

Narwhals in the ice: Habitat selection using GIS

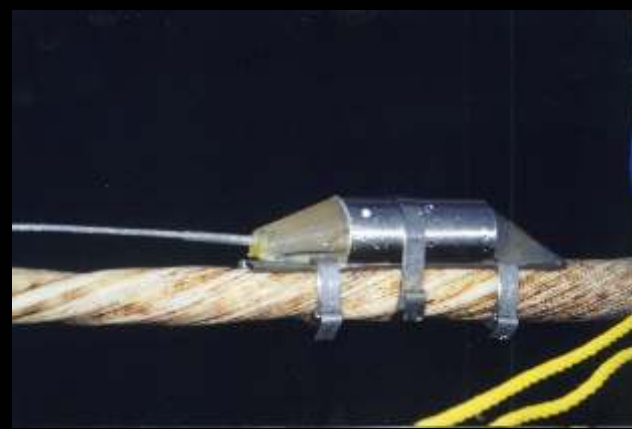
Kristin L. Laidre
 School of Aquatic and Fishery Sciences
 University of Washington, Box 355020
 Seattle, Washington, 98195

Mads Peter Heide-Jørgensen
 Greenland Institute of Natural Resources
 c/o National Marine Mammal Laboratory/AFSC/NMFS/NOAA
 7600 Sand Point Way NE, Seattle, WA 98115

Rune Dietz
 National Environmental Research Institute
 Frederiksborgvej 399, DK-4000, Roskilde, Denmark

Roderick C. Hobbs
 National Marine Mammal Laboratory/AFSC/NMFS/NOAA
 7600 Sand Point Way NE, Seattle, WA 98115

Pierre Richard
 Arctic Research Division, Department of Fisheries and Oceans
 501 University Crescent, Winnipeg, MB, R3T 2N6, Canada

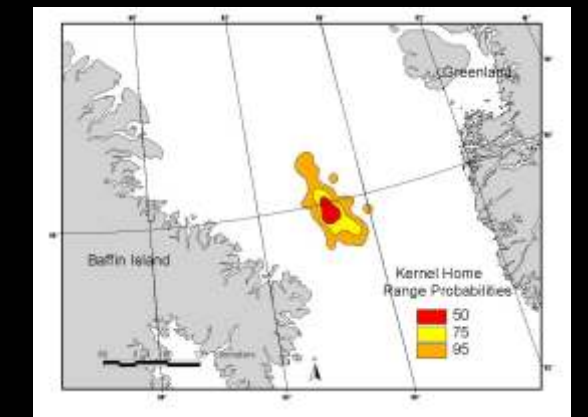
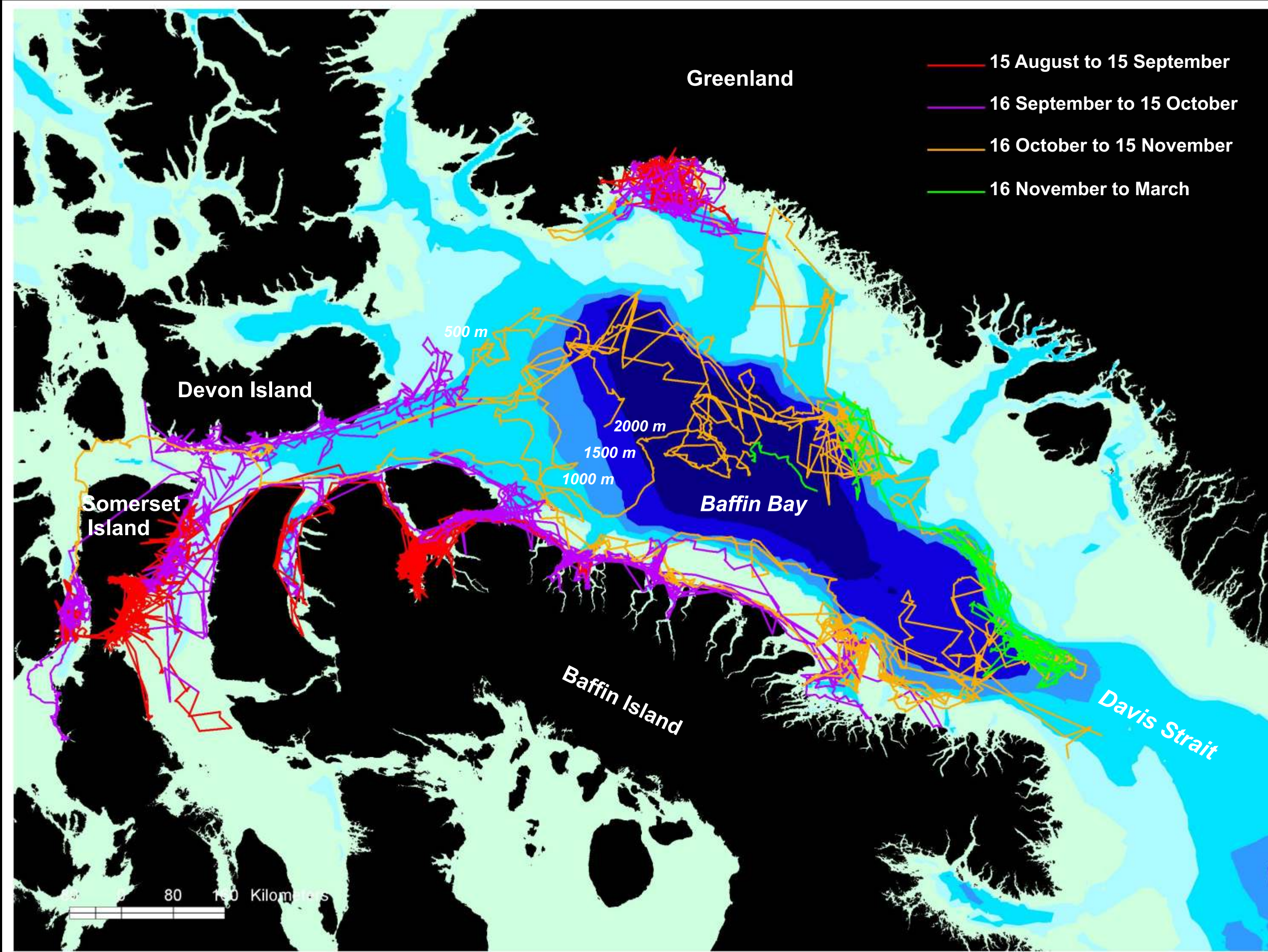


Recent developments in satellite telemetry have made it possible to gain insight on narwhal movements, dive behavior, and habitat use in areas inaccessible to humans.



Abstract

The narwhal (*Monodon monoceros*) is an ice-associated cetacean that inhabits Arctic seas bordering the Atlantic Ocean. In the summer months, narwhals visit inshore bays and fjords in the Canadian archipelago and Greenland. In the autumn, upon the formation of fast ice, narwhals are forced to move south out of these regions and spend the winter in areas covered by dense offshore pack ice. The use of satellite telemetry has made it possible to monitor the movements and dive behavior of narwhals during their fall migration. Between 1993 and 2001, 48 narwhals were instrumented with satellite-linked radio transmitters in Canada and Greenland. Their daily movements were monitored using Service ARGOS. The geographic locations from the satellite tags were imported into the Geographic Information System ArcView[®] and movement paths were analyzed for each whale using the Animal Movement Extension. To date, results show narwhals take at least three different paths to their wintering grounds in Baffin Bay and Davis Strait, with maximum travel distances of over 5,000 km in a 3-month period. We are currently using ARC/INFO[®] GRID and ArcView[®] to determine seasonal home range patterns and responses to sea ice formation, prey concentration, and sea surface temperature changes. Moving average Kernel home ranges are used to define temporal windows and determine spatial changes in area use. Home ranges are used as zone grids and spatial correlation and covariance are calculated between habitat variables within each zone.



Kernel probability home ranges are used to determine areas of high use. These vector coverages are converted to raster coverages and used as zone grids in ArcINFO GRID.



Questions

Is the winter distribution of narwhals related to sea ice? Prey availability? Bathymetry? Interspecific Competition?

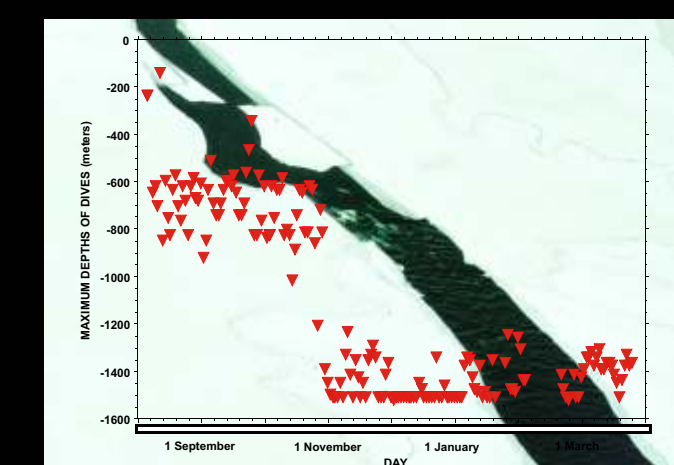
If ice edge is an important region for arctic species due to enhanced primary and secondary production, do narwhal movement patterns reflect this?

Are there predictable open water leads and cracks in the areas narwhals winter each year? To what extent can we use remotely sensed data to identify these ice characteristics?

Do narwhals have an affinity for specific sea ice concentrations? Does this change throughout the season?

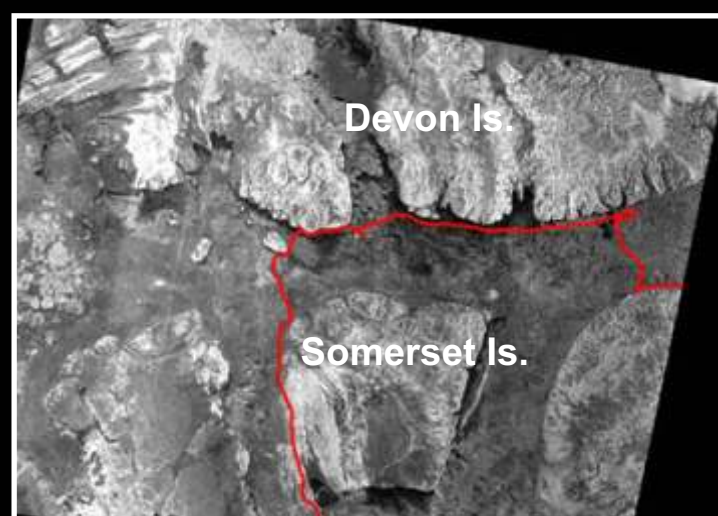


Narwhal activity patterns within each home range will be quantified using daily travel rates, surfacing time, maximum daily dive depths and dive rates. These variables will be included as attributes in the analysis.



Contact author email address: Kristin.Laidre@noaa.gov

Narwhals from both Canada and Greenland converge in the northern part of Davis Strait in November. The shelf drops off abruptly and the water is 1000-1500 m deep. In the winter, this area is completely covered with 9/10ths - 10/10ths pack ice except for shifting cracks and leads. This hostile habitat is where narwhals spend the entire winter.



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GIS tools & Sources

ESRI ArcView and ARC/INFO GRID
 ESRI Spatial Analyst
 ESRI Animal Movement Extension
 IBCAO (International Bathymetric Chart of the Arctic Ocean)

P. N. Hooge and B. Eichenlaub. 1997. Animal movement extension for ArcView Ver.1.1. Alaska Biological Center, USGS, Anchorage, AK USA

