Aquatic Mammals 2012, *38*(2), 161-188, DOI 10.1578/AM.38.2.2012.161

Behavioral Responses and Habituation of Pinnipeds and Small Cetaceans to Novel Objects and Simulated Fishing Gear With and Without a Pinger

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Abstract

Marine mammals are vulnerable to entanglement in nets and lines. To quantify their interactions with fishing gear, pinnipeds and small cetaceans were exposed to novel objects and simulated fishing gear in a zoological environment at SeaWorld San Diego. The objects included a line, a frame covered with gillnetting, and a pinger. Exposures were delivered using a baseline-exposure protocol, documenting naïve responses and using repeated trials to measure habituation or sensitization. Responses to objects paired with the pinger differed strikingly from others, stimulating behaviors consistent with aversion in all species. Among pinnipeds, harbor seals (*Phoca vitulina*) left the test pool or touched the pinger-associated object less often, although some eventually manipulated it extensively. California sea lions (*Zalophus californianus*) reacted initially with avoidance, defensive, and agonistic behaviors. However, they quickly returned to baseline activities and readily took fish from pingered nets. Northern elephant seals (*Mirounga angustirostris*) reacted the least. Among the cetaceans, bottlenose dolphins (*Tursiops truncatus*) and a Pacific white-sided dolphin (*Lagenorhynchus obliquidens*) did not manipulate the objects but made fast investigative or agonistic passes near them. Jaw claps and surface-active behaviors were most common during pinger trials. Commerson's dolphins (*Cephalorhynchus commersonii*) responded particularly strongly. Counts of some defensive or agonistic behaviors differed dramatically in the presence vs absence of the pinger, including bows (70 vs 0), roostertailing (117 vs 0), and fluke slaps (76 vs 2). Across seven trials, avoidance time in a refuge pool rose to > 90%, indicating sensitization. However, pinnipeds startled through gillnetting, and Commerson's dolphins charged it deliberately in spite of the pinger. Based on these experiments, it is more likely that pingers reduce entanglement by arousing aversion than by warning marine mammals to avoid a hazard.

Key Words: net alarm, pinger, fishing gear, entanglement, gillnet, behavior, neophobia, aversion, habituation, sensitization, agonistic behaviors, pinnipeds, small cetaceans

Introduction

Entanglement of cetaceans and pinnipeds in fishing gear and marine debris has become a significant cause of mortality worldwide (Žydelis et al., 2009). The most recent effort to estimate global marine mammal losses was based on bycatch data from U.S. fisheries, estimating a take of over 650,000 marine mammals annually, split roughly equally between pinnipeds and cetaceans (Read et al., 2006). In U.S. waters, gillnets were the greatest cause of bycatch for both taxa (Carretta et al., 2004; Read, 2005), but they were also commonly entangled in lines (e.g., float lines). California sea lions (*Zalophus californianus*), the Pacific harbor seal (*Phoca vitulina richardii*), and harbor porpoises (*Phocoena phocoena*) were identified as vulnerable.

A number of gear modifications to reduce bycatch have been tested in the last two decades, including acoustic net alarms or "pingers" (Kraus et al., 1997). However, the use of pingers has been controversial (Dawson et al., 1998; Kraus, 1999), and there is little information about the details of interactions between marine mammals and fishing-gear generally. There is some consensus that small cetaceans are *capable* of detecting nets as long as they are alert, within echolocation range, and actively emitting clicks (Hatakeyama & Soeda, 1990; Au & Jones, 1991; Au, 1994; Hatakeyama et al., 1994). However, small cetaceans often become entangled. Phocoenids and