



## **Passive Acoustic Monitoring for Marine Mammals in the Gulf of Alaska Temporary Maritime Activities Area September 2017 to September 2019, Interim Report**

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Humpback whale, Photo by Katherine Whitaker

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## Executive Summary

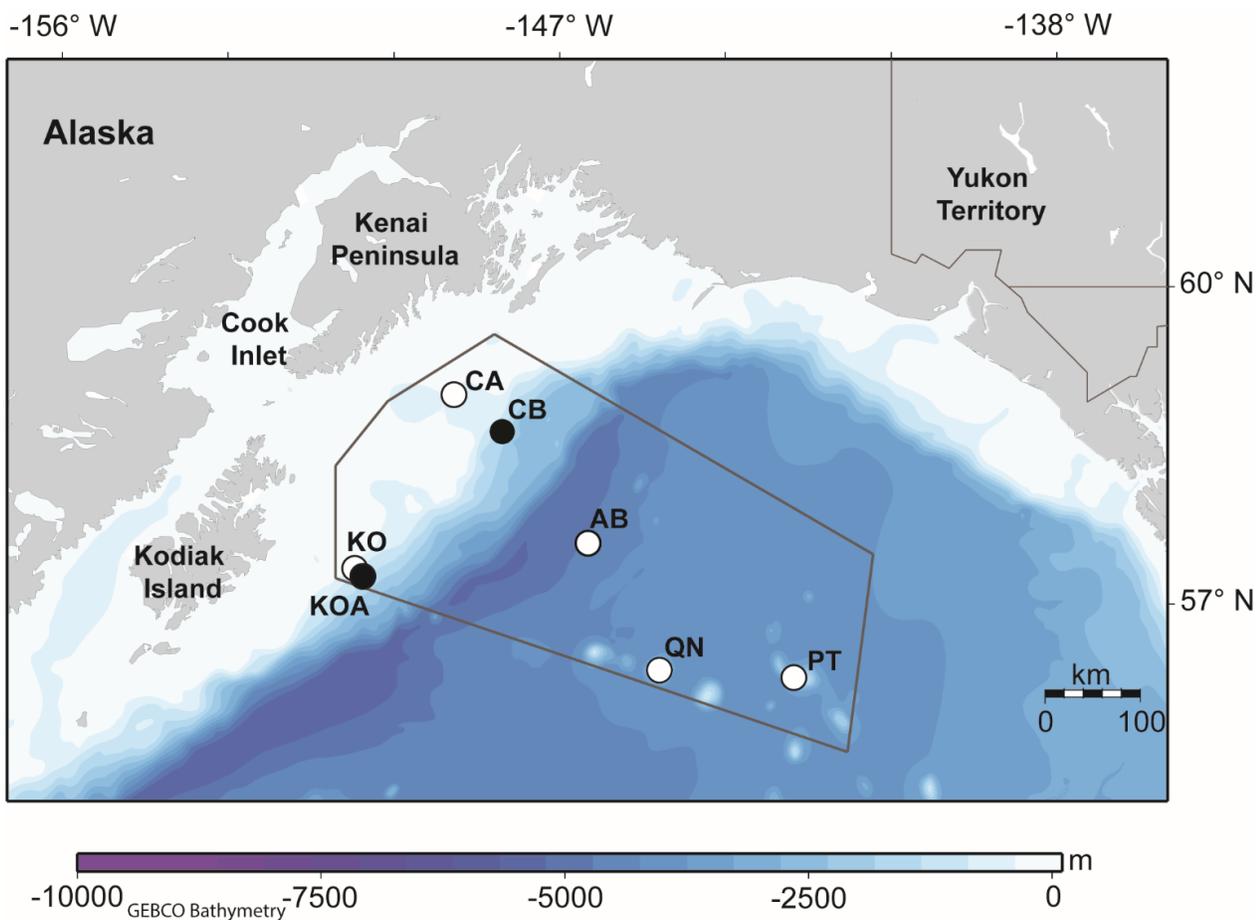
Passive acoustic monitoring was conducted in the Gulf of Alaska Temporary Maritime Activities Area (GATMAA) from September 2017 to September 2019 to record the low-frequency ambient soundscape and detect marine mammal and anthropogenic sounds during times of naval exercises in the area. High-frequency Acoustic Recording Packages (HARPs) recorded sounds between 10 Hz and 100 kHz at two locations: a continental slope site in deep water (~900–1,000 m depth, site CB) and a continental shelf site off Kodiak Island (~1,000 m depth, site KOA).

The low-frequency ambient soundscape, as well as marine mammal and anthropogenic sounds, will be analyzed for two sites in the Gulf of Alaska in the coming months. For marine mammal and anthropogenic sounds, data analysis will consist of detecting sounds by analyst visual scans of long-term spectral averages (LTSAs) and spectrograms, and by automated computer algorithm detection when possible. The data will be divided into three frequency bands and each band will be analyzed for marine mammal and anthropogenic sounds. The data will be examined for the following mysticete species: blue whales, fin whales, gray whales, North Pacific right whales, and humpback whales. The odontocete species that will be evaluated in the dataset are killer whales, sperm whales and beaked whales. Three anthropogenic signals will also be analyzed: mid-frequency active (MFA) sonar, low-frequency active (LFA) sonar, and explosions.

## Project Background

The Navy's Gulf of Alaska Temporary Maritime Activities Area (GATMAA) is an area approximately 300 nautical miles (nm) long by 150 nm wide, situated south of Prince William Sound and east of Kodiak Island (Figure 1). It extends from the shallow shelf region, over the shelf break and into deep offshore waters. The region has a subarctic climate and is a highly productive marine ecosystem as a result of upwelling linked to the counterclockwise gyre of the Alaska current.

A diverse array of marine mammals is found in this region, including baleen whales, beaked whales, other toothed whales, and pinnipeds. Endangered marine mammals that are known to inhabit this area are blue (*Balaenoptera musculus*), fin (*B. physalus*), humpback (*Megaptera novaeangliae*), North Pacific right (*Eubalaena japonica*), and sperm (*Physeter macrocephalus*) whales. North Pacific right whales are of particular interest as their current abundance estimate is only a few tens of animals, making them the most endangered marine mammal species in U.S. waters. Based on visual sightings in 2004–2006, a North Pacific right whale critical habitat was defined on the shelf along the southeastern coast of Kodiak Island, bordering the GATMAA.



**Figure 1. Locations of current (black circles) and previous (white circles) High-frequency Acoustic Recording Package (HARP) deployment sites in the GATMAA (gray line). Color indicates bathymetric depth with darker colors being deeper.**

In July 2011, an acoustic monitoring effort was initiated at two sites (CA and CB; Table 1) within the boundaries of the GATMAA with support from the Pacific Fleet under contract to the Naval Postgraduate School. The goal of this effort was to characterize the sounds produced by marine mammal species present in the area, determine their seasonal patterns, and evaluate the potential for impact from naval operations. The low-frequency ambient soundscape and anthropogenic sounds were also analyzed. Additional monitoring sites were added to this effort with PT in 2012, and KO and QN in 2013 (Table 1; Figure 1). In 2017, site AB was added to examine a deep-water site that is not located at a seamount, and in 2019 site KOA was added to monitor an area near the North Pacific right whale critical habitat (Table 1). This report will cover only sites CB and KOA, as monitoring effort was suspended for sites CA, KO, and PT in 2014, QN in 2017, and AB in 2017.

**Table 1. Locations for HARP deployment sites in GATMAA.**

Site	Latitude	Longitude	Depth (m)	Years Monitored
CA	59° 0.5 N	148° 54.1 W	200	2011 - 2014
CB	58° 40.26 N	148° 01.45 W	900	2011 – 2019
PT	56° 14.6 N	142° 45.46 W	1000	2012 – 2014
KO	57° 20.0 N	150° 40.1 W	200	2013 – 2014
QN	56° 20.48 N	145° 10.99 W	900	2013 - 2017
AB	57° 30.82 N	146° 30.05 W	1200	2017

KOA	57° 13.44 N	150° 31.70 W	1000	2019
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This report documents the data processing progress that has been made so far on recordings from two High-frequency Acoustic Recording Packages (HARPs) that were deployed within the GATMAA from September 2017 to September 2019 (Figure 1). The two sites include a continental slope site in deep water (site CB) and a shallow water site off Kodiak Island (site KOA) (Table 1). Data from site CB will be analyzed for September 2017 to September 2019 (Table 2). Data from site KOA will be analyzed from April 2019 to September 2019 (Table 2).

**Table 2. GATMAA acoustic monitoring since July 2011. Deployment periods analyzed in this report are shown in bold.**

Results from previous reporting periods are described in Baumann-Pickering et al. (2012), Debich et al. (2013), Debich et al. (2014), and Rice et al. (2015) and Rice et al. (2018).

Deployment Name	Deployment Period	Duration (days)	Duration (hrs)	Sample Rate (kHz)
CA01	7/13/2011 – 12/17/2011	157.97	3791.3	200
CB01	7/13/2011 – 2/19/2011	221.83	5323.97	200
CA02	5/3/2012 – 1/16/2013	343.94	8254.45	200
CB02	5/3/2012 – 2/12/2013	285.98	6863.63	200
PT01	9/9/2012 – 6/10/2013	274.63	6591.08	200
CA03	6/6/2013 – 6/17/2013	11.43	274.45	320
CB03	6/6/2013 – 9/5/2013	90.37	2168.85	200
KO01	6/9/2013 – 6/26/2013	18.09	434.05	200
PT02	6/11/2013 – 8/20/2013	70.02	1680.52	200
QN01	6/10/2013 – 9/11/2013	93.28	2238.80	320
CA04	9/6/2013 – 4/28/2014	234.74	5633.85	200
CB04	9/5/2013 – 4/28/2014	235.59	5654.27	200
KO02	9/8/2013 – 5/1/2014	234.91	5637.85	200
PT03	9/3/2013 – 3/21/2014	198.95	4774.73	200
QN02	9/11/2013 – 4/16/2014	217.03	5208.85	200
QN03	4/30/2014 – 5/24/2014	23.74	569.69	200
CA05	4/29/2014 – 9/9/2014	133.05	3193.18	200
CB05	4/29/2014 – 9/9/2014	133.19	3196.61	200
KO03	5/1/2014 – 9/11/2014	133.34	3200.07	200
PT04	4/30/2014 – 9/10/2014	133.27	3198.41	200
CB06	9/9/2014 – 5/1/2015	233.64	5607.44	200
QN04	9/10/2014 – 5/2/2015	233.37	5600.99	200
CB07	5/1/2015 – 9/6/2015	128.18	3076.35	200
QN05	5/2/2015 – 8/18/2015	108.51	2604.29	200
AB01	4/29/2017 – 9/13/2017	136.6	3278.36	200
CB08	4/30/2017 – 9/12/2017	135.13	3243	200
QN06	4/30/2017 – 9/13/2017	136.64	3279.39	200
<b>CB09</b>	<b>9/14/2017 – 6/16/2018</b>	<b>275.13</b>	<b>6603</b>	<b>200</b>
<b>KOA1</b>	<b>4/24/2019 – 9/27/2019</b>	<b>155.95</b>	<b>3742</b>	<b>200</b>
<b>CB10</b>	<b>4/25/2019 – 9/27/2019</b>	<b>154.79</b>	<b>3715</b>	<b>200</b>

## **Methods**

### **High-frequency Acoustic Recording Package (HARP)**

HARPs were used to record the low-frequency ambient soundscape as well as marine mammal and anthropogenic sounds in the GATMAA. HARPs can autonomously record underwater sounds from 10 Hz up to 160 kHz and are capable of over one year of continuous data storage. The HARPs were deployed in a seafloor mooring configuration with the hydrophones suspended at least 10 m above the seafloor. Each HARP hydrophone is calibrated in the laboratory to provide a quantitative analysis of the received sound field. Representative data loggers and hydrophones were also calibrated at the Navy's Transducer Evaluation Center facility to verify the laboratory calibrations (Wiggins and Hildebrand, 2007).

### **Data Collected**

Acoustic data have been collected within the GATMAA using autonomous HARPs since July 2011 (Table 2). Each HARP sampled continuously at 200 kHz except for deployments CA03 and QN01, which were sampled at 320 kHz (Table 2). The sites analyzed in this report are designated site CB and KOA (Table 1). A total of 14,060 hours, covering 585 days, of acoustic data were recorded for this reporting period. Data from site CB will be analyzed for September 14, 2017 to June 16, 2018 and again from April 25 to September 27, 2019 (Table 2). Data from site KOA will be analyzed from April 24 to September 27, 2019 (Table 2).

### **Data Analysis**

To date, analysis has not been performed for these deployments. In the coming months, data will be analyzed by visually scanning LTSAs in source-specific frequency bands and, when appropriate, using automatic detection algorithms to detect blue whale D calls, fin whale 20 Hz calls, humpback calls, sperm whale clicks, and beaked whale frequency-modulated pulses.

Recording over a broad frequency range of 10 Hz–100 kHz allows monitoring of the low-frequency ambient soundscape and detection of baleen whales (mysticetes), toothed whales (odontocetes), and anthropogenic sounds. The data will be examined for the following mysticete species: blue whales, fin whales, gray whales, North Pacific right whales, and humpback whales. The odontocete species that will be evaluated in the dataset are killer whales, sperm whales, and beaked whales. Three anthropogenic signals will also be analyzed: mid-frequency active (MFA) sonar, low-frequency active (LFA) sonar, and explosions.

### **Conclusion**

Passive acoustic monitoring was conducted at two sites in the GATMAA from September 2017 to September 2019 to record the low-frequency ambient soundscape and marine mammal and anthropogenic signals.

To date, the data has been recovered and processed but analysis has not been completed. A full report containing results on the low-frequency ambient soundscape, marine mammal and anthropogenic sounds will follow.

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