

Recent abundance of bowhead whales in Isabella Bay, Canada

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Abstract

An aerial survey of the late-summer concentration of bowhead whales in Isabella Bay, Nunavut, Canada, was conducted on 19 September 2009. A total of 28 sightings were obtained during 155 km survey effort. The resulting abundance of 1,105 (95% CI: 532-2,294) was corrected for whales that were submerged during the passage of the survey plane but not for whales missed by the observers because >90% of the sightings were detected by both platforms.

Introduction

Isabella Bay is a critical late-summer habitat for the Canada-Greenland population of bowhead whales (*Balaena mysticetus*) and the area was appointed a national wildlife area in 2008. It is known since the whaling period that bowhead whales concentrate in the summer in Isabella Bay where they were also hunted intensively (Finley 1990).

The abundance of bowhead whales in Isabella Bay has not been fully assessed before but Finley (1990) photographed as many as 107 different whales on 28-29 September 1986. Three whales were identified on photos from both days which suggest that the actual number of whales using Isabella Bay was much larger.

Dueck et al. (2008) surveyed the east coast of Baffin Island including Isabella Bay on 7 to 15 August 2003 and obtained five sightings of bowhead whales in Isabella Bay.

Here we report on a survey in Isabella Bay in September 2009 with the purpose of developing fully corrected abundance estimates for the bowhead whale aggregation.

Methods

Aerial survey

Six east-west going transect lines were surveyed in Isabella Bay, Baffin Island, on 19 September 2009 for detections of bowhead whales.

Each line were placed 0.1 latitudinal degrees apart and therefore the northern and southern border of the stratum were assigned to 0.05 degrees from the most northern and southern lines respectively. The western border followed the coast and the eastern border was the outline of the eastern end of the transects. The total search effort was 155 km and the stratum area was calculated at 2195 km² (Figure 1).

All four observers were dedicated to whale observations and sightings were pooled from each platform (right and left side of the plane). An interruption on transect 7 caused the right side observer to only record one sighting although the other right side observer detected at least 10 whales. Therefore the effort on the

right side was removed from the analysis and the effort (linear km) on transect 7 halved and the analysis included only sightings from the left platform.

The distances were calculated by multiplying the altitude by tangens to the declination angle measured with inclinometers when the sighting was abeam. Both on and off effort sightings were used to produce a global detection function. Only on effort sightings were used for the abundance estimate in Isabella Bay which included a total of 28 observations. No corrections were applied for sightings missed by the observers because >90% of the sightings were detected by both observers and correction for perception bias would only inflate the variance estimates. All analyses were made using the software program Distance 6.0.

Availability correction factor

In April 2009 four bowhead whales were tagged with satellite recorders in Disko Bay, Greenland. They were tracked across Baffin Bay and were present in Isabella Bay at the time of this survey.

The proportion of time the whales spent at the surface could then be used to correct for availability at the surface using the formula

$$\hat{N}_c = \hat{N} / \hat{a} \quad [\text{Formula 1}]$$

where \hat{a} is the availability correction factor i.e. proportion of time an animal is potentially available at the surface to be seen by the observers. The coefficient of variation (cv) calculated as the standard error in proportion to the mean is then

$$cv(\hat{N}_c) = \sqrt{cv(\hat{N})^2 + cv(\hat{a})^2} \quad [\text{Formula 2}]$$

The log-normal 95% confidence intervals are subsequently recalculated as

Lower confidence interval limit= N/C

Upper confidence interval limit= $N \cdot C$

$$\text{Where } C = \exp \left[z_{\alpha} * \sqrt{1 + \left\{ \log_e \left(\frac{\text{var} \hat{N}}{\hat{N}^2} \right) \right\}} \right] \quad [\text{Formula 3}]$$

Results and discussion

Based on the best model fit to the data were truncated at 2500 m, leaving 24 sightings for analysis. Based on the q-q plot and lowest AIC the best model was a model with a half-normal key (Figure 2, Table 1). The largest contributor to the coefficient of variation was the encounter rate accounting for 75%, followed by probability of detection (20%) and group size (5%).

Three whales were transmitting data (n=132 6-hr periods) in September 2009 and the average time spent at the surface was 20% (cv: 0.19) between 12:00 and 18:00 UTC (Table 1). This surface time was used to estimate the abundance corrected for availability bias, i.e. the animals that were submerged during the passage of the survey plane (Table 2). The density of sightings and time between sightings was short so it

was assumed that sightings were close to being instantaneous and no corrections for the search time was applied. The total estimated abundance was then 1105 animals (cv: 0.39, 95% CI: 532-2,294).

This survey confirms that Isabella Bay is an important summer concentration for bowhead whales (Finley 1990). During a survey of the east coast of Baffin Island in August 2003 only seven sightings of bowhead whales were obtained during 3556 km of survey effort (Dueck et al. 2008). That survey also covered areas about 50 km off the coast but resulted in only one offshore sighting whereas five of the sightings were obtained in Isabella Bay. The fully corrected abundance of 212 whales along East Baffin Island including Isabella Bay from Dueck et al. (2008) was considered problematic due to the low sighting rate and the difficulties with surveying the fjord system (op cit.). The survey presented here confirms that there are substantial numbers of bowhead whales on the east coast of Baffin Island in late-summer at the same time as large abundances of whales are found on the west side of Baffin Island. An aerial survey in 2002 in Prince Regent Inlet gave an abundance of 6,344 bowhead whales (95% CI 3,119-12,906) and a survey in Foxe Basin in 2003 gave an abundance of 1,525 (95% CI 333-6,990) which was accepted by IWC (see Report of Scientific Committee 2009, Annex F, p. 179).

A survey in West Greenland in April 2006 produced an abundance of 1229 (95% CI 495-2939) bowhead whales in the area around Disko Bay. This abundance is in the same magnitude as estimated for Isabella Bay (Heide-Jørgensen et al 2007). Satellite tracking of bowhead whales from Disko Bay in West Greenland has shown that several whales moved to Isabella Bay in 2004, 2006, 2008 and 2009 indicating that a large proportion of the bowhead whales from the winter and spring feeding ground in Disko Bay are found in Isabella Bay in late summer (Greenland Institute of Natural Resources).

Acknowledgements

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References

- Dueck, L., P. Richard and S.E. Cosens (2008) A review and re-analysis of Cosens et al. (2006) aerial survey assessment of bowhead whale abundance for the eastern Canadian Arctic. SC/60/BRG34.
- Finley KJ (1990) Isabella Bay: An important historical and present-day concentration area for the endangered bowhead whale (*Balaena mysticetus*) of the Eastern Canadian Arctic. *Arctic* 43: 137-152
- Heide-Jørgensen MP, Laidre K, Borchers D, Samarra F and Stern H (2007) Increasing abundance of bowhead whales in West Greenland. *Biology Letters* 3: 577-580

Table 1. Mean Surfacing time for four bowhead whales in the Canadian Eastern Arctic in September 2009

Whale ID/GMT	00:00-06:00	06:00-12:00	12:00-18:00	18:00-24:00	Grand Total
7927 (n=11)	0.22	0.17	0.19	0.17	0.18
20169 (n=117)	0.23	0.27	0.27	0.19	0.24
20689 (n=2)				0.24	0.24
21802 (n=2)			0.14	0.13	0.14
Grand Total	0.23	0.26	0.26	0.19	0.24

Table 2. Density and relative abundance of bowhead whales (*cv*: coefficient of variation, *df*: degrees of freedom, *CI*: confidence interval)

ABUNDANCE	Estimate	%cv	95%CI low	95%CI high
Density	0.1	33.6	0.05	2.21
Abundance	221	33.6	105	464
Abundance _{Corrected}	1,105	38.6	532	2,294

Bowhead distribution in Isabella Bay

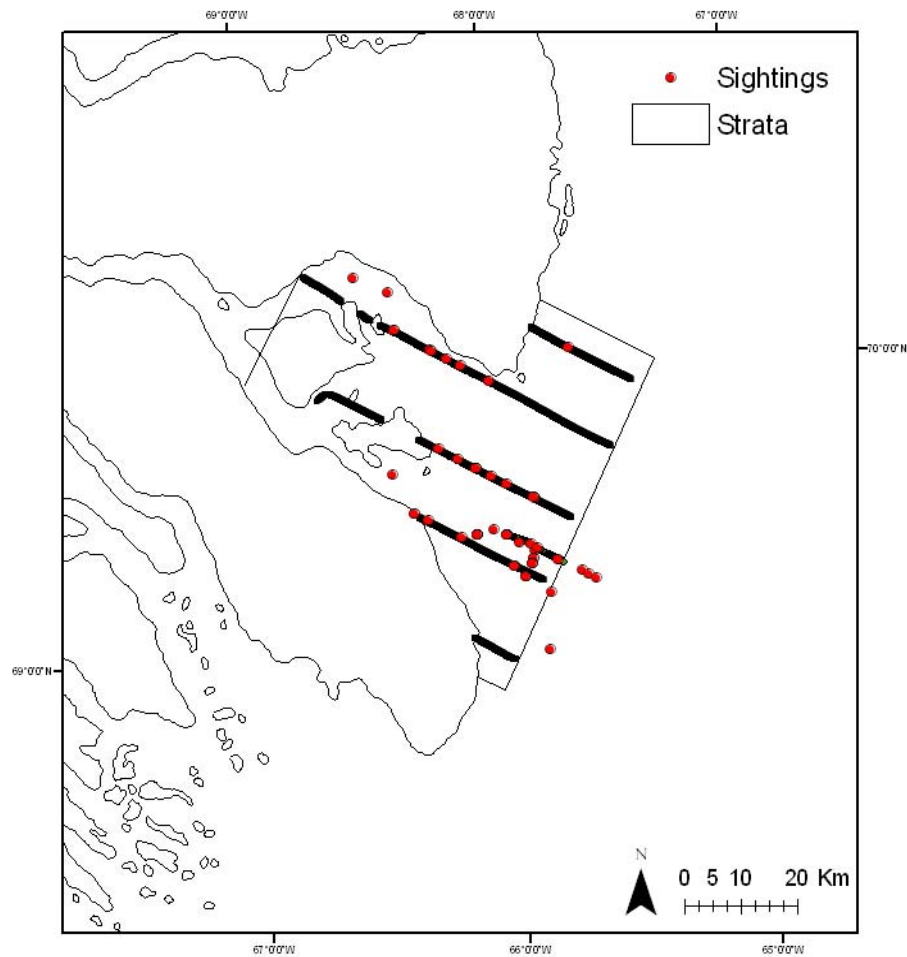


Figure 1. Distribution of bowhead whales in Isabella Bay showing both on and off effort sightings on 19 September 2009.

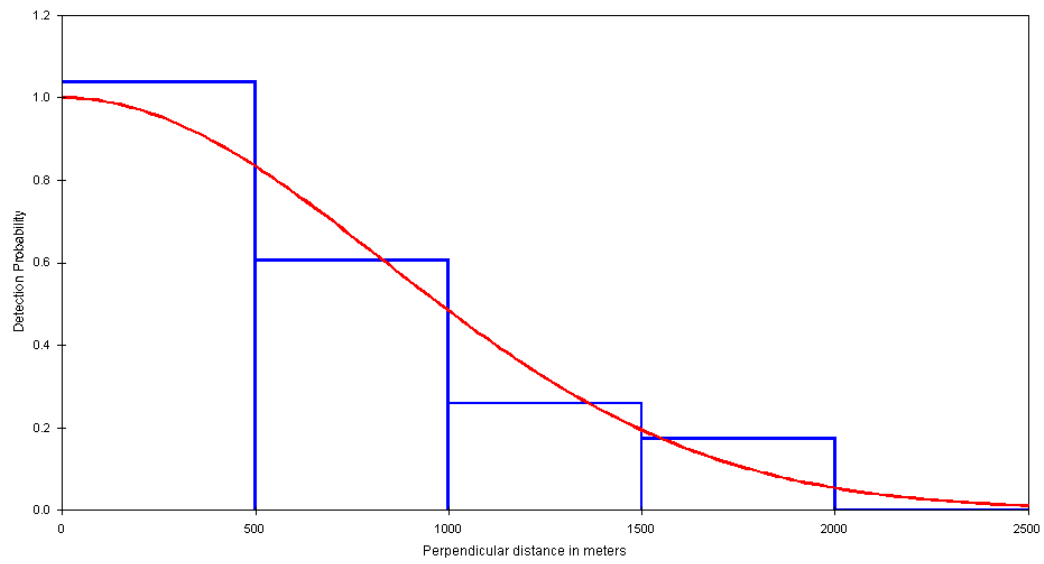


Figure 2. Probability of detection, half normal key, for the bowhead whales sightings.