Exxon Valdez **Oil Spill Trustee Council**
Long-Term Research and Monitoring, Mariculture, Education and Outreach
Annual Project Status Summary

****For Instructions for each section below, see Reporting Policy, II (B); the Reporting Policy can be found on the website, https://evostc.state.ak.us/policies-procedures/reporting-procedures/***

Project Number: 23220201

Project Title: Chugach Regional Ocean Monitoring (CROM) Program

Principal Investigator(s): Maile Branson, Chugach Regional Resources Commission (CRRC), Alutiiq Pride Marine Institute (APMI)

Willow Hetrick-Price, Chugach Regional Resources Commission (CRRC), Alutiiq Pride Marine Institute (APMI)

Reporting Period: Feb 1, 2023 – January 31, 2024

Submission Date (Due March 1 immediately following the reporting period): March 1, 2024

Project Website: https://www.alutiiqprideak.org/crom

Please check all the boxes that apply to the current reporting period.

☒ **Project progress is on schedule.**

☐ **Project progress is delayed.**

☐ **Budget reallocation request.**

☒ **Personnel changes**
There have been several changes to staff funded under this program. Allison Carl, a Sugpiaq descendant, Eyak Tribal member, and Chugach Alaska Corporation shareholder has replaced Annette Jarosz as the Biology Laboratory Manager. CRRC/APMI has hired Jacob Cohen, a recent graduate of Georgetown University as the Biology Laboratory Technician. CRRC has also hired Cora McKean, a recent graduate of the University of Miami, to fill the Chemistry Laboratory Technician role. All other staff have remained within their current positions. These key positions will have a positive impact on the project as the organization is now fully staffed to complete the project as awarded. Below is the current list of employees that are working on/charging to Project Number 23220201.

Position	Employee Name
CRRC Executive Director	Willow Hetrick-Price
APMI Science Director	Maile Branson
APMI Biology Laboratory Manager	Allison Carl
APMI Technician #1 (Biology)	Jacob Cohen
APMI Chemistry Laboratory Manager	Jacqueline Ramsay
APMI Technician #2 (Chemistry)	Cora McKean
Grants Administrator	Tanja Davis

1. Summary of Work Performed:

Administration:
To date, all of the budgeted equipment pieces under the initial phases of this award have been purchased. All but the Burke-o-Lator have been delivered. In light of CRRC's recent growth, the APMI research spaces require considerable expansion to accommodate the myriad of projects now being conducted at the facility. Construction of a new larger laboratory space is underway, with designated biosecure areas for molecular work and toxicology analyses. Some pieces of equipment have not been installed due to lack of space, and are awaiting construction completion prior to installation. Construction completion and final installation is projected to occur in spring 2024.

Sample Coordination:
From February 1, 2023 to January 31, 2024, APMI sent out sampling kits for dissolved inorganic carbon sampling (to monitor water quality parameters), phytoplankton net tows (to monitor for the presence of harmful algae), and shellfish sampling (to monitor for the presence of harmful algal toxins) to participating communities (Tables 1-3). In FY23, APMI has received 154 samples for dissolved inorganic carbon analysis, 139 phytoplankton samples, and 57 shellfish samples (Tables 1-3). In addition to these samples, several communities in the spill affected region, but outside the funded scope of this project have asked to be included in monitoring efforts. These data are included in both this report and the final submitted dataset.

Table 1. Dissolved inorganic carbon sample status.

Community	# FY22 Samples Received in FY23	# FY23 Samples Received	Lab Analysis Complete	Data Finalized
Armin F. Koernig Hatchery	16	1	17	17
Chenega	14	23	37	37
Eyak	10	6	16	16
Nanwalek	0	0	N/A	N/A
Port Graham	0	12	12	12
Seldovia	25	23	48	48
Seward	Continuous	Continuous	Continuous	Continuous
Tatitlek	9	3	12	12
Valdez	2	10	12	12
Total Samples	76	78	154	154

Table 2. Phytoplankton tow sample status.

Community	# Samples Received	Lab Analysis Complete	Data Finalized
Armin F. Koernig Hatchery	1	1	1
Chenega	37	25	25
Eyak	9	9	9
Homer	16	16	16
Nanwalek	0	N/A	N/A
Port Graham	33	27	27
Seldovia	12	12	12
Seward	25	25	25
Tatitlek	0	N/A	N/A
Valdez	7	1	1
Total Samples	139	115	115

Table 3. Shellfish sample status.

Community	# Samples Received	Lab Analysis Complete	Data Finalized
Chenega	4	4	4
Cordova	0	N/A	N/A
Nanwalek	0	N/A	N/A
Port Graham	22	18	18
Seldovia	1	1	1
Seward	24	22	22
Tatitlek	6	4	4
Valdez	0	N/A	N/A
Total Samples	57	49	49

Ocean Acidification Research Laboratory-Ocean Chemistry (Jacqueline Ramsay, Laboratory Manager & Cora McKean, Laboratory Technician):

A. Dissolved inorganic carbon analyses

Since February 1, 2023, a total of 154 dissolved inorganic carbon samples were received from CRRC communities (Table 1). Periodic collection of triplicate samples was requested for QA/QC purposes. Of the154 samples were received, 3 samples from the Armin F. Koernig Hatchery presented with pCO_2 values that were rejected during analysis QA/QC. These samples had an average standard deviation of ±802.630 when compared to pCO_2 values from samples received during FY23, and were regarded as extreme outliers. This occurs frequently with samples that did not receive adequate preservative or were overfilled, underfilled, frozen, or cracked during transport. APMI hopes to remedy this through sampler training, improvement of packaging material, and increased communication with both samplers and carrier services. The remaining 151 samples have been analyzed and are presented in cumulative time series for each region containing data from all analyzed samples under this project (Figures 1-32). Triplicate sampling events are denoted with error bars representing standard deviations, which are often too small to be visualized but are referenced in the figure captions. Dissolved inorganic carbon trends are best recognized over a longitudinal time scale, making comprehensive figures important, therefore all data presented here are from the full duration of sampling efforts at each site. Two sample sites are included within the Eyak region (North Fill and Orca), with the North Fill site being the most comprehensive. Sampling efforts for this program began at the North Fill dock (01/16/2019 – 04/13/2023) but were shifted to the Orca Lodge dock (10/19/2022 – 08/09/2023) due to community sampler safety concerns (Figures 9-16). Sample data from Seward are compiled through collections from continuous monitoring of the APMI facility intake. Live data streaming for the Seward monitoring site are being fed directly to Axiom (https://portal.aoos.org/#metadata/48037/station/data), however this process has experienced some disruption during the fiscal year due to infrastructure changes at the facility. Procurement of the new Burke-O-Lator is complete, and the unit is expected to arrive in April 2024. Installation of this equipment will be accompanied by laboratory training for APMI staff, conducted by Dr. Burke Hales.

B. Nutrient analyses

APMI has procured a small spectrophotometer with the intent of establishing and validating protocols for nutrient analysis prior to procurement of larger equipment. APMI has identified a contractual nutrient sample processing laboratory (Alaska Water Laboratories, Palmer, Alaska) and has been conducting nutrient sampling, protocol development, and interlaboratory validation for the target analytes.

Biology Laboratory-Harmful Algae (Allison Carl, Laboratory Manager & Jacob Cohen, Laboratory Technician):

C. Phytoplankton net tows and microscopy

Since February 1, 2023, a total of 139 phytoplankton net tow samples have been received by participating communities. A total of 115 of these samples have been analyzed via microscopy for harmful algae species identification by APMI staff (Table 2; Figures 33-34).

***Alexandrium* spp. detection:**
The majority of collections yielded observations with no *Alexandrium* spp. Detections of elevated levels of *Alexandrium* spp. occurred on a limited basis during the summer months (May-October) in both Seward and Port Graham (Figure 33).

***Pseudo-nitzschia* spp. detection:**
The majority of collections yielded observations with no *Pseudo-nitzschia* spp. Detections of elevated levels of *Pseudo-nitzschia* spp. occurred often in many monitoring communities in all months but January and February (Figure 34).

D. Shellfish toxin testing

During the summer of 2023, APMI received 57 shellfish samples from CRRC communities (Table 3). Throughout the fall of 2023 and in early 2024, CRRC/APMI biology staff worked alongside collaborators from National Oceanic and Atmospheric Administration National Centers for Coastal Ocean Science (NOAA NCCOS) and the University of Alaska Fairbanks College of Fisheries and Ocean Sciences (UAF CFOS) to set up and validate receptor binding assay (RBA) capability to examine total toxicity for paralytic shellfish toxins (PSTs). While not listed as a method to be used in this proposal, this is currently regarded as a superior method to the enzyme-linked immunosorbent assays (ELISAs), and is one of the few current approved methods for PST testing accepted by the US Food and Drug Administration (FDA). APMI now uses a combination of RBA and ELISA for both domoic acid and saxitoxin in blue mussels (*Mytilus edulis*) for this project. This equipment is currently housed at the UAF CFOS Seward Marine Center (SMC) Hood Laboratory due to limited laboratory space at APMI.

Saxitoxin detection:

Saxitoxin detection was determined using ELISAs for all 2023 samples. Saxitoxin detections for shellfish collected in the region exhibited concentrations well below the FDA regulatory limit (80 µg/100 g of tissue). Elevated concentrations were observed throughout the collection period (Figure 35).

Domoic acid detection:

A single domoic acid detection was recorded for shellfish collected in the region. This detection was below the legal limit for consumption (20 ppm) and occurred in a littleneck clam (*Leukoma staminea*) submitted by Tribal members from Chenega in May. All other tested shellfish exhibited concentrations below the assay limit of detection (Figure 36).

E. Phytoplankton qPCR detection

Procurement of the necessary laboratory components for this portion of the project has been completed, however, not all pieces of equipment have been installed due to pending laboratory construction and limited existing laboratory space. All phytoplankton tow samples that have been received in 2023 have been filtered and are stored at –80C at APMI after microscopic analysis. These samples are awaiting construction completion and equipment setup for qPCR analyses. CRRC has scheduled a PCR training with partners at the NOAA Alaska Fisheries Science Center for April 1, 2024. By this date, construction of the molecular laboratory space at APMI is expected to be completed. NOAA staff will lead APMI staff in laboratory setup and qPCR training.

Next Steps:
APMI plans to host an environmental sampler training and environmental education event in Seward on May 2, 2024. All Tribal samplers involved in the CROM Program will be invited. This training will include educational talks on harmful algae, shellfish toxins, ocean acidification, and the role of nutrients and environmental parameters in the development of harmful algal bloom events. Tribal samplers will also have the opportunity to share traditional ecological knowledge on the intersectionality of science and heritage. Immediately following these trainings, APMI staff will be traveling to each participating village to do one-on-one in person kickoff trainings with each citizen sampler.

Project Setbacks and Additional Sampling Sites:
This project has experienced three setbacks:

Community participation-While almost all of the seven participating Tribal communities have been regularly sampling, APMI has experienced limited communication with select communities, particularly in Port Graham and Nanwalek. These communities have both experienced heavy turnover, and many of the local residents eager to work with CRRC/APMI have moved out of the Village. APMI hopes to remedy this setback through the planned training in the spring. As an alternative, APMI has also reached out to Cook Inlet Aquaculture Association, who maintains their Port Graham Hatchery, as well as the Seldovia Village Tribe and the Kachemak Bay National Estuarine Research Reserve, to fill geographical sampling gaps and maintain adequate representative coverage. In Prince William Sound, the Prince William Sound Aquaculture Corporation has agreed to sample at the Armin F. Koernig Hatchery near Chenega, and the University of Alaska Prince William Sound College has agreed to sample in Valdez as part of its marine science program. APMI is also receiving samples from the Prince William Sound Stewardship Foundation, who conducts shellfish sampling during regular research cruises around Prince William Sound in collaboration with the U.S. Forest Service. These additional data collections are shared in the final uploaded dataset.

Staff turnover- CRRC has experienced staff turnover within this program, largely at the technician level. Some of these positions remained empty for several months before being filled. While not funded under this program, the supporting position of Environmental Coordinator through the Environmental Protection Agency's Indian General Assistance Program (EPA IGAP) has also experienced turnover, and remains unfilled. These positions provide much of the hands-on community interface and sampling coordination. The relationships with Tribal communities and councils have been disrupted by some of these gaps in employment, which has resulted in communication difficulties with samplers for some time periods during this project year.

Laboratory space- As mentioned above, CRRC's rapid growth has led to a limited amount of laboratory space. Construction of a new larger laboratory space is underway, with designated biosecure areas for molecular work and toxicology analyses. Some pieces of equipment have not been installed due to lack of space and are awaiting construction completion prior to installation. Construction completion and final installation is projected to occur in spring 2024.

2. Products:

Peer-reviewed publications:
N/A

Reports:
N/A

Popular articles: (see attached articles)

1. Hatchery International, January/February 2023 (Volume 24 | Issue 1). "Alutiiq Institute makes strides in shellfish" by Guest Author Nancy Erickson.

Conferences and workshops:
Within the reporting period, APMI staff have presented this project at the following conferences (presentations and trip reports (if attended in person) are included in Appendices 1-2).

Mariculture Conference of Alaska, February 15-17, 2023, Juneau, Alaska.
Branson, M. Chugach Regional Ocean Monitoring Program. Oral Presentation.

Jarosz, A., M. Branson, and S. Atkinson. Evaluation of Paralytic Shellfish Toxin Congeners in Resurrection Bay Bivalves. Oral Presentation.

Chugach Regional Resources Commission Annual Subsistence Gathering, March 23, 2023, Anchorage, Alaska.
Branson, M. Chugach Regional Ocean Monitoring Program. Oral Presentation.

Native American Fish and Wildlife Society Conference, April 24-27, 2023, Anchorage, Alaska.
Branson, M. Chugach Regional Ocean Monitoring Program. Poster Presentation.

Carl, A., A. Jarosz, D. Carl, E. Mailman, S. Atkinson, K. Mashburn, and M. Branson. Interlaboratory Validation of an Enzyme-Linked Immunosorbent Assay for Domoic Acid in Blue Mussels (*Mytilus edulis*) at the Alutiiq Pride Marine Institute. Poster Presentation.

Jarosz, A., S. Atkinson, and M. Branson. Evaluation of Paralytic Shellfish Toxin Congeners in Bivalves from Resurrection Bay, 2021-2022. Oral Presentation.

Seward Science Symposium, September 17, 2023, Seward, Alaska
Carl, A., A. Jarosz, D. Carl, E. Mailman, S. Atkinson, K. Mashburn, and M. Branson. Interlaboratory Validation of an Enzyme-Linked Immunosorbent Assay for Domoic Acid in Blue Mussels (*Mytilus edulis*) at the Alutiiq Pride Marine Institute. Poster Presentation.

Jarosz, A., E. Mailman, S. Atkinson, and M. Branson. Evaluation of Paralytic Shellfish Toxin Congeners in Resurrection Bay Bivalves. Poster Presentation.

Mailman, E. Chugach Reigonal Ocean Monitoring Program. Oral Presentation
Mailman, E., A. Jarosz, S. Atkinson, and M. Branson. Citizen Science in Early Detection of Harmful Algal Blooms in Southcentral Alaska. Poster Presentation.

Mashburn, K., M. Branson, A. Jarosz, A. Carl, E. Mailman, D. Carl, and S. Atkinson. Interlaboratory Validation of a Rapid Saxitoxin Assay for Three Species of Shellfish Commonly Consumed in Alaska. Poster Presentation.

Ramsay, J., W. Evans, C. Weekes, B. Hales, and J. Hetrick. Citizen Monitoring for Ocean Acidification in Alaska. Poster Presentation.

Alaska Marine Science Symposium, January 29-February 1, 2024, Anchorage, Alaska
Carl, A., A. Jarosz, D. Carl, E. Mailman, T. Leighfield, S. Atkinson, K. Mashburn, and M. Branson. Chugach Regional Ocean Monitoring Program: developing techniques and capacity for harmful algal bloom monitoring to support safe and informed subsistence harvests. Poster Presentation.

Jarosz, A., S. Atkinson, M. Branson. Paralytic Shellfish Toxin Congener Profiles in Three Species of Bivalves from Resurrection Bay, Alaska. Poster Presentation.

McKean, C., J. Ramsay, J. Cohen, J. Hetrick, and M. Branson. Ocean Acidification in Alaska's Coastal Communities Through Community Sampling. Poster Presentation.

Public presentations:
See conferences and presentations.

Data and/or information products developed during the reporting period:

CRRC is currently working on a GIS storymap, funded through the EPA IAGP program. CRRC is also featured in the AOOS GIS storymap. Both products will report data collected from this program.

Data sets and associated metadata:
Complete datasets for all activities under this award are available to the public in real time at www.alutiiqprideak.org/crom.

Data from this project are shared to the Alaska Ocean Observing System through both the Alaska Harmful Algal Bloom Network (https://ahab.aoos.org) and the Alaska Ocean Acidification Network (https://aoan.aoos.org/).

Testing results are featured in CRRC's quarterly newsletter, which is distributed to Tribal members in the spill-affected region.

Datasets are uploaded annually to Research Workspace.

Additional Products not listed above:
N/A

3. Coordination and Collaboration:

The Alaska SeaLife Center or Prince William Sound Science Center:
Through CRRC's involvement with the Community Organized Restoration and Learning (CORaL) Network (Project Number 23220400), CRRC has kept the Alaska SeaLife Center or Prince William Sound Science Center apprised of efforts of this funding. Efforts to share these data will continue. See discussion under *EVOSTC Education and Outreach Program* for more information.

EVOSTC Long-Term Research and Monitoring Program:
N/A

EVOSTC Mariculture Projects:
Data for this project are collected near kelp farm test sites funded by EVOSTC Project Number 23220300, Prince William Sound Kelp Mariculture Development for Habitat Restoration and Local Economy. The nearshore costal data collected through the CROM project will supplement the kelp project data collection, and should serve to inform performance assessments for current and future aquatic farm sites.

EVOSTC Education and Outreach Program

Data from this project are shared through the CORaL Network, an EVOSTC funded collaboration between the Alaska SeaLife Center (ASLC), Prince William Sound Science Center (PWSSC), Center for Alaskan Coastal Studies, Alaska Sea Grant, the Alutiiq Museum & Archaeological Repository, and Chugach Regional Resources Commission (EVOSTC Project Number 23220400). The CORaL Network is designed to build upon existing resources within the EVOS region through collaboration with listed organizations. The overarching goals are to ensure that science outreach is relevant, co-created, and culturally responsive to regional communities encouraging public use of available knowledge & resources related to the EVOS region. The data collected in this monitoring program are shared with the public, Tribes, and researchers through the CORaL program.

CORaL activities incorporating this project include:

- CRRC/ASLC/KEFJNP collaborative Seward meeting how to collectively work together and support each other's projects by sharing and identifying overlap and gaps. CROM was shared as one of the efforts to provide monitoring in the region.
- CRRC is working with ASLC, KEFJNP, and UAF SMC to host the annual Seward Science Symposium.
- CRRC is working with ASLC, KEFJNP, and UAF SMC to establish monthly Seward science talks.
- The CROM Program is featured in CRRC's Collective Alaska Native Perspectives Training, to be hosted in Kodiak, AK in April of this year.
- CRRC is working with ASLC, APMI, and the Qutekcak Native Tribe to provide a dynamic science and cultural education program called the Community Coastal Experience in partnership with CORaL Network. CROM efforts were included in this project as well.
- APMI & CRRC has successfully supported general outreach and education related to APMI CROM efforts through the CORaL Program. Local school groups have visited APMI for site tours, led by APMI staff. APMI/CRRC's education and outreach team has begun to develop a procedure for sharing work and data at CRRC communities. This development includes educational materials to reinforce understanding of marine health & mariculture related to APMI. Additional education and outreach efforts are listed in "*Coordination and Collaboration with ASLC and PWSSC.*"
- CRRC is a partner in the SACRED project, established to deepen the exchange of knowledge and experiences on the topics of environmental change, community engagement, and long-term relationship building to advance community resilience in Southcentral Alaska. This program maintains specific focus on environmental observation skill building, hands-on activities, and shared learning together. The CROM Program is among the topics discussed at SACRED gatherings.

APMI has been able to support the following students that will be using CROM data as part of their theses:

Annette Jarosz is an APMI staff member in the MS program at UAF CFOS using CROM data for her thesis. In addition, Emily Mailman is a former APMI staff member (not funded through this project) in the MS program at UAF CFOS working on harmful algae bioaccumulation. Both students will be working with the PI for their respective projects, and both students' projects will build on the techniques and data collection efforts in this project. Allison Carl is also a recently admitted MS student in the University of Alaska Anchorage Department of Biological Sciences. Project details for Allison's MS thesis project are still being developed.

In the previous fiscal year, APMI added a marine science internship for students in the region. In Seward, APMI participated in internship development in collaboration with Seward High School. This internship is designed to share the scientific fields represented at APMI. The internship exposes students to three tracks of focus: Mariculture, Chemistry, and Biology. In 2023, Seward High School student Aly Guernsey completed her internship program during the fall semester with a focus on biology laboratory skill development. Aly received introductory training in phytoplankton identification via microscopy and ELISA techniques through this award. APMI has recently welcomed Seward High School student Maddie Haas as an intern for the spring 2024 semester.

EVOSTC Individual Projects not listed above:
N/A

Trustee or Management Agencies:
N/A

Native and Local Communities:
CRRC has made Alaska Native and local community involvement a priority throughout all stages of the project thus far. Alaska Native community involvement is inherent in the structure of our organization. CROM was created at the request of CRRC's board, comprised of seven Tribal governing members. The CRRC Board serves at the direction of each Tribal Council and Board Members are chosen specifically because of their natural resource management inclinations. As part of this project, CRRC provided regular updates and reports on progress of this project at the following CRRC's Board of Directors' meetings to keep them apprised of the project's progress and current findings through distribution of Board packet material.

- March 28, 2023
- June 20, 2023
- September 27, 2023
- December 12, 2023

The inception of this program was a desire for shellfish safety monitoring in the CRRC communities, as expressed to CRRC staff by Tribal members during these board meetings.

APMI staff were able to visit each of the seven villages in the Chugach region during summer 2023. During these visits, APMI staff provided community members with an overview of harmful algal blooms, their ecological impacts, and how our organizations are partnering with Tribes to monitor them. Through the sampling program outlined in this project, CRRC has engaged numerous Tribal members to conduct shellfish sampling. This engagement was largely conducted via town hall style visits to all seven of the Tribal CRRC consortium communities, where staff members presented on or discussed harmful algal blooms, the goals of the project, and shellfish sampling in order to mitigate the risk of paralytic shellfish poisoning. General information on the CROM Program as well as specific data findings were shared with CRRC Tribal Members during CRRC's annual Gathering Event. We estimate this information was shared directly with a total of 100 people across all seven communities in 2023.

CRRC maintains an Alaska native hiring preference, and many of our staff are Tribal members from the region. This program employs one Tribal CRRC/APMI staff member as a Laboratory Manager. CRRC and APMI staff have also recruited Tribal youth to participate in sampling activities. Currently, two of the community samplers in this program are Tribal youth. Several CRRC and APMI staff, including multiple Tribal members, have received training in laboratory techniques through this project, providing direct capacity building to Tribal members.

4. Response to EVOSTC Review, Recommendations and Comments (if applicable):

May 2021

This project represents a tribally-led monitoring effort aimed at providing information on the distribution of harmful algal bloom species and toxins to inform shellfish harvest. The Science Panel recognized that a major strength of the proposal is that it is tribally-led and would be capacity building, but noted that the proposers could augment that strength by providing more detail on the specific capabilities that would be developed and the plan for long-term continuity. Concerns raised included the lack of a science plan (including data analysis and archiving), no plan for long-term sustainability of the monitoring, and concerns about how the data provided would actually be used by stakeholders such as subsistence harvesters. The PIs need to address how they will comply with Data Submission requirements -all projects funded by EVOSTC must submit data annually to the Data Management project.

PI Response:
APMI has clarified its data archival and sharing policy throughout the proposal, particularly in section 4C (pages 10-13) and section 9 (page 25).

We would like a more thorough explanation and justification of the sampling scheme to ensure that it would provide adequate and actionable information. As we understood the proposal, sampling was only one sample per week per site-- what are the odds of missing potential HABs with a single sample? How are the samples distributed in space?

PI Response:
Sampling locations are at each of the communities detailed in the proposal. CRRC has proposed utilizing these communities as sampling locations to leverage their existing successful community sampling program. These communities are distributed across Prince William Sound and Lower Cook Inlet, and provide a cost-effective means of sample collection in these remote locations. While discrete sampling on a weekly basis might not provide the most thorough monitoring coverage, it is the most feasible option that accounts for sample preservation, shipment, and processing in a timely fashion.

More detail is needed on the qPCR methods as it was not clear to the extent to which these methods had already been established vs required development; either way we needed more to evaluate the proposal. Additionally, we had some questions about how cell counts and species identification (not speciation) will be accomplished in the field as described (will these data be too rudimentary to be useful?).

PI Response:
The qPCR methods are in development, this has been noted in the proposal in section 4B (pages 7-9), along with a detailed proposed methodology provided in Appendix 2. APMI participates in a HAB qPCR specific working group to develop methods with several academic and agency partners in the national HAB network.

Under the current funding from the Administration for Native Americans and the USGS Climate Adaptation Science Center, all Tribal field samplers have received specified training on microscopy and cell counts using a hemacytometer from collaborators at both NOAA and UAF. A microscope and hemacytometer are provided to each Tribe for samplers to use onsite. These data are currently being collected under both of these awards. APMI recognizes these data are rudimentary, and while this collection is helpful, the goal of the current proposal is to scale up from basic microscopy to more quantitative methods of detection.

Do the PIs undertake periodic intercalibrations of analyses with other laboratories to ensure accuracy and comparability, e.g., NPRB project 1801: Prevalence of Paralytic Shellfish Toxins in the Marine Food Webs of PWS and Kachemak Bay, Alaska?

PI Response:
All analyses will undergo interlaboratory calibrations with the agency and academic partners listed in the proposal. Interlaboratory calibrations are conducted for seawater chemistry with

Dr. Burke Hales (OSU) and Dr. Wiley Evans (Hakai Institute), and for ELISAs with Dr. Shannon Atkinson (UAF). APMI has ranked in the top 10% in blind comparisons of interlaboratory accuracy and precision for DIC analyses. All other methods have been transferred to APMI by experts in the field, and are validated to a standard acceptable for peer-reviewed publication. Methodology for the remaining analyses is currently under development, and APMI participates in working groups to develop methods with several academic and agency partners in the national HAB network. This has been clarified in the proposal in section 4B (Pages 7-9).

We also ask that the PIs clarify how these data would augment current sampling for HABs elsewhere in Alaska and also potentially complement the oceanographic information (OA etc) provided by other entities. This does not mean that working with other entities is necessary to justify the

proposal, per se, but that we expect that PIs will recognize opportunities for outreach and leveraging other funded projects to help advance their goals and the goals of the overall program. We recognize the potential value of these data for the stated goal of informing harvest decisions, but also sees potential value of these data collected by the tribal community for the broader scientific community.

PI Response:
APMI is aware of other monitoring programs across the state, including those conducted by SEATOR, KBNERR, DEC, and others. Currently, KBNERR receives tow samples from PWSAC hatcheries, and the DEC commercial testing program operates exclusively on commercial shellfish samples for regulatory purposes. Furthermore, DEC testing results are often not timely, are not widely publicized for public access to inform both recreational and subsistence harvesters. Regular shellfish biotoxin testing is not part of any of the current publicly available southcentral Alaska monitoring programs. APMI would be the first and only entity to incorporate this testing into a regular monitoring program in the southcentral region. Although there are other public shellfish monitoring programs around the state, none of these programs cover Prince William Sound and Lower Cook Inlet. These regions are arguably among the most heavily utilized for recreational and subsistence harvest of both shellfish and other intertidal organisms. We feel that the state would benefit from a centralized monitoring and testing facility to serve southcentral Alaska. PIs recognize opportunities for outreach and leveraging other funded projects to help advance their goals and the goals of the overall program. APMI actively participates in collaborations through the AHAB, and have already applied for several grants collaboratively with a number of these institutions. This has been addressed in section 1 (pages 3-4)

Describing how data deposition requirements of the Invitation will be fulfilled will help here.

PI Response: APMI has clarified its data archival and sharing policy throughout the proposal, particularly in section 4C (pages 10-13) and section 9 (page 25).

Several other clarifications are requested. On Pg 9, "This project will compliment APMI's existing Gulf Watch OA monitoring project as a continuation and extension of these monitoring activities." This project, 21200127, is a 3-year project. The last year is scheduled for FY22. If this project proposal is funded, would the last year of project 21200127 be incorporated into this proposed project? Clarification is required to determine if proposed efforts are being duplicated.

PI response: These proposals encompass two separate projects, with completely separate sampling locations. This is clarified in section 11B (page 27) of the proposal with the following text: "While these proposals are similar with respect to ocean acidification monitoring efforts and an overlap in regional coverage, they do not share the same sampling locations. Instead, these two projects encompass entirely separate monitoring activities, each with distinctly unique sampling locations." Our data is publicly available on both our website (www.alutiiqprideak.org) and the IPACOA website (http://www.ipacoa.org/Explorer), and may be accessed at any time by both the scientific community and the public.

We appreciate comments and foresight into GWA monitoring continuation. Efforts were made to partner with GWA on this proposal with the notion of continuation of regular monitoring in the spill- affected region. These efforts were unsuccessful. Furthermore, GWA partners did not contact APMI

for continuation of this proposal. We feel that the more data we can provide, the better we can contribute to monitoring efforts across the region.

We would like to see more justification of funds requested in the proposal. For example, why does new equipment need to be purchased in FY22 if there are existing resources? Why does the Autoanalyzer need to be replaced in FY26?

PI Response:
APMI is taking a tiered approach to capacity building for each analysis. A more detailed explanation of this capacity building approach as it relates to the items requested has been provided in section 4B (pages 9-10). This proposal takes a tiered approach to capacity development. APMI is currently conducting ELISA assays using an existing plate reader. This capacity began in FY21. APMI has also been conducting DIC analyses using the BOL since 2012, however, our current BOL is outdated and cannot handle the significant increase in throughput associated with planned projects. The BOL also requires frequent maintenance and troubleshooting to operate, as it is the second BOL ever produced. Dr. Hales has refined this system since project initiation in 2012, and the new BOL models have the ability to process with greater efficiency/accuracy. APMI is planning on bringing on PCR technology in FY22, and will

finalize its analytical capacity with the addition of the Autoanalyzer in FY26. We believe this scaled approach is the most reasonable format with which to add these capacities. The only equipment APMI plans to replace is the BOL, and we are purchasing the autoanalyzer for the first time.

Over 50% of the funding requested is for salary for seven personnel; however, only two CVs are provided in the Project Personnel section of the proposal. Some additional information regarding personnel would be appreciated (e.g., who are they, what will their roles and responsibilities be on the project). Is there a longer-term plan for self-sustainability for this project as we assume there is a desire to continue monitoring after EVOSTC funding is no longer available?

PI Response: The proposal instructions only specified that "The CV's of all Principal Investigators and other senior personnel involved in the proposal must be provided". Therefore, CVs of junior personnel were not included. In response to reviewer comments, CVs of all personnel working on the project have been included, and a brief description of job duties has been added to the section 6 (pages 13- 22).

The external peer reviews of the proposal were supportive but also felt that additional details and methods clarification were needed. They also expressed concerns about the technical expertise needed for the molecular analyses and wanted to see more detail in that part of the proposal.

PI Response:
Proposed protocols for all analyses have been added as Appendices 1-4. Language has also been added to clarify that method development is underway for some of these analyses in section 4B (pages 7-9). Also in section 4B (page 9), we have highlighted technical expertise who plan to partner with in case external staff needs assistance.

PI Branson conducted her PhD work on molecular detection, and has significant experience in molecular-based assays.

Finally, we agree with reviewers that the PIs are wise to be cautious about making specific harvest recommendations based on their data. However, we also noted that informing about safe harvest is the main justification for the proposal. We would like to see a clearer statement of how the specific information made available is going to be used by tribal stakeholders.

PI Response:
The use of the information generated by Tribal citizens has been clarified throughout section 1 (pages 3-4).

September 2021

We were pleased with the PI responses and the resulting additions and clarifications in the proposal. We were persuaded by arguments about tiered capacity building and the lack of existing monitoring associated with subsistence harvest. The detailed protocols in the appendix gave the us confidence that the work would be carried out using accepted and vetted methodologies. However, we remain gravely concerned about the low number of samples taken at each site and time (only one). We appreciate the PI constraints but have serious concerns whether the sampling is sufficient to capture something useful and informative for stakeholders, and without that there is no justification for the proposal. This is a significant enough concern that we seriously considered a recommendation of Do Not Fund. However, given the merits of the proposal, we suggested an alternative that would allow the project to proceed if sampling concerns could be addressed. We suggest using the first year of the proposal to test what sampling intensity would be needed to detect events of interest, and how much variation there is among samples within a site. The PIs need to have confidence that lack of detection of HAB species is due to absence rather than limited sampling and patchiness in space or time. We note that given that the point of the project is not to make statistical comparisons among sites or times, the PIs may be able to address some concerns by still using a single sample, but sampling a larger volume of water, for example, and filtering it down prior to counting.

We do not wish to prescribe exactly how the PIs will design their sampling, but the justification should be scientific rather than logistical. This can be done through a combination of their own sampling and literature justification. This is a needed step to ensure confidence in the reported data by stakeholder groups. Given the Council's biennial review and five-year meeting cycle starting in FY22, our recommendation is to fund this project for FY22-FY24 and fund FY25-FY26 contingent on the sampling design justification and preliminary results from FY22-FY23. If successful, funding for FY27-31 may be determined in FY26.

PI Response:
We agree wholeheartedly with the concerns of the science panel, and acknowledge that sampler participation and consistency is a limitation of this proposal. However, a major goal of this program is to create science education, engagement, and stewardship opportunities for Tribal members, specifically youth. Currently, two of our Tribal samplers are youth, and one is a college student. These members are actively engaged in both front and back end components of the project, and regular data discussions are held with these members on a monthly basis. While we agree that data collected under this award must be scientifically rigorous, we would also like to acknowledge the value of Tribal engagement and stewardship.

5. Budget:

Budget Category:	Proposed FY 22	Proposed FY 23	Proposed FY 24	Proposed FY 25	Proposed FY 26	5-YR TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$343,695	$352,287	$361,095	$370,122	$379,375	$1,806,574	$370,499
Travel	$17,452	$35,860	$17,452	$35,860	$17,452	$124,076	$24,617
Contractual	$23,925	$17,725	$17,725	$22,725	$18,925	$101,025	$20,800
Commodities	$21,150	$16,800	$17,050	$16,800	$19,900	$91,700	$55,009
Equipment	$150,000	$0	$0	$0	$40,000	$190,000	$123,996
Indirect Costs (report rate here)	$60,608	$63,063	$61,668	$66,470	$64,999	$316,808	$71,009
SUBTOTAL	$616,830	$485,735	$474,989	$511,977	$540,651	$2,630,182	$665,930
General Administration (9% of subtotal)	$55,515	$43,716	$42,749	$46,078	$48,659	$236,716	N/A
PROJECT TOTAL	**$672,345**	**$529,451**	**$517,738**	**$558,054**	**$589,310**	**$2,866,899**	
Other Resources (In-Kind Funds)	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	

6. Figures:

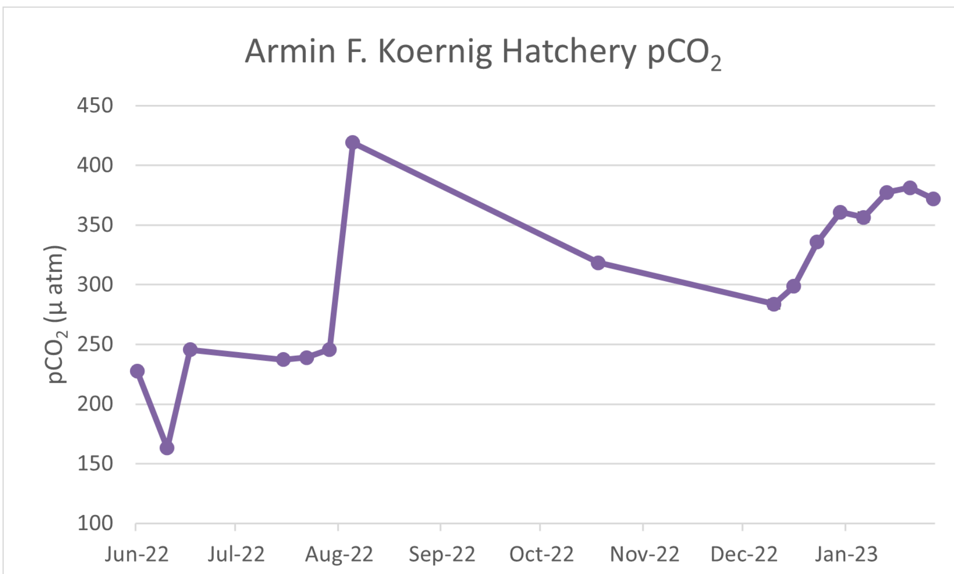

Figure 1. pCO_2 at Armin F. Koernig Hatchery for samples collected from 06/19/2022 - 02/05/2023. Samples included a standard deviation between 12/19/2022 triplicates at ±3.977 and a standard deviation between 01/15/23 triplicates at ±4.112. Error bars are not visible due to small standard deviation values.

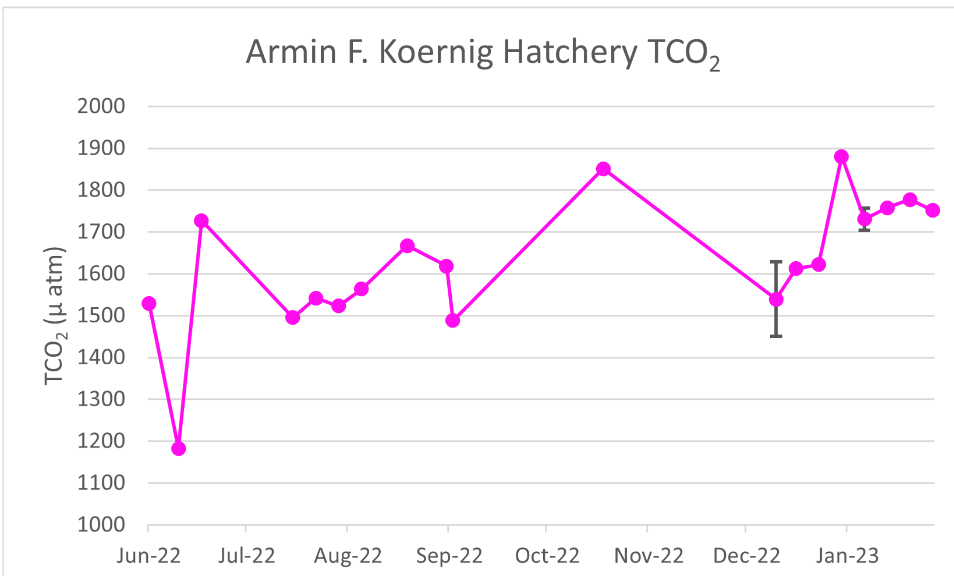

Figure 2. TCO_2 at Armin F. Koernig Hatchery for samples collected from 06/19/2022 - 02/05/2023. Error bars denote standard deviation between 12/19/2022 triplicates at ±89.026 and standard deviation between 01/15/23 triplicates at ±25.904.

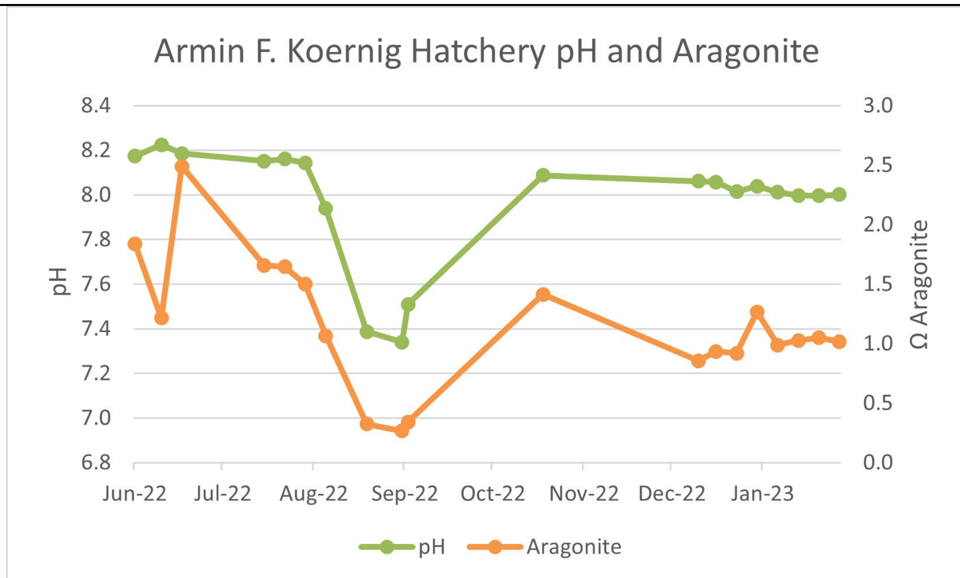

Figure 3. pH and aragonite saturation at Armin F. Koernig Hatchery for samples collected from 06/19/2022 - 02/05/2023. Standard deviation of 12/19/2022 triplicates is ±0.016 for pH and ±0.122 for aragonite. Standard deviation of 01/15/23 triplicates is ±0.009 for pH and ±0.045 for aragonite. Error bars are not visible due to small standard deviation values.

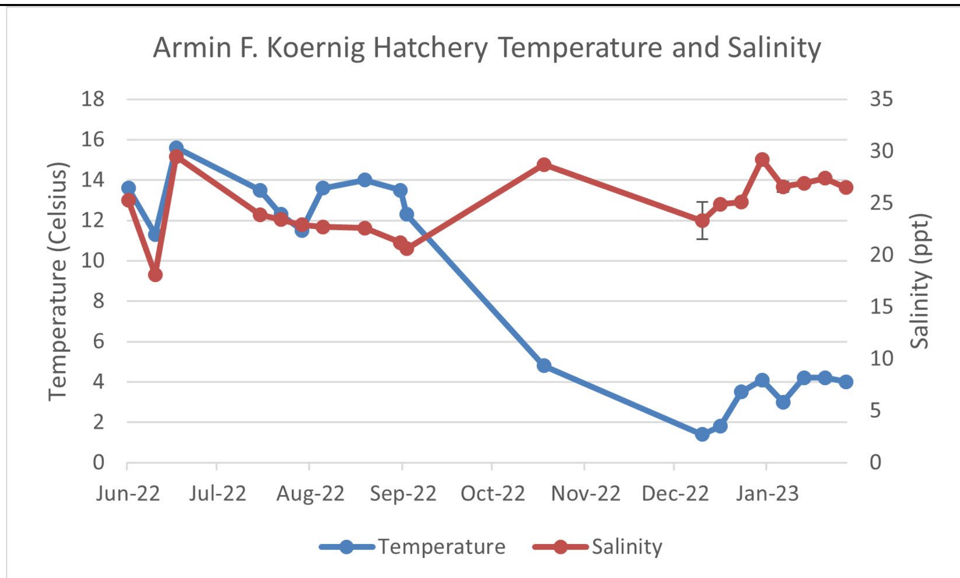

Figure 4. Temperature and salinity at Armin F. Koernig Hatchery for samples collected from 06/19/2022 - 02/05/2023. Error bars denote salinity standard deviation between 12/19/2022 triplicates at ±1.808 and standard deviation between 01/15/23 triplicates at ±0.513.

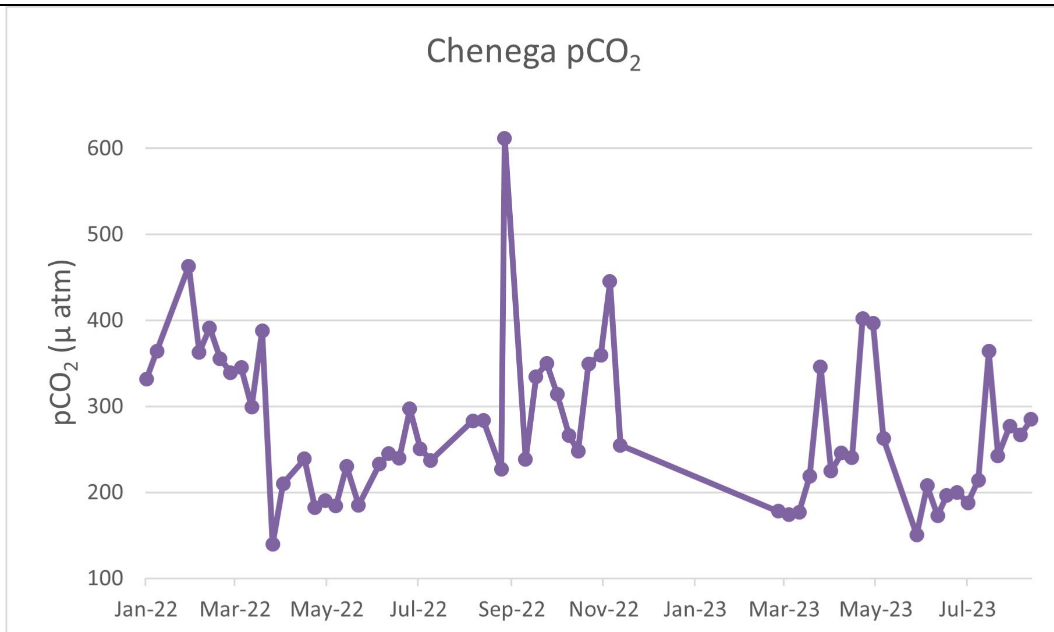

Figure 5. pCO_2 at Chenega for samples collected from 01/16/2022 - 08/27/2023. Samples included a standard deviation between 05/29/2022 triplicates at ±1.225 and a standard deviation between 06/26/2022 triplicates at ±2.301. Error bars are not visible due to small standard deviation values.

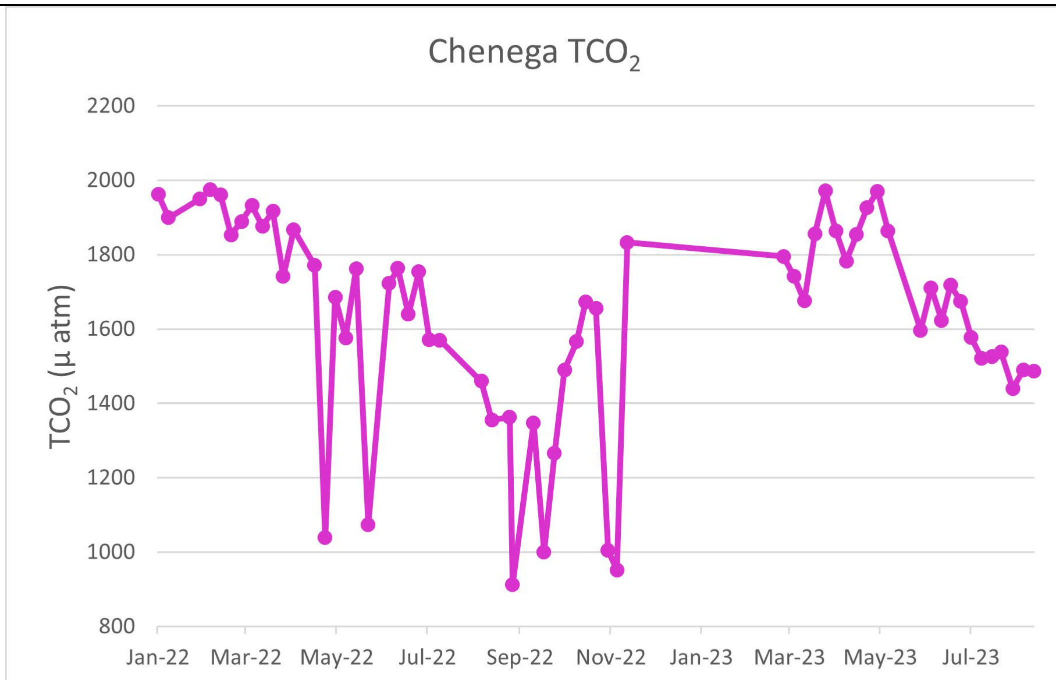

Figure 6. TCO_2 at Chenega for samples collected from 01/16/2022 - 08/27/2023. Samples include standard deviation between 05/29/2022 triplicates at ±4.045 and standard deviation of 6/26/2022 triplicates at ±2.966. Error bars are not visible due to small standard deviation values.

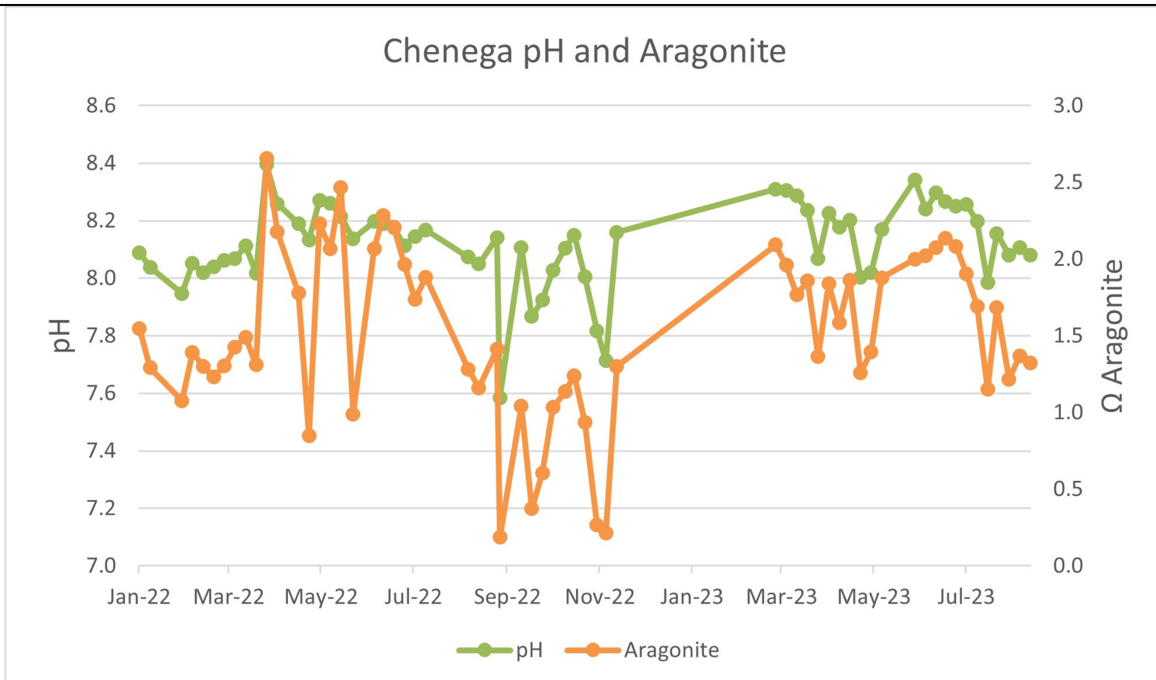

Figure 7. pH and aragonite saturation at Chenega for samples collected from 01/16/2022 - 08/27/2023. Standard deviation between 05/29/2022 triplicates is ±0.003 for pH and ±0.019 for aragonite. Standard deviation between 06/26/2022 triplicates is ±0.004 for pH and ±0.019 for aragonite. Error bars are not visible due to small standard deviation values.

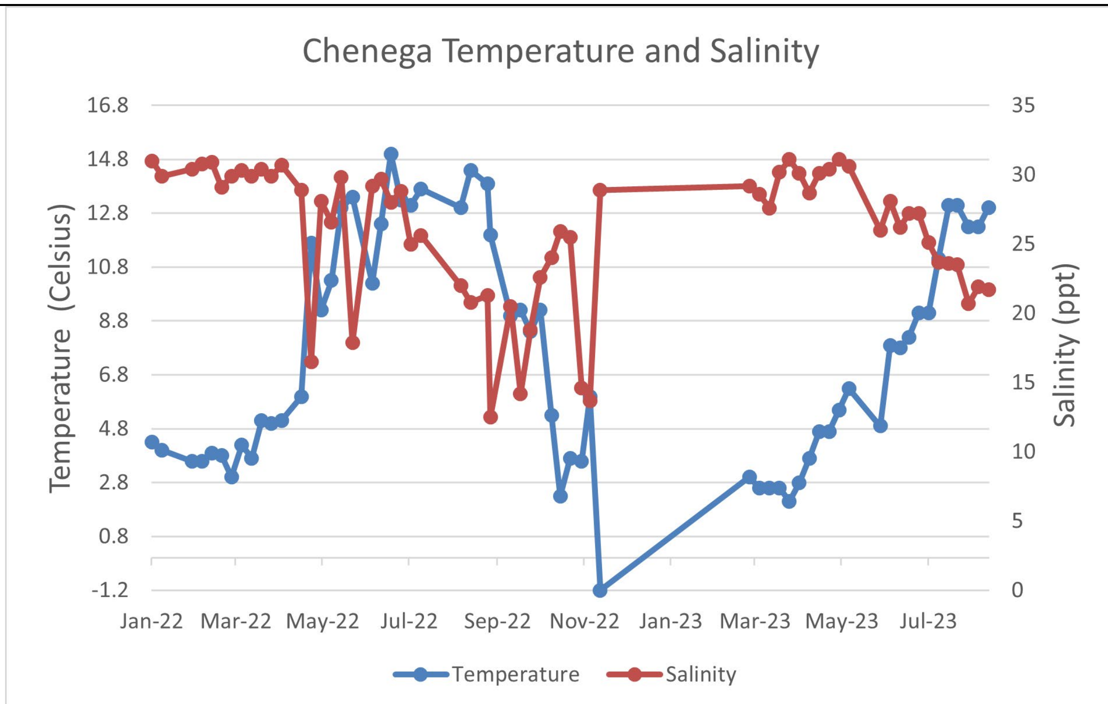

Figure 8. Temperature and salinity at Chenega for samples collected from 01/16/2022 - 08/27/2023.

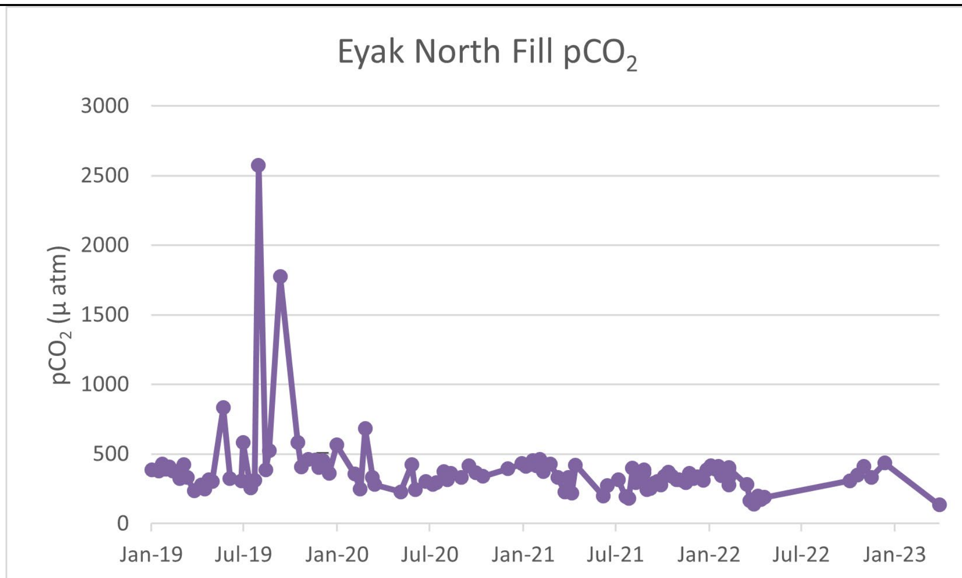

Figure 9. pCO_2 at the Eyak North Fill site for samples collected from 01/16/2019 - 04/13/2023. The Noth Fill data set contains 13 triplicates (12/18/2019, 05/20/2020, 08/12/2020, 01/27/2021, 02/24/2021, 04/7/2021, 06/30/2021, 08/18/2021, 10/28/2021, 12/16/2021, 01/28/2022, 02/24/2022, and 04/22/2022) and 3 duplicates (03/01/2020, 09/09/2021, and 11/24/2021). Standard deviations between duplicate and triplicate samples are as follows, respectively: ±55.849, ±19.937, ±15.782, ±8.889, ±7.189, ±9.193, ±1.398, ±1.478, ±10.665, ±19.987, ±6.323, ±0.704, ±8.429, ±7.844, ±12.126. Error bars are not visible due to small standard deviation values.

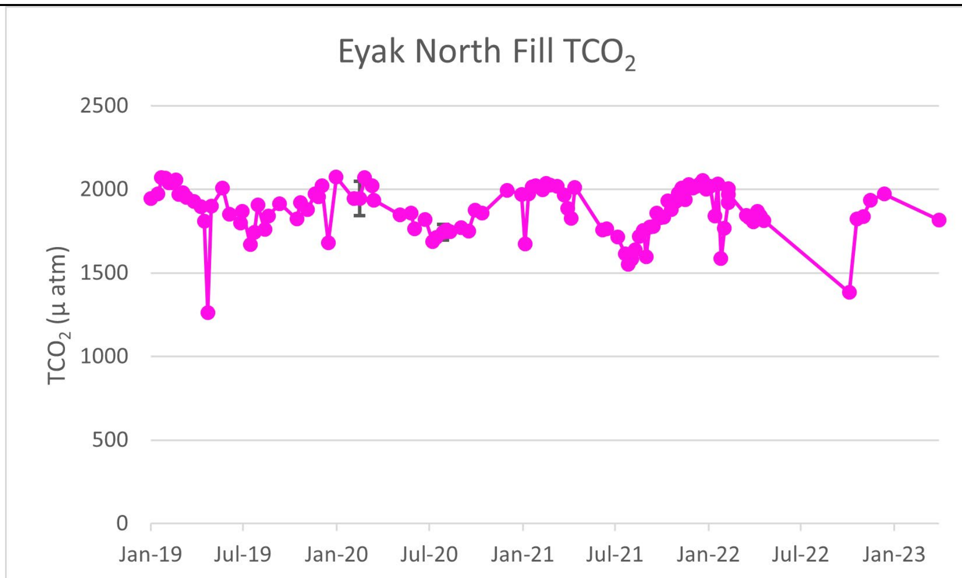

Figure 10. TCO_2 at the Eyak North Fill site for samples collected from 01/16/2019 - 04/13/2023. The Noth Fill data set contains 13 triplicates (12/18/2019, 05/20/2020, 08/12/2020, 01/27/2021, 02/24/2021, 04/7/2021, 06/30/2021, 08/18/2021, 10/28/2021, 12/16/2021, 01/28/2022, 02/24/2022, and 04/22/2022) and 3 duplicates (03/01/2020, 09/09/2021, and 11/24/2021). Standard deviation between triplicate and duplicate samples denoted by error bars are as follows, respectively: ±7.944, ±103.028, ±14.959, ±47.684, ±1.790, ±1.237, ±8.773, ±3.939, ±10.126, ±5.827, ±18.098, ±0.853, ±7.742, ±13.910, ±13.299, ±11.419.

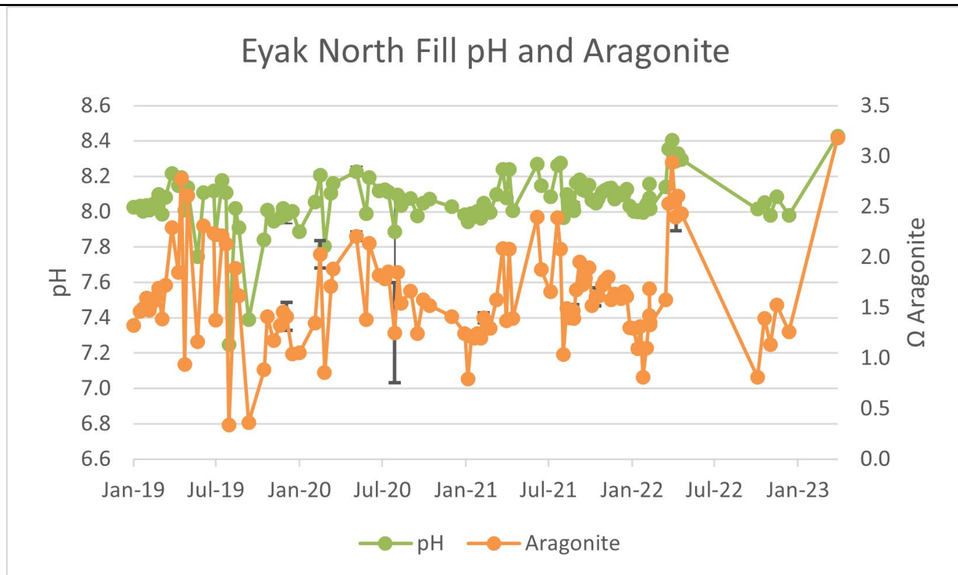

Figure 11. pH and aragonite saturation for the Eyak North Fill site for samples collected from 01/16/2019 - 04/13/2023. The Noth Fill data set contains 13 triplicates (12/18/2019, 05/20/2020, 08/12/2020, 01/27/2021, 02/24/2021, 04/7/2021, 06/30/2021, 08/18/2021, 10/28/2021, 12/16/2021, 01/28/2022, 02/24/2022, and 04/22/2022) and 3 duplicates (03/01/2020, 09/09/2021, and 11/24/2021). Standard deviation between triplicate and duplicate sample pH measurements are denoted by error bars and listed are as follows, respectively: ±0.048, ±0.019, ±0.027, ±0.221, ±0.007, ±0.009, ±0.002, ±0.001, ±0.008, ±0.021, ±0.022, ±0.007, ±0.002, ±0.010, ±0.005, ±0.025. Standard deviation between triplicate and duplicate sample aragonite measurements denoted by error bars and are listed as follows, respectively: ±0.138, ±0.135, ±0.042, ±0.495, ±0.015, ±0.048, ±0.013, ±0.005, ±0.015, ±0.061, ±0.089, ±0.006, ±0.013, ±0.031, ±0.013, ±0.136.

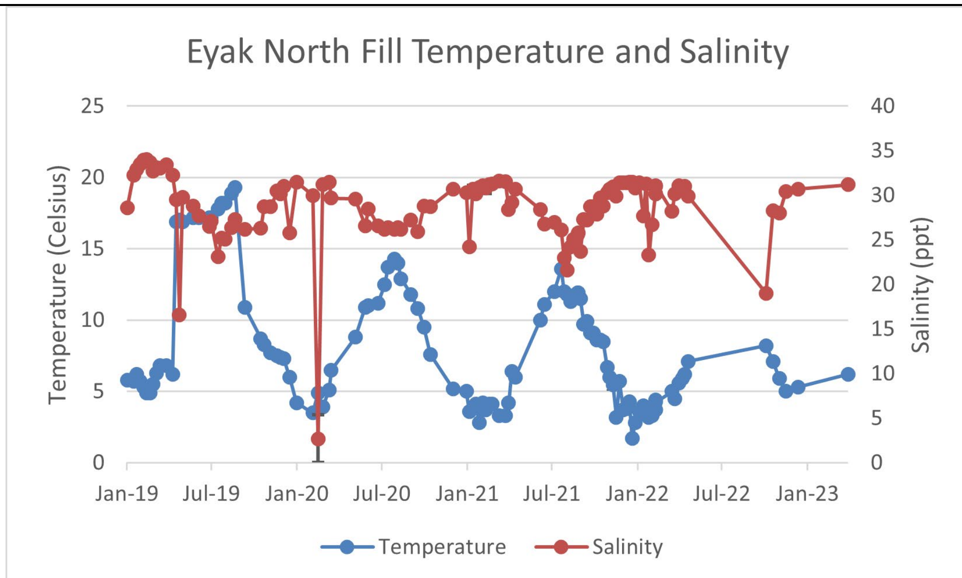

Figure 12. Temperature and salinity for the Eyak North Fill site for samples collected from 01/16/2019 - 04/13/2023. The Noth Fill data set contains 13 triplicates (12/18/2019, 05/20/2020, 08/12/2020, 01/27/2021, 02/24/2021, 04/7/2021, 06/30/2021, 08/18/2021, 10/28/2021, 12/16/2021, 01/28/2022, 02/24/2022, and 04/22/2022) and 3 duplicates (03/01/2020, 09/09/2021, and 11/24/2021). Error bars denote standard deviation between temperature readings for 11/24/2021 duplicates at ±0.353 and standard deviation between temperature readings for 02/24/2022 triplicates at ±0.230. Standard deviation between triplicate and duplicate sample salinity measurements denoted by error bars are as follows, respectively: ±0.173, ±1.131, ±0.153, ±0.436, ±0.635, ±0.058, ±0, ±0, ± 0.141, ±0.058, ±0, ±0.361, ±0.058.

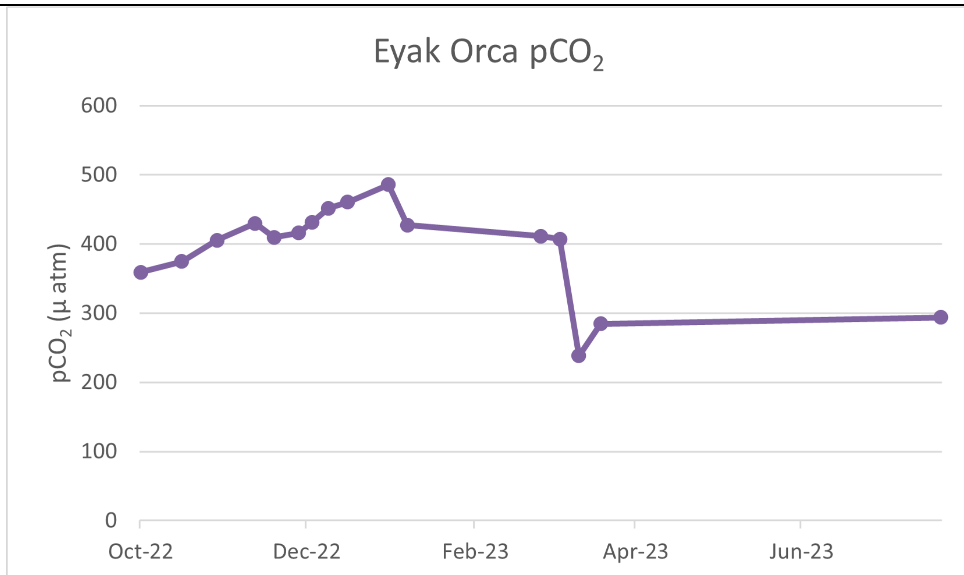

Figure 13. pCO_2 at the Eyak Orca site for samples collected from 10/19/2022 - 08/09/2023.

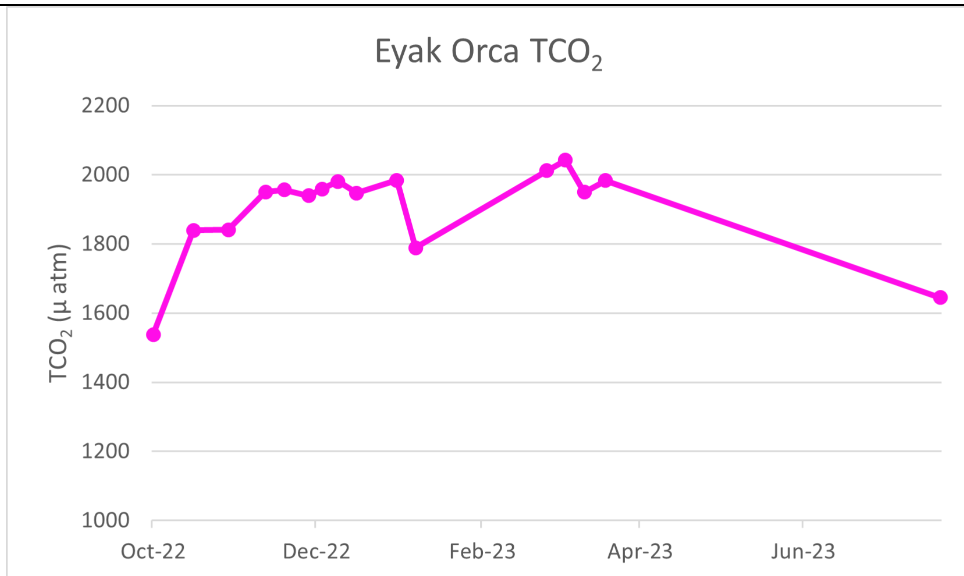

Figure 14. TCO_2 at the Eyak Orca site for samples collected from 10/19/2022 - 8/9/2023.

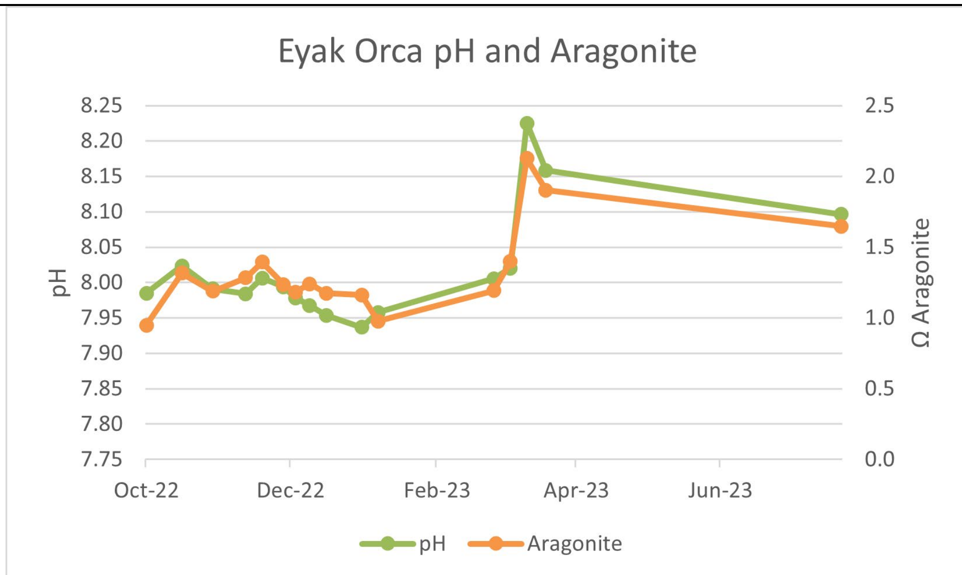

Figure 15. pH and aragonite saturation at the Eyak Orca site for samples collected from 10/19/2022 - 08/09/2023.

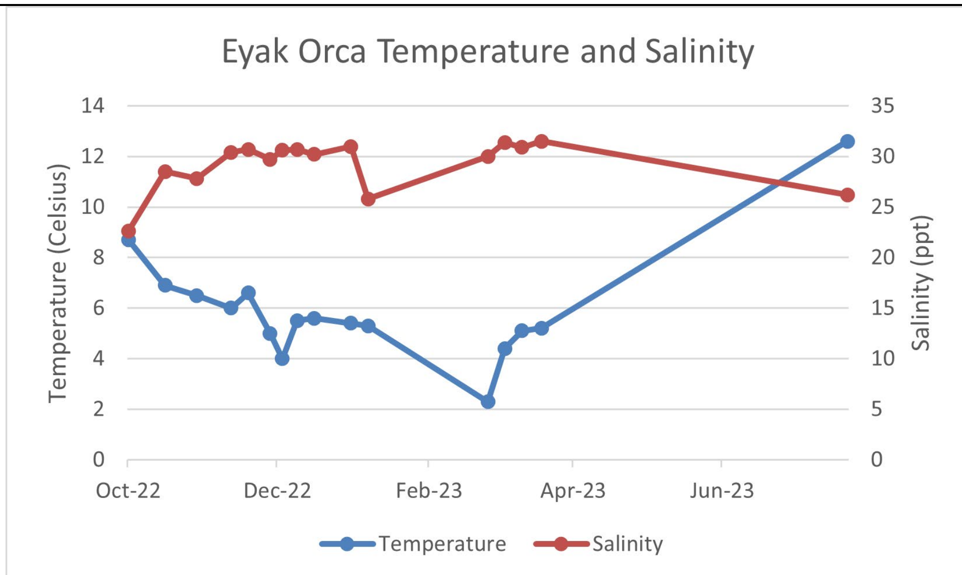

Figure 16. Temperature and salinity at the Eyak Orca site for samples collected from 10/19/2022 - 08/09/2023.

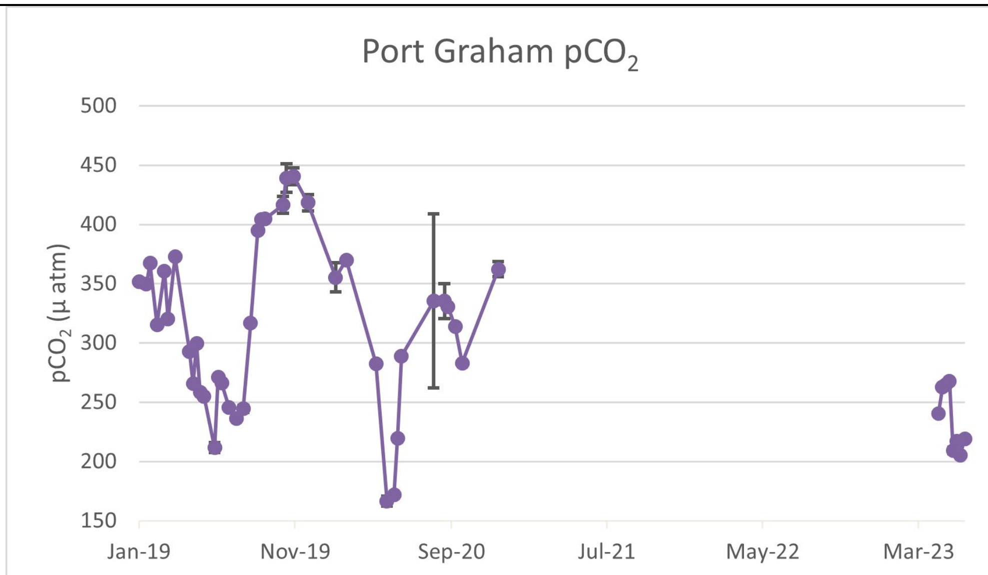

Figure 17. pCO_2 at the Port Graham site for samples collected from 01/18/2019 - 06/16/2023. The Port Graham sample set includes 19 triplicates: 02/01/2019, 03/15/2019, 05/10/2019, 06/14/2019, 07/12/2019, 08/09/2019, 09/20/2019, 10/25/2019, 11/01/2019, 11/15/2019, 12/13/2019, 02/05/2020, 05/15/2020, 06/05/2020, 08/14/2020, 09/04/2020, 12/18/2020, 05/24/2023, and 06/16/2023. Standard deviation between triplicate samples denoted by error bars are as follows, respectively: ±3.251, ±2.220, ±1.075, ±4.123, ±1.755, ±2.828, ±0.088, ±7.175, ±12.083, ±6.976, ±7.035, ±12.318, ±4.211, ±1.435, ±73.353, ±14.819, ±6.438, ±2.892, ±0.116.

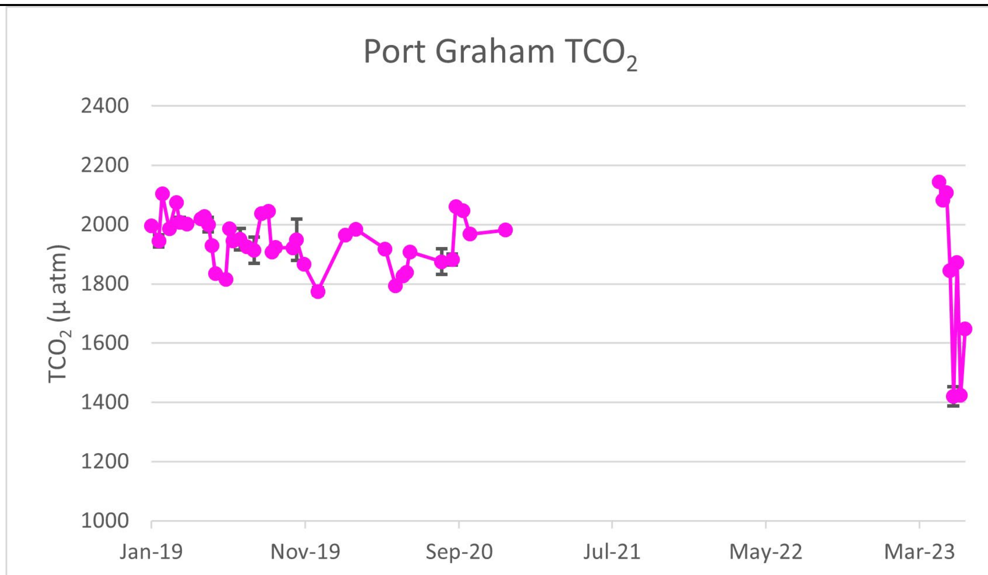

Figure 18. TCO_2 at the Port Graham site for samples collected from 01/18/2019 - 06/16/2023. The Port Graham sample set includes 19 triplicates: 02/01/2019, 03/15/2019, 05/10/2019, 06/14/2019, 07/12/2019, 08/09/2019, 09/20/2019, 10/25/2019, 11/01/2019, 11/15/2019, 12/13/2019, 02/05/2020, 05/15/2020, 06/05/2020, 08/14/2020, 09/04/2020, 12/18/2020, 05/24/2023, and 06/16/2023. Standard deviation between triplicate samples denoted by error bars are as follows, respectively: ±20.094, ±16.161, ±23.824, ±8.181, ±37.284, ±44.090, ±11.427, ±4.858, ±69.672, ±1.351, ±11.023, ±2.800, ±7.089, ±6.261, ±42.752, ±18.695, ±9.066, ±32.145, ±7.311.

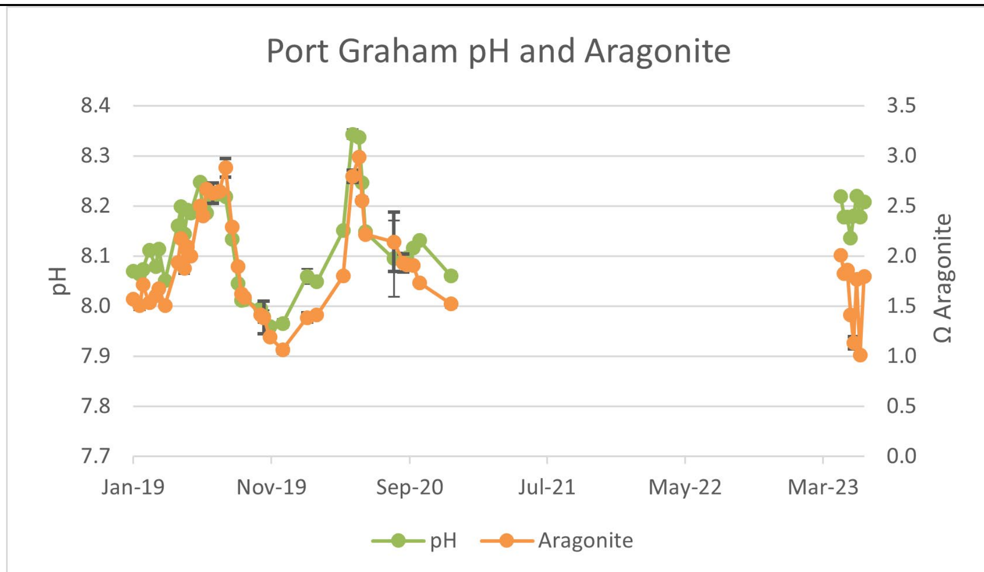

Figure 19. pH and aragonite saturation at the Port Graham site for samples collected from 01/18/2019 - 06/16/2023. The Port Graham sample set includes 19 triplicates: 02/01/2019, 03/15/2019, 05/10/2019, 06/14/2019, 07/12/2019, 08/09/2019, 09/20/2019, 10/25/2019, 11/01/2019, 11/15/2019, 12/13/2019, 02/05/2020, 05/15/2020, 06/05/2020, 08/14/2020, 09/04/2020, 12/18/2020, 05/24/2023, and 06/16/2023. Standard deviation between triplicate sample pH measurements are denoted by error bars as follows, respectively: ±0.007, ±0.003, ±0.006, ±0.006, ±0.004, ±0.005, ±0.002, ±0.007, ±0.013, ±0.008, ±0.009, ±0.015, ±0.010, ±0.004, ±0.076, ±0.018, ±0.008, ±0.010, ±0.002. Standard deviation between triplicate sample aragonite measurements are denoted by error bars as follows, respectively: ±0.039, ±0.023, ±0.048, ±0.023, ±0.100, ±0.092, ±0.018, ±0.013, ±0.165, ±0.011, ±0.031, ±0.048, ±0.062, ±0.031, ±0.297, ±0.090, ±0.030, ±0.060, ±0.015.

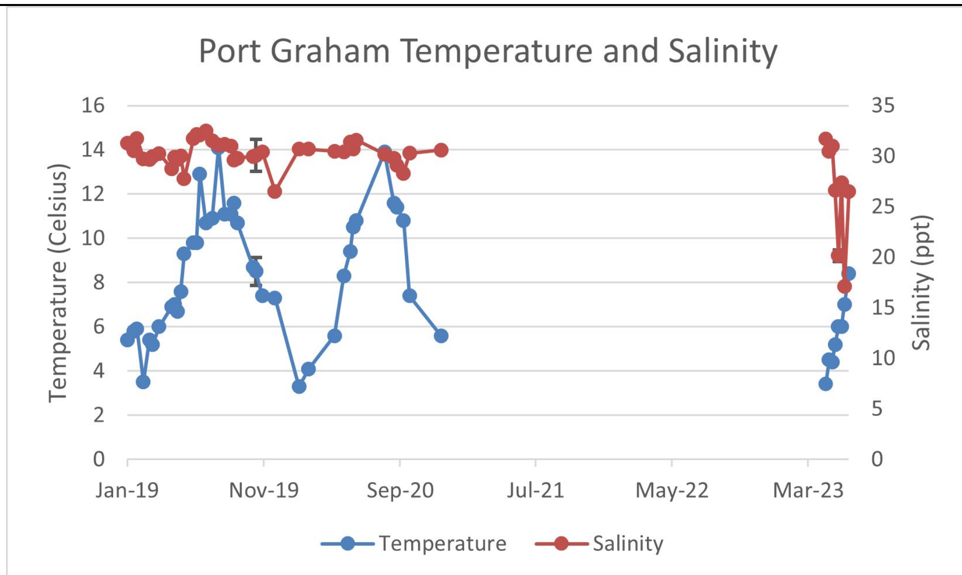

Figure 20. Temperature and salinity at the Port Graham site for samples collected from 01/18/2019 - 06/16/2023. The Port Graham sample set includes 19 triplicates: 02/01/2019, 03/15/2019, 05/10/2019, 06/14/2019, 07/12/2019, 08/09/2019, 09/20/2019, 10/25/2019, 11/01/2019, 11/15/2019, 12/13/2019, 02/05/2020, 05/15/2020, 06/05/2020, 08/14/2020, 09/04/2020, 12/18/2020, 05/24/2023, and 06/16/2023. Error bars denote standard deviation between 11/01/2019 triplicates at ±0.625 for temperature. Standard deviation between triplicate sample salinity measurements are denoted by error bars as follows, respectively: ±0, ±0, ±0, ±0, ±0, ±0.100, ±0.153, ±0.058, ±1.595, ±0, ±0.383, ±0.153, ±0.707, ±0, ±0, ±0, ±0, ±0, ±0, ±0.577, ±0.058.

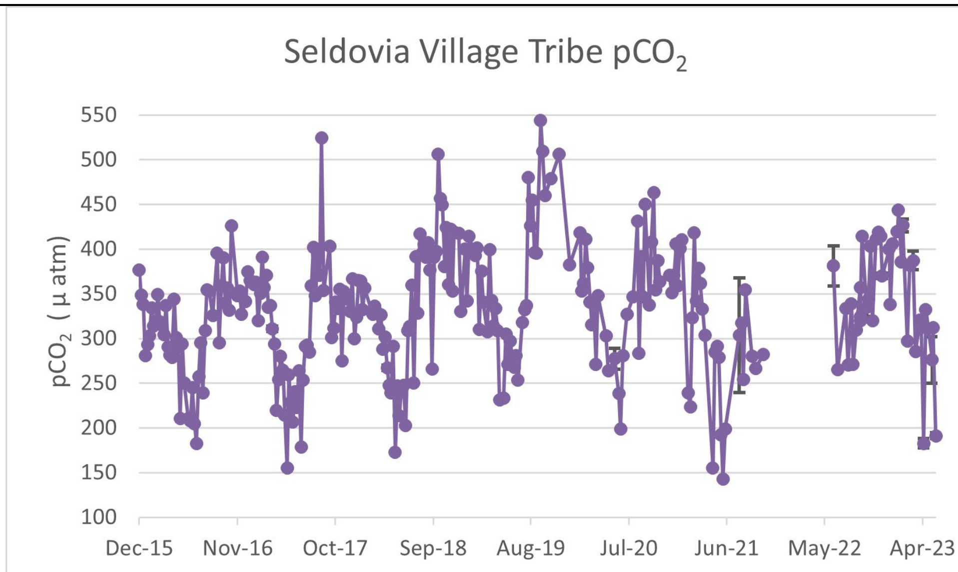

Figure 21. pCO_2 at the Seldovia Village Tribe site for samples collected from 12/10/2015 - 06/15/2023. The Seldovia sample site includes 17 triplicates (03/16/2017, 05/18/2017, 06/08/2017, 01/18/2018, 04/12/2018, 06/05/2020, 07/30/2021, 06/23/2022, 08/15/2022, 10/06/2022, 11/01/2022, 12/16/2022, 02/16/2023, 03/16/2023, 04/20/2023, 05/15/2023, and 06/15/2023). Standard deviation between triplicate samples denoted by error bars are as follows, respectively: ±3.003, ±0.933, ±1.717, ±0.859, ±3.030, ±11.811, ±64.156, ±22.255, ±1.104, ±10.031, ±1.444, ±2.891, ±6.999, ±10.375, ±5.166, ±25.999, ±3.351.

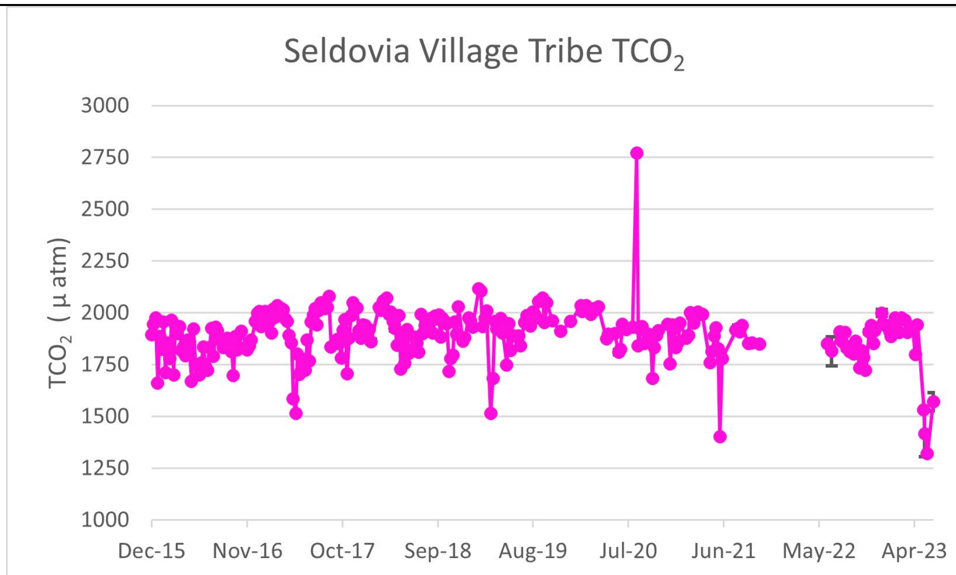

Figure 22. TCO_2 at the Seldovia Village Tribe site for samples collected from 12/10/2015 - 06/15/2023. The Seldovia sample site includes 17 triplicates (03/16/2017, 05/18/2017, 06/08/2017, 01/18/2018, 04/12/2018, 06/05/2020, 07/30/2021, 06/23/2022, 08/15/2022, 10/06/2022, 11/01/2022, 12/16/2022, 02/16/2023, 03/16/2023, 04/20/2023, 05/15/2023, and 06/15/2023). Standard deviation between triplicate samples denoted by error bars are as follows, respectively: ±6.832, ±3.052, ±2.445, ±11.775, ±11.775, ±13.744, ±14.841, ±70.774, ±8.886, ±13.625, ±8.785, ±16.707, ±5.917, ±5.962, ±109.856, ±44.157.

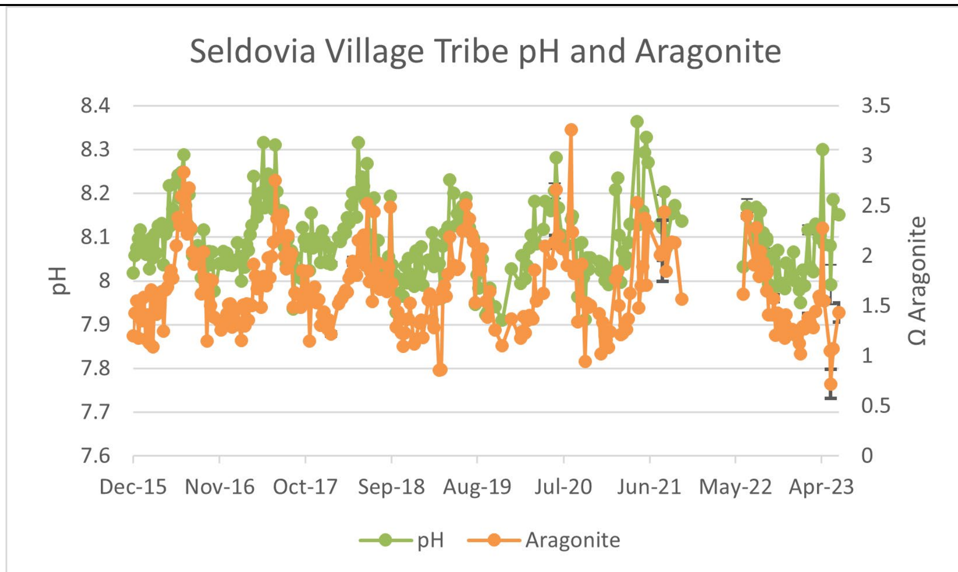

Figure 23. pH and aragonite saturation at the Seldovia Village Tribe site for samples collected from 12/10/2015 - 06/15/2023. The Seldovia sample site includes 17 triplicates (03/16/2017, 05/18/2017, 06/08/2017, 01/18/2018, 04/12/2018, 06/05/2020, 07/30/2021, 06/23/2022, 08/15/2022, 10/06/2022, 11/01/2022, 12/16/2022, 02/16/2023, 03/16/2023, 04/20/2023, 05/15/2023, and 06/15/2023). Standard deviation between triplicate sample pH measurements are denoted by error bars as follows, respectively: ±0.003, ±0.001, ±0.003, ±0.004, ±0.006, ±0.017, ±0.076, ±0.019, ±0.002, ±0.011, ±0.001, ±0.003, ±0.011, ±0.017, ±0.006, ±0.045, ±0.011. Standard deviation between triplicate sample aragonite measurements are denoted by error bars as follows, respectively: ±0.006, ±0.002, ±0.013, ±0.021, ±0.036, ±0.063, ±0.307, ±0.018, ±0.015, ±0.033, ±0.006, ±0.019, ±0.042, ±0.062, ±0.025, ±0.145, ±0.098.

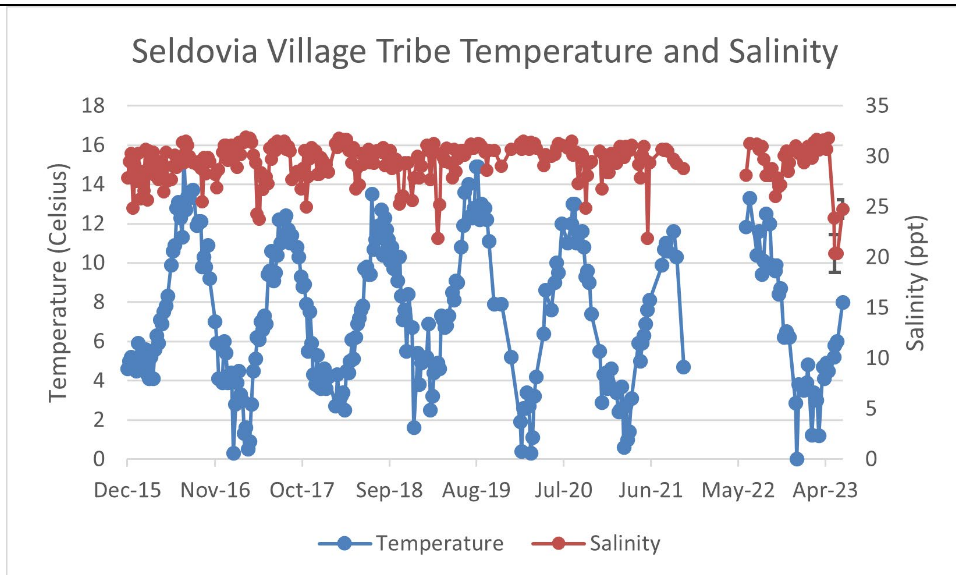

Figure 24. Temperature and salinity at the Seldovia Village Tribe site for samples collected from 12/10/2015 - 06/15/2023. The Seldovia sample site includes 17 triplicates (03/16/2017, 05/18/2017, 06/08/2017, 01/18/2018, 04/12/2018, 06/05/2020, 07/30/2021, 06/23/2022, 08/15/2022, 10/06/2022, 11/01/2022, 12/16/2022, 02/16/2023, 03/16/2023, 04/20/2023, 05/15/2023, and 06/15/2023). Error bars for temperature measurements denote standard deviation between 12/16/2022 triplicates at ±0.057, standard deviation between 02/16/2023 triplicates at ±0.057, and standard deviation between 03/16/2023 triplicates at ±0.100. Standard deviation between triplicate sample salinity measurements are denoted by error bars as follows, respectively: ±0.058, ±0.058, ±0, ±0.058, ±0.115, ±0.100, ±0.153, ±0.058, ±0, ±0.058, ±0.058, ±0.153, ±0.058, ±0.100, ±1.880, ±0.929.

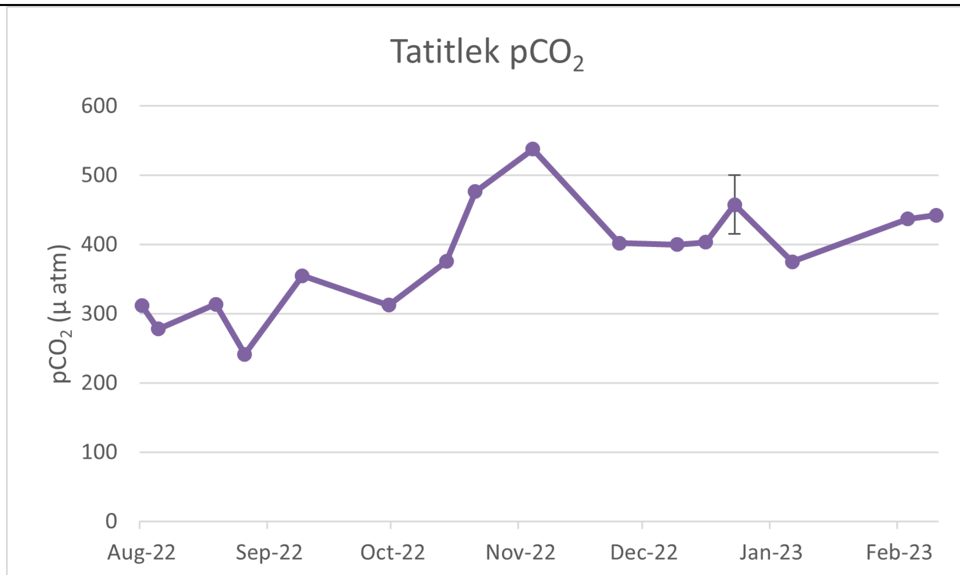

Figure 25. pCO_2 at the Tatitlek site for samples collected from 8/28/2022 - 3/9/2023. Error bars denote standard deviation between 09/22/2022 triplicates at ±4.885 and 01/19/2023 triplicates at ±42.455.

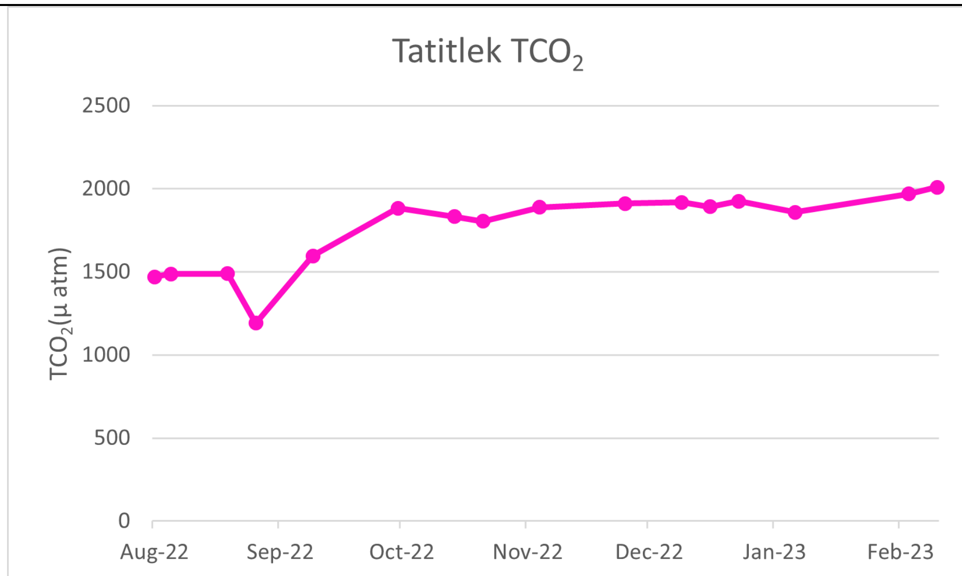

Figure 26. TCO_2 at the Tatitlek site for samples collected from 08/28/2022 - 03/09/2023. Data include standard deviation between 09/22/2022 triplicates at ±9.443 and 01/19/2023 triplicates at ±10.753. Error bars are not visible due to small standard deviation values.

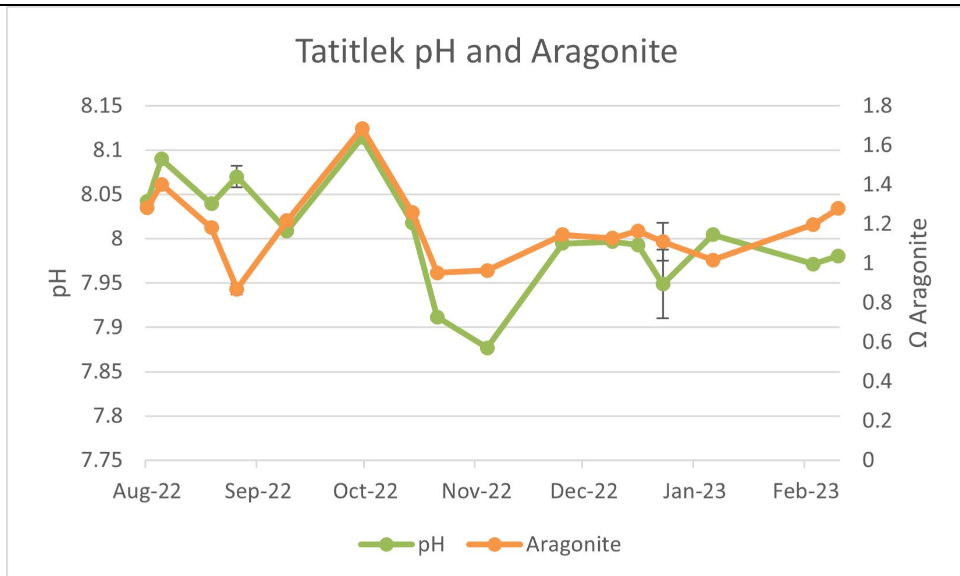

Figure 27. pH and aragonite saturation for the Tatitlek site for samples collected from 08/28/2022 - 03/09/2023. Error bars denote standard deviation between 09/22/2022 triplicates at ±0.012 and 01/19/2023 triplicates at ±0.039 for pH measurements, as well as standard deviation between 09/22/2022 triplicates at ±0.027 and 01/19/2023 triplicates at ±0.095 for aragonite measurements.

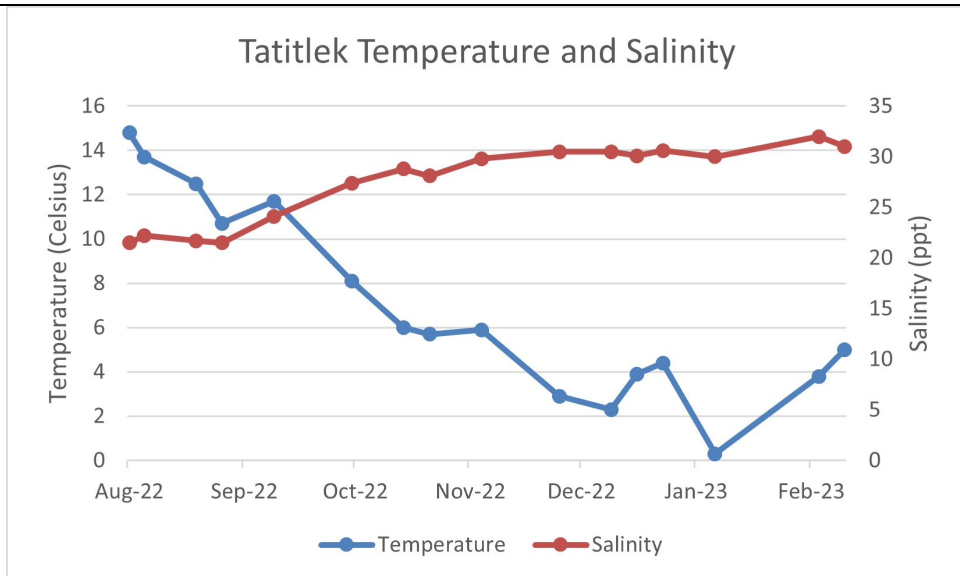

Figure 28. Temperature and salinity at the Tatitlek site for samples collected from 08/28/2022 - 03/09/2023.

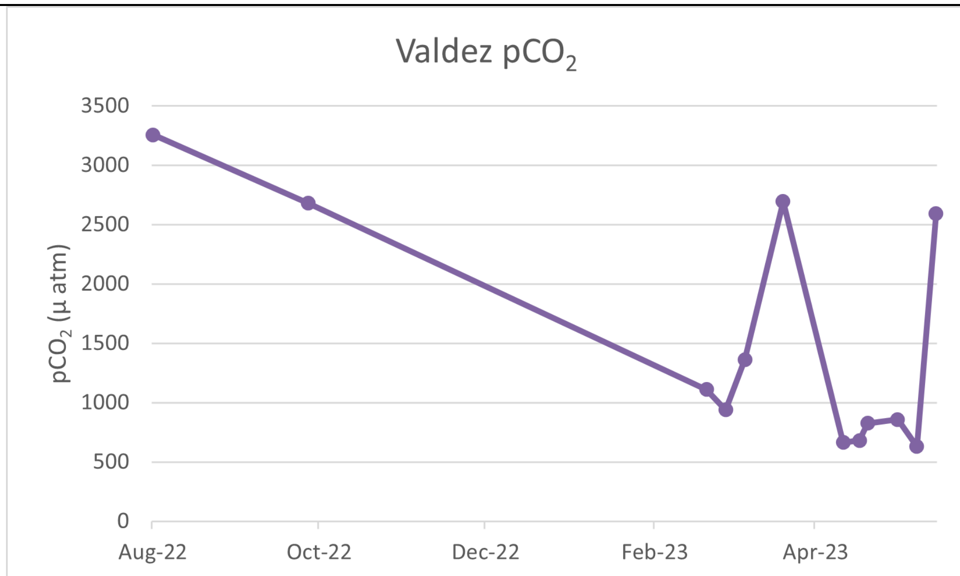

Figure 29. pCO_2 at the Valdez site for samples from 08/04/2022 - 05/18/2023.

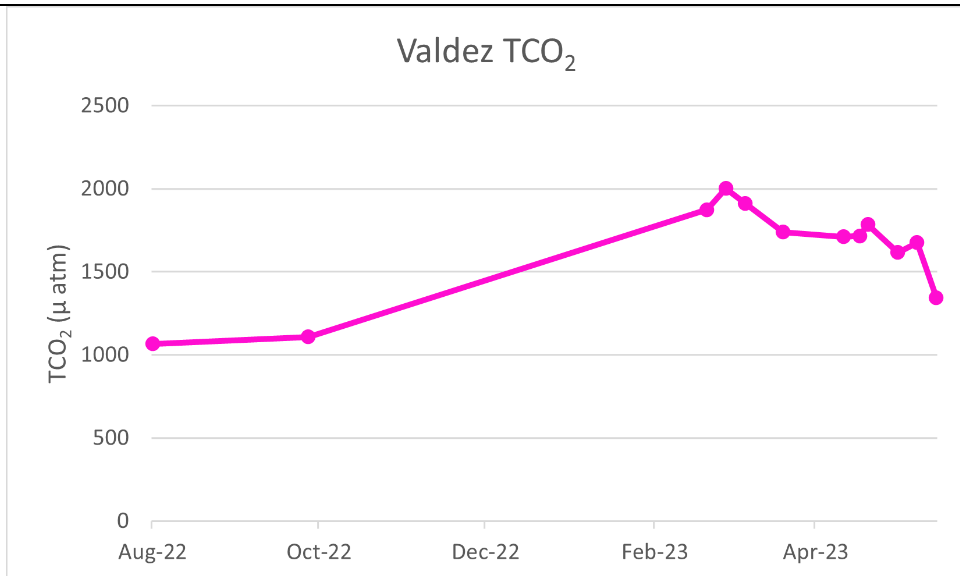

Figure 30. TCO_2 at the Valdez site for samples from 08/04/2022 - 05/18/2023.

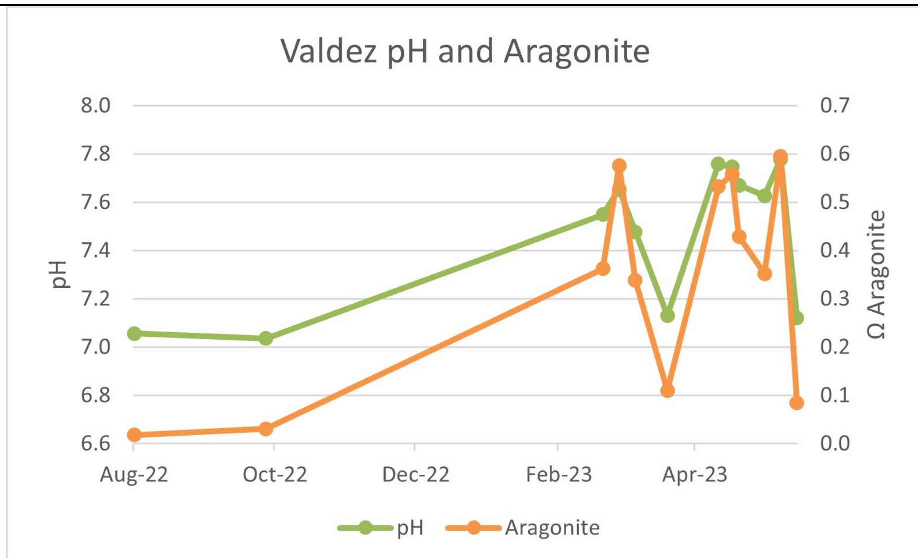

Figure 31. pH and aragonite saturation at the Valdez site for samples from 08/04/2022 - 05/18/2023.

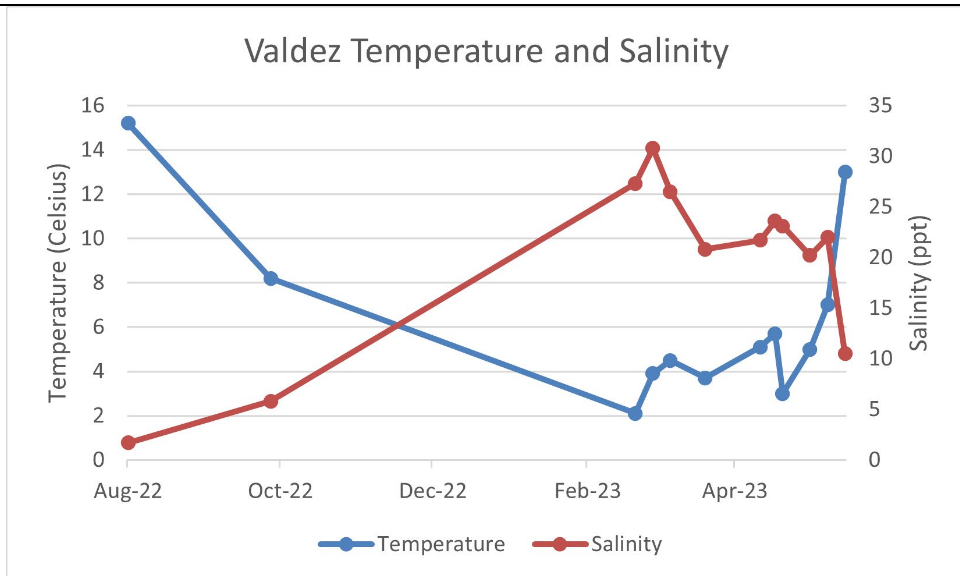

Figure 32. Temperature and salinity at the Valdez site for samples from 08/04/2022 - 05/18/2023.

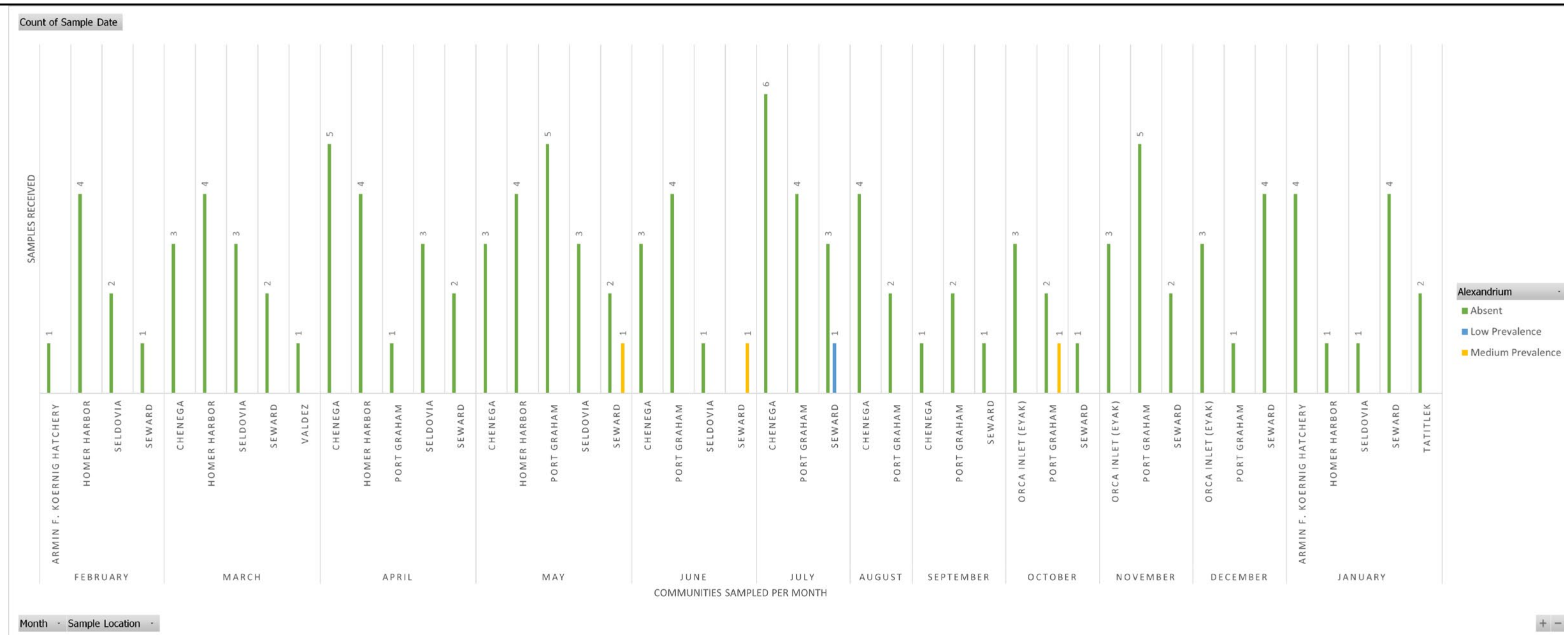

Figure 33. Prevalence of Alexandrium spp. evaluated through phytoplankton tows from February 1, 2023 to January 31, 2024.

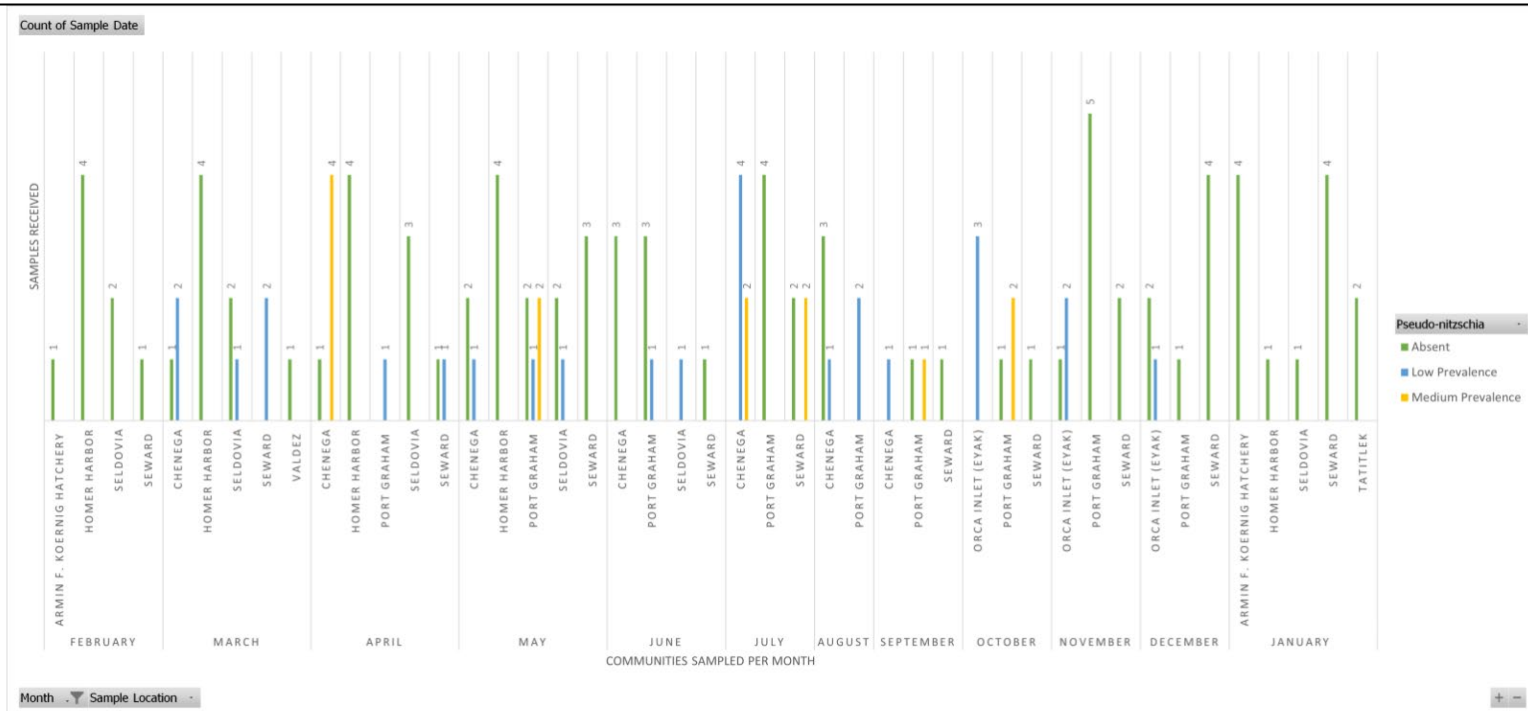

Figure 34. Prevalence of Pseudo-nitzschia spp. *evaluated through phytoplankton tows from February 1, 2023 to January 31, 2024.*

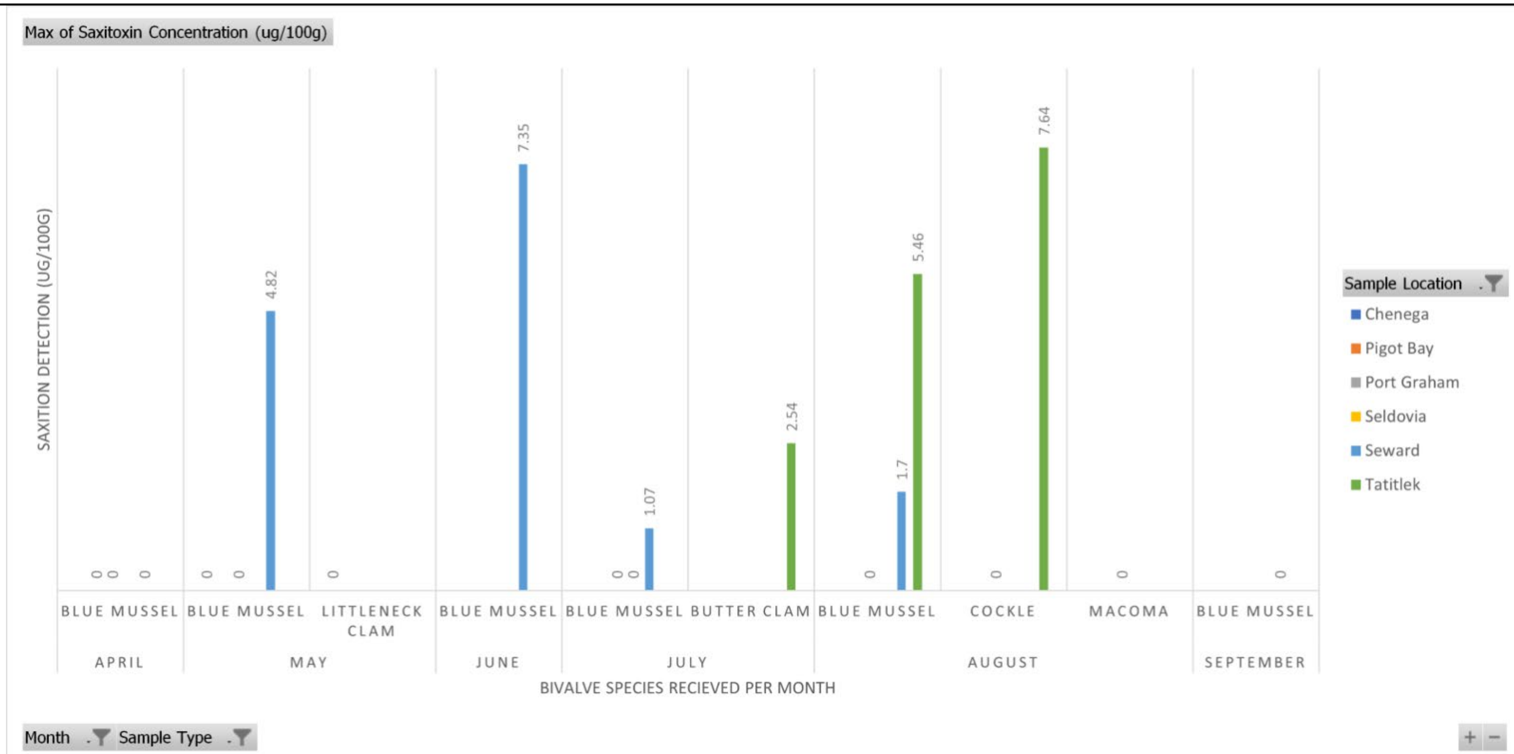

Figure 35. Concentrations of saxitoxin evaluated through shellfish collections from February 1, 2023 to January 31, 2024.

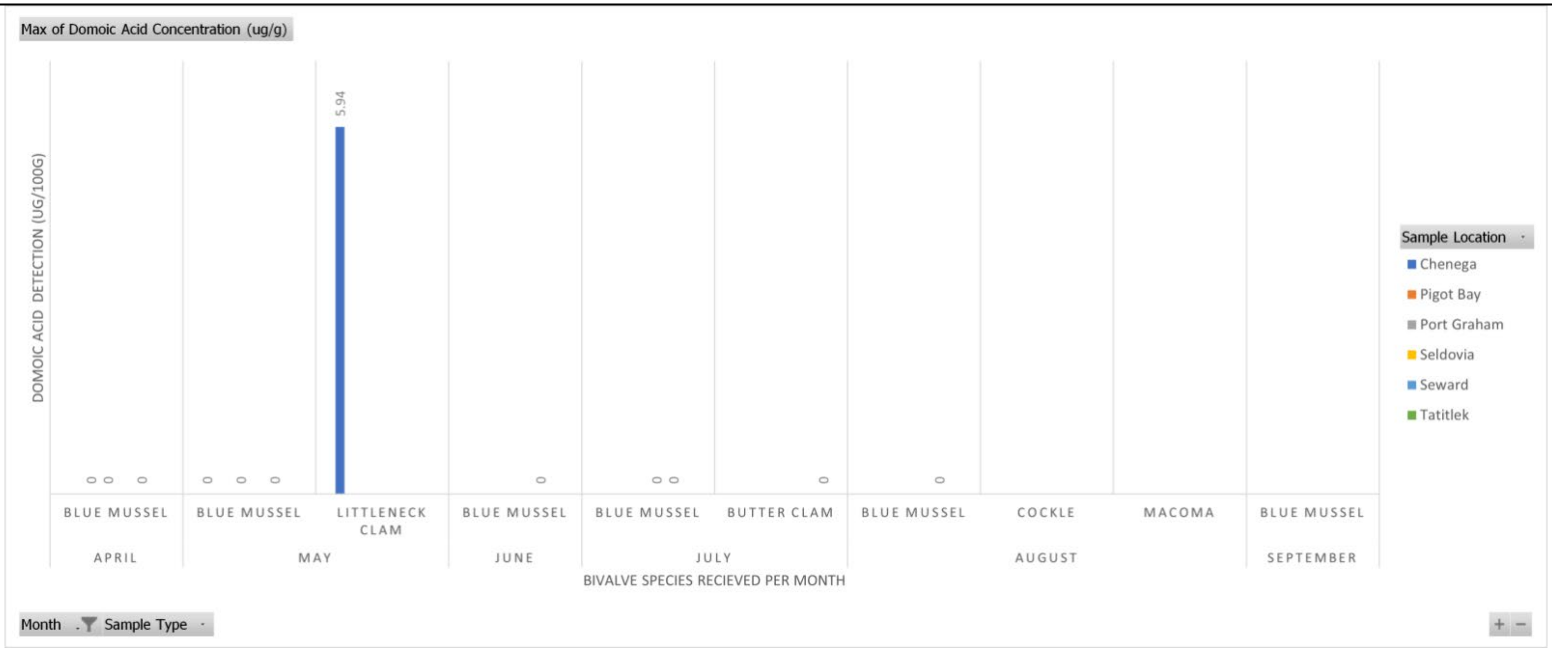

Figure 36. Concentrations of domoic acid evaluated through shellfish collections from February 1, 2023 to January 31, 2024.

Exxon Valdez **Oil Spill Trustee Council**

Long-Term Research and Monitoring, Mariculture, Education and Outreach

Annual Project Status Summary