

Crawford, J. A., L. T. Quakenbush, J. J. Citta, C. Irrigoo Jr. and P. R. Lemons. 2016. Using movement, diving and haul out behavior to identify the relative importance of foraging areas for walrus in the Alaskan Chukchi Sea. Alaska Marine Science Symposium, 25–29 January, Anchorage, AK. (Abstract and poster).

### **Using movement, diving and haul out behavior to identify the relative importance of foraging areas for walrus in the Alaskan Chukchi Sea**

Justin A. Crawford<sup>1\*</sup>, Lori T. Quakenbush<sup>1</sup>, John J. Citta<sup>1</sup>, Clarence Irrigoo Jr.<sup>2</sup>, and Patrick R. Lemons<sup>3</sup>

<sup>1</sup> Alaska Department of Fish and Game, Fairbanks, Alaska 99701;

<sup>2</sup> Walrus hunter and resident of Gambell, Alaska;

<sup>3</sup> U.S. Fish and Wildlife Service, Anchorage, Alaska 99503;

\* Correspondence: Justin.Crawford@alaska.gov

Female Pacific walrus and their young summer in the Chukchi Sea, resting on sea ice between benthic feeding bouts, when sea ice is available. The rapid decrease of sea ice in summer is changing walrus habitat in the Chukchi Sea and consequently the Pacific walrus is being considered for listing under the U.S. Endangered Species Act. Knowing the location and use of foraging areas is important as industrial and shipping activities increase. We worked with walrus hunters from Saint Lawrence Island to deploy 88 satellite-linked dive recorders on walrus in the Chukchi Sea during three multi-agency walrus research cruises in June of 2013–2015. Of the 88 tagged walrus, 79 were females (34 of which were accompanied by calves of the year and 45 were not) and 9 were adult males. Walrus were tracked for up to 124 days. Using data from 2013 and 2014, we identified Hanna Shoal, a known foraging area for walrus, and Icy Cape as two areas within the Alaskan Chukchi Sea with a higher than average density of dives. To evaluate the relative importance of these areas for foraging, we compared diving and haul out behavior within these two areas with that found in the rest of the Alaskan Chukchi Sea. Adult females (with and without calves) dove longer (6.2 vs. 4.5 min), made fewer dives (6.6 vs. 8.1 dives/hour), and hauled out for a larger proportion of time (22.1 vs. 17.0 min/hr) at Hanna Shoal than the other two areas ( $P < 0.01$ ). Icy cape and the rest of the Alaskan Chukchi Sea did not differ statistically. Walrus in better quality habitat, with higher densities of prey, are expected to make fewer dives, dives of longer duration and spend more time resting. As such, diving and haul out behavior indicated higher quality habitat near Hanna Shoal than Icy Cape and the rest of the Alaskan Chukchi Sea, which were similar to each other. Therefore, Icy Cape may not be higher quality foraging habitat than the Alaskan Chukchi Sea in general. Here we update our 2013 and 2014 results to include data from 2015.

Alaska Marine Science Symposium, 25–29 January 2016, Anchorage AK

# Using movement, diving and haul out behavior to identify the relative importance of foraging areas for walrus in the Alaskan Chukchi Sea

Justin A. Crawford<sup>1</sup>, Lori T. Quakenbush<sup>1</sup>, John J. Citta<sup>1</sup>, Clarence Irrigoo<sup>2</sup>, and Patrick R. Lemons<sup>3</sup>

<sup>1</sup>Alaska Department of Fish and Game, Fairbanks, Alaska, [Justin.Crawford@alaska.gov](mailto:Justin.Crawford@alaska.gov)

<sup>2</sup>Walrus hunter and resident of Gambell, Alaska, <sup>3</sup>U.S. Fish and Wildlife Service, Anchorage, Alaska



## INTRODUCTION

Pacific walrus (*Odobenus rosmarus*) winter in the Bering Sea. In spring, females move north with the receding sea ice and summer in the Chukchi Sea, resting on sea ice between benthic feeding bouts; most adult males remain in the Bering Sea where they rest on land. Over the past decade, sea ice in the Chukchi Sea has receded north beyond the shallow continental shelf in late summer. The rapid retreat of sea ice in summer is changing walrus habitat in the Chukchi Sea and, consequently, the Pacific walrus is being considered for listing under the U.S. Endangered Species Act. Knowing the location and use of foraging areas relative to industrial activities and shipping traffic in the Chukchi Sea is important.

## METHODS

- In association with a multi-agency (ADF&G, USFWS, and USGS) walrus research cruise in May and June of 2013–2015 we worked with hunters to **deploy satellite-linked transmitters on adult female walrus** in the Chukchi Sea (Fig. 1).
- We used a **state-space model** to predict locations to match the date and time of dive and haulout data.
- We **identified potentially important foraging areas** based on **kernel density estimates** of dive locations; high densities of dive locations suggest a higher quality foraging area (Fig. 2).
- To **evaluate the relative importance of areas identified for foraging**, we compared diving and haul out behavior within areas identified with that found in the rest of the Alaskan Chukchi Sea (“Other”).
  - We used a repeated-measures mixed model to test for differences in:
    - Dive rate
    - Dive duration
    - % of an hour hauled out
- Variables of interest included:
  - Area of use: determined by kernel density estimates
  - Calf: was the female with or without a calf of the year
  - Time of day
- Models were fit using SAS software (PROC MIXED and GLIMMIX) and the best model was selected using AICc.

**BEHAVIOR EXPECTATIONS:** In higher quality habitats, we expect walrus to:

- ↑ Density of dive locations
- ↑ Dive duration
- ↓ Dive rate
- ↑ Hauled out (resting time)



Figure 1. Clarence Irrigoo tagging walrus, June 2013.

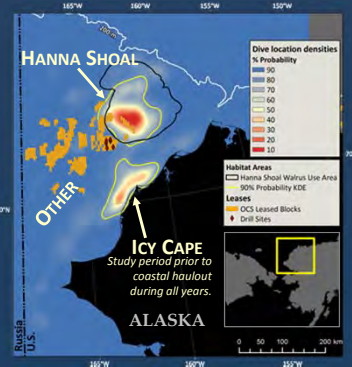


Figure 2. Kernel density estimates of dive locations used to predict potentially important foraging areas. We identified two areas as potentially important, Hanna Shoal and Icy Cape, and compared them to the rest of the Alaskan Chukchi Sea (“Other”).

## RESULTS

- We deployed 80 satellite-linked transmitters on adult walrus.
  - 60 transmitters sent dive and/or haul out data (27 females with calves & 33 females without calves) while in the Chukchi Sea.
  - Tags transmitted an average of 53 days (range: 7–134 days).
- We identified **Hanna Shoal** and **Icy Cape** as two areas within the Alaskan Chukchi Sea with a high density of dives (Fig. 2).
- Adult females (with & without calves) **dove longer and made fewer dives at Hanna Shoal** than the other two areas ( $P < 0.01$ ; Fig. 3).
- Adult females (with & without calves) **hauled out for a larger proportion of time at Hanna Shoal** than Icy Cape ( $P < 0.01$ ; Fig. 3).
- Adult females with calves hauled out longer** than females without calves at Hanna Shoal and Icy Cape ( $P < 0.01$ ; Fig. 3).

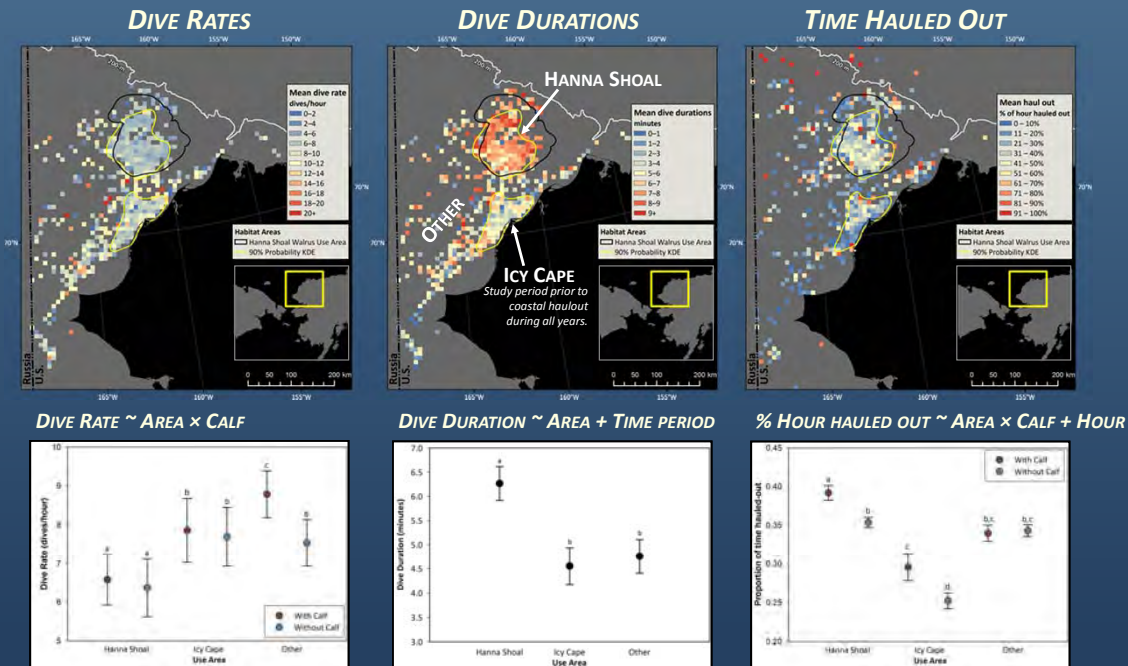
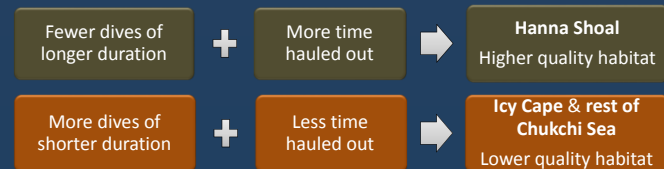


Figure 3. Spatial representation, final model from model selection, and results from final models of dive rate, dive duration, and % haul out. Differences by time are not shown but results reported do account for differences by time (time period for dive duration and hour for % hour hauled out).

## SUMMARY

- Foraging habitat near Icy Cape appears to be of lower quality than near Hanna Shoal.
- Activities associated with supporting a calf may obligate females with calves to haul out longer than females without calves.



## ACKNOWLEDGEMENTS

This project was primarily funded by the Bureau of Ocean Energy Management with additional support from the State of Alaska for research associated with the Endangered Species Act and marine mammals. We appreciate the support and assistance of the Eskimo Walrus Commission, the U.S. Fish and Wildlife Service (USFWS), and the U.S. Geological Survey. Research on walrus was conducted under permit #s: MA220876-0, MA220876-1, and MA039386-2 issued by USFWS and under ADF&G Animal Care and Use Permit #s: 2013-20, 2014-03, 2015-25. We thank the captains and crew of the R/V Norseman II and R/V Professor Multanovskiy for their skill in accommodating our challenging walrus research objectives.

