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**CRUISE REPORT
R/V DELAWARE II
Cruise No. DE 02-07**

LARGE WHALE SURVEY

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INTRODUCTION

The 2002 Large Whale Survey was conducted between August 5th and 28th 2002, 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. The first leg of the cruise also included an objective to obtain biopsy samples of northern bottlenose whales (*Hyperoodon ampullatus*) in the Gully to assist with an ongoing project by Dr Hal Whitehead of Dalhousie University.

The Scotian Shelf extends from Browns Bank in the west to the Laurentian Channel to 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 shelfbreak, 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 to the present; it includes much of the Scotian Shelf, including the eastern portions of the region out to (and across) the Laurentian Channel.
- (iii) Data collected aboard two earlier NMFS large whale surveys in 1998 and 1999. These surveys concentrated primarily on the region from Roseway Basin to Western Bank (notably the Emerald/LaHave complex), although effort in 1999 extended as far as French Bank to the north and the Gully to the south.

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.* 2002). 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. Consequently, 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 either Newfoundland or the Gulf of St Lawrence.

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 datasets 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 fin 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 0630 to 1830 unless weather conditions precluded observations. Three teams of four 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). Photographs were also taken of the head and dorsal fin of bottlenose whales. Fin whales were not 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 two 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.

RESULTS

Effort and areas covered

The *Delaware II* left Woods Hole at 17:00 on August 5th and proceeded to the Northern Edge of Georges Bank, then on across Northeast Channel to the shelf break. The vessel transited overnight to the shelf edge south of Emerald Bank, when surveys continued. A total of ten days were spent surveying for large whales on the first leg of the cruise. On one of these days, the visibility deteriorated in the early afternoon., and surveying was suspended.

During the first leg, the following areas were surveyed: all of the shelf break from south of Emerald Bank to the Gully; the Gully itself; the Stone Fence; Artimon Bank; much of the northern edge of Banquereau Bank; some of the southern portion of Misaine Bank; and French Bank (the latter in heavy haze).

The vessel proceed to Halifax on 16 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 shelf break area south of Emerald Bank, Roseway Basin and Browns Bank. A total of five days were spent surveying for large whales on the second leg, with an additional five 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 Stone Fence and on the northern edge of Banquereau Bank. In the latter area, unusually large groups (up to ten animals) were observed, sometimes remaining associated for periods of several hours.

No right whales, and very few fin whales, were sighted on the first leg. There was only a single blue whale sighting, in Logan Canyon. The blue whale was a very small individual and may have been a recently weaned calf of the year.

As expected, bottlenose whales were observed in the Gully together with a single sperm whale and various odontocetes. Other sperm whales were recorded in the Laurentian Channel, to the east of the Stone Fence.

Other species of cetacean observed during the cruise included bottlenose dolphins (*Tursiops truncatus*), common dolphins (*Delphinus delphis*), long-finned pilot whales (*Globicephala melana*) and Atlantic white-sided dolphins (*Lagenorhynchus acutus*). Two leatherback turtles (*Dermochelys coriacea*) were also recorded.

The second leg of the cruise (August 17-28) includes two days of transit and most of its survey effort was conducted in the Western Scotian Shelf waters. Fin and right whales were the most common large whales observed especially on Roseway Basin. Fin and humpback whales were the most abundant species on Browns Bank, and sei whales (*Balaenoptera borealis*) were found in low numbers in both regions.

Photo-identification, biopsy and sharing of material

Numerous individual humpback, right and bottlenose whales were identified photographically. The single blue whale observed was not photographed. Analysis of the photo-id data will occur over the next few weeks, so numbers of individuals cannot be given at this time. However, 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 a match within the Scotian Shelf: a whale photographed on French Bank in 1999 was resighted on the Stone Fence on 9th August 2002.

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. Right whale

photographs will go to the North Atlantic Right Whale Catalogue at the New England Aquarium. Bottlenose whale photos have already been sent to Dalhousie University.

A total of 62 biopsy samples were obtained. These included samples from 22 humpback whales, 16 right whales, 4 fin whales, nine bottlenose whales and 11 common dolphins.

Skin samples for genetic analysis will be provided to the University of California, Berkeley (humpback and fin whales), Cornell University (fin whales) and Trent University (right whales). Bottlenose whale samples have already gone to Dalhousie University, with a portion (fixed in formalin) provided to Dr Michael Moore 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 2002 Large Whale Survey was important in that it provided the first dedicated coverage of the eastern Scotian Shelf. Samples and photographs from this region will be particularly valuable in assessing population structure for humpback whales, and samples of bottlenose whales and common dolphin species will also be very useful for genetic analysis of those species.

The survey spent several days in 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. The whales have now returned, and the data collected during this cruise 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.* 2002). When available, a full copy of the edited data and associated photographic images will be made available to DFO on request.

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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 2002. 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*; Ha = *Hyperoodon ampullatus*.

Date	Time	Lat/long		Species	Number	Wx	Location/Notes
5							No survey - transit from Woods Hole
6	0750	42 10	67 20	Mn Bp	Several 1	oZ	Northern Edge
	1005	42 11	66 45	Mn Bp	2 3+	orM	
7	1220			Pm	1	bc, 4-5	Dawson Canyon
	1845	43 25	59 56	Bm	1	c	Logan Canyon
8	0800			Ha	many	c/o	Gully (lower portion)
	1400			Ha Pm	many 1	c/o	Gully (lower center, deepest water)
9	early & late	45 08	57 40	Mn Ba	20+ some	c	Northern end of the Stone Fence. A few more Mn to the south along the top portion of the Stone Fence.
10	early	44 25	57 20	Mn	5-8	bcv	Just west of southern end of the Stone Fence
	1700	45 07	57 38	Mn	15-20	bcv	Northern end of the Stone Fence again
11	early			Mn	2	bcv	Artimon Bank
	1840	44 40	59 01	Mn	6-9	bcv	North central edge of Banquereau; scattered
12	0630	44 40	59 01	Mn	5-6	bcv	Banquereau, same as last night
	1330	44 39	59 23	Mn	10-12	bcv	Northern edge of Banquereau, feeding on 30m bait
	1730	44 39	58 59	Mn	12-15	bcv	Ditto. One big group (8-9)
13	0800	44 37	59 01	Mn	12-15	cv, calm	Banquereau again. Group of 6, group of 4, others

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Date	Time	Lat/long		Species	Number	Wx	Location/Notes
	1400	44 38	59 12	Mn	15-20+	cb, calm	Ditto. Big groups again. Fog in evening.
14	0800	43 50	58 54	Ha	12+	bZ, calm	Gully, poor visibility
	1800			Pm	4	bZ, calm	Head of the Gully - not recorded
15	1745 1820			none Ba Bp	2 1	bcZ bcz	French Bank The Patch - neither recorded
16							No survey - Halifax
17						F	No survey - Halifax - transect
18						F	Western Gully
19						F	Western Gully
20						F	LaHave, Roseway Basin
21	1130 til 1730			Bp Eg Bb	15-20 13-17 12-16		Roseway Basin/Browns Bank
22						F	Roseway Basin
23				Eg Bp Mn Dd	8 20+ 1 100's	NE wind 15-20	Southern Roseway Basin Baccone Bank
24				Bp Mn	20+ 16-20	NE 15-20	Just north of Browns Bank
25		4249 4248	6523.5 6530	Mn Eg Eg	2 6 2	f/F	Browns Bank Roseway Basin Roseway Basin

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Date	Time	Lat/long		Species	Number	Wx	Location/Notes
26	08:15	4254	6520	Eg	2	bc	Roseway Basin
	11:00	4254	6530	Eg	20-23	SW15-20	
	12:30	4248	6531	Eg	1		
	17:00	4244	6519	Bp	8-10		
	17:00	4244	6519	Mn	1		
27				Bp			Georges Basin, Stout Swell, Gulf of Maine Animals scattered thru out the region.
				Mn			
				Bb			
				Ba			
28						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 2002 Large Whale Survey, cruise DE-0207.

