

Narwhal Pack Ice Habitat: *Increasing* threats?

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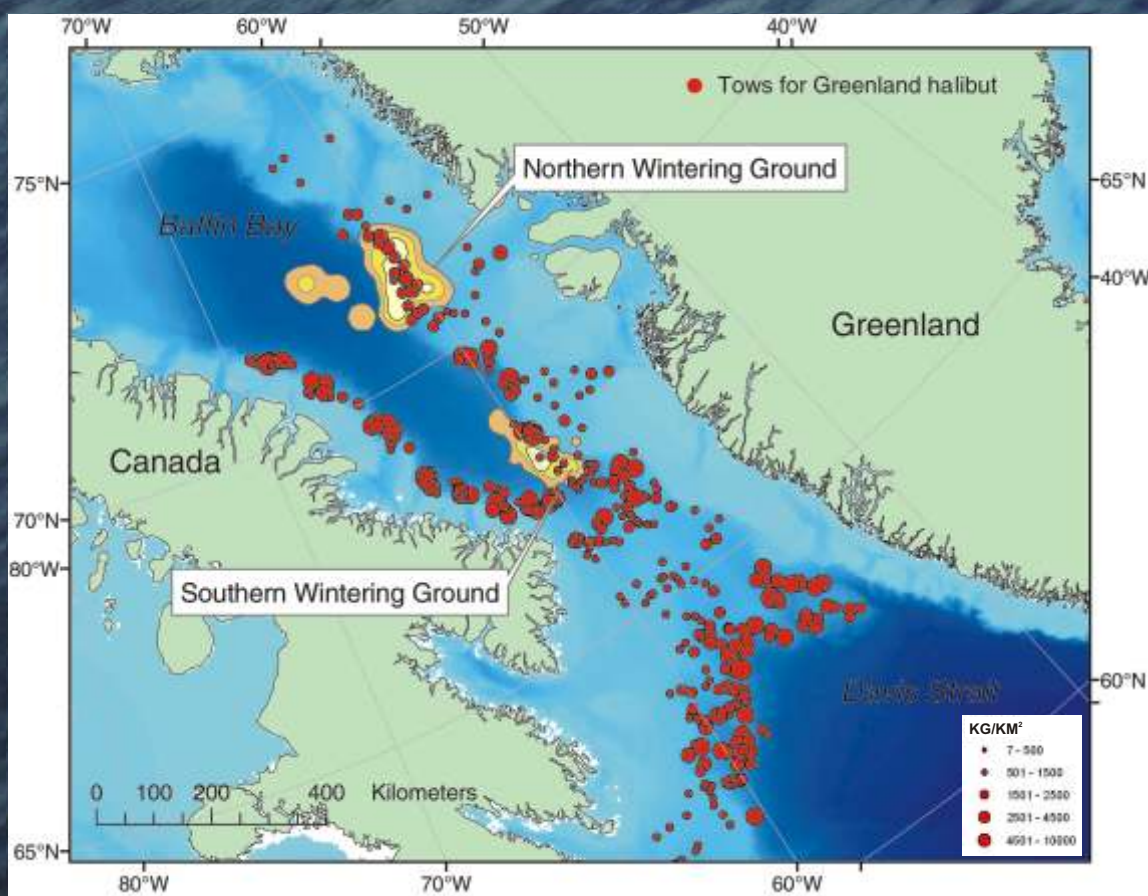


Abstract

Narwhals (*Monodon monoceros*) are among the most conspicuous of all cetaceans inhabiting dense Arctic pack ice and offer a unique opportunity for examining responses to anthropogenic and global warming-induced impacts in offshore areas. Narwhals make extensive annual migrations from high Arctic summering grounds to wintering grounds occupied between November and April in central Baffin Bay and North Davis Strait. Intense feeding behavior has been documented during winter based on stomach content studies, reduced Greenland halibut (*Reinhardtius hippoglossoides*) densities, and skewed Greenland halibut length frequencies in areas with whales. This suggests a major portion of the annual energy intake for narwhals in high Arctic Canada and West Greenland is obtained in Baffin Bay in winter. Imminent expansion of an offshore commercial fishery for Greenland halibut threatens narwhal feeding efficiency and overall fitness. Sea ice concentrations on wintering grounds average 97% and less than 3% open water is available to whales between 15 January and 15 April. Decreasing trends in the area of open water during the period of maximum ice cover have been found on wintering grounds, significantly so in northern Baffin Bay (-0.04% per year, SE 0.02). At the same time, interannual variability in the fraction of open water is significantly increasing at +0.03% per year (SE 0.006), leaving few options for narwhals to detect increasing ice trends in their habitat. Due to high site fidelity, complete coverage of the wintering grounds could lead to mass mortality of narwhals, as observed by ice entrapments in coastal areas. A combination of fewer leads and cracks, together with reduced halibut densities due to fishery operations, may critically affect narwhals. The fewer openings in the ice will reduce the surface area from which narwhals can depart to forage on the bottom, and at the same time, the reduced prey densities will be targeted by more whales. Understanding narwhal spatial habitat use patterns will lead to identifying regions that can be considered critical habitat, minimizing effects of anthropogenic factors, and predicting responses to climate change in the high Arctic.

Climate Change Impacts

Anthropogenic Impacts

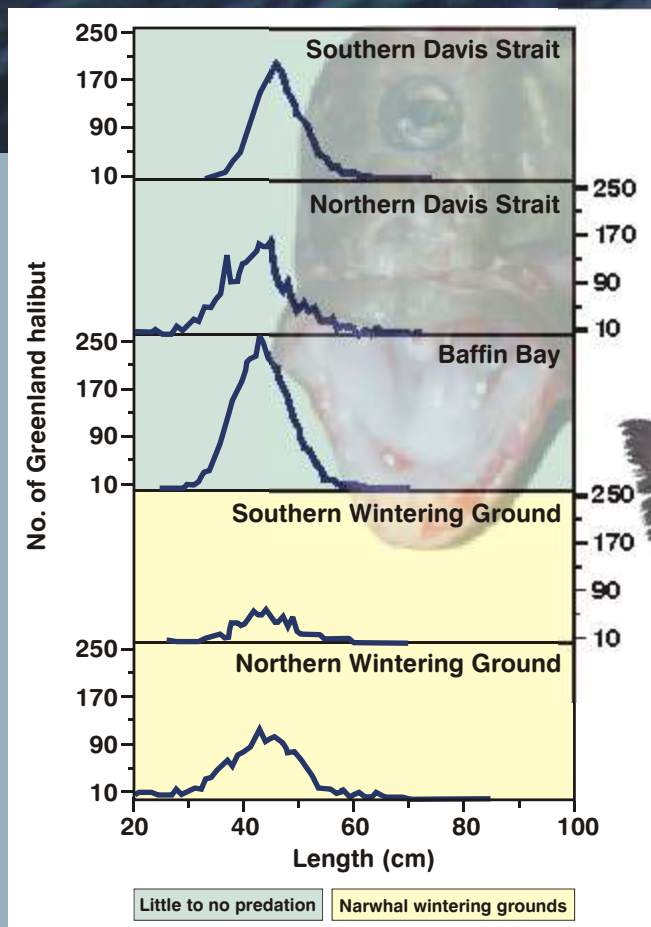


Narwhal wintering grounds in Baffin Bay shown together with the locations of trawls from Greenland halibut surveys in 2001. Wintering ground home ranges are based on 95% kernel area use from satellite telemetry data. For over 6 months, narwhals make daily dives to depths of 800-1,500 m to feed intensively on Greenland halibut in these wintering areas.

Large and significant differences in halibut density have been observed between narwhal wintering grounds and regions without narwhals. Densities and biomass are significantly lower in wintering grounds. Differences are on the order of 20,000 tons and correspond well with bioenergetic model predictions of biomass removed by narwhals on a diet of 50-75% Greenland halibut.



Since 1970, the oceanographic and biological climate in West Greenland has cooled. Baffin Bay and Davis Strait show strong significant increasing trends in wintertime sea ice concentrations and extent, as high as 7.5% per decade between 1979-1996, with comparable increases detected back to 1953. These same trends have been detected in narwhal winter pack-ice habitat.

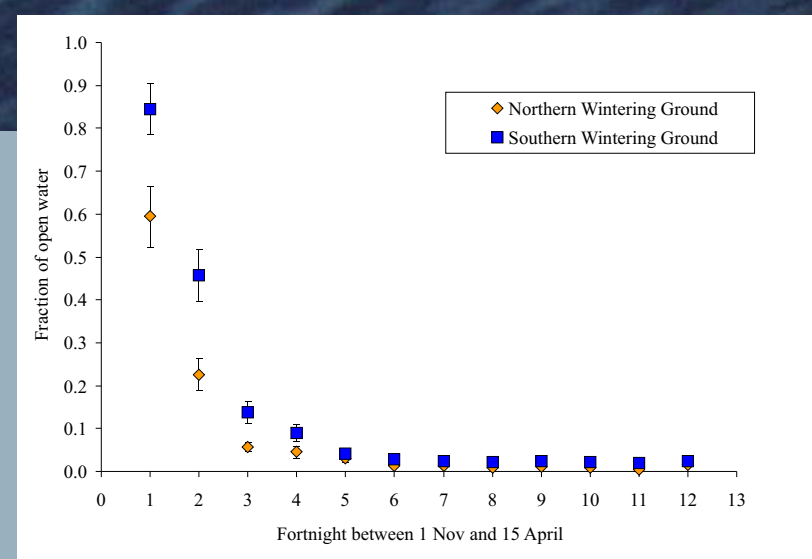


The differences in length frequency distributions between narwhal wintering grounds and non-whale areas may be indicative of selective removal of specific size classes of Greenland halibut.

Greenland halibut is an important natural resource in West Greenland and is taken in all seasons in inshore waters. There has recently been an increased interest in exploitable offshore Greenland halibut resources in Baffin Bay and exploratory fishery licences have been issued. Total allowable catches offshore nearly doubled between 2000-2002 and fishery operations are expected to increase.

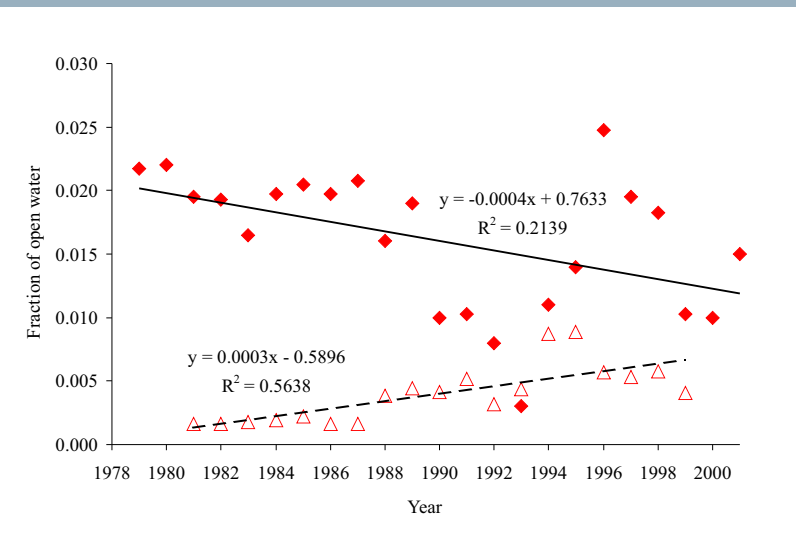


Narwhals maximize energy gain and fat storage in areas with reliable lipid-rich prey in Baffin Bay. Increasing Greenland halibut fishing operations in offshore waters will affect food availability and foraging success for wintering narwhal sub-populations.



Decreasing trend in the average fraction of open water on the Northern Wintering Ground based on average March sea ice concentrations, 1978-2001 (solid red symbols, solid line). The trend is highly significant at the 95% confidence level. A 5-year running average of the variance of the residuals shows an increasing trend in variability (open symbols, dashed line). Similar trends were found for the Southern Wintering Ground, however were not significant.

Open water declines rapidly after narwhals arrive in the wintering areas. The average fraction of open water (+/- SE) on the two wintering grounds is shown in two-week intervals between November 1 and April 15, 1978-2001.



Tusks collected from narwhals trapped in the ice in Disko Bay, West Greenland, 1915.

A reduction in the availability of open water may have deleterious consequences for narwhals. They require leads and cracks in the ice for oxygen and cannot maintain breathing holes. They are also highly vulnerable to ice entrapments due to high site fidelity, as demonstrated by several mass deaths of hundreds of animals. Narwhal ice entrapments may go undetected due to their offshore remote location in central Baffin Bay. Increasing sea ice also may exclude narwhals from important feeding areas.