Islands EEZ for the Base case option that considers the old and new *Koryo Maru* to be the same. The month and vessel effects for this GLMM are also shown, all with 95% confidence intervals. Figure 2 shows a comparison of the standardised CPUE series for the Base case, the Sensitivity case and the month factors split prior and post-2000 options. All series show a very similar trend in relative abundance of toothfish, though there are differences over the last three years.

Figure 3 shows a comparison of the relative abundance indices obtained by Brandão and Butterworth (2013) and those for the Base case. Both GLMMs consider the new and old *Koryo Maru* as the same vessel, with the difference being in whether the old or finer-scale new fishing areas are used. Both series show a similar trend in relative abundance, with the finer scale area definition providing a smoother series.

Figure 4 shows the month effects for the GLMM that includes split month factors prior and post-2000. Figure 5 shows monthly differences between the post and prior-2000 point estimates. There is a reduction in the month factors post-2000 for the months of June to September, which might be a

surrogate for cetacean depredation in the winter months. However the prior-2000 July effect is lower than those for adjacent months, which may indicate that cetacean depredation is not the only factor influencing a drop in abundance at that time of the year.

References

- Brandão, A. and Butterworth, D.S. 2013. Obtaining a standardised CPUE series for toothfish (*Dissostichus eleginoides*) in the Prince Edward Islands EEZ calibrated to incorporate both longline and trotline data over the period 1997-2013. DAFF Branch Fisheries document: FISHERIES/2013/OCT/SWG-DEM/57.
- Brandão, A. and Butterworth, D.S. 2014. Standardisation of the CPUE series for toothfish (*Dissostichus eleginoides*) in the Prince Edward Islands EEZ using finer scale fishing areas. DAFF Branch Fisheries document: FISHERIES/2014/JUN/SWG-DEM/17.

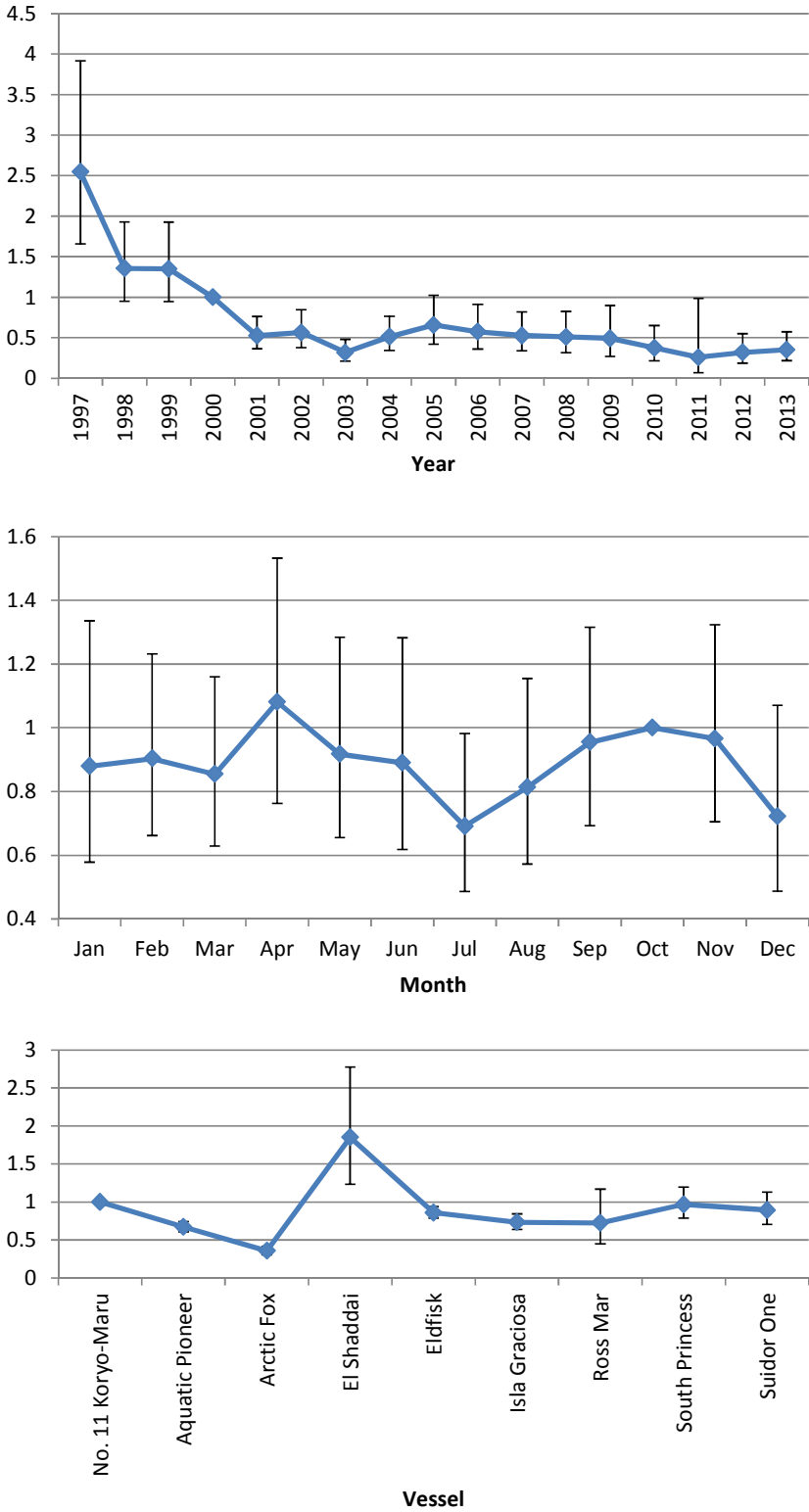


Figure 1. GLMM-standardised CPUE trends (top), month effects (middle) and vessel effects (bottom) together with 95% confidence intervals for the Spanish longline toothfish fisheries for the Prince Edward Islands EEZ when the old and new *Koryo Maru* are considered to be the same (Base case). Note that CIs are given relative to 2000 for CPUE, October (set at 1) for the month effect, and the *Kyo Maru* (set at 1) for the vessel effect.

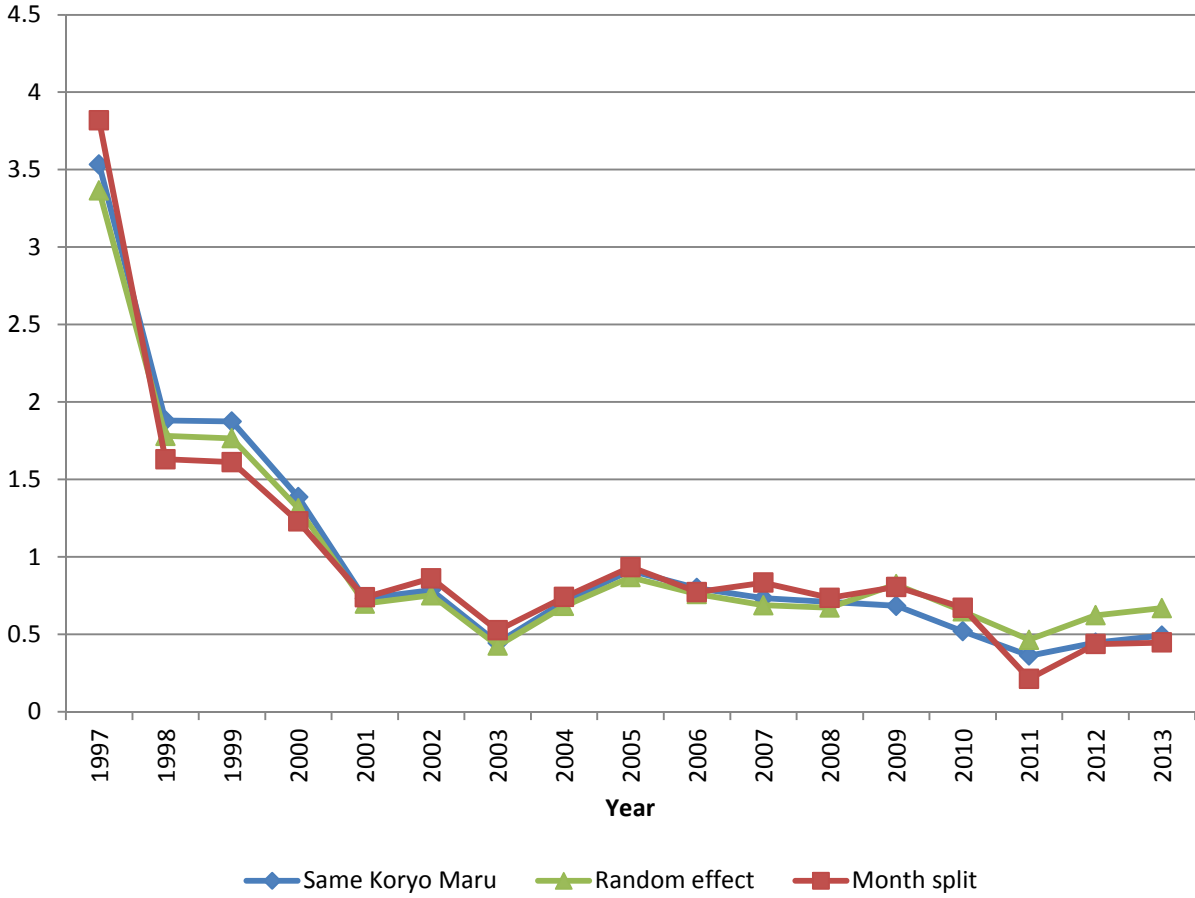


Figure 2. Comparison of the GLMM-standardised CPUE trends for the Spanish longline toothfish fisheries for the Prince Edward Islands EEZ between the Base case (“same” *Koryo Maru*), The sensitivity case (random vessel effect) and results when splitting the month factors prior and post-2000 (all are normalised to their mean over the 2008 to 2013 period).

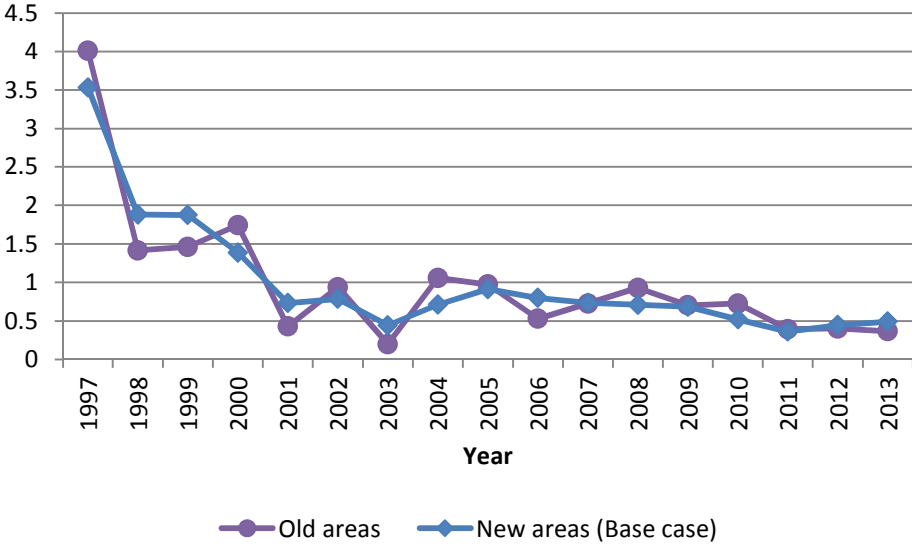


Figure 3. Comparison of the GLMM-standardised CPUE trends for the Spanish longline toothfish fisheries for the Prince Edward Islands EEZ between the Base case (“same” *Koryo Maru*) and that obtained by Brandão and Butterworth (2013) (i.e. both treat the two *Koryo Maru*’s as the same, but the latter considers fishing areas at a finer scale) (both are normalised to their mean over the 2008 to 2013 period).

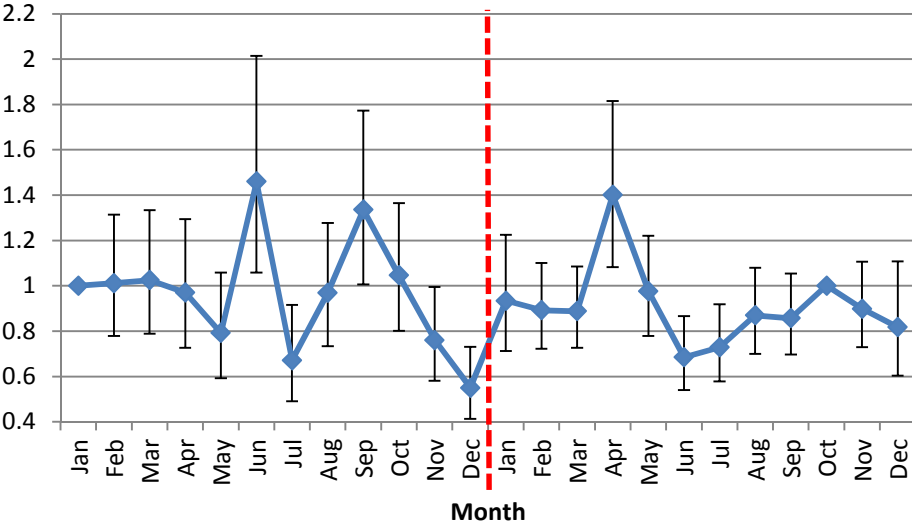


Figure 4. Month effect (with 95% confidence intervals) for the GLMM that splits the month factors prior and post-2000 (demarcated by the dashed vertical line).

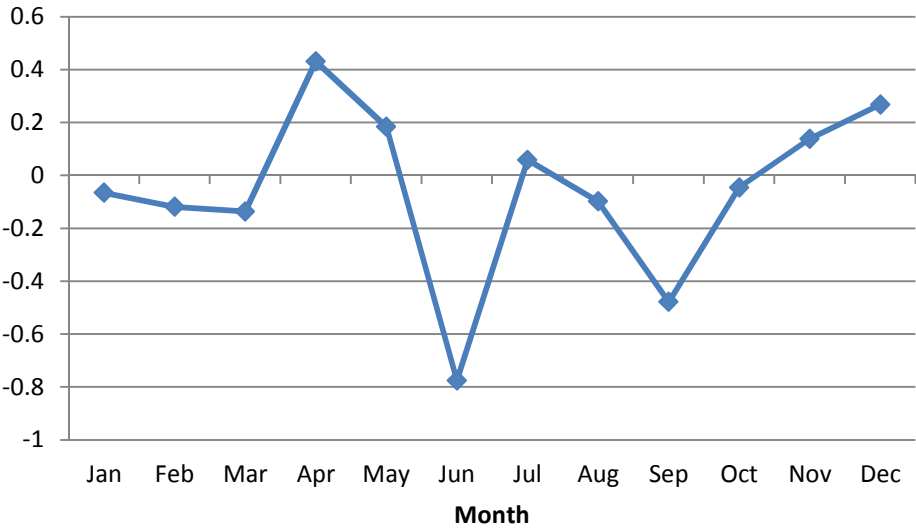


Figure 5. Monthly differences between post and prior-2000 point estimates.