

CRUISE RESULTS

NOAA FRV DELAWARE II Cruise No. DE 01-07 Marine Mammal Survey Calibration Study

CRUISE PERIOD AND AREA

The survey was conducted on the NOAA FRV DELAWARE II from 16 July to 3 August 2001. It started and returned to Woods Hole, MA. The southern border of the study area was near Boothbay Harbor, Maine, the northern border was north of Grand Manan Island, Nova Scotia, and the eastern border was near Digby, Nova Scotia (Figure 1). The survey was suppose to of been divided into two parts. Part I was to of tested the AWARE system and part II was to evaluate the DELAWARE II as a platform to conduct future line transect abundance surveys. Due to computer problems, part I was canceled, and so part II was conducted from the day we actually left the dock, 17 July 2001, to the end of the cruise, 3 August 2001. The rest of this report will only discuss part II.

OBJECTIVES

The primary goal of this cruise was to evaluate the FRV DELAWARE II as a platform to conduct future line transect abundance surveys. Secondary goals included: 1) investigate the feasibility and results from a passive acoustic survey conducted in conjunction with the visual survey, 2) obtain environmental and biotic data to correlate with the density and distribution of cetaceans, 3) obtain, when not conflicting with primary goals, biopsies of cetaceans, and 4) obtain, when not conflicting with primary goals, photo identification pictures of cetaceans.

METHODS

Line transect survey:

In general, the DELAWARE will be evaluated as a platform to conduct line transect abundance surveys by evaluating the practical issues of creating two “independent” teams on the ship, by evaluating the blind spot at the bow for both teams, by evaluating the responsive movement patterns of different cetacean species, and by comparing the sighting rate, effective strip width, $g(0)$, and density estimates resulting from data collected by the DELAWARE in different weather conditions to that collected by the other platform (NOAA Twin Otter aircraft) and to that collected by other ships in previous years. Track lines covered waters with different

characteristics, i.e., depth, temperature, distance from shore, degree of bottom slope topography, and expected density of harbor porpoise and other cetacean species. In addition, the same track lines were surveyed in different Beaufort sea states. Surveying was performed while traveling at approximately 10 knots and when Beaufort sea state conditions were four and below and visibility exceeded about 2 nmi. Surveying was conducted from 6 am to 6 pm, weather permitting, with an hour off for lunch.

One sighting team was located at the bow, 5.6m above the water line, and the other was on the flying bridge, 7.9m above the water line. The bow team surveyed using either naked eye, 7x50, or 20x60 power binoculars. The flying bridge team surveyed using 25x150 power binoculars. On each team, when binoculars were being used six scientists rotated through four observation positions. The observers in the outer two observation positions searched using binoculars. The observers in the inner two observation positions recorded the sightings data onto a computerized data sheet, and they also surveyed by naked eye when not recording data. When the bow team searched using naked eye, there were three observers on the team, and each observer recorded their own sightings data. Under this searching mode, hand-held binoculars were used when needed to confirm a species identification or group size. At the beginning of each day, observer positions were randomly determined. Every half hour observers rotated positions from port to center1 to center2 to starboard to rest to port again.

The starboard observer searched waters on the starboard side and a small overlap area on the port side: from 10° port of the track line to 90° starboard, where 0° is on the track line. The port-side observer searched waters on the port side and a small overlap area on the starboard side: from 10° to starboard of the track line to 90° port. The center observer(s) concentrated searching near the track line: from 40° port to 40° starboard of the track line.

When an animal group (porpoise, dolphin, whale, seal or turtle) was detected the following factors were recorded onto a computerized data entry device:

- 1) time of sighting, recorded to the nearest second,
- 2) species composition of the group,
- 3) radial distance between the team's platform and where the sighting was initially detected, estimated either visually when not using the binoculars or by reticles when using binoculars,
- 4) bearing between the line of sight to the group and the track line; measured by a polarus mounted near the observer or a polarus at the base of the binoculars,
- 5) best, high and low estimate of group size,
- 6) initial direction of swim,
- 7) number of calves,
- 8) initial sighting cue,
- 9) initial behavior of the group, and
- 10) any comments on unusual markings or behavior.

The location (latitude and longitude) of the ship when a sighting was detected was determined

subsequently using an algorithm which dead reckonings between recorded positions of the ship (see below). Ship's positions were recorded every minute.

In addition to the above sighting data, effort and environmental data were logged by a computer hooked up to a differential GPS. Every minute, the computerized GPS logger recorded the following factors:

- 1) time of recording,
- 2) latitude and longitude of ship's position,
- 3) ship's bearing,
- 4) ship's speed over the ground and through the water,
- 5) true wind speed and direction,
- 6) bottom depth,
- 7) surface water temperature at three depths, and
- 8) air temperature,
- 9) relative humidity,
- 10) barometric pressure,
- 11) surface water conductivity and salinity, and
- 12) surface fluorometer value.

The following factors were recorded every time one of the factors changed:

- 1) time of recording,
- 2) position of each observer, and
- 3) weather conditions: swell direction and height, Beaufort sea state, presence of rain or fog, percentage of cloud coverage, visibility (i.e., approximate distance to the horizon), vertical and horizontal position of the sun, and glare width and strength.

Passive acoustic survey:

While the two visual teams were surveying, a cable that contained two hydrophones was deployed behind and to the side of the DELAWARE to passively detect clicks and whistle sounds made by dolphins and whales.

A 400m hydrophone array composed of two Benthos AQ-4 elements mounted 3m apart in a oil filled tube was towed from a crane that was set to the starboard side of the ship. This was done to minimize noise interferences caused by the wake of the ship. The received analogic signal was amplified and transmitted to a desktop PC where it was digitized and recorded by specialized software designed by the International Fund for Animal Welfare (IFAW). A 75m hydrophone extension cable linked the PC, positioned in the stern lab, to the hydrophone cable that was on the stern deck. Navigational and environmental data were also simultaneously collected and stored in databases linked with the acoustic detection data. The system was calibrated using a digital BK Precision signal generator and a Tektronix 464 oscilloscope. To avoid potential interference from the vessel's power supply the hydrophone and recording PC were powered from a pair of isolated deep cycle 12v lead-acid batteries.

The hydrophone was deployed whenever a visual survey took place and at times at night when the ship was drifting or underway. It took about 10 minutes to deploy or recover the hydrophone cable. The hydrophone was recovered prior to the vessel coming to a stop e.g. for CTD and bongo measurements.

Hydrographic characteristics:

In addition to the computerized logger that continuously recorded bottom depth and surface temperature, a SEACAT¹ 19 Profiler (CTD) was used to measure temperature, depth, and salinity of the water column in which the Profiler was lowered into. The Profiler, which has an attached water pump, was lowered to within 5 meters of the bottom or to 200m, whichever was shallower. This was done at approximately 0600, 1130, and 1800 hours on days surveying was conducted and when not in the same place several days in a row.

Distribution of zooplankton:

At 1800, after the sighting survey, a bongo net was towed. A 505 mesh bongo was lowered obliquely while traveling at 1.5 to 2.5 knots to 200m or to within 10m of the bottom, whichever was shallower. The samples collected by both bongo nets were stored in jars containing sea water and formalin. Later the species composition and density will be determined and then correlated with the distribution and density of marine mammal species.

Biopsy samples:

A biopsy sample of one dead fin whale was obtained using a cross-bow that shot modified arrows, where the tip of the arrow is actually a corer that retains a 1 mm² sample of skin and blubber. Once the biopsy sample was retrieved it was wrapped in alcohol cleaned aluminum foil, labeled, then frozen. At the end of the cruise, the sample will be transferred to a vial with DMSO for long-term storage.

RESULTS

Line transect survey:

The DELAWARE surveyed approximately 1200 nautical miles of track line (Figure 1). About two-thirds of the survey transects (817 nmi; 68%) were in good weather conditions, Beaufort sea state 2 or less (Table 1).

Of the 19 days allocated to this survey, the first two days were used to set up the ship in Woods Hole and the last day was used to disembark in Woods Hole. Of the remaining 16 days, surveying was conducted for at least part of each day.

There were eight species of identifiable cetaceans seen during the survey: fin, sei, pilot, minke, right, and humpback whales, white-sided dolphins, and harbor porpoises. Harbor and grey seals were also identified. Number of groups of each species that were detected by each team on each day are found in Table 2.

The evaluation of the ship will be completed after the shipboard data are compared to the aerial data collected from the same track lines on the same days.

Passive acoustic survey:

From provisional analysis of the data that has occurred thus far, it was clear that:

1. Though the vessel towed the hydrophone through some dense areas of lobster gear there was no indication that the hydrophone ever became snagged on, or damaged by, this gear.
2. Some whales and dolphins that were seen were also detected acoustically.
3. Some whales and dolphins that were seen were not detected acoustically, even when close to the track line.
4. Some whales and dolphins were acoustically detected but not seen.
5. Though the ship was not designed as a silent boat, thus the vibrations of the diesel engine and generator produce a high level of background noise, clicks and whistles were detected at full speed (10 knots) and even more were detected at medium speeds (8-6 knots).
6. Though the hydrophone was designed to use in deep waters, the survey design covered mainly shallow areas where it was predicted the range at which cetacean vocalizations could be detected would be reduced due to increasing propagation loss and higher level of masking due to the engine noise echoes originated by the seabed. In spite of this limitation, the equipment has proved to be able of recording detections of white-sided dolphins (*Lagenorhynchus acutus*) and at least two species of mysticeti: fin whales (*Balaenoptera physalus*) and Atlantic northern right whales (*Eubalaena glacialis*).

These preliminary results suggest that the DELAWARE can provide a useful platform for acoustic surveys both in coastal waters, preferable at medium speeds, and in deep waters at full speed. The acoustic and visual data from this cruise are still be analyzed.

Hydrographic characteristics:

There were 32 CTD stations at which water temperature, depth and salinity were measured from the surface to the bottom or 200m, whichever were shallower. The location of the stations are depicted in Figure 1 (locations of vertical, water, and bongo stations).

Bongo samples:

There were 12 stations at which zooplankton samples were collected using bongo nets. At a later time, the species composition and density will be determined and correlated with the marine mammal distribution and density. The location of the stations are depicted in Figure 1.

Biopsy samples:

One biopsy tissue sample was collected from a dead fin whale found floating.

DISPOSITION OF DATA

Transect data will be maintained by the Protected Species Branch of the Northeast Fisheries Science Center at Woods Hole, MA, and are available from the NEFSC's Oracle database. The biopsy

sample will be archived at the NEFSC. The acoustic data were retained by the NEFSC and Jonathon Gordon at St. Andrews, Scotland who will process the data.

SCIENTIFIC PERSONNEL

NMFS, NEFSC, Woods Hole, MA

Debra Palka, Chief Scientist

Richard Pace

John Nicolas

Gordon Waring

Kathryn Bisack

Gina Reppucci

Fisheries and Oceans Canada, Quebec, Canada

Jean-Francois Gosselin

Contractors

Marjorie Rossman, Plymouth, MA

Virginie Chadenet, Quebec, Canada

Pete Duley, Sullivan, ME

Natacha De Soto-Aguillar, Cork, Ireland

Volunteer

Terri Krauska, Minden, NV

REFERENCES

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For further information contact: Richard Merrick, National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, Massachusetts 02543-1097. Telephone (508) 495-2291; FAX (508) 495-2258; INTERNET Richard.Merrick@noaa.gov.

Table 1. Length (and percentage) of track line surveyed in Beaufort sea state conditions 0-4 during NOAA FRV DELAWARE II cruise 01-07, Marine Mammal Survey Calibration Study, conducted during 16 July to 03 August 2001.

| Beaufort sea state | Track line length | % of total |
|--------------------|-------------------|------------|
| 0 | 40 | 8.4 |
| 1 | 148 | 12.7 |
| 2 | 629 | 65.6 |
| 3 | 246 | 11.5 |
| 4 | 130 | 1.8 |
| total | 1193 | 100.0 |

TABLE 2. A summary of sightings data collected during NOAA FRV DELAWARE II cruise 01-07, Marine Mammal Survey Calibration Study, conducted during 16 July to 03 August 2001. Also included are the area of the survey, the date, the average Beaufort sea state (weighted by time), trackline length, and the sighting station. X = does not apply.

| Area | date | avg Beauf | track length (nmi) | team | sight method | HP | Seals | Fin/Sei | Minke | Hump-back | Right | White-sided | Unk Cetacean | Other |
|-------------------|-------|-----------|--------------------|------|--------------|-----|-------|---------|-------|-----------|-------|-------------|--------------|-------|
| off of Bar Harbor | 19Jul | 1.8 | 75.7 | Top | 25 | 115 | 21 | 0 | 2 | 1 | 0 | 0 | 2 | 1 |
| | | | | Bow | Naked | 30 | 16 | 0 | 3 | 0 | 0 | 0 | 1 | 1 |
| & Penobscot Bay | 20Jul | 2.4 | 46.8 | Top | 25 | 28 | 3 | 4 | 0 | 0 | 0 | 4 | 7 | 3 |
| | | | | Bow | Naked | 20 | 2 | 4 | 0 | 0 | 0 | 0 | 2 | 0 |
| | 21Jul | 3.1 | 101.0 | Top | 25 | 42 | 4 | 1 | 4 | 0 | 0 | 0 | 1 | 4 |
| | | | | Bow | 20 | 31 | 11 | 3 | 5 | 0 | 0 | 0 | 0 | 1 |
| | 22Jul | 4.2 | 97.1 | Top | 25 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | | | | Bow | 20 | 5 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | 25Jul | 2.6 | 75.0 | Top | 25 | 8 | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| | | | | Bow | 20 | 3 | 9 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| | 26Jul | 2.5 | 60.2 | Top | 25 | 49 | 10 | 2 | 3 | 0 | 0 | 0 | 0 | 1 |
| | | | | Bow | 20 | 53 | 23 | 1 | 1 | 0 | 0 | 0 | 0 | 5 |
| | 27Jul | 2.6 | 108.4 | Top | 25 | 49 | 16 | 8 | 2 | 2 | 0 | 0 | 4 | 2 |
| | | | | Bow | 20 | 63 | 48 | 4 | 0 | 1 | 0 | 0 | 0 | 14 |
| | 01Aug | 2.2 | 103.8 | Top | 25 | 52 | 24 | 3 | 2 | 0 | 0 | 1 | 4 | 4 |
| | | | | Bow | Naked | 24 | 16 | 1 | 0 | 0 | 0 | 0 | 0 | 5 |

| | | | | | | | | | | | | | | |
|-----------------------------|-------|-----|-------|-----|---------|-----|----|----|----|----|----|----|---|---|
| off of Bath, ME | 23Jul | 3.7 | 101.7 | Top | 25 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | Bow | X | X | X | X | X | X | X | X | X | X |
| | 02Aug | 2.8 | 53.2 | Top | 25 | 8 | 1 | 5 | 4 | 0 | 0 | 0 | 2 | 0 |
| | | | | Bow | Naked | 10 | 1 | 1 | 3 | 0 | 0 | 0 | 0 | 1 |
| in Penob- scot Bay | 24Jul | 3.7 | 57.2 | Top | 25 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | Bow | Naked | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| in Bay of Fundy | 28Jul | 2.0 | 79.4 | Top | 25 | 144 | 1 | 10 | 7 | 0 | 11 | 8 | 5 | 1 |
| | | | | Bow | Naked | 55 | 7 | 8 | 8 | 5 | 4 | 1 | 5 | 3 |
| | 29Jul | 2.4 | 81.7 | Top | 25 | 97 | 6 | 5 | 2 | 5 | 10 | 2 | 3 | 1 |
| | | | | Bow | Naked | 41 | 3 | 3 | 2 | 6 | 2 | 0 | 4 | 4 |
| | 30Jul | 2.9 | 70.6 | Top | 25 | 27 | 3 | 7 | 3 | 4 | 10 | 3 | 0 | 2 |
| | | | | Bow | Naked | 10 | 2 | 3 | 1 | 5 | 7 | 10 | 5 | 0 |
| | 31Jul | 1.0 | 84.6 | Top | 25 | 154 | 10 | 8 | 15 | 12 | 9 | 3 | 1 | 2 |
| | | | | Bow | Naked+7 | 158 | 8 | 9 | 10 | 17 | 2 | 11 | 9 | 2 |

Figure 1. Approximate station and transect locations occupied during NOAA FRV DELAWARE II cruise 01-07, Marine Mammal Survey Calibration, conducted during 16 July to 03 August 2001.

