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Canadian Science Advisory Secretariat
Science Advisory Report 2013/053

WINTER RANGE OF BAFFIN BAY NARWHALS

Narwhal (Monodon monoceros) © R. Phillips

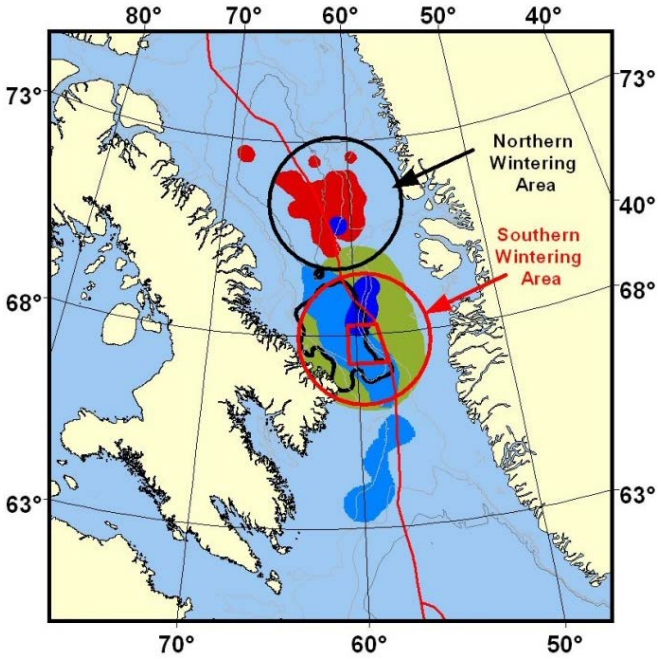

Figure 1. Winter home ranges of Baffin Bay narwhals. Admiralty Inlet 2009-2010 home range (open black polygon) is overlaid on past winter home ranges for Somerset Island (red), Admiralty Inlet (light blue), Eclipse Sound (green), Melville Bay (dark blue) summering stocks (from Dietz et al. 2008).The black and red circles identify the northern and southern narwhal over-wintering areas. The thick red polygon represents the area closed to Greenland Halibut fishing in NAFO Division 0A and the red line is the exclusive economic zone boundary between Canada and Greenland.

Context

Interest in the Greenland Halibut (also known as Turbot) fishery continues to increase in Arctic waters. Environmental impacts of this fishery (e.g., marine mammal entanglement, ghost fishing, and competition for important prey species) as well as those of the ongoing shrimp trawl fishery (e.g., benthic impacts) occur in Baffin Bay and Davis Strait though the magnitude and extent of these impacts are unknown. There is an area in the Northwest Atlantic Fisheries Organization (NAFO) Division 0A that is closed to Greenland Halibut fishing to protect winter feeding habitat of narwhals. DFO Resource Management has asked for a review of the overwintering information for Baffin Bay Narwhal to evaluate the existing NAFO Division 0A fishing closure boundaries.

SUMMARY

- Published tracking studies of narwhals delimited winter home ranges in Baffin Bay and Davis Strait for several summering stocks of narwhals in Canada and Greenland from the Baffin Bay narwhal population.
- One wintering area centers in northern Davis Strait and southern Baffin Bay, an area referred to as the Southern Wintering Area, which in large part is in Canadian waters.
- Narwhals from Admiralty Inlet, Eclipse Sound and Melville Bay summering stocks were tracked to Southern Wintering Area in the late 1990s and early 2000s.
- A new study showed that four individuals tracked from Admiralty Inlet also wintered in this same area in 2009-2010, suggesting that use of this area by that stock occurs annually.
- Animals in the Southern Wintering Area forage at depths over 800 m and a large part of their diet is composed of Greenland Halibut. It is estimated that over a five month period the stocks of narwhals occupying the Southern Wintering Area (32,000 narwhals) would require about 86,000 t of Greenland Halibut.

INTRODUCTION

There is an area in NAFO Division 0A that is closed to Greenland Halibut fishing (Figure 1). There is a fishing closure area (Figure 1) to protect winter feeding habitat of narwhals. The area is on the slope where water depths increase from the Davis Strait sill (~ 500 m depth) north down to about 2,000 m in southern Baffin Bay. Water temperatures on the slope are colder than those of the Davis Strait sill or the Labrador Sea. This slope supports an assemblage of marine fish species, with Greenland Halibut (*Reinhardtius hippoglossoides*) being the dominant one (Jørgensen et al. 2005), as well as a number of deep-sea coral species (Gass and Willison 2005, Kenchington et al. 2010). The closure was created to reduce fishing pressure, habitat destruction and local depletion of narwhal's main winter prey, Greenland Halibut (DFO 2007). It would also minimize gear entanglement of narwhals from both active and lost gear, protect and reduce gear damage to deep-water corals and other bottom fauna (DFO 2007). The closure does not target the whole winter range of narwhals but an area where several stocks of narwhals overlap in winter and where deep-sea corals are also found.

ANALYSIS

Tracking research on Baffin Bay narwhals equipped with transmitters has been conducted since 1997 with deployments in Tremblay Sound (Baffin Island) in 1997, 1998 and 1999; Creswell Bay (Somerset Island) in 2000 and 2001; and in Admiralty Inlet (Baffin Island) in 2003 and 2004 (summarised in Dietz et al. 2008). It was observed that narwhals from the Admiralty Inlet, and Eclipse Sound summering stocks winter in northern Davis Strait / southern Baffin Bay in an area identified as the Southern Wintering Area (Figure 1). Greenland's Melville Bay narwhal stock also winters in this area (Dietz et al. 2008). Narwhals from Somerset Island (equipped in Creswell Bay), on the other hand, wintered further north in central Baffin Bay in an area identified as the Northern Wintering Area (Figure 1).

An examination of dive behaviour data showed that the number of surface dives (0 to 50 m) and time at the surface declined from summer to winter and clear differences in diving depths were noted between the two wintering areas (Laidre et al. 2003). In the Northern Wintering Area, narwhals spent most of their time diving to between 200 and 400 m while narwhals in the Southern Wintering Area spent less time at shallower depths. Most of their time was spent

diving to 800 m or deeper (Laidre et al. 2003). Laidre et al. (2004b) reported that narwhal on their wintering grounds selected the bottom temperature range and gradient that often coincided with areas of concurrent high density of Greenland Halibut.

In narwhal stomachs collected from winter harvests in Disko Bay, West Greenland, Greenland Halibut, squid and shrimp were most common with Greenland Halibut constituting a significant winter resource, observed in 51% of 49 stomachs collected and often the only prey species identified in completely full stomachs (Laidre and Heide-Jørgensen 2005).

The Southern Wintering Area is estimated to have about 32,000 narwhals from the Admiralty Inlet, Eclipse Sound and Melville Bay summering stocks (Richard et al. 2010, Heide-Jørgensen et al. 2010). Based on a bio-energetic model (Laidre et al. 2004a), with a diet comprised of 50% Greenland Halibut, the stocks would require approximately 576 t per day, or about 86,000 t of Greenland Halibut for the five-month winter period.

The Northern Wintering Area supports a larger number of whales from the Somerset Island summering stock, estimated at approximately 45,000 in 1996. A diet with 50% Greenland Halibut would require 700 t per day with a total consumption over five months of 110,700 t of Greenland Halibut. This consumption estimate is greater than the estimated abundance of Greenland Halibut for the area, suggesting that prey species are actually not used in the same proportion in the diet of narwhals in the Northern Wintering Area as in the Southern Wintering Area. The shallower dive behaviour of narwhals in the Northern Wintering Area also supports this conclusion as Greenland Halibut is found mostly below 500 m depths.

Recent tracking data (2009-2010) were obtained for Admiralty Inlet narwhals and they indicate that their winter home range centered in the same general area as that of the Admiralty Inlet narwhals tracked in the winters of 2003-2004 and 2004-2005 (Figure 2), and overlapped with the past estimated winter home ranges of two other summering stocks (Eclipse Sound and Melville Bay). There is some variation between home ranges which can probably be attributed to some differences between individual narwhals tagged in different years and to changing ice or prey conditions between years. These results lend further support to the hypothesis that the Southern Wintering Area of southern Baffin Bay / northern Davis Strait is routinely used every year by Canadian Baffin Bay narwhal stocks (Dietz et al. 2008).

Sources of Uncertainty

There are a number of sources of uncertainty about the estimates of Greenland Halibut consumption by narwhals. They are based on the reasonable but untested assumption that the percentage of Greenland Halibut in the narwhal diet in the wintering areas is similar to the percentage in stomachs of narwhals caught in Disko Bay outside of the wintering areas. In addition, the estimates of narwhal numbers are mean estimates with no estimation error. The calculations are only there to emphasize the importance of Greenland Halibut in narwhal winter ecology. Note that the estimates are different from those presented in DFO (2007) or in Laidre et al. (2004a, b) because there have been new estimates of the narwhal stocks since those documents were released. Another source of uncertainty is the small sample size of animals tracked compared to the total population size. While there is consistency between years in the wintering range of tracked animals, there were two animals from Admiralty Inlet that ranged further south than the rest. A larger sample size of tracked narwhals, including narwhal from other summering stocks, may show further departures. Tracking over a larger number of years might also yield more year-to-year variation than is apparent from the new tracking data and the past tracking studies.

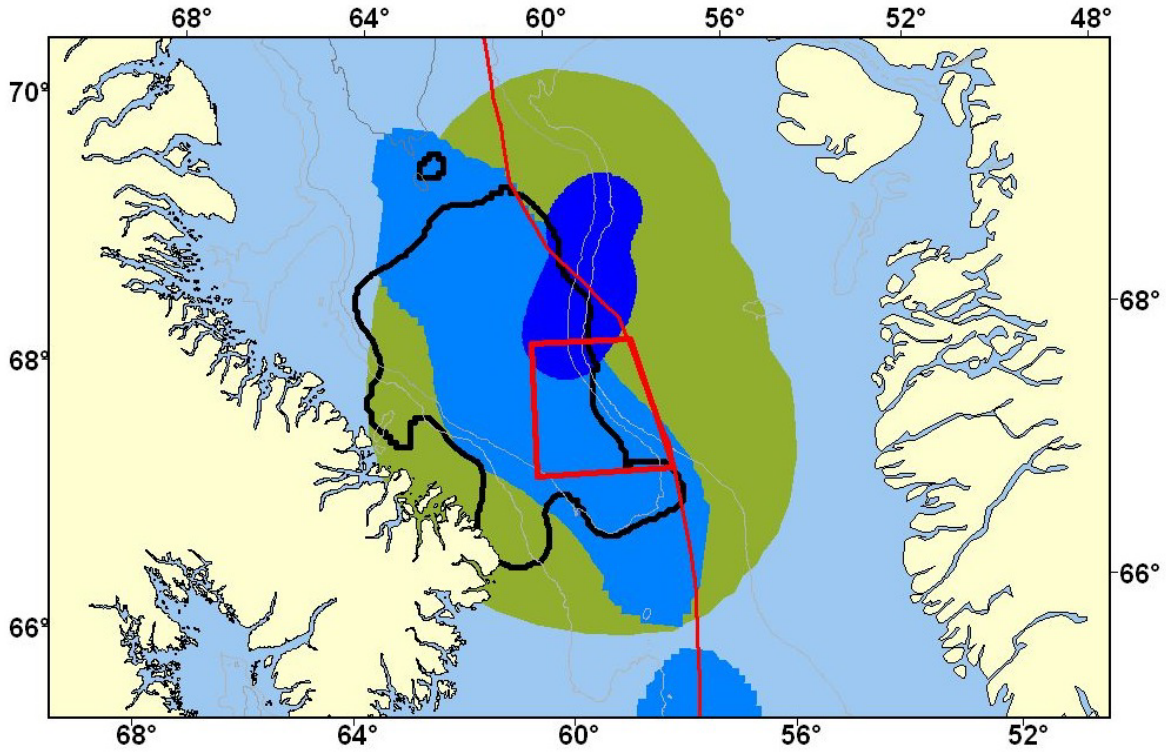

Figure 2. Admiralty Inlet 2009-2010 home range (black open polygons) superimposed on winter home ranges from Dietz et al. (2008). The thick red polygon represents the area closed to Greenland Halibut fishing in NAFO Division 0A and the red line is the Canada-Greenland exclusive economic zone (EEZ) boundary. Bathymetric contours (500, 1000, 2000 m) are included.

CONCLUSIONS AND ADVICE

The Southern Wintering Area located in the southern end of Baffin Bay and the northern part of Davis Strait is the wintering area for the Admiralty Inlet, Eclipse Sound and Melville Bay summering stocks, an aggregation of narwhals estimated at 32,000 animals. These animals appear to obtain more of their energetic requirements in winter than in summer. They dive deep (≥ 800 m) and a large proportion of their winter diet is composed of Greenland Halibut, perhaps consuming more than 86,000 t over a five-month winter period. The area closed to Greenland Halibut fishing covers an area of overlap of several narwhal stocks in the central portion of their winter range.

SOURCES OF INFORMATION

This Science Advisory Report is from the November 22-26, 2010 National Marine Mammal Peer Review Committee Meeting (NMMPRC). Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

DFO. 2007. Development of a closed area in NAFO 0A to protect narwhal over-wintering grounds, including deep-sea corals. DFO Can. Sci. Advis. Sec. Sci. Resp. 2007/002.

Dietz, R., Heide-Jørgensen, M.P., Richard, P., Orr, J., Laidre, K., and Schmidt, H.C. 2008. Movements of narwhals (*Monodon monoceros*) from Admiralty Inlet monitored by satellite telemetry. Polar Biol. 31: 1295–1306.

Gass, S.E., and Willison, J.H.M. 2005. An assessment of the distribution of deep-sea corals in Atlantic Canada by using both scientific and local forms of knowledge. *In* Cold-water Corals and Ecosystems. Edited by A. Freiwald and J.M. Roberts. Springer-Verlag Berlin Heidelberg, p 223-245.

Heide-Jørgensen, M.P., Laidre, K.L., Burt, M.L., Borchers, D.L., Marques, T.A., Hansen, R.G., Rasmussen, M., and Fossette, S. 2010. Abundance of narwhals (*Monodon monoceros*) on the hunting grounds in Greenland. J. Mammal. 91: 1135-1151.

Jørgensen, O.A., Hvingel, C., Møller, P.R., and Treble, M.A. 2005. Identification and mapping of bottom fish assemblages in Davis Strait and southern Baffin Bay. Can. J. Fish. Aquat. Sci. 62: 1833-1852.

Kenchington, E., Lirette, C., Cogswell, A., Archambault, D., Archambault, P., Benoit, H., Bernier, D., Brodie, B., Fuller, S., Gilkinson, K., Lévesque, M., Power, D., Siferd, T., Treble, M., and Wareham, V. 2010. Delineating Coral and Sponge Concentrations in the Biogeographic Regions of the East Coast of Canada Using Spatial Analyses. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/041. vi + 202 p.

Laidre, K.L., and Heide-Jørgensen M.P. 2005. Winter feeding intensity of narwhals (*Monodon monoceros*). Mar. Mamm. Sci. 21: 45-57.

Laidre, K.L., Heide-Jørgensen, M.P., Dietz, R., Hobbs, R.C., and Jørgensen, O.A. 2003. Deep-diving by narwhals *Monodon monoceros*: differences in foraging behaviour between wintering areas? Mar. Ecol. Prog. Ser. 261: 269-281.

Laidre, K.L., Heide-Jørgensen, M.P., Jørgensen, O.A. and Treble, M.A. 2004a. Deep-ocean predation by a high Arctic cetacean. ICES J. Mar. Sci. 61: 430-440.

Laidre, K.L., Heide-Jørgensen, M.P., Logdson, M.L., Hobbs, R.C., Heagerty, P., Dietz, R., Jørgensen, O.A. and Treble, M.A. 2004b. Seasonal narwhal habitat associations in the high Arctic. Marine Biol. 145: 821-831.

Richard , P.R., Laake, J.L., Hobbs, R.C., Heide-Jørgensen, M.P., Asselin, N.C., and Cleator, H. 2010. Baffin Bay Narwhal Population Distribution and Numbers: Aerial Surveys in the Canadian High Arctic, 2002-04. Arctic 63: 85-99.

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