Acoustic detection range of right whale upcalls detected in near real-time from a moored buoy and a Slocum glider

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BACKGROUND

- Less than 400 North Atlantic right whales
- Management relies on knowledge of whale distribution
- WHOI near real-time passive acoustic whale detection and classification system (DMON/LFDCS) has been operational since 2012
- Acoustic detections **not** used for management due partly to detection range uncertainty

GOAL: Characterize the detection range of the DMON/LFDCS on Slocum glider and moored buoy

METHODS

1. Deploy a horizontal line array (HLA) and vertical line array (VLA) of hydrophones near a DMON/LFDCS glider and buoy
2. Identify all right whale upcalls detected by each platform
3. Localize calls using normal mode back-propagation technique
4. Calculate range-dependent probability that a localized call was detected by the buoy or glider

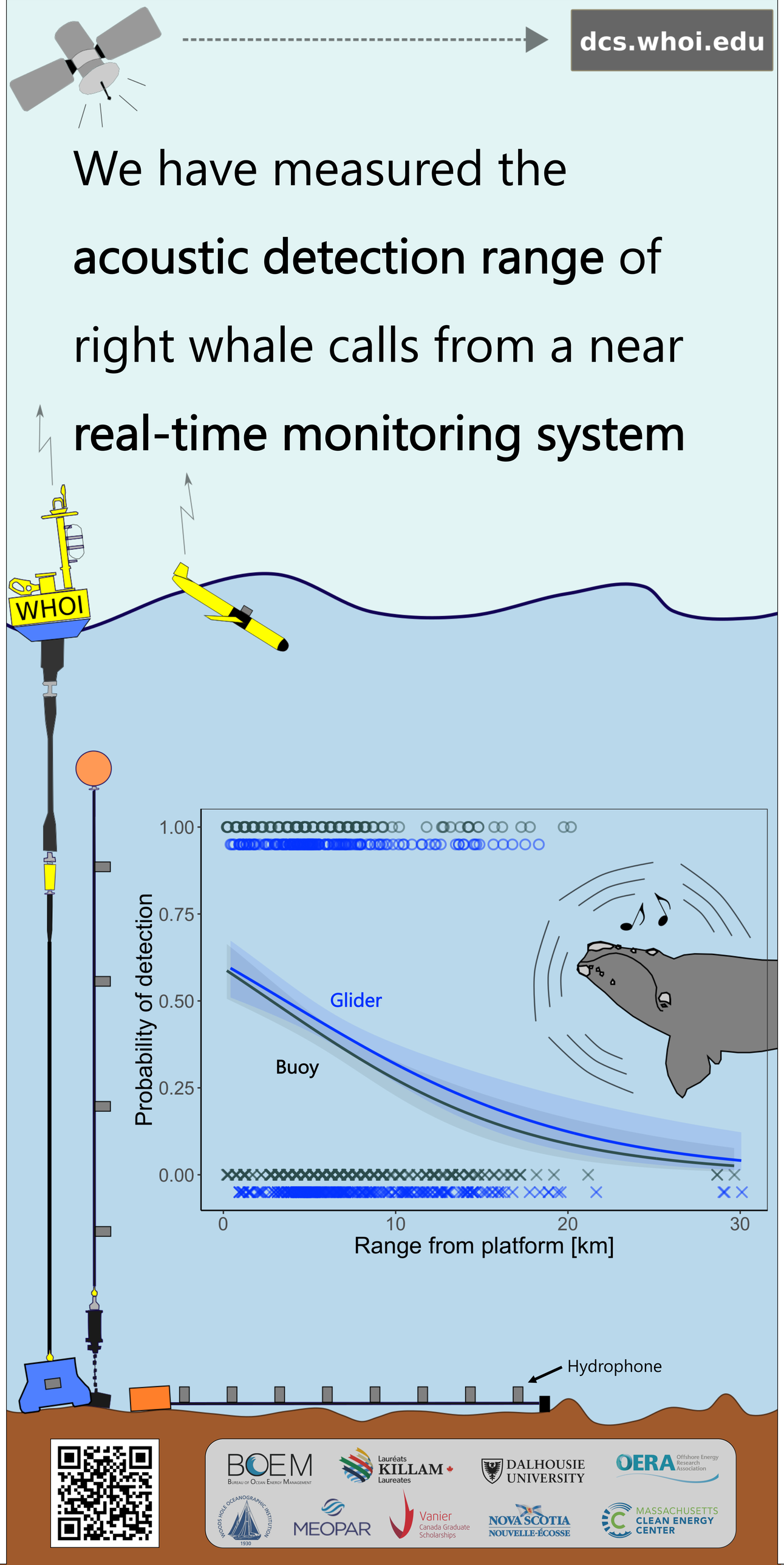
RESULTS

- Localized 42% (622/1485) of calls
- Logistic regression shows probability of detection decreased with range (km):

	50%	33%	5%
Glider	3.6	9.5	28.3
Buoy	2.8	8.0	24.6

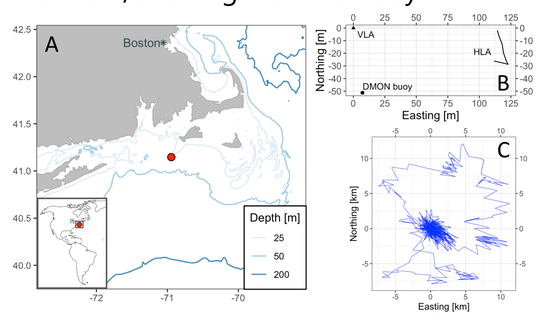
DISCUSSION

- Successful empirical characterization of detection range
- Detection range for buoy and glider similar to archival systems, demonstrating reliability of the DMON/LFDCS
- Estimates conservative, and improved by altering real-time validation protocols
- These results are specific to this study; more efforts are required to generalize



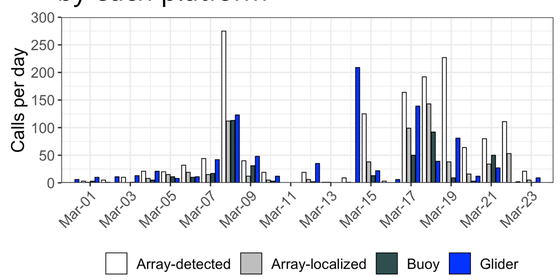
METHODS / RESULTS DETAILS

1. Deployed HLA and VLA alongside a DMON/LFDCS glider and buoy



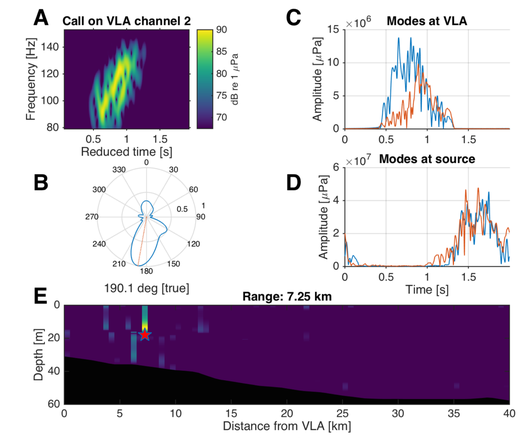
(A) Study site (red circle) in 30m water depth ~15 km southwest of Nomans Island, MA, USA, (B) positions of the VLA, HLA and buoy (DMON buoy) relative to the VLA, and (C) the trajectory of the glider (blue line) relative to the VLA from 28 Feb through 24 Mar 2017

2. Identified all right whale upcalls detected by each platform



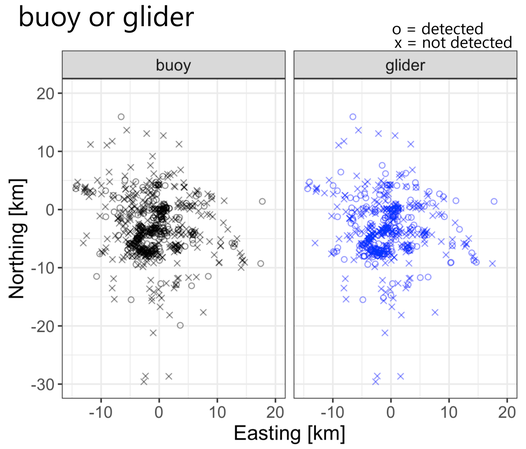
Daily counts of right whale upcalls detected in the HLA/VLA (white; n=1485), the buoy (black; n = 414), and the glider (blue; n = 886), as well as numbers of calls that were successfully localized (grey; n = 622).

3. Localized calls using 3D normal mode back-propagation technique with realistic bathymetry and water sound speed



Example localization workflow for a single call showing (A) the isolated call spectrogram from a single channel of the VLA, (B) beam pattern (blue) and estimated arrival angle (red line), (C) received amplitudes of modes 1 (blue) and 2 (red), (D) back-propagated amplitudes of the same modes, and (E) a normalized probability map of the back-propagation results with a star indicating the most likely range and depth of the calling whale.

4. Calculated range-dependent probability that a localized call was detected by the buoy or glider



The spatial distribution of localized right whale upcalls (n=622 for the buoy, n=503 for the glider). Open circles and crosses indicate calls detected and not detected by the buoy (black) and glider (blue), respectively.