

ID: W1968217553

TITLE: Beaked Whales Respond to Simulated and Actual Navy Sonar

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ABSTRACT:

Beaked whales have mass stranded during some naval sonar exercises, but the cause is unknown. They are difficult to sight but can reliably be detected by listening for echolocation clicks produced during deep foraging dives. Listening for these clicks, we documented Blainville's beaked whales, *Mesoplodon densirostris*, in a naval underwater range where sonars are in regular use near Andros Island, Bahamas. An array of bottom-mounted hydrophones can detect beaked whales when they click anywhere within the range. We used two complementary methods to investigate behavioral responses of beaked whales to sonar: an opportunistic approach that monitored whale responses to multi-day naval exercises involving tactical mid-frequency sonars, and an experimental approach using playbacks of simulated sonar and control sounds to whales tagged with a device that records sound, movement, and orientation. Here we show that in both exposure conditions beaked whales stopped echolocating during deep foraging dives and moved away. During actual sonar exercises, beaked whales were primarily detected near the periphery of the range, on average 16 km away from the sonar transmissions. Once the exercise stopped, beaked whales gradually filled in the center of the range over 2-3 days. A satellite tagged whale moved outside the range during an exercise, returning over 2-3 days post-exercise. The experimental approach used tags to measure acoustic exposure and behavioral reactions of beaked whales to one controlled exposure each of simulated military sonar, killer whale calls, and band-limited noise. The beaked whales reacted to these three sound playbacks at sound pressure levels below 142 dB re 1 μ Pa by stopping echolocation followed by unusually long and slow ascents from their foraging dives. The combined results indicate similar disruption of foraging behavior and avoidance by beaked whales in the two different contexts, at exposures well below those used by regulators to define disturbance.

SOURCE: PloS one

PDF URL: <https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0017009&type=printable>

CITED BY COUNT: 291

PUBLICATION YEAR: 2011

TYPE: article

CONCEPTS: ['Sonar', 'Beaked whale', 'Marine mammals and sonar', 'Human echolocation', 'Whale', 'Bioacoustics', 'Foraging', 'Range (aeronautics)', 'Sound (geography)', 'Acoustics', 'Oceanography', 'Geology', 'Biology', 'Fishery', 'Engineering', 'Ecology', 'Physics', 'Aerospace engineering']