

## INTRODUCTION

- Lancaster Sound is the largest national marine conservation area (NMCA) in the Canadian Arctic.
- There is a need to obtain more knowledge on species present in the NMCA such as narwhals in order to best manage the NMCA.
- The narwhal (*Monodon monoceros* L.) is a medium-sized odontocete living strictly in Arctic waters.
- Describing the distribution of narwhals will contribute to understanding narwhal activities and habitat use in the summer (i.e.: calving, resting etc...).

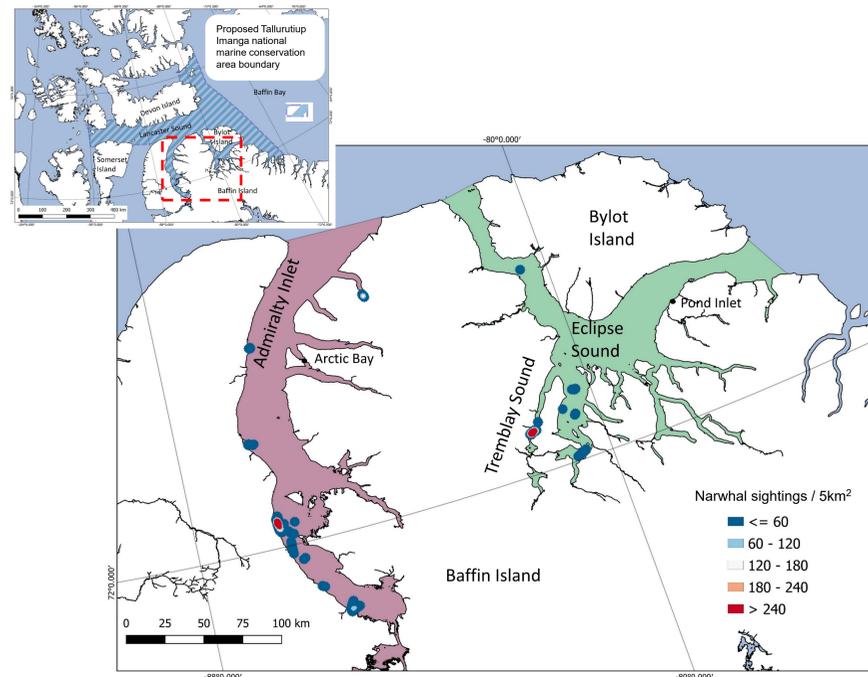


Fig. 2 Heat map of unique narwhal sightings / 5km<sup>2</sup> in Admiralty Inlet (pink) and Eclipse Sound (green) found from aerial photographs. Black dots show locations of closest Inuit communities.

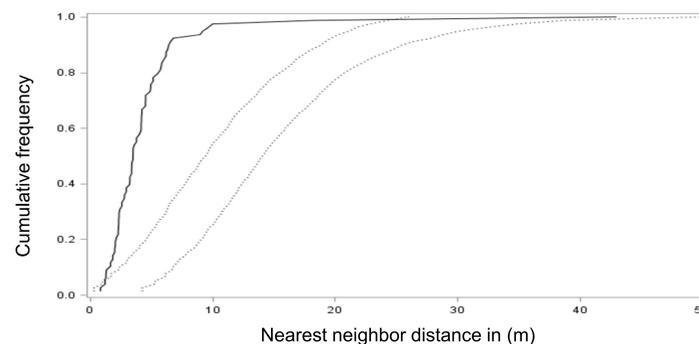


Fig. 3 Cumulative relative frequency distribution (bold solid curve) of narwhal nearest-neighbor distances (m), with 2.5<sup>th</sup> and 97.5<sup>th</sup> percentiles envelopes (dashed curves) evaluated from 999 independent partial realizations of a random point process.

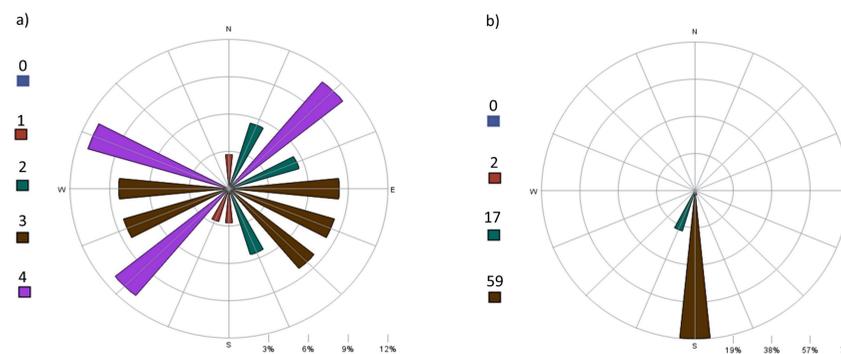


Fig. 4 Examples of two rose diagrams of narwhal azimuthal angle relative frequency obtained for two different photographs of Eclipse Sound and Admiralty Inlet regions. a) photo13,  $n = 36$ , location = Eclipse Sound (Tremblay Sound); b) photo 23,  $n = 78$ , location = Admiralty Inlet.

## RESULTS

- Overall, we detected 4,606 individuals from the photographs
- Narwhals were not randomly distributed (Fig. 2) but showed an aggregation pattern in which the nearest-neighbor distance was mostly less than 10 m (Fig. 3).
- Narwhal locations were concentrated in Tremblay Sound for the Eclipse Sound region and in the southern half of Admiralty Inlet in the Admiralty Inlet region (Fig. 2).
- Photos taken in Tremblay Sound indicated that narwhal directions were not unimodal (Fig. 4), whereas photos taken elsewhere indicated that narwhal directional movements were frequently unimodal (Fig. 4).

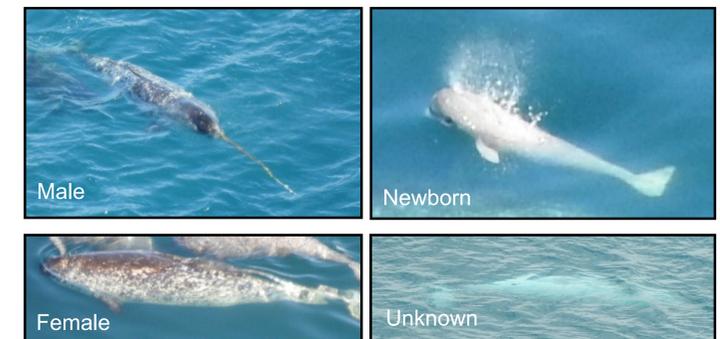


Fig. 5 Examples of narwhal sex and age categories.

## METHODS

- In August 2013, aerial photographs of narwhals were taken during surveys by the Department of Fisheries and Oceans (Fig.1 and 2).
- Based on the photographic observations, values for location coordinates, sex, age, and directionality were assigned to each narwhal.
- To determine whether narwhals were randomly distributed we performed Diggle's randomization procedure with nearest neighbour distances from photographs that contained more than 50 individuals.
- To determine if narwhals were travelling (going all in one direction) or engaged in other behaviors we applied directional statistical methods (such as Rao's uniformity test and Watson's test for the von Mises distribution) on azimuthal angles of narwhals in 25 photographs.

## DISCUSSION

- Directionality can be a proxy for narwhal behaviors: unimodal directionality indicates travelling, whereas non-unimodal directionality implies other activities.
- The different means of narwhal azimuthal angles and their aggregation patterns in Eclipse Sound and Admiralty Inlet lead us to believe narwhals use these habitats for specific purposes (i.e. calving, social behaviors). At the time of the survey, narwhals were probably involved in social activities in Tremblay Sound, whereas results from Admiralty Inlet indicated that narwhals were travelling further into the fjord.

## NEXT STEP

- Perform Diggle's randomization procedure with nearest neighbour distances on marked data points (males, females, newborns) to investigate sex and age distribution in the NMCA (Fig. 5).