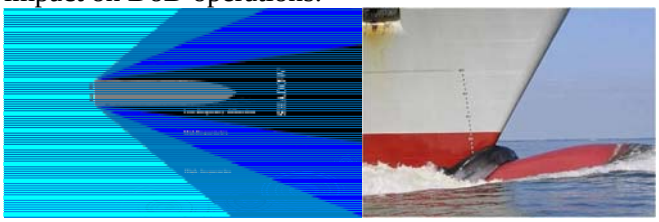
Near surface sound propagation, a key to alerting North Atlantic right whales of approaching DoD ships

Project # *06-145*

Background:

Whales are vulnerable to collisions when near the surface. Here the physics of near surface sound propagation can render the sounds of approaching large ships indistinguishable from the ambient background. Whales traveling near the surface can not hear the sounds of ships due to the confluence of Acoustical Shadowing and Lloyd's Mirror Effect. Collisions with endangered North Atlantic right whales are a major concern of the Jacksonville Naval Air Command and Kings Bay Submarine Base. When right whales are located in the area, delays and ship avoidance maneuvers effect base operations and security, especially when an SSBN is arriving or leaving base. A cost-effective technology that addresses the underlying acoustic cause of ship strikes is being developed to alert whales, mitigating the risk of collisions and impact on DoD operations.



Acoustic shadows can make the sounds of approaching ships undetectable to whales. Whales swimming or resting near the surface in the path of the ship cannot detect its' approach, while other whales, positioned off to the side or in deeper water, that hear the ship may actively seek refuge from the noise and surface into the quiet shadows directly ahead of approaching ships. This dangerous ambiguity of safety could be luring whales to their death.

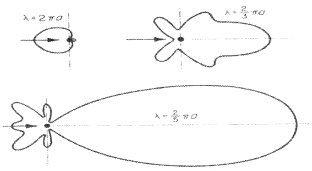
Objective:

This Legacy-funded project was to test the efficacy of prototype projectors for selectively fill-in the acoustic shadows ahead of ships with modulated ship noise. Two prototypes were tested, a Tonpliz array and a modified parametric array. The projectors are designed to eliminate the ambiguity of safety which acoustic shadows provide and effectively alert North Atlantic right whales near the surface of the direction of approaching ships.

Summary of Approach:

The efficacy of the prototypes was measured using gps instrumented floating buoys and vertical hydrophone arrays.

Field measurements were used to further evaluate diffraction models for various size ship hulls and apply directional projectors to selectively fill-in acoustic shadows for various size hulls.



Sphere diffraction model

Ship passing vertical arrays

Carey Tonpilz array

Parametric projector

Benefit:

The direct benefit to the Military is to enable DoD vessels to operate unimpeded even when North Atlantic right whales are in the vicinity. The acoustic alarms can mitigate ship strike risks and relax the imposition of speed restrictions and or rerouting. The benefit could be extended to commercial shipping interests.

Accomplishments:

The Tonpilz and parametric alarms proved to be effective at selectively "filling - in" acoustic shadows at the bow. Since collisions are often fatal encounters, expecting whales to learn to associate omnidirectional or novel alarms with approaching ships is not viable. Therefore, bow-mounted devices projected directional modulated ship noise. The noise was heterodyned to minimize Lloyd's mirror effects and eliminate a deceptive ambiguity caused by shadows to better alert whales of approaching ships.

Directional alarm at the bow to alert whales

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