

## Further evidence for a single stock of bowhead whales between Canada and West Greenland

M.P. Heide-Jørgensen \* and K.L. Laidre \*,<sup>+</sup>

\* Greenland Institute of Natural Resources  
Box 570  
DK-3900 Nuuk  
Greenland

+ Polar Science Center, Applied Physics Laboratory  
University of Washington  
1013 NE 40<sup>th</sup> Street  
Seattle, WA 98105

### ABSTRACT

This study augments the existing data on the movement patterns of bowhead whales (*Balaena mysticetus*) in waters between West Greenland the eastern Canadian high Arctic and provides further data supporting the single stock hypothesis. Recent results of satellite tracking of whales from West Greenland in 2005 and 2006 support the previous data demonstrating that the bowhead whales inhabiting Foxe basin, Hudson Bay, Hudson Strait, Eastern Baffin Island, Lancaster Sound with tributaries and West Greenland belong to one highly segregated population. These satellite tracking results are also in agreement with genetic studies, the catch history from Baffin Bay and Foxe Basin, and the reproductive and sex segregation of bowhead whales throughout the range.

### INTRODUCTION

In 1977 the International Whaling Commission (IWC) adopted a two-stock scenario for bowhead whales occupying eastern Canadian and western Greenlandic waters (Allen 1978). This classification was based on a paper submitted by Mitchell to IWC and was considered the most conservative approach for management (Allen 1978, Reeves and Mitchell 1990). The two stocks were identified as the Baffin Bay-Davis Strait (BB-DS) or Baffin Bay stock and the Hudson Bay-Foxe Basin (HB-FB) or Hudson Bay stock. They have been treated as separate populations since (see Mitchell and Reeves 1981; Bannister 1999; Cosens and Innes 2000; Finley 1990, 2001).

Reeves *et al.* (1983) examined bowhead whaling records and together with Reeves and Mitchell (1990), discussed the evidence both for and against the two-stock hypothesis. Both studies concluded that available data were insufficient for evaluating stock affinities in the region and the population identity of these bowheads has essentially remained unresolved.

Heide-Jørgensen *et al.* (2006) argued that bowheads summering in eastern Canada and wintering in West Greenland consist of a single population based on satellite tracking studies of bowhead whales tagged in West Greenland in 2001-2003. The study also demonstrated that bowhead whales travel long distances (>1,000 km) in relatively short periods of time (7-10 days) and suggested that there was no reason why whales should be restricted to small portions of the total potential range in eastern Canada and Greenland waters. They also noted that there was no evidence of geographical separation between the two putative stocks and that genetic evidence does not support the two-stock model (Postma *et al.* 2006).

This paper provides an update on satellite tracking studies of bowhead whales in Baffin Bay based on satellite tracking studies conducted in 2005 and 2006 and provides additional evidence that bowhead whales between Canada and Greenland belong to one stock.

### MATERIAL AND METHODS

Bowhead whales were instrumented with satellite tags in Disko Bay, West Greenland (Figure 1) (Telonics ST-15 and ST-16, or Wildlife Computers, Redmond, Washington SPOT1, 2, and 3 tags) by approaching surfacing whales in small boats and pushing tags under the skin into the blubber layer with an 8 m long fiberglass pole (methodological details in Heide-Jørgensen *et al.* 2003) or by delivery with a modified air gun (see Heide-Jørgensen *et al.* 2001). Tags were deployed during the month of May between 2001 and 2006 and location data were obtained from polar orbiting satellites via the ARGOS data collection system (Harris *et al.* 1990).

Sex of instrumented whales was obtained from genetic analyses of biopsies collected simultaneously with the instrumentation of the whales. The sex determinations were supplied by Lianne Postma, Fisheries and Oceans, Winnipeg, Canada. Age class was estimated on coarse visual estimates of length of the whales.

## RESULTS AND DISCUSSION

Satellite tracking has proven to be the most direct and efficient tool for studying migrations, site fidelity and stock identity of bowhead whales (Heide-Jørgensen *et al.* 2006). Migrations of bowhead whales have been studied intensively in West Greenland in the past 5 years by tracking of instrumented whales by satellite. In 2005 and 2006, 24 bowhead whales were satellite tagged in Disko Bay. This combined with previous data results in 47 bowhead whales have been tracked from Disko Bay in April and May. Of these tagged whales, some tracking durations have lasted over 9 months and revealed the summer concentration areas, fall migration routes, and wintering grounds (cf. Heide-Jørgensen *et al.* 2003 and 2006).

The first bowhead whales arrive in Disko Bay in February (data from 2005 and 2006) at Kitsissuarsuit and Qeqertarsuaq. The whales remain in the bay until June (demonstrated in 2006) and are mainly concentrated in the northern section near the coast of Disko Island. Some whales have been observed in the eastern part of the bay towards Ilulissat, north and offshore of Uummannaq, or around the islands in the opening of the bay. The timing of the annual departure from the bay varies slightly but usually occurs around mid May. The predominant migration route is a northwest bound path across Baffin Bay, probably through leads and cracks in the pack ice (Heide-Jørgensen *et al.* 2003, Heide-Jørgensen *et al.* 2006). The trip across Baffin Bay likely requires that the whales first move north along the West Greenland coast until they find a sufficient lead that intersects Baffin Bay running northwest to southeast. Such a lead likely facilitates open water for traveling during the relatively short time span (10 days) bowhead whales cross over to northern Canada. Some migration paths first heading north along the West Greenland coast or first west directly towards Baffin Island have also been documented, but are less common (see Fig. 1).

### *Summering areas*

After leaving the Disko Bay area in May bowhead whales move northeast on a very broad migratory corridor towards Pond's Bay, a commonly used area for all tagged whales (figs 2-4). Some whales stayed in that area whereas other whales moved around in the so called 'middle pack-ice' in northwestern Baffin Bay for an extended period during summer. Later in the summer the whales apparently separate into two groups; One that uses the coastal areas of the east coast of Baffin Island and other that travels west into Lancaster Sound and visits the fjord systems of Admiralty Inlet and Prince Regent Inlet. The western part of Prince Regent Inlet is used for a long period in August and in 2006 considerable time was also spent at the entrance to Bellot Strait where bowhead whales have previously been observed to congregate in August (Heide-Jørgensen unpubl. data).

### *Wintering grounds*

Previous movement studies of bowhead whales demonstrated that Hudson Strait is the preferred wintering ground for animals tagged in Disko Bay (see Heide-Jørgensen *et al.* 2006). Additional evidence for this was provided by one whale in 2005 (see Fig. 3). Other areas are also used as wintering grounds and they include the outer parts of Cumberland Sound, West Greenland, the North Water and Cape Dyer. Southwell (1898) and Brown (1868) indicated Hudson Strait was a wintering area for bowheads based on whaling records, and recent analysis of aerial surveys of Hudson Strait (conducted during March 1981) provided an abundance estimate of 1,272 (95% CI 484–3,346) whales. This suggests that Hudson Strait is perhaps the most important wintering ground for bowhead whales in Baffin Bay (Koski *et al.*, 2006).

### *Age and sex differences in migratory patterns*

All whales instrumented in 2005 and 2006 were considered to be sexually mature based on body length (estimated to exceed 14 m for all the whales). No immature, calves or newborn whales were seen in the study area between 2000 and 2007. Sex was determined for a large proportion of bowhead whales tagged between these years and there was a clear preponderance of females. Despite a small sample size of tagged males no obvious differences in migratory patterns could be detected between sexes (Fig. 3). Both sexes used the Pond's Bay area in June and moved along east Baffin Island to visit various fjords (incl. Isabella Bay). Both sexes also moved into Prince Regent Inlet and south in to Boothia Sound. They also spent time at the entrance to Bellot Strait and returned to Hudson Strait for wintering.

### *Stock identity*

The following evidence points to the conclusion that bowhead whales in Foxe Basin, Hudson Bay, East Baffin Island and West Greenland belong to the same stock:

- The whales use the same wintering ground. Hudson Strait is a wintering ground for bowhead whales from Foxe Basin, Hudson Bay and West Greenland and it is unreasonable to assume that whales from these different areas can maintain discrete stocks given that mating is believed to occur in winter.
- The whales use the same summering grounds. Movements of bowhead whales from Foxe Basin both northward into Prince Regent Inlet and southward to northern Hudson Bay have been recently documented by satellite tracking (Larry Dueck, unpublished data). Thus bowhead whales from West Greenland share summering grounds with whales from Foxe Basin.
- The whales make long-distance movements. Considering the wide-ranging capabilities of bowhead whales, their rapid travel speeds to specific concentration areas, thousands of kilometers traversed by single individuals and their shared summer and wintering grounds, it is unreasonable to assume that bowhead whales from the two presumed stocks can persist as functionally discrete stocks.
- Considerable genetic overlap. Genetic evidence does not support a stock separation between West Greenland and Foxe Basin (Postma et al. 2006).
- The catch history supports a single stock. Davis Strait and Baffin Bay bowhead whales were the first exploited in the late 17th century. After 1860 when whales in this region were depleted, whalers moved to Hudson Bay and southwestern Foxe Basin. What is exceptional about this geographic switch and the catch levels is that relatively few catches were made when whalers moved to Hudson Bay/Foxe Basin after depleting whales in Baffin Bay, despite the fact no whaling had ever occurred in Hudson Bay/Foxe Basin. Therefore, Foxe Basin was already depleted to similar levels as those in Baffin Bay when the whalers arrived, implying some connection between the two areas. If this was not the case, one would have expected whalers to find whales in higher densities in Foxe Basin and to catch whales in larger numbers, or at least comparable numbers, to the pristine conditions of Baffin Bay before depletion.
- The occurrence of bowhead whales in West Greenland is not self sustained. Skin biopsy samples of bowhead whales collected in Disko Bay between 2000 and 2006 show that 85% (n=93) of the whales sampled are females based on genetic sex determinations and length estimates suggest all were mature exceeding 12-14 m of body length (GINR unpubl. data). No – or very few calves – have been seen in West Greenland thus the females in Disko Bay must be either pregnant or resting. The other segments of the population, (i.e. mature males, immature whales and mothers with calves), must be located somewhere else in the Arctic. In Foxe Basin primarily females with calves and young immature whales are found, and no other areas besides this have conspicuous numbers of mother and calves (explaining where the whales from West Greenland reproduce). The present population segregation does not differ from the bowhead whale segregation reported during the whaling period (Southwell 1898, Brown 1868). Few reports of calves or newborns exist from the relatively large number of whales taken along West Greenland (Eschricht and Reinhardt 1866). Analysis of whaling records by Reeves and Cosens (2003) indicated that calves and sub-adults were taken by commercial whalers in northwestern Hudson Bay and Repulse Bay and that these areas were likely calf-rearing areas. Old males were thought to over-winter off the entrance to Hudson Strait, move to Disko Island in April and May, and then cross Baffin Bay to join the females and immature whales at Lancaster Sound (Southwell 1898).

## CONCLUSION

The stock division of bowhead whales was originally proposed in IWC as a conservative measure (IWC 1978, 1992), despite the fact that no data supported the division except the simultaneous occurrence of bowhead whales in two different areas in summer. With the latest studies of stock identity based on genetics and satellite tracking nothing seem to support the stock delineation. The primary obvious problems with the two-stock hypothesis are that 1) too few calves have been found in the putative Baffin Bay stock to maintain a viable population and 2) too few adults have been found in the putative Hudson Bay stock to produce the calves and sub-adults that have been seen there. Satellite tracking data have shown that there is no geographical separation between the two putative stocks, that whales occupying Foxe Basin move through Fury and Hecla Strait into Prince Regent Inlet (waters traditionally associated with the Baffin Bay stock), and that whales from the two putative stocks occupy the same wintering areas in Hudson Strait. The most reasonable explanation for these findings is that bowhead whales summering in the eastern Canadian Arctic and wintering off the west coast of Greenland consist of a single population. Those occupying Baffin Bay are the adult males and resting females and those occupying Prince Regent, Gulf of Boothia, Foxe Basin and north-western Hudson Bay are the nursing females, calves and sub-adults.

## REFERENCES

- Allen, K.R. 1978. Report of the Scientific Committee. Rep. Int. Whal. Commn. 28: 38-92.
- Bannister, J.L. 1999. Report of the Scientific Committee. J. Cetacean Res. Manage. 1 (Suppl.): 1-284.
- Brown, R. 1868. Notes on the history and geographical relations of the Cetacea. frequenting Davis Strait and Baffin's Bay. Proc. Zool. Soc. of London 1868: 533-556.
- Cosens, S.E. and Innes, S. 2000. Distribution and numbers of bowhead whales (*Balaena mysticetus*) in northwestern Hudson Bay in August 1995. Arctic 53: 36-41.
- Eschricht, D. F. and J. Reinhardt. 1861. Om Nordhvalen (*Balaena mysticetus* L.) navnlig med Hensyn til dens Udbredning i Fortiden og Nutiden og til dens ydre og indre Saerkjender. K. Danske Videnskabernes Selskabs Skrifter. Series 5, naturvidenskabelig og matematisk Afdeling 5:433-590.
- Finley, K.J. 1990. Isabella Bay, Baffin Island: An important historical and present-day concentration area for the endangered bowhead whale (*Balaena mysticetus*) of the Eastern Canadian Arctic. Arctic 43: 137-152.
- Finley, K.J. 2001. Natural history and conservation of the Greenland Whale, or Bowhead, in the Northwest Atlantic. Arctic 54: 55-76.
- Harris, R. B., S. G. Fancy, D. C. Douglas, G. W. Garner, S. C. Amstrup, T. R. McCabe, and L. F. Pank. 1990. Tracking wildlife by satellite: Current systems and performance. United States Department of the Interior, Fish and Wildlife Service, Fish and Wildlife Technical Report 30: 52 pp.
- Heide-Jørgensen, M.P., N. Øien, L. Kleivane, M.V. Jensen. 2001. A new technique for deploying satellite transmitters on baleen whales: tracking a blue whale (*Balaenoptera musculus*) in the North Atlantic. Marine Mammal Science 17(4): 949-954.
- Heide-Jørgensen, M.P., Laidre, K., Wiig, Ø., Jensen, M.V., Dueck, L., Schmidt, H.C., and Hobbs, R. 2003. From Greenland to Canada in ten days: Tracks of bowhead whales, *Balaena mysticetus*, across Baffin Bay. Arctic 56: 21-31.
- Heide-Jørgensen, M.P., Laidre, K.L., Jensen, M.V., Dueck, L. and L. D. Postma, L.D. 2006. Dissolving stock discreteness with satellite tracking: Bowhead whales in Baffin Bay. Marine Mammal Science, 22(1): 34-45.
- IWC 1978. Report of the Scientific Committee. Report of the International Whaling Commission 28:38-92.
- IWC 1992. Report of the Scientific Committee. Report of the International whaling Commission 42:51-270.
- Koski, W.R., M.P. Heide-Jørgensen, K.L. Laidre. 2006. Winter abundance of bowhead whales, *Balaena mysticetus*, in the Hudson Strait, March 1981. J. Cetacean Res. Manage. 8(2): 139-144.
- Laidre, K. L., M. P. Heide-Jørgensen, , T. G. Nielsen,. In Press. The role of the bowhead whale as a predator in West Greenland. Marine Ecology Progress Series.
- Mitchell, E. and Reeves, R.R. 1981. Catch history and cumulative catch estimates of initial population size of cetaceans in the eastern Canadian Arctic. Rept. Int. Whal. Commn. 31: 645-682.
- Postma, L.D., Dueck, L.P., Heide-Jørgensen, M.P. and Cosens, S.E. 2006. Molecular genetic support of a single population of bowhead whales (*Balaena mysticetus*) in Eastern Canadian Arctic and Western Greenland waters. 15pp. International Whaling Commission SC/58/BRG4.
- Reeves, R.R., Mitchell, E., Mansfield, A. and McLaughlin. 1983. Distribution and migration of the bowhead whale, *Balaena mysticetus*, in the eastern North American Arctic. Arctic 36: 5-64.
- Reeves, R.R. and Mitchell, E. 1990. Bowhead whales in Hudson Bay, Hudson Strait, and Foxe Basin: A review. Naturaliste can. (Rev. Ecol. Syst.) 117: 25-43.
- Reeves, R.R. and Cosens, S.E. 2003. Historical population characteristics of bowhead whales (*Balaena mysticetus*) in Hudson Bay. Arctic 56:283-292.
- Southwell, T. 1898. The migration of the Right Whale (*Balaena mysticetus*). Natural Science 12: 397-414.

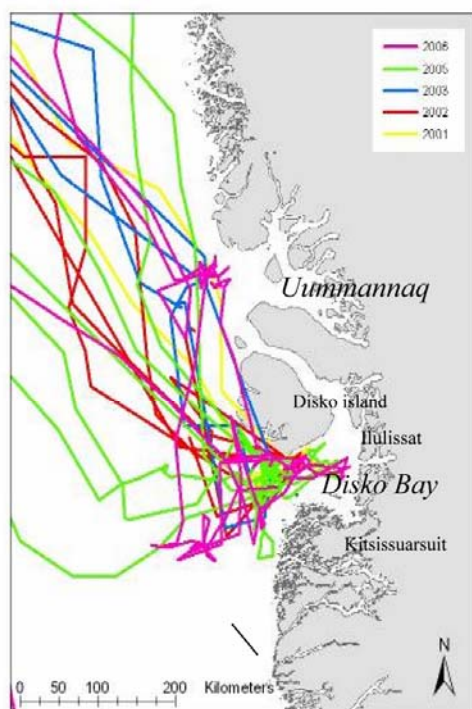


Fig. 1. Tracks of bowhead whales departing Disko Bay between 2001 and 2006 in spring during their migration towards Canada in May-June.

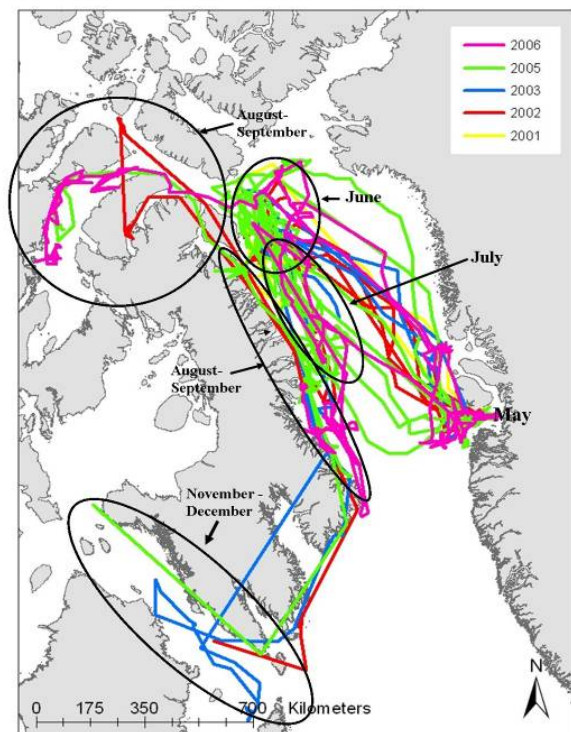


Fig. 2. Tracks of bowhead whales moving between West Greenland and the Canadian high Arctic and Hudson Strait.

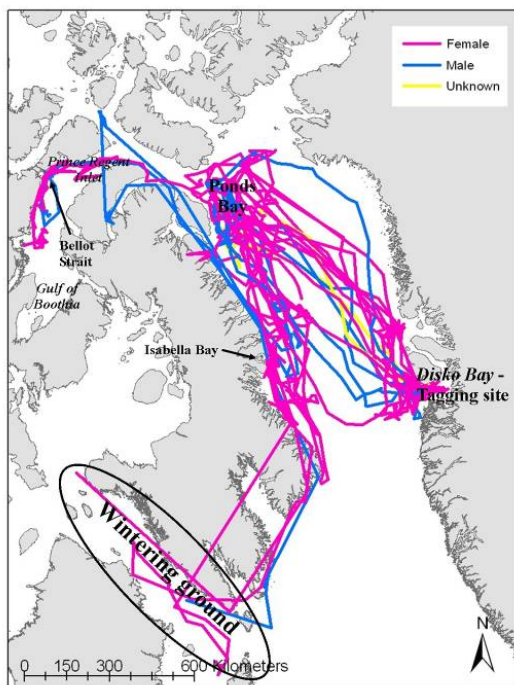


Fig. 3 Movements of bowhead whales from Greenland to Canada displayed for male and females separately.

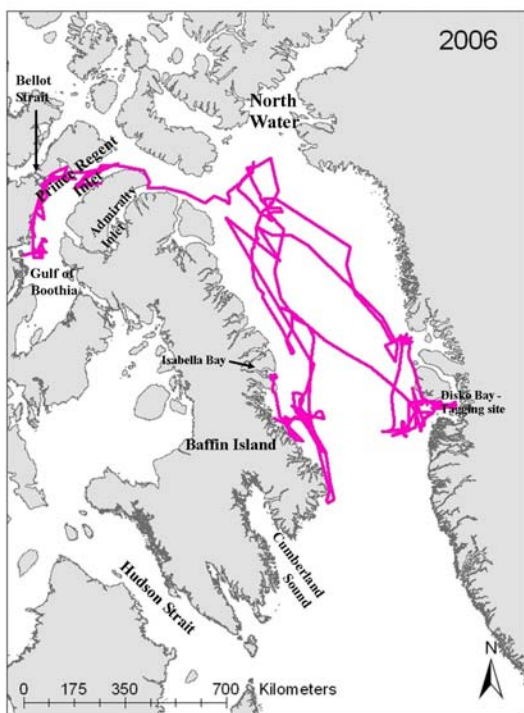


Fig. 4. Movements of three bowhead whales tagged in May 2006 in Disko Bay.