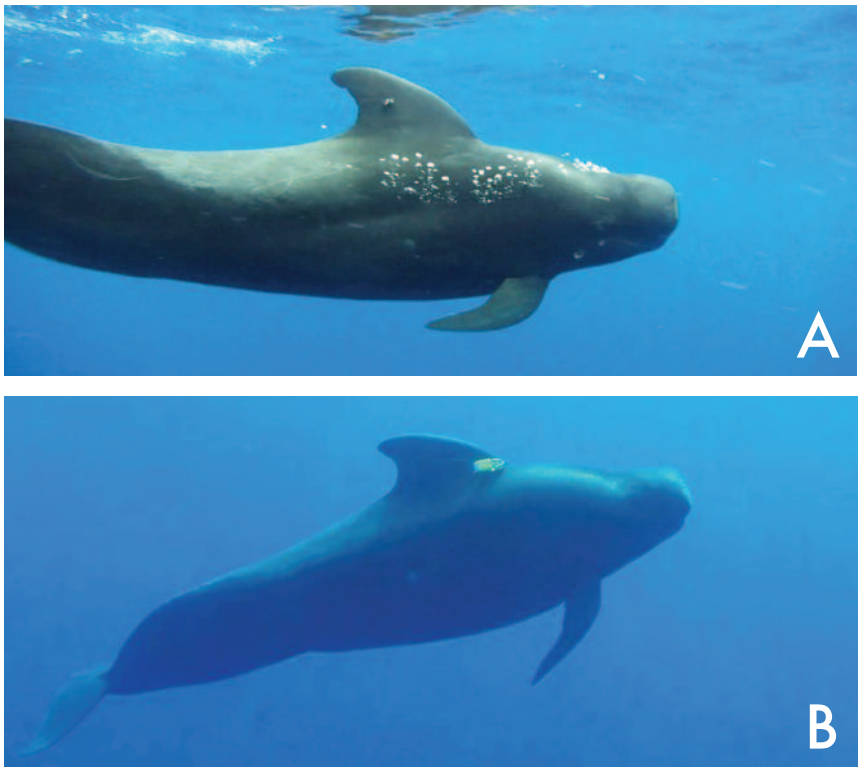
LIVING MARINE RESOURCES PROJECT 41

Improved Tag Attachment System for Remotely Deployed Medium-Term Cetacean Tags

NEED

The Navy requires data to support behavioral response criteria in its acoustic effects modeling. Animal telemetry (i.e., tagging) provides much of the needed marine mammal baseline behavioral data (diving, movement) and behavioral and physiological response to exposure from Navy sources. Longer tag attachment durations could offer improved data to better understand the duration and severity of behavioral responses to anthropogenic noise. The Navy is interested in research towards the redesign and/or improvement of medium-term tag attachment methods for dart-style tag attachments for marine mammals. Improved dart design is needed to increase tag deployment durations to an average of one to several months.



Two of the types of tags that could benefit from improvements in the tag attachment systems are shown attached to short-finned pilot whales: A. LIMPET tag, B. SMRT tag.

Tagging conducted under research permits15330 and 20605

SOLUTION

This demonstration project will build on previous Office of Naval Research-funded efforts and assess the feasibility of producing an alternative tag attachment element for remote tag deployment. The current attachment for the Low Impact Minimally Percutaneous External-electronics Transmitter (LIMPET) tag system employs darts—small diameter metal shafts with externally facing barbs, or petals. A significant concern is how these rigid anchors interact with the surrounding tissue when the external part of the tag is subjected to large dynamic forces (including physical contact with other animals and the seafloor or breaking the water surface), which is a common occurrence for many tagged cetaceans. The project team is exploring attachment mechanisms that are:

- More compatible with the animal's tissue
- Less susceptible to breakage
- Well balanced with the external tag electronics package
- Easily attached
- Able to remain attached for longer periods and
- Designed to work with the current suite of LIMPET tags and Sound and Motion Recording and Transmitting (SMRT) tags.

METHODOLOGY

The project is organized into four separate phases, with each subsequent phase determined by the outcome of the preceding one.

1. **Phase 1—Refine two existing designs: An elastic connection between a more tissue-friendly implanted anchor and existing LIMPET external package; and a single-point attachment, loosely tethered tag.**

   The team will collaborate with mechanical and biomechanical engineers on computer-aided design (CAD) and finite-element analysis. After refinement in CAD, physical prototypes will be constructed using rapid-prototyping methods to identify appropriate designs for testing. Employing the protocols previously developed for testing cetacean tag attachments, a static pull apparatus and a dynamic pendulum impact force tester will be used to test prototype attachment elements under simulated implanted conditions. The attachment element prototypes will be tested concurrently with existing LIMPET barbed darts to compare retention ability and resistance to in situ breakage. The prototype elements will be implanted into both simulated cetacean tissue (e.g., fiber-reinforced rubber) and tissue retained from stranded cetacean carcasses.

2 **Phase 2—Conduct field deployments of the most promising designs.**

   Designs will be tested on two species (short-finned pilot-whales in Hawaii, fin whales in Southern California or beaked whales off Guadalupe Island). The appropriate designs and target species will be decided after Phase 1. The primary goal in these field tests will be to significantly reduce variation in attachment times.

3. **Phase 3—Implement the lessons learned from field trials to improve the attachment element design(s).**

   Demonstrate the final design in field trials with the same two species chosen for Phase 2. Prepare a final report on the field trials.

4. **Phase 4—Conduct dedicated detailed follow-up studies to assess the condition of the previously tagged whales and demonstrate that the improved anchor design has not increased the negative effects of tagging.**

   This will include quantifying wound healing and the effects of tagging on whale survival, reproduction and behavior. The team will use high-resolution digital photos, histological examination of biopsy samples and imaging from forward-looking infrared (FLIR) cameras to examine how well tag attachment sites are healing and to evaluate thermoregulatory function in the dorsal fin. The diving and movement behavior of tagged animals will also be evaluated.

SCHEDULE

Phase 1 of the project is slated for completion in 2020. Depending on the decisions for subsequent phases, Phase 2 field deployments of initial designs will occur in 2021, Phase 3 deployment of final designs in 2022 and Phase 4 follow-up studies in 2023.

NAVY BENEFITS

Improved attachment mechanisms that support recording the movements and behavior of cetaceans over longer periods of time, and more consistently, than is currently possible will improve the Navy's ability to monitor cetaceans before, during and after exposure to Navy sources. This will enable the Navy to develop behavioral response functions that are more closely aligned to the statutory definition of take for military readiness activities.

TRANSITION

Project results will be presented at scientific conferences and submitted for publication in scientific journals. If successful, the improved tag anchor systems will be transitioned to the commercial market after completion of all functionality tests.

ABOUT THE PRINCIPAL INVESTIGATORS

Russel Andrews, the lead principal investigator, is a senior scientist with the Foundation for Marine Ecology & Telemetry Research. His expertise includes marine mammals, diving behavior and physiology, and remote monitoring equipment and instrumentation. Dr. Andrews earned his Ph.D. in Zoology at the University of British Columbia.

Greg Schorr, co-principal investigator, is a research biologist at the Foundation for Marine Ecology & Telemetry Research. He has been studying marine mammals for 18 years with much of his research focused on telemetry studies and deploying a wide variety of tags. His most recent focus has been using remotely deployed satellite tags to study beaked whale ecology and behavioral responses to anthropogenic sources of sound. Greg earned his geology degree from Colorado College.

About the LMR Program

The Living Marine Resources (LMR) program seeks to develop, demonstrate, and assess data and technology solutions to protect living marine resources by minimizing the environmental risks of Navy at-sea training and testing activities while preserving core Navy readiness capabilities. For more information, contact the LMR program manager at exwc_lmr_program@navy.mil or visit www.navfac.navy.mil/lmr.