Ocean water and blue mussel (*Mytilus edulis; yaak*) samples create baseline for climate change and pollution indicators and strengthen data sovereignty for the Tlingit community of Kake, Alaska

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Introduction

The Organized Village of Kake (OVK), Kake Tribal Corporation (KTC), and the City of Kake partnered with the Alaska Center for Climate Assessment and Policy at UAF to undertake investigation of climate change and environmental effects of pollution in and around Kake, Alaska between 2020 and 2022. From June to October 2020 the partnership focused on the implementation of a community-led ocean monitoring program, with Kake residents leading ocean water sampling and mussel (*Mytilus edulis; yaak*) collection. Ocean water samples were collected and analyzed for: temperature, salinity, pH, Dissolved Metals; Total Mercury; Nitrogen, Ammonia, and Fecal coliform. Blue mussel tissues were also collected and analyzed for Total Metals; Total Mercury; PST (Paralytic Shellfish Toxin, specifically saxitoxin); and Nitrogen. This data will be added to OVK’s climate and ecological archive and further strengthens the tribe’s data sovereignty. It will form a baseline for future data collection and analysis of this data will provide insight into the condition of the ocean around Kake and potential impacts on subsistence species and Kake community members.

Materials and Methods cont.

Research Questions

Primary research questions: What are the baseline levels of heavy metals, fecal coliform, PST and mercury in the waters and mussels around Kake?

Analysis Questions: Do heavy metal, fecal coliform, PST and mercury concentrations differ among sampling locations or across the 2020 sampling period (June-October)?

Discussion questions: What do these levels tell us about potential pollution and the impacts on community members and subsistence species?

Materials and Methods

Materials

• Primary sampling equipment included:

  - Bottle, B) Dr. Meter pH meter PH

  Figure 2. Primary sampling equipment: A) Fieldmaster Basic Water Bottle, B) Dr. Meter pH meter PHB-100V, and C) YSI Pro 30.

  - There were two types of water sampling events: S1, shore (Pt. MaCartney) and S2, approximately 13 miles from Kake (Pilot boat location)

Steps for water sampling

Figure 3. A map displaying the ocean water sampling sites S1 and S2 and the mussel collection sites Pt. White Jr. and Town Flats.

- All water sampling events consisted of individuals devoted to the following positions: logbook, clean hands, dirty hands, YSI and pH
- At shore events, samples were collected at a depth of one meter
- At offshore events, samples were collected from a depth of one meter and 6.1 meters
- Once samples were collected, they were stored in a fridge (at between 2 and 6 degrees Celsius) until they could be sent to the lab for processing

Figure 4. Left: A sampler holding the grab sampler at the S1 site. Right: Samplers collecting an ocean water sample at the S2 site.

Steps for mussel collection

- Mussel samples were collected from two sites, one near the shore site for water (Pt. White Jr.) and one located in town (Flats)
- Mussel samples were selected based on collecting a consistent size throughout the season
- Approximately 30 mussels were collected during each sample event
- Once collected, mussels were soaked in sea water from the collection site and then the water was drained
- Mussels were shocked with nonmetallic tools and frozen prior to sending to labs for processing

Data Analysis

- Data was analyzed using Microsoft Excel during the fall of 2020. A review of relevant literature and local and regional data is ongoing to compare our data with relevant thresholds.

Materials and Methods cont.

Results

• Ocean water and mussel tissue samples were tested for heavy metals, including: Cadmium, Chromium, Copper, Lead, Nickel, Silver, Zinc, in addition to Mercury, PST, and Fecal coliform, and PST
- RL: Reporting Limit, the lowest concentration of analyte reportable by lab considering dilution or other factors
- MDL: Minimum Detection Limit, the lowest concentration an analyte can be detected in a sample as determined by method or study
- ND: Not Detected at the reporting limit
• CMC: Criterion Maximum Concentration, the EPA’s recommended highest amount before posing significant risk to aquatic species

Figure 5. Left: Mussels before shucking. Right: Mussels after shucking.

Figure 6. A graph summarizing heavy metals and PST within mussel tissue samples. All analytes were either detected or not detected.

Figure 7. A graph summarizing heavy metals and fecal coliform within water samples. Heavy metals are characterized as being not detected, below their CMC, or above their CMC. Fecal coliform is either detected or not detected.

Conclusion

What are the standard levels of heavy metals, fecal coliform, PST and mercury in the waters and mussels around Kake?

• This dataset indicates relatively low concentrations of fecal coliform, heavy metals, and mercury in the ocean water surrounding Kake
• This dataset indicates the presence of heavy metals, PST, and mercury in mussels around Kake, but more samples are required to determine an accurate baseline
• The observation of many NDs is important when considering the impact of reduced ship traffic during the 2020 field season due to the Covid-19 pandemic

Do heavy metal, fecal coliform, PST and mercury concentrations differ among sampling locations or across the 2020 sampling period (June-October)?

• Additional samples are required to quantify seasonal changes
• Changes in analyte concentration at different locations and over time are dependent upon the analyte, time, and location
• More observations are required to answer the question of whether analyte concentrations differ across locations and time

What do these levels tell us about potential pollution and the impacts on community members and subsistence species?

• All heavy metals that were tested for have the potential to impact the biological species that live in the ocean water surrounding Kake
• High concentrations of Copper in water can impact salmon, an important subsistence species, and their olfactory senses
• Increasing frequency and magnitude of PST levels in subsistence shellfish species pose a threat to community members
• Accumulation of heavy metals in seals, another important subsistence species, can impact both the animal and the people consuming it

What do these data tell us about possible climate change effects?

• Ocean water and mussel samples, along with the analysis of salinity, temperature, and pH data are needed to determine any climate change effects
• Long-term data sets, paired with regional data, will be crucial in determining the effects of climate change around Kake

Future Research

• Logbook information and YSI results are currently being analyzed; this includes salinity, temperature, and pH readings from each sample event
• Third party data review is ongoing (checking for consistency, flags in the data, etc.)

References

SEATOR database: https://aphalernal.ana.gov/doc/Access/56081555-3b6d-4b2e-84ad-50b4c527b5f5
EPA site: https://www.epa.gov/wqc/national-recommended-water-quality-standards-visualisation
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Yaak is the Tlingit word for mussel.

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