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T. Aran Mooney: Fisheries Bycatch and Depredation

Fisheries Bycatch and Depredation

Net Target Strengths and Stiffness

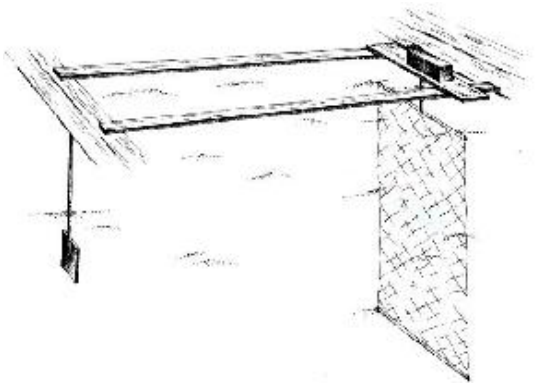
Work includes measuring target strengths (echo backscatter) and stiffness of gillnets. From these results I've predicted the distances dolphins and porpoises will detect the nets via echolocation.

This work includes:

Acoustic and stiffness properties of gillnets as they relate to small cetacean bycatch

Small cetaceans are incidental bycatch in gillnet fisheries. Dolphin and porpoise bycatch has been reduced by the use of barium sulphate-enhanced gillnets. This decreased entanglement is likely the result of either higher acoustic reflectivity or greater stiffness for barium nets. To address these variables our study quantified the acoustic reflectivity and stiffness of six net types including barium sulphate, iron oxide-enhanced and control demersal gillnets of sizes which typically target cod (*Gadus morhua*) and monkfish (*Lophius americanus*). Acoustic reflectivity, or target strength (TS), was assessed using dolphin and porpoise-like sonar signals from 0?-40?. Target strength values were used to calculate likely detection ranges. Barium sulphate and iron oxide-enhanced nets showed increased reflectivity compared to control nets, with the barium sulphate nets generating the highest TS values. Dolphins should detect these nets in time to avoid contact, but porpoises, with typically lower source levels, may not detect nets at a range great enough to avoid entanglement. Barium sulphate line was significantly stiffer than comparable nylon line. All lines lost stiffness when soaked in seawater for 24 h. Barium sulphate nets proved stiffer and more acoustically reflective, and both factors are likely important in reducing harbor porpoise bycatch.

Mooney TA, Au, WWL, Nachtigall PE, and Trippel, EA. 2007. Acoustic and stiffness properties of gillnets as they relate to small cetacean bycatch. 64(7): 1324-1332. ICES Journal of Marine Science.



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Barium sulphate net reflectivity

Target strengths of a nylon monofilament and an acoustically enhanced gillnet: Predictions of biosonar detection ranges

Thousands of marine mammals die each year in fisheries related entanglements. A substantial number of these animals entangle themselves in gillnets. Two populations that are in immediate danger are the coastal stock of the mid-Atlantic bottlenose dolphin, *Tursiops truncatus*, and the Gulf of Maine harbour porpoise, *Phocoena phocoena*. We investigated the efficacy of using an alternative net material made with barium sulphate hypothesized to be acoustically more reflective than traditional nets. By using simulated dolphin echolocation clicks, the target strengths of the experimental net was compared with the target strength of a similar gauge nylon net. Results demonstrated that at angles greater than normal incidence, but less than 40°, the new barium sulphate net was acoustically more reflective than the nylon net. However, at 0° there was no significant difference in the target strengths of the two nets. At angles greater than 40° both nets were difficult to discern from background noise. Target strengths of the nets were used to calculate detection ranges for *T. truncatus* and *P. phocoena*. Both species should be able to detect the experimental nets at a distance greater than the nylon nets. For *T. truncatus* this distance may be enough to reduce entanglement. However, because of *P. phocoena*'s lower source level echolocation signals, they may not detect either net with echolocation in time to avoid contact.

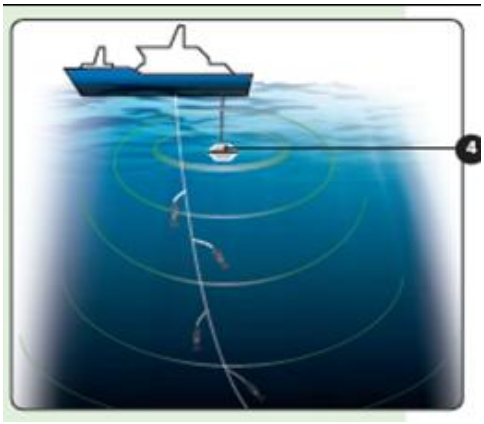
Mooney, TA, Nachtigall, PE, and Au, WWL. 2004. Target strengths of a nylon monofilament and an acoustically enhanced gillnet: Predictions of biosonar detection ranges. Aquatic Mammals. 30(2): 220-226.

Longline depredation and bycatch

I've also examined echolcation performance of false killer whales in the presence of acoustic deterent devices. These devices were designed to be associated with longlines and thus deter false killer whales from depredating, and occasionally becoming hooked on, the longline.

False killer whale (*Pseudorca crassidens*) echolocation and acoustic disruption: Implications for long-line bycatch and depredation

False killer whales (*Pseudorca crassidens*; Owen, 1846) depredate fish caught by the North Pacific pelagic long-line fishery resulting in loss of target species catch and the whales themselves becoming bycaught. This incidental take of false killer whales



exceeds sustainable levels. In an effort to address a potential solution to reducing this depredation and bycatch we tested an acoustic device designed to deter false killer whales from approaching long-lines by reducing the whales' echolocation performance capabilities. The device produced a series of complex, broadband signals (1-250 kHz) at high intensity levels (up to 182 dB). In the experiment, a trained false killer whale was asked to detect a target in the presence or absence of the acoustic device. Baseline performance capabilities were 95% correct responses. Initially, the device reduced the whale's echolocation performance to chance levels. However, subsequent sessions demonstrated improvement in echolocation performance up to 85%. This improvement was likely a result of behaviorally adapting to the task and a decrease in the source level of the echolocation "disruptor." The results underscore the challenges in using acoustic devices to reduce depredation and bycatch, and demonstrate the need for concern regarding anthropogenic noise levels and effects on odontocete echolocation capabilities.

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