

CRUISE REPORT
DELAWARE II LARGE WHALE SURVEY DE0307

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INTRODUCTION

The 2003 Large Whale Survey DE0307 was conducted between August 5th and 28th 2003, aboard the NOAA Ship *Delaware II*. The cruise was operated by the National Marine Fisheries Service (NMFS), Northeast Fisheries Science Center (NEFSC) in Woods Hole, Massachusetts.

The principal objectives of this cruise were: (i) to document the distribution of large whales on the Scotian Shelf, notably in areas which had previously been the subject of little or no dedicated survey effort; (ii) to photographically identify individual humpback (*Megaptera novaeangliae*), blue (*Balaenoptera musculus*) and North Atlantic right whales (*Eubalaena glacialis*) for the purpose of clarifying population structure; and (iii) to obtain biopsy samples from these three species as well as from fin whales (*Balaenoptera physalus*) and various odontocetes for genetic and other analyses. One objective of the first leg of the cruise was to gather information on water quality, marine mammal utilization, prey abundance in relation to the recently observed abnormal die-off of humpback whales reported in the region of the Northeast Channel, Northern Edge of George's Bank and near the Hague Line.

The Scotian Shelf extends from Browns Bank in the west to the Laurentian Channel in the east; it includes various banks and other bathymetric features. Past records of large whales from this region have come primarily from three sources:

- (i) A database of sightings from the whaling station at Blandford, Nova Scotia which operated from 1966 to 1972. Search effort for this operation encompassed an area from St Margaret's Bay, Nova Scotia to the shelf break, including Emerald Bank and Basin, Western Bank, and LaHave Bank and Basin.
- (ii) Incidental sightings from observers aboard seismic survey and other vessels reported to the Canadian Department of Fisheries and Oceans. This data set began in 1990 and has continued through the present; it includes much of the Scotian Shelf, including eastern portions of the region out to (and across) the Laurentian Channel.
- (iii) Data collected aboard three earlier NMFS large whale surveys in 1998, 1999 and 2002. These surveys concentrated primarily on the region from Roseway Basin to Western Bank (notably the Emerald/LaHave complex); effort in 1999 extended as far as French Bank to the north and the Gully to the south, and 2002 survey effort extended as far east as the Stone Fence portion of the Laurentian Channel.

The population identity of the whales observed on the Scotian Shelf has been unclear. Photographically identified humpback whales sampled by NMFS in 1998 and 1999 were compared to both the North Atlantic Humpback Whale Catalogue and to a regional catalogue from the Gulf of Maine; of 53 individual humpbacks from the Scotian Shelf, 13 matched to the Gulf of Maine, with evidence that many of these animals were transient in that area (Clapham *et al.* 2003). There were no matches to any other location in the North Atlantic, including Newfoundland; this is somewhat surprising given the proximity of the Scotian Shelf to the latter area, although comparisons are compromised by the lack of survey effort in Newfoundland after 1993, and by the absence of data from the eastern Scotian Shelf. One objective of the 2002 large whale survey was to obtain samples from the eastern portion of the Scotian Shelf to determine whether there is any exchange between this region and the Gulf of Maine, Newfoundland or the Gulf of St Lawrence. At this time, we have documented about a 10% match rate/exchange rate between the eastern Scotian Shelf and the Gulf of Maine humpback whale population.

Right whales occur regularly in Roseway Basin at the western margin of the Scotian Shelf, and have been observed sporadically in various other areas. However, their distribution and occurrence east of Roseway is poorly understood.

The Scotian Shelf appears to represent the southern limit of the range for blue whales in the western North Atlantic. Although individual blue whales are occasionally observed in the Gulf of Maine, such records are comparatively rare. In contrast, the data sets summarized above all suggest that blue whales are found regularly (albeit in small numbers) on the Scotian Shelf. One photographically identified individual blue whale (of three sampled by previous NMFS large whale surveys) matched to the Gulf of St Lawrence, which may indicate that the Scotian Shelf is an extension of the population from that much more extensively studied area.

Nothing is known for certain regarding the population identity of finback whales on the Scotian Shelf. The fin whales found there have been assumed to represent a part of a wider stock which ranges from the eastern seaboard of the U.S. to Nova Scotia and perhaps beyond, but since no samples have been obtained from the Scotian Shelf, past genetic analyses have not been able to shed light on this question.

METHODS

Survey area

The survey area (Figure 1) included waters from Browns Bank to the Laurentian Channel, out to the shelf break. Survey tracks were not designed to sample the area randomly, but were based upon often rather sparse past records of whale sightings, as well as assumptions concerning bathymetric characteristics of likely large whale habitats.

Survey protocols

Watches were conducted on the flying bridge from 0600 to 1800 unless weather conditions precluded observations. Teams of three observers used Big-Eye binoculars as well as naked eye to search for large whales, with one observer serving as a data recorder; positions were rotated every 30 minutes, and watches changed each hour. Strict line-transect survey protocols were not used on this cruise since the objective was to find concentrations of whales, not to estimate abundance.

All marine mammal sightings were recorded. Data taken included species, number in group, position, direction of movement and behavior. In addition, environmental variables were routinely recorded, and a suite of other information was automatically sampled by the ship's Scientific Computer System.

When large whales were sighted, at the discretion of the Chief Scientist the vessel would break track in an effort to obtain photographs for individual identification. If the weather conditions were good (usually Beaufort 3 or less, with minimal swell), one of two Rigid Hull Inflatable Boats (RHIBs) would be deployed for photo-identification and biopsy.

Where possible, whales were individually identified using variations in natural markings. These included the ventral fluke pattern as well as dorsal fin shape and scarring for humpback whales (Katona & Whitehead 1981), and callosity pattern and scarring for right whales (Kraus *et al.* 1986). Fin whales were not usually identified photographically.

Preliminary matching of humpback whale fluke photos was conducted on board using a Gulf of Maine catalogue provided by the Center for Coastal Studies, as well as images collected on the previous NMFS Scotian Shelf surveys. Copies of all identification photographs will be sent to the relevant institutions, listed below, depending on the species concerned.

Biopsy samples were taken using either a 45.5-kg or a 68-kg draw crossbow. All samples were frozen and/or

placed in DMSO for further analysis.

RESULTS

Effort and areas covered

The *Delaware II* left Woods Hole at 17:30 on August 5th and proceeded towards the Northeast Peak and Northern Edge of Georges Bank, then on across Northeast Channel to the shelf break. While on the Northeast Peak and when not engaged in whale surveys, 70 bucket samples and 102F m net tows were conducted at the surface (no cable required) in a grid pattern to assess *Alexandrium* biotoxin levels. Samples were preserved using formalin and ethanol.

A total of seven days were spent surveying for large whales on the first leg of the cruise. On several days, the visibility deteriorated and surveying was suspended.

During the first leg, the following areas were surveyed: SE Georges Bank; Northeast Peak of Georges, Northeast Channel; Georges Canyon; Baccaro Bank; all of the Scotian Shelf break from south of Emerald Bank; Emerald Basin; The Patch; the Bull Pen and Cow Pen; The Owl; Western Bank and The Slipper.

The vessel proceeded to Halifax on 15 August for a crew change, and sailed again the following day to begin the second leg of the cruise. During the second leg, the *Delaware II* surveyed the Scotian Shelf break area including Emerald Bank, French Bank, Middle Bank; along the northern edge of Banquereau Bank; Roseway Basin; Baccaro Bank and Browns Bank. The Northern Edge of Georges Bank and the Great South Channel were surveyed on the transit home to Woods Hole. A total of nine days were spent surveying for large whales on the second leg, with an additional three days lost to weather.

Cetacean distribution

Major sightings are summarized by day in Table 1.

By far the most common mysticete on the eastern Scotian Shelf was the humpback whale. Major concentrations of humpbacks were found on the northern edge of Banquereau Bank and the southwest corner of Middle Bank. In the latter area, unusually large groups (up to ten animals) were observed, sometimes remaining associated for periods of several hours.

On the first leg, right whales, fin and sei whales were sighted in fairly large numbers along the Northern Edge, Northeast Channel and the Northeast Peak of Georges Bank

The second leg of the cruise (August 16-28) included three days of transit (from Banquereau Bank to Roseway Basin and the Northern Edge of Georges to Cultivator Shoals to Woods Hole). Fin and humpback whales were the most abundant species on Baccaro Bank.

Other species of cetacean observed during the cruise included bottlenose dolphins (*Tursiops truncatus*), common dolphins (*Delphinus delphis*), long-finned pilot whales (*Globicephala melas*), sperm whale (*Physeter macrocephalus*); minke whale (*Balaenoptera acutorostrata*) and Atlantic white-sided dolphins (*Lagenorhynchus acutus*).

Photo-identification, biopsy and sharing of material

Right whales were observed on four different occasions. On August 7th, fourteen right whales; August 8th, seventeen right whales August 24th, 2 right whales; and August 25th, one right whale. All right whale sightings were reported to the Right Whale Sighting Advisory System (SAS). Only one right whale individual was photographed for identification. Right whale photographs will go to the North Atlantic Right Whale Catalogue at the New England Aquarium. Analysis of the photo-id data will occur over the next few weeks.

A total of 64 distinct humpback fluke photographs were obtained during the DE0307 cruise, including a minimum of 8 individuals photographed on the Scotian Shelf matched to the existing Gulf of Maine humpback whale catalogue.

We anticipate substantially increasing the existing sample size of identified humpback whales from the Scotian Shelf for investigation of stock identity. A preliminary comparison of humpback whale fluke photographs found several inter-annual matches for the waters of Scotian Shelf between 1998, 1999, 2002 and 2003.

All humpback whale fluke photos will be sent to the North Atlantic Humpback Whale Catalogue at College of the Atlantic, Bar Harbor, Maine, and to the Center for Coastal Studies in Provincetown, Massachusetts. A total of 41 biopsy samples were obtained. These included biopsy samples from 37 humpback whales, 2 finback whales, one minke whale and one common dolphin.

Skin samples for genetic analysis will be provided to the University of California, Berkeley (humpback, minke and fin whales). Humpback whale samples (fixed in formalin) have already gone to Joy Lapersitis and Mark Hohn at the Woods Hole Oceanographic Institution for toxicological analysis. Common dolphin samples are destined for the NOAA laboratory of Dr. Patricia Rosel (Charleston, SC) for her ongoing study of delphinid genetics.

DISCUSSION AND SUMMARY NOTES

The 2003 Large Whale Survey was important in that it provided a dedicated coverage of the eastern Scotian Shelf. Samples and photographs from this region will be particularly valuable in assessing population structure for humpback whales.

The survey spent several days around Browns Bank and Roseway Basin, which has historically been an important summer habitat for the critically endangered North Atlantic right whale. Roseway Basin is transited by numerous merchant ships, and considerable concern has been expressed about the potential for right whales being struck and killed in this area. Accordingly, the Government of Canada is currently preparing a proposal to the International Maritime Organization (IMO) to designate Roseway as an "Area To Be Avoided" by shipping. The data from the Large Whale Survey are being provided to Canada as support for the IMO proposal; these data are particularly important given the lack of information from Roseway in recent years, and the fact that right whales abandoned the area for several years beginning in 1993. Three right whales were documented in this region, and the data collected during this cruise will help demonstrate the continued importance of this habitat. Consequently, this information will be a key element of Canada's IMO campaign.

Once analyzed, the data from this cruise will be used to prepare one or more scientific papers for refereed journals (data from previous Scotian Shelf cruises have already been incorporated into such a publication, Clapham *et al.* 2003). When available, a full copy of the edited data and associated photographic images will be made available to DFO on request.

Maureen Lynch (WHOI) was aboard from August 5-15 to sample for Alexandrium--a phytoplankton that generates saxitoxin. Saxitoxin is a nerve agent that may be responsible for the recent humpback whale deaths. Every hour during transits she collected 16-liter water samples for Alexandrium counts from the ship's sea water flow through system. She was also collecting samples using a surface pump, surface net tows (0.5m 102um net) and Niskin bottles to assess the density of Alexandrium cells. When time allowed, the Delaware II was also making tows with 1m, 333um mesh bongo nets for assessing the uptake of saxitoxin to higher trophic levels. Analysis of these water samples should be completed over the next couple of months.

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Table 1. Summary of sightings on the Scotian Shelf, by day, for the *Delaware II* Large Whale Survey, 5-28 August 2003. Weather (Wx) abbreviations are given as Beaufort notation (see Appendix Table 1). Species codes: Mn = *Megaptera novaeangliae*; Bp = *Balaenoptera physalus*; Bm = *B. musculus*; Ba = *B. acutorostrata*; Pm = *Physeter macrocephalus*; Eg = *Eubalena glacialis*.

Date	Time	Lat/long		Species	Number	Wx	Location/Notes
5							No survey - transit from Woods Hole
6	1530	4124	6650	Mn	1		SE Georges Bank
7	1050	4218	6630	Bb Eg	5 5	r/f/o	Northeast Peak of Georges Bank, Northeast Channel
	1230 1600	4213	6617	Bb Eg Mn	5 6 1		
8	835	4126	6601	Eg	12+		Georges Canyon
	1300	4205	6608	Bp Bb	2 6		
9						f/F	Baccaro Bank
10						f/F	Baccaro Bank

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Date	Time	Lat/long	Species	Number	Wx	Location/Notes	
11					f/F	Emerald Basin	
12	0625	4416	6218	Mn	2	drizzle rain	The Patch
	1200	4418	6146	Mn	2	cloudy	Bull Pen/Cow Pen
	1455	4407	6126	Pm	1	cloudy	
	1740	4400	6140	Mn	2	cloudy	The Owl
13	am	4400	6130	Mn	6		The Owl
	pm	4343	6130	Mn	3		The Slipper
14	945 1700	4334 4412	6102 6225	Mn Mn	3 2/3		The Slipper Western Bank
15	1100			Bp	2		8 miles south of Halifax Harbor
16							depart Halifax
17		4451	6113	Ba Bp	2 2	f/drizzle	French Bank
18	0600	4422	6214	Gm	20	rain/Fog	next to the ship/ Emerald Basin
19	am	4415	6223	Mn Gm	12 60	unlimited vis	The Patch
20	am	4423	6223	Mn	35+	Beaufort 6 - to - 3	Middle Bank
21	all day	4423	6223	Mn	14	unlimited vis	Middle Bank
22	am	4439	5920	Mn	15-20	Beaufort 2 to 5	Banqueau Bank
23						rain/wind/	transit to Roseway Basin

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Date	Time	Lat/long		Species	Number	Wx	Location/Notes
24	0600	4254	6532	Dd Bp Ba	100's 5 1	unlimited vis	Roseway Basin and Browns Bank
		4258	6546	Mn	1		small dead, very decomposed humpback
	1500	4240	6612	Mn	2		Browns Bank
	1700	4242	6605	Eg	2		Browns Bank
25	am	4300	6436	Bp Mn	16 6	unlimited vis	Baccaro Bank
	1700	4244	6513	Eg	1		
26				Pm Mn	1 5	unlimited vis	Northeast Channel and North East Peak Just north of Georges Shoal/Cultivator Shoal
27				Mn	5		Just north of Georges Shoal/Cultivator Shoal
28	0700						arrive Woods Hole, Ma.

Appendix Table 1. Beaufort weather notation used in this report.

Code	Weather
b	no cloud
bc	1-3 octas cloud
cb	4-5 octas cloud
c	6-7 octas cloud
o	overcast (8 octas)
f/F	fog/dense fog
z/Z	haze/dense haze
v	unlimited visibility
r	rain
rr	continuous rain (>1 hour)
d	drizzle

Figure 1. Study area for 2003 Large Whale Survey, cruise DE-0207.

