EVALUATING POTENTIAL EFFECTS OF SATELLITE TAGGING IN LARGE WHALES: A CASE STUDY WITH GULF OF MAINE HUMPBACK WHALES

Dr. Jooke Robbins
Provincetown Center for Coastal Studies, 5 Holway Avenue, Provincetown, MA, 02657-1326 USA
Phone: (508) 487-3623 x116 FAX: (508) 487-4695 E-mail: jrobbins@coastalstudies.org

Dr. Phillip Clapham
National Marine Mammal Laboratory, Alaska Fisheries Science Center
7600 Sand Point Way NE, Building 4, Seattle, WA, 98115-6349 USA
Phone: (206) 526-4037 FAX: (206) 526-6615 E-mail: Phillip.Clapham@noaa.gov

Dr. Nicholas Gales
Australian Antarctic Division, 203 Channel Highway, Kingston, Tasmania, 7050, Australia
Phone: 61-3-62323437 FAX: 61-3-62323447 E-mail: Nick.Gales@aad.gov.au

Dr. Frances Gulland
The Marine Mammal Center, Marin Headlands, 1065 Fort Cronkhite, Sausalito, CA, 94965-2609 USA
Phone: (415) 289-7325 FAX: (415) 289-7333 E-mail: Gullandf@TMMC.org

Dr. Alexandre N. Zerbini
Cascadia Research Collective, 218 1/2 W 4th Ave., Olympia, WA 98501-1004 USA and
National Marine Mammal Laboratory, Alaska Fisheries Science Center
7600 Sand Point Way NE, Building 4, Seattle, WA, 98115-6349 USA
Phone: (206) 526-4511 FAX: (206) 526-6615 E-mail: alex.zerbini@noaa.gov

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http://www.coastalstudies.org
http://www.afsc.noaa.gov/nmml/
http://www.marinemammalcenter.org/
http://www.antarctica.gov.au/
http://www.cascadiaresearch.org/

LONG-TERM GOALS

This project is a study of satellite tag retention and health impacts among Gulf of Maine humpback whales (*Megaptera novaeangliae*). Its overall goal is to better understand short- and medium-term physical and physiological effects of Type I tags and to investigate the processes involved in tag rejection, failure and loss. This work is expected to inform future tag design and deployment, and particularly seeks to minimize impacts on whales while maximizing methodological performance.

OBJECTIVES

The specific objectives of this project are as follows: 1) to characterize the range of physical and physiological responses to the tag through the measurement of physical and physiological parameters; 2) to provide data to optimize tag performance, as well as to minimize tag loss and impact; 3) to quantify the effect of tagging on individuals and to attempt to correlate that to sex, age, reproductive condition, and tag location. The focal population is well-studied and expected to facilitate repeated re-sightings of tagged individuals with or without tags. We therefore expect to evaluate possible post-tagging shifts in habitat use of tagged whales relative to their known preferred habitat and other non-tagged individuals with similar habitat use patterns. We also hope to gather data on movements and habitat use of humpback whales in the Gulf of Maine to improve scientific understanding and management of this population.

APPROACH AND WORK PLAN

Up to 20 satellite tags will be placed on individually identified Gulf of Maine humpback whales annually over three years. The satellite tags being used in this study are the Wildlife Computers (Redmond, WA, USA) SPOT 5 transmitters custom-designed in an implantable cylinder housing (Mold 177). Tags will be deployed during a two-week period annually, as early as practicable in the feeding season. Project staff will identify individual humpback whales in the field and select them for tagging based on extensive data on individual age and/or age class, sex, reproductive histories and known residency patterns. Follow-up cruises are then performed on a weekly or bi-weekly basis through December of the tagging year. Monitoring is also facilitated by a collaborating network of commercial whale watching vessels. Wound size and healing are to be assessed from high resolution photographs, and changes in tag site appearance will be combined with re-sighting data to assess the impact of tagging on individuals.

The project is a collaboration of scientists from several institutions: the Australian Marine Mammal Centre (AMMC), Cascadia Research Collective (CRC), the Marine Mammal Center, (TMMC), the National Marine Mammal Laboratory (NMML) and the Provincetown Center for Coastal Studies (PCCS). PCCS is responsible for grant management and technical aspects of the project are coordinated by Dr. Robbins (PI, PCCS) and Dr. Zerbini (co-PI, CRC/NMML). Drs. Zerbini and Gales (Co-PI AMMC) are responsible for the preparation and deployment of satellite tags. Telemetry data will be managed and analyzed by Drs. Zerbini, Gales and Clapham (co-PI, NMML). Dr. Robbins leads efforts to select individuals for tagging and to document tagged whales. Assessments of physical and physiological responses to tagging is led by Drs. Gales and Gulland (co-PI, TMMC). Other data analysis and report writing are led by Drs. Robbins and Zerbini in collaboration with all co-investigators.

WORK COMPLETED

Sixteen satellite tags were deployed on North Atlantic humpback whales in the Gulf of Maine in July 2012, bringing the total number of tags deployed to 36. Tagging was performed by experts from NMML and CRC working with PCCS teams. The whales selected for tagging in 2012 represented a sample of well-known catalogued adults ranging in age from 12 to 34 years. Focal follows were performed for at least one hour after tagging to assess the nature of animal responses, injuries and tag placement. We also photo-identified other individuals in the vicinity of tagging operations to serve as a point of comparison for tagged whale behavior and residency characteristics. Follow-up cruises have been performed on a near-weekly basis during the feeding season in 2012 (38 days to date) to document tagged individuals. Cruises began in early spring to document last year's tagged whales as they returned from their winter breeding ground. In total, 3,825 images of implanted tags/tag sites have been processed in 2012 as part of the follow-up monitoring process. This includes opportunistic images submitted by commercial whale watch naturalists collaborating with the project. Progress has been made in characterizing impacts to individuals and in identifying tag modifications needed to improve health and tag performance (see "Results", below).

RESULTS

This was the second year of tag deployment and unfortunately it corresponded with a year of low whale density and residency in the study area. Fewer tags were deployed than planned due to difficulty in finding suitable candidates for tagging and follow-up monitoring efforts have also been impeded. At least four tagged whales moved north of the Gulf of Maine ground, where they were not accessible through our monitoring efforts. Fortunately, we were able to coordinate with colleagues off Newfoundland to document one individual with an active tag.

Despite the logistical challenges of 2012, we successfully re-sighted all but one of the whales tagged in 2011. Coverage of those individuals now spans more than 400 days in some cases, providing new insight into the longer term health of tagged whales. We have also re-located and documented all but two of the 2012 tagged whales. The latter individuals have been documented on an average of 7.6 days (min=1, max=14) since tag deployment, with observations spanning 43.3 days on average (min=1, max=79). Tags deployed in 2012 transmitted for 29.5 days on average, with three tags lasting for more than 80 days.

Research to date has confirmed considerable variation in physiological and behavioral responses to tagging. Some individuals have exhibited only minor responses, while others have had pronounced behavioral disturbance on the day of tagging and/or swellings at the tag site over the longer term. In one extreme case, a large swelling has persisted at the tag site for at least 390 days. We will continue to explore potential causes of this variation as the project continues.

Re-sightings of tagged individuals have revealed two design flaws that could explain the relatively short and variable duration of Type I satellite tags. The anchoring systems used in tags deployed in 2011 possessed a single articulation point designed to allow the tag to compensate for movement (shearing) between the muscle and the blubber. Follow-up monitoring indicates that the articulation failed in at least 7 out of 19 deployments. As a result, the transmitter prematurely detached from the anchor, resulting in shorter than expected tag durations. Photographic evidence indicates that breakage

occurred on the multi-braided cable or at the stop sleeves used to attach the cable to the anchor sections.

Another design limitation involves the interface of the anchor and the electronic package. In the current Type I tag designs, the transmitter attaches to the anchoring system via a threaded pin. We documented breakage or bending of the tag at the anchor/transmitter interface in 5 out of 16 deployments in 2012. The cause of the breakage is not known, but could have resulted from forces on the tag during deployment or post-deployment contact between the tagged whale and other animals or objects in the environment. This type of anchor/transmitter interface has been used for at least 10 years in Type I implantable tags, is nearly identical across all tag manufacturers and has been used in many telemetry studies worldwide. It is likely that flaws of this nature have been a regular event and were just not documented before because follow-up studies were limited and with insufficient temporal resolution to observe tag damage.

Although this project is still underway, the findings described above have already resulted in changes to tagging practices, as well as a collaborative proposal to ONR to redesign the Type I anchor to improve resilience and minimize impacts. The proposed development and testing may warrant postponing the third year of this tagging study.

IMPACT AND APPLICATIONS

National Security

Satellite tagging is an invaluable tool for quantifying the movements, range and habitat use patterns of cryptic large whale species. Making this technology as effective and benign as possible will increase the number of individuals, populations and species to which this technology can be applied. It has the potential to benefit the national security by identifying areas where at-sea activities by the Navy and Coast Guard may be least likely to be interrupted or result in impacts to marine mammal populations.

Economic Development

The intent of this collaborative research is to evaluate currently used tagging technologies and to make recommendations to improve effectiveness and minimize impacts. We plan to make our results openly available to individuals and companies who develop and/or use this technology. Efforts to improve tagging should provide greater and broader applications and sales.

Quality of Life

As noted above, satellite tagging produces data that can be critical for identifying migratory corridors, connections and critical habitats. This information is vital for conserving species, managing populations and reducing conflicts with humans. Thus, improvements to this technology should have a positive effect on the management and conservation of large whale species.

Science Education and Communication

The humpback whale is well-loved by the public and so an ideal species to foster interest and facilitate understanding of aspects of science and conservation. Humpback whales exhibit the largest recorded movements among mammals and migration is a topic of particular fascination for students and the public. Yet, for many populations, the specific routes and connections between areas are poorly understood. Tagging has the ability to both improve this knowledge but to also express it in a way that can be grasped visually by a wide audience. As such, we expect improvements in tagging technology to facilitate teaching and outreach.

TRANSITIONS

Economic Development

Representatives of the tag manufacturer (Wildlife Computers) have been informed of significant findings throughout the project, as part of collaborative efforts to improve and enhance tag design.

Science Education and Communication

This tagging project involves a significant outreach component, as the population under study supports a robust whale watching industry. Tagging is performed in the vicinity of private and commercial whale watchers and we have engaged whale watching naturalists to provide sightings and images of tagged whales. Naturalists have used this project as a tool for educating their passengers at sea and we have made movement data available to them and the wider public to facilitate understanding of humpback whale movements and habitat use (see "Outreach Materials", below). We particularly thank the following whale watching companies and/or affiliated organizations that have shared whale watching data with the project: Brier Island Whale and Seabird Cruises, the Dolphin Fleet, Captain John Boats, Blue Ocean Society, New England Coastal Wildlife Alliance, Whale and Dolphin Conservation Society and the Whale Center of New England.

RELATED PROJECTS

The results of this project continue to inform the tagging efforts of our co-investigators in the North Pacific and the Southern Hemisphere. In 2012, Zerbini and Robbins began a parallel project to compare the effects of Type I tags to LIMPET-style tags more commonly used in odontocetes. This work is being done in collaboration with staff from the Alaska Sealife Center/University of Alaska Fairbanks. Additionally, PCCS began a study with the Marine Stress Research Program at the New England Aquarium to assess humpback whale health from breath and fecal samples. We anticipate that this project will improve our understanding of the effects of human activities (including tagging) on individual humpback whales. Both projects were funded by the Pacific Life Foundation Marine Mammal Research Fund at the Ocean Foundation.

OUTREACH MATERIALS

Details about this project and near real-time tracks of tagged whales have been made publicly available at the following websites:

PCCS:
http://www.coastalstudies.org/what-we-do/humpback-whales/satellite-tagging.htm

OBIS-SEAMAP:
http://seamap.env.duke.edu/dataset/781

Seaturtle.org:
http://www.seaturtle.org/tracking/?project_id=660
http://www.seaturtle.org/tracking/?project_id=756