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

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I. LONG-TERM GOALS

This project is a study of satellite tag retention and health impacts among Gulf of Maine humpback whales (*Megaptera novaeangliae*). The 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 intended to inform tag design and deployment, and particularly seeks to minimize impacts on whales while maximizing methodological performance.

II. OBJECTIVES

The specific objectives of this project are as follows: 1) to characterize the range of 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. We also expect 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.

III. APPROACH

Up to 60 satellite tags (20 per year) are being deployed and studied on individually identified Gulf of Maine humpback whales. The focal population is well-studied, allowing repeated re-sightings of tagged individuals with and without tags. 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 are being deployed during a two-week period annually, as early as practicable in the feeding season. Individual humpback whales are identified in the field and selected for tagging based on extensive data on individual age, sex, reproductive histories and known residency patterns. Focal follows are performed for at least one hour after tagging to assess the nature of animal responses, injuries and tag placement. Follow-up cruises are then performed on a weekly or bi-weekly basis and supplemented with data from a collaborating network of commercial whale watching vessels. The condition of the tag, tag site and individual are assessed from high resolution photographs and video. Other individuals are also being documented in the vicinity of tagging operations to use as a point of comparison for tagged animal behavior and residency characteristics.

IV. WORK COMPLETED

A total of 43 Type 1 satellite tags have been deployed on humpback whales in the Gulf of Maine since the project started in 2011. Tags have been deployed on well-known, catalogued adults and include a balanced sample of males (n=22) and females (n=21). Follow-up coverage has been made available to the project team and other experts on-line during the project to facilitate evaluations of tag failure, tag site condition and health. The final round of deployments was postponed from 2013 to 2014 in order to undertake important tag design modifications, as described below. However, follow-up monitoring on previously tagged whales was continued opportunistically in 2013. Data analyses are on-going, but preliminary results have been presented in a number of professional venues in 2013, including the 44th annual conference of the International Association for Aquatic Animal Medicine, the 65th annual meeting of the Scientific Committee of the International Whaling Commission and the 20th Biennial Conference on Marine Mammals.

V. RESULTS

This project has demonstrated the feasibility and value of a structured tag assessment study based on dedicated follow-up monitoring. It has been facilitated by the well-studied nature of the Gulf of Maine humpback whale population, its fidelity to coastal sites and its overlap with collaborating observers. These conditions have allowed us to focus on individuals that we were likely to reliably re-encounter within and between seasons. Repeated re-sightings have provided data with which to visually assess causes of transmission failure as well as the apparent short- and medium-term effects of tagging on individuals.

As previously reported, the first two years of this project revealed important Type 1 satellite tag design flaws that could partially explain the relatively short and variable duration of Type I satellite tags. One involved the failure of an articulation point that was designed to compensate for movement (shearing) between the muscle and the blubber. Through follow-up documentation, we determined that breakage at the articulation point was causing the transmitter to detach prematurely from the anchor, resulting in shorter than expected tag durations. Our documentation also suggested that this breakage was responsible for some of the effects observed in tagged individuals. These findings prompted a rapid improvement to the tags used in this project and others.

This project also identified a weakness in the standard interface that connects the SPOT 5 transmitter to an anchor. This flaw resulted in bending and/or breakage in 5 out of 16 tags deployed in 2012. This type of 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 these types of failures are a regular event and just not previously documented. Given the significance of this finding, we postponed the third year of tag deployments until 2014 and worked with Wildlife Computers on an integrated tag that eliminates the interface between the tag and the anchor. Limited deployments of this new form suggest improved tag durations and potentially milder physiological responses. However, performance and effects will be more fully evaluated in our final year of deployments. Our work is also contributing to a new ONR-funded project focusing on further improvements to satellite tag design.

All of the tags deployed to date have yielded valuable data on short- and medium-term effects of Type 1 tags on individuals. Individuals tagged in 2011 have now been documented on an average of 26.5 unique days (max=58), with some observations now extending to as many as 849 days post-deployment. Whales tagged in 2012 have been documented on an average of 10.5 days (max=21), with some observations now spanning 465 days. The frequency and span of observations have provided important detail on the nature and duration of foreign body response to Type 1 tags, as well as the need for standardized approaches for assessing those effects. Our results are also yielding insight into effects on behavior, health, apparent survival and reproduction. A report further detailing preliminary results is available on-line (see References, below), but final analyses will depend on the final year of tag deployment and follow-up monitoring.

VI. IMPACT/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.

VII. 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.

VIII. RELATED PROJECTS

This project is related to ONR grant N000141310653, entitled "Improving large cetacean implantable satellite tag designs to maximize tag robustness and minimize health effects to individual animals." It is also related to a project comparing the effects of Type I tags to LIMPET-style tags more commonly used in odontocetes. The latter project work is being done in collaboration with staff from the Alaska Sealife Center/University of Alaska Fairbanks with funding from the Pacific Life Foundation Marine Mammal Research Fund at the Ocean Foundation.

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