

Movements and Habitat Use of Dwarf and Pygmy Sperm Whales using Remotely-Deployed LIMPET Satellite Tags

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LONG-TERM GOALS

Dwarf (*Kogia sima*) and pygmy (*K. breviceps*) sperm whales are among the least known species of odontocetes, despite their distribution in oceanic waters world-wide. There is some evidence that both species may be at least occasionally impacted by Navy sonar activity (Hohn et al. 2006; Weilgart 2007). The long-term goals of this research are to reduce uncertainty regarding movements and habitat use of these species in Hawaiian waters, an area where these species are exposed to Navy activities.

OBJECTIVES

The objectives of this research are to assess site fidelity, movements, and habitat use of dwarf and pygmy sperm whales in Hawai‘i over periods of weeks to months, through the remote deployment of LIMPET satellite tags. Knowledge of site fidelity and movements among islands will allow for assessment of the likelihood of repeat exposure to anthropogenic activities, as well as determination of whether individuals are part of smaller island-associated populations or open-ocean populations. The results will also help in identifying preferred habitats where overlap with anthropogenic activities is most likely to exist.

APPROACH

Field operations

Dwarf and pygmy sperm whales have a reputation for being difficult to approach (Willis and Baird 1998), and there has been limited work with free-ranging individuals of either species in the wild anywhere in the world. Over the last 12 years, as part of a multi-species study of odontocetes in Hawai‘i (Baird et al. 2013), we have been working with dwarf and pygmy sperm whales using small vessels, involving approaching groups for individual photo-identification (Mahaffy et al. 2009). As part of this work we have been able to identify certain behavioral patterns of dwarf sperm whales that facilitate relatively close approaches to the animals without obviously disturbing them. With this experience, during field projects in October 2013, July 2014, November/December 2014, and in spring 2015, we will undertake small-boat based field projects in Hawaiian waters, and approach groups of either species with the intent to attempt tagging using LIMPET satellite tags (see e.g., Schorr et al. 2009; Baird et al. 2011a). Field efforts will be concentrated in specific depth ranges where previous

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surveys have indicated relatively high density of dwarf sperm whales (Baird et al. 2013). To maximize the chances of success at tagging these species, the research vessel will primarily be operated by the PI, who has extensive experience driving small vessels around this species, and the tagger will be Daniel Webster, who, as of September 2013, has deployed 79 LIMPET tags on eight different species of odontocetes (including 24 tags on three different species of similar-sized odontocetes).

Tags used will be either the Wildlife Computer Spot-5 location-only tag or Mk10A location/dive tag in LIMPET configuration. Location-only tags will be programmed to transmit ~10-12 hours per day with transmission hours corresponding to those hours with the greatest satellite coverage, but with hours spread out over the day to allow for obtaining multiple locations each day. Locations would be obtained both during the day and at night, to allow for comparisons of day- and night-time habitat use and movements (cf. Scott et al. 2001). Location-dive tags will be programmed to transmit ~18-20 hours per day, to maximize the likelihood of obtaining complete dive records as well as location information.

When encountered, dwarf and pygmy sperm whales will be approached slowly, with efforts made to remain with the group for as long as possible while minimizing the likelihood of disturbing individuals. From previous experience with these species, and other difficult-to-approach species such as beaked whales, we have learned that groups can be followed for extended periods by obtaining GPS locations on the location where whales dive, remaining close (<100 m) to those locations while the whales are down, and repeating this in an iterative fashion over a series of dives to obtain the general direction, speed of travel, and spatial spread of a group. After determining this during a series of surfacing/dive cycles, it is possible to predict approximately where individuals will surface after long dives, allowing for closer approaches than would otherwise be possible. It is using this iterative process that we expect to be able to occasionally deploy LIMPET satellite tags. If it is possible to tag more than one individual within a group, a second tag would be deployed, to allow for assessment of group dynamics, and, if individuals separate, to obtain information on more than one group. During this process we will also be photographing all individuals present.

If tagged individuals remain within our study area during ongoing field projects we will attempt to use Argos locations and uplinks received in the field to re-locate the tagged individual, to assess tag attachment and also to obtain photos of companion individuals for re-sighting analyses.

Data processing and analyses

Argos location data obtained would be processed to eliminate unrealistic locations using the Douglas Argos-filter. Filtered locations would be processed with ArcGIS to obtain bathymetric data (depth, slope, distance from shore) for each location. If more than one tag is deployed with a temporal overlap in tag data, distances between locations received on the same satellite overpasses will be calculated with an R program, to determine whether individuals are acting independently or in concert. Data would be analyzed to assess habitat use (preferred depth, slope, distance from shore), movements in relation to the island slope, day/night differences in habitat/movements, and, if individuals move offshore, movements in relation to eddy fields (e.g., Woodworth et al. 2011).

Photos obtained of tagged and companion individuals will be added to a long-term photo-identification catalog held by CRC (Baird 2005; Mahaffy et al. 2009). Photos will be used to assess sighting history and sex (for those previously documented with/without calves present), to aid in interpretation of movement data. Information on the depth of the group, combined with the sighting history and association patterns of individuals within the group, would also be used to assess whether the

individual was part of the island-associated population or an open-ocean population (cf. Baird et al. 2011b). Association analyses will be undertaken in SOCPROG and network analyses illustrated using Netdraw.

WORK COMPLETED

Field operations were undertaken off Hawai'i Island in October 2013 and July 2014. Dwarf sperm whales were encountered on seven occasions during field operations in 2013 and 2014. All encounters were in depths <1000 m (median = 650 m, range 425-849 m). Group sizes ranged from 1-6 (median = 2) individuals. Encounters ranged in duration from 21 min to 1 h 33 min. Six of the seven encounters were terminated when the group was lost. While no satellite tags were deployed, we were able to photo-identify individuals in all seven encounters, with 14 individuals identified. Of the 14, 10 were categorized as adults. Of these, two were considered slightly distinctive, five were considered distinctive, and three were considered very distinctive. Excluding the two slightly distinctive individuals, as the probability of re-sighting slightly distinctive individuals is low, five of the eight distinctive or very distinctive individuals had been previously documented off the island.

Planning is underway for additional field operations in November/December 2014, and spring 2015.

RESULTS

Five of the eight distinctive individuals photo-identified had been previously documented off the island of Hawaii. One individual, HIKs020 in our photo-identification catalog, was first documented off the island in November 2004. Our sighting of this individual in October 2013 represents the ninth time HIKs020 had been documented (in seven different years) over a nine-year span. One individual, HIKs050 in our catalog, was first documented in October 2008, and re-sighted in October 2013 and in January 2014, with sightings in four years over a five-year span. Combined these re-sightings provide evidence of high site fidelity for this species.

IMPACT/APPLICATIONS

If we are successful at deploying LIMPET satellite tags on either of these species, the information obtained will dramatically increase what is known about these very poorly understood species of odontocetes, and provide the first detailed movement data for these species. Photo-identification data obtained is already providing hitherto unavailable information on the long-term site fidelity of dwarf sperm whales. These species inhabit Navy ranges, are potentially susceptible to impacts from naval activities, and yet because of the difficulty in detecting them in anything other than ideal sea conditions are underrepresented in sighting data. Information obtained will allow for an assessment of the likelihood of repeated exposure to anthropogenic activities as well as identify preferred habitats where overlap with anthropogenic activities is most likely to exist.

RELATED PROJECTS

Field work in October 2013 was undertaken in association with two other field efforts, to leverage additional field time to increase the likelihood of tagging success. One project is "Remote Release Device for Marine Mammal Electronic Tags" funded through a Science and Technology Transfer (STTR) program Phase II Option 1 contract, Office of Naval Research Contract N00014-11-C-0092 issued to Wildlife Computers with a subcontract to the Alaska SeaLife Center. The other project is

“Hawaiian odontocete assessment: updating photo-identification catalogs for estimating abundance, assessing the nature and extent of fishery interactions with pantropical spotted dolphins, and examining false killer whale movements”, funded by the NOAA Pacific Islands Fisheries Science Center (PIFSC) under Grant Number NA13OAR4540212. Field work in July 2014 was also undertaken in association with the PIFSC grant. Field work to be undertaken in November/December 2014 will be undertaken in association with a project on “False killer whale movements in relation to longline fishing activity: assessment of interactions using satellite tag and fisheries data to develop best practices to reduce bycatch”, funded by the NOAA Bycatch Reduction Engineering Program under Grant Number NA14NMF4720319.

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