Integrating remote sensing methods to measure social delphinid baseline behavior and responses to Navy sonar

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Introduction

Oceanic delphinids are generally not endangered or threatened, have typically not been observed in mass-stranding events associated with Navy sonar. Potential responses of these species are often inferred from laboratory measurements or from anecdotal observations in uncontrolled contexts, each of which has significant limitations in predicting responses in these common species for realistic sonar exposures. To date there have been no direct experimental studies of the potential responses of these animals in known, controlled conditions.

Building on related studies in a number of field sites, we will develop and utilize a novel integration of several established remote-sensing methods to quantify behavior and biopsy sampling to measure stress hormone levels in three delphinid species that are common and frequently exposed to Navy mid-frequency active sonar (MFAS) off California. We will evaluate potential responses to simulated mid-frequency active sonar (MFAS) using controlled exposure experiments (CEEs). The nature of the resulting data will be necessarily and categorically different from previous response studies involving tagging of single individuals. Beyond the fact that getting tags to stay on individuals has proven infeasible to date, these social species typically occur in groups and group members likely interact in their response to external stimuli. As such, the group, or part of the group, is likely the more relevant unit of analysis.

Objectives

I. Develop integrated, cross-disciplinary methods to simultaneously track group movement and behavior using shore- or vessel-based visual observers, aerial photogrammetry, and remote-deployed acoustic recorders.

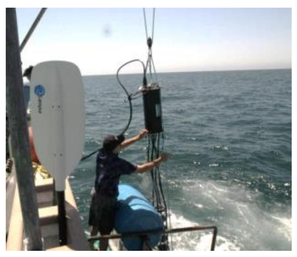
II. Apply group-sampling methods using integrated technologies to better characterize typical (undisturbed) behavioral parameters for these species.

III. Obtain biopsy samples for use in a collaborative research project to measure stress hormone levels

IV. Obtain direct measurements of group behavioral changes and stress hormone responses, if any, resulting from experimentally controlled simulated Navy MFAS for three delphinid species that occur in large numbers in Navy range areas, including common dolphins (*Delphinus sp.),* bottlenose dolphins (*Tursiops truncatus*), and Risso's dolphin (*Grampus griseus*).

Methods

Building on our recent and ongoing research, we will develop and utilize a novel integration of three different complementary systems to measure aspects of baseline behavior and potential behavioral responses to simulated mid-frequency active sonar (MFAS) using controlled exposure experiments (CEEs) in three delphinid species. Standard biopsy sampling procedures will be used to obtain tissue samples. A custom vertical line array sound source (right) will project simulated MFAS signals during CEEs.

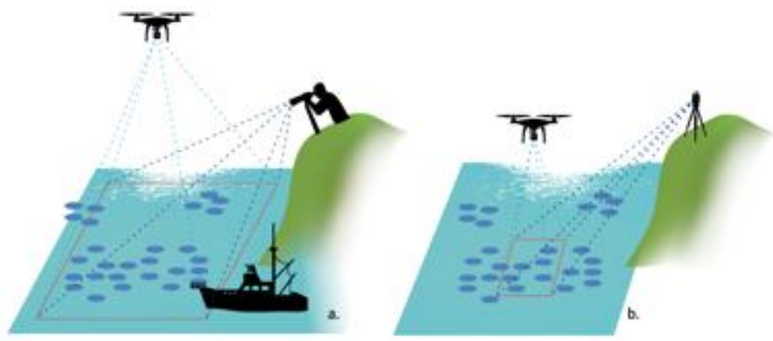


Remote sensing methods include:

(1) shore- and vessel-based visual sampling;
(2) unmanned aerial systems (UAS) for photogrammetry;
(3) Remote-deployed passive acoustic sensors

UAS being deployed from a small research vessel

Aerial photogrammetry images of bottlenose (l) and common dolphins (r)



Schematic representation of two complementary scales of observation using UASs and visual observations

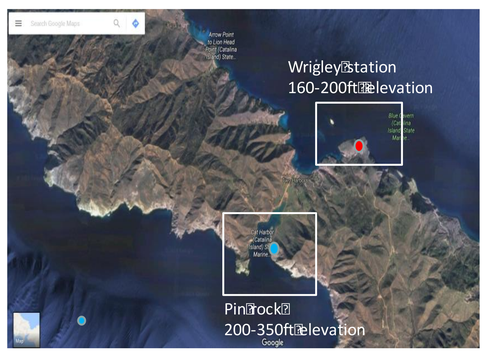
Shore-based theodolite and visual observation station

Planned Field Effort

I. 23 June to 2 July 2017 (technology integration assessment; baseline data; no CEEs)

II. 27 Sept to 7 Oct 2017 (baseline data & MFAS CEEs)

III. mid-late June 2018 (baseline data & MFAS CEEs)



Two initial shore-based visual observation stations on Catalina Island, CA

All research will be conducted under current NMFS permits (#19116), Cascadia IACUCs, and DOD BUMED authorizations