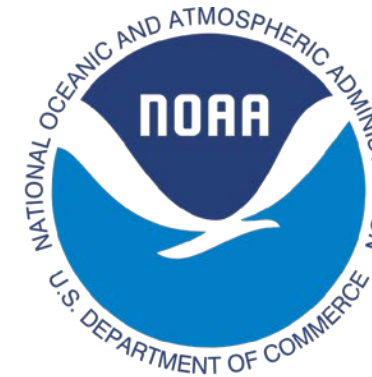


# Surgery at Sea – “Hawkeye” meets Vitus Bering

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## Background

As part of the NOAA research on ecology, health, abundance and trends of Alaskan phocids, 35 harbor seals (*Phoca vitulina*) were captured in the central and western Aleutian Islands in September 2016. Ten of these seals received dual life history transmitters (LHX2, Wildlife Computers, Redmond, WA). LHX2 tags provide data on individual animal survival, locations and causes of mortality, and in females can detect birth events. Such data can inform on seasonality and age distributions of causes of mortality and end-of-life emigration. They are surgically implanted in an animal’s abdominal cavity and will transmit data via satellite following extrusion from the carcass after the end of the animal’s life.

## Procedure

Seals were captured at seven haul-out sites between Adak Island and Attu Island and moved onto the research vessel where they were allowed to rest in a quiet enclosed area for 2 hours before processing. Surgeries were performed inside a specially designed portable surgical room under aseptic conditions by qualified personnel. Animals were sedated with midazolam and butorphanol, then masked for surgical anesthesia with isoflurane in medical oxygen and an endotracheal tube placed to allow positive pressure ventilation. Transmitters were gas-sterilized with ethylene oxide gas and sterile surgical instruments, drapes, gloves and gowns were utilized. The abdomen was accessed via a ventral midline incision just caudal to the umbilicus and closed with monofilament antibacterial suture in multiple layers. While still under anesthesia, the seals received a head-mounted satellite transmitter for post-release tracking up to the annual molt. A second satellite transmitter for long-term tracking was attached to the inter-digital webbing of a rear flipper. Sedation was reversed with flumazenil and naltrexone, and oxygen continued until recovery allowed extubation. Seals were monitored for 2 hours following surgery in a clean, dry enclosure and released when fully recovered from anesthesia, without evidence of bleeding from the incision and with internal temperature (transmitted from LHX2 tags) between 36.4 to 38.4 °C.

## Post-release monitoring

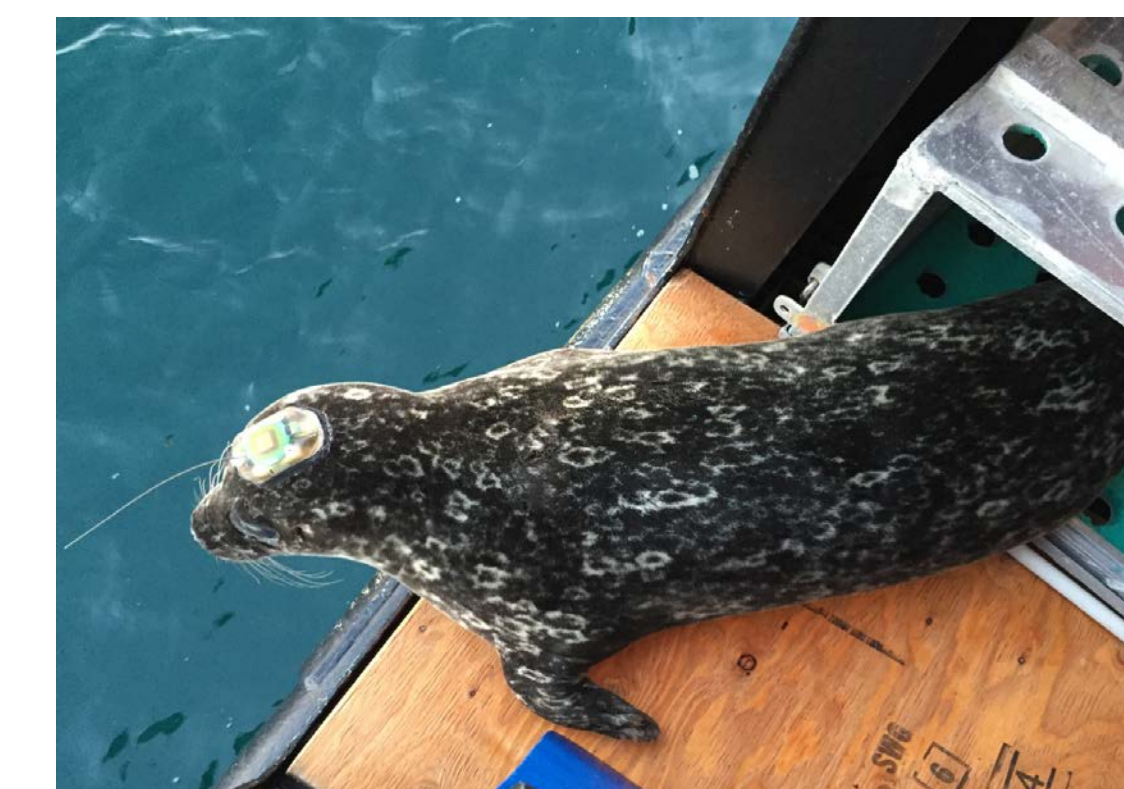
Monitoring of satellite tag data indicated that all seals returned to their capture site and made typical foraging dives within a few hours after release. The seals continued to exhibit seemingly normal movement, dive, and/or haul-out behaviors for at least the next 2 months. Satellite tag monitoring is continuing and a quantitative comparison of behaviors between surgery vs. non-surgery seals will be conducted soon.



Portable surgery room on aft deck of research vessel R/V Norseman at Massacre Bay, Attu Island



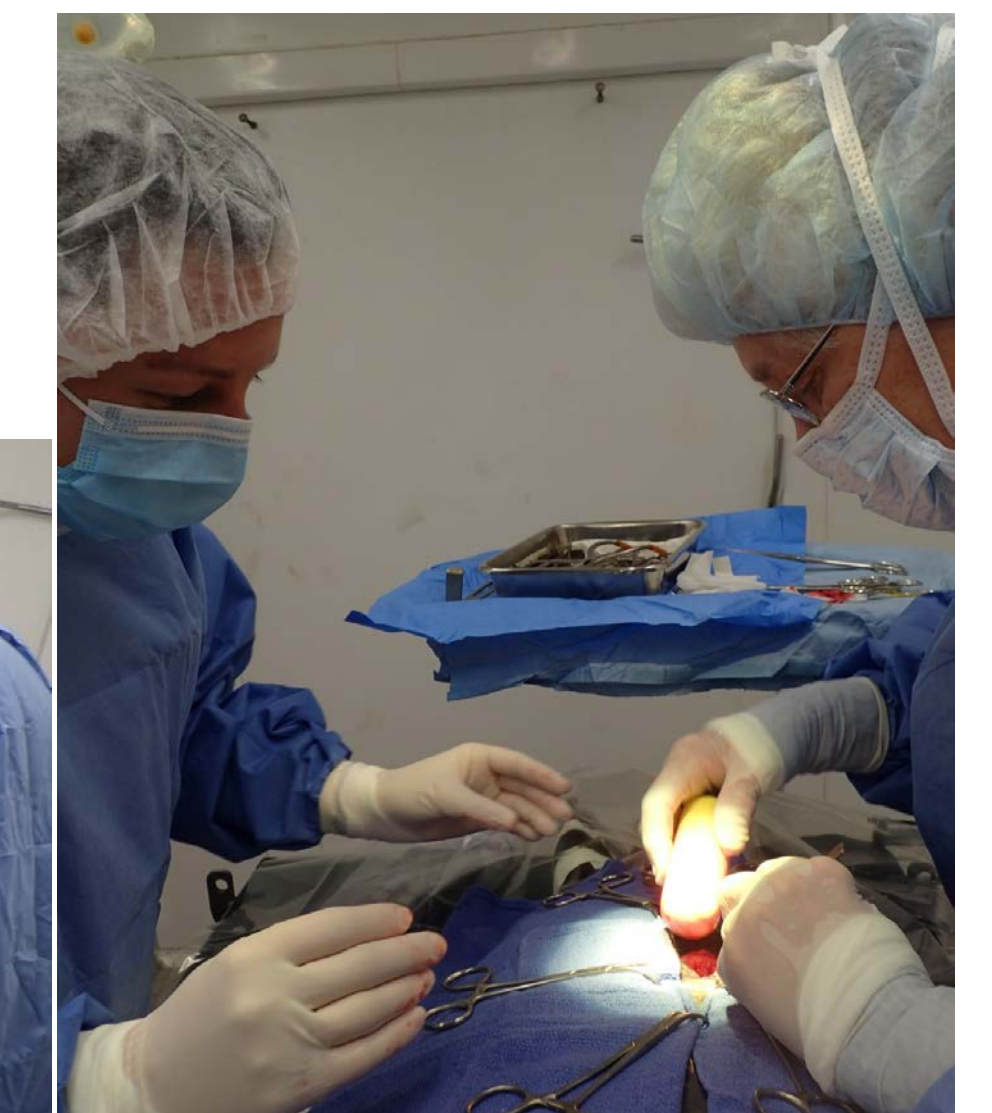
LHX2 implant



Implanted harbor seal at release 2 hours post op with head mounted satellite tag.



Surgical team (surgeon, assistant and anesthetist) placing intra-abdominal LHX tag utilizing isoflurane anesthesia.



Anesthetic monitoring equipment

## Conclusions

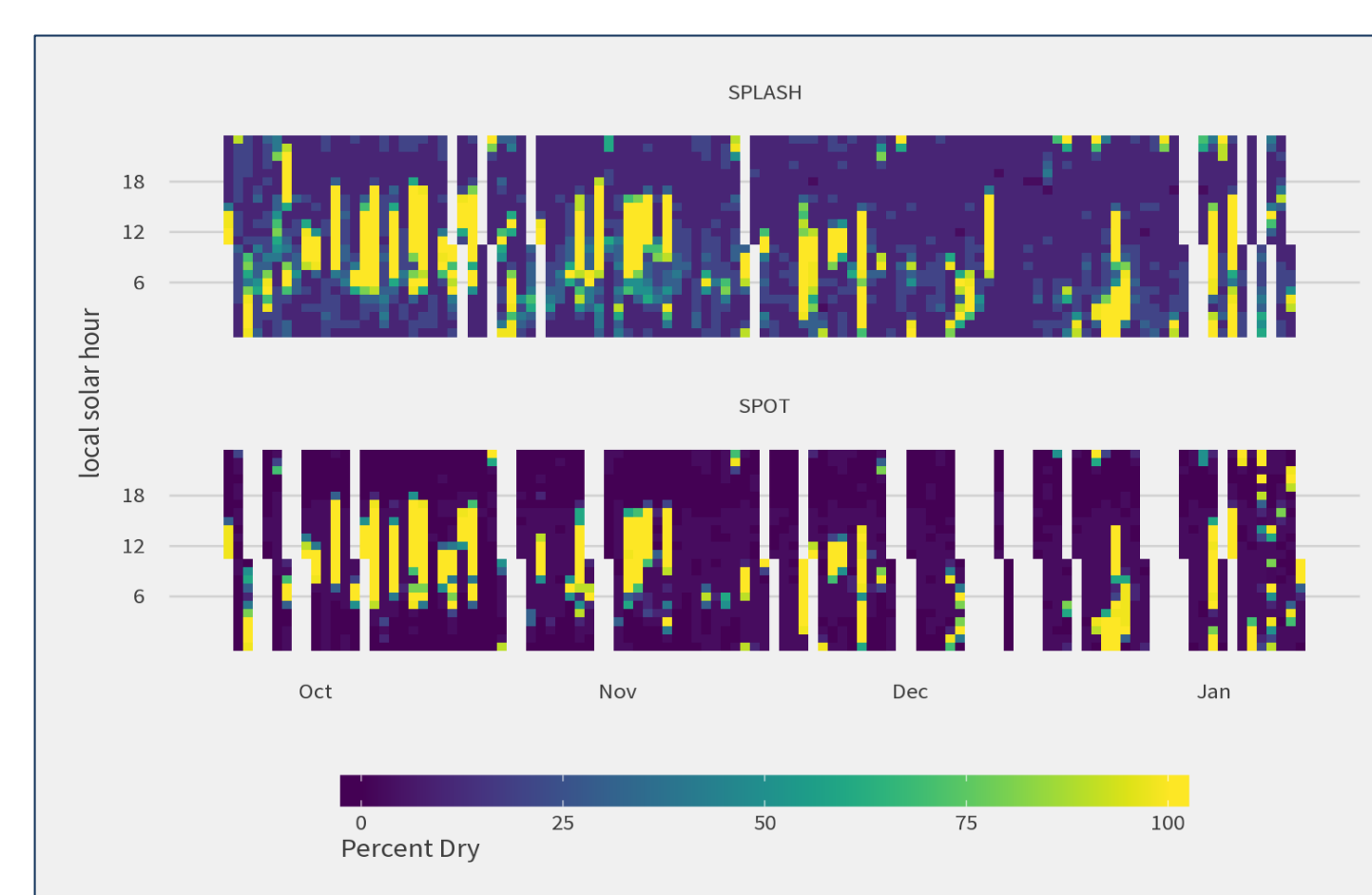
Although phocid anesthesia and subcutaneous transmitter implants with same day release have previously been performed at sea in Alaska, difficulties with hypothermia during anesthesia, prolonged anesthetic recovery, rejection of implants and poor data collection were encountered.<sup>1,2,3</sup> Advances in equipment, anesthesia and surgical technique were developed during short term captive studies in Steller sea lions and rehabilitating harbor seals and applied to this project. This is the first report of successful intra-abdominal surgery in a pinniped with rapid release in a remote area combined with successful post release monitoring of the implanted seals.

## Acknowledgements:

The authors are indebted to the many Alaska SeaLife Center Animal Care and Research staff who contributed to the development of the LHX project over the past 10 years and to the NOAA Fisheries project members and the crew of the M/V Norseman for their support and expertise in harbor seal capture, handling and satellite tagging. This research was conducted under NMFS Permit #19309 and Alaska Fisheries Science Center / Northwest Fisheries Science Center AAC&U form A /NW2016-1.

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Examples of haul out and dive behavior reports for an implanted harbor seal

