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Physiological and behavioral response to intra-abdominal transmitter implantation in Steller sea lions

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Abstract

The absence of a direct, long-term measure of individual Steller sea lion survival led to the development of implanted, delayed transmission satellite tags specifically for this species (Life History Transmitter, LHX). To assess possible effects of implant procedures and LHX tags, we undertook a two-stage approach to monitor: 1) immediate physiological response under controlled conditions in temporary captivity, and 2) post-release movement and dive behavior via externally mounted satellite data recorders (SDR). Six juvenile sea lions were monitored up to 8 weeks post-implant for physiological indications of post-surgical effects. Overall, mass, body condition and blood parameters did not change during the study period. There was limited white blood cell elevation and acute-phase reaction in the first 2 weeks post-implant. During the 3 months of post-release tracking, all sea lions returned to their respective capture haul-outs. Shorter and shallower dives during the first week post-release suggested a possible recovery period similar to other non-LHX individuals released from temporary captivity. For all subsequent weeks, dive depth, duration, frequency and dispersal distances of LHX animals were comparable to free-ranging individuals. All physiological and behavioral responses noted were temporary in nature, supporting LHX implantation as a viable alternative for long-term survival monitoring of free-ranging sea lions.

Keywords: Acute-phase reaction; Dive behavior; *Eumetopias jubatus*; Intra-abdominal implant; Satellite telemetry; Steller sea lion

1. Introduction

Advances in wildlife tracking technology have provided biologists with the tools to monitor animal dispersal, foraging patterns and to document mortality events in animals ranging in size from mice to bears (Smith, 1980; Philo et al., 1981; Wheatley, 1997; Monnett and Rotterman, 2000; Ågren et al., 2000). External tracking devices are now routinely utilized to collect data from free-ranging pinnipeds (e.g., Lander et al., 2001; Raum-Suryan et al., 2002; Loughlin et al., 2003). Technological advances have improved the quality and quantity of transmitted data, however, tag longevity continues to be limited by transmitter battery life and attachment techniques. In pinnipeds, abrasion, pelage breakdown and the annual

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molt limit the tracking period for externally attached devices to several months. For species of particular concern, such as the endangered stock of Steller sea lions (*Eumetopias jubatus*), longer-term monitoring is crucial to accurately define vital rates and life history parameters, and constraints faced by the population.

Steller sea lions were listed as endangered through the western portion of their range in 1997 (62 Federal Register 24345). Only limited knowledge of their life history traits are available due to the difficulty in initial capture and extremely low recapture rate of this species which spends a large proportion of its life at sea. Critical information on annual survivorship for the various age classes are limited, relying primarily on mathematical models for estimating age specific vital rates (e.g., York, 1994; Holmes and York, 2003; Winship and Trites, 2006). Brand based mark-resight studies may provide detailed data, but require very large sample sizes and yield no information on individual causes of mortality (Gerrodette, 1987; Link and Barker, 2005). Intraperitoneal implanted tags such as those used successfully in other highly aquatic mammals (e.g., *Enhydra lutris*, Williams and Siniff, 1983; Monnett and Rotterman, 2000) can provide the required long term data, and yield information on causes of mortality. However, conventional implanted tracking devices are limited by range of VHF transmissions, and battery life. The specifically developed Life History Transmitter (LHX) overcomes this limitation through the collection and archiving of dive behavior data throughout the life of the host animal, transmitting only after the host has died and the tag is extruded from the carcass. The absence of any transmissions throughout the life of the host extends battery life beyond ten years, and allows use of the Argos satellite-based data recovery system (Horning and Hill, 2005).

The substantial constraints of working with large pinnipeds in remote locations are multiplied when working with an endangered species. All procedures must follow strict guidelines, endure rigorous review and testing, as well as strive to provide maximal data with minimal impact. However, intra-abdominal implantation had not yet been attempted in this species for which every mortality must be prevented. Surrogate species can provide a wealth of information on basics of the procedure (e.g., *Zalophus californianus*, M. Haulena, M. Horning and J. Mellish, unpublished data), but eventually the method must be tested on the target population to accurately assess the feasibility of the procedure.

We evaluated the immediate post surgical physiological response (up to 8 weeks) and longer-term post release behavioral response (up to 3 months) to LHX implantation in six juvenile Steller sea lions brought into temporary captivity for research purposes (e.g., Mellish et al., 2006). The technical specifications of the tag (Horning and Hill, 2005) and the surgical procedure (M.

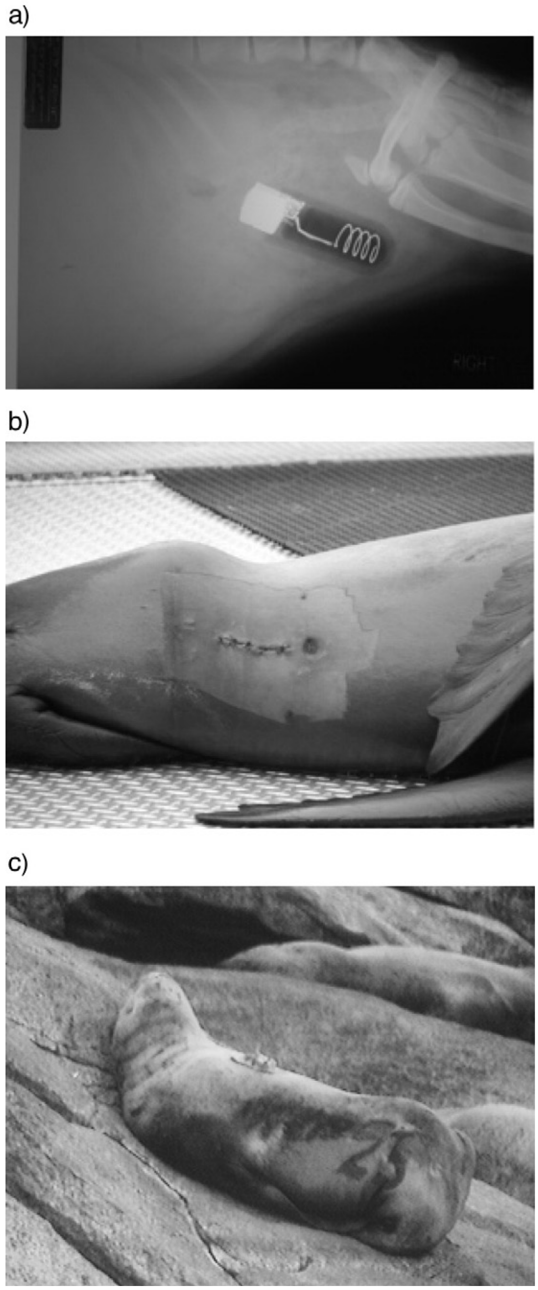

Fig. 1. a) X-ray radiographic image of an LHX device implanted into a 66 kg female California sea lion (*Zalophus californianus*) under NMFS permit #1034-1685 for an earlier trial. On the larger, juvenile Steller sea lions (*Eumetopias jubatus*), the LHX device has a length of about two vertebrae. b) Ventral location of incision site 2 weeks post-procedure in a juvenile Steller sea lion. c) Resight of LHX animal 15 weeks post-implant and 10 weeks post-release.