The Inception of Two Long-Term Passive Acoustic Monitoring Programs in the Gulf of Alaska

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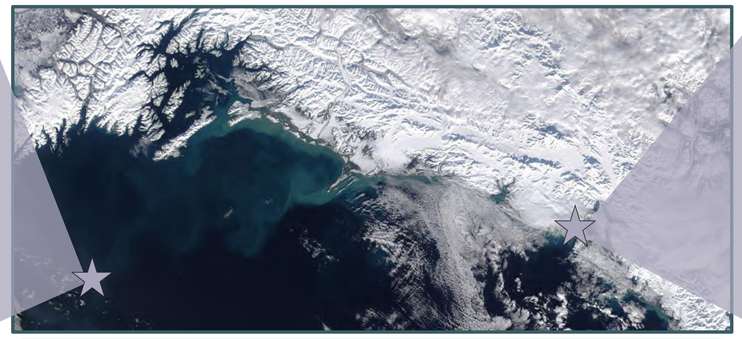
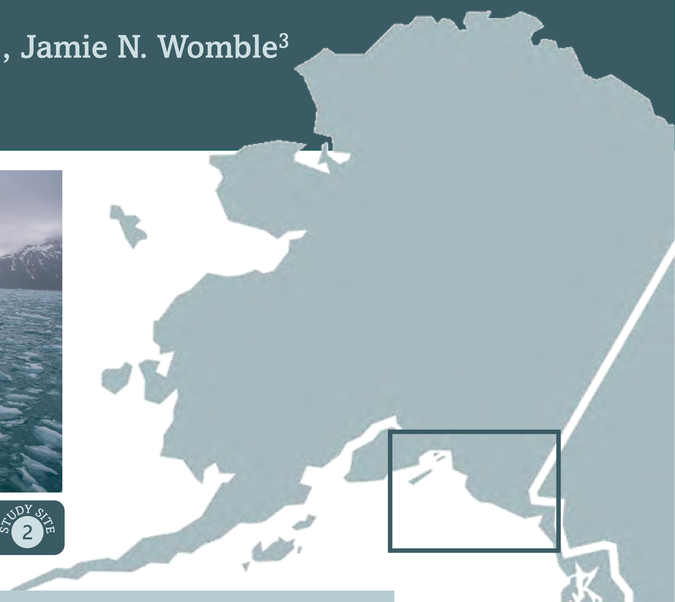
Seward Line Shelf Break (Study Site 1)



Northern Gulf of Alaska

Disenchantment Bay (Study Site 2)



Background

The **Gulf of Alaska (GOA)** is a highly productive and dynamic subarctic ecosystem subject to the effects of numerous anthropogenic disturbances, including warming, ocean acidification, oil spills, and ship traffic noise pollution.

GOA oceanographic moorings support management and long-term monitoring programs investigating the **underwater soundscapes**, **oceanographic drivers**, and **anthropogenic noise** of two contrasting marine ecosystems. Acoustic samples are recorded year-round at both sites.

Objective

To analyze new and existing GoA sound recordings to investigate the **biophonic** (biological), **geophonic** (abiotic), and **anthropogenic** contributors to the GOA's overall soundscape.

Why It Matters

Biological production in the GOA relies on a mosaic of factors including a patchy nutrient supply. Oceanographic observations at the two mooring sites quantify nutrient and phytoplankton standing crop distributions, elucidate physical patterns, and provide information to **assess long term change**.

The GOA marine ecosystem is vulnerable to the effects of global climate change, which result in **receding ice fields**, **altered stratification**, and other changes with ecological ramifications. The concurrent passive acoustic monitoring of these two sites adds context to the influence of physical dynamics on the productivity of the region.

Main Takeaways

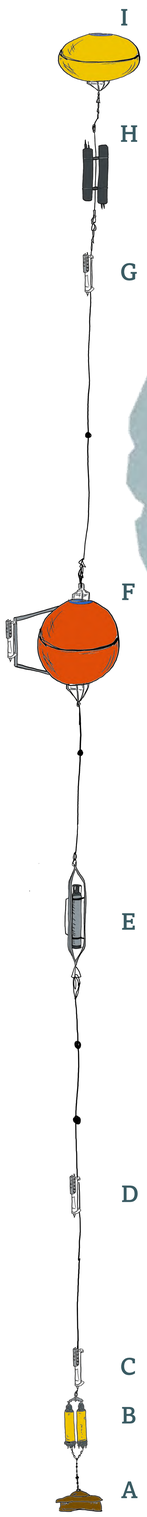
(1) Sound is ubiquitous and heterogeneous in the GoA, resulting in temporally and spatially distinct **soundscapes** that reflect marine mammal and fish ecology, glacier calving, wind speed, rainfall, underwater tectonic activity, and anthropogenic disturbances.

(2) Continental shelf soundscapes were dominated by endangered baleen whales, poorly studied toothed whales, ships, and storms.

(3) Fjordal soundscapes were dominated by iceberg collisions, cruise ships, and smaller vessels. Notably few cetacean vocalizations were detected.

Site 1: GEO Mooring

Site 2: DB Mooring



Study Site 1: Gulf of Alaska Ecosystem Observatory (GEO)

SITE

Northern Gulf of Alaska Long Term Ecological Research Program (NGA LTER)

National Science Foundation

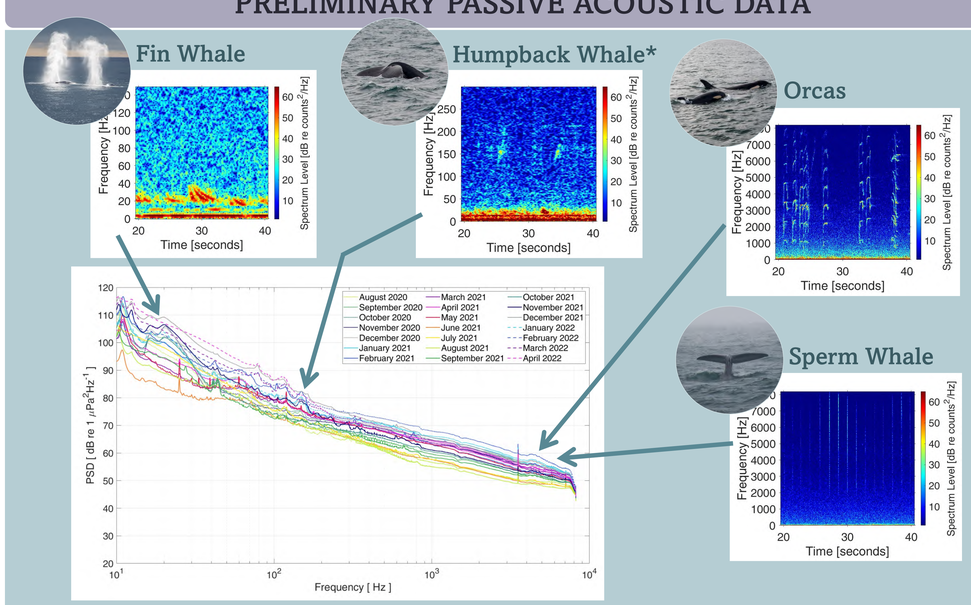
Est. 2017

INSTRUMENTATION

A	Railroad Wheel		Sacrificial Anchor
B	EdgeTech Acoustic Release		Retrieval System
C	SBE37 MicroCAT		CTD
D	AURAL M2 (10-16384 Hz)		Passive Acoustic Recorder
E	HydroBios Sediment Trap		Particle Collector
F	Sexton Custom Build		Particle Camera
G	ADCP Float		Current Velocities
H	AZFP		Active Acoustic Profiler
I	MBARI OsmoSampler		Trace Metals Water Sampler
J	AquaMonitor		Water Sampler + CTD
K	Near Surface Float		Recovery Beacon

* Black dots represent thermistors

PRELIMINARY PASSIVE ACOUSTIC DATA



Representative power spectral densities (PSD) of acoustic samples, spanning 10-8192 Hz. Lines represent average RMS spectral levels for each on-effort month. Acoustic samples were recorded on a 25/60 minute duty cycle. To create each monthly spectra line, the PSD was calculated as the average from all samples recorded in the first week of the month (n = 168). Overall sound pressure levels are relatively consistent across time, but distinct peaks occur at notable frequencies seasonally as marine mammals move through the region.

Disenchantment Bay Mooring (DB)

SITE

Outer Coast Oceanographic Monitoring Program

Southeast Alaska Inventory & Monitoring Network

National Park Service

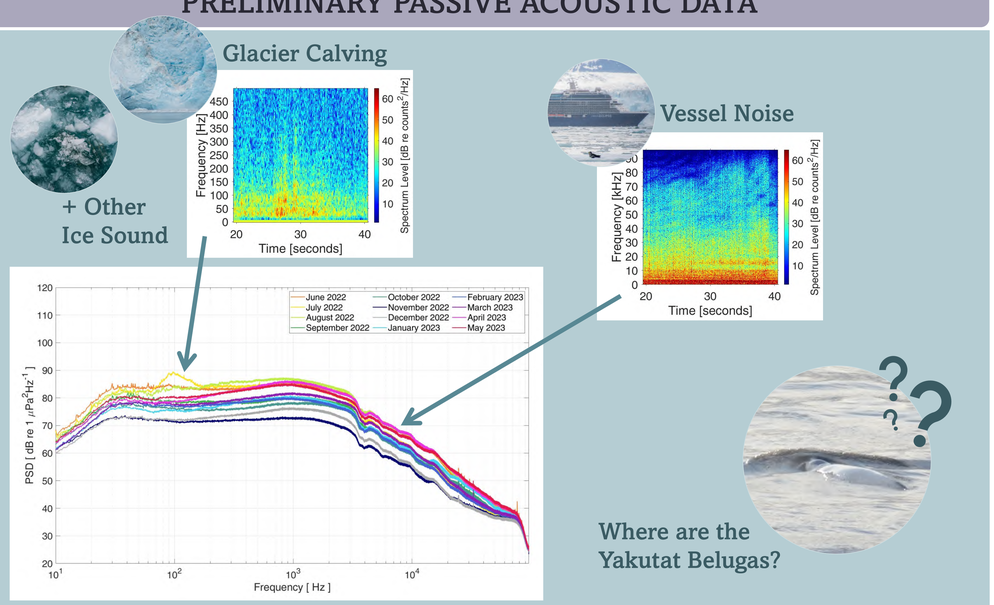
Est. 2022

INSTRUMENTATION

A	Railroad Wheel		Sacrificial Anchor
B	EdgeTech Acoustic Release		Retrieval System
C	SBE37 MicroCAT		CTD
D	SBE37 MicroCAT		CTD
E	SoundTrap 600 HF (0.1-192 kHz)		Passive Acoustic Recorder
F	ADCP Float with MicroCAT		Current Velocities + CTD
G	SBE37 MicroCAT		CTD
H	ECOPAR + ECOTriplet		PAR, chlorophyll, fluorescence, backscattering
I	Near Surface Float		Recovery Beacon

* Black dots represent thermistors

PRELIMINARY PASSIVE ACOUSTIC DATA



Representative power spectral densities (PSD) of acoustic samples, spanning 10-192000 Hz. Lines represent average RMS spectral levels for each on-effort month. Acoustic samples were recorded on a 7/60 minute duty cycle. To create each monthly spectra line, the RMS PSD was calculated as the average from all samples recorded in the first day of the month (n = 24). Overall sound pressure levels decrease during winter months, but frequency-specific peaks are relatively consistent.

Next Steps

(1) Further data exploration:
- Custom code for more efficient spectra production
- Sound source specific presence rates across diel and seasonal cycles

(2) Design an analysis that compares rates of marine mammal detections from before and after significant geophonic and anthropogenic noise events

(3) Further data collection via moorings and autonomous DMON-equipped gliders

Acknowledgements

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Links

Digital Poster

Drawing on Science: An oceanography graduate student's artistic interpretation of the Gulf of Alaska