

## **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 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 the doctoral research. In the second and third 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, we focused on behavioral observations and passive acoustic recordings of mother calf pairs from a small boat in each of the habitat areas using the protocols established in 2011. In 2011, we collected ~40 hours of acoustic data from 16 mother-calf pair follows representing 11 different individuals. Two mother calf pairs were followed on multiple occasions in two 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 2011, with no calls detected with mother-calf pairs that were alone. Twenty-nine calls were detected during one event when a mother-calf pair was joined by a juvenile right whale. Mother-calf pairs regularly vocalized 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-calf pair were together.

## **RESULTS**

**Southeastern U.S.** – Data collection was conducted between 4 January and 1 March, 2012 as part of a related award to Penn State. A total of nine days of behavioral observations and acoustic recordings were collected. Relatively few calves were born to North Atlantic right whales in 2012, with a total of 6 mother-calf pairs detected in the Southeastern U.S. from aerial survey teams in the states of Georgia and Florida (<http://rightwhales.neaq.org/2012/02/notes-about-calving-ground.html>). Acoustic recordings were made with a towed single-element towed hydrophone while the mother-calf pairs were moving, and with three hydrophones deployed from the vessel during stationary periods. Over 20 hrs of recordings were made from 4 different m/c pairs, 2 of which were recorded on multiple occasions.

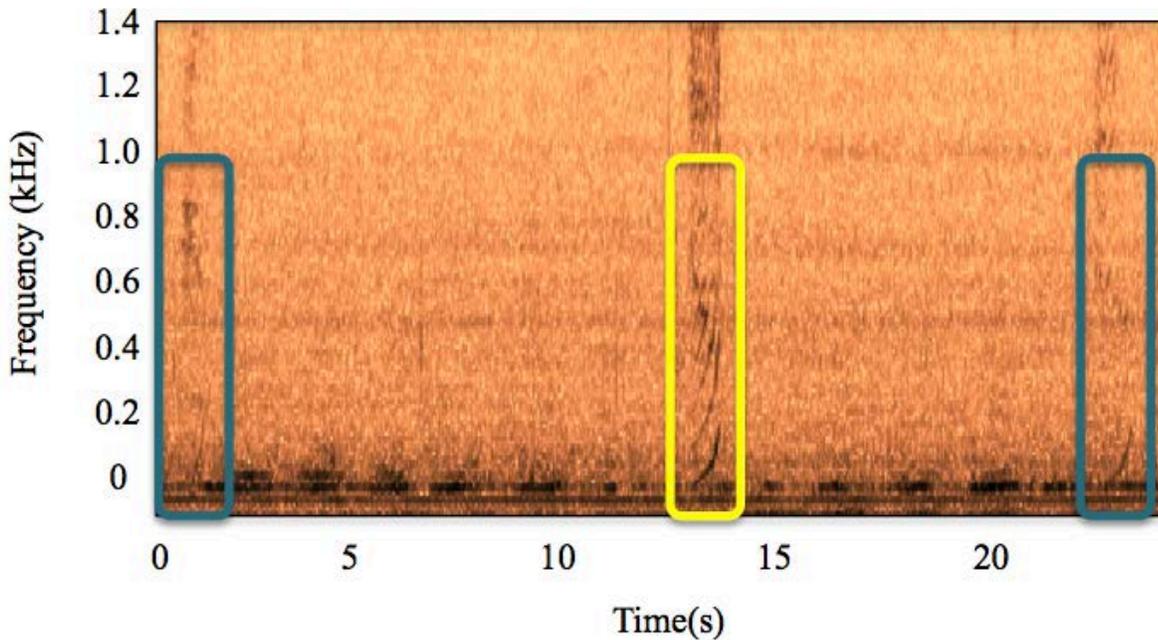
Right whale vocalizations were detected on only one occasion, when a calf made a curious approach and circled the follow boat.

**Cape Cod Bay** – Data collection took place between 1 April – 15 April, 2012. A total of two days of behavioral observations and acoustic recordings were collected between 4 April – 13 April, 2012. Due to equipment failure, no additional data were collected in CCB after April 13. However, there were few sightings of the 5 remaining mother calf pairs in this habitat in 2012.

**Bay of Fundy** - Data collection was conducted between 5 August – 21 September, 2012. Acoustic recordings were made with a towed three-element towed hydrophone while the mother-calf pairs were moving, and with a single spar buoy deployed from the vessel during stationary periods. A total of three days of behavioral observations and acoustics recordings were collected. Very few right whales were sighted in the Bay of Fundy habitat in 2012, the most commonly sighted individuals were a single mother-calf pair, #3390. This was the only mother-calf pair in the Bay of Fundy in 2012 allowing us to conduct three follows of the same pair separated by 4 days and 16 days. This same pair was followed on multiple occasions in the Southeastern U.S. in 2012, giving us good data to assess behavioral and acoustic changes with increasing calf independence. The spacing between the mother-calf pair changed significantly between the two habitats, with the calf consistently more than one body length from the mother in the summer habitat (Figure 1). Numerous calls were detected from the mother-calf pair during reunion events and from the calf while alone at the surface for extended periods of time (Figure 2).



**Figure 1. Photographs showing the spacing between the same right whale mother-calf pair (#3390) a) in the Southeastern U.S. with the calf immediately next to the mother and b) in the Bay of Fundy, Canada, where the calf is trailing the mother and likely out of visual range underwater.**



**Figure 2.** A spectrogram showing a call exchange of contact calls between a right whale mother (blue boxes) and her calf (yellow box) in the Bay of Fundy, Canada.

### **Summary and Future Directions**

Overall consistent trends in behavior are emerging from data collected from 2010-2012. Mother-calf pairs produced very few sounds that were detectable (at ranges of ~100m 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 the Bay of Fundy during reunion events between mothers and their calves and when calves were alone at the surface. In terms of surface behavior, calves were consistently in much closer proximity to their mothers in the Southeastern U.S. than in the Bay of Fundy habitat 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 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.