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BIG BANG? INTENSE ULTRASOUND DOES NOT HAVE ANY DETECTABLE EFFECTS ON THE SQUID *LOLIGO PEALEII*

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INTRODUCTION

There are two important sources of ultrasound in the aquatic environment. One is the anthropogenic source in the form of echosounders and the other is the biosonar system of toothed whales. Both systems are very powerful, with source sound pressure levels of more than 220 dB re 1 µPa (peak to peak) (Au 1993). Their widespread use means that many fish and cephalopods often are exposed to intense ultrasound, but only a few studies have been conducted on the effects of these exposures. In this experiment (Wilson et al. 2007), we exposed the squid, *Loligo pealeii,* to intense ultrasonic signals to test for behavioural responses and to test if toothed whales may use intense echolocation signals to debilitate their prey.

METHODS

Twelve squid were exposed to ultrasonic click types at two repetition rates (16 and 125 clicks/s) with received sound pressure levels of 199-

226 dB re 1 µPa (peak to peak), mimicking the sound exposure from a nearby toothed whale or echosounder. Video recordings of the squids were analyzed by comparing a 3-s preexposure with the 3-s exposure scoring for the following behaviours: change in chromatophore patterning of the skin, inking presence, and fast forward or backward jetting presence.

RESULTS

The *Loligo pealeii* did not show any apparent behavioural response when stimulated. They did not reveal antipredator behaviour as parameterized above irrespective of click type and repetition rate. When exposed to clicks with received levels in excess of 222 dB re 1 µPa (peak to peak), there were no signs of acoustic debilitation.

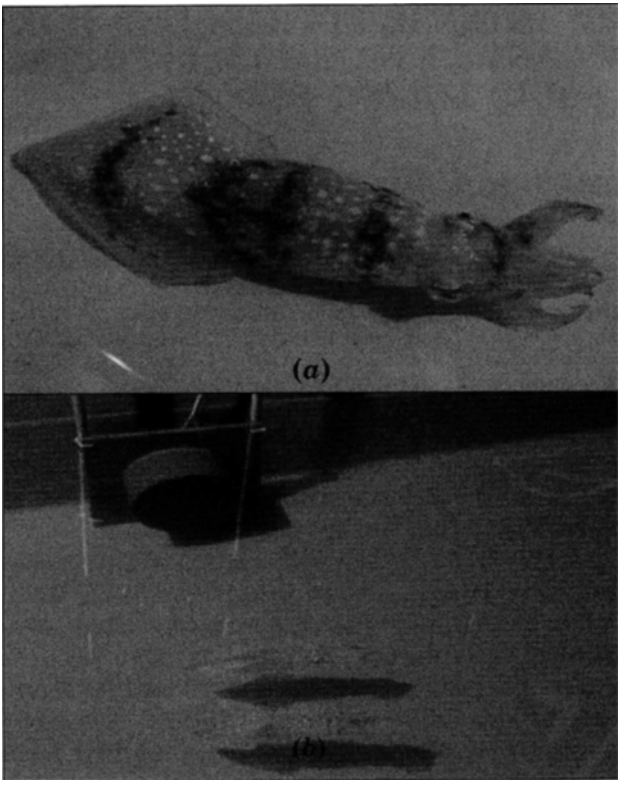

Figure 1. (*a*) *Loligo pealeii* showing a typical response to threat by settling at the bottom, showing disruptive coloration characterized by dark transverse bands on the body. (*b*) Two *Loligo pealeii* passing immediately in front of the transducer. The squids are receiving clicks with sound pressure levels of 223 dB re 1 µPa (peak to peak) but continue calm normal swimming and coloration.

DISCUSSION

There were no signs of the antipredator behaviours that could be expected if the squid detected and perceived the ultrasonic sound pulses as coming from an approaching predator. Approaching predators provide several other sensory cues to their prey, and squids might have evolved other ways of detecting an approaching toothed whale. Cephalopods can detect low-frequency particle motions, and it is conceivable that they may detect the low-frequency vortices that a swimming toothed whale creates for every fluke stroke. We demonstrate that intense ultrasonic clicks with received levels up to 226 dB re 1 µPa (peak to peak) do not acoustically debilitate this cephalopod species. Therefore, *Loligo pealeii* do not seem to detect echolocating toothed whales by their very intense echolocation clicks, and we conclude that echosounders do not affect cephalopods either.

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