



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: 25220201

Project Title: Chugach Regional Ocean Monitoring (CROM) Program

Principal Investigator(s): Willow Hetrick-Price, Allison Carl, Chugach Regional Resources Commission (CRRC), Alutiiq Pride Marine Institute (APMI). Allison Carl is the author of this report, and it has been reviewed and approved by Willow Hetrick-Price.

Reporting Period: February 1, 2025 – January 31, 2026

Submission Date (Due March 1 immediately following the reporting period): March 18, 2026

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.

No-cost extension request.

The need for a no-cost extension is primarily driven by delays in receipt of the award, which compressed the effective period of performance and limited the time available to complete all planned activities within the original timeline. Despite this constraint, the program has remained on track and continued to make steady progress, building on its initial foundation and maintaining strong momentum. Consistent leadership and coordination have supported effective implementation, allowing core activities to proceed as planned. The program has also strengthened regional ocean monitoring capacity, improved in-region response and communication related to environmental events, and reinforced collaboration among Tribal, state, federal, and academic partners, enhancing the overall impact and integration of monitoring efforts across Alaska. The requested extension will provide the necessary time to complete remaining activities and ensure that all deliverables are finalized to a high standard without requiring additional funding.

Will the requested budget adjustment change the original scope or objectives of the project?

No Yes



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Amount requested to carry over to the next fiscal year: \$591,491.45

How will the requested carryover be spent in the next fiscal year: As outlined above, the subaward for this project was signed on October 6, 2022, causing a significant delay in spending ability. The funds requested for carryover are a result of this delay and are to be spent as originally outlined in the award.

Personnel changes

No personnel changes occurred during the reporting period.

Table 1. **Project** milestone and task progress by fiscal year and quarter, beginning February 1, 2022.

C = completed, D = delayed, X = planned or not completed.

Fiscal Year Quarters: 1= Feb. 1-April 30; 2= May 1-July 31; 3= Aug. 1-Oct. 31; 4= Nov. 1-Jan 31

| Milestone/Task | FY22 | | | | FY23 | | | | FY24 | | | | FY25 | | | | FY26 | | | |
|---|------|---|---|---|------|---|---|---|------|---|---|---|------|---|---|---|------|---|---|---|
| | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| Milestone | | | | | | | | | | | | | | | | | | | | |
| Water sampling and carbonate chemistry analysis | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | X | X | X | X |
| Water sampling and nutrient analysis | | | | | | | | | | | | | | | | | X | X | X | X |
| Phytoplankton sampling and visual analysis | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | X | X | X | X |
| Phytoplankton sampling and qPCR analysis | | | | | D | D | D | D | D | D | D | D | D | D | D | D | X | X | X | X |
| Blue mussel sampling and biotoxin analysis | C | C | C | | C | C | C | | C | C | C | | C | C | C | | X | X | X | |
| Annual trainings | C | | | | C | | | | C | | | | C | | | | X | | | |
| Data QA/QC | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | X | X | X | X |
| Reporting | | | | | | | | | | | | | | | | | | | | |
| Annual reports | | | | | C | | | | C | | | | C | | C | | X | | | |
| Final report (due Mar 1, 2027) | | | | | | | | | | | | | | | | | | | | X |
| Deliverables | | | | | | | | | | | | | | | | | | | | |
| Data posted online | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | X | X | X | X |



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Table 2. CRRC CROM Personnel

| Position | Employee Name |
|-----------------------------------|----------------------|
| CRRC Executive Director | Willow Hetrick-Price |
| APMI Science Director | Vacant |
| APMI Biology Laboratory Manager | Allison Carl |
| APMI Technician #1 (Biology) | Jana Wheat |
| APMI Chemistry Laboratory Manager | Sierra Lloyd |
| APMI Technician #2 (Chemistry) | Vacant |
| Grants Administrator | Tara Miller |

1. Summary of Work Performed:

- A. *Administration:* CRRC’s administrative employees ensured management of the award funds and maintained compliance with regulatory and financial requirements. The Executive Director provided strategic oversight and managed staff, while the Grant Accountant and supporting administrative staff managed financial reporting, budgeting, and expense tracking to ensure fiscal responsibility. The Grants and Contracts Administrator oversaw compliance, reporting, and subaward and contract management.
- B. *CRRC CROM personnel:* there are two unfilled positions under this program (Table 2). The Chemistry Lab Manager is currently in the hiring process for the Chemistry Lab Technician position. It is anticipated that the position will be filled in the next reporting period. The Executive Director is assessing the vacant Science Director position.
- C. *Laboratory:* To date, all budgeted equipment pieces under the initial five-year phase of this award have been purchased and all but one delivered (see below). All equipment is housed at the APMI facility. Both Laboratory spaces began documenting internal protocols which included assay and equipment protocols, troubleshooting processes and contacts, and inventory and maintenance schedules.
 - a. **Autoanalyzer procurement and protocols:** The final piece of equipment funded under this program is the autoanalyzer for nutrient analysis to be housed in the APMI Chemistry Laboratory. The procurement process began during the reporting period, and the equipment is scheduled to be installed in the next reporting period.
- D. *Sample Coordination:* From February 1, 2025, to January 31, 2026, APMI sent out sample kits which included supplies for collecting the following samples: dissolved inorganic carbon to monitor marine water quality parameters, phytoplankton net tows to monitor for the presence of harmful algae, harmful algae blooms (HABs), and shellfish to monitor for the presence of harmful algal toxins. Sampling kits were sent to participating Chugach communities and partner Tribes and organizations. During the reporting period, APMI received 486 samples for dissolved inorganic carbon analysis, 116 phytoplankton samples, 121 water filters for quantitative PCR (qPCR) analysis, 88 samples for total saxitoxin concentration and domoic acid concentration detections. Samples received, samples analyzed, and data finalized are outlined in Tables 3-7. The sample set included Chugach communities in the spill affected region and partners outside



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the funded scope of this project who, subsequent to the funding, requested to be included in monitoring efforts.

Table 3. Dissolved inorganic carbon sample status

| Samples collected through CROM Program (CRRC staff/Community Samplers) | | | |
|--|------------------|------------------------|----------------|
| Community | Samples Received | Lab Analysis Completed | Data Finalized |
| Chenega | 6 | 6 | 6 |
| Eyak | 58 | 46 | 46 |
| Nanwalek | 24 | 24 | 24 |
| Port Graham | 3 | 3 | 3 |
| Seward | 63 | 51 | 14** |
| Tatitlek | 1 | 1 | 1 |
| Valdez | 19 | 12 | 12 |
| Whitter | 19 | 19 | 19 |
| Samples collected through collaborations (partner Tribes, citizen science, research) | | | |
| Kachemak Bay National Estuarine Research Reserve (Homer) | 24 | 24 | 24 |
| Seldovia Native Tribe | 11 | 11 | 11 |
| Kenaitze Indian Tribe | 68 | 68 | 67 |
| Kodiak Area Native Association (KANA) | 190* | 190 | 186 |
| Total Samples | 486 | 455 | 413 |

*11 samples were lost in transit from KANA. Shipping protocols have been adjusted to prevent future incidents. Number shown is the number of samples received that were able to be analyzed.

**Many samples from Seward were discarded after analysis due to lack of fixative during sample collection. Samples were discarded and the fixative is now used onsite to ensure sample quality. See *APMI CROM Chemistry Laboratory* section for more details.



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Table 4. Phytoplankton net tow sample status

| Samples collected through CROM Program (CRRC staff/Community Samplers) | | | |
|---|------------------|------------------------|----------------|
| Community | Samples Received | Lab Analysis Completed | Data Finalized |
| Chenega | 0 | 2 | 2* |
| Eyak | 28 | 30 | 30* |
| Nanwalek | 6 | 6 | 6 |
| Port Graham | 3 | 3 | 3 |
| Seward | 50 | 51 | 51* |
| Tatitlek | 1 | 1 | 1 |
| Valdez | 0 | 0 | 0 |
| Whittier | 12 | 12 | 12 |
| Latouche Island | 1 | 1 | 1 |
| Samples collected and analyzed through collaborations (partner tribes, citizen science, research) | | | |
| Homer | 0 | 1 | 1* |
| Seldovia | 9 | 9 | 9 |
| | | | |
| Total Samples | 110 | 116 | 116 |

*There is an increased number of finalized data due to samples that were not analyzed at the end of the previous reporting period and were carried over to the current set.



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Table 5. Shellfish samples status: total saxitoxin concentration analysis

| Samples collected through CROM Program (CRRC staff/Community Samplers) | | | |
|---|------------------|------------------------|----------------|
| Community | Samples Received | Lab Analysis Completed | Data Finalized |
| Chenega | 0 | 1 | 1* |
| Eyak | 9 | 6 | 6 |
| Nanwalek | 8 | 8 | 8 |
| Port Graham | 2 | 2 | 2 |
| Seward | 32 | 53* | 53* |
| Tatitlek | 3 | 3 | 3 |
| Valdez | 0 | 0 | 0 |
| Cook Inlet** | 3 | 3 | 3 |
| Whittier | 9 | 9 | 9 |
| Latouche Island | 1 | 1 | 1 |
| Samples collected and analyzed through collaborations (partner tribes, citizen science, research) | | | |
| Kachemak Bay National Estuarine Research Reserve (Homer, Western Cook Inlet, Ninilchik) | 7 | 7 | 7 |
| Prince William Sound Stewardship Foundation | 9 | 8 | 8*** |
| Seldovia Native Tribe | 5 | 5 | 5 |
| Overall Samples | 88 | 106 | 106* |

*Many samples from the program kickoff have not yet been tested, which resulted in more data points being finalized than samples received. It is anticipated that all backlogged toxin samples will be completed in the next reporting period.

**These samples were opportunistic and submitted through APMI's mariculture department. Samples were collected in a common subsistence use area that is not monitored for algal toxins.

***Some samples received did not have enough tissue samples to process for both saxitoxins and domoic acid.



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Table 6. Shellfish samples status: domoic acid concentration analysis

| Samples collected through CROM Program (CRRC staff/Community Samplers) | | | |
|---|------------------|-----------------------|----------------|
| Community | Samples Received | Lab Analysis Complete | Data Finalized |
| Chenega | 0 | 1 | 1* |
| Eyak | 9 | 6 | 6 |
| Nanwalek | 8 | 8 | 8 |
| Port Graham | 2 | 2 | 2 |
| Seward | 32 | 34 | 34* |
| Tatitlek | 3 | 5 | 5* |
| Valdez | 0 | 0 | 0 |
| Lower Cook Inlet | 3 | 3 | 3 |
| Whittier | 9 | 9 | 9 |
| Latouche Island | 1 | 1 | 1 |
| Samples collected and analyzed through collaborations (partner tribes, citizen science, research) | | | |
| Kachemak Bay National Estuarine Research Reserve (Homer, Western Cook Inlet, Ninilchik) | 7 | 7 | 7 |
| Prince William Sound Stewardship Foundation | 9 | 9 | 9 |
| Seldovia Native Tribe | 5 | 5 | 5 |
| Overall Samples | 88 | 90 | 90* |

*Many samples from the program kickoff have not yet been tested which resulted in more data points being finalized than samples received. It is anticipated that all backlogged toxin samples will be completed in the next reporting period.



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Table 7. Water filters status (qPCR analysis)

| Samples collected through CROM Program (CRRC staff/Community Samplers) | | | |
|--|------------------|-----------------------|----------------|
| Community | Samples Received | Lab Analysis Complete | Data Finalized |
| Chenega | 0 | 0 | 0 |
| Eyak | 24 | 0 | 0 |
| Nanwalek | 0 | 0 | 0 |
| Port Graham | 0 | 0 | 0 |
| Seward | 94 | 0 | 0 |
| Tatitlek | 0 | 0 | 0 |
| Valdez | 3 | 0 | 0 |
| Total CROM Samples | 121 | 0 | 0* |

*CROM laboratory staff are currently finalizing laboratory protocols. qPCR data will be finalized after interlaboratory validations are completed. See *APMI CROM Biology Laboratory* section for more details.

APMI Ocean Chemistry Laboratory, Sierra Lloyd, Chemistry Laboratory Manager:

- A. *New laboratory staff and training:* The Chemistry Laboratory Manager traveled to the Hales Lab at Oregon State University (OSU) February 16 - 21, 2025, for intensive training on the Burke-O-Lator protocols, continuous monitoring, and discrete sample analysis. The Chemistry Lab Manager has since restored function to both Burke-O-Lators and completed the long backlog of samples. Dr. Burke Hales from the Hales Lab also traveled to APMI on July 13, 2025, to assist with the necessary coding to restore function to the newer-model Burke-O-Lator, review protocols and train the Chemistry Lab Manager on the equipment in-house.
- B. *Dissolved inorganic carbon analyses (discrete samples):* Since February 1, 2025, the chemistry lab received a total of 486 dissolved inorganic carbon samples from CRRC communities and partner organizations (Table 3). During this reporting period, 11 sample bottles were broken during shipping from Kodiak Area Native Association (KANA); these samples were not included in the number of samples received (Table 3). Since the incident, APMI has supplied KANA with sturdier shipping materials to prevent accidents like this. A monthly collection of triplicate samples is requested for QA/QC purposes. Of the 486 samples received in the reporting period, 455 samples were analyzed and 413 were included in the 2025 data set. Of the 486 samples received, two were not analyzed as they were known to be taken improperly. Of the 455 samples analyzed, 41 were excluded during QA/QC analysis. Of the excluded samples, 4 were excluded due to analyst errors, while the remaining 37 samples were collected in Seward and were excluded due to improper preservation methods. The Seward sampler was trained to use the fixative and CROM staff have not observed this issue since the training. Samples with average standard deviations greater than 1% of the measured sample value indicate minor sample collection error. Error under 10% may indicate the process of off gassing during collection time,



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whereas larger error indicates sampler error (e.g., missing fixative or organic contamination in the sample). Community samplers with recurring errors have been contacted and provided copies of protocols. The 413 samples that passed QA/QC are presented in cumulative time series for each region containing data from all analyzed samples under this project (Figures 1-20). 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.

- C. *Dissolved inorganic carbon analysis (continuous monitoring)*: APMI's CROM Chemistry Laboratory houses two Burke-O-Lators; these allow the program to run discrete samples on one system without disrupting the Burke-O-Lator that provides continuous monitoring of incoming seawater at APMI to monitor ocean chemistry. The data from the continuous monitoring efforts are live streamed to the Alaska Ocean Observing System (AOOS) Ocean Data Explorer ([Ocean Data Explorer: Alutiiq Pride Marine Institute Burke-o-Lator](#)). Data streaming was down when the Chemistry Lab Manager arrived on site and was restored as of April 1, 2025. During this reporting period, there were occasional pauses in the data stream due to regular maintenance and weather events; the machine was powered in August 2025 for trouble shooting and it was found that the gas sensor needed to be recalibrated. Recalibration of select Burke-O-Lator components must be sent out of state for servicing and may take months to return. Program staff are exploring options for purchasing backup components during recalibration services to prevent long gaps in the continuous monitoring. When continuous monitoring is down, either for troubleshooting or regular maintenance, the data archived can be found on the AOOS Ocean Data Explorer. The continuous monitoring Burke-O-Lator was turned back on after the end of the reporting period (February 6, 2026).
- D. *Nutrient analyses*: APMI procured a small spectrophotometer in the previous reporting period with the intent of establishing and validating protocols for nutrient analysis prior to procurement of the autoanalyzer budgeted for fiscal year 2026. The spectrophotometer has since been used to support small scale ocean monitoring projects (See *other collaborations* for more details); however, it has been identified that the more precise autoanalyzer is required to provide meaningful data around nutrient analysis near Chugach communities. The Chemistry Lab Manager researched equipment models and costs and started to develop the necessary standard protocols for sample collection and preservation to ensure quality data are produced. The invoicing and payment process for procuring the model AA500 SEAL Autoanalyzer is underway as of the end of January 2026. Further research into the needs associated with equipment procurement is ongoing. These needs include ensuring lab infrastructure can maintain electrical requirements for the equipment; obtaining necessary reagents and sample storage to ensure high quality data are produced from the program; and building an inventory of additional supplies needed for nutrient sampling (e.g., bottles, filters, fixatives etc.).



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APMI Biology Laboratory, Allison Carl, Biology Laboratory Manager & Jana Wheat, Biology Laboratory Technician

- A. *HAB event response*: CRRC staff worked closely with regional Tribes and partners including Port Graham, Nanwalek, the Alaska Harmful Algal Bloom (AHAB) Network, and the Kachemak Bay Nation Estuary Research Reserve (KBNERR) during two HAB events in Kachemak Bay in the summer and fall of 2025. The first bloom occurred during July 2025 where increased numbers of *Pseudo-nitzschia* spp. were observed in Kachemak Bay by KBNERR staff. The second event was an *Alexandrium* spp. bloom first observed by KBNERR staff at Gull Island. CROM staff attended event response meetings, coordinated expedited phytoplankton and shellfish samples from Nanwalek, Port Graham, and Seldovia during both events. Additionally, CROM staff assisted in sample coordinating and analysis of blue mussels, gooseneck barnacles, and razor clam samples from KBNERR that were collected from Cook Inlet and Ninilchik during the *Pseudo-nitzschia* spp. bloom. Between both blooms 27 samples were processed for both domoic acid and saxitoxins in various species of interest (Appendix A). CROM Biology Lab staff coordinated, processed, and analyzed samples and reported data back to Tribal leaders. Additionally, results were shared with the AHAB Network and KBNERR to help with decision making within the Network and to inform communications throughout Kachemak Bay. After the *Pseudo-nitzschia* spp. bloom in July, CRRC staff coordinated Tribal consultations with Nanwalek (September 27, 2025) and Port Graham (October 11, 2025) to discuss the both events and how CRRC could best support their communities and receive feedback from Tribal leaders regarding event response; KBNERR staff were in attendance during these consultations to help communicate HAB event information and AHAB Network response. Community reports were developed by CRRC and KBNERR to document the series of events and HAB response (Appendix A). Final reports were sent to Tribes after the consultations with updated data to ensure the HAB events were documented for both communities. Results from Tribal consultations indicate that Tribes are interested in the development of educational materials and contact sheets that can be housed in Tribal offices and/or community rooms. Building relationships and sampling capabilities through the CROM Program has ensured that samples were collected and processed within the communities where people harvest intertidal and marine resources.
- B. *Coordinating efforts*: CROM staff coordinated regularly collected samples throughout the Chugach region. The program received samples from Eyak, Nanwalek, Port Graham, and Qutekcaq. In addition to Chugach community samples, the program also onboarded a sampler in the City of Whittier, coordinated samples with Seldovia Village Tribe, and received opportunistic blue mussel samples from the Prince William Sound Stewardship Foundation (PWSSF; the Biology Lab Manager is a board representative of this organization). CROM biology staff participated in monthly AHAB Networks calls to stay up to date on state-wide monitoring efforts and worked towards standardizing field and laboratory methods, as well as to strategize response to HAB events. The Biology Lab Manager holds a seat on the AHAB Steering Committee and participated in discussions about sample coordinating, monitoring, and communication efforts and future directions of the AHAB Network.



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- C. *Phytoplankton net tows and microscopy*: During this reporting period 116 phytoplankton net tow samples were analyzed via microscopy for harmful algae species identification by CROM staff (Table 4; Figure 29). Laboratory staff recorded the presence and absence of other algal species common to southcentral Alaska (Figure 30). Samples not yet analyzed were received at the end of the reporting period and have not been processed. Microscopy results for target HAB species were categorized into three groups (absent, detected and elevated) based on cell counts (detected = 1-10 cells per slide; elevated ≥ 10 cells per slide).
- i. ***Alexandrium spp. results***: *Alexandrium spp.* were detected via microscopy on one occasion in Tatitlek in May 2025. Detected cells were observed in elevated numbers. The Tribe was notified immediately via email which included a toxin report, language around paralytic shellfish toxins, and contacts for more resources or questions.
 - ii. ***Pseudo-nitzschia spp. results***: In 2025, elevated levels occurred on several occasions in Seward, Port Graham, and Eyak; elevated levels were observed between April and July, but detections began as early as March.
 - iii. ***Dinophysis spp. results***: *Dinophysis spp.* were frequently observed at low levels throughout the reporting period with elevated levels observed in Seward in May and July.
- D. *Harmful Algae Bloom Modeling*: Model development was initiated during this reporting period, and 2025 data will be included in the model during the next annual reporting period.
- E. *Laboratory update*: The Biology Laboratory determines domoic acid concentration levels via the Gold Standard Diagnostics [ON0021] ABRAXIS® Domoic Acid (Onsite Technologies) ELISA and identifies total saxitoxin concentration using a receptor binding assay (RBA). The Biology Laboratory Manager successfully moved the Microbeta2 plate reader for RBAs from the UAF Seward Marine Center to the APMI biology lab on March 21, 2025. During the reporting period, CROM biology lab staff experienced unexpected delays in the analysis of total saxitoxin concentration due to missing background protocols. On May 8, 2025, during a routine field service appointment for the plate reader, the service technician from the equipment manufacturer accidentally deleted all background protocols for the equipment. The Lab Manager restored known protocols (i.e., general details the machine needs to know about the assay); however, the missing background protocols (i.e., normalization processes that the machine applies to the results once the machine is done reading) live within layers of folders. The company again evaluated the equipment, and all protocols were restored (September 26, 2025); laboratory staff have since processed all backlogged samples from the 2025 reporting period. While the equipment was down, APMI reached out to the Southeast Alaska Tribal Ocean Research (SEATOR) Environmental Research Lab to run three community samples that were suspected to contain elevated levels of saxitoxin. SEATOR is an intertribal organization who also uses the RBA and graciously agreed to run these community samples at no cost to CRRC or the Tribe.
- F. *Shellfish toxin testing*: APMI received a total of 88 shellfish samples for HAB toxin analysis and analyzed all samples including a selection of backlogged samples (Tables 5 and 6).



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- i. **Saxitoxin detection results:** Soft-shell clams, blue mussels, and butter clams were collected near Tatitlek during the same time of the elevated *Alexandrium* spp. cell counts in May 2025. All three of the samples sent out for analysis returned positive results (Appendix A). Blue mussels and butter clams were found to be holding toxins at 475 µg/100g and 411 µg/100g respectively, which are well over the regulatory limit of 80 µg/100g (Figure 31). Butter clams are known to hold saxitoxin for extended periods of time compared to other species, however high toxin levels in the blue mussels indicate there was a bloom at the time of sample collection. The Tribe was contacted immediately and made aware of the presence of paralytic shellfish toxins (Appendix A). Additional sampling in Kachemak Bay during an *Alexandrium* spp. bloom showed increased detections of paralytic shellfish toxins; although toxin levels were higher in some areas, all samples processed through APMI's Biology Lab were found to be below the federal regulatory limit (Figure 31).
 - ii. **Domoic acid detection results:** Domoic acid detections throughout the region exhibited concentrations well below the FDA regulatory limit (20 µg/g) (Figure 32). Increased sampling in Kachemak Bay during a *Pseudo-nitzschia* spp. bloom resulted in numerous domoic acid detections in late July; although cells were present, all toxin detections were found to be below the federal regulatory limit (Figure 32).
- G. **Molecular lab:** CROM's Biology Laboratory staff integrated environmental DNA (eDNA) and quantitative PCR (qPCR) for phytoplankton detection. Laboratory staff continued to run standards for *Alexandrium* spp. Numerous standards were examined to establish a limit of detection for the equipment (see *Project Setbacks* section D for more details). In-state validation options are currently being explored. Once validated, phytoplankton species identification data will be finalized and reported.
- iii. **Sample collection:** Samples are collected using a Smith-Root eDNA Citizen Scientist Sampler; this consists of a vacuum pump attached to a 2-L collection reservoir and tubing, a sterile filter can be attached to the tubing. Through collaborative efforts with CRRC's Tribal Fish and Wildlife Department's Herring Monitoring Project funded by the Administration of Native Americans, APMI received water filter samples from Cordova that will be analyzed for HAB species. CRRCs Biology staff are working to ensure assay accuracy and efficiency prior to sample processing. All sample filters have had DNA extracted and are being stored at -80°C until analysis. There is a current backlog of 309 sample filters (Table 7). Once protocols are established and validated, lab staff will focus on processing the backlog and implementing increased eDNA sampling throughout the region.



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Annual Sampler Workshop (all CROM staff):

APMI hosted the annual water sampler workshop virtually on May 7, 2025. CRRC's Indian General Assistance Program (IGAP) Environmental Coordinator is typically heavily involved in hosting this event. However, due to the unfilled IGAP position and uncertainty in federal funding at the time of the event (CRRC's Board placed the organization on a spending freeze during the initial months of the new administration until management was able to provide financial assurances that satisfied the board's concerns), the workshop was shifted from an in-person event to virtual workshop. There were 25 attendees from Tribal and partner organizations. In past years, during virtual events, the process of reviewing sampling protocols was a challenge due to limited bandwidth for streaming videos from the harbor making it difficult for samplers to see how field methods look in practice. To remedy this, CROM staff worked to create videos of both field and lab protocols. All Tribal samplers involved in the CROM Program were invited, as were samplers and partners from other regions. This workshop included educational talks on harmful algae, shellfish toxins, ocean acidification, and the role of marine nutrients in the development of harmful algal bloom events. An introduction to eDNA and sample protocols was included in this year's workshop for program participants. The flyer, agenda, sign in sheet, and presentations can be found in Appendix B.

Community Travel (available CROM staff):

CROM staff traveled to Port Graham and Valdez to train samplers; these communities were unable to schedule a visit during the previous reporting period. Below is an overview of community travel:

- A. *Valdez (06/13/2025)*: The Biology Lab Manager traveled to Valdez to train a new sampler. Previously, to help fill the role of sampling, Prince William Sound College hosted student samplers in Valdez; during this reporting period, a community member was identified and trained for environmental sampling to increase regularly collected samples. CROM staff reviewed all sampling protocols in depth and collected a set of eDNA samples. Because the harbor master was not present at the time to give permission, CROM staff were unable to set up the blue mussel net during this visit. Valdez has a large and active boat harbor, CROM staff later connected with harbor staff and waited for permission to hang the net via email. The mussel net was hung on July 2025; However, the sampler reported that when they return to the harbor to collect samples, the net had been removed. CROM staff will continue to work with the Valdez Harbor staff, Valdez Native Tribe, and Samplers to increase awareness around environmental monitoring occurring in the community. CROM staff will also discuss areas that may be better for hanging up the net during the field season.
- B. *Port Graham (06/26/2025)*: The Biology Laboratory Manager visited Port Graham and the Tribe's IGAP Environmental Coordinator to check in and review sampling protocols. CROM staff worked with the Environmental Coordinator to teach the Summer Youth Program participants about environmental sampling and long-term regional monitoring. The youth participants helped collect blue mussels, set up the holding net, and collected a set of CROM samples.
- C. *Whittier (08/11/2025)*: The CRRC IGAP Environmental Coordinator traveled to Whittier to train a regional participant to collect environmental samples. The Environmental Coordinator reviewed



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water sampling field methods, assisted in collecting blue mussels for toxin monitoring, and hung the holding net in a slip hosted by Lazy Otter Boat Charters.

Data Dissemination and Management:

- A. *Community Reports:* CROM staff have developed brief community reports with overviews of each parameter the program monitors and results specific to each community (Appendix C). Reports were sent directly to Tribal leaders in December 2025 with data attached to ensure Tribes are included in data management and can review data prior to public updates and reports.
- B. *Axiom Research Workspace:* 2025 program data were updated on Research Workspace. Data included dissolved inorganic carbon, phytoplankton monitoring, and shellfish toxin data sets. Forward-facing data are available to the public through the AOOS Gulf of Alaska Data Portal here (<https://gulf-of-alaska.portal.aos.org/#metadata/7825fa08-4bc8-4032-836c-1b3f08fed0a1/project>). The Biology Lab Manager is currently working through edits to metadata with Axiom staff for final archival and DOI assignments for the first three years of program data.
- C. *Public Service Announcements (PSAs):* When HAB toxin levels were elevated or above regulatory limits, CRRC shared community PSAs directly with Tribal leaders (Appendix C). CRRC supports Chugach Tribes by providing information to Tribal leaders and their communities to support informed shellfish harvests and baseline near-shore data. CRRC is not a regulatory agency and does not implement any regulations in any Tribal or local community.

Networks and Working Groups:

Staff working under the CROM Program participated in the following networks and working groups:

- A. *Alaska HAB (AHAB) Network:* Biology staff attended the virtual, monthly AHAB meetings and the Biology Lab Manager maintained a seat on the Network's steering committee.
- B. *Alaska OA (AOA) Network:* The Chemistry Lab Manager attended the virtual, monthly AOA meetings, as well as the annual networking dinner hosted during AMSS.
- C. *The Alaska/Washington (AKWA) eDNA working group:* The Biology Lab Manager attended the virtual, monthly AKWA meetings to discuss ongoing research and monitoring using eDNA in Alaska.
- D. *Marine Carbin Dioxide Removal(mCDR) Journal Club:* The Chemistry Lab Manager attends monthly conversations around viability of mCDR in Alaska.
- E. *CROM quarterly meetings:* CROM staff hosted these meetings through CRRC's IGAP Environmental Coordinator. Due to the IGAP Coordinator position vacancy, these meetings were paused during reporting period. A new IGAP Environmental Coordinator was hired in July 2025, and both meetings were reinstated September 2025. These are a set of two meetings: one for CROM program samplers in the region, and another for state-wide samplers and program managers. Sampler meetings give CROM staff an opportunity to talk about results and give those who are sampling in the communities an opportunity to ask questions and give feedback. The state-wide meetings are for those sampling or managing sampling programs around the state.



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These meetings are used as a time to troubleshoot assays, standardize programs, discuss partnerships and outreach opportunities, and highlight upcoming events or funding opportunities.

Project setbacks during this reporting period:

- A. *Community Sampling Coverage:* The program has struggled to maintain samplers in Chenega, Tatitlek, and Valdez. CROM staff will continue to connect with community members through regional networks, travel, and events to identify interested participants in each Chugach community.
- B. *Sampling accessibility:* Samples are typically collected from a dock or harbor; Nanwalek does not have a harbor, which makes water sampling difficult in this community. To remedy this, Nanwalek's community sampler has been collecting various water chemistry samples from different areas around the Village. APMI staff are analyzing samples from Nanwalek and will continue to work with this sampler to identify safe and accessible areas to appropriately collect samples.
- C. *Laboratory infrastructure:* The initial Burke-O-Lator, supported in part by AOOS, is designed for continuous monitoring and malfunctioned during the time when the Chemistry Laboratory Manager position was vacant. To preserve the equipment, it was shut down during the previous reporting period (FY24 Annual Report). After being hired in January 2025, the Chemistry Lab Manager completed her training at OSU (February 17, 2025) and re-established the continuous monitoring in Resurrection Bay and completed analysis on the full backlog of discrete community samples. The continuous monitoring system was reinstated in April 2025, but the data stream experiences extended outages due to regular maintenance and cleaning, heavy rain events, and routine parts replacement and calibration.
- D. *Biological sample analysis turnover time:* The most common challenge during implementation of eDNA analysis is contamination. CROM biology staff worked to produce negative controls but regularly experienced positive detections, particularly for HAB species; this is likely attributed to primer contamination in assay reagents. CROM staff have ordered new reagents and are refining assay protocols to ensure the lab produces high-quality data.
- E. *CROM HAB interlaboratory verifications:* The biology lab had planned to send domoic acid and phytoplankton samples to the NOAA NCCOS laboratory in Charleston, SC. Select domoic acid samples from the potential bloom in Kachemak Bay were to be sent for liquid chromatography-mass spectrometry (LC-MS). Low-level detections of domoic acid have the potential to have matrix effects, resulting in potentially less accurate results. LC-MS is highly specific and can identify compounds even at low levels. Although CROM staff have already validated ELISA methods for domoic acid, this is another step in assuring data quality. Select phytoplankton samples were also to be sent to NOAA NCCOS for speciation. Key samples with elevated levels of *Pseudo-nitzschia* spp., *Alexandrium* spp., and/or *Dinophysis* spp., were to be analyzed via scanning electron microscopy (SEM). Phytoplankton consists of numerous groups of unique species, which can be extremely difficult to distinguish species via light microscopy. SEM is an extremely precise method for phytoplankton speciation which results in both accurate speciation



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and detailed images of species present in the samples. Due to the extended government shut down, these additional validations were not completed; program staff will attempt to coordinate the validations in the 2026 reporting period.

2. Products:

Peer-reviewed publications:

This program is in the early stages of relationship building and data collection. Large scale data interpretations and publication processes will begin in future reporting periods.

Reports:

N/A

Popular articles:

National Centers for Coastal Ocean Science. (2025, November 26). NOAA supports paralytic shellfish poisoning toxin sampling in Kachemak Bay. NOAA. Available here: [NOAA Supports Paralytic Shellfish Poisoning Toxin Sampling In Kachemak Bay - NCCOS - National Centers for Coastal Ocean Science](#)

Conferences and workshops: APMI staff presented the CROM Program significance, methods, and data at the following conferences and workshops.

APMI Annual Water Sampler Workshop: Seward, AK, May 7, 2025 (Appendix B)

1. Carl, A. Chugach Regional Resources Commission, Alutiiq Pride Marine Institute, and CROM Overview. Oral presentations.
2. Wheat, J., and Carl, A. Phytoplankton and HABs Shellfish Sampling Methods and Results. Oral presentation.
3. Lloyd, S. Ocean Acidification Sampler Training. Oral presentation.
4. Lloyd, S. Ocean Acidification Results and Impacts. Oral presentation.

Kodiak Area Native Association Water Quality Workshop: Kodiak, AK, June 3-5, 2025.

1. Lloyd, S. Ocean Acidification Sampler Training. Oral presentation.

Pacific Northwest Indigenous Aquaculture Summit: James Tows S’Klallam Tribe, WA, September 15 – 18, 2026.

1. Carl, A. Chugach Regional Ocean Monitoring (CROM) Program Graduate Scholarship Recipient Update. Oral presentation.



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Alaska Marine Science Symposium: Anchorage, AK, January 26-30, 2026. In addition to providing data and edits for the keynote talk and the AHAB poster presentation, CROM staff provided the following poster presentations:

1. Lloyd, S., Carl, A., Wheat, J., Thomas, R., Hales, B., Hubbard, D., Hetrick-Price, W., Hetrick, J. Community-Based Ocean Chemistry Monitoring in the Chugach Region.
2. Thomas, R., Wheat, J., Lloyd, S., Hetrick-Price, W., Carl, A. Effective Early Detection Monitoring of Harmful Algal Blooms and Ocean Acidification with Community Monitoring.
3. Wheat, J., Jarosz, A., Thomas, R., Carl, A. Harmful Algal Monitoring in the Chugach Region to Support Safe Subsistence Harvesting.
4. Carl, A., Branson, M., Causey, D., Briggs, B. Using Environmental DNA to investigate intertidal biodiversity in the Chugach region of Alaska.

Public presentations: CRRC staff presented this project at the following public events (presentations with slides included in Appendix D).

CRRC Southcentral Inter-Tribal Subsistence Cooperative Management Alliance meeting, March 7, 2025

Carl, A. Overview of the Chugach Regional Ocean Monitoring Program. Oral, virtual presentation.

PWSSF Natural History Symposium, Whittier, AK, May 13, 2025

McKnight, R. Introduction to the Chugach Peoples, CRRC Programs, and Land Acknowledgement. Oral presentation. View here: <https://www.youtube.com/watch?v=VZC8JUq77A8>

Stewards of the Bay: Community Connections Series, Seward, AK, February 27, 2025.

McKnight, R., and Carl, A. CROM Program: next steps in molecular monitoring. Oral presentation.

Seward Science Symposium, Seward, AK, October 22, 2025.

Carl, A. Chugach Regional Ocean Monitoring Program Overview. Oral presentation.

Data and/or information products developed:

- A. *Community Reports:* focused reports were developed and distributed to Tribal leadership during the reporting period (December 2025) (Appendix C). Moving forward, communities will receive updated data sheets prior to publication. Additional reports were shared during HAB events to Port Graham and Nanwalek.
- B. *CROM Story Map:* The IGAP Environmental Coordinator has completed and will continue to update the CROM Story Map. The story map highlights each Chugach Community, has a timeline of the CROM program, and gives a brief review of data produced through the program.



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The Story Map will be presented to communities during travel scheduled for the next reporting period and CROM staff will work to integrate community input and add the story map into the APMI Website and develop the site with input from community members. The story map can be viewed here: [Ocean Water Quality Monitoring in the Chugach Region](#).

- C. *Harmful Algal Bloom Monitoring Video*: Through CROM and CRRC's EPA IGAP funding, program staff worked with Bjørn Olsen to develop a promotional video describing the HABs in the region and subsistence harvesting resources. Program staff are finalizing video edits, and the video will be available in the next reporting period.

Data sets and associated metadata:

Complete datasets for all activities under this award are available to the public online at the Alutiiq Pride Marine Institute website (www.alutiiqprideak.org/crom). Data sets and metadata are updated quarterly on the Axiom Research Workspace and are available to the public through the AOOS Gulf of Alaska Data Portal (<https://gulf-of-alaska.portal.aos.org/#metadata/7825fa08-4bc8-4032-836c-1b3f08fcd0a1/project/files>).

Additional Products not listed above:

CRRC updated its Alutiiq Pride quarterly newsletter format. The newsletters produced during the reporting period included general program updates and partner projects supported in part by CROM. Full newsletters are shared via social media and are available to the public through the CRRC website (<https://crrcalaska.org/category/the-alutiiq-pride-newsletter/>)

3. Coordination and Collaboration:

The Alaska SeaLife Center or Prince William Sound Science Center:

- A. *Community Organized Restoration and Learning (CORaL) Network*: Through CRRC's involvement with then CORaL Network (Project Number 25220400), CRRC has kept the Alaska SeaLife Center (ASLC) or Prince William Sound Science Center (PWSSC) apprised of efforts of this project. Efforts to share data will continue. See more details under *the EVOSTC Education and Outreach Program* section.
- B. *ASLC*: CROM staff are in early stages of partnership building with ASLC staff. The CROM Program staff toured the facility, including laboratory spaces, on March 21, 2025, to discuss potential areas of collaboration.

EVOSTC Long-Term Research and Monitoring Program:

N/A

EVOSTC Mariculture Projects:

Samples and environmental data for this project were collected near kelp farm test sites funded by EVOSTC (Project Number 25220300), Prince William Sound Kelp Mariculture Development for Habitat



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Restoration and Local Economy. The CROM Chemistry Lab supports this project through samples processing and analysis.

EVOSTC Education and Outreach Program

- A. *CORaL Network*: Data from this project are shared through the CORaL Network, an EVOSTC funded collaboration between the ASLC, PWSSC, Center for Alaskan Coastal Studies, Alaska Sea Grant, the Alutiiq Museum and Archaeological Repository (EVOSTC project 25220503), and Chugach Regional Resources Commission (EVOSTC Project Number 25220400). The CORaL Network is designed to build upon existing resources within the spill effected region through collaborative efforts. 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. CROM data and information was shared with the public, Tribes, and researchers through the following CORaL program events:
- i. **Collective Alaska Native Perspective (CANP)**: The CROM Program was featured at the CANP workshop that was hosted in Cordova, February 11-13, 2025. CROM staff participate in CANP to understand impacts from research and western science on Indigenous communities.
 - ii. **Stewards of the Bay Community Connection Series**: CROM discussions were held during these series events on February 27, 2025 (Appendix D).
 - iii. **Seward Science Symposium**: an overview of the CROM program was given at the symposium on October 22, 2025 (Appendix D).
 - iv. **Site visits and school tours**: 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 CRRC's Education and Outreach staff.

Other Collaborations and efforts funded under this program:

- A. *Prince William Sound Stewardship Foundation*: CRRC regularly participated in PWSSF projects and events. The PWSSF hosts their annual summer projects and participants collect blue mussel samples from Prince William Sound which are then frozen and sent to APMI for HAB toxin analysis. The Foundation also hosted the annual Natural History Symposium in Whittier and CRRC staff were invited to start the day with an introduction to the region and highlights from the CROM program.
- B. *Kodiak Area Native Association water quality workshop*: CRRC regularly partnered with other Tribal organizations through the CROM Program. The Chemistry Lab Manager traveled to Kodiak to provide water sampling methods.
- C. *Research Collaborations*: Through the CROM Biology Lab and Mariculture Department, staff engaged in various research projects and partnerships through the University of Alaska System. CROM staff supported numerous research collaborations with the University of Alaska



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Anchorage. Projects are ongoing and include saxitoxin exposures on blue mussels and hydrocarbon exposures on bivalves. Additionally, the program has supported student learning using the detection of HAB toxins in marine birds from die-offs in the Aleutian Islands. CROM staff also collaborated in ongoing research with the University of Alaska Fairbanks and the EPSCOR Interface of Change project; CROM biology staff collected soft shell and butter clam samples throughout different live stages in a hatchery setting for genomic sequencing. The CROM Biology Lab was used to store and prepare extractions that were sent out of state for sequencing.

- D. *Northern Gulf of Alaska LTER Cruise with UAF (September 15-24, 2025)*: the CROM Lab Technician participated in water sampling using Conductivity, Temperature and Depth Instruments.
- E. *Cordova Culture week*: Staff from CRRC's Education Department attended the Mt. St. Ellis Culture week and conducted educational activities with the students regarding the CROM Program.
- F. *Seward High School Collaborations*:
 - i. **National Ocean Science Bowl (NOSB)**: CROM staff were asked to assist with a field trip with Seward High School's NOSB teams aboard the UAF R/V Nanuq into Resurrection Bay. The Chemistry Lab Manager attended field trips and gave overviews and demonstrations of carbonate chemistry sampling and eDNA field sampling methods. CROM staff worked to support the Seward High School during this event by volunteering as NOSB competition staff.
 - ii. **Phytoplankton microscopy overview (December 1, 2025)**: The Biology Lab Manager was invited to discuss HABs and HAB toxins and brought prefiltered phytoplankton tows for marine biology students to analyze via microscopy.
 - iii. **Ocean Monitoring Overview and Coloring (January 21, 2026)**: The Education and Outreach Director and the Chemistry Lab Manager were invited to present CROM to high school students and brought overview materials and coloring sheets.
- G. *Tribal Youth Training Program*: CRRC's Tribal Fish and Wildlife Department received funds the Administrations for Native Americans to host a youth training program in the region. CROM staff are developing curriculum to be used in the program for the collection of ocean chemistry, phytoplankton, eDNA, and mussel samples. One objective of the program is to increase capacity for community sample collection. Finalized curriculum will be reported in the next reporting period.
- H. *Educational Development*: APMI supported the following students that have used CROM data or resources as part of their educational development:
 - i. **APMI Internships**: APMI hosted a marine science internship for youth (high school, recent high school graduates, and new college students). APMI participated in internship development in collaboration with Seward High School which allowed local students to receive school credit for internship participation. This internship is designed to inform students of the scientific fields represented at APMI and how they relate to marine



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health and cultural continuity. The internship exposes students to three tracks of focus: Mariculture, Chemistry, and Biology, and includes a focused project at the end of the internship. During the 2025 spring semester, CROM supported one high school intern. This student focused her internship project on understanding nitrate and phosphate contents in kelp grown in Prince William Sound (Appendix E).

ii. **University of Alaska Graduate Programs:**

- a. The APMI Mariculture Director is enrolled in the Master of Science program at UAF CFOS using CROM data for her thesis. Her project focuses on saxitoxin congener profiles in various species throughout different seasons and analyzes the correlations between size and toxicity in butter clams.
- b. The APMI Biology Lab Manager was admitted into the University of Alaska Anchorage's Department of Biological Sciences Graduate Program in the fall of 2023 to pursue a Master of Science. Her thesis project focuses on building context and baseline data around intertidal eukaryotic diversity and, in part, produces data related to harmful algal species presence in multiple areas of Resurrection Bay. This project is also working to validate self-preserving filters for field use in rural communities and remote sampling areas to be processed in the CROM eDNA lab.

EVOSTC Individual Projects not listed above:

N/A

Trustee or Management Agencies:

CRRC's APMI staff submit annual holding permits through the Alaska Department of Fish and Game (Appendix F). Blue mussels are collected in bulk in April and are held in a mussel net at the dock where samples are collected. Permits allow community samplers to hold blue mussels on the dock throughout the sampling season.

Indigenous and Local Communities:

CROM was created at the request of CRRC's board, which is 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's Executive Director provided quarterly updates to the CRRC's Board of Directors through distribution of Board packet material. The Executive Director also requested each Board member to encourage their Tribe to increase the participation of their community samplers. The inception of this program was a desire for shellfish safety monitoring in the CRRC communities, as expressed to CRRC staff by Tribal members. Below is a list of outcomes from the CROM program on local and Indigenous communities through engagement that occurred during the reporting period:



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- A. *Local Capacity*: Since its inception, the CROM program has expanded local capacity for marine research through multiple avenues. Staff engaged with students, researchers, educators, Tribal members, environmental organizations, and community members, which has directly strengthened citizen science and collaborative monitoring efforts. The program has been invested in building and maintaining robust laboratory spaces tailored to local needs. CROM laboratories are active partners in long-term monitoring and marine research collaborations, serving as a bridge between community priorities and scientific inquiry. CRRC's CROM staff support environmental research and community food safety and security, particularly in rural Southcentral Alaska. Through these activities, the CROM program is creating sustainable infrastructure and partnerships that ensure long-term monitoring capacity remains rooted in local and Tribal communities.
- B. *In-state collaborations*: The CROM program accepts samples through various partnerships which include Tribes and citizen scientists throughout the region and state (Table 8). These samplers expressed an interest in specific environmental parameters related to their communities. They are responsible for coordinating samples with APMI staff, and the CROM program provides sampling supplies (e.g., reusable bottles, phytoplankton nets, mussel bags, preservatives, data sheets, etc.).

Table 8. Samples received from communities outside of the region

| Participating Entity | Sample Types Received |
|--------------------------------|---|
| The City of Adak | Ocean chemistry |
| Kenaitze Indian Tribe | Ocean chemistry |
| Kodiak Area Native Association | Ocean chemistry |
| Seldovia Village Tribe | Shellfish, phytoplankton tow, ocean chemistry |
| Qawalangin Tribe of Unalaska | Ocean chemistry |

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

N/A



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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 | \$266,046 | \$361,095 | \$370,122 | \$379,375 | \$1,720,332 | \$835,804.02 |
| Travel | \$17,452 | \$35,860 | \$17,452 | \$35,860 | \$17,452 | \$124,076 | \$71,369.90 |
| Contractual | \$23,925 | \$17,725 | \$17,725 | \$22,725 | \$18,925 | \$101,025 | \$86,530.46 |
| Commodities | \$21,150 | \$71,044 | \$17,050 | \$16,800 | \$19,900 | \$145,944 | \$137,931.13 |
| Equipment | \$150,000 | \$35,443 | \$0 | \$0 | \$40,000 | \$225,443 | \$192,903.88 |
| Indirect Costs (report rate here) | \$60,608 | \$59,617 | \$61,668 | \$66,470 | \$64,999 | \$313,362 | \$173,500.27 |
| SUBTOTAL | \$616,830 | \$485,735 | \$474,989 | \$511,977 | \$540,651 | \$2,630,182 | \$1,498,039.66 |
| 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 | |
| <p>INSTRUCTIONS: This summary page provides a five-year overview (FY 22-26) of proposed funding and actual cumulative spending which includes the non-trustee agency and trustee agency worksheets. This Summary Page should automatically populate as the formulas reference the cells in the non-trustee agency and trustee agency worksheets. Please make sure the totals given are correct. The column titled 'Actual Cumulative' will be updated each fiscal year and included in the annual report (include information on the total amount actually spent for all completed years of the project). On the Project Annual Report Form, if any line item exceeds a 10% deviation from the originally-proposed amount; provide detail regarding the reason for the deviation.</p> | | | | | | | |



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6. Figures

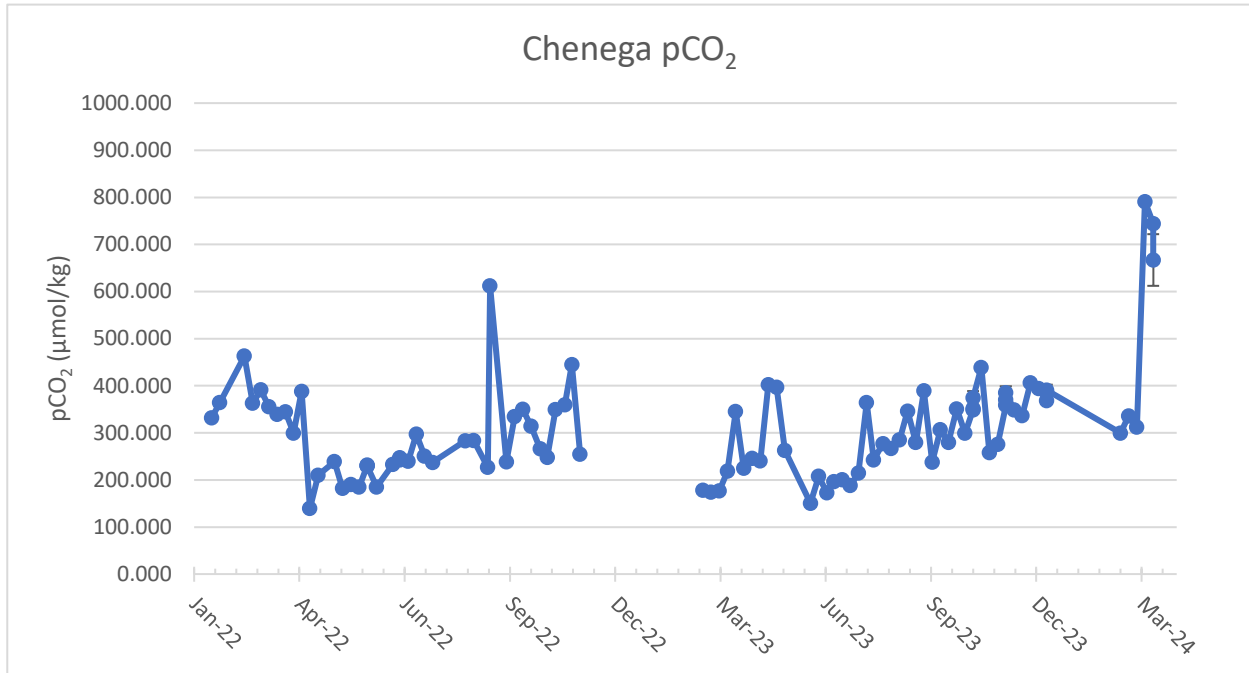


Figure 1. $p\text{CO}_2$ ($\mu\text{mol kg}^{-1}$) at Chenega for samples collected from 01/16/2022 - 3/31/2024. Standard deviation between triplicate and duplicate samples denoted by error bars. The Chenega sample set contains 4 triplicates (mean \pm standard deviation) on 05/29/2022 (230.688 ± 1.225), 06/26/2022 (245.060 ± 2.301), 10/29/2023 (358.246 ± 14.080), and 12/31/2023 (382.504 ± 12.126) and 2 duplicates on 11/26/2023 (372.098 ± 18.753) and 3/31/2024 (705.735 ± 54.751). Error bars are not visible due to small standard deviation values.



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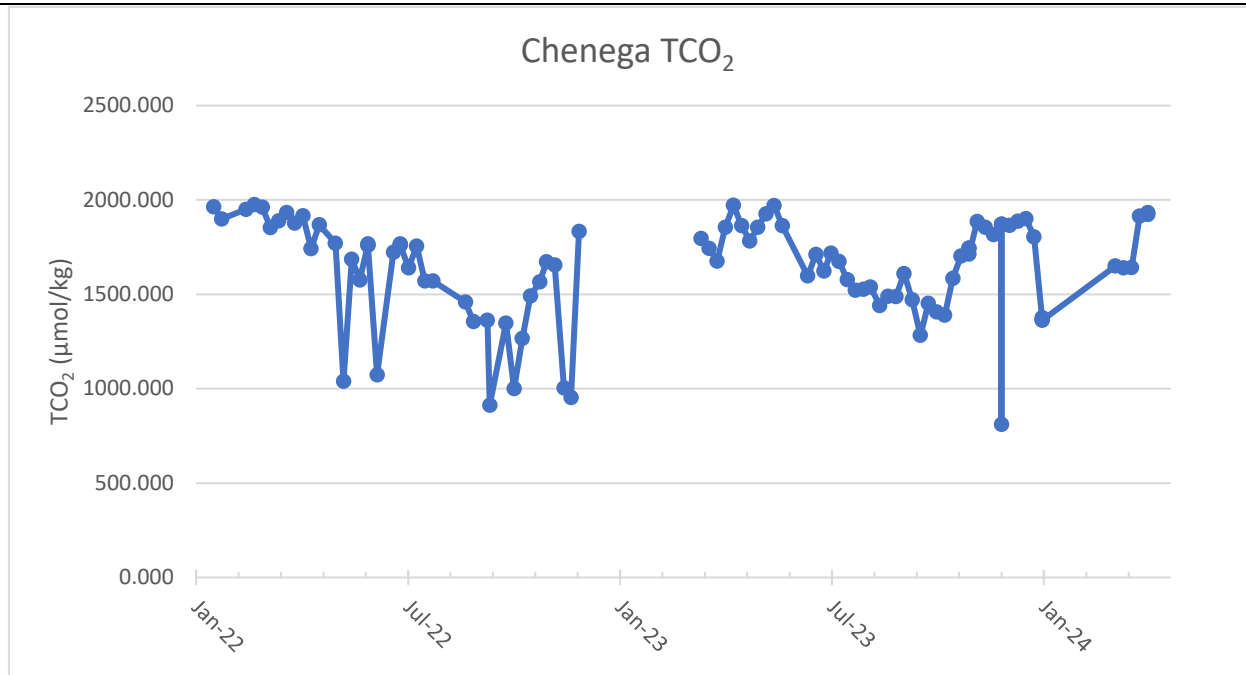


Figure 2. TCO₂ (µmol kg⁻¹) at Chenega for samples collected from 01/16/2022 - 3/31/2024. The Chenega sample set contains 4 triplicates (mean ± standard deviation) on 05/29/2022 (1762.904±4.045), 06/26/2022 (1763.237±2.966), 10/29/2023 (1733.317±18.119), and 12/31/2023 (1367.775±7.290) and 2 duplicates on 11/26/2023 (1870.886±0.740) and 3/31/2024 (1928.235±7.601). Error bars are not visible due to small standard deviation values.



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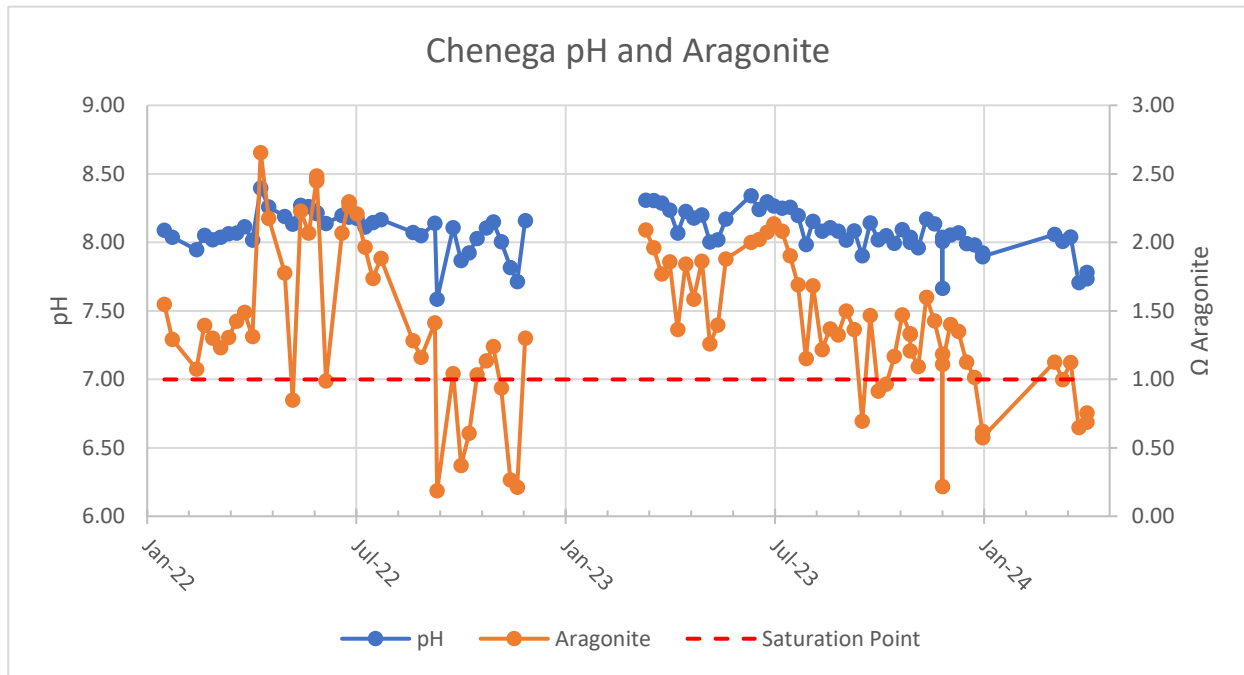


Figure 3. pH and aragonite saturation (no units associated) at Chenega for samples collected from 1/16/2022 - 3/31/2024. The Chenega sample set contains 4 triplicates (mean \pm standard deviation) on 05/29/2022 (8.213 ± 0.003 ; 2.456 ± 0.019), 06/26/2022 (8.189 ± 0.004 ; 2.284 ± 0.019), 10/29/2023 (8.023 ± 0.022 ; 1.147 ± 0.054), and 12/31/2023 (7.906 ± 0.01 ; 60.592 ± 0.026) and 2 duplicates on 11/26/2023 (8.024 ± 0.021 ; 1.291 ± 0.071) and 3/31/2024 (7.758 ± 0.033 ; 0.722 ± 0.049). Standard deviation between triplicate and duplicate samples denoted by error bars.



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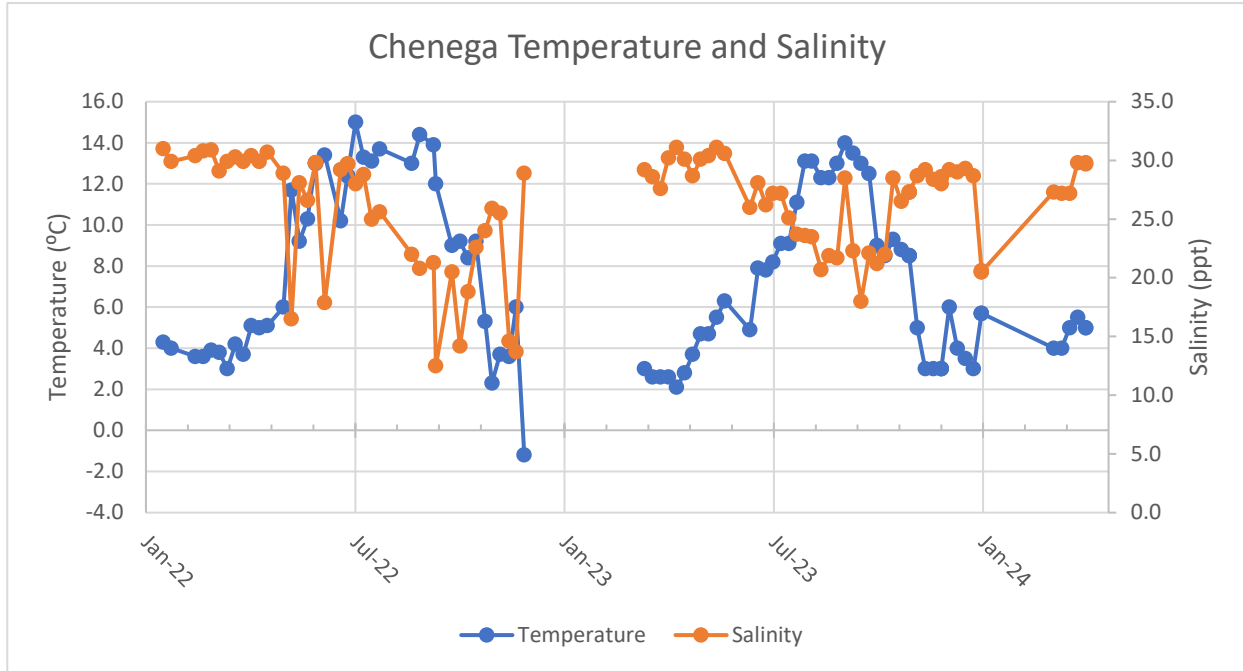


Figure 4. Temperature and salinity at Chenega for samples collected from 01/16/2022 - 3/31/2024. The Chenega sample set contains 4 triplicates (mean \pm standard deviation) on 05/29/2022 (13.0 ± 0.0 ; 29.8 ± 0.0), 06/26/2022 (12.4 ± 0.0 ; 29.7 ± 0.0), 10/29/2023 (8.5 ± 0.0 ; 27.3 ± 0.0), and 12/31/2023 (5.7 ± 0.0 ; 20.5 ± 0.1) and 1 duplicate on 3/31/2024 (5.0 ± 0.0 ; 29.8 ± 0.1). Error bars are not visible due to small standard deviation values.



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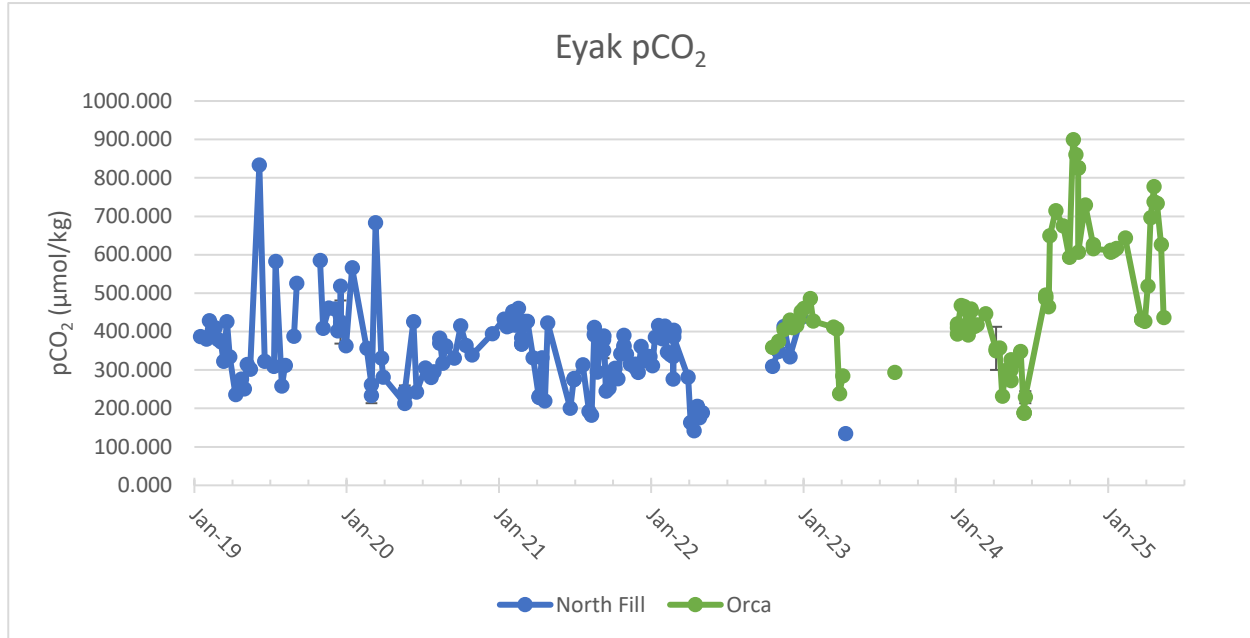


Figure 5. $p\text{CO}_2$ ($\mu\text{mol kg}^{-1}$) at the Eyak sites (which transitioned from North Fill to Orca Bay in 2022) for samples collected from 1/16/2019 - 5/15/2025. The Eyak data set contains 22 triplicates (mean \pm standard deviation) on 12/18/2019 (453.789 ± 55.850), 5/20/2020 (229.628 ± 15.782), 1/27/2021 (424.345 ± 7.189), 2/24/2021 (372.859 ± 9.193), 4/7/2021 (229.780 ± 1.398), 6/30/2021 (275.910 ± 1.478), 8/18/2021 (398.714 ± 10.665), 10/28/2021 (371.422 ± 16.559), 12/16/2021 (325.086 ± 0.704), 1/28/2022 (391.225 ± 8.429), 2/24/2022 (394.786 ± 7.844), 4/22/2022 (197.937 ± 12.126), 01/06/2024 (407.867 ± 13.614), 02/08/2024 (455.233 ± 2.838), 04/08/2024 (352.668 ± 3.261), 05/14/2024 (299.865 ± 27.287), and 06/14/2024 (188.609 ± 0.994), 8/5/2024 (490.303 ± 4.269), 10/22/2024 (752.697 ± 126.638), 11/27/2024 (620.263 ± 5.470), 1/8/2025 (608.390 ± 2.583), and 3/23/2025 (431.567 ± 0.690), and 5 duplicates on 3/1/2020 (247.250 ± 19.937), 8/12/2020 (376.158 ± 8.890), 9/9/2021 (364.811 ± 19.987), 11/24/2021 (310.527 ± 6.323), and 4/22/2025 (757.415 ± 28.518). Standard deviations between triplicate samples denoted by error bars.



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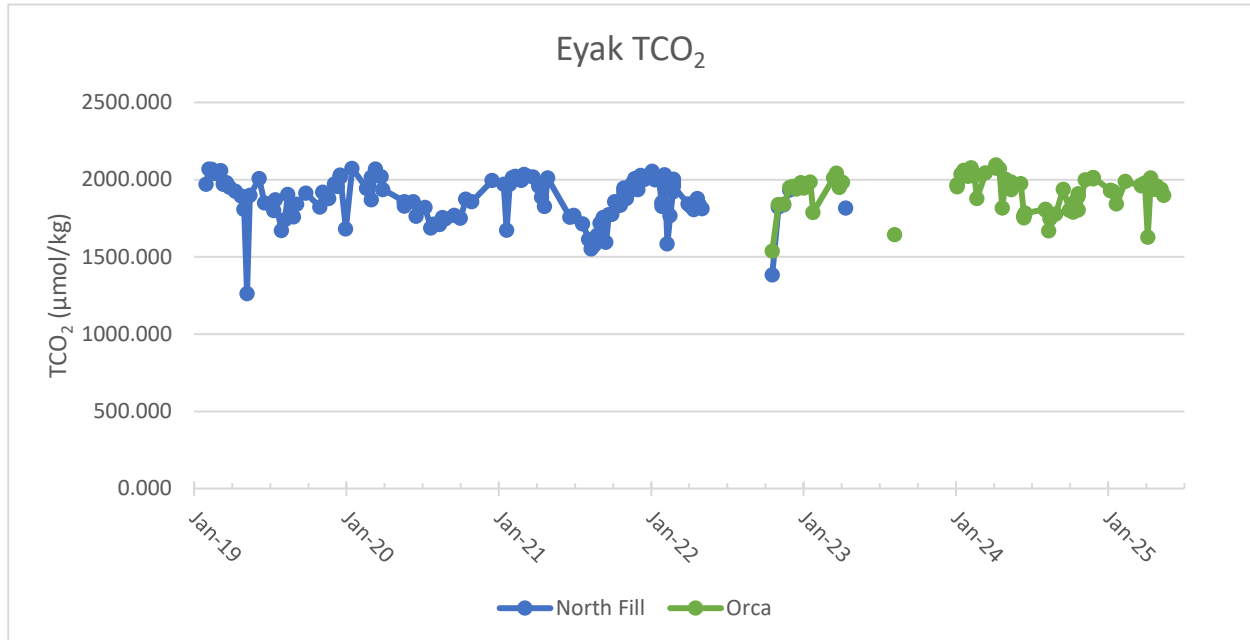


Figure 6. TCO_2 ($\mu\text{mol kg}^{-1}$) at the Eyak sites (which transitioned from North Fill to Orca Bay in 2022) for samples collected from 1/16/2019 - 5/15/2025. The Eyak data set contains 22 triplicates (mean \pm standard deviation) on 12/18/2019 (2021.367 ± 7.944), 5/20/2020 (1847.324 ± 14.960), 1/27/2021 (1973.400 ± 1.791), 2/24/2021 (1998.558 ± 1.237), 4/7/2021 (1967.769 ± 8.773), 6/30/2021 (1765.535 ± 3.940), 8/18/2021 (1583.563 ± 10.126), 10/28/2021 (1930.728 ± 18.098), 12/16/2021 (2009.592 ± 7.742), 1/28/2022 (1841.756 ± 13.911), 2/24/2022 (1970.838 ± 13.299), 4/22/2022 (1870.019 ± 11.420), 01/06/2024 (1962.704 ± 7.140), 02/08/2024 (2071.252 ± 5.798), 04/08/2024 (2087.252 ± 9.791), 05/14/2024 (1967.223 ± 27.0705), 06/14/2024 (1761.615 ± 7.033), 8/5/2024 (1806.580 ± 2.294), 10/22/2024 (1868.700 ± 56.214), 11/27/2024 (2011.657 ± 5.089), 1/8/2025 (1930.637 ± 1.883), and 3/23/2025 (1963.533 ± 2.862), and 5 duplicates on 3/1/2020 (1944.065 ± 103.028), 8/12/2020 (1716.458 ± 8.074), 9/9/2021 (1752.094 ± 5.827), 11/24/2021 (2006.837 ± 0.853), and 4/22/2025 (1940.125 ± 3.076). Standard deviations between triplicate samples denoted by error bars.



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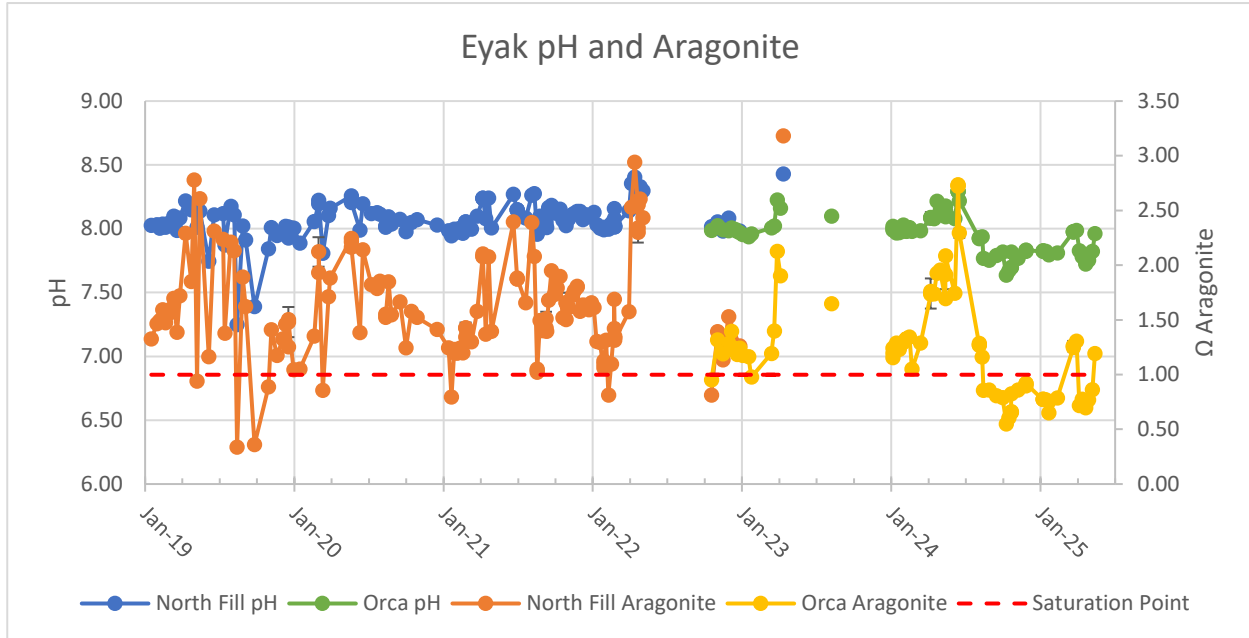


Figure 7. pH and aragonite saturation (no units associated) at the Eyak sites (which transitioned from North Fill to Orca Bay in 2022) for samples collected from 1/16/2019 - 5/15/2025. The Eyak data set contains 22 triplicates (mean \pm standard deviation) on 12/18/2019 (7.981 \pm 0.049; 1.412 \pm 0.138), 5/20/2020 (8.227 \pm 0.027; 2.206 \pm 0.135), 1/27/2021 (7.988 \pm 0.007; 1.212 \pm 0.015), 2/24/2021 (8.047 \pm 0.009; 1.399 \pm 0.048), 4/7/2021 (8.238 \pm 0.002; 2.086 \pm 0.013), 6/30/2021 (8.146 \pm 0.001; 1.875 \pm 0.005), 8/18/2021 (7.965 \pm 0.009; 1.035 \pm 0.015), 10/28/2021 (8.049 \pm 0.022; 1.604 \pm 0.089), 12/16/2021 (8.105 \pm 0.002; 1.619 \pm 0.013), 1/28/2022 (7.999 \pm 0.010; 1.094 \pm 0.031), 2/24/2022 (8.018 \pm 0.006; 1.328 \pm 0.013), 4/22/2022 (8.286 \pm 0.026; 2.397 \pm 0.136), 01/06/2024 (8.002 \pm 0.015; 1.196 \pm 0.044), 02/08/2024 (7.981 \pm 0.001; 1.325 \pm 0.002), 04/08/2024 (8.085 \pm 0.003; 1.745 \pm 0.014), 05/14/2024 (8.135 \pm 0.042; 1.898 \pm 0.196), 06/14/2024 (8.291 \pm 0.001; 2.727 \pm 0.008), 8/5/2024 (7.925 \pm 0.004; 1.273 \pm 0.009), 10/22/2024 (7.737 \pm 0.069; 0.712 \pm 0.096), 11/27/2024 (7.827 \pm 0.005; 0.911 \pm 0.012), 1/8/2025 (7.824 \pm 0.002; 0.773 \pm 0.003), and 3/23/2025 (7.975 \pm 0.001; 1.257 \pm 0.009), and 5 duplicates on 3/1/2020 (8.208 \pm 0.020; 2.026 \pm 0.135), 8/12/2020 (8.015 \pm 0.008; 1.537 \pm 0.021), 9/9/2021 (8.033 \pm 0.022; 1.469 \pm 0.061), 11/24/2021 (8.129 \pm 0.007; 1.803 \pm 0.006), and 4/22/2025 (7.732 \pm 0.016; 0.712 \pm 0.024). Standard deviations between triplicate samples denoted by error bars.



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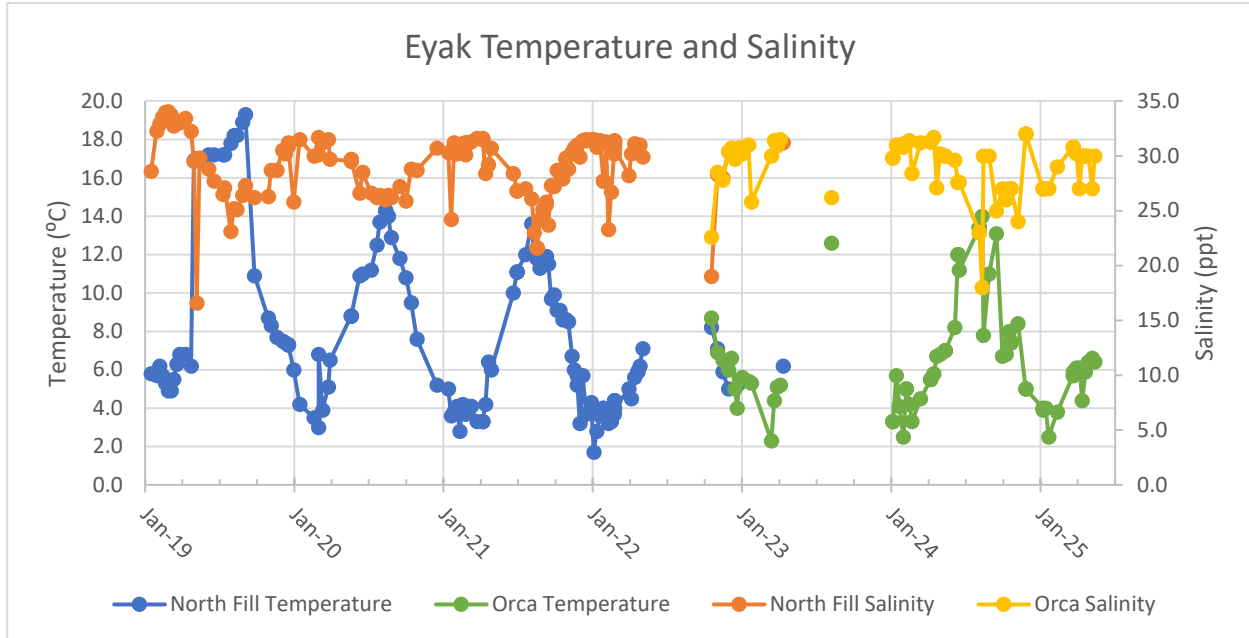


Figure 8. Temperature and salinity at the Eyak sites (which transitioned from North Fill to Orca Bay in 2022) for samples collected from 1/16/2019 - 5/15/2025. The Eyak data set contains 22 triplicates (mean \pm standard deviation) for temperature and salinity on 12/18/2019 (7.3 \pm 0.0; 31.0 \pm 0.2), 5/20/2020 (8.8 \pm 0.0; 29.6 \pm 0.1), 1/27/2021 (3.8 \pm 0.0; 30.7 \pm 0.4), 2/24/2021 (3.7 \pm 0.0; 30.8 \pm 0.6), 4/7/2021 (3.3 \pm 0.0; 31.5 \pm 0.1), 6/30/2021 (11.1 \pm 0.0; 26.8 \pm 0.0), 8/18/2021 (11.8 \pm 0.0; 21.6 \pm 0.0), 10/28/2021 (8.6 \pm 0.0; 29.7 \pm 0.1), 12/16/2021 (3.7 \pm 0.0; 31.4 \pm 0.1), 1/28/2022 (4.0 \pm 0.0; 27.7 \pm 0.0), 2/24/2022 (4.3 \pm 0.4; 31.1 \pm 0.2), 4/22/2022 (5.9 \pm 0.0; 31.0 \pm 0.1), 01/06/2024 (3.3 \pm 0.0; 29.8 \pm 0.0), 02/08/2024 (5.0 \pm 0.0; 31.2 \pm 0.1), 04/08/2024 (5.5 \pm 0.0; 31.3 \pm 0.0), 05/14/2024 (7.0 \pm 0.0; 31.3 \pm 0.0) 06/14/2024 (7.0 \pm 0.0; 30.0 \pm 0.0), 8/5/2024 (13.4 \pm 0.0; 23.0 \pm 0.0), 10/22/2024 (7.4 \pm 0.1; 27.0 \pm 0.0), 11/27/2024 (5.0 \pm 0.0; 32.0 \pm 0.0), 1/8/2025 (4.0 \pm 0.1; 27.0 \pm 0.0), and 3/23/2025 (5.8 \pm 0.1; 30.8 \pm 0.0), and 5 duplicates on 3/1/2020 (4.9 \pm 2.7; 30.9 \pm 1.1), 8/12/2020 (14.3 \pm 0.0; 26.3 \pm 0.1), 9/9/2021 (11.9 \pm 0.0; 25.6 \pm 0.1), 11/24/2021 (5.5 \pm 0.4; 31.0 \pm 0.1), and 4/22/2025 (5.9 \pm 0.0; 30.0 \pm 0.0). Error bars are not visible due to small standard deviation values.



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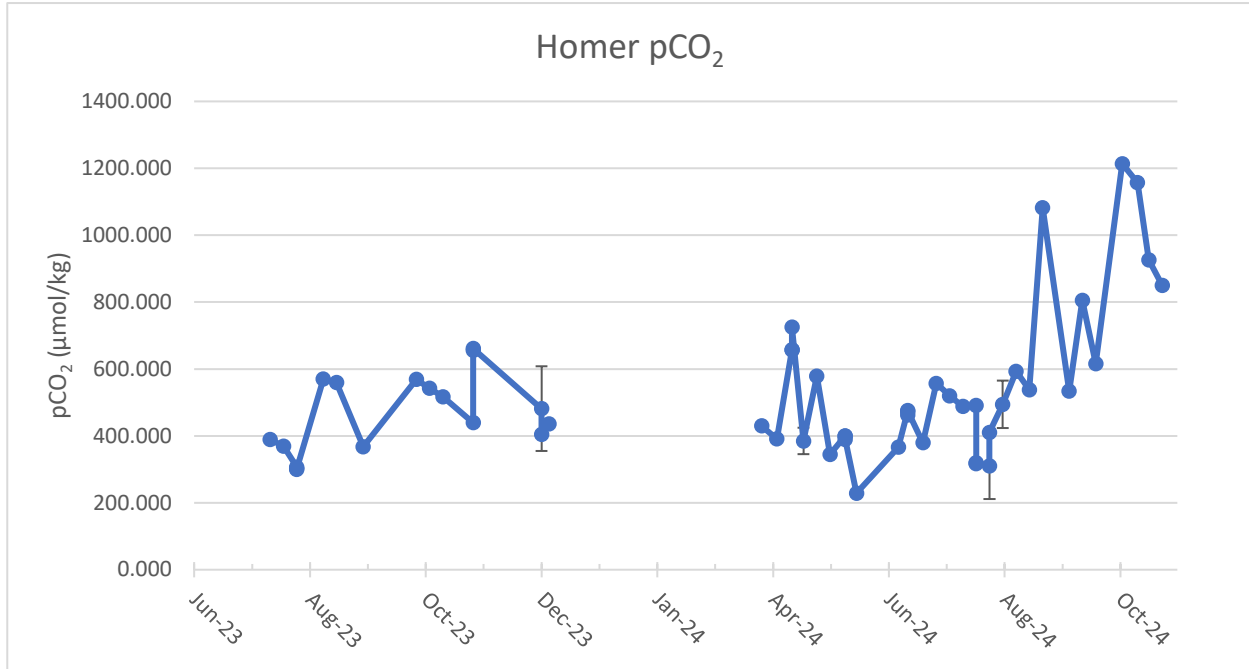


Figure 9. pCO₂ (µmol kg⁻¹) at Homer site for samples collected from 07/11/2023 - 10/23/2024. The Homer data set contains 6 triplicates (mean ± standard deviation) on 07/25/2023 (303.048±3.418), 10/26/2023 (585.516±39.259), 04/11/2024 (680.285±126.453), 05/09/2024 (396.342±54.705), 06/11/2024 (470.653±7.116), and 07/17/2024 (376.053± 99.869), and 2 duplicates on 12/01/2023 (442.832±6.144) and 07/24/2024 (360.655±70.605). Standard deviation between triplicate and duplicate samples denoted by error bars.



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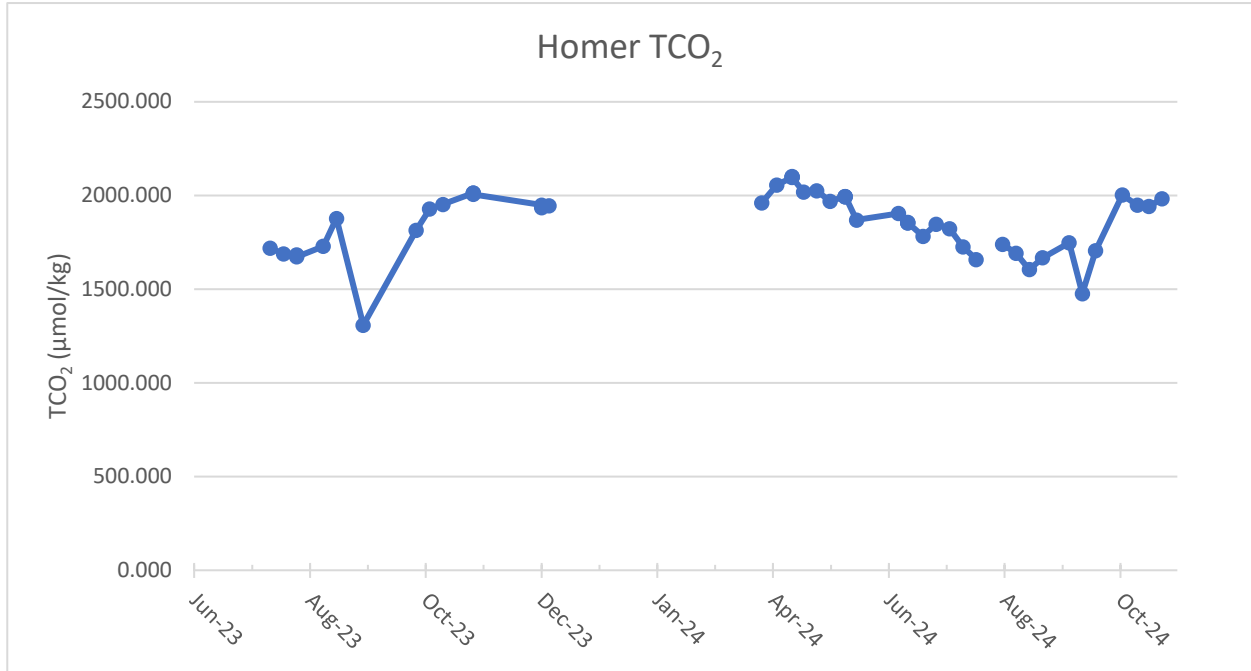


Figure 10. TCO₂ (µmol kg⁻¹) at Homer site for samples collected from 07/11/2023 – 10/23/2024. The Homer data set contains 5 triplicates (mean ± standard deviation) on 07/25/2023 (1677.977±5.093), 10/26/2023 (2010.839±3.955), 04/11/2024 (2098.175±2.351), 05/09/2024 (1993.803±1.009), and 06/11/2024 (1855.080±1.254) and 1 duplicate on 12/01/2023 (1942.513±9.715). Error bars are not visible due to small standard deviation values.



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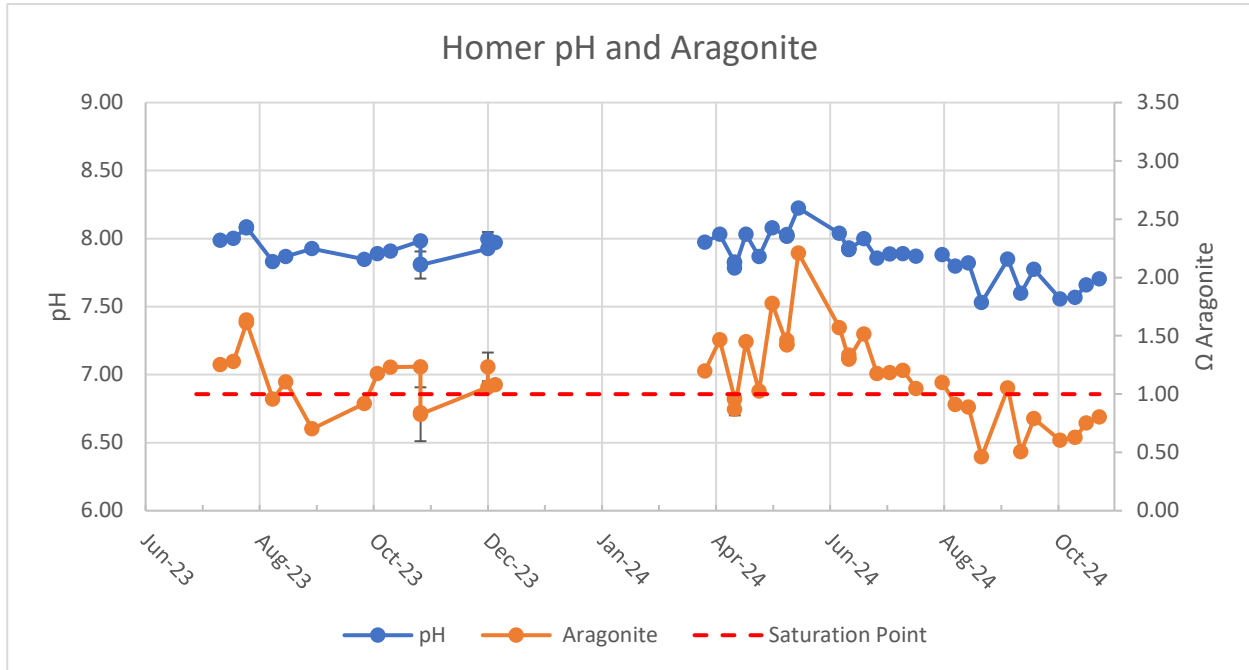


Figure 11. pH and aragonite saturation (no units associated) at Homer site for samples collected from 07/11/2023 – 10/23/2024. The Homer data set contains 5 triplicates (mean \pm standard deviation) for pH and aragonite on 07/25/2023 (8.082 ± 0.004 ; 1.621 ± 0.012), 10/26/2023 (7.866 ± 0.100 ; 0.967 ± 0.231), 04/11/2024 (7.811 ± 0.025 ; 0.929 ± 0.051), 05/09/2024 (8.021 ± 0.007 ; 1.436 ± 0.0221), and 06/11/2024 (7.923 ± 0.01 ; 1.312 ± 0.020), and 1 duplicate for pH and aragonite on 12/01/2023 (7.962 ± 0.050 ; 1.147 ± 0.123). Standard deviation between triplicate and duplicate samples denoted by error bars.



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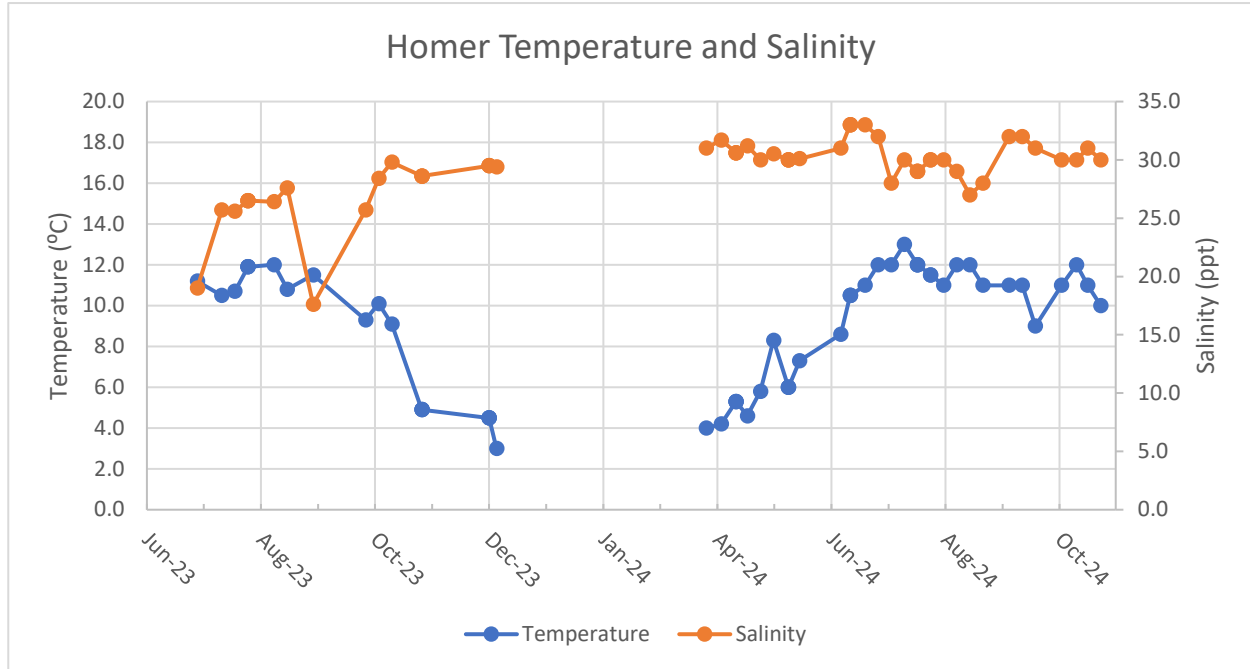


Figure 12. Temperature and salinity at Homer site for samples collected from 07/11/2023 – 10/23/2024. The Homer data set contains 3 triplicates (mean \pm standard deviation) for temperature and salinity on 07/25/2023 (11.0 \pm 0.0; 26.5 \pm 0.0), 10/26/2023 (4.9 \pm 0.0; 28.6 \pm 0.0), 04/11/2024 (5.3 \pm 0.0; 28.6 \pm 0.0), and 05/09/2024 (6.0 \pm 0.0; 30.0 \pm 0.0), 06/11/2024 (10.5 \pm 0.0; 33.0 \pm 0.0), 07/17/2024 (12.0 \pm 0.0; 29.0 \pm 0.0) and 2 duplicates for temperature and salinity on 12/01/2023 (4.5 \pm 0.0; 29.5 \pm 0.0) and 07/24/2024 (11.5 \pm 0.0; 30.0 \pm 0.0). Error bars are not visible due to small standard deviation values.



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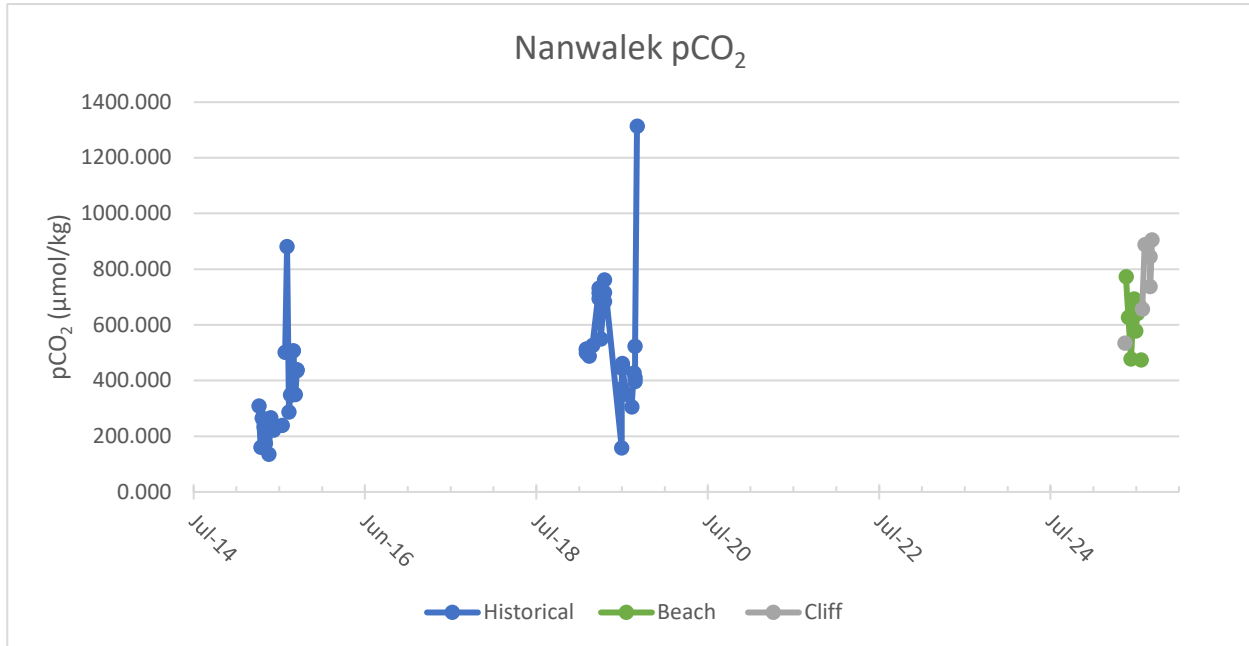


Figure 13. pCO₂ (μmol kg⁻¹) at the Nanwalek site for samples collected from 4/5/2015 to 9/7/2025. The Nanwalek data set contains 6 triplicates and 2 duplicates (mean ± standard deviation) on 9/14/2015 (436.709 ± 1.941); 1/30/2019 (507.233 ± 8.007); 3/26/2019 (713.106 ± 18.757); 4/18/2019 (719.728 ± 38.498); 7/2/2019 (452.332 ± 9.575); 8/26/2019 (442.521 ± 69.252); 7/28/2025 (728.030 ± 102.530); 8/30/2025 (790.325 ± 75.144). Error bars are not visible due to small standard deviation values.



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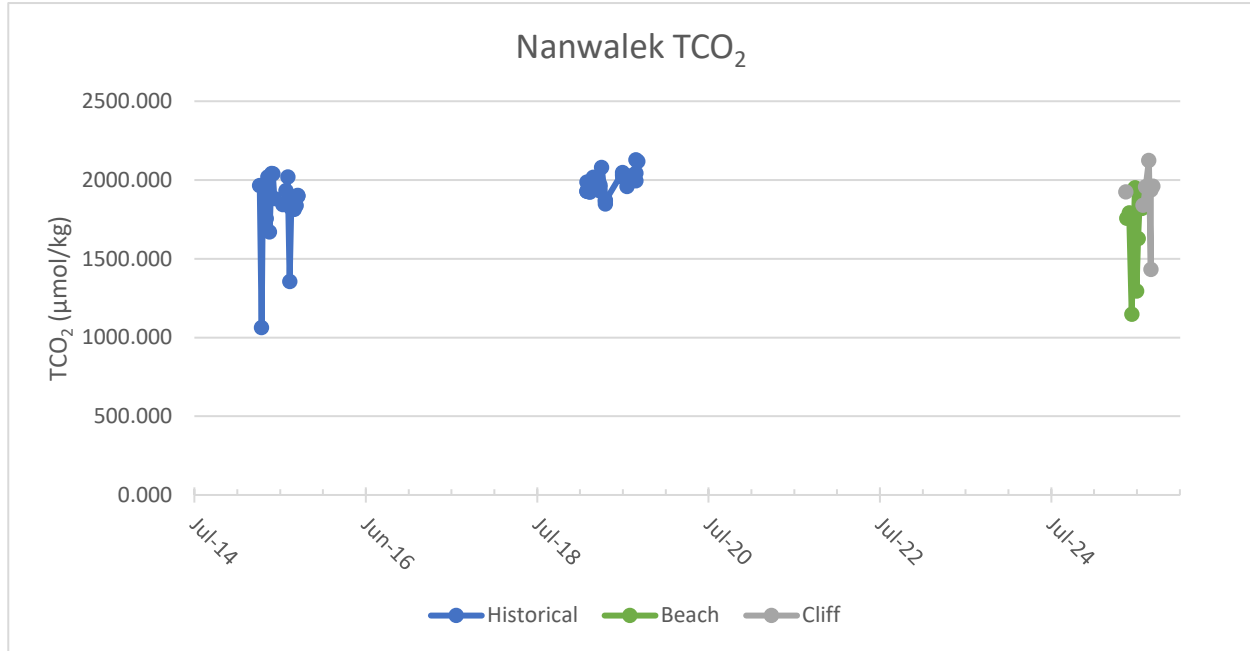


Figure 14. TCO₂ ($\mu\text{mol kg}^{-1}$) at the Nanwalek site for samples collected from 4/5/2015 to 9/7/2025. The Nanwalek data set contains 6 triplicates and 3 duplicates (mean \pm standard deviation) on 9/14/2015 (1900.551 ± 3.424); 1/30/2019 (1949.016 ± 33.556); 3/26/2019 (1952.181 ± 19.510); 4/18/2019 (1863.304 ± 12.146); 7/2/2019 (2027.039 ± 9.614); 8/26/2019 (2056.710 ± 67.192); 7/23/2025 (1863.715 ± 60.323); 7/28/2025 (1814.324 ± 38.916); 8/30/2025 (1685.624 ± 356.988). Error bars are not visible due to small standard deviation values.



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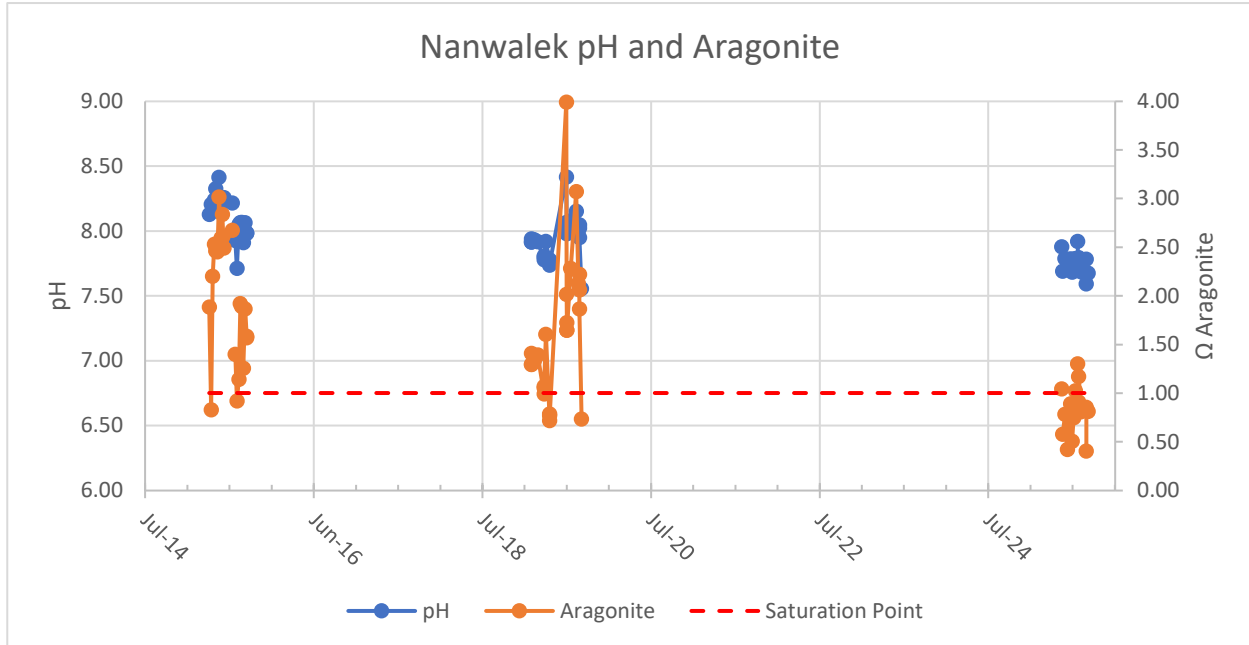


Figure 15. pH and aragonite saturation at the Nanwalek site for samples collected from 4/5/2015 to 9/7/2025. The Nanwalek data set contains 6 triplicates and 2 duplicates (mean \pm standard deviation) on 9/14/2015 (7.984 ± 0.002 ; 1.578 ± 0.008); 1/30/2019 (7.923 ± 0.014 ; 1.335 ± 0.065); 3/26/2019 (7.795 ± 0.014 ; 1.039 ± 0.041); 4/18/2019 (7.761 ± 0.021 ; 0.759 ± 0.036); 7/2/2019 (7.988 ± 0.010 ; 1.673 ± 0.045); 8/26/2019 (8.007 ± 0.051 ; 2.051 ± 0.178); 7/28/2025 (7.747 ± 0.069 ; 1.042 ± 0.184); 8/30/2025 (7.688 ± 0.134 ; 0.632 ± 0.316). Error bars are not visible due to small standard deviation values.



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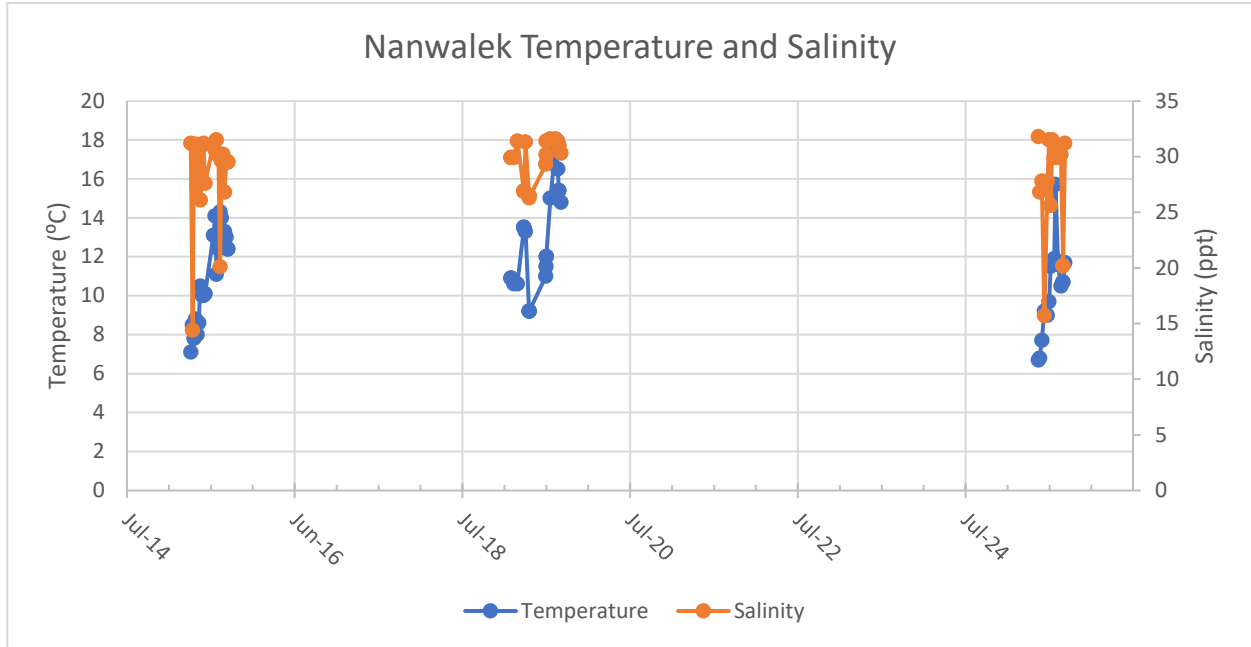


Figure 16. Temperature and salinity data at the Nanwalek site for samples collected from 4/5/2015 to 9/7/2025. Temperature and salinity data at this location were not taken in triplicate.



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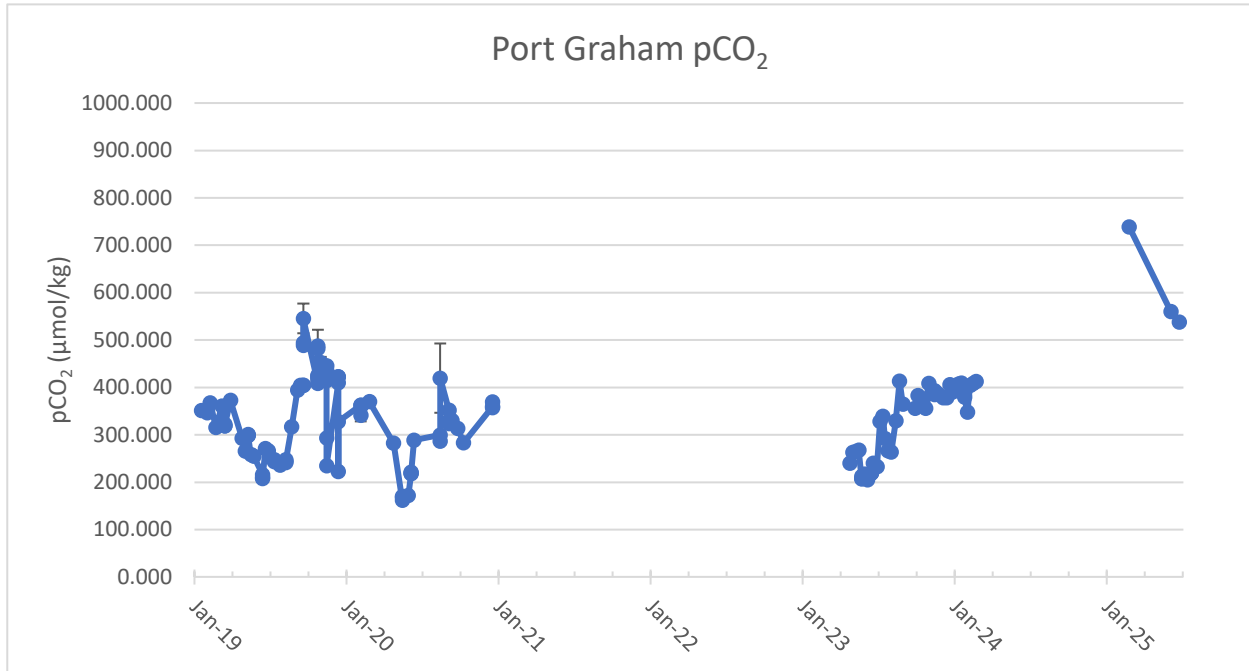


Figure 17. pCO₂ (µmol kg⁻¹) at the Port Graham site for samples collected from 01/18/2019 – 06/25/2025. The Port Graham sample set includes 21 triplicates (mean ± standard deviation) on 02/01/2019 (349.524±3.251), 03/15/2019 (320.036±2.220), 05/10/2019 (299.388±1.075), 06/14/2019 (211.509±4.123), 07/12/2019 (245.381±1.755), 08/09/2019 (244.369±2.828), 09/20/2019 (404.473±0.088), 10/25/2019 (416.298±7.175), 11/01/2019 (439.113±12.083), 11/15/2019 (431.892±6.976), 12/13/2019 (418.283±7.035), 02/05/2020 (355.220±12.318), 05/15/2020 (166.648±4.211), 06/05/2020 (219.406±1.435), 08/14/2020 (335.304±73.353), 09/04/2020 (335.361±14.819), 12/18/2020 (362.171±6.438), 05/24/2023 (209.199±2.892), 06/16/2023 (219.181±0.116), 11/15/2023 (389.770±4.055), and 01/19/2024 (403.065±7.179). Standard deviation between triplicate samples denoted by error bars.



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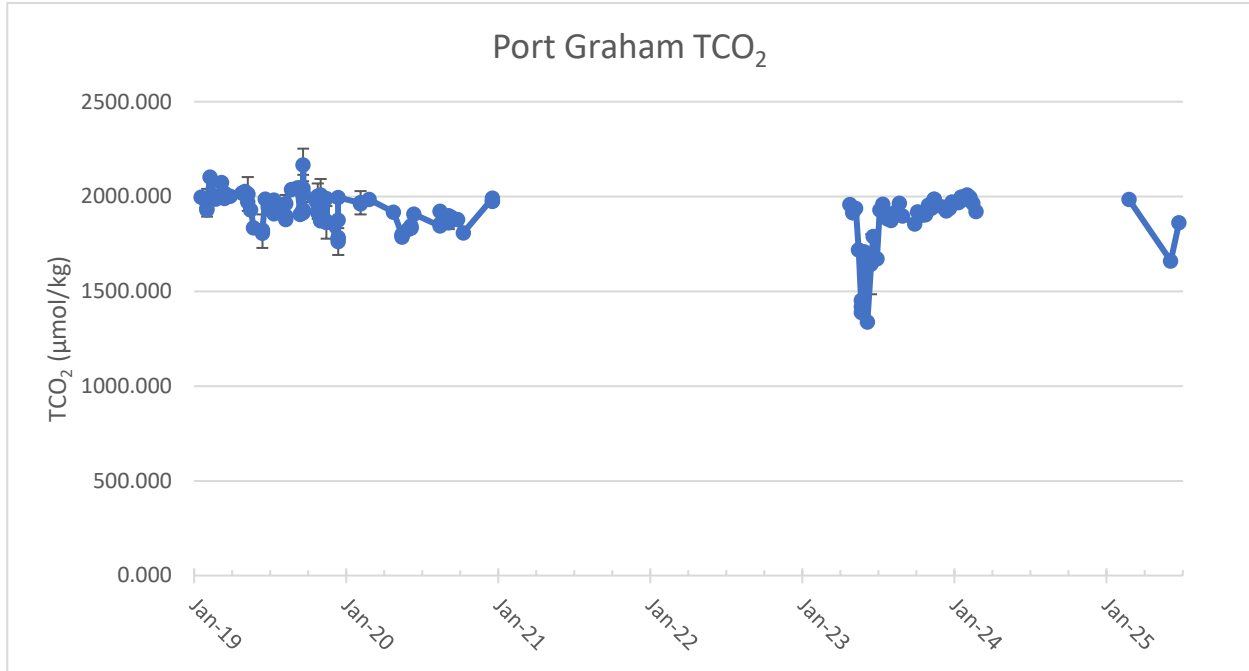


Figure 18. TCO₂ (μmol kg⁻¹) at the Port Graham site for samples collected from 01/18/2019 – 06/25/2025. The Port Graham sample set includes 21 triplicates (mean ± standard deviation) on 02/01/2019 (1944.787±20.094), 03/15/2019 (2007.943±16.161), 05/10/2019 (1999.763±23.824), 06/14/2019 (1815.341±8.181), 07/12/2019 (1950.495±37.284), 08/09/2019 (1913.384±44.090), 09/20/2019 (2003.974±11.427), 10/25/2019 (1921.299±4.858), 11/01/2019 (1948.489±69.672), 11/15/2019 (1908.983±1.351), 12/13/2019 (1774.593±11.023), 02/05/2020 (1964.955±2.800), 05/15/2020 (1792.891±7.089), 06/05/2020 (1837.981±6.261), 08/14/2020 (1874.419±42.752), 09/04/2020 (1882.354±18.695), 12/18/2020 (1981.141±9.066), 05/24/2023 (1420.559±32.145), 06/16/2023 (1648.896±7.311), 11/15/2023 (1982.762±5.644), and 01/19/2024 (1991.462±10.120). Standard deviation between triplicate samples denoted by error bar.



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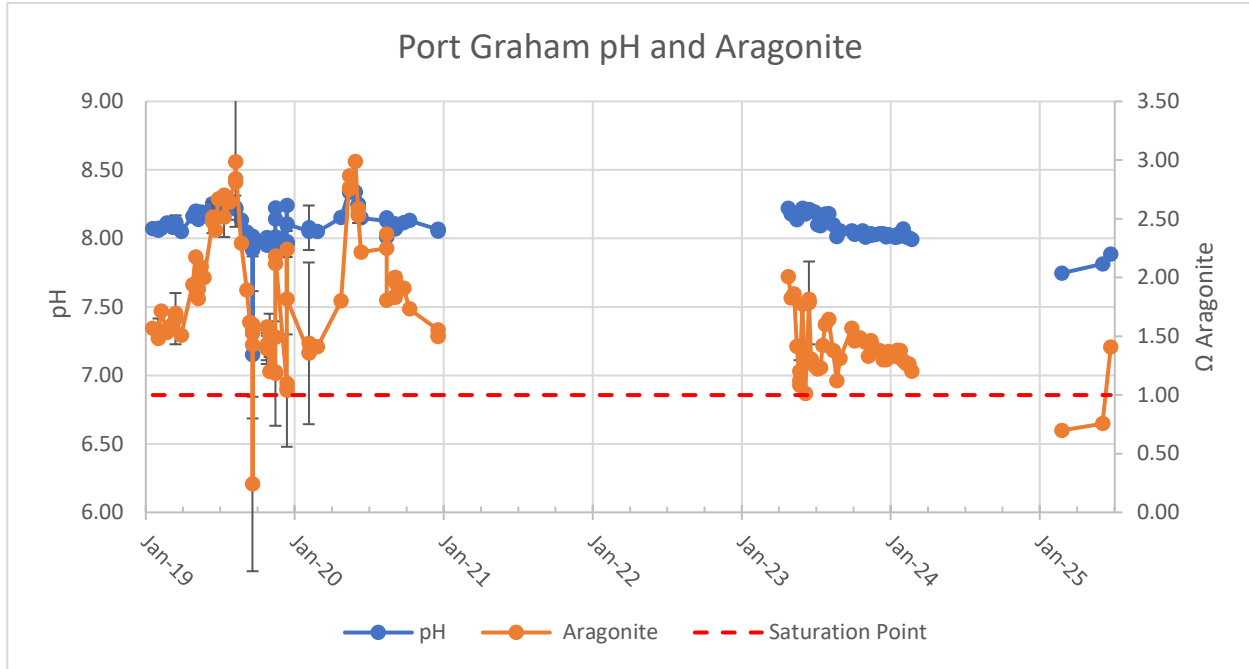


Figure 19. pH and aragonite saturation (no units associated) at the Port Graham site for samples collected from 01/18/2019 – 06/25/2025. The Port Graham sample set includes 21 triplicates (mean \pm standard deviation) for pH and aragonite on 02/01/2019 (8.064 ± 0.007 ; 1.506 ± 0.039), 03/15/2019 (8.114 ± 0.003 ; 1.673 ± 0.023), 05/10/2019 (8.144 ± 0.006 ; 1.875 ± 0.048), 06/14/2019 (8.247 ± 0.006 ; 2.498 ± 0.023), 07/12/2019 (8.216 ± 0.004 ; 2.625 ± 0.100), 08/09/2019 (8.218 ± 0.005 ; 2.879 ± 0.092), 09/20/2019 (8.012 ± 0.002 ; 1.586 ± 0.018), 10/25/2019 (7.995 ± 0.007 ; 1.414 ± 0.013), 11/01/2019 (7.979 ± 0.013 ; 1.385 ± 0.165), 11/15/2019 (7.959 ± 0.008 ; 1.189 ± 0.011), 12/13/2019 (7.965 ± 0.009 ; 1.065 ± 0.031), 02/05/2020 (8.059 ± 0.015 ; 1.385 ± 0.048), 05/15/2020 (8.343 ± 0.010 ; 2.794 ± 0.062), 06/05/2020 (8.246 ± 0.004 ; 2.553 ± 0.031), 08/14/2020 (8.095 ± 0.076 ; 2.141 ± 0.297), 09/04/2020 (8.088 ± 0.018 ; 1.930 ± 0.090), 12/18/2020 (8.060 ± 0.008 ; 1.520 ± 0.030), 05/24/2023 (8.179 ± 0.010 ; 1.135 ± 0.060), 06/16/2023 (8.208 ± 0.002 ; 1.797 ± 0.015), 11/15/2023 (8.027 ± 0.006 ; 1.444 ± 0.019), and 01/19/2024 (8.016 ± 0.008 ; 1.348 ± 0.029). Standard deviation between triplicate samples denoted by error bars.



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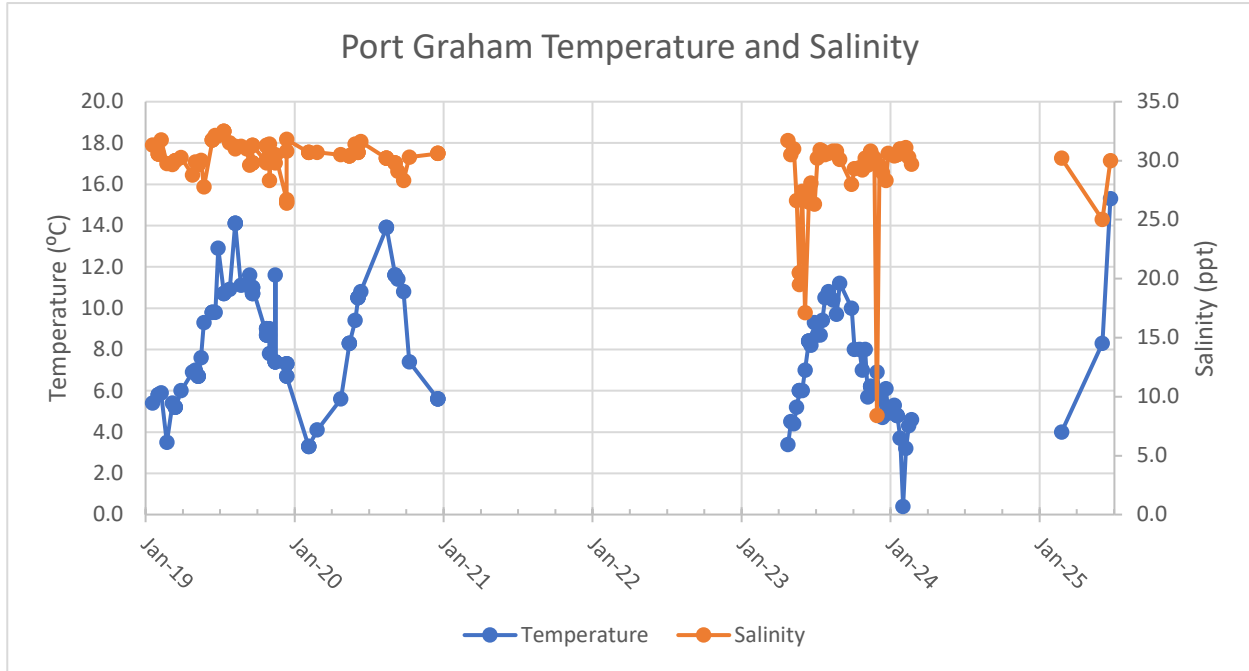


Figure 20. Temperature and salinity at the Port Graham site for samples collected from 01/18/2019 – 06/25/2025. The Port Graham sample set includes 21 triplicates (mean \pm standard deviation) for temperature and salinity on 02/01/2019 (5.80 \pm 0.0; 30.5 \pm 0.0), 03/15/2019 (5.2 \pm 0.0; 30.0 \pm 0.0), 05/10/2019 (6.7 \pm 0.0; 29.7 \pm 0.0), 06/14/2019 (9.8 \pm 0.0; 31.7 \pm 0.0), 07/12/2019 (10.7 \pm 0.0; 32.5 \pm 0.0), 08/09/2019 (14.1 \pm 0.0; 31.1 \pm 0.1), 09/20/2019 (10.7 \pm 0.0; 29.8 \pm 0.0), 10/25/2019 (8.7 \pm 0.0; 30.0 \pm 0.2), 11/01/2019 (8.5 \pm 0.6; 30.1 \pm 1.6), 11/15/2019 (7.4 \pm 0.0; 30.4 \pm 0.0), 12/13/2019 (7.3 \pm 0.0; 26.5 \pm 0.1), 02/05/2020 (3.3 \pm 0.0; 30.7 \pm 0.0), 05/15/2020 (8.3 \pm 0.0; 30.4 \pm 0.0), 06/05/2020 (10.5 \pm 0.0; 30.7 \pm 0.0), 08/14/2020 (13.9 \pm 0.0; 30.2 \pm 0.0), 09/04/2020 (11.6 \pm 0.0; 29.8 \pm 0.0), 12/18/2020 (5.6 \pm 0.0; 30.6 \pm 0.0), 05/24/2023 (6.0 \pm 0.0; 20.2 \pm 0.6), 06/16/2023 (8.4 \pm 0.0; 26.5 \pm 0.1), 11/15/2023 (6.2 \pm 0.0; 30.7 \pm 0.1), and 01/19/2024 (4.8 \pm 0.0; 30.5 \pm 0.0). Standard deviation between triplicate samples denoted by error bars.



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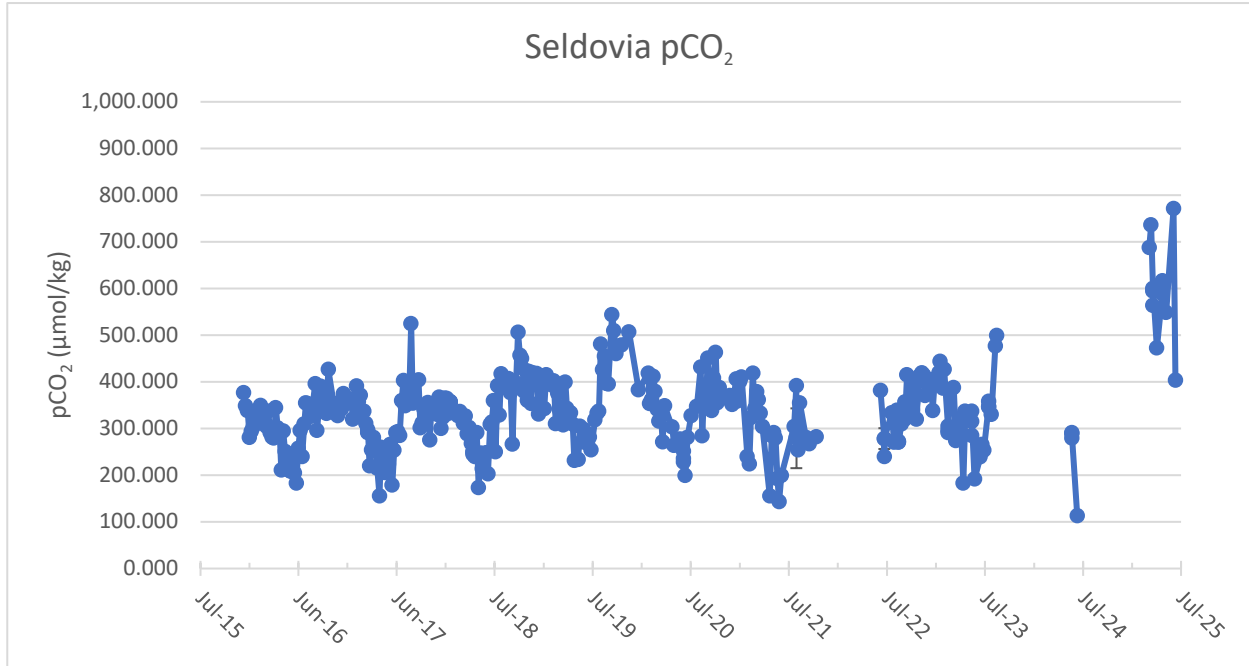


Figure 21. $p\text{CO}_2$ ($\mu\text{mol kg}^{-1}$) at the Seldovia Village Tribe site for samples collected from 12/10/2015 - 06/11/2024. The Seldovia sample site includes 20 triplicates (mean \pm standard deviation) on 03/16/2017 (293.679 \pm 3.003), 05/18/2017 (206.469 \pm 0.933), 06/08/2017 (263.667 \pm 1.717), 01/18/2018 (356.249 \pm 0.859), 04/12/2018 (247.732 \pm 3.030), 06/05/2020 (238.209 \pm 11.811), 07/30/2021 (317.589 \pm 64.156), 06/23/2022 (265.147 \pm 22.255), 08/15/2022 (271.105 \pm 1.104), 09/08/2022 (333.570 \pm 20.255), 10/06/2022 (344.140 \pm 10.031), 11/01/2022 (411.215 \pm 1.444), 12/16/2022 (399.736 \pm 2.891), 02/16/2023 (297.167 \pm 6.999), 03/16/2023 (285.561 \pm 10.375), 04/20/2023 (332.595 \pm 5.166), 05/15/2023 (312.101 \pm 25.999), 06/15/2023 (242.281 \pm 3.351), 07/17/2023 (350.099 \pm 6.621), 05/22/2024 (286.416 \pm 6.095), and 03/20/2025 (585.737 \pm 19.576). Standard deviation between triplicate samples denoted by error bars.



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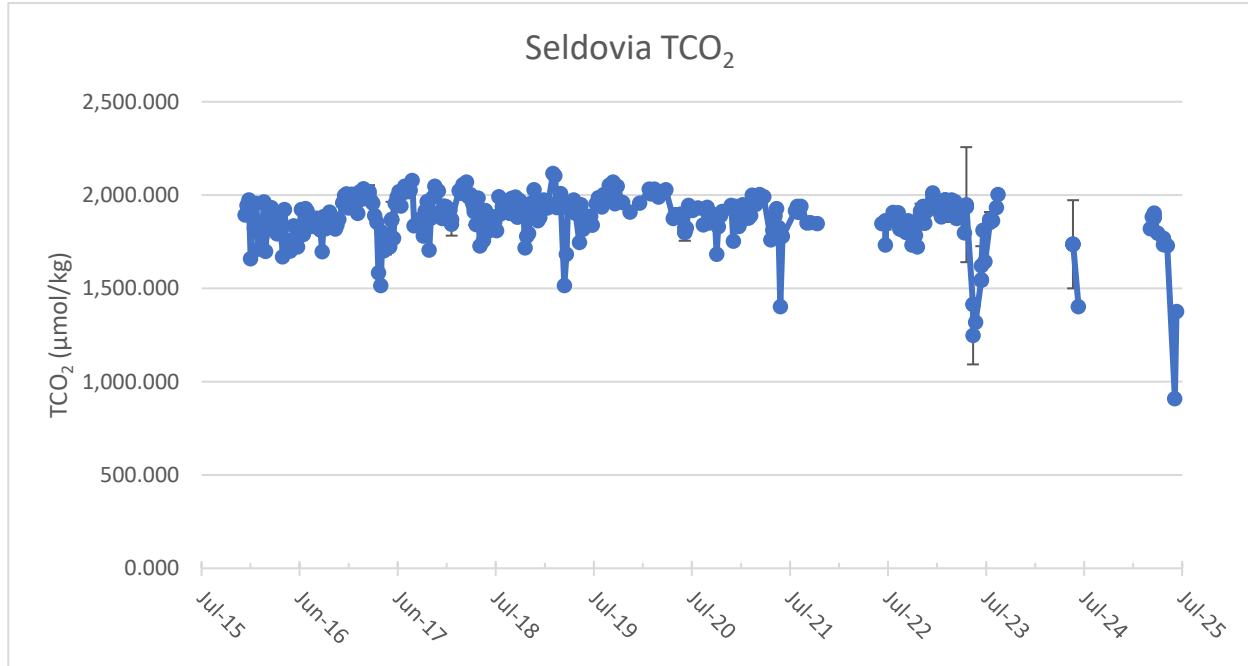


Figure 22. TCO_2 ($\mu\text{mol kg}^{-1}$) at the Seldovia Village Tribe site for samples collected from 12/10/2015 - 06/11/2024. The Seldovia sample site includes 21 triplicates (mean \pm standard deviation) on 03/16/2017 (2016.195 \pm 6.832), 05/18/2017 (1716.653 \pm 3.052), 06/08/2017 (1869.489 \pm 2.445), 01/18/2018 (1861.388 \pm 11.775), 04/12/2018 (1924.729 \pm 11.775), 06/05/2020 (1809.757 \pm 13.744), 07/30/2021 (1924.446 \pm 14.841), 06/23/2022 (1814.554 \pm 70.774), 08/15/2022 (1829.141 \pm 8.886), 09/08/2022 (1812.917 \pm 10.311), (10/06/2022 (1818.381 \pm 13.625), 11/01/2022 (1908.553 \pm 8.785), 12/16/2022 (1999.475 \pm 16.707), 02/16/2023 (1904.623 \pm 5.917), 03/16/2023 (1900.030 \pm 21.272), 04/20/2023 (1942.581 \pm 5.962), 05/15/2023 (1359.796 \pm 96.295), 06/15/2023 (1571.444 \pm 44.157), 07/17/2023 (1862.493 \pm 8.593), 05/22/2024 (1737.717 \pm 0.960), and 03/20/2025 (1890.107 \pm 13.448). Standard deviation between triplicate samples denoted by error bars.



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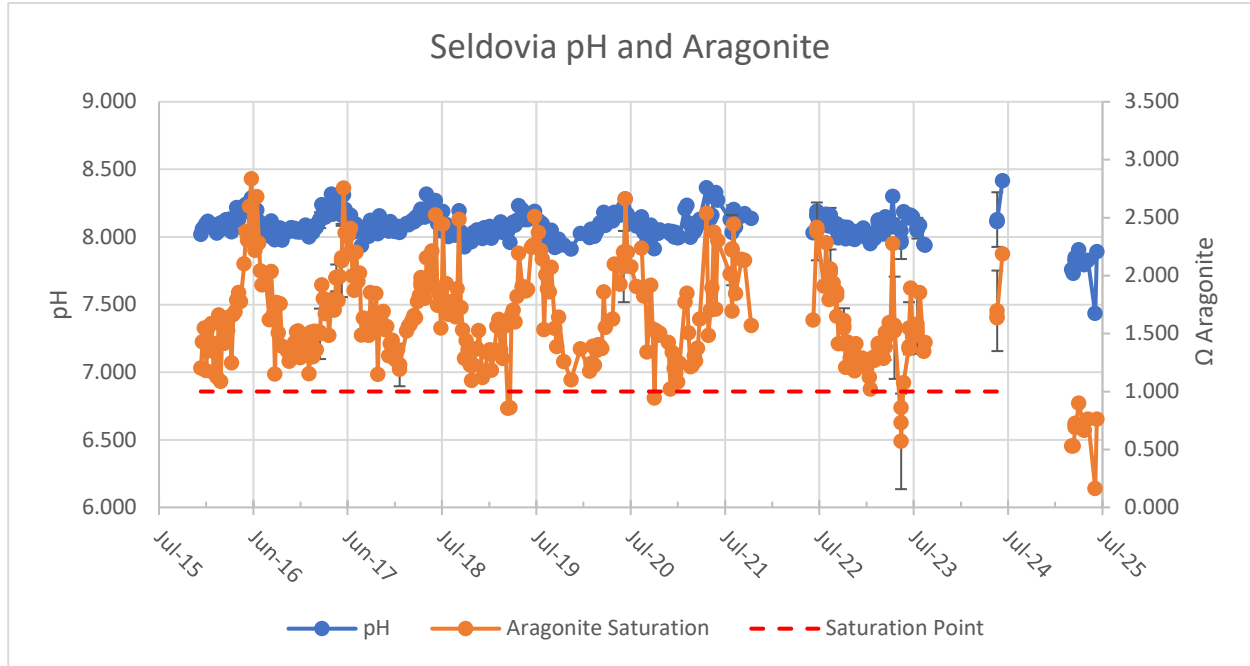


Figure 23. pH and aragonite saturation (no units associated) at the Seldovia Village Tribe site for samples collected from 12/10/2015 - 06/11/2024. The Seldovia sample site includes 21 triplicates (mean \pm standard deviation) for pH and aragonite saturation on 03/16/2017 (8.127 ± 0.003 ; 1.505 ± 0.006), 05/18/2017 (8.244 ± 0.001 ; 1.983 ± 0.002), 06/08/2017 (8.163 ± 0.003 ; 2.138 ± 0.013) 01/18/2018 (8.039 ± 0.021), 04/12/2018 (8.200 ± 0.006 ; 1.945 ± 0.036), 06/05/2020 (8.206 ± 0.017 ; 2.139 ± 0.063), 07/30/2021 (8.121 ± 0.076 ; 2.049 ± 0.307), 6/23/2022 (8.168 ± 0.019 ; 2.400 ± 0.018), 08/15/2022 (8.079 ± 0.002 ; 2.044 ± 0.015), 09/08/2022 (8.079 ± 0.027 ; 1.778 ± 0.112), 10/06/2022 (8.063 ± 0.011 ; 1.576 ± 0.033), 11/01/2022 (7.995 ± 0.001 ; 1.288 ± 0.006), 12/16/2022 (8.015 ± 0.003 ; 1.266 ± 0.019), 02/16/2023 (8.116 ± 0.011 ; 1.382 ± 0.042), 03/16/2023 (8.130 ± 0.017 ; 1.447 ± 0.062) 04/20/2023 (8.083 ± 0.006 ; 1.549 ± 0.025), 05/15/2023 (7.992 ± 0.045 ; 0.721 ± 0.145), 06/15/2023 (8.151 ± 0.011 ; 1.434 ± 0.098), 07/17/2023 (8.057 ± 0.008 ; 1.549 ± 0.032), 05/22/2024 (8.119 ± 0.009 ; 1.660 ± 0.032), and 03/20/2025 (7.835 ± 0.013 ; 0.708 ± 0.019). Standard deviation between triplicate samples denoted by error bars.



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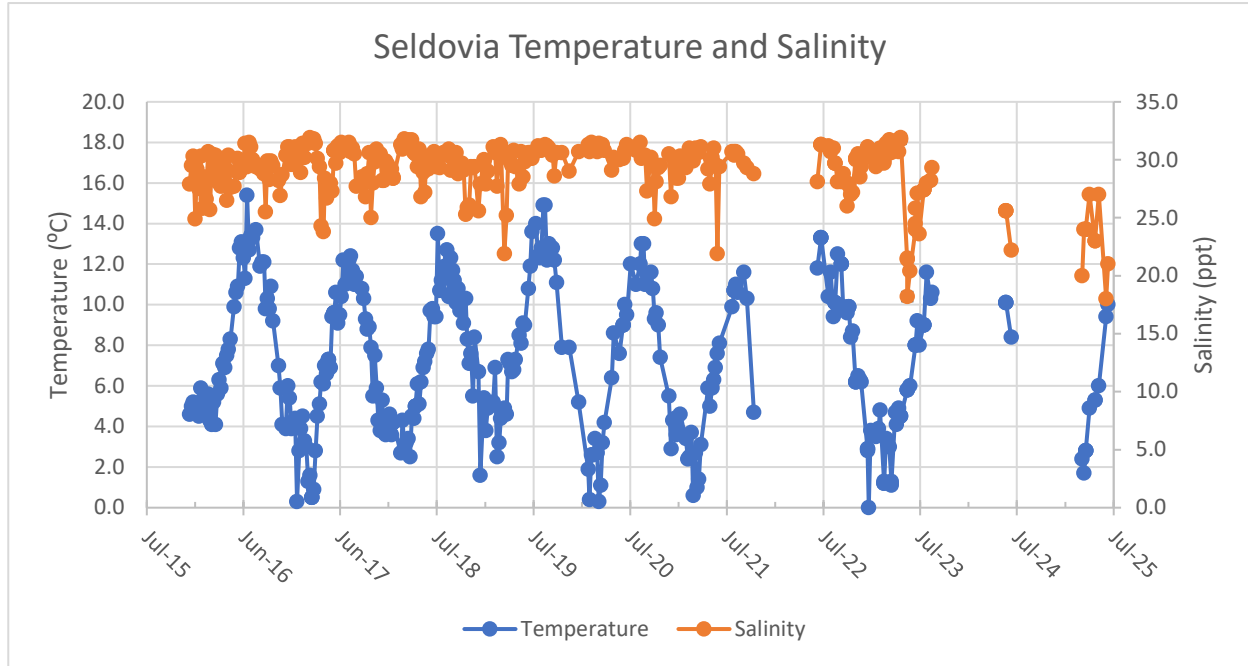


Figure 24. Temperature and salinity at the Seldovia Village Tribe site for samples collected from 12/10/2015 - 06/11/2024. The Seldovia sample site includes 21 triplicates (mean \pm standard deviation) for temperature and salinity on 03/16/2017 (0.5 ± 0.0 ; 31.6 ± 0.1), 05/18/2017 (7.3 ± 0.0 ; 27.7 ± 0.1), 06/08/2017 (9.6 ± 0.0 ; 30.8 ± 0.0), 01/18/2018 (4.2 ± 0.0 ; 28.4 ± 0.1), 04/12/2018 (5.0 ± 0.0 ; 30.6 ± 0.1), 06/05/2020 (9.0 ± 0.0 ; 30.2 ± 0.1), 07/30/2021 (10.7 ± 0.0 ; 30.6 ± 0.1), 06/23/2022 (13.3 ± 0.0 ; 31.3 ± 0.0), 08/15/2022 (10.1 ± 0.0 ; 29.7 ± 0.0), 09/08/2022 (12.0 ± 0.0 ; 28.2 ± 0.1), 10/06/2022 (9.9 ± 0.0 ; 27.9 ± 0.0), 11/01/2022 (6.2 ± 0.0 ; 30.1 ± 0.1), 12/16/2022 (2.9 ± 0.1 ; 31.0 ± 0.0), 02/16/2023 (1.2 ± 0.1 ; 29.8 ± 0.1), 03/16/2023 (1.2 ± 0.1 ; 30.7 ± 0.1), 04/20/2023 (4.5 ± 0.0 ; 31.8 ± 0.1), 05/15/2023 (5.8 ± 0.0 ; 20.4 ± 1.9), 06/15/2023 (8.0 ± 0.0 ; 24.8 ± 0.9), 07/17/2023 (9.0 ± 0.0 ; 27.4 ± 0.0), 05/22/2024 (10.1 ± 0.0 ; 25.6 ± 0.0), and 03/20/2025 (2.8 ± 0.0 ; 24 ± 0.0). Standard deviation between triplicate samples denoted by error bars.



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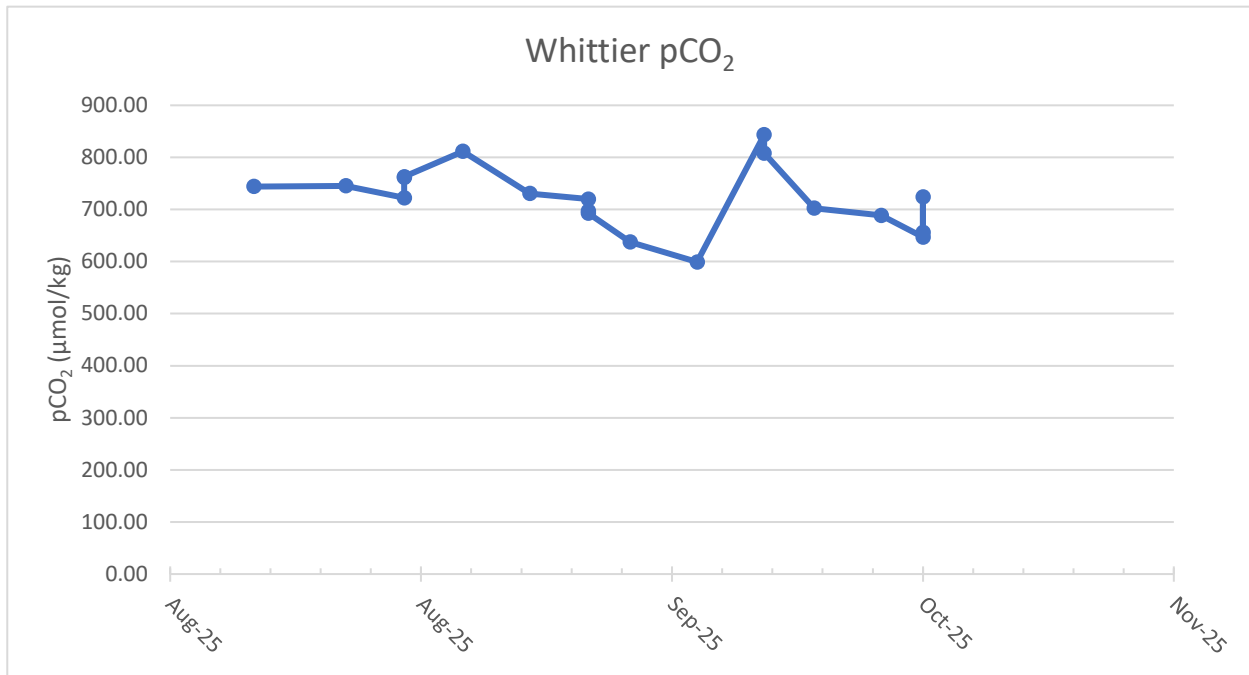


Figure 25. pCO₂ (µmol kg⁻¹) at the Whittier site for samples collected from 8/11/2025 to 10/30/2025. The Whittier data set contains 3 triplicates and 1 duplicate (mean ± standard deviation) on 8/29/2025 (748.87 ± 23.10); 9/20/2025 (703.15 ± 14.70); 10/11/2025 (825.69 ± 24.98); 10/30/2025 (675.57 ± 42.14). Error bars are not visible due to small standard deviation values.



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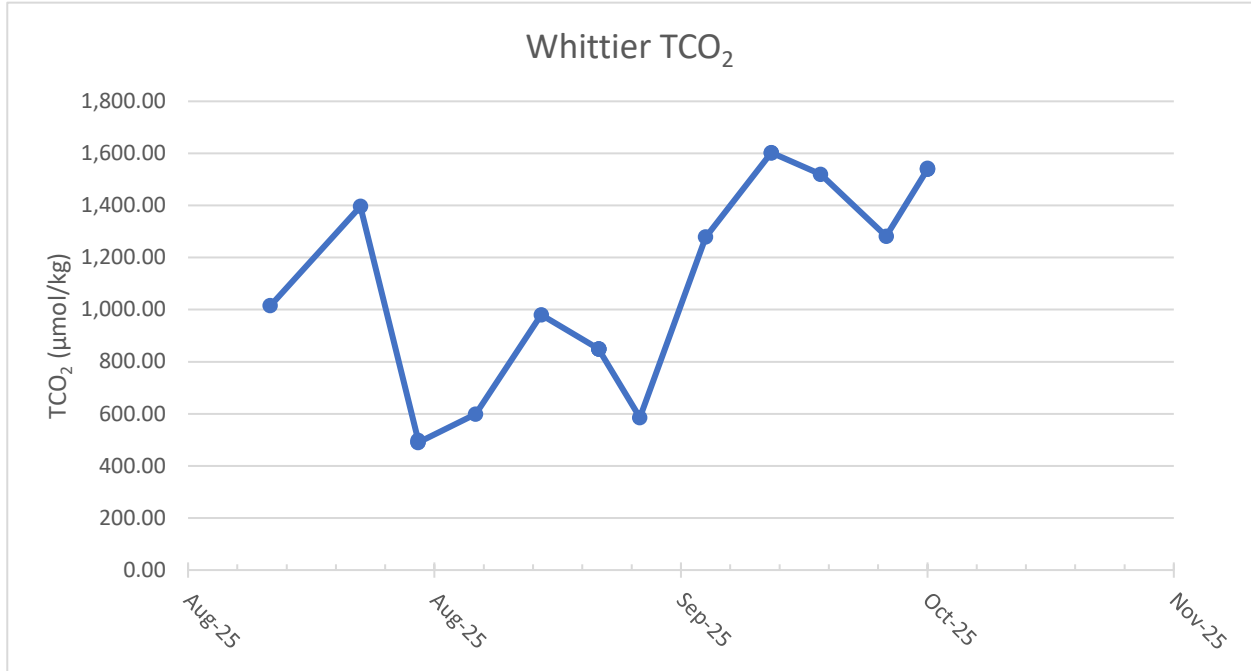


Figure 26. TCO₂ (µmol kg⁻¹) at the Whittier site for samples collected from 8/11/2025 to 10/30/2025. The Whittier data set contains 3 triplicates and 1 duplicate (mean ± standard deviation) on 8/29/2025 (493.294 ± 4.133); 9/20/2025 (848.483 ± 0.531); 10/11/2025 (1602.165 ± 0.672); 10/30/2025 (1540.350 ± 2.051). Error bars are not visible due to small standard deviation values.



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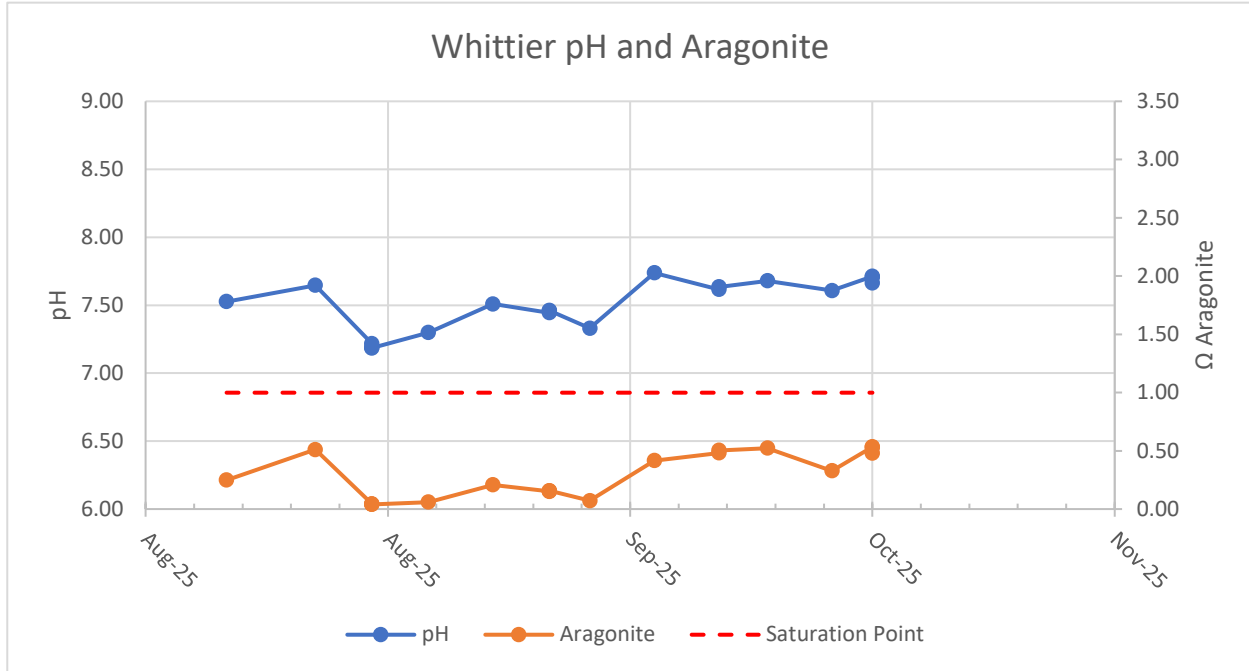


Figure 27. pH and aragonite saturation at the Whittier site for samples collected from 8/11/2025 to 10/30/2025. The Whittier data set contains 3 triplicates and 1 duplicate (mean \pm standard deviation) on 8/29/2025 (7.197 ± 0.0183 ; 0.043 ± 0.00231); 9/20/2025 (7.455 ± 0.00929 ; 0.156 ± 0.00346); 10/11/2025 (7.626 ± 0.0134 ; 0.494 ± 0.0156); 10/30/2025 (7.694 ± 0.0262 ; 0.515 ± 0.0298). Error bars are not visible due to small standard deviation values.



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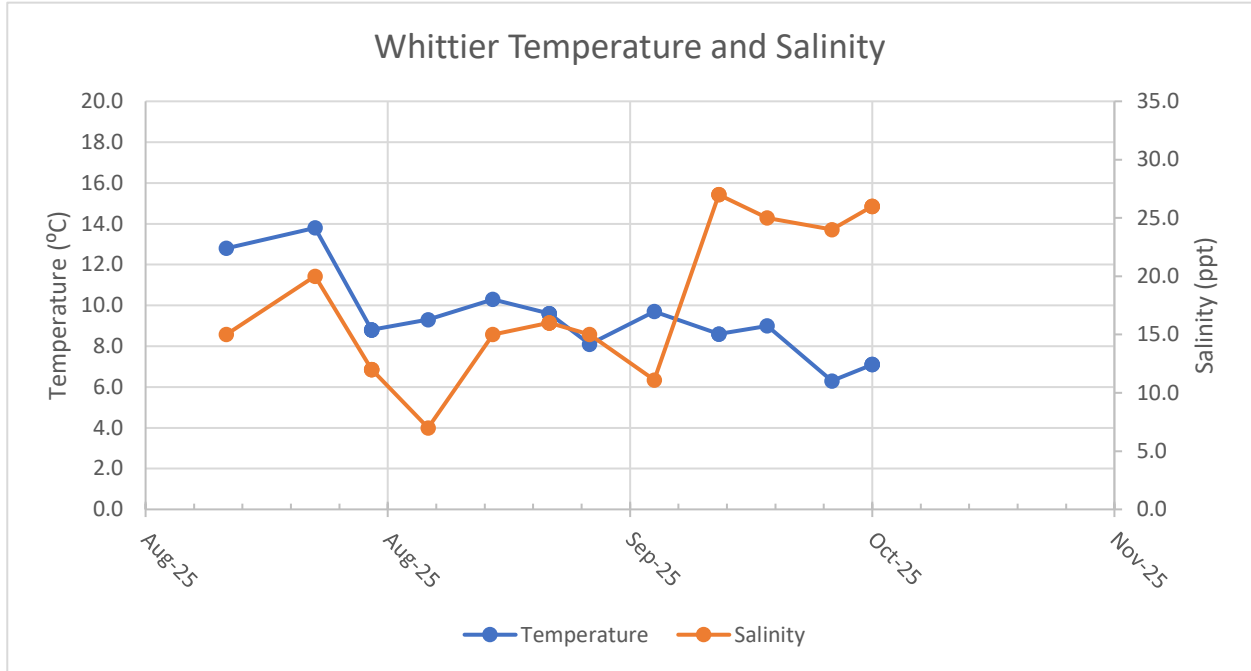


Figure 28. Temperature and salinity at the Whittier site for samples collected from 8/11/2025 to 10/30/2025. Temperature and salinity data were not taken in triplicate.



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Figure 29. Prevalence of *Dinophysis* spp., *Pseudo-nitzschia* spp., and *Alexandrium* spp. from phytoplankton tows analyzed via microscopy from March 2024 to January 2026 (n=116). Results are categorized into three groups, absent, detected, and elevated, based on cell counts (detected = 1-10 cells per slide; elevated ≥ 10 cells per slide).



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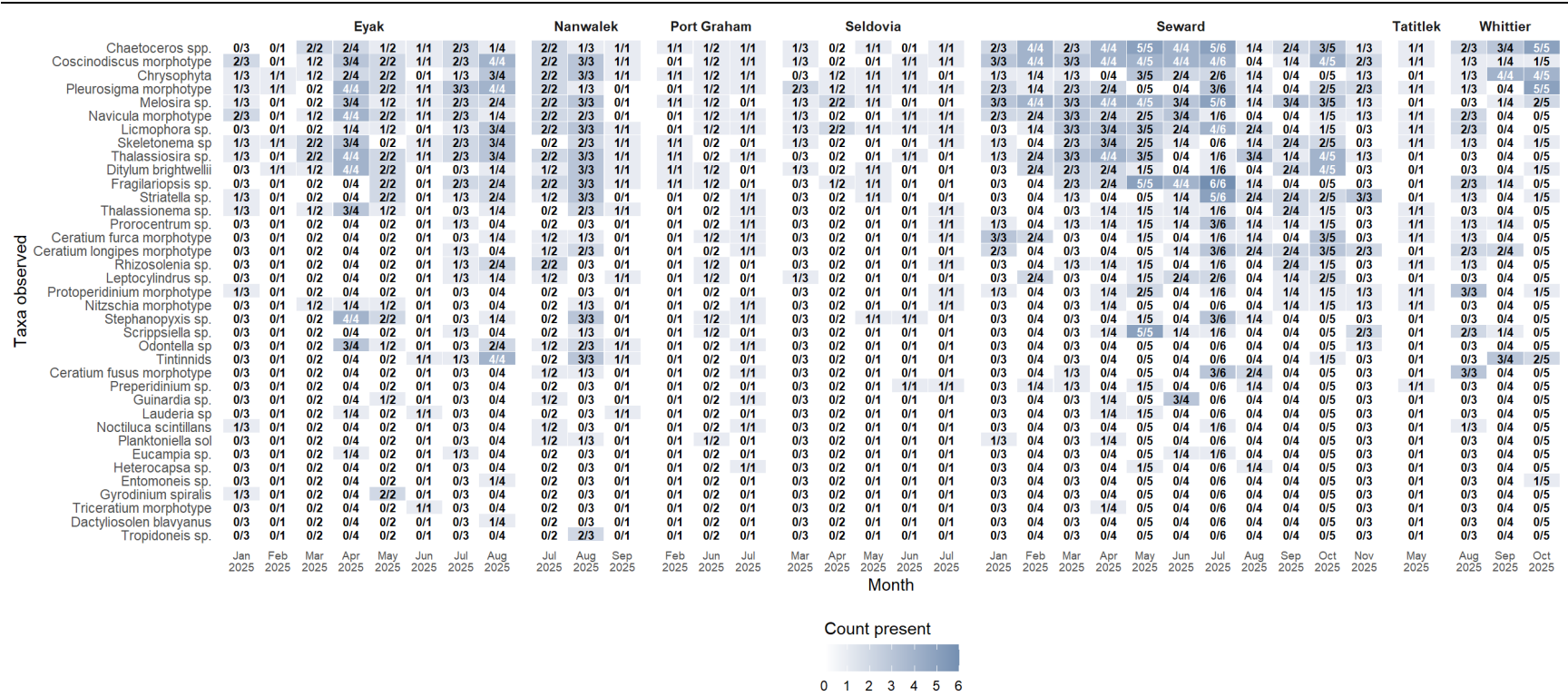


Figure 30. Observed presence of phytoplankton species common to southcentral Alaska. Numbers represent present/absent observations of phytoplankton for each sample received (i.e., number of times observed/number of samples received that month).



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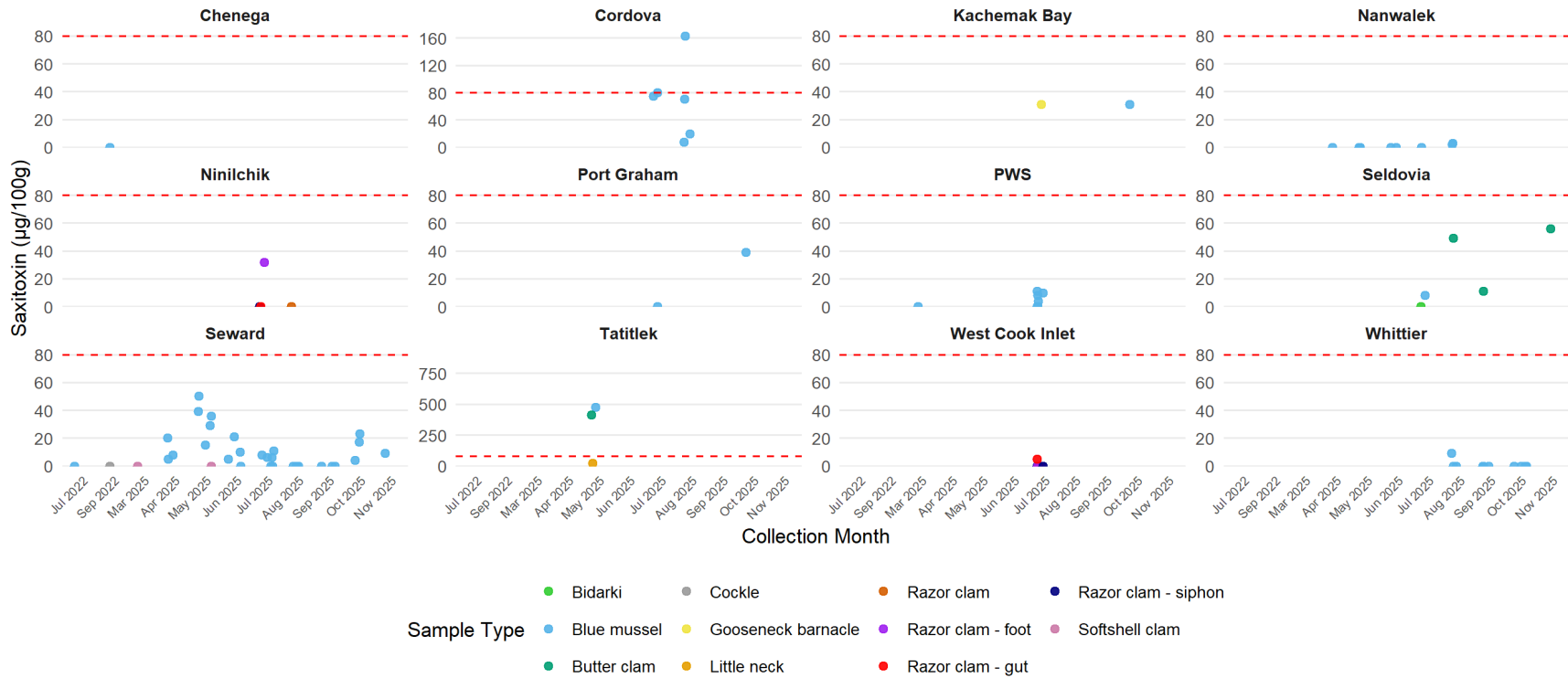


Figure 31. Each graph represents detections of saxitoxin ($\mu\text{g}/100\text{g}$) in bivalves ($n=106$) collected between July 2022 to November 2025. Samples were analyzed via RBA. The dots represent the samples that resulted in detectable concentrations. The red dashed line denotes the U.S. FDA regulatory limit of $80 \mu\text{g}/100\text{g}$ for paralytic shellfish toxins.



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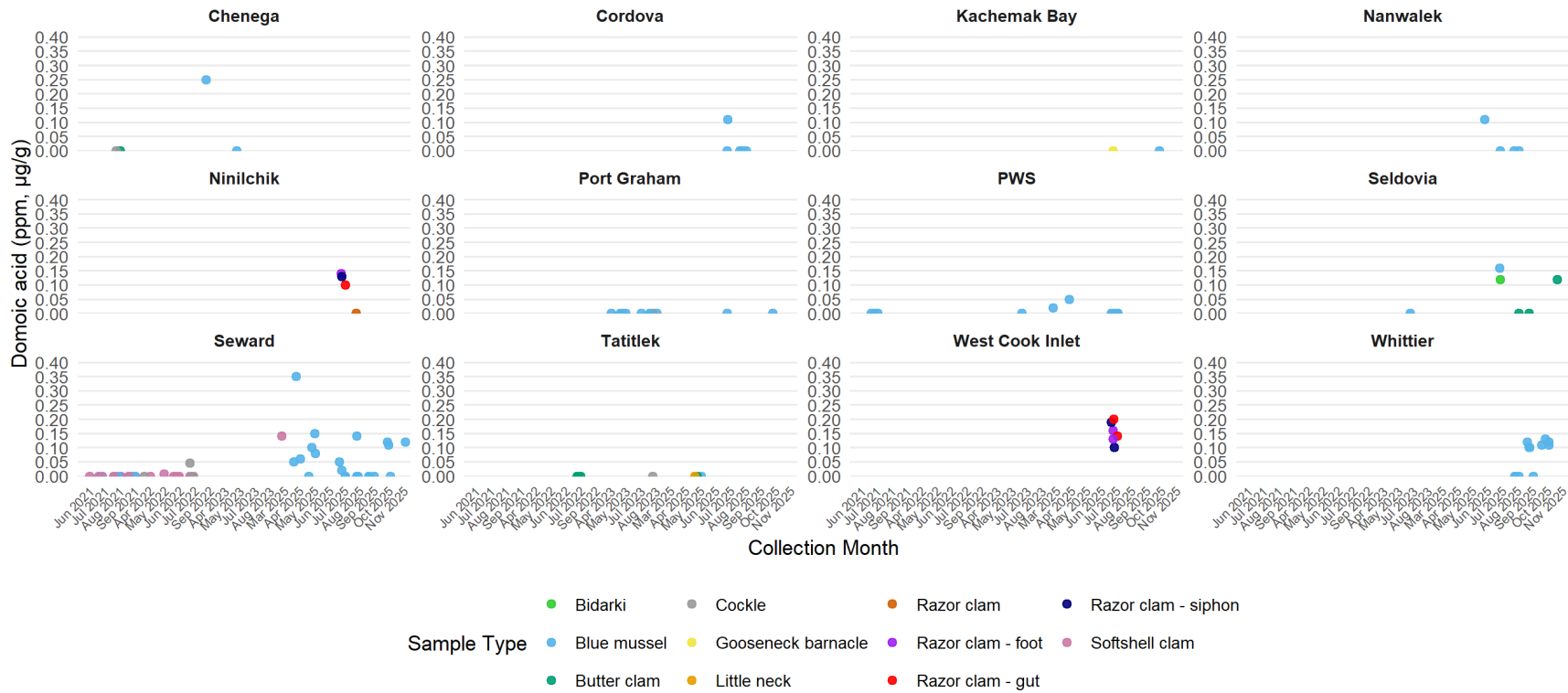


Figure 32. Each graph represents detections of domoic acid ($\mu\text{g}/100\text{g}$) in bivalves ($n=90$) collected between July 2021 to November 2025. Samples were analyzed via ELISA. The dots represent the samples that resulted in detectable concentrations. All detections were well below the U.S. FDA regulatory limit of 20 ppm.