NUNAVUT WILDLIFE MANAGEMENT BOARD
Agenda: Regular Meeting No. RM 001-2012
March 13 , 2012 (8:30 AM to 5:00 PM)
Large Board Room, Hotel Arctic, Iqaluit, Nunavut

	No:	Item:	Tab:	Presenter:	Time Limit
8:30 AM to 8:35 AM	1	Call to Order / Opening Prayer		Chairperson	5 minutes
8:35 AM to 8:40 AM	2	Opening Remarks and Introductions		Chairperson	5 minutes
8:40 AM to 8:50 AM	3	Agenda: Review and Approval	1	Chairperson	10 minutes
	4	Environment Canada (EC): Issues/Decisions		EC Staff	
8:50 AM to 9:15 AM		a) Management Plan Barrow's Goldeneye	2		25 minutes
	5	Fisheries and Oceans (DFO): Issues/Decisions		DFO Staff	
9:15 AM to 9:40 AM		a) Sport Hunting Walrus with Bow and Arrow	3		25 minutes
9:40 AM to 10:00 AM		b) Confederation Fiord Emerging Char Fishery Application	4		20 minutes
BREAK 10:00AM to 10:15 AM					
10:15 AM to 10:45 AM		c) Conversion of Northern Shrimp Fishery in Shrimp Area 2	5		30 minutes
	6	NWMB Items: Issues/Decisions		NWMB staff	
10:45 AM to 11:00 AM		Struck and Loss Workshop	6	WMB/FMB	15 minutes
11:00 AM to 11:20 AM		Bowhead Whale Total Allowable Harvest Review	7	WMB	20 minutes
11:20 AM to 11:30 AM		ACCWM Caribou Management Plan Update (Verbal)	8	DWM	10 minutes
11:30 AM to 11:40 PM		Narwhal Management Update (Verbal)	9	WMB	10 minutes
LUNCH 12:00 to 1:30 PM					
1:30 PM to 1:40 PM		Walrus Sports Hunt Policy Update (Verbal)	10	WMB	10 minutes

	No:	Item:	Tab:	Presenter:	Time Limit
1:40 PM to 1:50 PM		Kingnait Fiord Update (Verbal)	11	WMB/FMB	10 minutes
1:50 PM to 2:00 PM		Fisheries Allocation Workshop Update (Verbal)	12	FMB	10 minutes
2:00 PM to 2:10 PM	7	Other Presentations	13	Chairperson	10 minutes
2:10 PM to 2:20 PM	8	Date and Location of Next Meeting-	14	Chairperson	10 minutes
2:20 PM to 2:25 PM	9	Adjournment and Closing Prayer			5 minutes

SUBMISSION TO THE NWMB FOR

Information: Decision: X

Issue: Approval of the proposed Management Plan for the Barrow's Goldeneye, eastern population, pursuant to the *Species at Risk Act* (SARA)

Background:

The Barrow's Goldeneye is a sea duck that occurs in three distinct populations in North America and Iceland. The Eastern population of Barrow's Goldeneye in North America was assessed in 2000 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as a species of special concern and was listed as such in Schedule 1 of the *Species at Risk Act* (SARA) in 2003.

The Eastern population comprises approximately 6800 individuals, which is equivalent to 2100 pairs. The species breeds primarily in the boreal forests of Quebec, north of the Estuary and Gulf of St. Lawrence. While most of the population also winters in the Estuary and the Gulf, its wintering range extends to the coast of the Atlantic provinces and Maine.

Barrow's Goldeneye do not breed or winter in Nunavut, but based on satellite telemetry, some adult males have been found to moult in the Arctic along the shores of eastern Hudson Bay and the south coast of Baffin Island (Figure 1). Bird surveys conducted in 2000 in Southern Baffin Island did not find any Barrow's Goldeneye. Communities (Kimmirut, Iqaluit and Sanikiluaq) that are nearest to the locations where Barrow's Goldeneye might be found have been asked for their input on this issue but results were not available at the time this Briefing Note was submitted. CWS will report on those results during the presentation.

The main threats to the Barrow's Goldeneye, eastern population, occur in its habitats in southern Canada and include logging, the stocking of fishless lakes, and oil spills. Hunting in the St Lawrence Estuary and sediment contamination may also pose threats to this population.

Management Plan:

The Species at Risk Act requires that a management plan must be written for species listed as a species of special concern.

The management goal is to maintain and, if possible, increase the current population size and range of the Barrow's Goldeneye, Eastern population. In order to achieve this objective, the size of the population must be maintained for the next ten years at not less than 6800 individuals across the species' range. General strategies and management activities designed to achieve this goal are set out in the proposed management plan.

There are no activities proposed in the management plan that would occur in Nunavut.

The Nunavik Marine Region Wildlife Management Board has reviewed and supported the draft SARA Management Plan for Barrow's Goldeneye.

Recommendations:

The NWMB is asked to consider whether or not they wish to make a formal decision on supporting the national SARA Management Plan for Barrow's Goldeneye, and if so, whether or not they approve of the Management Plan.

Prepared by:
Lisa Pirie
Canadian Wildlife Service, Iqaluit

10 February 2012

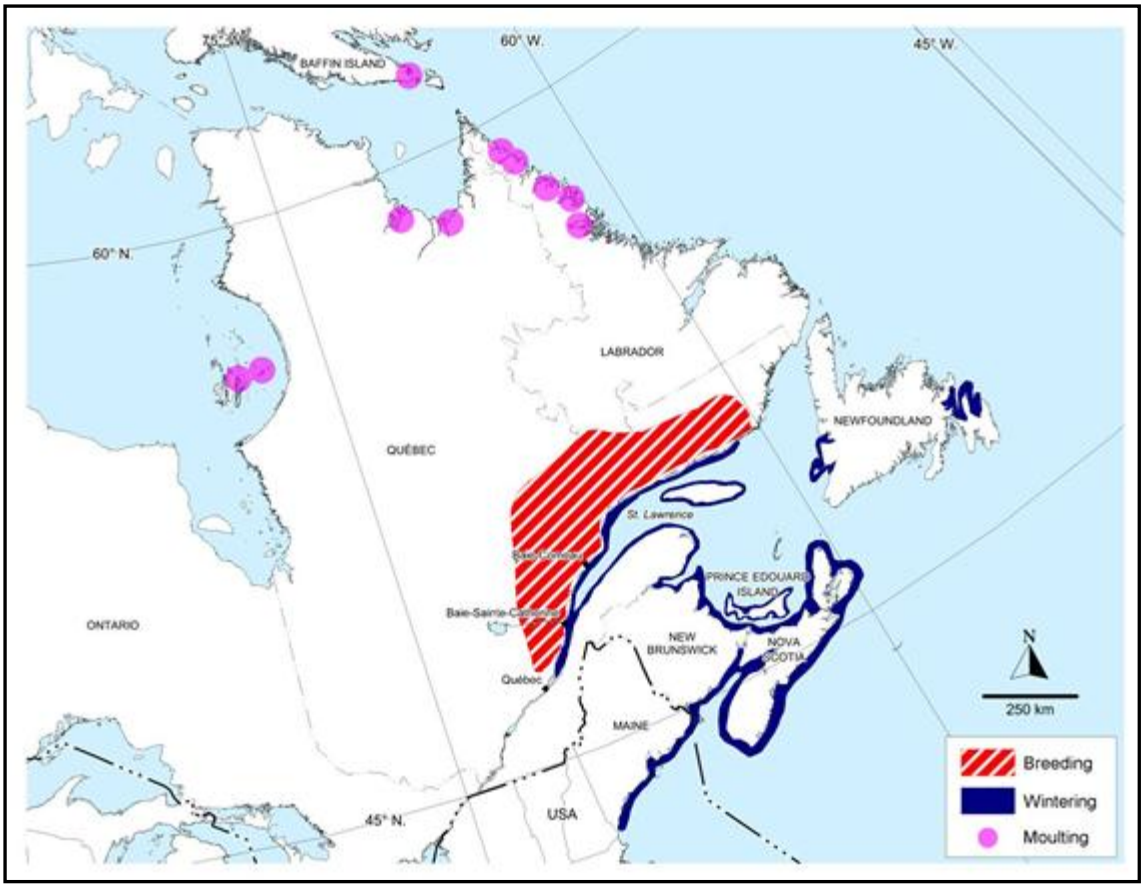


Figure 1. This figure shows the distribution of Barrow's Goldeneye, eastern population in Canada. It shows breeding, wintering and moulting locations for the eastern population of Barrow's Goldeneye in Canada. The solid shading indicates wintering areas, the striped shading represents breeding areas and the dots indicate moulting areas.

Proposed Management Plan for the Barrow's Goldeneye (*Bucephala islandica*), Eastern Population, in Canada

SUMMARY

This is a summary of the information provided in the proposed management plan for the Barrow's Goldeneye, eastern population. The Barrow's Goldeneye was listed as a species of special concern under the *Species at Risk Act* in 2000. It was re-assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2011 and its status as a species of special concern was confirmed.

Date of Assessment: May 2011

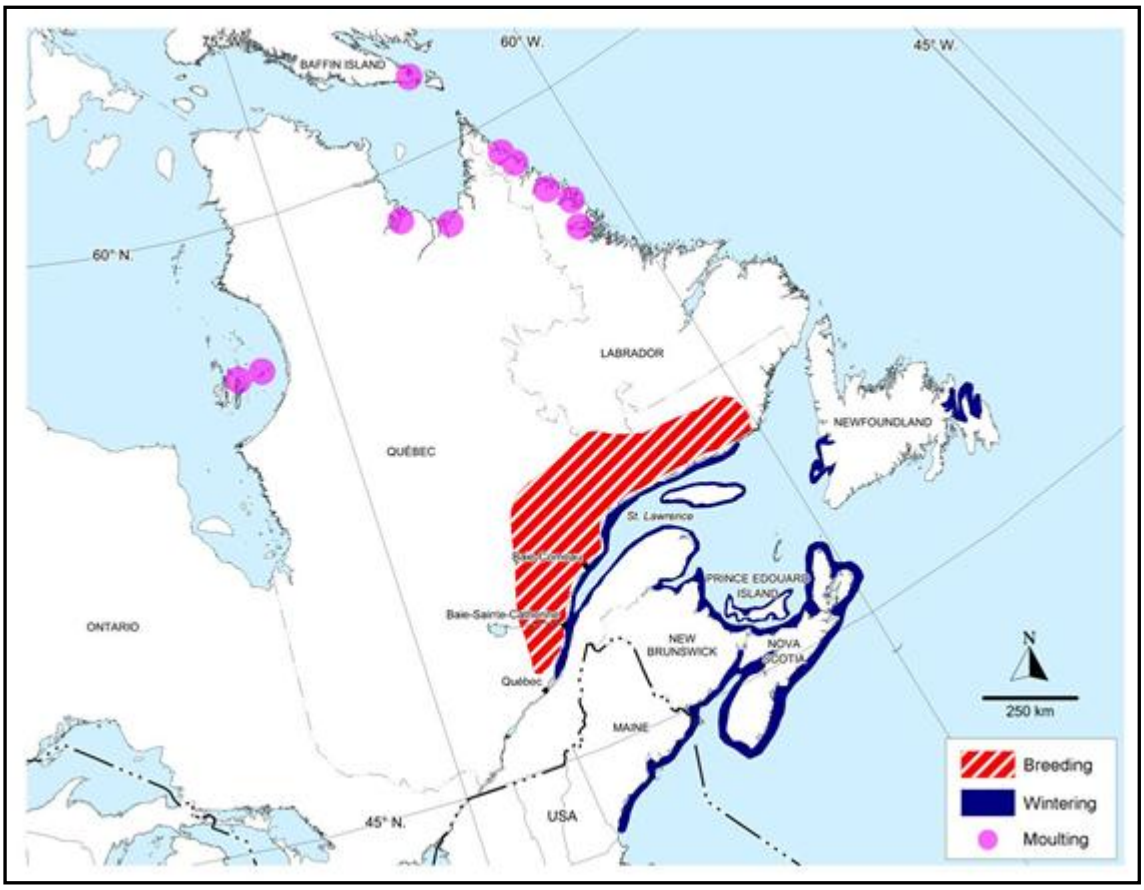
Common Name (population): Barrow's Goldeneye, Eastern Population

Scientific Name: *Bucephala islandica*

Reason for Designation: Numbers of individuals in this eastern population are limited. Although threats such as limited habitat availability and oil spill potential have been identified, none is currently at a scale that would impact negatively on the population.

Canadian Occurrence: Quebec, New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland and Labrador

COSEWIC Status History: Designated Special Concern in November 2000. Status re-examined and confirmed in May 2011.



This is Figure 2 from the proposed management plan. It shows breeding, wintering and moulting locations for the eastern population of Barrow's Goldeneye in Canada. The solid shading indicates wintering areas, the striped shading represents breeding areas and the dots indicate moulting areas.

There are three populations of Barrow's Goldeneye in the world: western North America, eastern North America and Iceland. This proposed management plan is for the eastern North American population only.

The proposed management plan is a plan that sets the goals and objectives for maintaining sustainable population levels for Barrow's Goldeneye, a species that is sensitive to environmental changes but is not in danger of becoming extinct.

This summary is based on the information in the full English version of the Barrow's Goldeneye management plan.

The original English copy of the proposed management plan has been provided to the Nunavut Wildlife Management Board for reference.

Information about Barrow's Goldeneye (pages 2-5)

This section of the proposed management plan for Barrow's Goldeneye provides some information about Barrow's Goldeneye such as what they look like, their population and distribution in Canada, nesting and wintering biology, and things that may limit their breeding densities.

- Barrow's Goldeneye is a sea duck. Adult males are black and white with a shiny purple head and a crescent-shaped white patch at the base of the bill. Females are brown and white and during winter and spring they have a bright orange bill.
- There are an estimated 6800 individuals in the eastern North American population.
- Barrow's Goldeneye nest in tree cavities.
- They breed north of the St. Lawrence Estuary and Gulf in the boreal forest of eastern North America, and winter in the St. Lawrence Estuary and Gulf.
- Barrow's Goldeneye do not nest or winter in Nunavut, but based on satellite telemetry, some adult males have been found to moult in the Arctic along the shores of eastern Hudson Bay and Ungava Bay and along the north coast of Labrador and the south coast of Baffin Island. Very little is known about the moulting grounds of females.
- They use small fishless lakes at high altitudes for mating and raising their young. Fishless lakes have more invertebrate species than lakes with fish, providing more food for Barrow's Goldeneye.

Threats to Barrow's Goldeneye (pages 6-8)

This section of the proposed management plan describes the things that might cause Barrow's Goldeneye populations to drop. In order of highest concern, there are five main threats to Barrow's Goldeneye:

- **Logging** – Loss of available trees for nesting in and poor quality habitat resulting from increased access to previously undisturbed (by humans) lakes that are now easy to access.
- **Fish stocking** – Introduction of fish in lakes that are normally fish-free reduces the amount of food available for Barrow's Goldeneye.
- **Oil spills** – Oil could get onto the sea ducks feathers and affect its ability to stay warm or cool and interfere with its ability to fly.
- **Hunting** - There are federal regulations for hunting Barrow's Goldeneye (i.e. bag limits and possession limits), however, on the breeding grounds and during the October hunting season in the St. Lawrence Estuary and Gulf, there is concern that because they look similar Barrow's Goldeneye may be accidentally shot by hunters of Common Goldeneye. There is no concern about harvest on their moulting grounds (i.e. in Nunavut).
- **Sediment contamination** – Barrow's Goldeneye are known to gather in areas where the sediment is contaminated. How this could affect Barrow's Goldeneye is not known.

Management Actions (pages 8-11)

The long-term objective of this management plan is to maintain and, if possible, increase the population size and range of the Barrow's Goldeneye, Eastern population, in Canada. In order to achieve this objective, the size of the population must be maintained for the next ten years at not less than 6800 individuals across the Canadian range of the population.

A number of actions have already been completed or are underway in an effort to meet the management objective, including: land management, protection of some fishless lakes, federal migratory bird hunting regulations, surveys of breeding and wintering birds, habitat surveys, articles written to create awareness for the general public, pamphlets and posters, etc.

Further actions are scheduled to be taken between 2011 and 2015:

- *Management, conservation and stewardship of the species and its habitat* – developing better forest management practices, prohibiting stocking of fishless lakes, introducing sustainable hunting practices, protecting important wintering, breeding and moulting grounds.
- *Research and monitoring* – breeding population monitoring, developing winter survey protocols, providing nesting boxes to increase nesting sites.
- *Outreach and communication* – develop materials to educate hunters, land managers and enforcement officers about Barrow's Goldeneye, conduct annual patrols to make sure bag and possession limits are being followed, involve key interest groups in efforts to reduce threats.

Success of the management objective will be evaluated every five years to determine if:

- In the long-term, the Canadian population and range of the Barrow's Goldeneye, Eastern population, are maintained and, if possible, increased.
- Over the next 10 years, the size of the population is maintained at not less than 6800 individuals throughout its Canadian range.

SUBMISSION TO THE

NUNAVUT WILDLIFE MANAGEMENT BOARD

FOR

Information: **Decision: X**

Issue: Sport hunting walrus with bow and arrow

Background:

Requests to use bow and arrows during the walrus sport hunt are not new to the walrus fishery. This issue has been brought to the Board's attention previously; in 2004, the Nunavut Wildlife Management Board decided to not allow the use of bows or cross bows in the walrus sport hunt (Resolution 04-096).

In recent years there has been renewed interest in using bow and arrows during the walrus sport hunt. Fisheries and Oceans Canada has received requests from both hunters and outfitters. In all instances the requests have been denied.

The Marine Mammal Regulations state the following:

Section 25. No person shall fish for walrus with a firearm unless the person uses

A) a rifle and bullets that are not full metal-jacketed that produce a muzzle energy of not less than 1,500 foot pounds; or
B) a shotgun and rifled slugs that produce a muzzle energy of not less than 1,500 foot pounds.

Fisheries and Oceans Canada has identified some concerns with using a bow and arrow during this type of hunting.

Concerns:

- Increased struck and lost rates because a walrus can switch to anaerobic respiration (without oxygen) for a short time period, giving the walrus an opportunity to flee and enter the water where it is likely to drown and less likely to be retrieved
- There is the potential for an arrow to penetrate through the animal increasing the risk of injuring more than one walrus with one shot
- A bullet to the head or neck area often results in a quick death of the animal, the subsequent shock to the brain also aids in quick death. With an arrow, there is no "shock" to the brain so a heart or lung shot is more likely to be used. This would lead bleeding and/or suffocating as the means to death which contravenes the Marine Mammal Regulation (MMR s.8) where "No person shall attempt to kill a marine mammal except in a manner that is designed to kill it quickly."

Recommendations:

Aside from the Marine Mammal Regulations, Fisheries and Oceans Canada would like the support of the Nunavut Wildlife Management Board on this decision to ensure that the walrus sport hunts are conducted in a way that supports responsible hunting methods. Fisheries and Oceans Canada recommends the Nunavut Wildlife Management Board permanently re-instate its 2004 decision to not allow the use of bows or cross bows in the walrus sport hunt and add the decision as a licence condition starting in the 2012 hunting season.

Prepared by: Fisheries Management and Science
Eastern Arctic Area, Central and Arctic Region
Fisheries and Oceans Canada

Date: January 30, 2012

SUBMISSION TO THE

NUNAVUT WILDLIFE MANAGEMENT BOARD

FOR

Information: **Decision: X**

Issue: Confederation Fiord Emerging Char Fishery Application

Background:

The Nattivak Hunters and Trappers Organization (HTO), Qikiqtarjuaq, NU have requested an exploratory licence for Arctic Char from the Confederation Fiord Area. The HTO is the applicant and has consulted with their membership and Fisheries and Oceans Canada (DFO). This briefing note and the attached fishing plan are being presented to the Nunavut Wildlife Management Board for decision.

According to the application and previous correspondence with the applicant Arctic Char are abundant in the four Confederation Fiord Lakes (Figure 1). Currently, there is minimal subsistence fishing that takes place in the area. The HTO feels that these lakes have the potential to develop into a viable commercial fishery.

Confederation Fiord Area:
The most current information available was provided by the community of Qikiqtarjuaq. Traditional and local knowledge, including current fisher reports, suggests that the proposed exploratory harvest level of 2000 kg in the attached fishing plan is reasonable. Furthermore, this initial harvest level is consistent with previous exploratory harvest levels recommended by DFO for other areas. The collection of information as per the five-year exploratory protocol would allow DFO science to evaluate harvest levels. DFO recommends the exploratory fishery begin with the 1st year of the 5-year approach due to the limited information currently available.

The five-year exploratory fishery protocol is intended to provide information on the viability of a fishery in a particular waterbody. The protocol requires effort be taken to annually harvest the full quota over the five-year period, and the collection of biological characteristics of the fish caught at,,a minimum, the start and at the end of the five-year period. Changes to the population structure following continuous harvest of the maximum quota may indicate that the harvest level is not sustainable. However, if the harvest over that period does not change indicators of population health, then the existing level of harvest is likely sustainable. Harvest of the full quota annually is necessary for this approach.

Recommendations:

Based on a review of the available information and science advice, DFO's view is there would be a moderate risk[1] of harm from fishing if the attached fishing plan was approved.

The fishery should be monitored to assess the effect of the exploratory fishery on the stock and the following conditions implemented:

- Each fishery should follow the exploratory fisheries five-year approach, with all samples and data being submitted annually to DFO-Science in Winnipeg, as per the Exploratory Licence;
- Minimum gillnet mesh-size of 5 ½ inches employed.

Consultations: DFO Central & Arctic Region
Nattivak Hunters' and Trappers' Organization
Parks Canada

Prepared by: Chris Lewis
Fisheries Management Biologist
Fisheries and Oceans
Eastern Arctic Area

Date: Feb. 3, 2011

Attachment 1:
Confederation Fiord Area Emerging Char Fishery Fishing Plan.

[1] Moderate risk: some information is missing which would allow for the assessment of the health of the stock. We think fishing at this level may not adversely affect the stock; however, it is very important to collect data from any harvest that occurs. It is also important to reassess the stock once biological data has been collected and analyzed.

ATTACHMENT:

CONFEDERATION FIORD AREA EMERGING CHAR FISHERY PLAN

LICENCE APPLICANT:
Nattivak Hunters' and Trappers' Organization (HTO), Qikiqtarjuaq, NU

PURPOSE:
To develop a sustainable commercial char fishery and promote economic opportunities for Inuit in Qikiqtarjuaq.

LOCATION & HARVEST LEVEL:

Waterbody	**Coordinates**	**Exploratory Harvest Level (kg)**
Confederation Fiord Area – 4 Lakes: (1): Ugallipaaq; (2): Qikiqtalik; (3): Akullipaaq; (4): Tasiujaq.	(1): 68°09'00"N 68°00'00"W; (2): 68°12'00"N 67°58'00"W; (3): 68°13'00"N 67°56'00"W; (4): 68°12'00"N 67°55'00"W.	2000 kg (total)

METHODS:
Fishing will take place during the winter months, ideally between February and April. The HTO will be the licence holder and as such will coordinate community members to fish the exploratory harvest level. The exploratory char fisheries five-year approach for collecting biological and catch-effort data will be followed. A minimum gillnet mesh-size of 5.5 inches will be employed. Any harvested Arctic Char that is exported across Nunavut's territorial borders will follow the prescribed direction by the Canadian Food Inspection Agency as directed by the "Fish Inspection Act" and "Fish Inspection Regulations."
Given that the Confederation Fiord Area is adjacent to Auyuittuq National Park, Parks Canada has also been contacted.

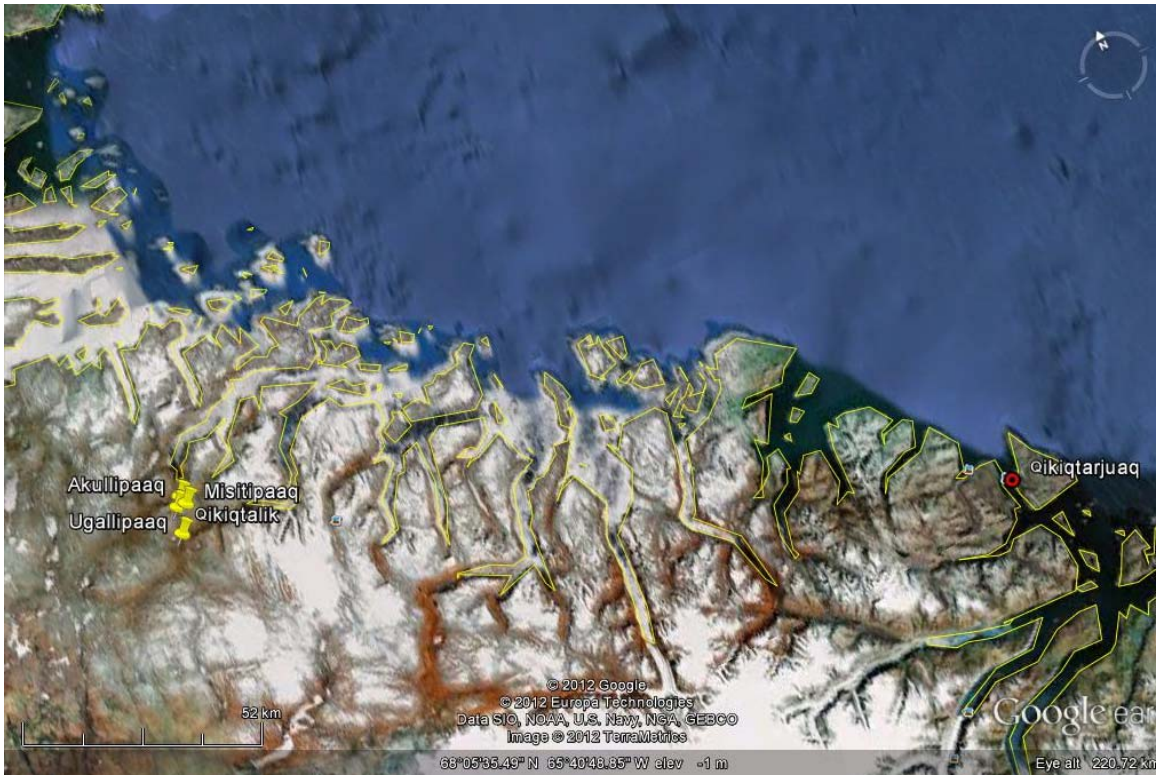


Figure 1. Locations of Confederation Fiord Area Lakes, Nunavut.

SUBMISSION TO THE

NUNAVUT WILDLIFE MANAGEMENT BOARD

FOR

Information: **Decision: X**

Issue: Conversion of Northern Shrimp fishery in Shrimp Fishing Area 2 east of 63°W from exploratory to commercial status

Background:

The Northern Shrimp (*Pandalus borealis*) fishery in Shrimp Fishing Area 2 (SFA2) east of 63°W (Fig. 1) was designated as an official exploratory fishery in 1999 even though fishing in the north end of the area started in the late 1970s. As per DFO's *New Emerging Fisheries Policy*, the objective of an exploratory fishery is to determine whether a species/stock can sustain a commercially viable operation and to collect biological data to build a preliminary database on stock abundance and distribution.

The Total Allowable Catch (TAC) for this area has been maintained at 3,500 tonnes (t) since 1999 and has sustained commercial fishing operations for the past thirteen years. The TAC has never been fully harvested with average annual catches ranging between 31t and 974t. Catch per Unit Effort varied without trend at a moderate level from 1999 to 2008/09 and increased significantly during the past two fishing seasons (2009/10 and 2010/11).

In SFA2 east of 63°W, research trawl surveys have been conducted annually since 2005 with plans for the survey to continue indefinitely. DFO Science assessed the status of shrimp populations in 2008, 2010, and 2011 and advice is available at the Canadian Science Advisory Secretariat website (http://www.isdm-gdsi.gc.ca/csas-sccs/applications/Publications/index-eng.asp). In each assessment, SFA2 east of 63°W was shown to have an actual exploitation rate (based on the catch taken in the fishery) of ~2% but a potential exploitation rate of ~11%. In comparison to other shrimp fishing areas within Canada, if all the current quotas were taken the exploitation rate would be considered conservative. There is sufficient biological data on *Pandalus borealis* abundance and distribution to indicate at present the harvest level is sustainable and the stock is healthy. Measures are in place to monitor the status of this exploited stock on an annual basis.

This fishery has completed the feasibility and exploratory stages of development as outlined in the *New Emerging Fisheries Policy* as well as some elements of the commercial stage (e.g. Integrated Fishery Management Plan in place). With a change in fishery status from exploratory to commercial, allocation holders in this fishery would continue to pay the prescribed access fee of $66.50 per tonne.

Consultations:
DFO will be presenting this proposal at the annual Northern Shrimp Advisory Committee (NSAC) meeting (March 8, 2012) in Montreal, Quebec. Nunavut industry, co-management partners and other stakeholders have all been invited. The NSAC recommendation will be forwarded to the Minister for decision.

Recommendation:
The NWMB approve the conversion of the Northern Shrimp (*Pandalus borealis*) fishery in Shrimp Fishing Area 2 (SFA2) east of 63^{o}W from exploratory to commercial status.

Prepared by:
Beth Hiltz, Fishery Management Coordinator, Resource Management, Winnipeg

Date: February 9, 2012

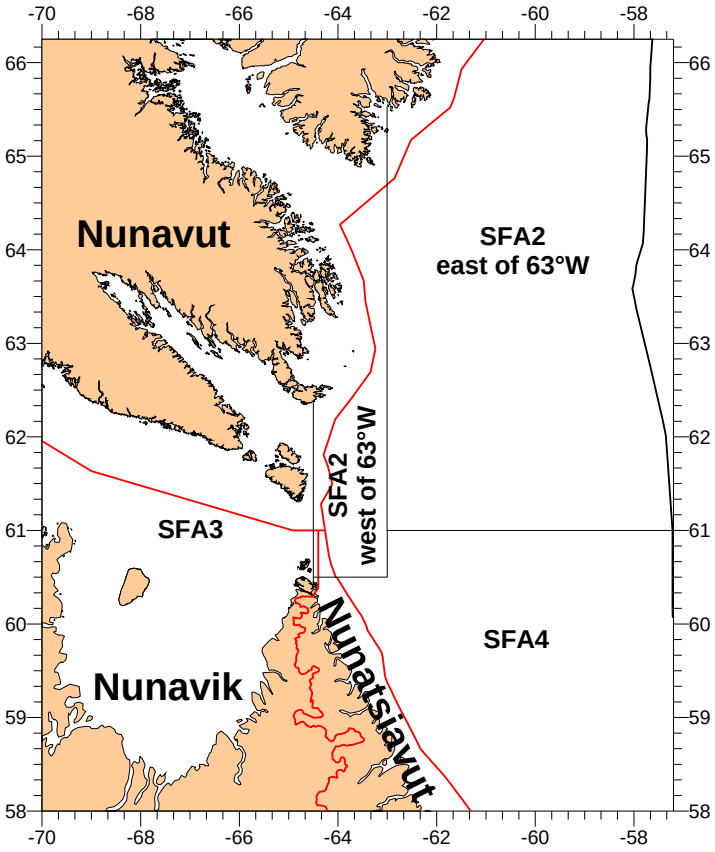


Fig. 1 Shrimp fishing areas (SFAs).

SUBMISSION TO THE

NUNAVUT WILDLIFE MANAGEMENT BOARD

FOR

Information: ____ **Decision: __X__**

Issue: Proposed co-management partner marine mammal struck and loss workshop (2012/2013 fiscal year)

Background: Co-management partners held a narwhal working group meeting held on February 6th-7th 2012 in Ottawa to discuss the 3rd draft of the narwhal Integrated Fisheries Management Plan (IFMP). At the meeting, there was a detailed discussion pertaining to reducing struck and loss[1]. NWMB staff suggested that a proposal could be put forth to the Board to consider holding a struck and loss workshop in Nunavut to address this management concern.

Struck and loss is perceived as a problem for hunters, managers and the public. It is clearly understood that hunters make all attempts to reduce struck and loss rates. However, in order to make sustainable management decisions when establishing or modifying total allowable harvests, the managers of the resource (i.e. NWMB, DFO, RWOs, HTOs) require reliable struck and loss information to inform these decisions.

The North Atlantic Marine Mammal Commission (NAMMCO) frequently holds workshops to address issues surrounding struck and lost in marine mammals, however there has never been a Nunavut forum to discuss issues and solutions. An NWMB funded workshop, in collaboration with Nunavut Tunngavik Incorporated (NTI) and Fisheries and Oceans Canada (DFO), would provide such a forum.

Recommendation: This proposal is at the very early stages of development, and the NWMB staff require direction from the Board on whether this is an initiative with which the Board would like to proceed.

The recommendation from NWMB staff is that the Board approve the following:

Draft Resolution:
RESOLVED that the NWMB approve:

1. A funding commitment of $100,000 to conduct a workshop in Nunavut on marine mammal struck and loss;
2. That the funding commitment be conditional on the following:

[1] Stuck and loss can be defined as the following: An animal is said to be "struck" when it is hit by a weapon (e.g. harpoon) or by a projectile (e.g. bullet). An animal is said to be "lost" when it either (a) is injured and escapes the hunter or (b) is killed but not landed or lost during the landing process.

a. The formation of a working group with NTI and DFO to prepare a draft agenda and discuss workshop participants;
b. The provision of a report to the NWMB following the workshop that identifies issues and recommendations on how to move forward with addressing marine mammal struck and loss management issue.

Consultations: Anna Magera, Fisheries Management Biologist, NWMB; Rebecca Jeppesen, Director of Wildlife Management;

Prepared By: Adam Schneidmiller, Wildlife Management Biologist, NWMB

Date: February 14th, 2012

SUBMISSION TO THE

NUNAVUT WILDLIFE MANAGEMENT BOARD

FOR

Information: ____ **Decision: __X__**

Issue: Nunavut Wildlife Management Board review of bowhead total allowable harvest (TAH)

Background: At the Nunavut Wildlife Management Board's (NWMB or Board) Regular Meeting No. 2011-004, the NWMB considered a request from Nunavut Tunngavik Incorporated (NTI) to extend the total allowable harvest (TAH) of three bowhead whales for 2012 and 2013, and recommended that the NWMB conduct a review of the three recommendations specified in the Board's March 11th 2009 decision (refer to Appendix 1 for the NWMB's resolution and recommendations).

After consideration of NTI's request the Board decided to proceed by requesting from relevant departments and organizations to provide their views with respect to NTI's request to extend the TAH of three bowhead whales per year for 2012 and 2013 and requesting that DFO and NTI provide a report with respect to the three recommendations from the NWMB's TAH decision. The invitation was issued on January 24th 2012 with a deadline for responses of February 24th 2012.

The NWMB received a written response from Fisheries and Oceans Canada (DFO) but did not receive written responses from NTI or the Regional Wildlife Organizations (RWOs). Although NTI did not provide a written submission it was communicated to NWMB staff over the phone and confirmed through email that NTI would provide responses to the NWMB's recommendations from its TAH decision verbally at the Board meeting. The DFO responses to the NWMB's recommendations are provided as appendices to this briefing note for Board consideration and are summarized below.

NTI's proposal to extend the TAH of three bowhead whales for 2012 and 2013

DFO: Supports NTI's proposal due to the extension being consistent with DFO's current science advice for the Eastern Canada-West Greenland (EC-WG) bowhead population, which considers the current harvests of bowhead whales by Nunavik and Greenland.

NWMB Recommendation #1 - development of sharing arrangements with Nunavik and Greenland

DFO: In response to a sharing arrangement with Greenland, it was noted that Canada is not a member of the International Whaling Commission (IWC), therefore there is currently no appropriate forum for management discussions with Greenland. DFO specified that once an appropriate forum is established, Canada and Greenland will begin to discuss shared stewardship of the EC-WG bowhead population. With respect to Nunavik, it was noted that DFO prefers that Nunavut Inuit (NTI) and Nunavik Inuit (Makivik) develop a sharing arrangement within the existing TAH for the EC-WG bowhead harvests.

NWMB Recommendation #2 - re-examination of current scientific information

DFO: In response to the re-examination of historic pre-commercial whaling estimates for the EC-WG bowhead population, DFO provided a recent scientific publication entitled "Commercial and subsistence harvests of bowhead whales in Eastern Canada and West Greenland" (Higdon, 2010). The main conclusion of the report is that it estimates that a combined harvest from all sources during the years 1520 to 2009 results in a total estimated removal of 70,000 bowhead whales, with most (88%) being taken by commercial whalers[1]. This estimate does not include struck and lost whales or known gaps for certain nations/areas,

In response to the reconciliation of current population estimates, DFO indicated that its estimate remains unchanged and is consistent with the IWC's estimate. DFO further indicated that it has initiated a process to update the existing abundance estimate (currently scheduled to be available in 2015) and will reassess the advice regarding the TAH for the population following the review of the abundance estimate.

NTI: To provide verbal response at the Board meeting.

NWMB Recommendation #3-NTI continue to ensure that necessary equipment and training is available

NTI: To provide verbal response at the Board meeting.

Recommendations: Responses provided by DFO and the submission provided by NTI from RM 2011-004 indicate support for maintaining the current TAH of three bowheads for the Nunavut Settlement Area for the next two years. If the NWMB is satisfied with the reports provided and the review conducted through this briefing, then there is no requirement for the NWMB to modify its March 11th 2009 decision. However, the Board should provide a resolution

[1] The publication does not specifically address the recommendation from the NWMB (i.e. provision of pre-commercial whaling estimates) as the publication only provides an overview and estimate of the total removal of bowheads from 1530-2009. There is still the requirement

indicating that it has completed its review following the 2011 harvesting season and will not be modifying its March 11th, 2009 decision.

Draft Resolution:

> *"RESOLVED that upon the review and consideration of reports and submissions following the 2011 harvest season regarding the total allowable harvest (TAH) for the Eastern Canada-West Greenland (EC-WG) bowhead population in the Nunavut Settlement Area (NSA), the NWMB has decided to not modify the TAH for the EC-WG bowhead population (3 whales annually) in the NSA."*

Consultations: Anna Magera, Fisheries Management Biologist, NWMB; Rebecca Jeppesen, Director of Wildlife Management;

Prepared By: Adam Schneidmiller, Wildlife Management Biologist, NWMB

Date: February 24th, 2012

APPENDIX 1: NWMB resolution and recommendations concerning the total allowable harvest for bowhead whales in the Nunavut Settlement Area (March 11th 2009)

RESOLUTION:

"*RESOLVED that the NWMB establish an annual total allowable harvest of three bowhead whales for the NSA –to be reviewed following the 2011 harvesting season –which will restrict Inuit harvesting only to the extent necessary: (a) to effect the valid conservation purpose of continuing the successful restoration and revitalization of the depleted population of Eastern Canada –West Greenland bowhead whales (Sections 5.3.3 (a) and 5.1.5 (d) of the Nunavut Land Claims Agreement (NLCA); and (b) to provide for public safety (NLCA S 5.3.3 (c)).*"

RECOMMENDATIONS:

1. That the Department of Fisheries and Oceans (DFO) and Nunavut Tunngavik Incorporated (NTI) engage in appropriate discussions –and work towards reaching agreements –with neighboring jurisdictions (Nunavik and Greenland) concerning both the sharing and the responsible stewardship of the Eastern Canada – West Greenland bowhead whale population;

2. That DFO continue in its efforts to: (a) re-examine –in light of new information –the historic, pre-commercial whaling population numbers for the Eastern Canada –West Greenland bowhead whale population; and (b) seek a reconciliation of its current population estimates with those of the International Whaling Commission;

3. In anticipation of potential future increases in the TAH, NTI continue to ensure that necessary equipment and training needs keep pace with the number of hunts undertaken in the NSA.

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Nunavunmi Anngutighatigut Aulapkaijitkut Katimajiat
Nunavut Wildlife Management Board

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Tammaqtailinahuarniriit anngutighat atuqhugit Inuit qaujimajatuqangillu ilihimaniillu ilitquhiannin
Conserving wildlife through the application of Inuit Qaujimajatuqangit and scientific knowledge

January 24th, 2012

Hon. Keith Ashfield Minister of Fisheries & Oceans Government of Canada	Cathy Towtongie President Nunavut Tunngavik Inc.	James Qillaq Chairperson of the Qikiqtaaluk Wildlife Board
Ross Tatty Chairperson of the Kivalliq Wildlife Board	Lucassie Nakoolak A/Chairperson of the Kitikmeot Regional Wildlife Board	

Re: Nunavut Wildlife Management Board review of bowhead total allowable harvest

Dear co-management partners,

In 2009, the Nunavut Wildlife Management Board (NWMB or Board) recommended the establishment of an annual total allowable harvest of three for bowhead whales for the Nunavut Settlement Area (NSA) and this decision was accepted by the Minister.[1] To reiterate the Board's March 11, 2009 decision was the following:

> *"RESOLVED that the NWMB establish an annual total allowable harvest of three bowhead whales for the Nunavut Settlement Area –to be reviewed following the 2011 harvesting season –which will restrict Inuit harvesting only to the extent necessary:*
> *(a) To effect the valid conservation purpose of continuing the successful restoration and revitalization of the depleted population of Eastern Canada – West Greenland bowhead whales (Sections 5.3.3 (a) and 5.1.5 (d) of the Nunavut Land Claims Agreement (NLCA)), and*
> *(b) To provide for public safety (NLCA S 5.3.3(c))."*

In addition to the Board's decision, the NWMB made the following three recommendations:

1. The Department of Fisheries and Oceans (DFO) and Nunavut Tunngavik Inc. (NTI) engage in appropriate discussions – and work towards reaching agreements – with neighboring jurisdictions (Nunavik and Greenland) concerning both the sharing and the responsible stewardship of the Eastern Canada – West Greenland bowhead whale population;

2. DFO continue in its efforts to:
    a. re-examine – in light of new information –the historic, pre-commercial whaling population numbers for the Eastern Canada – West Greenland bowhead whale population; and

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[1] Refer to Appendix 1 for March 11th 2009 NWMB decision concerning the level of total allowable harvest for the Eastern Canada – West Greenland bowhead whale population in the Nunavut Settlement Area and Appendix 2 for April 29th 2009 Ministerial acceptance of the Board's decision;

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b. seek a reconciliation of its current population estimates with those of the International Whaling Commission; and

3. In anticipation of potential future increases in the TAH, NTI continue to ensure that the necessary equipment and training needs keep pace with the number of hunts undertaken in the NSA.

At Regular Meeting (RM) No. 004-2011, held December 7th in Iqaluit, NTI submitted a request for the NWMB to extend the TAH of three bowhead whales per year for 2012 and 2013, and recommended that the NWMB conduct a review of the recommendations specified in its March 11th 2009 TAH decision[2].

After careful consideration, the NWMB requests that your department or organization provide your views with respect to NTI's recommendation to extend the TAH of three bowhead whales per year for 2012 and 2013. Furthermore, the NWMB is requesting that DFO and NTI provide a report with respect to the three recommendations in the NWMB's March 11th 2009 TAH decision.

All submissions must be provided in English and Inuktitut to the NWMB by no later than **5:00 p.m. on February 24th 2012**. Submission can be made in person, by courier or by mail. If sending by fax or electronically (i.e. by email), please confirm by phone with the NWMB to ensure that a complete and legible copy of the transmission has been received by the Board. Electronic submissions should be sent to the following email address: receptionist@nwmb.com.

Following receipt of reports from all co-management partners, the NWMB will conduct a comprehensive review and will report to all co-management partners the results of its review.

If you require any further information or if you have any questions or concerns, please do not hesitate to contact the NWMB.

Yours sincerely,

Mikidjuk Akavak
Chairperson of the
Nunavut Wildlife Management Board

cc. Gabriel Nirlungayuk, Director of Wildlife, Nunavut Tunngavik Incorporated
Glenn Williams, Wildlife Advisor, Nunavut Tunngavik Incorporated
Eric Kan, Area Director-Eastern Arctic Area, Department of Fisheries and Oceans

[2] Refer to Appendix 3 for NTI's submission to Regular Meeting No. 004-2011;

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Nunavut Wildlife Management Board

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Tammaqtailinahuarniriit anngutighat atuqhugit Inuit qaujimajatuqangillu ilihimaniillu ilitquhiannin
Conserving wildlife through the application of Inuit Qaujimajatuqangit and scientific knowledge

March 11, 2009

NWMB - SENT e-mailed
DATE: Mar. 12/09 JJ

The Honourable Gail Shea
Minister of Fisheries and Oceans
15th Floor, Centennial Tower
200 Kent Street
Ottawa, Ontario
K1A 0E6

Dear Ms. Shea:

Re: Decision by the Nunavut Wildlife Management Board concerning the level of total allowable harvest for the Eastern Canada – West Greenland bowhead whale population in the Nunavut Settlement Area

NWMB decision and recommendations:
On February 10th 2009, the Nunavut Wildlife Management Board (NWMB or Board) held a public hearing in Iqaluit, Nunavut, to consider the proposed removal of the level of total allowable harvest (TAH) for bowhead whales in the Nunavut Settlement Area (NSA). After having taken into careful account the reliability and persuasiveness of both the written and oral evidence submitted, the NWMB unanimously approved the following resolution:

"*RESOLVED that the NWMB establish an annual total allowable harvest of three bowhead whales for the Nunavut Settlement Area – to be reviewed following the 2011 harvesting season – which will restrict Inuit harvesting only to the extent necessary:*

(a) to effect the valid conservation purpose of continuing the successful restoration and revitalization of the depleted population of Eastern Canada – West Greenland bowhead whales (Sections 5.3.3(a) and 5.1.5(d) of the Nunavut Land Claims Agreement (NLCA)), and

(b) to provide for public safety (NLCA S.5.3.3(c))."

In addition to its decision, the NWMB made the following three recommendations:

1. The Department of Fisheries and Oceans (DFO) and Nunavut Tunngavik Inc. (NTI) engage in appropriate discussions - and work towards reaching agreements - with neighboring jurisdictions (Nunavik and Greenland) concerning both the sharing and the responsible stewardship of the Eastern Canada – West Greenland bowhead whale population;

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2. DFO continue in its efforts to:
   (a) re-examine - in light of new information - the historic, pre-commercial whaling population numbers for the Eastern Canada – West Greenland bowhead whale population; and
   (b) seek a reconciliation of its current population estimates with those of the International Whaling Commission; and

3. In anticipation of potential future increases in the TAH, NTI continue to ensure that necessary equipment and training needs keep pace with the number of hunts undertaken in the NSA.

Preliminary factors considered by the NWMB:
In making its decision, the Board took into account the following preliminary factors:

1. At NWMB Special Meeting No. 11 (July 6-7, 2005), based upon recommendations from NTI, the Board approved several equipment modifications – for reasons of public safety - to the *Naujaat Aviq Hunt Plan* for the 2005 Repulse Bay bowhead hunt. Among those modifications was the following requirement: "*The new harpoon darting guns and Penthrite 'Super Bomb' Grenades be used exclusively as the primary method of harvest, and there be no use of a shoulder gun in the hunt*" (NWMB Resolution 2005-068). That safety requirement was also followed in the 2008 hunts.

2. At NWMB Regular Meeting No. 51 (April 24-26, 2007), NTI publicly presented and recommended *Bowhead Whale Hunt Plan Guidelines*, which included "*Primary killing equipment (harpooning equipment) that will deploy an exploding device...*"

Evidence and arguments considered:
In making its decision pursuant to NLCA Sections 5.3.3(a) and (c), the NWMB carefully reviewed all of the evidence and arguments presented to it, including the following:

Size of the Eastern Canada – West Greenland bowhead whale population

(a) In 2007, DFO concluded that the Eastern Arctic bowhead whale population is most likely part of a single population known as the Eastern Canada – West Greenland bowhead whale population, shared by Nunavut, Nunavik and Greenland. (DFO, NWMB February 10th 2009 Bowhead Whale Hearing Transcript (Transcript), p.71, lines 16-24)

(b) The estimate of the population of Eastern Canada – West Greenland bowhead whales is somewhere between a low of approximately 5,000 and an estimated high of 43,000 whales. (DFO, NWMB February 10th 2009 Bowhead Whale Hearing Binder (Binder), Tab 8, p.1 and Tab 9, p.2); NTI, Transcript, p.25, lines 4-8)

(c) DFO's most recent fully corrected partial population estimate for the Eastern Canada – West Greenland bowhead whale population is 14,400 whales (CI 4,811 – 43,105). (DFO, Binder, Tab 8, p.1, and Tab 9, p.2; DFO, Transcript, p.73, lines 7-9)

(d) NTI does not dispute the DFO population estimate of approximately 14,000 animals in the Eastern Canada – West Greenland bowhead whale population. (NTI, Transcript, p.65, lines 10-13)

(e) DFO carried out surveys in 2002, 2003 and 2004. However, because bowheads are so mobile, "*...we got concerned about the fact if you start adding the numbers that you see in different years, you might be counting the same animals more than once. So in effect because of that we only used the areas that had yielded the highest numbers in one particular year, which was 2002.*" (DFO, Transcript, p.80-81, and p.82, lines 19-25)

(f) Among the areas not covered in the 2002 survey are Repulse Bay, Coral Harbour, Cumberland Sound, Hudson Strait, Igloolik, Hall Beach, Isabella Bay (Igaliqtuuq) and Kimmirut. (NTI, Transcript, p.130, lines 15-26, and p.131, lines 1-12)

(g) DFO does not deny that a number of areas were not included in the survey, but it did estimate numbers in other regions, and those numbers are in the 1,000 to 2,000 range. (DFO, Transcript, p.132, lines 10-16)

(h) "*...even though it's a partial coverage, the estimate of 2002 does cover the areas with the highest densities of bowheads and therefore is not that far off from the total number. But I could be wrong.*" (DFO, Transcript, p.133, lines 4-8)

(i) DFO is of the view that its population estimate is not very precise – "*...you're pretty damn certain that there's 4,300 whales. The mean estimate, which is 14,4, you're about 50 percent confident that there's at least that number in nature out there. And then as you get to the lower end your confidence is tiny. 43,000 – you have virtually no confidence in that number, maybe 5 percent – 2.5 percent actually.*" (DFO, Transcript, p.83, lines 4-19, and p.85, lines 8-16)

(j) "*There is continued discussion, both nationally and internationally, on the appropriate analytical method to estimate the abundance of the eastern Canada – west Greenland bowhead population. These discussions have produced a range of abundance estimates over the past three years.*" (DFO, Transcript, p.73, lines 1-7)

(k) The DFO population estimate was presented to IWC scientists who disagreed with it, and were concerned about over-estimation "- *they took our data and revised it completely and came up with their own estimate, which gives a mean*

estimate of 6,000 animals. And they used that to assign the quota to Greenland, and strike limit. So once we saw that we went ahead and looked at their concerns and are presently working on a reanalysis of that to see if there's some improvements that can be made that would make it more acceptable to the IWC Scientific Committee..." (DFO, Transcript, p.107, lines 5-12, and 16-25)

(l) The contribution made by Inuit to the conservation status of bowhead whales is the *Inuit Bowhead Knowledge Study* (IBKS), which was contradictory to the science at the time of its release [2000], but which has stood the test of time better than the scientific information. In fact, science has now caught up with the traditional knowledge (NTI, Transcript, p.36, lines 1-25; DFO, Transcript, p.78, lines 18-26, and p.79, line 1)

(m) The NWMB should look at the strengths and weaknesses of both the IBKS and the scientific study, because there are pros and cons to each. (NTI, Transcript, p.42, lines 17-21)

(n) "*Right now we observe many bowhead whales, and sometimes when you go out boating you get concerned because your boat might be toppled over by the bowhead whale. And since the last survey the bowhead whale population has increased drastically...*" (Pangnirtung Elder, Transcript, p.148, lines 10-15)

Proposed *Potential Biological Removal* for the bowhead whale population

(o) "*Potential biological removal* [PBR] *is the maximum number of whales that can be removed by all human-induced mortality – for example, hunting, net entanglement, ship strikes – and still ensure continued recovery of the population.*" (DFO, Transcript, p.74, lines 1-6)

(p) Given the high level of uncertainty with the present estimates of both the current and the pre-commercial whaling population size, DFO recommends a potential PBR of 18 whales from this population. "*DFO research will continue towards refining the various factors used in estimating abundance.*" (DFO, Transcript, p.74, lines 19-25. p.76, line 26, and p.77, lines 1-2)

(q) NTI does not endorse the PBR that is set at 18 whales. This is an ultra-conservative number. If such a process were used for polar bears, the quota would be 24 bears. In fact, the polar bear TAH is approximately 500 bears (NTI, Transcript, p.26, lines 4-5, and p.27, lines 1-8)

(r) "*...this* [PBR] *is not necessarily ultraconservative. I think it is precautionary... it's an accepted method...if you utilized the current COSEWIC status recommendation of threatened, then your recovery factor in the equation would be .3 and not .1*" (NTI Transcript, p.45, lines 4-6, and p.46, lines 10-13)

(s) Currently, the total Inuit harvest from this population is five per year – 3 (planned) by Nunavut, 1 by Nunavik and 1 by Greenland. The PBR is more than three times the current harvest level. (NTI, Transcript, p.29, lines 9-17)

(t) The population would presumably continue to recover even if the PBR was calculated at 90 whales, but that recovery would be much slower – probably 100 years (DFO, Transcript, p.111, lines 17-20)

Level of recovery of the bowhead whale population

(u) The estimated historic population was 11,500 bowhead whales. "*...it appears from the scientific information that you do not have a depleted population because the current DFO population estimate is 14,400 whales*". [NLCA S.5.1.5(d)] (NTI, Transcript, p.30, lines 21-26, and p.31, lines 1-2)

(v) Although NTI has not consulted with enough Inuit to say whether bowheads have recovered to historic levels, at least some Inuit feel that they have recovered. In any case, the information before the NWMB is that the population has recovered, and Inuit are not disputing that. (NTI, Transcript, p.38, lines 17-24, and p.39, lines 17-19)

(w) If one were to take a precautionary approach, and look more towards the lower end of the confidence interval (5,000 to 9,000 whales), then the population is in a recovery stage. (NWMB, Transcript, p.49, lines 23-26)

(x) "*...currently the calculation of the potential biological removal rate is one that accommodates a continuing recovery. So it's basically irrelevant whether the population has recovered or it hasn't recovered...*" (NTI, Transcript, p.170, lines 2-6)

(y) "*Is the population recovered or not? Well, as you can see from the numbers, if you believe it's at 14,4 and you believe the recovery target is as stated in the recovery potential assessment which is, by the way, an old document ...then you would say, yeah, the population is recovered. But in fact if you want to have a lot of certainty about the recovery you have to look up here in the lower confidence intervals. So at 4,000, the population is not recovered.*" (DFO, Transcript, p.89, lines 22-26, and p.90, lines 1-8)

(z) The pre-commercial population size estimate is currently being revised, as researchers have discovered new whaling logs indicating more whales were killed during the commercial period. "*...this information has gone to the IWC for review, and it will probably generate some new estimate of pre-commercial population size.*" (DFO, Transcript, p.101, lines 13-22)

Public safety considerations with respect to bowhead hunts

(aa) About five years ago, a working group of experienced Inuit hunters and whaling captains began to work with a professional, having expertise in the

manufacturing of arms, to design "*...a piece of equipment for deploying the new Penthrite grenades that were designed by the Alaska Whaling Commission. And we've purchased three sets of this equipment...*" That's one set for each of three hunts. (NTI, Transcript, p.55, lines 11-20, and p.57, line15)

(bb) Training is provided to each whaling captain and crew in the safe handling and deployment of the new equipment, as well as with respect to the anatomy of bowhead whales. (NTI, Transcript, p.63, lines 5-12)

Threats to the bowhead whale population

(cc) The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessed bowhead whales as threatened in 2005. While COSEWIC is planning a reassessment in 2009, this bowhead population should – in the meantime - still be considered as threatened.(DFO, Transcript, p.71, lines 13-16, and p.73, lines 10-16)

(dd) Changes in the Arctic environment will likely result in an increase in the use of large vessels used for commercial ventures such as tourism, fishing and mining operations. The potential for ship collisions could increase as ships more frequently traverse important bowhead areas. "*...it's well-documented that the nearest cousin to the bowhead, the right whale, has frequent accidents with large ships, especially ships like the ones used by mining companies...*" (DFO, Transcript, p.74, lines 23-26, and p.75, lines 1-4, and p.94, lines1-4)

(ee) The experience with right whales becoming entangled in seal or beluga nets and dying suggests the same possibility for bowheads. (DFO, Transcript, p.99, lines 24-26, and p.100, lines 1-7)

Level of total allowable harvest for the bowhead whale population

(ff) Based upon a PBR of 18 and the proposal (by Nunavut, Nunavik and Greenland) to take only 5 whales, "*...it would appear that we do have a vital, healthy population that can sustain the current harvest.*" [NLCA S.5.1.5(c)] (NTI, Transcript, p.30, lines 6-12)

(gg) "*Based on this information* [the abundance of bowhead whales and current Inuit harvesting levels] *and the objectives of the NLCA, NTI on behalf of Inuit of Nunavut respectfully submits that there is no valid conservation purpose, public health or public safety reason to have a TAH on bowhead whales in the NSA...*" (NTI, Binder, Tab 3, p.2)

(hh) "*Until there is more certainty in the current and historic population estimates, DFO is of the view that NWMB should continue to set a short-term total allowable harvest for bowhead whales in the Nunavut Settlement Area.*" (DFO, Transcript, p.75, lines 5-9)

(ii) "*NTI and the Wildlife Policy Advisory Committee, which is the chairs and co-chairs of the three RWOs, have indicated that for the next five years the needs level for Inuit in Nunavut is three whales a year, and plans and preparations are being made to organize and equip three hunts a year. WPAC also supports the continuation of a community hunt plan as a requirement prior to the hunts being done. Inuit are also committed to continuing to use best equipment available to do the hunts, and in the last four hunts we've been using new equipment that is more efficient and more effective.*" (NTI, Transcript, p.27, line 19-26, and p.28, lines 1-6)

(jj) "*...there currently is no quantitative limit on bowhead whales anywhere in Canada outside the NSA.*" (NTI, Transcript, p.52, lines 25-25, and p.53, line1)

(kk) "*...We do know what would happen when there is no TAH because that's what happens in Nunavik. Nunavik does not have a TAH. Their hunt is not out of control, it's not unregulated, it's not unorganized. It's a hunt very similar to the ones that we do here in Nunavut...*" (NTI, Transcript, p.171, lines 5-10)

(ll) "*...the quantitative limit for Nunavik Inuit... is one. The quantitative limit for Greenland Inuit ... is one per year... with everyone, I think, being allowed to have two strikes. When you're actually looking at potential removal you have to double whatever everybody is taking to be on the cautious side of things.*" (NWMB, Transcript, p.54, lines 11-20; see also DFO, Binder, Tab 8, p.2)

(mm)"*...all the harvests in Nunavut have never had a lost animal. All the animals that have been struck have been landed.*" (NTI, Transcript, p.56, lines 5-7)

(nn) If there is no TAH, there is still a requirement to obtain a licence to hunt a bowhead whale. In addition, "*...5.7.6 of the Land Claims Agreement gives the RWOs the authority to self-regulate the harvesting of their HTOs, which would mean that the RWOs are still requiring the use of the equipment that we're using, that they're requiring a hunt plan that comes from the community, the proper preparation, the proper equipment and the proper training before these hunts are done...*" (NTI, Transcript, p.154, lines 21-26, and p.155, lines 1-7)

(oo) "*Once we remove the TAH it's going to be a free-for-all for each of the communities. Have you considered whether it's going to improve the system if you remove the total allowable harvest...If you want to be considering removal, I would like you to seriously consider the consequences...*" (Qikiqtaaluk Wildlife Board (QWB), Transcript, p.138, lines 16-26)

(pp) A community-based management system for bowhead whales could be used, similar to the one currently in place for other whales. "*...Because as I stated before, that the quota system actually causes overhunts, and perhaps you can put a quota on just to make sure, keep them down before we actually come up*

with the community-based management for bowhead whale hunt." (QWB, Transcript, p.161, lines 14-21)

(qq) If Inuit harvest too many bowhead whales, the meat and the blubber would be wasted. The whole whale should be utilized. (Pangnirtung and Repulse Bay Elders, Transcript, p.162, lines 7-13, and p.164, lines 11-17)

Agreements with other jurisdictions concerning the bowhead whale population

(rr) One of the stumbling blocks in this process is that there is no representation in the hearing process by Greenland and Nunavik. (QWB, Transcript, p.69, lines 3-9)

(ss) DFO has not initiated any discussions with Greenland in terms of sharing arrangements for this bowhead population. (DFO, Transcript, p.128, lines 9-15)

(tt) DFO recommends that the NWMB and its Nunavik counterpart [the NMRWB] engage in discussions to decide upon a bowhead sharing arrangement between the two jurisdictions/land claim areas. (DFO, Transcript, p.117, lines 22-26, and p.118, lines1-9)

(uu) NTI and Makivik have been working very closely for approximately two years concerning bowhead harvesting, but NTI does not see the necessity for a formalized agreement since there appear to be more bowheads available than both Inuit groups are prepared to harvest. (NTI, Transcript, p.64, lines 11-13 and 19-23)

International concerns with respect to Canada's management of the bowhead whale population

(vv) A significant increase in or removal of the TAH may attract unwanted international attention, and may even provoke other nations to impose sanctions on Canada – especially considering the current COSEWIC designation of threatened. (DFO, Transcript, p.75, lines 16-26, and p.75, lines1-3)

(ww) Negative international perceptions and potential international criticism are not permissible grounds under the NLCA for either the NWMB or the Minister to justify limitations on harvesting bowhead whales. (NTI, Transcript, p.31, lines 9-16)

(xx) To remove the TAH would give the impression that Canada would increase its take of bowhead whales – "*Canada would appear to be setting a precedent for allocation before any sharing arrangement had been developed between Canada and Greenland.*" (DFO, Transcript, p.76, lines 7-15)

Conclusions:
In carrying out its deliberations, the NWMB carefully considered the written and oral arguments and evidence put forward by NTI that the Board should entirely remove the TAH for bowhead at this time – including that:

- DFO's population estimate for the Eastern Canada – West Greenland bowhead whale population is 14,400 whales;
- The IBKS supports the position that the population has significantly increased in recent decades;
- The DFO-endorsed PBR of 18 is more than three times higher than the proposed annual take of 5 whales by Nunavut, Nunavik and Greenland;
- Because the PBR accommodates a continuing recovery, it is irrelevant whether the population has recovered or not;
- The PBR could arguably be calculated at a considerably higher level than 18;
- Inuit are committed to responsibly and safely carrying out each hunt;
- There is no quantitative limit on bowhead whales in Nunavik;
- Even without a TAH, there would still be a legal requirement to obtain a licence for each bowhead hunt; and
- International concerns and criticisms are not permissible grounds under the NLCA to justify limitations on harvesting bowhead whales.

At the same time, and just as carefully and conscientiously, the Board fully considered the arguments and evidence presented by DFO and the other parties who participated in the hearing process.

In reaching its decision, the NWMB found the following arguments and evidence to be particularly reliable and persuasive:

- Bowhead whales hunted in Nunavut waters belong to a single population known as the Eastern Canada – West Greenland bowhead whale population, shared by Nunavut, Nunavik and Greenland;
- The population estimate for the Eastern Canada – West Greenland bowhead whale population is not precise – between 4,811 and 43,105 whales – with higher confidence at the lower end of the confidence interval;
- The estimate of the International Whaling Commission Scientific Committee is 6,000 animals;
- DFO is currently working on a re-analysis of its data, to see if improvements can be made;
- Both the IBKS and scientific surveys are in agreement that the Eastern Canada – West Greenland bowhead whale population has increased dramatically from the low levels that persisted for a considerable length of time following the commercial whaling era;
- The estimated pre-commercial population of 11,500 whales is being seriously re-examined, following the discovery of new whaling logs indicating more whales were killed during the commercial period – and a new estimate is likely to be generated;

- Given the high level of uncertainty with the present estimates of both the current and the pre-commercial whaling population size, it is not advisable at this time to conclude that the Eastern Canada – West Greenland bowhead whale population has recovered;
- For the next five years, the needs level for Nunavut Inuit is three bowhead whales a year;
- In terms of potential removal through hunting, up to four strikes per year are permitted for Nunavik (two strikes, one landing) and Greenland (two strikes, one landing), and up to six strikes are permitted for 2009 (Greenland – four strikes, two landings – due to no hunt in 2008);
- In combination with Nunavut's proposed three hunts (six strikes, three landings), the total potential removal from the population through hunting – while very unlikely - would be up to ten whales per year (twelve in 2009);
- Ship collisions and gear entanglement are potential threats to bowhead whales, that may result in occasional accidental deaths;
- Inuit are committed to responsibly and safely carrying out each hunt, and have in place three sets of the equipment necessary to deploy the new Penthrite grenades – one set for each of three hunts;
- There are quantitative limits on bowhead whale hunting in both Nunavik and Greenland;
- International concerns and criticisms are not permissible grounds under the NLCA to justify limitations on Inuit harvesting of bowhead whales; and
- No sharing arrangements have yet been developed between Nunavut and Nunavik, or between Canada and Greenland, concerning the Eastern Canada – West Greenland bowhead whale population.

Based upon its careful consideration of all the arguments and evidence received, the NWMB has concluded that a precautionary approach is required in the circumstances. Because the Eastern Canada – West Greenland bowhead whale population has increased so dramatically, the Board is confident that its precautionary approach can reasonably accommodate a Nunavut harvest that entirely satisfies the needs level for Nunavut Inuit, as formally identified by NTI, and the Chairs and Co-chairs of the three Regional Wildlife Organizations.

A limitation of three whales – with the TAH of three permitting up to two strikes per harvest attempt (six strikes in total) – will restrict Inuit harvesting only to the extent necessary to effect the valid conservation purpose of continuing the successful restoration and revitalization of the Eastern Canada – West Greenland bowhead whale population. In addition, such a limitation ensures that the number of hunts coincides with the number of sets of equipment necessary to deploy the new Penthrite grenades – thus limiting Inuit harvesting only to the extent necessary to provide for public safety.

NWMB request for a prompt response from the Minister

Minister Shea, the NWMB hereby forwards its decision to you pursuant to NLCA S.5.3.17. While acknowledging that you have up to sixty days to provide a response (NLCA S.5.3.18), the Board requests that you treat this particular decision as an urgent

matter requiring a prompt reply. If there is to be up to three bowhead hunts this summer, Nunavut's Regional Wildlife Organizations and relevant Hunters and Trappers Organizations require as much time as possible to properly prepare for those hunts – including with respect to such matters as the selection of the hunt locations, the whaling crews, the provision of training, the assembly of appropriate whaling equipment, and the development (and subsequent NWMB approval) of comprehensive Whale Hunt Plans. Those Plans will need to address all of those matters just mentioned, as well as the towing, landing, processing, disposition and distribution of the harvested whales. Should your response not arrive soon - even if it is an acceptance of the NWMB decision – one or more of the proposed 2009 hunts will be put in jeopardy.

Please do not hesitate to contact the NWMB at any time, if you have questions or concerns with respect to the Board's decision and recommendations – or if the NWMB can be of other assistance in helping you to provide a swift response to its decision.

Yours sincerely,

Harry Flaherty, A/Chairperson of the
Nunavut Wildlife Management Board

c.c. Eric Kan, Area Director, Eastern Arctic Area Office, Fisheries and Oceans Canada

Minister of
Fisheries and Oceans

Ministre des
Pêches et des Océans

Ottawa, Canada K1A 0E6

APR 2 9 2009

Mr. Harry Flaherty
Acting Chairperson
Nunavut Wildlife Management Board
P.O. Box 1379
Iqaluit, NU
X0A 0H0

Dear Mr. Flaherty,

Thank you for your letter dated March 11, 2009 conveying the Nunavut Wildlife Management Board's (NWMB) decision concerning the level of total allowable harvest (TAH) for the Eastern Canada – West Greenland bowhead whale population in the Nunavut Settlement Area (NSA).

At your public hearing of February 10, 2009, the NWMB was presented with opposing views on whether or not a TAH for bowhead whales should be established for the NSA. The effort of the NWMB in providing a detailed explanation on how it derived its decision and recommendations is most helpful.

This letter confirms that I accept the NWMB's decision to "*establish an annual total allowable harvest of three bowhead whales for the Nunavut Settlement Area – to be reviewed following the 2011 harvesting season...*"

It should be clearly understood that the three recommendations set out in the NWMB's letter are not solely directed at Fisheries and Oceans Canada (DFO). My Department will, with the involvement of Nunavut and Nunavik interests, begin discussions with Greenland concerning the management of this shared bowhead population and continue its efforts to finalize the historic, pre-commercial whaling abundance estimates and to reconcile its current population estimates for the Eastern Canada – West Greenland bowhead population with those of the International Whaling Commission.

.../2

Once again I would like to express my appreciation to you and the members of the NWMB for your effective management of the very challenging issue of setting a TAH for the Eastern Canada – West Greenland bowhead whale population in the Nunavut Settlement Area.

Sincerely,

Gail Shea, P.C., M.P.

c.c. The Honourable Leona Aglukkaq, P.C., M.P.

Wildlife Briefing Note

NTI Request NWMB to Extend the TAH of 3 Bowhead Whales per year for 2012 and 2013. DFO and NTI to report/update on NWMB recommendations.

Background:
The NWMB decision dated 11 March 2009, was accepted by the Minister of Fisheries and Oceans on 29 April 2009. The decision was as follows:

"RESOLVED that the NWMB establish an annual total allowable harvest of three bowhead whales for the Nunavut Settlement Area – to be reviewed following the 2011 harvesting season – which will restrict Inuit harvesting only to the extent necessary:

(a) to effect the valid conservation purpose of continuing the successful restoration and revitalization of the depleted population of Eastern Canada – West Greenland bowhead whales (Sections 5.3.3(a) and 5.1.5(d) of the Nunavut Land Claims Agreement (NLCA)), and

(b) to provide for public safety (NLCA S.5.3.3(c))."

In addition to this decision, the NWMB made to following recommendations:

1. The Department of Fisheries and Oceans (DFO) and Nunavut Tunngavik Inc. (NTI) engage in appropriate discussions – and work towards reaching agreements - with neighboring jurisdictions (Nunavik and Greenland) concerning both the sharing and the responsible stewardship of the Eastern Canada – West Greenland bowhead whale population;
2. DFO continue in its efforts to:
    a. Re-examine – in light of new information – the historic, pre-commercial whaling population numbers for the Eastern Canada – West Greenland bowhead whale population; and
    b. Seek a reconciliation of its current population estimates with those of the International Whaling Commission; and
3. In anticipation of potential future increases in the TAH, NTI continue to ensure that necessary equipment and training needs keep pace with the number of hunts undertaken in the NSA.

The three Regional Wildlife Organizations by resolution have decided that for the five year period beginning in 2009 and ending in 2013 inclusive, that Inuit in the NSA will only harvest 3 bowhead whales per summer.

Recommendation:
NTI recommends that the NWMB set a TAH on Bowhead Whales in the NSA for the 2012 and 2013 at 3 Bowheads per year, prior to the 2012 bowhead hunting season. NTI also would request that the NWMB review the three recommendations made in the 11 March 2009

decision that were acknowledged by the Minister and request written responses from both DFO and NTI on progress made on these recommendations to date.

Prepared by
NTI Wildlife Department
4 November 2011

Eric Kan
Area Director
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Iqaluit, NU
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Mr. Mikidjuk Akavak
Chairperson
Nunavut Wildlife Management Board
< receptionist@nwmb.com >

February 23, 2012

RE: request from Nunavut Tunngavik Incorporated to extend the existing annual Total Allowable Harvest of three bowhead whales per year for the 2012 and 2013 seasons.

Dear Mr. Akavak:

This is in response to your correspondence of January 24, 2012, addressed to the Honourable Keith Ashfield, Minister of Fisheries and Oceans, regarding the request from Nunavut Tunngavik Incorporated (NTI) to extend the existing annual Total Allowable Harvest (TAH) of three bowhead whales per year for the 2012 and 2013 seasons. NTI also recommended that the Nunavut Wildlife Management Board (NWMB) conduct a review of the recommendations specified in the Board's TAH decision of March 11, 2009. I have been asked to respond on the Minister's behalf.

Fisheries and Oceans Canada (DFO) supports NTI's request to extend the TAH of three bowhead whales per year for the 2012 and 2013 hunting seasons. The request is consistent with DFO's current science advice for the Eastern Canada-West Greenland (EC-WG) bowhead population, which was presented at the NWMB's Public Hearing on February 10, 2009. DFO's science advice also considers present harvests of bowhead whales by Inuit in Nunavik and Greenland.

The NWMB has also requested an update on its 2009 recommendations to DFO with respect to the EC-WG bowhead population (i.e., sharing agreements with neighbouring jurisdictions, bowhead catch history and population estimation). With respect to jurisdictional agreements, EC-WG bowheads are harvested by Inuit in Greenland and Nunavik. Because Canada is not a member of the International Whaling Commission (IWC), and although DFO scientific studies are discussed with the IWC Scientific Committee, there is currently no appropriate forum for management discussions with Greenland. Once the appropriate forum is established, Canada and Greenland will begin to discuss shared stewardship of the EC-WG bowhead whale population.

Within Canada, DFO prefers that Nunavut and Nunavik Inuit develop a mutually agreeable sharing arrangement within the existing TAH for EC-WG bowhead harvests. DFO is of the view that this initiative should be led by NTI and Makivik.

With respect to EC-WG bowhead population abundance, I have attached a recent publication for the information of the NWMB and its technical staff. It results from a re-examination of historic, pre-commercial whaling population numbers for this population (see Higdon, attached).

DFO's current population estimate and that of the IWC are similar given the considerable uncertainty derived from the Department's survey data. In September 2011, DFO initiated a process to update the existing abundance estimate for the EC-WG bowhead population. A revised abundance estimate is planned for 2015, at which time DFO will reassess the scientific advice regarding the TAH recommended for EC-WG bowhead whales.

Thank you for writing, and I look forward to continued collaboration in this important matter.

Yours sincerely,

Eric Kan

Eric Kan
Area Director
Eastern Arctic
Central and Arctic Region

Commercial and subsistence harvests of bowhead whales (*Balaena mysticetus*) in eastern Canada and West Greenland

JEFF W. HIGDON*

Contact email: jeff.higdon@dfo-mpo.gc.ca

ABSTRACT

Commercial harvesting of bowhead whales (*Balaena mysticetus*) from the eastern Canada-West Greenland population started with Basque whalers in the Strait of Belle Isle *ca* 1530 AD. Subsistence harvests have an even longer history, and the first culture to be active bowhead whalers was the Thule, which replaced the Dorset culture in the central and eastern Arctic *ca* 1200 AD. Previous harvest compilations have been incomplete, and back-calculated population models have thus been negatively biased. In recent decades this population has shown significant recovery and is the subject of Inuit subsistence harvests in both Canada and West Greenland. A revised historic abundance estimate is needed to examine the level of recovery; this requires *inter alia* a revised and updated catch series. Available information from multiple anthropological, archaeological, historic and recent sources, and estimate commercial and subsistence harvests in eastern Canada and West Greenland is summarised. From 1530–1915, commercial whalers took an estimated 55,916–67,537 (median 61,537) bowhead whales (varying assumptions on the intensity of the Basque harvest), which is known to be incomplete. Inuit harvests before commercial whaling began (1200–1529 AD) were estimated at 11,435 whales, based on the abundance of whale bone at winter houses excavated by archaeologists. After 1500 AD, Inuit whaling declined, and the total estimated harvest between 1530 AD and the end of commercial whaling was 8,406 whales. Inuit whaling declined again after commercial whalers overharvested the population and only 65 whales are known to have been harvested (or struck and lost) from 1918–2009. The Inuit harvest statistics are based on scattered data and a number of assumptions, with some evidence that at least parts of the series are underestimated. Even if harvests were higher, they would have probably not been large enough to cause population declines. The long tradition of Inuit bowhead whaling was negatively impacted by commercial harvests. Combining all harvests from 1530–2009 AD results in a total estimated kill of some 70,000 whales (not including struck and lost whales and known gaps for some nations and eras), with most (88%) taken by commercial whalers. Data quality varies considerably by nation and era, and was assigned to a 3-point scale for reliability, with over half the harvest considered to be the least reliable. This is the most comprehensive summary and estimate of bowhead harvests for this region, but is still known to be incomplete and is based on a number of assumptions and disparate data sources.

KEYWORDS: STATISTICS; WHALING – ABORIGINAL; WHALING – HISTORICAL; WHALING – REVISED CATCHES; ARCTIC OCEAN; ATLANTIC OCEAN; MODELLING

INTRODUCTION

The bowhead or Greenland right whale (*Balaena mysticetus*), found in circumpolar waters, is the most northerly distributed baleen whale. Both it and the closely-related North Atlantic right whale (*Eubalaena glacialis*) were long considered the 'right' whales to hunt, and the data series of commercial harvests for these species are the longest of all cetaceans. COSEWIC (Committee on the Status of Endangered Wildlife in Canada) formerly considered two eastern Canadian populations (Davis Strait-Baffin Bay and Hudson Bay-Foxe Basin), both 'Threatened' (based on likely incomplete data). Recent genetic and satellite tagging data (Dueck *et al.*, 2006; Heide-Jørgensen *et al.*, 2006; 2003; Postma *et al.*, 2006) indicate that the bowhead whales in eastern Canada and West Greenland constitute a single population with considerable age and sex structuring. A single-stock hypothesis has also been tentatively endorsed by the IWC, pending genetic re-analysis (IWC, 2008). COSEWIC reassessed the status of bowhead whales in the eastern Arctic given the new information on stock structure (and abundance) and recently upgraded the eastern Canada-West Greenland (EC-WG) population to 'Special Concern' (COSEWIC, 2009). The population supports a limited subsistence hunt by Inuit in both Canada (Nunavik and Nunavut) and West Greenland.

Subsistence bowhead whaling by Thule Inuit in the central and eastern Arctic started *ca* 1200 AD following an eastward migration from Alaska originating *ca* 1000 AD. Commercial harvesting started with Basque whalers *ca* 1530 AD and ended with American and Scottish whalers in Hudson Bay in the early 1900s. This paper summarises the available harvest data for bowhead whales in the waters of eastern Canada and West Greenland. These data are mostly from published sources. Archived sources in museums will undoubtedly provide further information; however such diligent research is beyond the scope of this manuscript.

Catch series are an important component of population assessments, along with an understanding of stock structure and present abundance. In particular, they allow the estimation of the unexploited population size and thus can be used to assess the status of a population in relation to its past and present abundance. This, in turn, can affect whether and to what level catches can be allowed that meet management and conservation objectives. There have been several past attempts to estimate pre-whaling population size (reviewed by Woodby and Botkin, 1993). Mitchell (1977) used a three-step method that involved summing the number of whales killed during the peak decade, correcting upwards for struck and lost whales, and estimating the residual population after the peak decade, based on the number of whales harvested in following decades. Using this method, Mitchell (1977) estimated the Davis Strait 'stock' to be about 6,000 whales in 1729 and the Hudson Bay 'stock' about 680 in 1859. The Davis Strait estimate was subsequently revised

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to 11,000 in 1825 (Mitchell and Reeves, 1981). Woodby and Botkin (1993) used a simple population model and estimated similar pre-exploitation population sizes. The IWC Scientific Committee now uses a 'management procedure approach' (e.g. Punt and Donovan, 2007) that explicitly takes uncertainty into account. It is therefore important that catch history series are carefully reviewed and uncertainties identified. More complete harvest data will provide better assessments and ultimately management advice.

A number of different nations harvested bowhead whales, and the harvest series is far from complete with the availability of harvest records varying considerably amongst nations and eras. In addition, there are limitations associated with the available data on commercial bowhead whaling (see Ross, 1979a; 1979b). There are also a number of errors in many whaling sources, for example, see Schevill (1957) on Sanderson (1956) ('an irresponsible book… Ivan Sanderson's carelessness is evident…'), Barkham (1994) on Proulx (1993), Sanger (1985) on Jenkins (1971) and Jackson (1978) (which, despite being one of the best sources on British whaling, still contains a number of errors), and Higdon (2008a) on Romero and Kannada (2006). Ultimately, nearly all sources and most major commentaries are flawed to some extent.

A number of different native cultures have inhabited the Canadian eastern Arctic and West Greenland (e.g. McGhee, 1990; Stoker and Krupnik, 1993). The Thule, the first culture to be active bowhead whalers, migrated eastward from Alaska *ca* 1000 AD and arrived in the central and eastern Arctic *ca* 1200 AD (Friesen, 2004; Park, 2000; Savelle and McCartney, 1990). Inuit in West Greenland and eastern Canada traditionally used bowhead whales for subsistence, and bones were used in the construction of winter houses (Kaplan, 1985; Savelle and McCartney, 1990; Taylor, 1988). Blubber and baleen were also traded to Euroamerican whalers and traders. Inuit harvests themselves probably did not have significant negative effects on bowhead whale population sizes, given the small populations of hunters and the selection for young whales (McCartney and Savelle, 1985; 1993; Savelle and McCartney, 1991; 1994). However, when taken in concert with commercial whaling after *ca* 1530, subsistence removals are part of the cumulative effect on population size and should therefore be included in any harvest series. Apart from in recent years, there is little documentation of Inuit harvests, and no harvest series exist.

Research efforts on the Thule and historic Inuit cultures have seldom been designed to examine whaling in a quantitative manner, but rather have been site-specific studies designed around cultural-historic questions (Savelle and McCartney, 1990). This makes it difficult to quantify the importance of bowhead whales to the Thule and historic Inuit cultures. For the purposes of reconstructing harvests to estimate pre-commercial exploitation population size, kills during the classic Thule phase (the peak of aboriginal bowhead whaling, occurring prior to commercial exploitation) are not relevant. However, knowledge of the importance of bowhead whales to early Thule culture adds context to the estimates of harvests after 1530 AD.

The harvest data are summarised by nation and divided into two broad sections – 'Euroamerican' (c.f. Caulfield, 1993) and Inuit subsistence whaling. The first European bowhead whalers were Norse settlers in West Greenland from 986 until *ca* 1500 AD (Jones, 1986). The settlers used whales for subsistence purposes (Degerbol, 1936; Enghoff, 2003; McGovern *et al.*, 1996), but the number of animals harvested is not known. However it was probably small and occurred prior to the establishment of commercial whaling; thus no harvest data are included here. Commercial efforts of all nations were influenced by numerous political, social and economic factors that are beyond the scope of this review. A number of sources are available, including Jackson (1978), Ross (1993) and Scoresby (1820). A preliminary version of this study is available as a Canadian Science Advisory Secretariat Research Document produced by the Government of Canada (Higdon, 2008b).

EUROAMERICAN WHALING

Commercial whaling grounds

Commercial bowhead whaling in eastern Canada and West Greenland occurred on a number of different 'grounds' (see summaries by Reeves *et al.*, 1983; Ross, 1993). The geographical distribution of whaling was related to whale abundance but also changed in response to numerous socioeconomic and political factors (Ross, 1993). Nineteenth-century whalers had a detailed knowledge of bowhead distribution and migration patterns, and this knowledge allowed the fleets to establish itineraries for catching whales at different seasons and in different areas (Reeves *et al.*, 1983). The seven main grounds are shown in Fig. 1.

The first bowhead whaling ground in the western North Atlantic, the Strait of Belle Isle/Gulf of St. Lawrence area ('Grand Bay'), was used by the Basques starting *ca* 1530 and already in decline by the late 1500s (Barkham, 1984). A multi-nation fishery for bowheads on grounds along the West Greenland coast (to *ca* 73°N) was started by the Dutch and Germans in the late 1600s, although no catch data are available until 1719 (de Jong, 1978; 1983; Ross, 1979a). Shore stations were established by Danish colonists in the early 1700s, but most whales were taken in a spring and summer ship-based fishery centered near the West Greenland coast (Reeves *et al.*, 1983). This included much of the Davis Strait whaling conducted by the Dutch, Germans and British (particularly prior to 1817 when the western Baffin Bay fishery started). Many important grounds on the 'east side' (i.e. Greenland side of Davis Strait) were depleted by the early 1800s (Reeves *et al.*, 1983).

The 'south-west fishing' grounds, centered on the pack ice edge in the Resolution Island area, were an alternative to the West Greenland ('east side') grounds in the spring. The whaling occurred at the mouth of Hudson Strait, along the southeast coast of Baffin Island to Cumberland Sound, and along the northeast coast of Labrador (Reeves *et al.*, 1983). This was among the most difficult fisheries to prosecute (Scoresby, 1820), since although large numbers of whales were seen, they were hard to catch because of the weather and the ice (Gray, 1888). Whaling could start as early as April and often lasted through June (Reeves *et al.*, 1983), with whales sometimes still caught as late as July in icy conditions near the Labrador coast (Scoresby, 1820).

The 'west water' was a summer fishery conducted in the vicinity of Pond Inlet, the Lancaster Sound region, Prince Regent Inlet and the northern Gulf of Boothia. The fishery

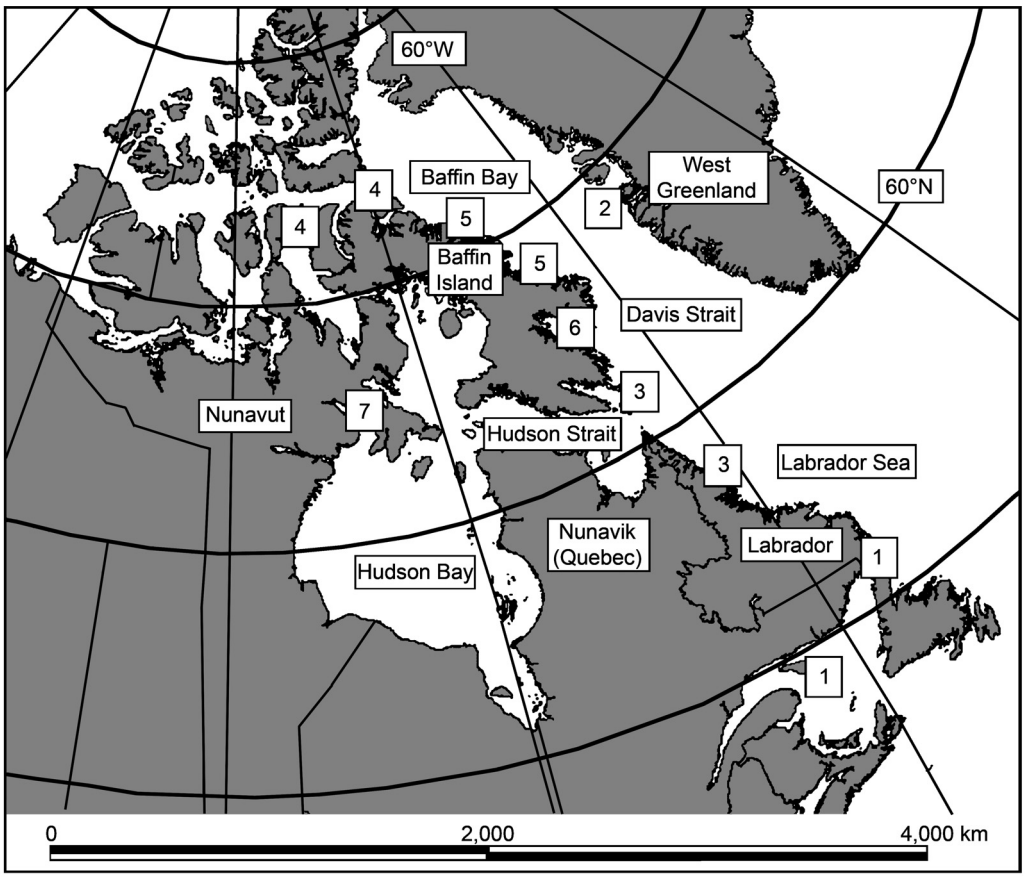

Fig. 1. Map of the eastern Arctic showing the seven main whaling grounds: 1) Strait of Belle Isle/Gulf of St. Lawrence ('Grand Bay'); 2) the West Greenland coast, or 'east side' grounds; 3) the spring 'south-west fishing' grounds, including the northeast coast of Labrador, the mouth of Hudson Strait, and southeast Baffin Island; 4) the summer 'west water' grounds, including Pond Inlet, the Lancaster Sound region, and Prince Regent Inlet; 5) the autumn 'rock-nosing' grounds along the entire east coast of Baffin Island; 6) Cumberland Sound, a spring and fall fishery; and 7) northwestern Hudson Bay.

started in 1817 when Scottish vessels first penetrated the Melville Bay ice and crossed Baffin Bay (Ross, 1979a; 1993). Large whales were often present off the mouth of Pond Inlet (Smith, 1922) and most catches were made here from early June to early September (Brown, 1868; Low, 1906). A number of authors have written about the abundance of whales in Prince Regent Inlet and the northern Gulf of Boothia during July, August and early September (reviewed by Reeves *et al.*, 1983). Some years were 'closed seasons', in which the land-floe persisted in western Baffin Bay and blocked the entrances to Pond Inlet and Lancaster Sound. Large numbers of whales would aggregate along the land-floe when their westward migration was blocked; and harvests were often high but comprised of small (young) whales (Finley and Darling, 1990; Lubbock, 1937; Reeves *et al.*, 1983).

The autumn 'rock-nosing' grounds were found along almost the entire east coast of Baffin Island. This was an inshore fishery undertaken by vessels that failed to fill their holds at the 'south-west fishing' or 'west water' grounds (Reeves *et al.*, 1983). Vessels would leave the Lancaster Sound area in late August or early September and some would remain on the grounds until November; by this time they would be rock-nosing in Cumberland Sound or south. In the late 1800s, Cumberland Sound also became an important ground for early and late-season whaling, often using shore-stations and with some overwintering (Ross, 1979a; 1993; Sanger, 2007). The last ground opened was northwest Hudson Bay, which had a short lifespan (1860–1915). American and Scottish vessels arrived in mid-August, whaled for a month before finding a winter harbour, and then started spring floe-edge whaling from whaleboats in May (Ross, 1974; 1979a).

Basque whalers

The Basques are an ethnic group who primarily inhabit an area known as the Greater Basque Country (*Euskal Herria* in the Basque language), located around the western end of the Pyrenees on the coast of the Bay of Biscay and straddling parts of northeastern Spain and southwestern France (Douglass and Bilbao, 2005). The ancestral Basque homelands encompass parts of each country, and while Basques living within Spanish borders are officially considered citizens of Spain, they consider themselves a separate group entirely (Kurlansky, 1999). The Basques first started whaling in the eastern Atlantic (Bay of Biscay) before moving to the northwest Atlantic. Basque whalers became established in the Strait of Belle Isle *ca* 1530 AD and were there on an annual basis until *ca* 1630 (Aguilar, 1986; Barkham, 1977; 1978; 1984; Cumbaa, 1986). The fishery peaked in the mid 1500s (the most productive decades were the 1560s and 1570s) and was in decline by the 1580s, with some ships returning half-empty (Aguilar, 1986; Barkham, 1984). Basque effort greatly diminished after *ca* 1590, and the north shore of the Strait of Belle Isle was abandoned by the early 1630s (Barkham, 1984). It was not until *ca* 1580

that the whalers extended their grounds west into the Gulf of St. Lawrence, an expansion that occurred after the peak whaling efforts (Barkham, 1978; McLeod *et al.*, 2008).

Basque whaling in Newfoundland and the Gulf of St. Lawrence officially ended in 1713 with the signing of the Treaty of Utrecht, although the industry had been in decline long before this time (however scattered French Basque vessels were still active along the north shore of the Gulf of St. Lawrence in the 1730s, Reeves and Mitchell, 1986). Most of the 20 known whaling stations were abandoned by the mid-1600s, but at least one station (Petit Mécatina, QC) was active into the early 1700s (McLeod *et al.*, 2008). Overhunting was one potential cause of whaling decline, but other factors such as conflict with local aboriginal peoples, rising taxes, alternative economic pursuits like cod fishing, and impressments of whaleships into naval service all played a role (reviewed by Ross, 1993). The opening of the Spitsbergen fishery in the early 1600s, with its large and previously unexploited whale stocks, was undoubtedly a major factor in the decline of Grand Bay whaling. Both English and Dutch vessels in Spitsbergen hired Basque whalers (de Jong, 1978; 1983; Jenkins, 1971).

Several authors have estimated the typical catch per year during the peak of Basque whaling. Using 12 whales per vessel and 20–30 vessels per year, Aguilar (1986) estimated a total yearly harvest of 300–500 whales (not including those struck and lost) and suggested that 25,000–40,000 whales were killed during the peak period of *ca* 1530–1610. Barkham (1984) used 15 ships per year (but acknowledged that there were likely at least 20 ships during the peak years), and an average capacity of 1,000 barrels per ship to estimate peak yields of 300 whales per year. Aguilar's (1986) fig. 4 provides a measure of Basque whaling effort, based on the number of extant manuscripts or written references as an index of activity. However, this must be used with caution as the relative abundance of documents is not necessarily correlated with whaling intensity. The number of documents written before 1530 was negligible (*ca* 3%). The proportion of written references (Aguilar, 1986) peaks from the 1550s to the 1570s, agreeing well with the peak in whaling activity as reported by Barkham (1984). Previous authors have assumed an approximate 50–50 split with bowheads and right whales, although recent evidence suggests that the harvest was in fact nearly all bowheads (see below).

Aguilar (1986) assumed an average yield of 12 whales per vessel, based on an average vessel capacity of 1,000 Spanish barrels and an average yield of 85 barrels per whale (which appears to represent an average or typical yield for both balaenid species). However he stated that 'the usual yield from a single whale was between 70 and 140 barrels of *fat*' (Aguilar, 1986, p.195), but then stated that each barrel contained '180 litres of *oil*' [my italics]. The capacity of a Spanish barrel was 180l, and a typical yield of 85 barrels would equal 15,300l of blubber or oil (range 12,600 to 25,200l for 70–140 barrels). Allen (1908) estimated the oil production for Spitsbergen bowheads as 80–100 hogsheads (hhd) per whale, a measure equivalent to 140l (or 11,200–14,000l per whale). If Aguilar (1986) was in fact referring to oil, then his estimates are much higher than Allen's. Scoresby (1820) stated that West Greenland whales delivered 14 tons or tuns (*ca* 13,350l or 95hhd) of oil on average, in agreement with Allen (1908) and considerably lower than Aguilar's (1986) estimate. It is assumed that Aguilar's (1986) typical yield of 85 Spanish barrels (or 109hhd) was in fact referring to barrels of blubber and not oil.

Table 1

Estimated Basque whale harvest (all species) in the Strait of Belle Isle and Gulf of St. Lawrence assuming the proportion of written references (Aguilar, 1986) represents actual whaling effort, with various assumptions as to the total number of whaling vessels (20, 25, or 30) during the peak harvest period 1551–75. Catch per year assumes an average vessel capacity of 12 whales (Aguilar, 1986). A small proportion of written references (*ca.* 3%) were dated pre-1530. Genetic data (McLeod *et al.*, 2008) indicate that nearly all (*ca.* 90%) whales were bowheads.

Period	Percentage of written references[1]	Harvest/year with different numbers of vessels during peak (1551–75)		
		20	25	30
1530–50	20.5	219	273	328
1551–75 (peak)	22.5	240	300	360
1576–1600	19.5	208	260	312
1601–25	10	107	133	160
1626–50	7	75	93	112
1651–75	11	117	147	176
1676–1700	4.5	48	60	72
1701–13	2	38	48	57
Total estimated harvest		**24,968**	**31,182**	**37,429**

[1]From fig. 4 of Aguilar (1986).

Basque whalers built tryworks on shore to render the oil (Aguilar, 1986) before returning to France or Spain. A 0.75 conversion factor, i.e. 3 tons of oil from 4 tons of blubber (Scoresby, 1820, see also Gad, 1973, p.221); of Aguilar's (1986) 85 barrel average results in 64 Spanish barrels (or 82hhd) of oil and is thus in closer agreement with Allen (1908) and Scoresby (1820). Assuming an average vessel capability of 1,000 Spanish barrels, as per Aguilar (1986) and Barkham (1984), a typical yield of 64 barrels of oil per whale would increase the capacity to about 16 whales per vessel. However, given the uncertainty around these estimates, Aguilar's (1986) more conservative estimate of 12 whales per ship is retained. Assuming this as a typical yield per vessel, Table 1 shows estimated Basque harvests from 1530–1713, using a range of peak vessel numbers and assuming the distribution of written records is representative of effort. An estimate of 25 vessels per year during the peak of Basque whaling effort equates to an average of 300 whales per year during the peak period. Estimates of 20 and 30 vessels results in yearly peak harvests of 260 or 360 whales per year, respectively, agreeing well with the estimates by Aguilar (Aguilar, 1986) and Barkham (1984).

Historical research has shown that there were two distinct Basque whaling periods, the summer season in June/July and the winter whaling season. During the early years of Basque whaling, the vessels generally returned to Europe after the summer season, but in the 1550s the whalers discovered an influx of whales that arrived in September/October, after which they began to stay for the winter whaling season (Huxley [Barkham] 1987 in McLeod *et al.*, 2008). The two seasons were typically interpreted as a right whale hunt in the summer and a bowhead hunt during the winter (Aguilar, 1986; Cumbaa, 1986). However given that the harvest was nearly all bowhead whales (see below), the distinct summer and winter whaling seasons likely represented sex- and/or age-

based segregation and migration of the bowhead population (McLeod *et al.*, 2008). The summer seasonal hunt was largely abandoned by the mid-1570s (McLeod *et al.*, 2008).

The *San Juan* which sank in Red Bay, Labrador in autumn 1565 was discovered in the late 1970s (Barkham and Grenier, 1978). Excavation led to the recovery of a number of bones of whales that the Basques harvested in the 1500s (Barkham, 1984). Cumbaa (1986) examined humeri of 17 individuals, and osteological analysis suggested nine bowhead and eight right whales. However recent genetic analyses of these same bones have shown that the harvest was actually nearly all bowhead; Rastogi *et al.* (2004) analysed 21 humeri that had been identified using osteological analyses as eight bowheads and 13 right whales but their DNA analysis identified only one as a right whale and the remaining 20 as bowhead. The bones were from a minimum of 16 individuals – this suggests a harvest that was *ca* 94% bowhead whales. McLeod *et al.* (2006) present preliminary results of more extensive analyses than that of Rastogi *et al.* (2004). Analyses of 188 bones from 18 different sites indicate that 183 are from bowhead whales, one is from a right whale, and four are from other species (Frasier *et al.*, 2007). Additional genetic analyses have since been conducted on 218 bone samples, from 10 different sites (McLeod *et al.*, 2008). Five different species were present, and 203 of these bones (93%) were from bowhead whales. The 218 bones were from a minimum of 80 individuals, and 72 of these were bowheads (90%).

There is thus considerable evidence that the vast majority (≥90%) of Basque harvests were bowhead whales. Assuming a peak of 25 vessels (the midpoint of Table 1, also see Aguilar, 1986), 31,182 whales might have been harvested from 1530–1713, of which an estimated 28,075 were bowheads (assuming 90% of the total harvests). Assumed peak vessel numbers of 20 and 30 result in an estimated bowhead harvest of 22,454 and 33,683, respectively.

Aguilar (1986) suggested that 25,000–40,000 whales were taken from 1530–1610. In the present assessment, the harvests during this peak period are lower, with 67% of the total taken prior to 1610 (20,930 whales, 18,846 of which were bowheads). The proportion of written references per 25-year period declined after 1551–1575, which agrees with Barkham's (1984) suggestion of the peak of Basque whaling effort. However, it increased again after 1651 although Basque whaling had declined considerably by this time and most whaling stations had been abandoned (McLeod *et al.*, 2008). Much of the available written documentation may actually have been in reference to past whaling activities and may thus not be completely representative of Basque whaling effort. Nonetheless, the recent genetic analyses (McLeod *et al.*, 2008; McLeod *et al.*, 2006; Rastogi *et al.*, 2004) clearly indicate that large numbers of bowhead whales were taken by the Basque fleet. The relationship (in terms of population structure) between these whales and the current population is also unknown. They may have been a component of a wide-ranging stock such as found today, or they may have been from a geographically separate stock that was extirpated. Furthermore, at that time (the Little Ice Age, Fagan, 2000; Lamb, 1995), the climate may have been such that bowheads from Davis Strait, Baffin Bay and Hudson Bay, as found in the 1700s and later, were excluded from more northerly latitudes by heavy ice and thus had a more southerly distribution.

The harvest series estimated here ends in 1713, but both French and Spanish Basque vessels were active in Davis Strait after this time. French Basque reportedly started whaling in Davis Strait in 1719 (Du Pasquier, 1986), and both French and Spanish vessels were reported off Disko Bay, West Greenland, by the 1730s (Ciriquiain-Gaiztarro, 1961; Gad, 1973); no data was found for Spanish Basque harvests or effort in Davis Strait. Du Pasquier (1986) provides the number of French Arctic vessels known per year from 1613–1766, although the list is incomplete and the data sources available did not distinguish between grounds east and west of Greenland. French Basque vessels were also still occasionally present along the North Shore of the Gulf of St. Lawrence in the 1730s (Reeves and Mitchell, 1986). The French Basque Arctic fishery started to decline after the mid-1730s and ended in 1766 (du Pasquier, 1986). No estimate of Davis Strait harvests is included here.

Dutch whaling

Dutch whaling in Davis Strait started in the 1600s as an extension of their dominance on the Spitsbergen grounds. However harvest data are only available after 1719, when the trade became considerable enough to be distinguished from that which occurred east of Greenland (de Jong, 1978; 1983). In Davis Strait, the number of Dutch vessels peaked in 1732 (Vaughn, 1986). After this, numbers fluctuated, with a near-continuous decline after 1770 (de Jong, 1978). Both de Jong (de Jong, 1978; 1983) and Ross (Ross, 1979a) provide statistics on the number of vessels sailed and the number of whales flensed for the Davis Strait fishery. Ross (1979a) notes 3,329 voyages catching 7,644 whales from 1719–1826. De Jong's (1978; 1983) numbers are slightly higher, showing 3,348 Dutch vessels capturing 7,697 whales from 1719–1823. The harvest series used here is based on the source with the highest number of whales caught, with yearly gaps filled in from the other source where appropriate. De Jong (1978; 1983) includes more harvests than Ross (1979a), but this second source contains catch information for 1802 and 1824–1826, not included by de Jong (1978; 1983). Ross' (1979a) catches for these years were added to the de Jong (1978; 1983) series for a total Dutch catch of 7,699 whales from 1719–1826. This is an incomplete series and thus an underestimate, since, as noted above, Dutch traders and whalers were in West Greenland by the late 1600s (Kuup and Hart, 1976) but no data are available until after 1719. Additionally, Dutch whalers occasionally took right whales ('Noordkapers') in the 1700s while hunting for bowheads in Davis Strait (Reeves and Mitchell, 1986); thus estimates based on oil returns may include some unknown proportion of non-bowhead returns.

British whaling

Both England and Scotland have a long history of Arctic whaling. In the early 1600s, the English competed fiercely with the Dutch in the Spitsbergen fishery (Conway, 1904; 1906; de Jong, 1978; 1983; Ross, 1993). The Dutch eventually dominated and the English fleet essentially gave up whaling by 1650, returning in the 1700s after Davis Strait whaling had started. It is not possible to conclusively

determine when the English first started Davis Strait whaling (Vaughn, 1986) but it was probably around 1750 when the British government increased the bounty for whaling vessels (Jackson, 1978; Ross, 1979a; 1993). English vessels also participated to some extent in whaling in the Strait of Belle Isle (Mitchell and Reeves, 1983). British whaling began to increase significantly in the 1770s as the Dutch fleet declined (Ross, 1993; Vaughn, 1986). In 1817, two Scottish vessels crossed to Baffin Island and caught a large number of whales, which led to the development of a new British fishery in Lancaster Sound and along the Baffin Island coast, involving a counter-clockwise circuit of Baffin Bay (Dunbar, 1972; Ross, 1979a; 1993; Vaughn, 1986; 1991). By the second half of the 19th century, the industry was dying, and only the Scots continued to outfit vessels. Scottish whalers continued to be successful because they expanded their harvest to other species such as white whales (*Delphinapterus leucas*) and seals and pioneered the use of steam-powered vessels (Jackson, 1978; Sanger, 1985).

Sanger (1985) presents harvest statistics for both Davis Strait and east of Greenland for 1750–1801, but for Scottish vessels only. In Davis Strait, 84 Scottish vessels caught 301 whales. Ross (1979a; 1993) presents British whaling data from 1814 onwards, using a variety of sources including whaling logbooks and the 'Kinnes Lists', a nearly continuous shipping list giving the particulars of whaling voyages, in the possession of the Dundee firm of Robert Kinnes and Sons. The Kinnes Lists begin in 1790 and end in 1911, but do not separate Davis Strait catches until 1814. Ross (1979a) included 20,043 whales harvested by 2,600 vessels ('ship-seasons') from 1814–1911. Ross (1979a) described the limitations in his approach, and was careful to note the provisional nature of his harvest series and that additional research was required. One source of uncertainty with these estimates is with the species composition. In the mid-1800s, some British vessels took humpback whales (*Megaptera novaeangliae*), and the practice of doing so may have occurred more frequently than is generally believed (Mitchell and Reeves, 1983). Davis Strait whalers also took right whales on occasion (Reeves and Mitchell, 1986).

Chesley Sanger (Memorial University of Newfoundland, St. John's, NL) has provided unpublished data collected during his PhD research (Sanger, 1985) that adds to the harvest series presented by Ross (1979a). Sanger (unpublished data) includes Scottish harvests from 1751–1813 (1,519 whales, and includes the 1750–1801 data from Sanger, 1985), and both Scottish and English harvests from 1814–1910. Sanger (unpublished data) used the same Kinnes Lists as Ross (1979a) but updated this using other sources (mainly newspapers), particularly for the Scottish aspect of the fishery. Sanger (unpublished data) provides a total British harvest of 20,308 whales (12,111 by Scottish and 8,197 by English) secured by 2,607 vessels (1,659 Scottish and 948 English) from 1814–1910. This is a slight increase in terms of the number of vessels and whales taken over Ross (1979a). The biggest difference between the two series is Sanger's inclusion of Scottish catches from land-station catches in Cumberland Sound, which Ross (1979a; 1979b) noted were missing from his compilation. From 1853–1890, a minimum of 68 overwintering Scottish voyages secured at least 346 whales (Sanger, 2007). The harvest series here therefore uses Sanger (unpublished data) as the main source for British whaling until 1910, with harvests for 1911 (four whales) from Ross (1979a), resulting in a total British harvest of 20,312 whales.

None of the aforementioned sources provide English data prior to 1814, with the exception of six whales harvested by the Hudson's Bay Company (HBC) from 1767–1772 (Ross, 1974; 1979a). However, Jackson (1978) provides some limited information to help fill gaps for early English whaling: the number of English vessels from 1733–1785; the number of Scottish vessels from 1750–1785; yearly average oil and bone returns for 1733–1795; and the number of English and Scottish vessels clearing to, and entering from, 'Greenland' for 1781–1800. Jackson (1978) does not distinguish between whaling east and west of Greenland, but Sanger (1985) does for the number of Scottish vessels sailed, and whales harvested, for 1750–1801.

For the present paper, it is assumed that the English started whaling in Davis Strait in 1750 (Jackson, 1978; Ross, 1979a; 1993). This is the first year Scottish whaling data, separated into the two grounds, are available (Sanger, 1985; in 1750 there was only one Scottish vessel, which fished east of Greenland). From 1733–1749 the number of English 'Greenland' vessels ranged from 3–6 (Jackson, 1978). If there was any British activity in Davis Strait prior to 1750, as suggested by Jenkins (1971) and Gad (1973), it was likely of minor importance. Scottish whalers were in Davis Strait from 1751–1754, then moved all their effort to East Greenland, not returning again until 1787 (Sanger, 1985). From 1787–1814 the catch between the two grounds fluctuated, in some years more whales were harvested east of Greenland, in others the majority were taken in Davis Strait (Sanger, unpublished data).

The oil returns in Jackson (1978) for 1750 onwards were converted to number of whales using 6.8hhd (140l each) to one ton and 90hhd per whale (Allen, 1908). The number of whales harvested by English vessels was determined by subtracting the Scottish northern whale harvest from both grounds (Sanger, 1985; unpublished data). The proportion of Scottish vessels and whale harvests in Davis Strait (Sanger, 1985) was then used to estimate the proportion of total English vessels and whales (from Jackson, 1978) that were in Davis Strait. This resulted in an estimate of 1,292 whales captured by 408 vessels (Table 2). When combined with Sanger's (1985; unpublished data) Scottish data, the total British harvest prior to the establishment of the Kinnes Lists in 1814 was estimated as 2,811 whales, with the majority (1,519) caught by the Scots, and most of these (1,245) taken from 1801 to 1813 (Sanger, unpublished data). Ross (1979a) estimated that there were over 400 British voyages to Davis Strait prior to 1814, and the estimated number of voyages here (408 English plus 84 Scottish) agrees well with this. There may have been additional English voyages, for example from 1801–1813, and also during the 1755–1786 period when the Scots fished east of Greenland only (Jackson, 1978; Sanger, 1985).

Estimating the early English harvest in this manner assumes that Scottish and English vessels were equal in their distribution on the two grounds, which may not be the case. In 1750, there was one Scottish vessel, which fished on the East Greenland grounds (Sanger, 1985), so in this estimate

Table 2

English Davis Strait whaling efforts from 1750–1800 estimated using British vessel and oil data from Jackson (1978). Oil yield converted to number of whales using Allen (1908), English whale harvest determined by subtracting Scottish harvests from Sanger (1985), and proportion of total vessels and total whale harvest in Davis Strait estimated using Scottish whaling effort (Sanger, 1985).

	English 'Greenland fishery'		Estimated English in W. Greenland			
Year	Vessels	Whales	Vessels	Whales	Whales/vessel	Notes
1750	19	27	–	–	–	Reportedly 20 English vessels in Davis Strait (Proulx, 1986 – but not a reliable source, Barkham, 1994)
1751	23	34	4	32	8.0	
1752	30	19	3	2	0.7	
1753	35	6	2	0	0.0	
1754	52	45	3	0	0.0	
1755 to 1786	1,852	3,107	0	0	–	No Scottish vessels in Davis Strait 1755–86 (Sanger, 1985). An estimated 1,852 English voyages caught 3,107 whales from 1755–86 but none assigned to West Greenland
1787	217	657	7	33	4.7	
1788	222	461	50	144	2.9	Reportedly 90 English whalers in West Greenland waters (Gad, 1982)
1789	151	336	62	183	3.0	
1790	103	264	47	71	1.5	
1791	93	212	32	108	3.4	
1792	87	170	52	27	0.5	
1793	73	226	42	101	2.4	
1794	53	190	13	92	7.1	
1795	40	194	12	62	5.2	
1796	44	278	10	73	7.3	
1797	57	354	17	66	3.9	
1798	59	359	24	114	4.8	
1799	60	366	12	96	8.0	
1800	54	345	16	88	5.5	
Total	3,324	7,650	408	1,292	–	

none of the 19 English vessels were assigned to Davis Strait (Table 2). Although Proulx (1986) stated that there were 20 English vessels in Davis Strait in that year (but see Barkham, 1994 for problems with the accuracy and reliability of Proulx [specifically Proulx 1993, but the issues are relevant to the 1986 publication as well]). In 1788, I estimate 50 English vessels in Davis Strait; however Danish sources indicated that there were 90 'English' whalers in West Greenland waters (Gad, 1982). Even when the seven Scottish vessels (Sanger, 1985; unpublished data) are added, the total number of British vessels is much lower than 90. This again suggests that Scottish whaling effort may not be representative of English effort, but detailed archival research would be required to address this.

Another source of whale products for British markets was barter between the HBC and Hudson Strait Inuit. The baleen from a minimum of 115 bowhead whales was collected between 1737 and 1800 (Barr, 1994). This excludes baleen collected by HBC supply voyages from 1670–1736 and 1801–1913 (approximately 660 trips total, Cook and Holland, 1978). Whaling in Hudson Bay was attempted by the HBC between 1767 and 1772, but was largely unsuccessful and only six whales were taken (Ross, 1974; 1979a).

The total (minimum) British whale harvest therefore includes 1,519 whales taken by the Scots from 1751–1813 (Sanger, 1985; unpublished data), 20,312 whales taken by the combined British fleet from 1814 to 1911 (Ross, 1979a; 1993; Sanger, unpublished data), six whales harvested by the HBC in Hudson Bay in the 1700s (Ross, 1974; 1979a), 115 whales secured by the HBC through trade (Barr, 1994), and an estimated 1,292 whales taken by the English fleet between 1751 and 1800 (based on data in Jackson, 1978 and the assumptions noted above, and likely incomplete). Combining all data results in a total minimum British removal of 23,244 whales from 1737–1911.

German whaling

German vessels first started whaling on the Spitsbergen grounds and were heavily involved in Arctic whaling by the late 1600s (de Jong, 1978; 1983). Ross (1979a) and de Jong (1983) provide some data on German Davis Strait whaling from 1719 to the late 1700s, although German vessels were again there prior to 1719 (Gad, 1970; Vaughn, 1986). According to Ross (1979a), the Germans caught 327 whales on 264 voyages from 1719–1792. The harvests in de Jong (1983) are lower, with 207 vessels and 277 whales from 1719–1783. For both sources the data are limited and do not include all the different whaling ports; therefore they provide underestimates of the total harvest. Data on German whaling in Davis Strait between 1792 and 1826, when the last German vessel sailed (Hacquebord, 2005), and prior to 1719, are unavailable. The harvest series, based on Ross (1979a) and updated for gaps with de Jong (1983), includes an estimated harvest of 332 whales.

Danish-Norwegian whaling in West Greenland

The Danes also first started whaling at Spitsbergen. Sporadic trips to Davis Strait were undertaken in the 1650s but no catches were apparently made (Gad, 1970). Small numbers of vessels were whaling in Davis Strait in the early 1700s (Gad, 1970; 1973), but the number of whales caught, if any, is unknown. These vessels were chiefly traders, not whalers, but they secured some whalebone from Greenland Inuit (Gad, 1973). In 1721, Danish colonies were established in West Greenland and a ship was outfitted specifically for Davis Strait whaling (Gad, 1973; Jones, 1970). Despite a

trade monopoly granted in 1723, the Danes faced stiff competition from Dutch traders and were never very successful with either whaling or trading (Gad, 1973; Jones, 1970). Several West Greenland whaling stations were established in the 1770s (Gad, 1973), and up to eight stations and 12 ships were operating in the late 1780s (Gad, 1982). Local hired Inuit did the whale hunting, using European boats and tackle. War between Denmark-Norway and England starting in 1807 impacted Greenland trade (Gad, 1982), but Danish whalers were still active into the late 19th century (Vaughn, 1984).

There is no complete summary of the Danish bowhead whale harvest in Davis Strait. Gad (1973; 1982) provides some information in his narrative of the history of Greenland. Gad (1973) summarised blubber and baleen secured in trade and whales actively killed for 1721–1776. De Jong (1983) stated that adult whales typically yielded 30–40 tuns (tons, 953.9l or 252 US gallons) of blubber and calves and juveniles yielded 5–10 tuns. Scoresby (1820) gave the average yield of West Greenland bowheads as 14 tuns of oil, or 17.5 tuns of blubber using a 1.25 conversion factor. However given that the contemporary age-class structure in Disko Bay, West Greenland is nearly all (*ca* 85%) large adults >14 m in length (Heide-Jørgensen *et al.*, 2007; Laidre *et al.*, 2007, also see Eschricht and Reinhardt, 1866), I assumed a typical yield of 30 tuns of blubber per whale. Danish barrels (tønde) used to hold whale oil were equivalent to 131.5l (*ca* 34.7 US gallons), and this value was used to convert barrels to tuns. The minimum number of whales was estimated using the 30 tuns/whale conversion factor. Decreasing the estimate to 17.5 tuns of blubber per whale (Scoresby, 1820) would increase the estimated harvest, and my estimates could be considered conservative. In some years (e.g. 1755 and 1773), Gad (1973) noted that the totals included a mix of seal and whale oil; I arbitrarily assumed half of each when estimating total bowhead harvests. The estimated Danish harvest (mainly from trade with Inuit) is 95 whales from 1721 to 1776. This is a combination of both estimated numbers from blubber secured in trade and the number killed by colonists working with local Inuit. Gad (1973) reported 31 of the total estimate as actively killed by colonists and locals. These data are incomplete, with no information available for 27 of the 56 years. In addition, sometimes an entire whale harvested by the Greenlanders was shared amongst the locals, with the traders receiving none (Gad, 1973).

Cooperative shore-station whaling conducted by the Danes and West Greenland Inuit started *ca* 1777 (Vaughn, 1984). Gad (1982, p.206) provides a graph showing the production (in barrels, i.e. tøndes) of Greenland whale oil refined in Copenhagen from 1777–1807 (1785–87 missing), that provides a more comprehensive measure of whaling effort than for previous years. The oil refined for each year was estimated (to the nearest 25 barrels) from the graph and the number of whales estimated as follows: using the above 30 tuns of blubber per whale average, provides an average yield of 24 tuns of oil (conversion factor from Scoresby, 1820) or about 22,894l, or 174 tøndes per whale. The total oil yield from Gad's (1982) graph was converted to whales using the 174 conversion factor. The estimated annual number of whales ranges from 1–25 (average of 14) with a total estimated harvest of 393 whales from 1777–1807. An unknown proportion of these whales were harvested on the Spitsbergen grounds. I have assumed an even distribution between the two grounds, which results in a West Greenland harvest of 197 whales. Although this assumption may not be valid it is consistent with the limited available data; the estimated West Greenland harvest in 1798 was eight whales, and Gad (1982) reported that nine were taken, and Sandgreen (1973, in Caulfield, 1993) reported that the Disko Bay shore-stations landed six whales in 1777, compared to seven estimated here using oil returns (prior to the correction for Inuit blubber distribution as discussed below).

Harvests previous to 1777 (summarised from Gad, 1973) occurred on the West Greenland grounds only and no correction for Spitsbergen harvests is necessary. Until 1803, Greenlanders received half the blubber of whales they helped capture; after 1803 the natives received two-thirds (Gad, 1982). Estimated harvests from 1777 (establishment of shore stations) to 1803 were therefore corrected by a factor of two, and those for 1804–1807 by a factor of three, resulting in a total of 524 whales from 1721–1807 (range 1–26, with no data for 30 years). Cooperative whaling attempts occurred prior to the establishment of shore-stations in 1777, but a correction for Greenlanders receiving half the blubber of landed whales prior to this is not used in this paper as some of the blubber came from trade and not active whaling. The estimated harvest from 1721–1807 is therefore likely an underestimate.

Vaughn (1984) suggested that the average Danish catch was 20–30/year at the end of the 18th century, declining to half that in 1800–1850, with only one animal per year by 1870, when only one station was still working (also see Eschricht and Reinhardt, 1866; Rink, 1877). The yearly average compiled from Gad (1982) for 1777–1799 is 16 whales (with no data for three years), slightly under the lower limit suggested by Vaughn (1984). The estimated average harvest from Gad (1982) for 1800–1807 is 14 whales per year (range 2–22), in good agreement with Vaughn's (1984) estimate of 10–15 from 1800–1850. Caulfield (1993) reported that the Danish catch at Qeqertarsuaq in 1804 was 20 whales, compared to a total estimated catch of 21 whales here using the oil return data (and after correction for Inuit shares). The catch at Qeqertarsuaq declined to 12 whales in 1816 and was down to only 1–2 each year by the 1830s and 1840s (Amdrup *et al*., 1921; Fisker, 1984; both in Caulfield, 1993). Whaling operations were shut down at Qeqertarsuaq in 1851 due to economic difficulties (Sveistrup and Dalgaard, 1945 in Caulfield, 1993). Danish shore-station whaling ended throughout West Greenland in the late 19th century (Vaughn, 1984). My estimated harvest of 524 whales up to 1807 (using data from Gad, 1973; 1982) was updated with an additional 14 whales per year assumed for 1808–1850 (average estimate for 1800–1807), declining to five per year for 1851–1869, and dropping again to 1 per year from 1870 to an assumed end date of 1890. For this part of the harvest series, I assume Vaughn (1984) implicitly included the fact that Inuit received a share of the blubber of harvested whales, and no correction was included. The total estimated Danish harvest is 1,242 whales from 1721–1890.

The Danish colonial records mentioned by Eschricht and Reinhardt (1866, p.4) are available on microfilm (M.

Klinowska, pers. comm. in Reeves *et al.*, 1983), and analyses of these records began in the early 1980s (Klinowska, 1982). Some information on bowhead catches is recorded in the daybooks of the shore-stations of the Royal Greenland Trading Company, and the majority survive in the State Archive in Copenhagen, running from 1774 to 1916 (Klinowska, 1982). Klinowska (1982) provides a brief description of the available data but did not conduct a full analysis. Eschricht and Reinhardt (1866) had access to the same data but unfortunately only mention it briefly. Klinowska (1982) examined bowhead movements (arrival and departure dates and length of stay at the different stations) and used a series of explanatory variables including catch per decade. However, instead of summarising the Danish shore-station catches, Klinowska (1982) used the international catches summarised by Ross (1979a). It is unfortunate that neither Eschricht and Reinhardt (1866) nor Klinowska (1982) summarised the daybook data, as these could provide additional information to the summaries and assumptions in Gad (1973; 1982) and Vaughn (1984) that were used here to estimate Danish shore-station catches.

One additional manuscript, again unpublished, contains reference to this archived data. Klinowska and Gerslund (1983), submitted as a proposal to the IWC for continued research, summarised the daybooks for November-June from four of the nine northern shore-stations for the year 1800–1801. This reportedly represented the first year of a reasonable run of records for the area. However, the proposal for continued research was not supported (M. Klinowska, pers. comm., 18 February 2008). Analyses of these archived logbooks could be undertaken, but would require time, resources, and specialised expertise. The microfilms are available from the IWC. The four daybooks examined by Klinowska and Gerslund (1983) included a total harvest of at least 50 bowhead whales in 1800–1801, including one taken by an English vessel and 17 taken at the Holsteinsborg station. The remainder were taken at four stations in Disko Bay. This represents landed whales only and is a subset of the available data. It is apparent that significant numbers of whales were taken by Danish shore-stations. In the present harvest series, I estimated Danish harvests of 22 whales in 1800 and 14 in 1801; these are thus known to be an underestimate. However without having the Daybook data summarised for other years, it is currently not possible to determine to what extent the Danish harvests may have been underestimated. While limited to one year only, the available data suggest that Vaughn (1984) (and by extension, this study) may have greatly underestimated Danish whaling effort in the early 1800s. Examination of the data may also provide guidance on species composition of the harvest. It is assumed that whale oil returns represented bowhead whales only. However West Greenlanders had a well-developed humpback whale fishery established by the late 1700s (Mitchell and Reeves, 1983; Reeves and Smith, 2002). Danish shore stations probably took humpback whales opportunistically, and some of the oil returns may represent this species (or even right whales).

French (non-Basque) whaling

French (and Spanish) Basque whaling has been discussed previously. However non-Basque French vessels were also active in the Northern whale fishery. The French Basque fishery ended in 1766, but a whaling company was established in Dunkirk (outside the Basque region) in 1784 with support from the government, and was active on both northern and southern whaling grounds until 1788, but with little success (Du Pasquier, 1986). French whaling also expanded after 1788 with a colony of Nantucketers who settled at Dunkirk. The proportion of those vessels that traveled to northern regions is unknown, but based on du Pasquier's (1986) text and Table 6 it does appear that most (if not all) harvests were of right whales in the South Atlantic. The Government of France again tried to revive the industry in 1817 with American expertise and capital. Du Pasquier's (1986) Table 8 indicates that few of these vessels went to Northern grounds, with most whaling in the Southern Hemisphere (between 1–4 vessels per year from 1817–1837 on Northern grounds, and in most years only one). Some of these vessels likely traveled to whaling grounds west of Greenland, but no data on relative proportions are available in du Pasquier (1986). Another source (Du Pasquier, 1982) may contain more information. Given the low numbers of vessels involved, I have assumed that harvests west of Greenland were negligible, and none are included here.

American whaling

Yankee whaling started in New England in the mid-1600s as a coastal, shore-based fishery similar to that of the Basques (Stackpole, 1953). In 1712, the first sperm whale (*Physeter macrocephalus*) was taken by an American vessel, launching an expansion into pelagic regions (Starbuck, 1878). The first American vessel to visit Davis Strait did so in 1732 (Starbuck, 1878 and according to Bernard, 1761 in Ross, 1979a), and by 1737 the Davis Strait fleet from Massachusetts alone consisted of 50–60 vessels (Clark, 1887; Stackpole, 1953). The main targets in this fishery were sperm and right whales, but bowhead whales were probably also taken (Jackson, 1978; Reeves *et al.*, 1983; Reeves and Mitchell, 1986). Starbuck (1878) provides some general discussion on sporadic 18th-century American voyages to Davis Strait, while Stackpole (1953) discusses some specific voyages. However, no comprehensive data on the number of voyages or the size of the catch are available, and there are no harvest records available for this aspect of the American fishery (Jenkins, 1971; Ross, 1979a). In June 1753, the sloop *Greyhound* took a whale near 60°N in Davis Strait amongst heavy ice (Stackpole, 1953: 43–44), and Reeves and Mitchell (1986) considered this to most likely be a bowhead (although it was reported as a right whale by Townsend, 1935).

The ceding of Canada to England opened up the Gulf of St. Lawrence and Strait of Belle Isle to Yankee whalers, and by the mid-1760s up to 100 New England vessels were active there (Scoresby, 1820; Starbuck, 1878). There are again no data available but it is likely that at least some bowhead whales were taken. Some American vessels in the Strait of Belle Isle attempted to overwinter or arrive early in the spring when ice was still present, suggesting active bowhead whaling (Reeves and Mitchell, 1986). The whales pursued by the *Reliance* in the Strait of Belle Isle in the 1760s were likely bowhead (Reeves and Mitchell, 1986).

In the 1840s, American whalers again started visiting Davis Strait and Baffin Bay (Clark, 1887). In the 1850s

whalers from both New England and Scotland established a shore-based fishery in Cumberland Sound (Hacquebord, 2005; Ross, 1979a; 1984: 1985; Sanger, 2007). After 1860, American (and some Scottish) whalers moved into Hudson Bay, a predominantly American fishery that lasted until the early 1900s (Ross, 1979a; 1993). Ross (1979a) contains American whaling data starting in 1846, when the Americans returned to Davis Strait and Baffin Bay, and starting in 1860 for Hudson Bay. During this time, 349 vessels caught 945 whales. American Arctic whaling occurred primarily in the Pacific region, starting in the mid 1800s (Bockstoce, 1986; Bockstoce and Botkin, 1983), and only a minor proportion (< 5%) of American bowhead harvests in the mid- to late 1800s occurred in the eastern Arctic (Clark, 1887). Ross' (Ross, 1979a, also 1974) harvest reconstructions were based on oil and baleen returns, and he assumed that the returns reflected bowhead whales only. However, American vessels travelling to Hudson Bay ('Hudson's Bay') or Cumberland Sound ('Cumberland Inlet') often cruised for right whales off Greenland before reaching the bowhead whaling grounds (Reeves and Mitchell, 1986), and some of the returns included by Ross (1979a) could represent right whales. Yankee whalers in the Arctic after 1820 were also aware of the market for humpback oil and lowered their whaleboats for that species on occasion (Mitchell and Reeves, 1983). In 1878, the New Bedford brig *A.J. Ross* chased humpback whales along the Labrador coast while heading to the Hudson Bay bowhead grounds (Reeves and Smith, 2002).

Best (1987) estimated the landed catch of baleen whales made by American whalers from 1805–1909, building largely on logbook data originally presented in Townsend (1935). He estimated that American vessels took 248–291 bowhead whales from 1815–1819. However this appears to be an extrapolation from the five bowheads taken by the ship *Mars* of Nantucket in 1817, the only vessel catching bowhead whales for this time period that was listed by Townsend (1935). This was before the American expansion into the western Arctic, and these whales would thus possibly have been captured in the Strait of Belle Isle, Davis Strait or the Labrador Sea. However, the five whales taken by the *Mars* also could have been taken east of Greenland. In the absence of additional information, I consider the figure of 248–291 whales to be uncertain and have not included this in the harvest reconstruction.

The American Offshore Whaling Voyage database (Lund *et al.*, 2008) includes three voyages by the *Richmond* of New Bedford, for 'Hudson's Bay', in July 1816–May 1817 (1,700bbl oil), July 1818–19 (1,800bbl oil), and again from July 1827–28 (1800bbl oil and 12,295lbs bone). The total oil harvest from these three over-wintering voyages was 5,300 barrels. This would represent about 44 bowheads, using the average Davis Strait yield of 120bbl as reported by Best (1987), if it was assumed that all were bowheads, which probably is not the case. Whaling masters would sometimes declare a voyage to one region but then sail to another (Ross, 1979a), and these voyages occurred well-before the known start of American whaling on the Hudson Bay ground. The harvests could have occurred in southern Davis Strait or along the Labrador coast, but also possibly occurred east of Greenland. As noted, the catch was also not necessarily all bowheads.

Given this uncertainty, the only American harvests included here are the 945 from 1846–1915 estimated by Ross (1979a). No harvests from the 1700s or early 1800s are included for the reasons noted above and therefore the total catch is an underestimate to an unknown degree.

Canadian whaling

Some Canadian colonists reportedly tried to take up whaling in the Strait of Belle Isle and Gulf of St. Lawrence after the Basques left but were largely unsuccessful (Proulx, 1986). Quebec residents of the Gaspé Bay, on the south shore of the St. Lawrence, were whaling from sailing vessels throughout the 1800s (Mitchell and Reeves, 1983). During the American Revolution, some American whalers moved north and helped build whaling industries in Newfoundland and Nova Scotia (Jackson, 1978). Colonial whaling concentrated mostly on humpback whales (Clark, 1887; Mitchell and Reeves, 1983; Reeves and Smith, 2002). However in 1842, Bonnycastle wrote that whales of all species were taken in Newfoundland waters, including 'the largest mysticetus or great common oil whale of the northern oceans, which occasionally visits these waters' (Clark, 1887: 217). The Little Ice Age started in the 13th century, when pack ice began advancing southwards in the North Atlantic, and ended about 1850 when the climate again began to warm (Fagan, 2000; Lamb, 1995). With southward expansion of pack ice, it seems possible that at least some bowhead whales were taken by colonial whalers in the Strait of Belle Isle and the Gulf of St. Lawrence prior to the mid 1800s, although no harvests are known. Shore station-based 'modern' whaling began in Newfoundland in the early 1900s, but no bowhead whales were reported taken (Dickinson and Sangar, 2005).

Summary of commercial harvests (see Fig. 2 and Table 3)

For all nations combined, the estimated commercial harvest is 55,916–67,537 whales from 1530–1915 AD (61,537 whales with a peak Basque effort of 25 vessels per year). In the eastern Arctic (including the Gulf of St. Lawrence and Strait of Belle Isle), the most active whalers were the Basque and the British. There are a number of gaps in this series and the total harvest is probably underestimated. Many

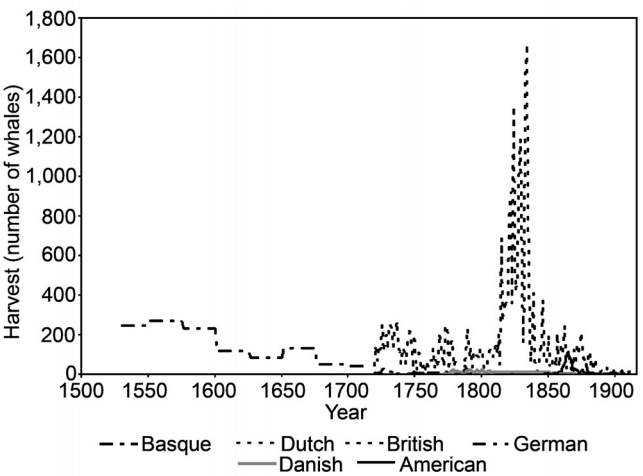

Fig. 2. Estimated commercial harvest of bowhead whales in eastern Canada and West Greenland, 1530–1915 AD, by nation. The Basque harvest is based on an assumed peak of 25 vessels per year.

Table 3
Summary of commercial bowhead whale harvests, by nation (see text for further details).

Nation	Start date	End date	Estimated bowhead harvest
Norse settlers, W. Greenland	1150	Pre-1500	Unknown but likely minor (subsistence)
Basque	1530	1713	22,454–33,683[1]
	1714	1766	Unknown
Dutch	1600s	1718	Unknown
	1719	1826	7,699
British	1737	1911	23,244[2]
German	1600s	1718	Unknown
	1719	1792	332
Danish-Norwegian	1600s	1720	Unknown
	1721	1890	1,242
French (non-Basque)	1784	1837	Unknown
American	1700s	1700s	Unknown
	1846	1915	945
Canadian	????	????	Unknown
Total estimated harvest[3]	**55,916–67,537 (61,537)**		

[1]Range of values depending on assumptions of vessels per year during peak (1551–75) (see Table 1). [2]Includes 115 whales secured by Hudson's Bay Company (HBC) through trade with Hudson Strait Inuit and six whales taken by HBC whalers in the mid-1700s, but excludes possible English Davis Strait harvests in the mid-1700s and 1801–1814. [3]Range of values depending on assumed number of Basque vessels, value in parentheses assumes a peak Basque effort of 25 vessels per year (midpoint of Table 1).

assumptions regarding the distribution of whaling effort, species composition of the catch, and average catch per vessel have been employed, and these may not be valid in many cases. Despite these uncertainties, this commercial harvest series is more complete than the previous summaries it builds upon (e.g. de Jong, 1978; 1983; Ross, 1979a; 1993).

INUIT SUBSISTENCE WHALING SINCE 1200 AD

The Thule culture

The Thule culture (Mathiassen, 1927), direct ancestors of today's Inuit, spread eastward from Alaska starting *ca* 1000 AD, arriving in the central Canadian Arctic *ca* 1200 AD, and eventually reaching the eastern Arctic, Labrador and West Greenland (Friesen, 2004; Park, 2000; Savelle and McCartney, 1990). Bowhead whales were critically important to the initial Thule expansion (McCartney, 1977; McGhee, 1969–1970; 1972; 1975). A warming trend led to a decrease in summer ice cover, and a range expansion for both whales and whalers. The decline in whaling and abandonment of the High Arctic *ca* 1500 AD was a consequence of a cooling trend that increased ice cover and decreased bowhead distribution.

McCartney (1977) distinguished between 'classic' and 'modified' Thule, where classic Thule (*ca* 1000–1300 AD, but with significant regional variation) refers to the early culture carried from the Chukchi and Beaufort Seas into the Canadian Arctic. The classic Thule culture coincided with a major warming episode when bowhead whales achieved their maximum range (McCartney and Savelle, 1985). The modified Thule culture (McCartney, 1977) refers to adaptations that corresponded with the onset of cooler temperatures, when the reduction in bowhead whale availability led to a shifting of Thule subsistence patterns. The human population largely abandoned the central and high Arctic between *ca* 1400–1600 AD, likely due to reduced whale availability. The transition from classic to modified Thule was not uniform. Schledermann (1979) noted temporal and geographic variability in Thule whaling and suggested that the 'baleen period' lasted to between 1400 and 1700 AD, with the later date corresponding to sites on more open waters where whales were still accessible.

Bowhead whale bones were used extensively in the construction of Thule winter houses. Houses were built using bones with a high 'architectural utility' such as mandibles, maxillae and premaxillae, ribs, and scapulae (Savelle, 1997). Thule winter house construction was highly variable, resulting from differing spatiotemporal availability of bowhead whales in addition to differences in whaling-related social status between households (Dawson, 2001; Whitridge, 2002).

The relative numbers of whales that were killed as opposed to scavenged is unknown. This has led to a questioning of the role of active bowhead whaling (Freeman, 1979; Yorga, 1979). However there is considerable direct and indirect evidence that bowheads were actively harvested (McCartney, 1980; McCartney and Savelle, 1985; Savelle and McCartney, 1988; Savelle and McCartney, 1990). The most convincing information comes from estimates of the size of whales, as nearly all (97%) of the remains at classic Thule sites in the central Arctic were from yearling whales (McCartney and Savelle, 1985; 1993; Savelle and McCartney, 1991; 1994). Thule whalers actively selected for immature whales between 7–10m in length (McCartney and Savelle, 1993; Savelle and McCartney, 1991; 1994), presumably related to their ease of capture.

There was significant geographic and temporal variation in Thule subsistence patterns and not all groups used bowhead whales to the same degree (Mathiassen, 1927; McCartney and Savelle, 1985; Savelle and McCartney, 1990; 1994; 1999). Quantifying the importance of bowhead whales to the classic Thule diet has proven difficult. Bones of small animals such as ringed seals (*Pusa hispida*) are generally considered to be 'diet-derived', but bowhead bones can be 'shelter-derived' as well (McCartney, 1980). Bowhead whales have thus often been excluded from many zooarchaeological studies of Thule subsistence patterns (e.g. Staab, 1979). McCartney and Savelle (1985), using data from Rick (1980) on faunal remains from Thule winter houses on Somerset Island, provide some rough estimates of the relative importance of bowhead whales during the classic Thule phase (i.e. pre-1300 AD). McCartney and Savelle (1985) used some conservative estimates to suggest that at a minimum the food value of bowheads was equal to the food from all other animals combined and that the bowhead to 'other' food ratio could be as high as 3:1–5:1. Savelle and McCartney (1990) conservatively estimated that one juvenile whale was equal to some 120 caribou (*Rangifer tarandus*) or 180 ringed seals. Whales would have also been used for fuel (i.e. oil), and this may have been just as important as the food value, if not more so.

Harvest series for the Thule culture pre-1500 AD

Stoker and Krupnik (1993) summarised data from McCartney (1979), who examined whale bone winter houses at Thule sites throughout the central Arctic region (excluding Labrador and the Ungava Peninsula) and estimated that

Table 4

Estimated bowhead whale use by classic Thule culture (*ca.* 1200–1500 AD) in the central and eastern Canadian Arctic (columns 1–4 from McCartney, 1979 as summarised by Stoker and Krupnik, 1993).

Region	No. houses	Avg. whales per house	Min. no. whales	Median total whales	Whales per year (300 years)	Nunavut region
Somerset Island	183	10–15	1,830–2,745	2,288	8	Qikiqtaaluk
Boothia Peninsula	50	4–5	200–250	225	1	Kitikmeot
Admiralty Inlet	93	3	279	279	1	Qikiqtaaluk
Navy Board-Pond inlets	161	3	483	483	2	Qikiqtaaluk
Clyde area	140	2–3	280–420	350	2	Qikiqtaaluk
Broughton area	303	1	303	303	1	Qikiqtaaluk
Cumberland Sound	389	3	1,167	1,167	4	Qikiqtaaluk
Frobisher Bay-Hudson Strait-Foxe Peninsula	155	2–3	310–465	388	2	Qikiqtaaluk
Western H. Bay-Repulse Bay-Southampton Island	300	1	300	300	1	Kivalliq
Western Melville Pen. and adj. islands	103	3	309	309	1	Qikiqtaaluk
Ellesmere-Northern Devon islands	186	2–3	372–558	465	2	Qikiqtaaluk
Lancaster Sound-Barrow Strait	131	1–2	131–262	197	1	Qikiqtaaluk

6,301–8,215 individual whales were used. It seems reasonable to assume that nearly all whales were actively harvested given the preponderance of young whales (McCartney and Savelle, 1985; 1993; Savelle and McCartney, 1991; 1994), as Holocene stranding (mortality) profiles are similar to live population profiles (Savelle *et al.*, 2000), i.e. younger whales were not more likely to strand. McCartney's (1979) data, as shown by Stoker and Krupnik (1993), are included in Table 4. The average number of whales used per year (i.e. harvested) was determined using the median total whale estimate and a 300 year time period (Stoker and Krupnik, 1993); each site was assigned to one of the three current Government of Nunavut regions and all estimates were rounded up to whole animals.

The Kitikmeot Region is poorly represented in Table 4, with only one location (Boothia Peninsula). However this region historically did not contain large numbers of whales and Thule Inuit there depended mostly on ringed seals and caribou (Mathiassen, 1927; McCartney and Savelle, 1985; Savelle and McCartney, 1990). The Kivalliq Region also has poor coverage, with the only surveys in western Hudson Bay. However this area would represent the most productive whaling zone in the region (Ross, 1974). Ungava Bay, Labrador and Greenland are also excluded (see below). Most data are for the Qikiqtaaluk Region, but this is reasonable as most early Thule whaling would have occurred in the central Arctic islands.

The classic Thule period for the different regions was defined based on Schledermann (1979) (Table 5). For Repulse Bay the baleen period as reported by Schledermann (1979) occurred from 1000–1100 to 1400 AD, but the period is started here at 1200 AD (Friesen, 2004; Park, 2000). An average harvest of one whale per year in western Hudson Bay-Repulse Bay-Southampton Island (Table 4) over this period would result in 201 whales (Table 6). The baleen period in Cumberland Sound was from 1250–1650 AD (Table 5). A harvest of four whales per year (Table 4) until 1500 AD results in a total harvest of 1,004 whales. For the remaining regions in Table 4 the total harvest was 21 whales per year. It is assumed that the abandonment of the central and high Arctic Islands, or at least a shifting of subsistence strategies, was complete by 1500 AD. This, combined with establishment by 1200 AD, would result in a further Thule harvest of 6,321 whales. For Labrador, no harvests are added before 1500, following Schledermann (1979). For West Greenland, Schledermann (1979) (Table 5) dated the start of the baleen period as 1200 AD (although this may be too early, Friesen, 2004; Park, 2000). A West Greenland harvest of ten whales per year (Vaughn, 1984) results in an estimated harvest of 3,010 whales pre-1500. The total estimated harvest is thus 10,536 whales pre-1500 AD, peaking from 1250–1400 with an estimated average of 36 per year (Table 6).

Quality of harvest estimates

There are several lines of evidence to suggest that harvests may be underestimated. The harvest per region is based on McCartney's (1979) whalebone winter house data (as summarised by Stoker and Krupnik, 1993). For at least some regions the minimum numbers of individuals (MNI) calculations in McCartney (1979) are negatively biased because large numbers of buried bones were not included (McCartney and Savelle, 1985). This, combined with significant bone removal by prehistoric and historic Inuit, in addition to contemporary Inuit for whalebone carvings (McCartney, 1979), significantly reduced the amount of bone counted at some sites. In addition, not all whale crania or mandibles ended up in winter houses, with many left on beach processing sites or stockpiled in caches for future architectural use (Savelle, 1997). The estimated yearly harvest for Somerset Island is only eight whales (Table 4), yet the caches there could have stored the meat and blubber of 15–25 animals (Savelle and McCartney, 1990). In comparison to most commercial data, the Inuit harvest estimates are the least reliable of this summary (see

Table 5

Approximate dates of the 'baleen period' as defined by Schledermann (1979). In this assessment the start of the baleen period for Repulse Bay was changed to 1200 AD (see text).

Site	Approximate time period (AD)
Naujan (Repulse Bay)	1000–1100 to 1400
Cumberland Sound	1250 to 1650
Labrador	1500 to 1700
Comer's Midden (Northwest Greenland)	1200–1300 to 1550
Sermermiut (Disko Bay, Greenland)	1200–1300 to 1650

Table 6

Summary of estimated Thule/Inuit bowhead whale harvests in eastern Canada and West Greenland between 1200 and 2009 AD. Estimated average yearly harvest provided, except for Labrador 1771–1849 and all regions post-1917, where annual harvest statistics (with an unknown level of completeness) are available.

Location	Period (AD)	Yearly harvest	Total whales
Pre-1500			
Repulse Bay (Naujan)	1200–1400	1	201
Cumberland Sound	1250–1500	4	1,004
Remainder of Canadian Arctic	1200–1500	21	6,321
West Greenland	1200–1500	10	3,010
Total			10,536
Peak harvest	1250–1400	36	
1501 – 'historic'			
Western Baffin Island	1501–1650	11	1,650
Labrador	1501–1700	5	1,000
Hudson Bay/Nunavik	1501–1700	5	1,000
Northwest Greenland	1501–1550	5	250
Southwest Greenland	1501–1650	5	750
Total			4,650
Peak harvest	1501–1550	31	
'Historic' period			
Cumberland Sound	1651–1860	10	2,100
Northern Hudson Strait (southern Baffin Island)	1651–1860	3	630
Southwest Hudson Bay (Marble Island south)	1701–1860	1	160
Repulse Bay (and Foxe Basin)	1701–1860	2	320
Nunavik	1701–1860	2	320
Labrador	1701–1770	5	350
	1771–1849	Variable	143*
West Greenland	1651–1721	5	355
	1722–1770	3	147
	1771–1900	1	130
Total			4,655
Peak harvests	1793	34	
	1781	32	
	1651–1721	28	
Post-commercial whaling period			
All regions	1918–2009	Variable	65**
Totals			
Total harvest 1200–2009 AD			19,906
Harvest 1530–2009 AD			8,471

*Includes 36 struck/lost. **Includes 14 struck/lost.

below). Savelle (in review) has incorporated additional archaeological data (revised bone counts, additional sites) than that available in Stoker and Krupnik (1993), and classic Thule harvests may have been considerably higher than that estimated here.

Harvest series for the Thule culture post 1500 AD (pre-'historic')

Thule whaling declined in the central Arctic after *ca* 1500 AD, before the start of widespread commercial whaling. Bowhead whaling survived only on the western coast of Baffin Island, Hudson Bay, West Greenland and Labrador (Stoker and Krupnik, 1993). Schledermann (1979) suggested that deteriorating climate conditions in the central Arctic resulting in population movement into regions where open water conditions allowed continued hunting of bowhead whales. For the post-1500 AD Thule harvest it is assumed that bowhead hunting continued only in the locations noted above and again used the 'baleen period' dates in Table 5. For western Baffin Island, the five locations in Table 4 (Navy Board and Pond inlets, Clyde area, Broughton area, Cumberland Sound and Frobisher Bay-Hudson Strait-Foxe Peninsula) have a combined total of 11 whales per year. Assuming the baleen period ended at 1650 AD (Table 5), the total harvest of whales from 1501–1650 AD for all these regions is 1,650.

For Labrador, the 'baleen period' ended in 1700 AD (Table 5). Assuming a harvest of five whales per year, (average harvest at the time of initial Moravian contact, Taylor, 1988 – see below) results in 1,000 whales 1501–1700 AD. According to Schledermann (1979) the Thule site at Repulse Bay (Naujan) was occupied until 1400 AD (Table 5). However after *ca* 1500–1600 AD whaling again occurred in western Hudson Bay (Stoker and Krupnik, 1993). Assuming a harvest of five whales per year (see below) results in a total western Hudson Bay harvest of 1,000 whales 1501–1700 AD. For West Greenland a harvest of ten whales per year (Vaughn, 1984), or five each in the northwest and southwest, is again assumed. The baleen period lasted until 1550 AD in northwest Greenland and 1650 AD in southwest Greenland (Table 5), for an estimate of 1,000 whales from 1501–1650 AD. The combined estimated harvest for 1501–1650/1700 AD is 4,650 whales, peaking early (1501–1550) with an average of 31 whales per year (Table 6).

Historic Inuit bowhead whaling

The Historic Inuit period also exhibits significant geographic variation, with definitions largely dependent on the time of

first European contact. For example, McCartney (1977) defined the historic period in Hudson Bay as starting in 1610. In West Greenland, the first extensive European contact did not begin until Danish-Norwegian colonisation in 1721 (Gad, 1973; Rink, 1877), although there was limited contact with European traders and whalers before this time. A similar situation occurred in Labrador where there was only limited contact until the late 18th century when Moravian mission stations were established. Inuit on Baffin Island were in contact with European explorers starting in the 1600s (in addition to possible contact with the Norse before this, Fitzhugh, 1985). European (and American) contact in the Canadian eastern Arctic culminated in the mid-1800s with the presence of many commercial whalers, which had a profound effect on local Inuit (Ross, 1974; Ross, 1979b). In this summary, all dates begin, somewhat arbitrarily, to bridge the gap between Schledermann's (1979) 'baleen period' dates (Table 5) and those discussed in this section.

A large body of literature exists from whalers, explorers and missionaries, and some early ethnographic accounts of native whaling are available (Boas, 1888; Cranz, 1820; Egede, 1745; Oswalt, 1979; Parry, 1824; 1826; Ross, 1819). These accounts, while clearly indicating that early historic period native whaling occurred, are brief and of little value in reconstructing harvest numbers. In most cases the authors were less concerned with describing Inuit harvesting practices than they were with general ethno-cultural observations or notations of discoveries.

Many of these ethnographic accounts also described situations in which early European whalers had already reduced whale populations and had a significant effect on Inuit culture, thus impacting the very lifestyles they described (Taylor, 1979). The presence of Euroamerican whalers in places such as Pond Inlet, Cumberland Sound and northwest Hudson Bay may have had a significant effect on the native harvest of bowheads. Both Clark (1979) and Freeman (1979) suggest that trade with Euroamericans may have created renewed interest in bowhead whaling among Inuit. In many cases, some of the whales harvested by Inuit may be included in the commercial totals through trade of baleen and blubber. Despite these shortcomings, historic ethnographic accounts are of some value in reconstructing Inuit bowhead harvests during the early contact period, although a number of assumptions are necessary, which may or may not be valid.

Historic whaling in Nunavut and Nunavik waters

Some limited data are available for three areas in Nunavut: Cumberland Sound, southeastern Baffin Island on Hudson Strait, and northwest Hudson Bay.

Cumberland Sound

Some data on contact-period Inuit whaling are available for Cumberland Sound, which commercial whalers first entered in 1839 (Haller, 1966, in Taylor, 1979). In 1840 Penny observed freshly killed whales in Cumberland Sound (M'Donald, 1841), and stated that Inuit there killed 'annually from 8 to 12 whales', something worth noting as it was 'peculiar to these Esquimaux' (Penny, 1840, in Stevenson, 1997: 40). Captain Penny travelled extensively in the region and was very familiar with eastern Baffin Island, and his statement suggests that by the mid-1800s bowhead whaling in this area was largely limited to Cumberland Sound. Inuit oral history on North Baffin Island indicates that bowhead whaling declined in the historic period prior to the arrival of Scottish whalers, who then hired local Inuit hunters (J. Alooloo, Pond Inlet Hunters and Trappers Organisation, pers. comm., 18 April 2007).

However Penny's statement is contradictory to both Schledermann's (1979) 'baleen period' end of 1650 AD (Table 5) and the estimated annual harvests from archaeological evidence (Table 4). Two possibilities may explain the discrepancy in dates. First, the presence of foreign whalers and traders, and thus foreign trade items, prompted the Inuit to increase bowhead harvests strictly as a trade item (Clark, 1979; Freeman, 1979). The second possibility, and the one preferred by Stevenson (1997), is that Schledermann's (1979) stratigraphic sequence was correct but that his chronological and cultural interpretations were not (also see Friesen, 2004; Park, 2000). Regardless of the reason, the available ethnographic evidence suggests that in the early to mid-1800s Cumberland Sound Inuit took an average of ten whales per year, a high harvest level unique to this region. For the discrepancy in annual harvest numbers, it is worth noting the earlier discussion regarding the likely underestimates of pre-contact harvest due to the limitation of using whalebone houses only (also see Savelle, in review). Another possibility is increased human population size in Cumberland Sound due to migration from central and high Arctic regions with cooling climatic conditions (Schledermann, 1979).

Hudson Strait

Barr (1994) presented data on baleen secured by HBC ships in Hudson Strait and Hudson Bay (here included with British whaling harvests). Most baleen came from Hudson Strait (78% of the total from 1737–1778), and then mainly from the Kimmirut area. Barr (1994) estimated that from 1737–1800, the products of 65 average-sized bowhead whales (i.e. one per year) were traded by Inuit of southern Baffin Island. In some years the equivalent of three to five average-sized whales was traded (Barr, 1994). In Labrador, only 24 of 63 whales (38%) killed from 1771–1784 had marketable baleen over 1.8m long (Taylor, 1988). Given this information, along with the cultural (i.e. Thule) tradition of selection for small whales, it seems likely that during the mid through late-1700s, an average of three whales per year was being harvested by Inuit along the northern side of Hudson Strait, with harvests in some exceptional years possibly exceeding ten whales.

Ross (1974) presents evidence that the Inuit harvest decreased by the late-1800s. In 1880, Inuit took three whales under contract to an American whaling firm, and a whaling/trading station was established in central Hudson Strait shortly after. By this time commercial whaling had already reduced whale numbers in Hudson Bay. Inuit occasionally took whales using boats supplied by the station but numbers were not large. In 1886, local Inuit stated that no whales had been taken in three years (Ross, 1974). Maxwell (1979) summarised archaeological and ethnographic information for the Kimmirut region and suggested that small numbers of bowhead whales may have

been harvested up until 70 years ago (i.e. the early 1900s). Much of the baleen was probably traded and is thus likely included in the harvest series for American and Scottish whalers (Ross, 1974; 1979a; Sanger, unpublished data).

Western Hudson Bay

The Hudson's Bay Company also secured baleen along the western Hudson Bay coast, although amounts were much lower than in Hudson Strait (Barr, 1994). From 1737–88 Barr's (1994, p.242) table 2 includes only 7,058lbs of baleen traded at Churchill and another 7,032lbs secured by expeditions north to Marble Island. This equals a total of *ca* 10 average-sized bowhead whales over the 42 year period, or an average of one whale every four years. Ross (1974) also summarised HBC trade between Churchill and Marble Island and gave similar numbers. Hearne (1795) witnessed three whales harvested near Churchill in a 20-year period prior to 1795, and Hudson Bay Inuit killed one whale, and struck and lost two, in 1828 (Reeves *et al.*, 1983; Reeves and Mitchell, 1990). Given the suggestions above for Hudson Strait harvests, an average of one whale per year may have been taken in Hudson Bay from Marble Island south.

The presence of whale bone on eastern Melville Peninsula suggests a long history of bowhead harvesting in Foxe Basin continuing into the historic period (Stoker and Krupnik, 1993). However, Parry (1824) was informed by local Inuit that most whales were found in the Repulse Bay area. The estimates above based on the baleen trade do not include the Repulse Bay region, which would have been the most productive area for bowhead whaling in Hudson Bay. It may be reasonable to assume that an average of one to two bowhead whales was taken in the area every year. Inuit harvests likely declined in the later 1800s as they did in Hudson Strait (Ross, 1974).

Total estimated Nunavut and Nunavik harvest, 'historic' period

For the 'historic' period, my estimated Inuit harvests in Nunavut and Nunavik end in 1860. This date corresponds to the initiation of commercial whaling in Hudson Bay and occurs just after the establishment of shore stations in Cumberland Sound in the mid-1850s. Some whales were probably harvested after 1860 (e.g. Maxwell, 1979; Ross, 1974), but most whale products would have been traded to American and Scottish whalers and thus included in the commercial harvest series for those countries. Assuming Penny's estimation of 8–12 whales per year (Stevenson, 1997) is correct, this would result in a total Cumberland Sound harvest of 2,100 whales (i.e. 10 per year) from 1650–1860. However the discrepancy between the harvest levels in Table 4 and Penny's statement is still unresolved. In addition, the commercial harvests off West Greenland in the 1700s reduced the bowhead population, and may have negatively impacted Inuit harvest levels. For northern Hudson Strait (southern Baffin Island), an average of three whales per year is assumed for 1701–1860, for a total of 480 whales.

For southwestern Hudson Bay (south of Marble Island), an average harvest of one whale per year is assumed, for a total of 160 whales from 1701–1860. Assuming a combined average yearly harvest of two whales in Repulse Bay and Foxe Basin results in an additional 320 whales from 1701–1860. No bowhead harvest data are available for Nunavik (eastern Hudson Bay and southern Hudson Strait). McCartney (1979) excluded the Ungava Bay region, so there is no archaeological data and any harvests in this region were thus excluded from the pre-contact harvest series. There are also no ethnographic accounts for harvests, but contemporary Inuit have suggested that Nunavimmiut may have traditionally harvested a maximum of 3–4 bowheads per year (A. Kullula and J. Peters, Makivik Corp., pers. comm., 14 March 2007). A possibly conservative estimate of two whales per year results in another 320 whales from 1701–1860. The majority of Nunavik harvests would have occurred in northeast Hudson Bay and Hudson Strait, however Inuit have reported bowhead occurrence during winter at some of the more southern islands on the east side of Hudson Bay (Low, 1906). Inuit on the Belcher Islands, in southeast Hudson Bay, reportedly have a historic tradition of bowhead whale hunting (L. Arragutainaq, Sanikiluaq Hunters and Trappers Organisation, pers. comm., 7 September 2007). Harvests in this region of Hudson Bay may thus have been higher than assumed here.

The total estimated harvest in Nunavut and Nunavik for the period 1651/1701 (depending on region) to 1860 is 3,530 whales (Table 6). The harvest series is based on scattered ethnographic accounts and a number of untestable assumptions. While these estimates are based on the best data available there is unfortunately no way to determine the level of bias. One source of negative bias is the at least occasional harvests in other regions. For example, in 1869 Inuit in Admiralty Inlet killed five large whales (Hall, 1876). It is unknown whether historic Inuit in this or other excluded regions harvested whales on a regular basis.

Labrador

Bowhead whaling was introduced to Labrador by Thule migrants at least by 1500 AD (Kaplan, 1985) and possibly as early as 1350 AD (Jordan, 1978). The estimated harvest between 1501 and 1700 AD was 1,000 whales (five per year), based on Taylor's (1988) data that showed an average of 4–5 whales per year were harvested during the early contact period (1771–84). Direct contact with Europeans before this time was minimal, and the early Moravian mission records used by Taylor (1988) represent a whaling complex that was aboriginal in all but a small number of technical adaptations (Taylor, 1979). A number of historical sources are available starting in the late-1700s, and these provide information on bowhead harvests during the historic period. In 1771, Moravian missionaries encountered Inuit who wanted to barter baleen (Hillier, 1967 in Schledermann, 1979), signifying a long-standing tradition of trade with Europeans. This suggests a continuation of active bowhead whaling between 1700 and the establishment of the Moravian missions in 1771. My estimated Labrador harvest for 1701–70 is thus 350 whales (i.e. five per year).

Labrador is unique relative to other eastern Arctic regions in that there are detailed historical accounts of native bowhead whaling. Taylor (1974; 1988) summarised known harvests in Labrador using Moravian mission documents; these data were updated with Brice-Bennett (1978) and Reeves et al. (1983). From 1771–1849 Labrador Inuit

harvested a minimum of 107 bowhead whales (plus another 36 struck and lost), and found 56 drift whales (which were likely struck and lost in Davis Strait before drifting to the Labrador coast) (Table 6).

West Greenland

Extensive contact between West Greenland Inuit and Europeans started with Danish-Norwegian colonisation in 1721 (Gad, 1973). For the harvest series, a harvest of five whales per year (Vaughn, 1984) for southwest Greenland is assumed for 1651–1721, for an estimated 355 whales. After colonisation some whale products were traded and therefore included in Danish-Norwegian commercial harvests. However, in many cases Inuit harvested whales and kept all products for their own use, so an average of three whales per year was assumed for the period 1722–70 (before the establishment of Danish shore stations, Gad, 1973). The total estimated West Greenland harvest for this 49-year period is 147 whales.

The Greenlandic hunt for bowhead whales lost its importance in the late 18th or early 19th century due to declining stocks, which prompted a shift to other large whales such as humpback whales (Caulfield, 1993; Kapel, 1979; Kapel and Petersen, 1982; Rink, 1877). In the mid- to late-1800s West Greenlanders averaged one bowhead whale per season (Rink, 1877), supplemented by several drift whale carcasses and one or two humpback whales. Assuming an average harvest of one bowhead per year from 1771–1900, results in an additional 130 whales taken, in addition to the cooperative harvests made with Danish shore-stations discussed previously.

Summary of historic period whaling

In summary, an estimated total of 4,655 whales were taken by Inuit in eastern Canada and West Greenland during the historic whaling period (Table 6).

Inuit harvests post-commercial whaling

In many areas, a tradition of native bowhead whaling that existed as recently as the late-1800s did not persist into the 20th century (Caulfield, 1993; Kapel, 1979; Kapel and Petersen, 1982; Reeves and Mitchell, 1985). Commercial overexploitation was undoubtedly a major factor in this discontinuation. However, after commercial whaling ended there were continued but sporadic Inuit harvests throughout the 20th century, often using equipment left by commercial whalers.

Mitchell and Reeves (1982) and Reeves *et al.* (1983) summarised known harvests and whales struck and lost after 1915. Additional records are available in Gaston and Ouellet (1997, 2000), and Richard (2000) containing comments by R.R. Reeves. In 1985 hunters shot a whale near Arviat in western Hudson Bay; it is unknown whether they killed the animal, but a carcass washed ashore nearby soon after (Stewart *et al.*, 1991). Only three whales were reported harvested in West Greenland during the 20th century (Kapel, 1979; Kapel and Petersen, 1982; Reeves and Heide-Jørgensen, 1996). One young (9–10m) bowhead whale was killed in a white whale net in northwest Greenland in autumn 1980 (Kapel, 1985), for a total known West Greenland kill of four whales post-commercial whaling. Nunavik Inuit reportedly captured a whale in 1979, but it was not killed and subsequently escaped, even after having some skin and blubber removed (A. Kullula and J. Peters, Makivik Corp., pers. comm., 14 March 2007), that was not included in the sources above. Other local Inuit have also reported that this event actually occurred in the 1960s, not the 1970s (Noble, 2008). In total, a minimum of 36 whales were killed, with another 14 struck and lost and three drift whales utilised, by Canadian and Greenland Inuit from 1918–1988. Documentation is sporadic and opportunistic, and these harvests represent minimum values. Most reports summarised by Mitchell and Reeves (1982) came from published sources (e.g. Degerbol and Freuchen, 1935; Sutton and Hamilton, 1932) or HBC post journals, and all are limited in time and space. Mitchell and Reeves (1982) suspected that considerably more whaling had taken place than was reported.

In recent years Canadian Inuit have been issued licenses to conduct subsistence harvests (DFO, unpublished data). In 1994 there was an unlicensed kill in northern Foxe Basin, and there have been licensed harvests since 1996. One whale was taken in each of 1996, 1998, 2000, 2003, and 2005. Three bowheads (two in Nunavut and one in Nunavik) were harvested in each of 2008 and 2009. West Greenland has recently obtained a quota of two strikes per year for the five years 2008–2012, with carry-over (IWC, 2008), and three whales were landed in 2009. In 2004 another bowhead was caught in a net in West Greenland; a kill was attempted but the whale escaped after being injured with rifles (Siku Circumpolar News Service, 2004). Prior to 2003 eight bowhead whales were reported entangled in nets in eastern Canada and West Greenland (DFO, unpublished data). Since that time an additional four whales have been reported to be entangled – two in 2005 and one in 2006 in Nunavut, and one in Disko Bay in 2003 (DFO, unpublished data). It is unknown if this 2003 report from West Greenland represents confusion with the whale that was reportedly entangled and then shot (but escaped) in 2004 (Siku Circumpolar News Service, 2004). The fates of these whales are unknown, but all reportedly disappeared with at least part of the net. However given that they were not shot at (except the 2003 or 2004 whale in West Greenland), they were not included as harvested whales in the catch series. Thus, the total (minimum) harvest between 1918 and 2009, for both eastern Canada (with no known harvests in Labrador) and Greenland combined, is 65 whales, including 14 struck and lost* (Table 6).

Summary of Inuit subsistence harvests

In total, an estimated 19,906 bowhead whales may have been harvested by Inuit in eastern Canada and West Greenland since 1200 AD (Table 6). Most (11,435 whales, 57%) were taken before commercial whaling became established *ca* 1530 AD. There are a number of assumptions included, based on limited and sometimes contradictory data, and unfortunately testing of these assumptions will be difficult. Inuit harvest levels post-1530 AD are small in relation to commercial harvests (Fig. 4), and harvests at these levels would have remained sustainable had commercial

*2010 harvests: two in Canada (DFO, unpublished data) and three in West Greenland (Heide-Jørgensen *et al.,* 2010).

overexploitation not significantly reduced the whale population.

TECHNOLOGICAL ADVANCES IN WHALING

The entire history of Arctic bowhead whaling can be considered 'traditional' whaling, in contrast to the 'modern' whaling of the late 1800s and 1900s. The technological differences between the two eras are profound. Modern whaling employed numerous technological advances including floating factories, harpoon cannons, and fast steam-powered catcher boats, enabling the capture of the fastest baleen whales. Bowhead whaling in the eastern Arctic utilised mainly hand harpoons from small man-rowed whaleboats, and, for almost its entire history, depended on sailing vessels to make their way through Arctic ice fields. Nonetheless, there were some technological advances throughout the history of bowhead whaling.

In the early years, vessels were usually multipurpose ships (de Jong, 1978). When ice fishing started off Spitsbergen in 1660, the Dutch and Germans started fortifying vessels with an extra layer of planks and extra beams and knees to resist the pressure of ice floes (de Jong, 1978). The British first tried fortifying a ship against the ice in 1790, but it was a failure as the ship was crushed (Jackson, 1978). The biggest technological advance in Arctic whaling vessels was the use of steam power to easier penetrate the Arctic ice. The first steam whaler sailed from Hull in 1857 (Jackson, 1978). Scotland had better luck with steamers than the English ports, and their whaling and sealing fleets quickly became dominated by steam-powered vessels. Between 1861 and 1881, the Scottish fleet changed from 13% to 95% steamers (Jackson 1978), including the entire Dundee fleet by 1873 (Clark, 1887; Jackson, 1978). During the second half of the 19th century, a small fleet of Scottish steamers regularly voyaged through the North Water (Dunbar, 1972; Vaughn, 1991). By the 1870s, Scottish vessels were predominately steam powered, and their catch rates were almost always higher than sailing vessels (Table 7). However, they did not consistently outperform sailing vessels and in some years sailing vessels caught more whales on average. That being said, even when the average catch per vessel was higher for sailing vessels, steam-powered vessels caught larger whales (Sanger, 1991). The large technological advances provided by steam vessels (chiefly the opportunity to penetrate further into the Canadian Arctic) occurred during the final days of the eastern Arctic bowhead hunt, when bowhead numbers were low. The vast majority of Arctic bowhead whales were taken by sailing vessels.

Most bowhead whales taken in eastern Arctic waters were caught using hand harpoons; harpoon cannons were never successfully used in this fishery. However, there were attempts by several nations to invent a suitable cannon. The Danes attempted to build their own several times from the 1760s to 1780s, and experimented with an English-built canon in the 1790s (Gad, 1982). Some British whalers had reportedly experimented with harpoon guns in the 1730s (Sanderson, 1956), again in the 1790s (Gad, 1982), and yet again in 1821 (Jenkins, 1971). Over time, the inventions improved in quality, but whalers generally preferred to use a hand harpoon. The harpoon cannon never became popular until the 'modern' whaling era (the modern harpoon gun, invented in 1860 by the Norwegian sailor Sven Foyn, came into popular use in the 1880s).

Table 7

Numbers of sail and steam powered vessels in British Davis Strait and East Greenland whaling 1865–1876, with total whale harvest and average catch per vessel, by vessel type (data from Clark, 1887).

	Number of vessels		Number of whales		Catch per vessel	
Year	Sail	Steam	Sail	Steam	Sail	Steam
1865	15	11	5	62	0.3	5.6
1866	13	15	42	37	3.2	2.5
1867	11	30	16	8	1.5	0.3
1868	12	18	23	111	1.9	6.2
1869	10	16	8	14	0.8	0.9
1870	8	14	18	61	2.3	4.4
1871	6	15	11	141	1.8	9.4
1872	5	17	9	125	1.8	7.4
1873	4	18	12	160	3.0	8.9
1874	3	16	0	190	0.0	11.9
1875	2	18	13	85	6.5	4.7
1876	3	17	5	77	1.7	4.5

Another whaling invention that improved catch efficiency was the tail knife. It came into use with both Danish and British whalers in the early nineteenth century (Gad, 1982; Scoresby, 1820). It was created to cut the whale's tendons and muscles, preventing it from using its tail. Greenland Inuit were reported to be extremely pleased with its efficiency (Gad, 1982).

STRUCK AND LOST RATES

All of the harvest estimates presented here are of the number of landed whales only, with no accounting for whales which were struck and lost (except for the recent Inuit harvests for which information is reported). Struck and lost animals include those which were harpooned and escaped (to presumably die), those that were killed but lost due to bad weather, breaking lines, etc, and those products that were on ships which sunk or burned. For population modelling, it is necessary to estimate the percentage of whales that were killed but not retrieved. Woodby and Botkin (1993) reported a 24% loss rate for the Bering Sea stock during the nineteenth century (i.e. 24% of the total struck not captured or about 1 in 4 whales struck but not landed). Mitchell (1977) used a 15% loss rate for Hudson Bay and a 20% loss rate for Davis Strait in his calculations of pre-exploitation bowhead population sizes. Mitchell and Reeves (1981) and Woodby and Botkin (1993) used similar values (also see IWC, 1992). In modelling the Spitsbergen bowhead stock, Allen and Keay (2006) used a loss rate of 20%. Those authors tested the sensitivity of their model, and an increase in loss rate to 25% or a decrease to 15% resulted in only slight changes (about 4%) to the pristine stock size estimate.

In the 1780s, the Danish Greenland colonists made a concerted effort to get the Greenlanders to stop whaling from umiaks due to high struck and loss rates (Gad, 1982). By 1788, Greenland Inuit employed in Danish whaling were all using the new 'European' methods with Danish sloops, ropes and tackle. Even with improved equipment, colony whalers lost a large number of whales. For example between December 1779 and mid-May 1780 whalers at Godhavn caught two whales but lost five (Gad, 1973). Klinowska and

Gerslund (1983) summarised struck and lost rates at three Danish shore stations for 1800–1801, and loss rates ranged from 21% to 75% (eight landed and six lost at the Vester Eiland station). For the three stations combined, a total of 28 whales were landed and 13 were struck and lost (overall loss rate 46%). Of these 13 whales, two were definitely dead; and a third was lost with five harpoons and four lines attached and assumed moribund (Klinowska and Gerslund, 1983). Two additional whales were reported lost at Ritenbank (a secondary report from the Godhavn daybook). In recent years (since the mid-1990s) about 80% of the bowheads struck by Alaskan subsistence whalers are landed (Suydam *et al.*, 2007), although in the past up to half those struck were lost (Hess, 1998). Technological and methodological improvements have resulted in this increase in the proportion of whales landed, but the majority of struck but lost whales are considered to have a poor chance of survival (Suydam *et al.*, 2006; 2007).

In the 1700s and 1800s, French whalers targeting Southern right whales (*Eubalaena australis*), a closely related species with similar characteristics and behaviour lost 30–40% of the whales struck (Du Pasquier, 1986). Reeves and Mitchell (1986) used loss rate factors of 1.25–1.57 for American pelagic whaling for North Atlantic right whales. The factor of 1.57 was calculated for the northern Cape Farewell Ground, which would be most similar in environmental conditions to the bowhead whaling grounds, but this was based on few data (13 whales captured, six killed but lost, and one struck but lost). The IWC has used correction factors of 1.2–1.6 for assessments of global right whale populations (IWC, 1986; 2001). These correction factors may be too low, given that Scarff (2001) estimated a struck-lost correction factor of 2.4 for pre-modern ship-based whaling for Pacific right whales (*Eubalaena japonica*). Hacquebord (2005) suggested that the Basques caught approximately 300 whales per year in Grand Bay, but struck and lost another 150 (i.e. a correction factor of 1.5). Bad weather was a factor in the loss of killed whales. In 1852, a British whaler caught four whales along the northwest Baffin Island coast, but severe weather caused three to break adrift from the boat and be lost (Reeves *et al.*, 1983). In some years large numbers of ships were lost, often with cargoes on board. At least 82 ships were lost in Davis Strait from 1819–1843 (Mitchell and Reeves, 1981). The population modelling exercises undertaken as part of the IWC's AWMP consider the sensitivity of varying struck and lost rates; it should be noted that it is likely that they were higher than the 15–20% used previously (Mitchell and Reeves, 1981; Mitchell, 1977; Woodby and Botkin, 1993), at least for some nations and eras.

AGE AND SEX SEGREGATION OF HARVESTS

Bowhead whales exhibit considerable age- and sex-based segregation in their spatiotemporal distribution (Dueck *et al.*, 2006; Finley, 1990; Heide-Jørgensen *et al.*, 2006). In Disko Bay, West Greenland, few calves or juvenile whales have been observed in recent decades, and this pattern is consistent with observations made during the commercial whaling period (Eschricht and Reinhardt, 1866; Heide-Jørgensen *et al.*, 2007). Most (85%) bowhead whales in Disko Bay in spring are large adult females >14m long that are unaccompanied by calves (Heide-Jørgensen *et al.*, 2007; Laidre *et al.*, 2007). Foxe Basin is an important nursery area and is characterised by a large proportion of juvenile whales and cows with calves (Cosens and Blouw, 2003). Commercial whalers did not enter Foxe Basin so it is unknown whether this population structure was the same historically.

Klinowska and Gerslund (1983) suggested that the Disko Bay region was a calving ground, based on the catch of a pregnant female in April 1801 (also see Eschricht and Reinhardt, 1866) in addition to the catch of a very small calf in May of the same year. This animal was reportedly *ca* 3.8m long (12 Danish feet, or 'fod'), with baleen 0.9m long (3 fod). The foetus from the pregnant female was reported to be 4.7m long (Eschricht and Reinhardt, 1866; Klinowska and Gerslund, 1983), considerably larger than the young calf. The baleen plates were also significantly longer than reported for bowhead calves from Alaska (60cm, George and Suydam, 2006). However, the Danish logs gave measurements to the nearest 10 fod (3.14m) (Klinowska and Gerslund, 1983) and the length was probably overestimated. Historical body length data are also difficult to compare with modern data due to differences in the way measurements were taken. Until the modern era, length was typically measured along the body contour rather than in a straight line. Given the gestation lengths of bowhead whales (Koski *et al.*, 1993) and the fact that most bowhead whales currently observed in West Greenland are large adult females (Heide-Jørgensen *et al.*, 2007; Laidre *et al.*, 2007), it is not surprising that pregnant females were found there in spring. Alaskan bowhead calves are usually born between early April and early June (Koski *et al.*, 1993) and births have been observed in Foxe Basin as late as June (NWMB, 2000). However, most calves are born before the females arrive in the Foxe Basin nursery.

There are limited data available on the sex and age composition of commercial bowhead whale harvests in Hudson Bay. Reeves and Cosens (2003) summarised data from logbooks of American whalers from 1862–1905 and provided the age and sex of 164 whales that were struck, killed or sighted. All age classes were represented, with calves making up *ca* 16%, subadults 32% and adults 52% of the harvests. Sex was not reported for the majority of adult whales (64 of 85), but most with data were females (17 of 21 adult whales). Northwestern Hudson Bay may have been a historically important nursery area.

Some data are also available on British catches in Baffin Bay. On the 'south-west fishing' ground whales of both sexes were taken and they were usually large (Duncan, 1827; Lubbock, 1937; Reeves *et al.*, 1983). Finley and Darling (1990) analysed data from the logbook from the whaling vessel *Cumbrian* in 1823 (also in Lubbock, 1937; Reeves *et al.*, 1983). This vessel took adult whales of both sexes (at a near 50:50 ratio) in addition to calves. Excluding calves (known by whalers as 'suckers'), males ranged in size from 9.1 to 16.2m, and females were generally larger (12.8–17.1m). Reeves *et al.* (1983) summarised data from the *Abram* in 1839, which took large whales up to 18m long (Finley and Darling, 1990) on the rock-nosing grounds along the east coast of Baffin Island. This 'rock-nosing' was a specialised bowhead whale fishery that occurred along the east Baffin coast in the autumn and was directed at large

whales. In 1827, the *Cumbrian* took 18 whales which were all adults (> 13.7m), and these whales may have been taken along the east coast of Baffin Island (Finley and Darling, 1990). In 'close-seasons' heavy ice conditions excluded whales and whalers from Lancaster Sound. In these years whalers typically encountered large numbers of small whales along the Lancaster Sound ice edge, and total yields were lower due to the prevalence of small whales (Finley and Darling, 1990; Lubbock, 1937; Reeves *et al.*, 1983). Spring whales taken at the floe edge in Cumberland Sound were generally small, but those taken in the fall were usually large (Reeves *et al.*, 1983).

Klinowska and Gerslund (1983) provide total length data for nine whales harvested in Disko Bay (the 'east side' grounds) in 1800–1801, including the calf noted above. The other eight whales were all large adults ranging in size from 15.7 to over 25m. This 25m animal is considerably larger than contemporary adult whales and most likely represents an overestimation due to rounding up and/or different measurement techniques. Two additional whales had baleen lengths over 2.51m (8 fod), and two had baleen lengths over 3.14m (10 fod); thus also representing adult whales. The calf noted above was captured at the same time as an adult whale over 18m long (but again note the potential for significant rounding errors and differences in the way measurements were taken). These limited data suggest that the historical bowhead population in West Greenland was similar to that observed there today, i.e. mostly large adult females (Heide-Jørgensen *et al.*, 2007; Laidre *et al.*, 2007).

The average yields recorded during the later stages of the Baffin Bay fishery (post-1860), after the introduction of steam power, suggest that the industry was processing smaller whales, a similar pattern to that observed on the Spitsbergen grounds (Finley, 1990; Finley and Darling, 1990). During the 1870s, steam-powered vessels were able to penetrate the 'nursery grounds' in Prince Regent Inlet (Ross, 1985). Markham (1874) presented baleen length data on whales taken by the *Arctic* in 1873, mostly from Prince Regent Inlet (also in Finley and Darling, 1990; Sanger, 1991). The harvest again comprised calves and large whales, with a sex ratio of non-calves approaching 50:50. Total whale length was estimated using baleen length data and the regression equation of Lowry (1993). Females taken ranged from *ca* 6m to over 16m in length, while males were slightly smaller, up to *ca* 15.8m. Sanger (1991: Table 2) summarised the baleen lengths of 31 whales harvested by 16 Scottish steam voyages to Davis Strait between 1885 and 1890, of which 29 were adults. Most whales currently observed during autumn in Isabella Bay (Baffin Bay) are large adults >13m long (Finley, 1990), suggesting that current segregation patterns are similar to those historically.

Cumbaa (1986) examined bones from the Basque whaling station at Red Bay and nearly all were from adult whales. Only one young animal (8–9m total length) was found in 17 individual whales assessed but there was a large range in size. One or two bones may have come from a foetal whale, suggesting that pregnant females may have been harvested. The two distinct whaling seasons of the Basques, which were historically thought to refer to right whales (summer) and bowhead whales (autumn), may have resulted from sex- and/or age-based segregation and migration of the bowhead population (McLeod *et al.*, 2008).

Sex ratios in the Baffin Bay fishery approached 50:50, and the size of whales harvested declined towards the end of the commercial whaling period. The use of steam-powered vessels (chiefly by the Scottish fleet) in the late 1800s allowed whalers to penetrate further into the Canadian Arctic and enter the Prince Regent Inlet nursery grounds, which may have resulted in an increased harvests of calves and juveniles towards the later stages of the fishery. A higher proportion of calves were taken in Hudson Bay, with a higher proportion of subadults taken in Baffin Bay and a similar proportion of adults taken on both grounds. This pattern is possibly due to northwest Hudson Bay being an important historical nursery ground. Basque harvests in Labrador require further study, but limited evidence suggests that mostly adult whales were taken. Early Thule whalers took mostly juvenile and subadult whales (McCartney and Savelle, 1985; 1993; Savelle and McCartney, 1991; 1994), but the size of whales taken by Inuit hunters after *ca* 1500 AD has not been well documented. In Labrador during the late 1700s a variety of age classes were taken, ranging from juveniles to large adults (Taylor, 1974; 1988). Inuit hunters in the High Arctic also appear to have at least occasionally taken larger whales (e.g. five large whales in Admiralty Inlet in 1869; Hall, 1876).

DATA QUALITY

The harvest data included here are compiled from a variety of sources, and there is considerable variation in the quality and availability of harvest data. For certain nations and eras (e.g. Dutch after 1719, English after 1814) harvests are based on 'hard data' on the number of vessels and whale yield (oil and/or baleen or actual number taken). These harvests can be considered the most accurate and reliable, but even with these data there are a number of assumptions and uncertainties. Harvest estimates are often based on assumptions of typical whale yield and the number of whales is estimated based on oil and/or baleen data. In his summary of whale catches, Ross (Ross, 1979a: 118) was careful to note that '[p]rinted figures tend to possess an air of unassailable reliability. The impressive columns of numbers …by their smug, self-confident appearance, may suggest a degree of accuracy that is in fact entirely unwarranted'.

For many nations and eras, time series data of vessel numbers and whale products obtained are not available. For these harvests it was necessary to employ a number of assumptions that may not be accurate. Harvest data was therefore scored for data quality and reliability on a three-point scale as follows:

(1) Most reliable, harvest data from published peer-reviewed studies with annual data on harvests (either number of whales or yield in oil and/or baleen) and number of vessels if applicable (commercial harvests), with harvests west of Greenland explicitly separated from those on the Spitsbergen grounds. Examples of 'most reliable' harvest data include those made by American whalers after 1846 (Ross, 1979a), Dutch after 1719 (de Jong, 1978; Ross, 1979a), English after 1814 (Ross, 1979a; Sanger, unpublished data), Scottish after 1750 (Sanger, 1985), German harvests after 1719 (de Jong, 1978; Ross, 1979a), and Inuit harvests in Labrador from

1771–1849 (Brice-Bennett, 1978; Reeves *et al.*, 1983; Taylor, 1974; 1988) and those during the 1900s after commercial whaling ended (DFO, unpublished data; Gaston and Ouellet, 1997 J. Peters and A. Kulula pers. comm; Kapel, 1979; 1985; Kapel and Petersen, 1982; Mitchell and Reeves, 1982; NWMB, 2000; Reeves *et al.*, 1983; Reeves and Heide-Jørgensen, 1996; Richard, 2000; Siku Circumpolar News Service, 2004; Stewart *et al.*, 1991).

These Inuit harvests should not be considered 'complete', but they are based on actual documentation and are thus 'more reliable' than the estimates made in this paper for other regions and eras using average harvests based on bone availability. Additionally, despite the commercial data generally being considered 'most reliable', a number of uncertainties exist as discussed previously (e.g. assuming oil or bone came exclusively from bowheads and not also humpbacks or right whales, incomplete records, limited temporal or port coverage, etc).

(2) Moderately reliable, some data available on either whale yields or vessel numbers, but not separated into the Davis Strait and Spitsbergen grounds or with no catch/vessel data. Harvests were assigned to the Davis Strait fishery based on assumptions on effort and harvest efficiency (catch/vessel) from other nations or using an even 50:50 split. Examples of 'moderately reliable' harvest data include early English harvests (estimated using vessel and product data from Jackson, 1978 and a number of assumptions), and Danish shore-station whaling in West Greenland between 1721 and 1807 (using data from Gad, 1973; 1982 and a number of assumptions).

(3) Least reliable, harvests estimated using a variety of disparate data sources and assumptions, and not based on any actual time series data of vessel numbers or whale products. The 'least reliable' harvest data here include those of the Basques in the Strait of Belle Isle and Gulf of St. Lawrence, all Inuit harvests excluding those noted above, and Danish catches in West Greenland from 1808 to the late 1800s (using assumed average harvests from Vaughn, 1984).

Table 8 summarises the estimated harvests by era and nation and the reliability of the data. The 'most reliable' data (score = 1) include a total estimated harvest of 31,136 whales between 1719 and 1915. Over half of the total compiled harvests (31,435–42,664 whales, depending on estimated Basque harvest) are based on a number of assumptions and are considered the 'least reliable'.

SUMMARY, CONCLUSIONS AND DIRECTIONS FOR FURTHER RESEARCH

The history of bowhead whaling in the waters of eastern Canada and West Greenland is long and varied, and I have attempted to compile all readily available harvest data. However this compilation was limited mainly to published sources (the exception being some of C. Sanger's British data), and no archival material was examined. There is additional information available in museums and archives (e.g. the daybooks of the Royal Greenland Trade, Eschricht and Reinhardt, 1866; Klinowska, 1982; Klinowska and Gerslund, 1983). However, such detailed historical research was beyond the scope of this project and much painstaking research will be needed to fill gaps in the harvest series, which will never be truly complete. Nonetheless, the harvest data presented here (Figs 2–5, Tables 4, 6, 8) represent an improvement over de Jong (1978) and Ross (1979a), which were previously the most complete harvest series available. Using this revised harvest series will improve estimates of pre-exploitation population size over previous attempts (Mitchell and Reeves, 1981; Mitchell, 1977; Woodby and Botkin, 1993).

The quality of catch reporting varies considerably between different nations and eras. Dutch data are among the most extensive and accurate; however there are differences between the harvest series provided by different sources (de Jong, 1978; 1983 vs.; Ross, 1979a). Similar situations exist for both British (Ross, 1979a vs.; Sanger, unpublished) and German (de Jong, 1983 *vs*. Ross, 1979a) whaling. The differences are small and mostly reflect varying assumptions about the oil and baleen yield of an average bowhead and differences in deciphering historical documents. In Table 3,

Table 8

Summary of commercial and Inuit subsistence harvests of bowhead whales in eastern Canada and West Greenland since 1530 AD, with estimates of data quality.

Nation	Era	Harvest	Data quality	Source(s)
Basque	1530–1713	22,454–33,683	3	Numerous assumptions (see text)
Dutch	1719–1826	7,699	1	de Jong (1983); Ross (1979a)
Scottish	1750–1813	1,519	1	Sanger (1985; unpublished data)
English	1750–1800	1,292	2	Jackson (1978) and assumptions
English (HBC)	1767–1772	6	1	Ross (1979a)
British (Scottish and English)	1814–1911	20,312	1	Ross (1979a); Sanger (unpublished data)
English (HBC trade)	1737–1800	115	1	Barr (1994)
German	1719–1792	332	1	de Jong (1983); Ross (1979a)
Danish-Norwegian	1721–1776	95	2	Gad (1973)
	1777–1807	429	2	Gad (1982)
	1808–1890	718	3	Vaughn (1984) and assumptions
American	1846–1915	945	1	Ross (1979a)
Inuit (excl. Labrador 1771–1849)	1530–1917	8,263	3	Numerous assumptions (see text)
Labrador Inuit	1771–1849	143	1	Brice-Bennett (1978); Reeves *et al.* (1983); Taylor (1974; 1988)
Inuit post-commercial whaling	1918–2009	65	1	DFO (unpublished data); Gaston and Ouellet (1997); Kapel (1979; 1985); Kapel and Peterson (1982); Mitchell and Reeves (1982); NWMB (2000); J. Peters and A. Kulula (pers. comm.); Reeves *et al.* (1983); Reeves and Heide-Jørgensen (1996); Richard (2000); Siku Circumpolar News Service (2004); Stewart *et al.* (1991)

the total commercial harvest estimate is based on the source with the highest recorded harvest, with yearly gaps filled in using other sources where appropriate.

For Basque whaling, a complete catch series is unavailable, although some relevant information undoubtedly exists in French-language materials (Du Pasquier, 2000; 1982). The Basques were active in the Strait of Belle Isle and Gulf of St. Lawrence from *ca* 1530 AD and the fishery peaked in the mid-1500s (Barkham, 1984). The vast majority of harvested whales were bowheads (McLeod *et al.*, 2008; 2006; Rastogi *et al.*, 2004). Peak harvests in the range of 300–500 whales per year have been estimated (Aguilar, 1986; Barkham, 1984; this study). Basque whalers also fished in Davis Strait in the 1700s, at least sporadically, but harvests are unknown. There are no data concerning Dutch Davis Strait whaling prior to 1719 (de Jong, 1978; 1983; Ross, 1979a). A similar situation exists with the German harvest series (de Jong, 1983; Ross, 1979a), which is not only limited in temporal coverage but also with incomplete port coverage. No complete history of Danish whaling at the West Greenland colonies has been written. The summaries of Gad (1973; 1982) and Vaughn (1984) presented here are only an initial step towards establishing a catch history for this phase of whaling.

Data on British harvests in Davis Strait for 1750–1801 are available for Scottish harvests only (Sanger, 1985) and after 1814 for both English and Scottish harvests (Ross, 1979a; 1993; Sanger, unpublished data). Data on vessels and whales harvested are also available for Scottish whaling only from 1802–1813 (Sanger, unpublished data). Jackson (1978) provides limited data on English harvests from 1750–1800. A number of assumptions resulted in the estimated English whale kill for those years (Table 2). This is a slight improvement over previous compilations containing no estimates, but it is no substitute for detailed historical research. Another source of British whale products was trade between Inuit and the HBC. Barr (1994) summarised data for 1737–1800, which included the baleen from *ca* 115 whales. While these data assist in providing a more complete harvest series, they again do not summarise the entire trade.

Ross (1979a) provides American Davis Strait whaling after 1846 and in Hudson Bay from 1860. However, this series is missing harvests from the first American whaling trips to Davis Strait in the 1700s. Best (1987) provides an estimate of 248–291 bowheads taken by American whalers from 1815–19. This occurred previous to the American expansion into the Pacific grounds, so these whales were possibly harvested in Davis Strait by right and sperm whaling vessels. However they could have been taken east of Greenland as well, and given this uncertainty they have not been included in my harvest series. After the Basques left the Strait of Belle Isle and Gulf of St. Lawrence Canadian colonists conducted sporadic whaling there (Reeves and Mitchell, 1986). At least some bowheads may have been taken (Bonnycastle's 1842 statement that whales taken in Newfoundland waters included 'the largest mysticetus or great common oil whale of the northern oceans, which occasionally visits these waters', Clark, 1887: 217).

Inuit throughout eastern Canada and West Greenland have harvested bowhead whales for centuries. Knowledge of the total Inuit harvest will always be elusive but there are some

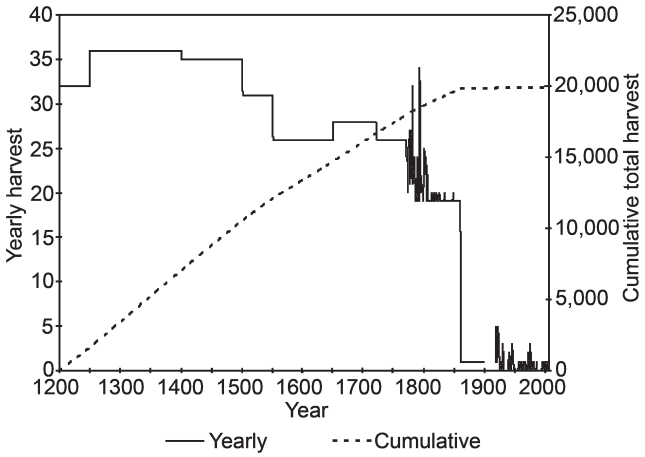

Fig. 3. Estimated yearly and cumulative Inuit harvests of bowhead whales in the eastern Canadian Arctic and West Greenland from 1200–2009 AD. Pre-1500 harvests represent the classic Thule culture, and the majority of Inuit harvests occurred during this time, prior to the establishment of commercial whaling *ca* 1530 AD.

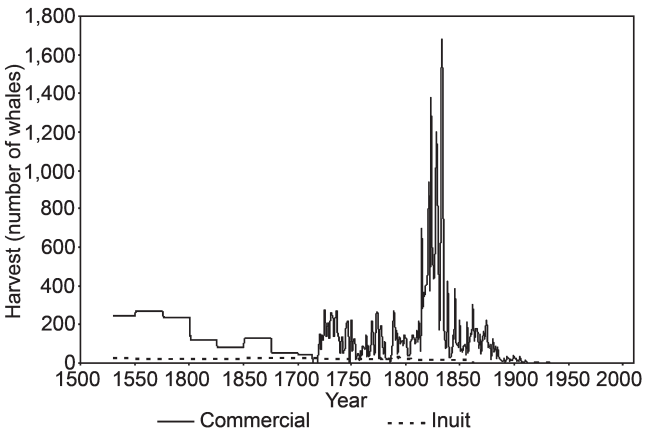

Fig. 4. Comparison of commercial and Inuit subsistence harvest levels of bowhead whales in the eastern Arctic, 1530–2009 AD. Commercial harvests assume peak Basque whaling effort of 25 vessels per year.

data. The total estimated Inuit harvest from 1200–2009 AD is 19,906 whales (Fig. 3, Table 6 but see Savelle (in review) for higher estimated Classic Thule harvests). The majority (57%) were harvested prior to the start of commercial whaling *ca* 1530 AD. Low numbers were reported harvested after the cessation of commercial whaling in the early 1900s, but additional unreported Inuit whaling likely took place (Mitchell and Reeves, 1982; see NWMB, 2000).

An estimated harvest of almost 20,000 animals may sound unreasonably high; however this took place over *ca* 800 years and never exceeded an estimated 36 whales per year (during the peak of the classic Thule period). In most years, harvests were considerably lower, and even during peak years Inuit harvests paled in comparison to those made by commercial whalers (Fig. 4). Inuit harvests alone would not have negatively impacted a healthy bowhead population and would have remained sustainable if commercial whalers had not reduced the species to such low numbers. With an annual growth rate of 3–4% (George *et al.*, 2004), a pristine population of 10,000 whales (likely an underestimate; Woodby and Botkin, 1993) would produce far more calves per year than the number of young whales taken for

subsistence purposes. Even if this harvest series significantly underestimates true harvest levels (Savelle, in review), there would likely have been little effect on bowhead population size in the absence of commercial harvests.

Estimated Inuit harvests, as summarised in Fig. 3, show little annual variation, except for Labrador harvests during the early contact period (when Moravian missionaries kept detailed records). The Inuit harvest series for the remaining regions and time periods (and also for Basque whaling) is based on estimated average yearly harvests and ignore the variability that undoubtedly occurred.

The Inuit harvest series is based on limited data and a number of assumptions which will be extremely hard to test. One method which may be used to better quantify the importance of bowhead whales over time is the use of stable isotopes. Coltrain *et al.* (2004) used stable isotope signatures of skeletal remains to measure the importance of different species to modified Thule whalers in Hudson Bay. Bowhead whales accounted for approximately 12% of the total dietary intake. Without similar data from other regions and time periods it is difficult to convert this to an estimate of the number of whales used or how the importance of bowhead whales changed over time. Analyses of isotopic signatures of classic Thule remains, perhaps from Somerset Island, would assist in quantifying the importance of bowhead whales over time. Another pertinent research avenue would be examination of skeletal remains from Labrador Inuit. Analysis of remains from *ca* 1500 to the mid-1800s could be used in conjunction with the detailed harvest series in the Moravian mission documents (Taylor, 1974; 1988) to better assess the importance of bowhead whales over time. However an assessment such as this still would not incorporate the importance of bowhead whale oil as fuel.

Overall, the combined commercial and Inuit harvests in eastern Canada and West Greenland since 1530 AD was estimated at 70,008 whales (Fig. 5, Tables 3, 6, also Appendix 1). The manuscript includes little information on the numbers of vessels and/or catch per voyage data are available for some whaling nations and/or periods (see Appendix 1), but not all (and those with said data are considered the 'most reliable', Table 8). This harvest series can now be used with a population model to improve past estimates of pre-exploitation population size. All whale harvests reported here are landed whales only, with no accounting for struck and lost whales (with the exception of recent Inuit harvests as discussed above). During population modelling and assessment it will be necessary to explore various assumptions regarding struck and loss rates, noting that rates of 15–20% used previously (Mitchell, 1977) may be too conservative. Overall, the use of this expanded harvest series and more detailed modelling techniques, will provide more accurate estimates of pre-whaling population size and improve conservation and recovery planning for eastern Canada-West Greenland bowhead whales.

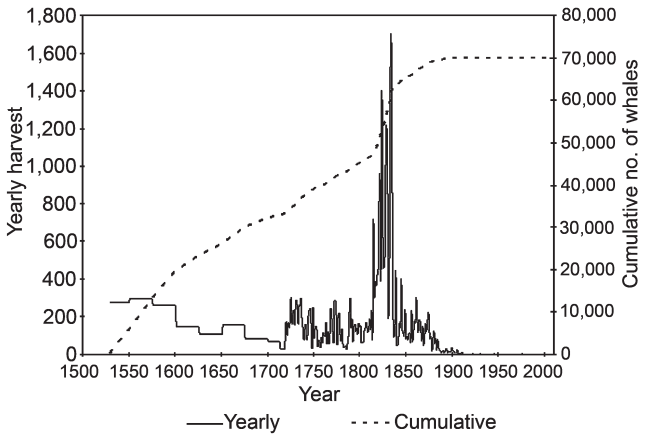

Fig. 5. Total yearly and cumulative harvest of bowhead whales in eastern Canada and West Greenland, 1530–2009 AD, combining commercial and Inuit harvests (assuming 25 Basque vessels per year during peak).

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Appendix 1

Harvest series for bowhead whales in eastern Canada and West Greenland, from 1530 to 2009 AD, assuming 25 Basque vessels per year at the peak of their whaling activities in the Gulf of St. Lawrence/Strait of Belle Isle. Catch per vessel (CPV) data is provided where available. The summary is known to be incomplete in many cases and is based on a number of assumptions and disparate data sources, as discussed in the text.

		Dutch		Scottish		English		Hudson's Bay Company		German			American			
Year	Basque	Whales	CPV	Whales	CPV	Whales	CPV	Whaling	Trade	Whales	CPV	Danish	Whales	CPV	Inuit	Total
1530	246	–	–	–	–	–	–	–	–	–	–	–	–	–	31	277
1531	246	–	–	–	–	–	–	–	–	–	–	–	–	–	31	277
1532	246	–	–	–	–	–	–	–	–	–	–	–	–	–	31	277
1533	246	–	–	–	–	–	–	–	–	–	–	–	–	–	31	277
1534	246	–	–	–	–	–	–	–	–	–	–	–	–	–	31	277
1535	246	–	–	–	–	–	–	–	–	–	–	–	–	–	31	277
1536	246	–	–	–	–	–	–	–	–	–	–	–	–	–	31	277
1537	246	–	–	–	–	–	–	–	–	–	–	–	–	–	31	277
1538	246	–	–	–	–	–	–	–	–	–	–	–	–	–	31	277
1539	246	–	–	–	–	–	–	–	–	–	–	–	–	–	31	277
1540	246	–	–	–	–	–	–	–	–	–	–	–	–	–	31	277
1541	246	–	–	–	–	–	–	–	–	–	–	–	–	–	31	277
1542	246	–	–	–	–	–	–	–	–	–	–	–	–	–	31	277
1543	246	–	–	–	–	–	–	–	–	–	–	–	–	–	31	277
1544	246	–	–	–	–	–	–	–	–	–	–	–	–	–	31	277
1545	246	–	–	–	–	–	–	–	–	–	–	–	–	–	31	277
1546	246	–	–	–	–	–	–	–	–	–	–	–	–	–	31	277
1547	246	–	–	–	–	–	–	–	–	–	–	–	–	–	31	277
1548	246	–	–	–	–	–	–	–	–	–	–	–	–	–	31	277
1549	246	–	–	–	–	–	–	–	–	–	–	–	–	–	31	277
1550	246	–	–	–	–	–	–	–	–	–	–	–	–	–	31	277
1551	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1552	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1553	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1554	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1555	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1556	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1557	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1558	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1559	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1560	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1561	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1562	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1563	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296

Cont.

		Dutch		Scottish		English		Hudson's Bay Company		German			American			
Year	Basque	Whales	CPV	Whales	CPV	Whales	CPV	Whaling	Trade	Whales	CPV	Danish	Whales	CPV	Inuit	Total
1564	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1565	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1566	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1567	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1568	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1569	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1570	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1571	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1572	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1573	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1574	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1575	270	–	–	–	–	–	–	–	–	–	–	–	–	–	26	296
1576	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1577	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1578	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1579	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1580	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1581	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1582	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1583	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1584	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1585	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1586	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1587	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1588	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1589	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1590	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1591	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1592	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1593	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1594	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1595	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1596	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1597	234														26	260
1598	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1599	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1600	234	–	–	–	–	–	–	–	–	–	–	–	–	–	26	260
1601	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1602	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1603	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1604	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1605	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1606	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1607	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1608	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1609	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1610	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1611	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1612	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1613	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1614	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1615	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1616	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1617	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1618	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1619	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1620	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1621	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1622	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1623	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1624	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1625	120	–	–	–	–	–	–	–	–	–	–	–	–	–	26	146
1626	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1627	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1628	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1629	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1630	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1631	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1632	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1633	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1634	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1635	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1636	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1637	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110

Cont.

		Dutch		Scottish		English		Hudson's Bay Company		German			American			
Year	Basque	Whales	CPV	Whales	CPV	Whales	CPV	Whaling	Trade	Whales	CPV	Danish	Whales	CPV	Inuit	Total
1638	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	116
1639	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1640	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1641	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1642	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1643	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1644	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1645	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1646	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1647	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1648	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1649	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1650	84	–	–	–	–	–	–	–	–	–	–	–	–	–	26	110
1651	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1652	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1653	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1654	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1655	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1656	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1657	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1658	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1659	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1660	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1661	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1662	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1663	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1664	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1665	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1666	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1667	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1668	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1669	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1670	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1671	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1672	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1673	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1674	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1675	132	–	–	–	–	–	–	–	–	–	–	–	–	–	28	160
1676	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1677	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1678	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1679	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1680	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1681	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1682	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1683	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1684	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1685	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1686	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1687	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1688	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1689	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1690	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1691	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1692	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1693	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1694	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1695	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1696	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1697	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1698	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1699	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1700	54	–	–	–	–	–	–	–	–	–	–	–	–	–	28	82
1701	43	–	–	–	–	–	–	–	–	–	–	–	–	–	28	71
1702	43	–	–	–	–	–	–	–	–	–	–	–	–	–	28	71
1703	43	–	–	–	–	–	–	–	–	–	–	–	–	–	28	71
1704	43	–	–	–	–	–	–	–	–	–	–	–	–	–	28	71
1705	43	–	–	–	–	–	–	–	–	–	–	–	–	–	28	71
1706	43	–	–	–	–	–	–	–	–	–	–	–	–	–	28	71
1707	43	–	–	–	–	–	–	–	–	–	–	–	–	–	28	71
1708	43	–	–	–	–	–	–	–	–	–	–	–	–	–	28	71
1709	43	–	–	–	–	–	–	–	–	–	–	–	–	–	28	71
1710	43	–	–	–	–	–	–	–	–	–	–	–	–	–	28	71
1711	43	–	–	–	–	–	–	–	–	–	–	–	–	–	28	71

Cont.

		Dutch		Scottish		English		Hudson's Bay Company		German			American			
Year	Basque	Whales	CPV	Whales	CPV	Whales	CPV	Whaling	Trade	Whales	CPV	Danish	Whales	CPV	Inuit	Total
1712	43	–	–	–	–	–	–	–	–	–	–	–	–	–	28	71
1713	43	–	–	–	–	–	–	–	–	–	–	–	–	–	28	71
1714	–	–	–	–	–	–	–	–	–	–	–	–	–	–	28	28
1715	–	–	–	–	–	–	–	–	–	–	–	–	–	–	28	28
1716	–	–	–	–	–	–	–	–	–	–	–	–	–	–	28	28
1717	–	–	–	–	–	–	–	–	–	–	–	–	–	–	28	28
1718	–	–	–	–	–	–	–	–	–	–	–	–	–	–	28	28
1719	–	43	1.5	–	–	–	–	–	–	1	0.3	–	–	–	28	72
1720	–	145	2.3	–	–	–	–	–	–	7	1.2	–	–	–	28	180
1721	–	65	0.6	–	–	–	–	–	–	8	0.5	1	–	–	28	102
1722	–	136	2	–	–	–	–	–	–	11	1.8	1	–	–	26	174
1723	–	113	2.5	–	–	–	–	–	–	5	1.3	1	–	–	26	145
1724	–	135	2.3	–	–	–	–	–	–	6	3	3	–	–	26	170
1725	–	251	3.1	–	–	–	–	–	–	27	3	1	–	–	26	305
1726	–	114	1	–	–	–	–	–	–	23	1	0	–	–	26	163
1727	–	179	1.8	–	–	–	–	–	–	14	0.7	1	–	–	26	220
1728	–	199	2.2	–	–	–	–	–	–	14	1.6	0	–	–	26	239
1729	–	122	1.3	–	–	–	–	–	–	9	1.1	0	–	–	26	157
1730	–	214	2.6	–	–	–	–	–	–	8	1	1	–	–	26	249
1731	–	255	2.6	–	–	–	–	–	–	6	0.5	2	–	–	26	289
1732	–	219	1.6	–	–	–	–	–	–	15	0.8	1	–	–	26	261
1733	–	136	1.2	–	–	–	–	–	–	1	0.2	1	–	–	26	164
1734	–	230	2.5	–	–	–	–	–	–	6	0.8	1	–	–	26	263
1735	–	226	2.2	–	–	–	–	–	–	6	1.5	2	–	–	26	260
1736	–	269	2.9	–	–	–	–	–	–	1	1	3	–	–	26	299
1737	–	151	1.7	–	–	–	–	–	1	4	1	4	–	–	26	186
1738	–	115	1.6	–	–	–	–	–	1	–	–	0	–	–	26	142
1739	–	52	0.9	–	–	–	–	–	1	–	–	0	–	–	26	79
1740	–	114	3.5	–	–	–	–	–	1	–	–	0	–	–	26	141
1741	–	137	4	–	–	–	–	–	1	1	1	0	–	–	26	165
1742	–	50	1	–	–	–	–	–	1	2	2	0	–	–	26	79
1743	–	76	1.5	–	–	–	–	–	1	–	–	2	–	–	26	105
1744	–	183	4.7	–	–	–	–	–	1	–	–	0	–	–	26	210
1745	–	207	6.7	–	–	–	–	–	1	–	–	4	–	–	26	238
1746	–	217	5.4	–	–	–	–	–	1	–	–	5	–	–	26	249
1747	–	132	3.6	–	–	–	–	–	1	4	4	4	–	–	26	167
1748	–	0	0	–	–	–	–	–	1	–	–	6	–	–	26	33
1749	–	206	5	–	–	–	–	–	3	16	4	0	–	–	26	251
1750	–	58	1.3	–	–	–	–	–	2	2	0.5	2	–	–	26	90
1751	–	67	1.5	5	5	32	–	–	1	5	1	0	–	–	26	136
1752	–	108	2.6	4	4	2	–	–	1	9	1.8	4	–	–	26	154
1753	–	100	2.1	2	2	0	–	–	2	3	1	0	–	–	26	133
1754	–	18	0.5	0	0	0	–	–	1	0	0	0	–	–	26	45
1755	–	41	1.4	0	0	0	–	–	1	–	–	9	–	–	26	77
1756	–	40	1.5	–	–	0	–	–	1	–	–	0	–	–	26	67
1757	–	10	0.5	–	–	0	–	–	5	–	–	0	–	–	26	41
1758	–	66	8.3	–	–	0	–	–	1	–	–	0	–	–	26	93
1759	–	39	1.8	–	–	0	–	–	1	0	0	0	–	–	26	66
1760	–	78	5.2	–	–	0	–	–	2	10	3.3	0	–	–	26	116
1761	–	70	3	–	–	0	–	–	2	7	2.3	0	–	–	26	105
1762	–	66	2.4	–	–	0	–	–	1	4	1.3	0	–	–	26	97
1763	–	132	3.8	–	–	0	–	–	1	8	4	6	–	–	26	173
1764	–	31	0.8	–	–	0	–	–	3	1	0.5	0	–	–	26	61
1765	–	82	2.3	–	–	0	–	0	1	11	3.7	1	–	–	26	121
1766	–	33	1	–	–	0	–	0	1	0	0	0	–	–	26	60
1767	–	80	2.4	–	–	0	–	1	2	3	1	0	–	–	26	112
1768	–	208	5.8	–	–	0	–	1	2	9	3	2	–	–	26	248
1769	–	159	3.8	–	–	0	–	0	1	7	1.8	0	–	–	26	193
1770	–	86	1.9	–	–	0	–	0	5	6	1.5	0	–	–	26	123
1771	–	38	1	–	–	0	–	3	1	0	0	0	–	–	24	66
1772	–	240	6.3	–	–	0	–	1	2	12	6	5	–	–	24	284
1773	–	250	5.8	–	–	0	–	–	1	9	4.5	7	–	–	20	287
1774	–	179	3.7	–	–	0	–	–	2	5	1.7	1	–	–	25	212
1775	–	19	0.4	–	–	0	–	–	6	1	0.3	0	–	–	26	52
1776	–	145	3.7	–	–	0	–	–	6	7	2.3	14	–	–	27	199
1777	–	178	4	–	–	0	–	–	2	5	1.7	14	–	–	21	220
1778	–	55	1.2	–	–	0	–	–	4	1	0.3	22	–	–	26	108
1779	–	36	0.8	–	–	0	–	–	–	0	0	10	–	–	27	73
1780	–	91	2.5	–	–	0	–	–	6	2	2	14	–	–	23	136
1781	–	–	–	–	–	0	–	–	6	1	1	20	–	–	32	59
1782	–	–	–	–	–	0	–	–	1	3	3	14	–	–	21	39
1783	–	2	0.2	–	–	0	–	–	3	0	0	16	–	–	22	43
1784	–	8	1.3	–	–	0	–	–	1	–	–	14	–	–	24	47
1785	–	5	5	–	–	0	–	–	2	–	–	0	–	–	22	29

Cont.

		Dutch		Scottish		English		Hudson's Bay Company		German			American			
Year	Basque	Whales	CPV	Whales	CPV	Whales	CPV	Whaling	Trade	Whales	CPV	Danish	Whales	CPV	Inuit	Total
1786	–	39	5.6	–	–	0	–	–	–	–	–	0	–	–	19	58
1787	–	41	5.9	5	5	33	–	–	1	–	–	0	–	–	19	99
1788	–	21	1.9	25	3.6	144	–	–	2	0	0	18	–	–	19	229
1789	–	23	2.9	48	4.4	183	–	–	–	6	3	16	–	–	24	300
1790	–	10	0.7	16	1.6	71	–	–	–	0	0	22	–	–	23	142
1791	–	18	1.4	25	3.1	108	–	–	–	0	0	24	–	–	19	194
1792	–	2	0.2	6	0.5	27	–	–	–	0	0	14	–	–	19	68
1793	–	–	0	13	1.6	101	–	–	–	–	–	6	–	–	34	154
1794	–	14	4.7	21	7	92	–	–	–	–	–	12	–	–	22	161
1795	–	–	–	24	8	62	–	–	4	–	–	12	–	–	21	123
1796	–	–	–	17	8.5	73	–	–	5	–	–	26	–	–	20	141
1797	–	1	1	12	4	66	–	–	–	–	–	10	–	–	21	110
1798	–	–	–	13	3.3	114	–	–	4	–	–	16	–	–	19	166
1799	–	–	–	17	8.5	96	–	–	2	–	–	14	–	–	20	149
1800	–	–	–	21	7	88	–	–	2	–	–	22	–	–	25	158
1801	–	–	–	26	8.7	–	–	–	–	–	–	14	–	–	23	63
1802	–	0	0	30	10	–	–	–	–	–	–	14	–	–	22	66
1803	–	–	–	36	5.1	–	–	–	–	–	–	2	–	–	24	62
1804	–	–	–	89	9.9	–	–	–	–	–	–	21	–	–	19	129
1805	–	–	–	101	6.7	–	–	–	–	–	–	18	–	–	21	140
1806	–	–	–	133	9.5	–	–	–	–	–	–	18	–	–	22	173
1807	–	–	–	119	9.2	–	–	–	–	–	–	6	–	–	19	144
1808	–	–	–	86	6.6	–	–	–	–	–	–	14	–	–	19	119
1809	–	–	–	116	12.9	–	–	–	–	–	–	14	–	–	19	149
1810	–	–	–	158	14.4	–	–	–	–	–	–	14	–	–	19	191
1811	–	–	–	98	8.9	–	–	–	–	–	–	14	–	–	19	131
1812	–	–	–	206	12.9	–	–	–	–	–	–	14	–	–	19	239
1813	–	–	–	47	2.1	–	–	–	–	–	–	14	–	–	20	81
1814	–	–	–	150	6.8	538	12	–	–	–	–	14	–	–	19	721
1815	–	–	–	92	5.4	175	5.3	–	–	–	–	14	–	–	19	300
1816	–	–	–	134	8.4	223	8	–	–	–	–	14	–	–	20	391
1817	–	–	–	144	7.6	188	5.5	–	–	–	–	14	–	–	19	365
1818	–	–	–	104	5.2	285	6.6	–	–	–	–	14	–	–	20	423
1819	–	–	–	119	5.7	275	6.5	–	–	–	–	14	–	–	19	427
1820	–	–	–	307	14	463	13.2	–	–	–	–	14	–	–	20	804
1821	–	6	6	478	13.7	445	10.1	–	–	–	–	14	–	–	20	963
1822	–	2	2	226	6.3	131	5	–	–	–	–	14	–	–	19	392
1823	–	11	11	974	26.3	381	15.2	–	–	–	–	14	–	–	19	1399
1824	–	0	0	318	6.8	278	7.9	–	–	–	–	14	–	–	19	629
1825	–	2	1	206	4.1	217	5.7	–	–	–	–	14	–	–	20	459
1826	–	0	0	245	5.3	212	5.3	–	–	–	–	14	–	–	19	490
1827	–	–	–	562	16.5	396	12.4	–	–	–	–	14	–	–	19	991
1828	–	–	–	662	14.1	525	14.6	–	–	–	–	14	–	–	19	1220
1829	–	–	–	436	9.5	431	10.3	–	–	–	–	14	–	–	19	900
1830	–	–	–	56	1.2	104	2.5	–	–	–	–	14	–	–	19	193
1831	–	–	–	195	4.8	215	5.5	–	–	–	–	14	–	–	19	443
1832	–	–	–	784	23.1	699	25	–	–	–	–	14	–	–	19	1516
1833	–	–	–	844	21.6	824	22.9	–	–	–	–	14	–	–	19	1701
1834	–	–	–	498	14.2	373	11	–	–	–	–	14	–	–	20	905
1835	–	–	–	117	2.9	49	1.6	–	–	–	–	14	–	–	19	199
1836	–	–	–	44	1.2	18	0.9	–	–	–	–	14	–	–	19	95
1837	–	–	–	69	2.9	20	2.9	–	–	–	–	14	–	–	19	122
1838	–	–	–	255	11.6	160	20	–	–	–	–	14	–	–	19	448
1839	–	–	–	44	2.2	40	4.4	–	–	–	–	14	–	–	19	117
1840	–	–	–	9	0.7	6	0.9	–	–	–	–	14	–	–	19	48
1841	–	–	–	10	2.5	5	1.3	–	–	–	–	14	–	–	19	48
1842	–	–	–	44	14.7	11	11	–	–	–	–	14	–	–	19	88
1843	–	–	–	101	7.8	34	8.5	–	–	–	–	14	–	–	19	168
1844	–	–	–	72	4.5	37	5.3	–	–	–	–	14	–	–	19	142
1845	–	–	–	278	21.4	95	19	–	–	–	–	14	–	–	19	406
1846	–	–	–	71	4.7	23	4.6	–	–	–	–	14	0	0	19	127
1847	–	–	–	49	3.3	22	4.4	–	–	–	–	14	9	9	19	113
1848	–	–	–	35	3.9	24	4.8	–	–	–	–	14	8	8	20	101
1849	–	–	–	178	17.8	23	2.1	–	–	–	–	14	9	9	19	243
1850	–	–	–	37	3.7	7	0.9	–	–	–	–	14	5	5	19	82
1851	–	–	–	52	4.7	18	6	–	–	–	–	5	4	4	19	98
1852	–	–	–	41	4.6	12	3	–	–	–	–	5	0	0	19	77
1853	–	–	–	58	6.4	21	4.2	–	–	–	–	5	9	4.5	19	112
1854	–	–	–	81	6.8	3	1.5	–	–	–	–	5	9	4.5	19	117
1855	–	–	–	38	2.9	2	1	–	–	–	–	5	0	0	19	64
1856	–	–	–	178	11.9	32	16	–	–	–	–	5	1	0.3	19	235
1857	–	–	–	37	1.9	1	0.5	–	–	–	–	5	8	2	19	70
1858	–	–	–	59	3	28	4.7	–	–	–	–	5	14	4.7	19	125
1859	–	–	–	113	6.6	29	7.3	–	–	–	–	5	12	3	19	178

Cont.

		Dutch		Scottish		English		Hudson's Bay Company		German			American			
Year	Basque	Whales	CPV	Whales	CPV	Whales	CPV	Whaling	Trade	Whales	CPV	Danish	Whales	CPV	Inuit	Total
1860	–	–	–	98	4.7	13	1.9	–	–	–	–	5	33	3	19	168
1861	–	–	–	188	7	61	10.2	–	–	–	–	5	52	5.2	1	307
1862	–	–	–	100	4.3	12	2.4	–	–	–	–	5	61	6.1	1	179
1863	–	–	–	25	1.9	3	1	–	–	–	–	5	84	4.9	1	118
1864	–	–	–	65	3.8	–	–	–	–	–	–	5	114	4.2	1	185
1865	–	–	–	81	7.4	5	2.5	–	–	–	–	5	89	3.9	1	181
1866	–	–	–	44	2.8	2	2	–	–	–	–	5	69	3.1	1	121
1867	–	–	–	16	1.1	2	2	–	–	–	–	5	52	2.2	1	76
1868	–	–	–	126	7.4	–	–	–	–	–	–	5	20	1.7	1	152
1869	–	–	–	17	1.4	1	1	–	–	–	–	5	27	2.5	1	51
1870	–	–	–	80	8.9	–	–	–	–	–	–	1	24	2.7	1	106
1871	–	–	–	147	12.3	–	–	–	–	–	–	1	19	2.4	1	168
1872	–	–	–	114	8.8	–	–	–	–	–	–	1	9	1.1	1	125
1873	–	–	–	170	14.2	–	–	–	–	–	–	1	11	2.2	1	183
1874	–	–	–	212	15.1	–	–	–	–	–	–	1	13	3.3	1	227
1875	–	–	–	96	6	–	–	–	–	–	–	1	23	4.6	1	121
1876	–	–	–	71	4.4	–	–	–	–	–	–	1	9	2.3	1	82
1877	–	–	–	87	5.4	–	–	–	–	–	–	1	8	1.1	1	97
1878	–	–	–	10	0.6	–	–	–	–	–	–	1	6	0.6	1	18
1879	–	–	–	74	4.6	–	–	–	–	–	–	1	15	2.1	1	91
1880	–	–	–	117	8.4	–	–	–	–	–	–	1	7	1.2	1	126
1881	–	–	–	48	4	–	–	–	–	–	–	1	8	0.9	1	58
1882	–	–	–	79	6.6	–	–	–	–	–	–	1	8	1.6	1	89
1883	–	–	–	18	2	–	–	–	–	–	–	1	5	1	1	25
1884	–	–	–	79	7.9	–	–	–	–	–	–	1	3	0.8	1	84
1885	–	–	–	29	2.2	–	–	–	–	–	–	1	2	0.5	1	33
1886	–	–	–	19	1.4	–	–	–	–	–	–	1	3	0.6	1	24
1887	–	–	–	14	1.6	–	–	–	–	–	–	1	6	2	1	22
1888	–	–	–	8	0.9	–	–	–	–	–	–	1	0	0	1	10
1889	–	–	–	11	2.8	–	–	–	–	–	–	1	0	0	1	13
1890	–	–	–	20	2.5	–	–	–	–	–	–	1	2	2	1	24
1891	–	–	–	6	1	–	–	–	–	–	–	–	1	0.5	1	8
1892	–	–	–	8	1.3	–	–	–	–	–	–	–	4	2	1	13
1893	–	–	–	32	6.4	–	–	–	–	–	–	–	1	0.5	1	34
1894	–	–	–	16	2.7	–	–	–	–	–	–	–	6	3	1	23
1895	–	–	–	6	1	–	–	–	–	–	–	–	2	0.7	1	9
1896	–	–	–	6	1.5	–	–	–	–	–	–	–	11	2.2	1	18
1897	–	–	–	12	2.4	–	–	–	–	–	–	–	3	0.8	1	16
1898	–	–	–	6	1.5	–	–	–	–	–	–	–	10	3.3	1	17
1899	–	–	–	28	3.5	–	–	–	–	–	–	–	9	4.5	1	38
1900	–	–	–	18	2.6	–	–	–	–	–	–	–	6	3	1	25
1901	–	–	–	15	2.5	–	–	–	–	–	–	–	7	3.5	0	22
1902	–	–	–	12	2	–	–	–	–	–	–	–	0	0	0	12
1903	–	–	–	14	2	–	–	–	–	–	–	–	2	2	0	16
1904	–	–	–	11	1.6	–	–	–	–	–	–	–	1	1	0	12
1905	–	–	–	23	2.3	–	–	–	–	–	–	–	9	9	0	32
1906	–	–	–	7	0.8	–	–	–	–	–	–	–	0	–	0	7
1907	–	–	–	3	0.3	–	–	–	–	–	–	–	0	0	0	3
1908	–	–	–	5	0.8	–	–	–	–	–	–	–	0	0	0	5
1909	–	–	–	3	0.8	–	–	–	–	–	–	–	0	0	0	3
1910	–	–	–	13	1.4	–	–	–	–	–	–	–	0	0	0	13
1911	–	–	–	4	0.7	–	–	–	–	–	–	–	2	2	0	6
1912	–	–	–	–	–	–	–	–	–	–	–	–	1	1	0	1
1913	–	–	–	–	–	–	–	–	–	–	–	–	0	0	0	0
1914	–	–	–	–	–	–	–	–	–	–	–	–	0	0	0	0
1915	–	–	–	–	–	–	–	–	–	–	–	–	0	0	0	0
1916	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1917	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1918	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1919	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	5
1920	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1921	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	3
1922	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	5
1923	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	2
1924	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1925	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1926	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1927	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1928	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1929	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1930	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	3
1931	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1932	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1933	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0

Cont.

		Dutch		Scottish		English		Hudson's Bay Company		German			American			
Year	Basque	Whales	CPV	Whales	CPV	Whales	CPV	Whaling	Trade	Whales	CPV	Danish	Whales	CPV	Inuit	Total
1934	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1935	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1936	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1937	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1938	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1939	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1940	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	2
1941	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1942	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1943	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1944	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1945	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	3
1946	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1947	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1948	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1949	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1950	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1951	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1952	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1953	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1954	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1955	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1956	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1957	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1958	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1959	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1960	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1961	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1962	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1963	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1964	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1965	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1966	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1967	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1968	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1969	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1970	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1971	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	2
1972	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1973	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1974	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1975	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	3
1976	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1977	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1978	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1979	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1980	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1981	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1982	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1983	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1984	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1985	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1986	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1987	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1988	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1989	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1990	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1991	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1992	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1993	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1994	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1995	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1996	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1997	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
1998	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
1999	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
2000	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
2001	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
2002	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
2003	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
2004	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
2005	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1
2006	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
2007	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
2008	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	3
2009	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6	6
Total	**28,075**	**7,699**	**0**	**13,634**	**0**	**9,489**	**0**	**6**	**115**	**332**	**0**	**1,242**	**945**	**0**	**8,471**	**70,008**