

Field Testing and Performance Evaluation of the Long-Range Acoustic Real-Time Sensor for Polar Areas (LARA)

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LONG-TERM GOALS

With ONR/DURIP funding (award # N00014-13-1-0345), we are currently developing the Long-term Acoustic Real-Time Sensor for Polar Areas (LARA) which combines the advantages of both submerged and surface acoustic observing systems. LARA makes stationary passive acoustic monitoring efforts more effective, and provides maximum flexibility allowing for a wide range of applications even in ice-covered polar areas. While the ONR/DURIP award provides funding to design and manufacture the prototype unit, it doesn't cover expenses for field testing and performance evaluation. This new ONR award will allow us to conduct initial short-term deployments of LARA of the Newport, OR coast followed by a one-year deployment in the seasonally ice-covered northern Bering Sea, AK. Throughout the deployment we will closely monitor LARA remotely from Newport, OR and make changes to the firmware if necessary. After recovery a full data analysis and performance evaluation of the recorded acoustics and engineering data will be conducted.

OBJECTIVES

Most state-of-the-art passive acoustic monitoring systems are designed to stay submerged for the entire deployment period (for a summary see Mellinger *et al.*, 2007). Deep-moored instruments feature a number of advantages. For example, they are not subject to the wear and tear caused by surface waves. However, with archival instruments it is not possible to access data, gain timely information on the presence of acoustic signals of interest (e.g., marine mammal vocalizations or seismic events), or identify system malfunctions prior to instrument recovery. Furthermore, it is not possible to update the system clock by GPS, which might drift significantly during long-term deployments and hinder accurate localization of sound sources when using multiple instruments (e.g., for tracking vocalizing

animals) in an array configuration. A few passive acoustic monitoring systems use a surface buoy to overcome some of these disadvantages but cannot be reliably operated in polar areas with potential ice coverage. In addition, surface buoys are exposed to ocean surface waves, which can cause cable strumming (acoustic noise) and potentially be damaged by collisions with vessels or vandalized. The Long-term Acoustic Real-Time Sensor for Polar Areas (LARA) combines the advantages of both submerged and surface systems. The real-time information system makes stationary passive acoustic monitoring more effective, and provides maximum flexibility allowing for a wide range of applications even in ice-covered areas.

APPROACH

We will test the prototype LARA mooring twice off the Newport, OR coast for approximately 2 weeks in summer 2016. After completion of these tests and potential design modifications, LARA will be deployed in the northern Bering Sea, AK in summer/fall 2017 and operated remotely for one year duration. After recovery in summer/fall 2018, collected engineering and acoustic data will be analyzed and result disseminated.

Site selection, Bering Sea

We propose to deploy LARA at N62.194, W174.668 (73 m water depth) in the vicinity of NOAA/PMEL's long-term mooring M8¹. This site is chosen for four reasons:

- Ice coverage
Even though the sea ice extent in the Bering Sea varies significantly annually, the proposed mooring location has been ice covered for several months every year over the last decade (Sullivan *et al.*, 2014).
- Logistics
Working in the northern Bering Sea/Arctic is logistically challenging and very expensive. However, we were able to secure the necessary shiptime for deployment/recovery of the LARA mooring. The shiptime will be provided at no-cost to this project by NOAA/PMEL.
- Marine mammal presence
Within the scope of the one-year Bering Sea deployment we will focus on the real-time detection of beluga whale (*Delphinapterus leucas*) echolocation clicks. LARA's PAM board already features a functional and robust click detector which has been successfully used to detect odontocete echolocation clicks in real-time via acoustically equipped floats (Matsumoto *et al.*, 2013). This detector (Klinck and Mellinger, 2011) can easily be modified for the detection of beluga whale clicks. The implementation of new detectors and classifiers is planned for the near future. Beluga whales have been extensively studied during the summer months. However, information on the abundance and distribution of this species during the winter months is lacking. The proposed mooring location (Fig. 1) is located within an area which is thought to be a primary wintering ground of the Western Arctic beluga population (Richard, 2002). Acoustic observations in this area will provide new information on the winter distribution of the beluga whale in the northern Bering Sea.

¹ http://www.pmel.noaa.gov/foci/foci_moorings/mooring_info/mooring_location_info.html

- Available metadata
NOAA/PMEL is operating a long-term environmental mooring at this site which collects a suite of physical and biological oceanographic parameters (Sullivan *et al.*, 2014). This metadata will be very useful to interpret the collected engineering and acoustic data.

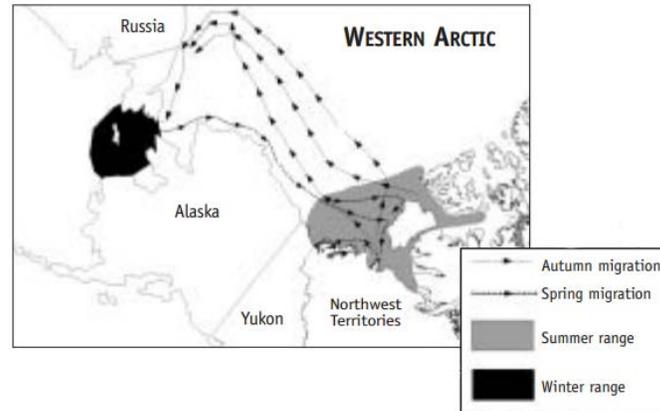


Fig. 1: Distribution and migration of the beluga whale. Source: Richard (2002). Yellow star marks approximate proposed LARA mooring location.

Tasks

[a] Test LARA off Newport, OR

LARA will be deployed twice off the Oregon coast using OSU's research vessel Pacific Storm and operated for 2 weeks duration. These initial tests are necessary to work out the ideal deployment/recovery procedure and ensure proper function of all LARA components.

[b] Deploy LARA in the Bering Sea

LARA will be deployed in the northern Bering Sea utilizing a NOAA vessel. The deployment cruise (~3 weeks duration) is planned for summer/fall of 2017. Detailed cruise information are not available at this point.

[c] Operate LARA remotely

LARA (deployed in the Bering Sea) will be remotely operated from Newport, OR. LARA will send daily information on acoustic detections and system status updates (engineering data). We will closely monitor LARA throughout the deployment and make changes to LARA's firmware whenever necessary (via bi-directional Iridium communication link).

[d] Recover LARA in the Bering Sea

LARA will be recovered in the northern Bering Sea from the NOAA vessel Ronald H. Brown. The deployment cruise (~3 weeks duration) will occur in summer/fall of 2018. Detailed cruise information is not available at this point.

[e] Data Analysis

After recovery of LARA, we will thoroughly analyze all collected engineering, environmental and acoustic data sets in the lab.

[f] Dissemination of results

Results will be disseminated through annual reports and a peer-reviewed publication.

WORK COMPLETED

Subaward funds have been distributed to Oregon State University. The LARA unit is currently undergoing some modifications and will be ready for testing in spring/summer 2016.

RESULTS

Because the funds were disseminated later than expected, the schedule of the project needed to be adjusted. The revised plan is to conduct extensive testing off the Newport, OR coast in summer 2016 and to deploy LARA in the Arctic in summer 2017.

IMPACT/APPLICATIONS

LARA will expand our capability of long-term passive-acoustic real-time monitoring and more importantly allow us to conduct research in ice-covered regions such as the Arctic, a high priority area of DoD. LARA will also function as a test and development platform for new and improved detection algorithms which will potentially be implemented and used on acoustically equipped gliders and floats as well as the Marine Mammal Monitoring on Navy Ranges (M3R) systems at AUTEK and SCORE. In addition LARA technology will be useful for real-time monitoring of deep-ocean seismic and volcanic activity (e.g., Dziak *et al.*, 2012) - especially in areas where SOSUS coverage no longer exists. For example, the LARA system is intended to be used to monitor continued and impending magmatic activity at Axial Volcano and the Middle Valley Ridge segment in the northeast Pacific Ocean. Both areas have seafloor volcanic eruptions forecast for the near future, and the LARA moorings will allow us to observe the accuracy of these models in real-time.

TRANSITIONS

Not applicable.

RELATED PROJECTS

ONR/DURIP project “Long-term Acoustic Real-Time Sensor for Polar Areas (LARA)”, Award Number: N00014-13-1-0345. This award funded the initial development of the instrument.

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PUBLICATIONS

None.

PATENTS

None.

HONORS/AWARDS/PRIZES

None.