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Mitigating odontocete by-catch and depredation in pelagic longline fisheries using physical deterrence at the hook.

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As the size of human populations increase globally, so too does the demand for food. Fish stocks have become increasingly important in meeting this demand, with widespread exploitation of fish stocks from all oceans now commonplace. Spatial overlap between fisheries and other fish consumers, such as marine mammals, has become extensive as a result. This situation increases the occurrence of operational interactions, such as depredation (where the catch is removed or damaged by a foraging predator) and by-catch (where the depredating predator is incidentally caught). Reports from tuna pelagic longline fisheries in the Southern Hemisphere indicate that odontocetes (toothed whales) sometimes depredate a small proportion of the commercial catch. There are also concerns among conservationists that odontocetes may regularly become caught and drown on longline hooks, thus increasing the risk of decline in some populations.

Given there has been mixed success when implementing acoustic technologies to mitigate odontocete depredation and by-catch, there may be benefits in developing and testing technologies designed to physically deter individuals from approaching a baited hook or a caught fish. Many fishers have reported that odontocetes actively avoid tangles in the longline gear, suggesting that simulations of tangled gear near a caught fish on the longline gear may assist in mitigating odontocete depredation and by-catch. Two devices have been designed by the Australian Marine Mammal Center (AMMC; Australian Government), in collaboration with an Australian plastic technology and manufacturing company and a UK fishing gear technology company. One device is comprised of a monofilament nylon cage (approximately 450 mm in diameter and 850 mm long; the 'cage device') and the other is comprised of two lengths of small-link stainless steel chain (each 1500 mm long; the 'chain device'). Once the baited hook catches a fish, a pressure-release mechanism on the attached device allows it to move towards and then envelope the caught fish.

The high numbers of hooks set on pelagic longlines present an opportunity to test the effectiveness of the two devices under controlled experimental conditions. A preliminary investigation of this problem as resulted in the first of such controlled experiments being conducted on an Australian longline vessel in the Coral Sea in July 2011. Depredating odontocetes were given the opportunity to choose between fish caught on either control snoods (those without the cage or chain devices attached) or treatment snoods (those fitted with the cage or chain device). In practice, units of the two devices were attached alternately to each snood along the longline, several meters up from the baited hook, as they were set (i.e. 1. control – 2. treatment [cage device] – 3. control – 4. treatment [chain device] – 5. ……). Each snood was placed approximately 30 meters apart on the mainline. As such, the three proposed aims were to assess the impact of the cage and chain devices on rates of (i) target fish catch, (ii) odontocete depredation and (iii) odontocete by-catch.

A total of 4,532 hooks (from 10 sets over 10 days) were observed hauled during the Coral Sea trial, under normal operational conditions. While this is a preliminary trial and it is acknowledged that a much larger sample size is required in order to obtain a statistically robust result, analyses indicated that the presence of the devices on snoods had little or no effect on target fish catch rate (Chi squared test [cage/chain – control]: $P = 0.41$; GLM [cage device – control]: $P = 0.38$; GLM [chain device – control]: $P = 0.73$). Unfortunately, no operational interactions with odontocetes were observed during the trial, resulting in the 2nd and 3rd aims remaining unaddressed. Interestingly, another pelagic longlining vessel operating in the vicinity at the time of the recent trial reported odontocete depredation on three consecutive days. Results of independent monitoring during the previous year, where 27,830 hooks were observed hauled on the same vessel and in the same region, revealed that 1.9 fish depredated by odontocetes were hauled per 1,000 hooks (i.e. 9% of the overall fish catch) and that 0.11 odontocetes were by-caught per 1,000 hooks. All by-caught odontocetes were released alive by cutting away the snood line from the mainline. The extent of their injuries was not determined.

Three elements of the gear's performance became apparent during the trial. Firstly, there were no instances of device failure, suggesting their design and manufacture were of a high quality. Secondly, there were almost no instances of the devices tangling in the fishing gear, or causing the fishing gear to behave differently, despite the potential for hydrodynamic drag caused by the size of the cage device and for accelerated sinking caused by the weight of the chain device. Thirdly, fishers found it relatively easy to incorporate the devices into the standard fishing operations, with minimal impact on setting time, although hauling time was markedly slower (between 1.5 and 2 times longer than 'normal' pace).

The results presented here are preliminary and there is still a need to obtain much more data to address the 2nd and 3rd aims. The results will be critical in determining if the devices are successful in mitigating odontocete interactions with pelagic longline fisheries. It may also be prudent to identify odontocete depredation 'hot spots' in other oceanic regions, in order to obtain data that accounts for regional variations in gear type and depredating odontocete species. Recent reports suggest that pelagic longline fisheries operating in some regions of the Indian Ocean may offer such opportunities.

Given the economic cost to the various pelagic longline fisheries and the conservation cost to the odontocete populations that interact operationally with them, there is a need to continue developing physical deterrence strategies and other appropriate mitigation measures to address this problem. The results of this study demonstrate that non-lethal depredation mitigation technologies have the potential to be successful. It should be noted that odontocete depredation is a relatively minor cause of declines in fisheries yields, which are more likely to be caused by overfishing.