Non-lethal strategies for mitigating odontocete by-catch and depredation in longline fisheries: physical and psychological deterrence at the hook.

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In 2009, the Australian Government (in collaboration with the Fijian Government, FFA, WWF and four major pelagic longline licence holders) embarked on a project to mitigate the economic and conservation impacts of toothed whale depredation and by-catch in pelagic longline fisheries. The impetus for the project arose from concerns tabled a workshop held in Apia (Samoa) in 2002. This project provides a rare opportunity to tackle both problems simultaneously. The aim was (i) to develop two devices that physically or psychologically deterred depredating whales by simulating gear tangles (several fisher reports indicate these are avoided), and (ii) assess their effectiveness under rigorous experimental conditions in an operational environment.

Due to the fishing gear being within diving range of toothed whales, the devices were necessarily complex. Each design comprised a trigger mechanism that allowed it to remain clear of a baited hook to allow unimpeded fishing, before the tension of a caught fish caused the deterrent structure to be deployed. In the trial gear, the devices were set on alternate branchlines (treatment-control experiment) so that a number of factors could be compared, such as fish catch rate, depredation rate and by-catch rate, plus a number of operational elements. An additional 'non-trial' section was set, so edge effects could be detected. Results from an earlier exploratory trip, using TDRs, indicated that the addition of a device to the fishing gear that weighted 100g would not impact on the soak depths reached more than the combined effects of tide, current and surface wind.

From 94 sets, 119,844 hook hauls were monitored, with ~83% of those occurring in the Fiji EEZ for logistical and economic reasons. Surprisingly, the catch rate was higher on the treatment (protected) hooks (Cain device: 0.0470+0.0019 fish caught per hook; Cage device: 0.0472+0.0020) compared with control (unprotected) hooks (0.0404$\pm$0.0013 fish caught per hook), suggesting the devices either attract more fish, or deterred more predators. There was also evidence of an edge effect, with the branchlines (effectively all controls) in the non-trial section catching less than the controls in the trial section (0.0260$\pm$0.0008 fish caught per hook).

Depredation by the three main predator groups recorded – toothed whales, cookie cutter sharks and pelagic sharks – was highest on controls hooks in both the trial and the non-trial sections. Interestingly, cookie cutter shark damage was much more frequent than damage by the other two groups and depredation damage by pelagic sharks was around the same order of magnitude as for toothed whales, suggesting shark damage also has an extensive economic impact on the fishery. Specifically for toothed whales, there were 27 depredation events, 24 of which occurred on control hooks. The remaining 3 occurred on lines with devices attached that did not deploy, effectively rendering them controls. Of the 27 depredation events, there were 7 occasions where at least two fish were caught consecutively, thus allowing 'feeding choice' to be studied. On each occasion, the fish on the control (unprotected) branchline was depredated, while the fish caught on the adjacent branchline with a device attached (protected) was not.

There were 4 toothed whales by-caught during the study – 3 false killer whales and 1 melon-headed whale – all on control branchlines. Each was released alive by cutting the branchline, thus all retained an entanglement and their fate remains unknown. Interestingly, neither of these species

was observed before or during the fishing event throughout the study, while pilot whales were observed on 6 occasions but did not become by-caught. This suggests that observing the presence of specific toothed whale species may not be a good indicator of an increased likelihood of a depredation by or by-catch event of that species.

A number of operational aspects were studied – fish survival, fish size, hauling speed and device triggering success – all having positive results. These are outlined in the final report.

Many of the outcomes of this study were positive and provide encouragement for ongoing research in this space, although further funding is required. Some companies have expressed a desire to implement the gear in a commercialised context, suggesting that elements of refinement and costing need to be explored and resolved before large-scale manufacture would be possible. Advances achieved in this study in the development of trigger mechanisms and delivery of small structures to a hook that has caught a fish present opportunities for hybridisation, by including small acoustic deterrence units alongside the chain and cage. The final report for this project should become available on the Australian Antarctic Division website towards the end of 2013, with at least to publications following soon after in peer reviewed journals.