

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 the 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 five months of the year for a period of 5

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years (January-February off the coast of Florida, April in Cape Cod Bay, 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. 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 first year of the project, preliminary data were collected in the Bay of Fundy in August. A female graduate student was recruited to conduct research on the project as part of her doctoral research. In the second, third, and fourth years 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. In 2011, we were able to assess the best methods for a standardized data collection protocol that will allow for consistency between the diverse habitats as the mother-calf behavior changes with the calf's growth. In 2012 and 2013, we focused on behavioral observations and passive acoustic recordings of mother calf pairs from a small boat in each of the habitat areas using these protocols.

In 2011, we collected ~40 hours of acoustic data from 16 mother-calf pair follows representing 11 different individuals. In 2012, we collected ~30 hours of acoustic data from 10 mother-calf pair follows representing 4 different individual mothers. In both years, at least one mother-calf pair was followed on multiple occasions in multiple habitats, with sightings separated by six months, allowing us to assess developmental changes in the behavior of the calf. Very low vocalization rates were detected from the mother-calf pairs in the southeastern U.S. in both years. In 2011, no calls were detected from mother-calf pairs that were alone, while in 2012 calls were detected by a pair alone but only during a curious approach to the boat by a calf. In contrast, mother-calf pairs regularly vocalized while separated and during reunion events after separation in the Bay of Fundy summer habitat, when the calf was older and more independent from the mother. Few or no vocalizations were detected when the mother and calf were together.

RESULTS

Southeastern U.S. – Data collection was conducted between 4 January and 24 February, 2013. A total of 12 days of behavioral observations and acoustic recordings were collected. This year was a more productive calving year than 2012, with a total of 19 mother-calf pairs detected in the Southeastern U.S. from aerial survey teams in the states of Georgia and Florida and 1 pair detected in Cape Cod Bay (<http://rightwhales.neaq.org/2013/03/20-right-whale-moms.html>). Acoustic recordings were made with

a towed single-element towed hydrophone while the mother-calf pairs were moving, and with two spar buoy hydrophones that were additionally deployed from the vessel during stationary periods. Over 28 hrs of recordings were made from 9 different mother-calf pairs, 2 of which were recorded on multiple occasions. Right whale vocalizations were detected on three separate days and all were made during a curious approach by the calf.

Cape Cod Bay – Data collection took place between 15 April and 1 May, 2013. A total of 7 days of behavioral observations and acoustic recordings were collected. Acoustic recordings were made with a towed three-element hydrophone while the mother-calf pairs were moving, however the number of elements we were able to deploy varied depending on depth. When the pair was stationary, acoustic recordings were made with two spar buoy hydrophones as well. Almost 20 hours of recordings were made from 7 different mother-calf pairs. Of those pairs, 4 had been recorded in the southeast just two months prior. We were able to record vocalizations from one of these pairs in both habitats, giving us a unique opportunity to assess both calf behavioral and acoustic development.

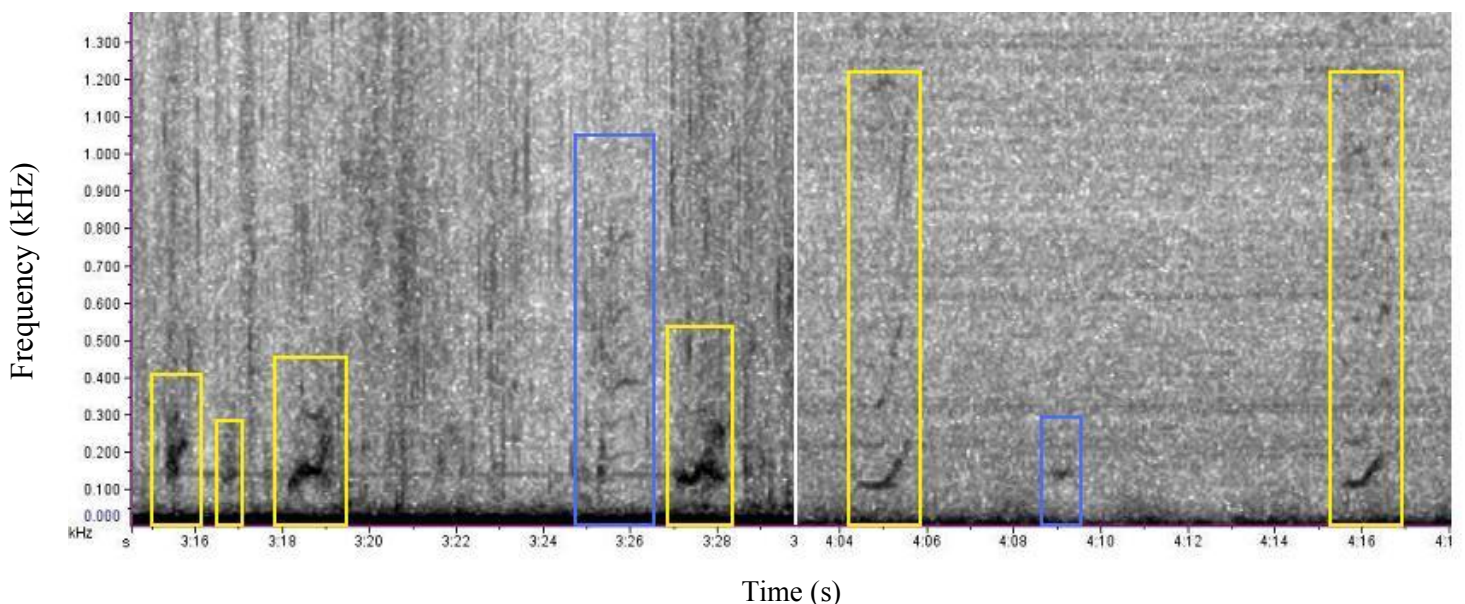


Figure . Vocal development in the 2013 of right whale calf. *The spectrogram on the left shows calf (yellow) and cow (blue) vocalizations from the southeast calving grounds in 2013. The spectrogram on the right shows vocalizations from Cape Cod Bay 2013 from the same calf and cow pair. The time span between the two recordings was 100 days.*

Bay of Fundy – Data collection began 5 August, 2013 and is currently in progress. 2013 appears to be an anomalous year with few right whales sighted in the Bay of Fundy in August.

Summary and Future Directions

Overall consistent trends in behavior are emerging from data collected from 2010-2013. Mother-calf pairs produced very few sounds that were detectable (at ranges of ~100 m or more) in the Southeastern U.S. when the calf was less than four months in age. Instances when sounds were documented involved interaction between the mother-calf pair and either another whale or a novel object in their environment that elicited a curious approach. In contrast, right whale vocalizations produced in bouts were commonly detected in Cape Cod Bay and the Bay of Fundy during reunion events between mothers and their calves, when calves were alone at the surface, and during social interactions with

other individuals. In terms of surface behavior, calves were consistently in much closer proximity to their mothers in the Southeastern U.S. than in the Cape Cod Bay or Bay of Fundy habitats and spent more time at the surface. These results indicate that passive acoustic detection may be an unreliable tool to detect right whale mother-calf pairs in the Southeastern U.S..

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. Then we will be able 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

Award Number: N00014-10-1-0507, “Acoustic Behavior of North Atlantic Right Whale (*Eubalaena glacialis*) Mother-Calf Pairs” at Penn State was the previous counterpart to this award. Data collected in Florida in 2012 was funded by this related award.