Arctic Research Initiative Final Report

Monitoring bowhead whale occurrence and habitat in the Bering Sea using passive acoustics

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The northern Bering Sea is home in winter to vocal Arctic marine mammal species such as bowhead and beluga whales, bearded seals, and walrus, but is inhabited by more temperate species during the summer, such as gray, fin, and humpback whales. Year-round monitoring of this region is difficult because of its remoteness as well as harsh weather conditions and sea ice in the winter. To investigate the species that inhabit these waters and the oceanographic conditions that may attract the animals to the region, passive acoustic monitoring is essential. Passive acoustics offers a relatively low-cost method to detect vocal marine mammals continuously for periods ranging from weeks to years. With support from the Arctic Research Initiative, we took advantage of an opportunity to install passive acoustic recorders on existing moorings in the Bering Strait, and to acquire data from existing recorders in the Bering Sea to study the migration and habitat of bowhead whales.

As the Arctic experiences increasingly extensive ice-free periods, anthropogenic activities such as commercial fishing, shipping and oil and gas extraction are likely to intensify in the Bering Sea to the detriment of marine mammals (e.g., entanglement in fishing gear, collision with vessels, acoustic disturbance). Moreover, climate change may alter environmental conditions and prey distributions, potentially leading to changes in the timing of migrations or shifts in distribution for top predators like the bowhead whale. Changes such as these are of particular interest to the native subsistence hunters of coastal Alaska, who depend upon the seasonal occurrence of many marine mammals for their survival. It is therefore important to identify relationships among bowhead occurrence and environmental conditions to better understand how changes in the ocean may affect the distribution and behavior of the bowhead whale.

We had originally planned to install passive acoustic recorders acquired with ARI funds in two locations in the Bering Strait for a single year during an annual joint Russian-American cruise to the region. Our collaborator, Dr. Kate Stafford from the University of Washington and a regular participant in these cruises, has been able to recover the recorders, install new hard drives and batteries, and re-deploy these same recorders for the past *three* years, providing us a much longer acoustic time series than we had originally anticipated. In addition to these data, we have collaborated with the National Marine Mammal Laboratory to acquire passive acoustic recording data from two other locations in the Bering Sea. All of these acoustic datasets come from moorings that are equipped with physical oceanographic sensors, allowing a novel comparison between bowhead whale presence at the moorings (via acoustic detection) and oceanographic conditions to better understand how the environment may influence bowhead occurrence in the region.

MIT/WHOI Joint Program student Carter Esch is currently analyzing these data as part of her doctoral thesis. She is applying a new automated whale call detection and classification system developed in the Baumgartner Lab at WHOI to analyze the thousands of hours of acoustic data we have acquired. She will be examining these automated detections along with the physical oceanographic data collected at the moorings as well as ice cover data from the National Snow and Ice Data Center to better understand the relationship between bowhead whales and their environment.

We are exceedingly grateful to the Clark Arctic Research Initiative for funding the purchase of new recorders and for providing student support for Ms. Esch to analyze these important data.