

Acoustic Behavior of North Atlantic Right Whale (*Eubalaena glacialis*) Mother-Calf Pairs

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LONG-TERM GOALS

The long-term goal of this project is to quantify the behavior of mother-calf pairs from the North Atlantic right whale (*Eubalaena glacialis*) to determine a) why mothers and calves are more susceptible to collisions with vessels and, b) determine the vocal behavior of this critical life stage to assess the effectiveness of passive acoustic monitoring to detect mother-calf pairs in important habitat areas.

OBJECTIVES

The primary objectives of this project are to: 1) determine the visual detectability of right whale mother-calf pairs from surface observations, 2) determine the acoustic detectability of right whale mother-calf pairs, 3) determine the acoustic detection ranges of mother-calf calls through propagation modeling, 4) assess the ontogeny or changes in behavior with calf development, and 5) assess the individual distinctiveness of right whale vocalizations.

APPROACH

This proposal involves a detailed behavioral study of endangered North Atlantic right whale mother-calf pairs to document their activity budgets, movement patterns, and sound production in two critical habitat areas in U.S. waters and a designated conservation area in Canada over the course of entire migration corridor from the Southeastern United States through the Gulf of Maine to the Bay of Fundy. These data will be collected using a combination of passive acoustic recording and monitoring methods coupled with detailed behavioral observations in four months of the year for a period of 5

years (December-January off the coast of Florida, April – Cape Cod Bay in Massachusetts, and August-September in the Bay of Fundy, Canada). These data will be used to assess the effectiveness of visual and passive acoustic monitoring in detection and tracking of individual whales and how these parameters may change with the development of the calves.

Year 1 will involve preliminary field seasons to test the feasibility and logistics of focal follow methods in each of the three key habitat areas off the coast of Florida, in Cape Cod Bay and in the Bay of Fundy, Canada. Years 2, 3, 4 and 5 will involve more extensive field seasons in each of the three habitat areas to collect behavior on individual mother-calf pairs with the goal of collecting repeated samples from individual pairs in multiple habitat areas and on different days to look at changes in behavior as the calves develop. Analysis of data will begin after the first preliminary field seasons and propagation modeling will start at the end of the first year with the recruitment of a graduate research assistant at Penn State. It is anticipated that ongoing analysis and presentation of results will continue through the study, with urgent topics (e.g. - call types and parameters for passive acoustic detection of mother-calf pairs) analyzed and published first, and other more detailed behavioral analyses being published as adequate sample sizes are obtained (e.g. surface behavior, ontogeny of behavior, individual recognition of calls).

WORK COMPLETED

During the second year of the project full field seasons for data collection were carried out in each of the three main habitat areas to determine typical mother-calf behavior and to assess the best methods for a standardized data collection protocol that will be consistent between the diverse habitats as the mother-calf behavior changes with the calf's growth. A number of acoustic recording methods, ranging from towed cabled hydrophone arrays, fixed rigid arrays, and towed gliders were tested to identify the best system to reliably determine bearing to any recorded sounds while observing mother-calf pairs with highly variable movement patterns in water depths ranging from 10-200 m. A standardized behavioral sequencing protocol was established and tested in all three habitat areas. Environmental data sampling for sound propagation modeling were collected in each habitat on multiple days.

RESULTS

Summary – A total of 14 right whale mother-calf follows were conducted in 2011 for a total of 40 hours of behavioral and acoustic recording data. Two mother-calf pairs were resighted in multiple habitats, demonstrating the feasibility of collecting longitudinal data on mother-calf behavioral modification as the calf matures. A variety of previously undescribed behaviors and interactions between the mother and her calf were observed and integrated into a standardized behavioral data collection protocol. Vocalization rates were extremely rare, with vocalizations detected during a curious approach to the vessel by the calf, during a period when another whale joined the mother-calf pair, and during reunion events in the Bay of Fundy when the mother actively separated from her calf for periods of time.

Southeastern U.S. – Data collection took place between 2 January and 31 March, 2011. Seven days of behavioral observations and acoustic recordings of mother-calf pairs were collected between 20 January – 24 February 2011 (Figure 1). This was significantly fewer days of data collection than anticipated due to unusually poor weather conditions in the Southeastern U.S. this past winter. No mother-calf pairs were observed in the area during the month of March, despite several days with good weather and aerial survey support. Acoustic recordings were made with a towed 3-element hydrophone

array while the mother-calf pairs were moving, and with three hydrophones deployed from spars off the vessel during stationary periods. Over 17 hrs of recordings were made from 4 different m/c pairs, 2 of which were recorded on multiple occasions. Standardized acoustic and behavioral data collection protocols were developed as the basis for the field season in Cape Cod Bay and the Bay of Fundy. Right whale vocalizations were detected on only one occasion, when a juvenile whale was sighted near the mother-calf pair and joined the pair. No sounds were detected from mother-calf pairs while they were alone, either during travel or social periods at the surface.



Figure 1 – Right whale mother-calf pair interacting off the coast of Florida in February 2011. Image collected under NMFS permit #775-1875.

Cape Cod Bay – Data collection took place between 7 April - 2 May 2011. Four days of behavioral observations and acoustic recordings were collected between 14 April – 2 May 2011. North Atlantic right whales were encountered on each day on the water, with mother-calf pairs encountered on three of four days. Hydrophone recordings and behavioral observations were obtained from mother calf pairs on two of the days. No recordings or behavioral observations were obtained on the third day, due to rough sea conditions. Over 8 hours of recordings were made from two different mother-calf pairs, each recorded on different days. One of the mother-calf pairs was also recorded for over 2 hrs in February of 2011 in the southeastern calving grounds. Right whale vocalizations were detected only once from the mother-calf pair, when the calf made a curious approach to the vessel and it's mother was sub-surface. No vocalizations were detected during periods of apparent foraging or travel by the pair. Other distant right whale vocalizations were heard when other right whales were in the vicinity.

Bay of Fundy

Data collection took place between 2 August and 31 August 2011. Five days of behavioral observations and acoustic recordings were collected between 5 August – 24 August 2011. Acoustic recordings were made with a towed 3-element hydrophone array while the mother-calf pairs were moving. Over 14 hrs of recordings were made from three different m/c pairs, one of which was recorded on multiple occasions. In total, focal follows were conducted on three different mother-calf

pairs. One mother-calf pair (mother #2029) was followed three times (9, 17, & 24 Aug). This same mother-calf pair was also recorded earlier this year on the breeding grounds off the coast of St. Augustine, Florida, indicating that our goal of repeat follows of individual whales is feasible for this study. Right whale vocalizations were detected from mother-calf pairs during reunion events after the mother separated from the calf for a period of time (Figure 2). Sounds were detected when a mother participated in a surface active group, though the sounds could not be definitively assigned to the mother or the calf due to numerous other whales in the immediate vicinity. No sounds were detected from mother-calf pairs while they were travelling or resting together at the surface.

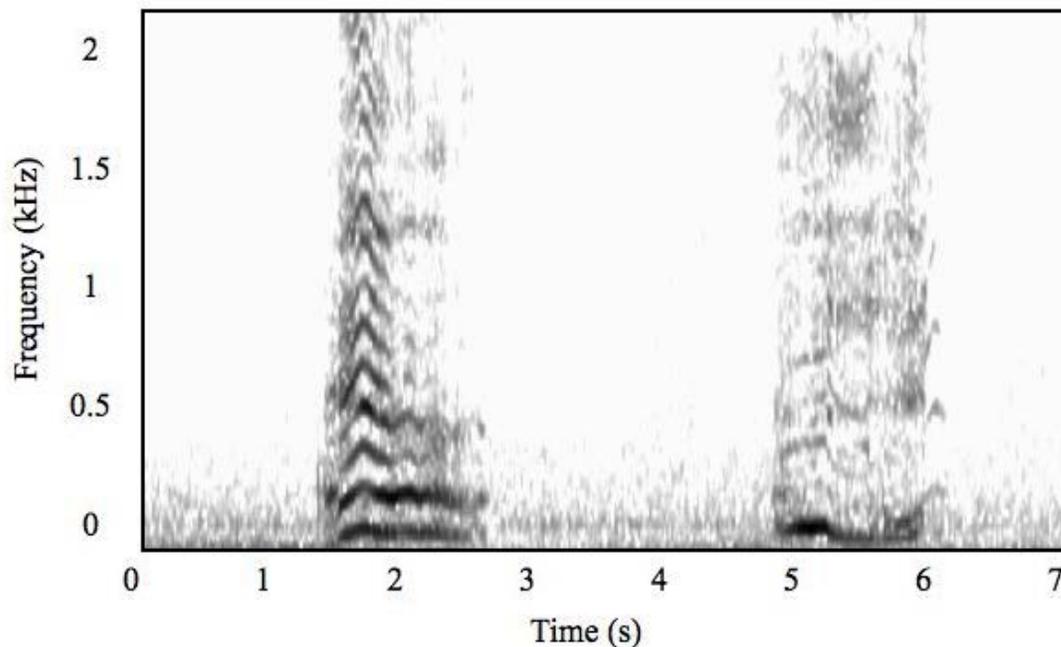


Figure 2. Two calls recorded from an 8 month old calf in the Bay of Fundy.

IMPACT/APPLICATIONS

The outcomes of this study will be identification of behaviors that increase the risk for vessel strike of mothers and calves and quantification of the swimming and vocal behavior of mothers with calves to assess both the visual and acoustic detectability of these individuals to mitigate the potential for serious injury to this critical segment of the right whale population from collision with vessels.

RELATED PROJECTS

None.