

Monitoring Harmful Algal Bloom Species Using Environmental DNA

Project Final Report

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Executive Summary

The purpose of this project was to investigate the use of environmental DNA as a tool to monitor Harmful Algal Blooms. Over the course of this FIF-supported research, I worked with undergraduate research students to collect weekly water samples spanning several months in Juneau, and presented the results of this work at a number of conferences, symposia, and public talks. Additionally, this project was used as the foundation for a course-based research experience at UAS in the Spring of 2025.

Summary of Goals and Intentions

The overall goal of this project was to quantify environmental DNA (eDNA) from *Alexandrium catenella* along the shoreline of recreational harvesting beaches using both active and passive collection methods, and to compare these results to Paralytic Shellfish Toxin (PST) levels in relevant shellfish species. Additionally, I intended to incorporate this project into my Experimental Design and Data Analysis (BIOL S355) course in the Spring of 2025, in order to provide students with the opportunity to creatively contribute to an authentic research project in an upper division Biology class. Finally, this project had the goal of helping me build an Alaska-based research program that would enable me to apply for further funding to extend this work.

Reflective Narrative of the Project

Overall, this project was highly successful in addressing its goals. Because of the support of this Faculty Initiative Fund (FIF), I was able to mentor an undergraduate research student in 2025 in order to collect and process 21 weeks of water samples in Juneau spanning June to October. As a result of this work, we compared sampling locations around Auke Bay near the UAS campus as well as 15 miles north at Amalga Harbor, and additionally tested methods of sampling including active and passive sampling, the latter of which was accomplished using the Passive eDNA Sample Apparatus (PESCA) devices. These devices were designed and set to us by Dr. Jessica Glass at the University of Alaska Fairbanks and our incorporation of them in our sampling represented the first time these devices were field tested to specifically sample marine phytoplankton. In addition to water samples, we collected 21 weeks of Blue mussel samples in order to compare our *Alexandrium catenella* eDNA data to Paralytic Shellfish Toxin levels in this shellfish species. As a result of this sampling campaign, we were able to collect data during the week of a Harmful Algal Bloom (HAB) event that occurred in Juneau in September 2025; our collection of data during this event has allowed us to show how our molecular detection method can sensitively and specifically measure a rise in *A. catenella* ocean levels approximately one week before toxin levels peak in shellfish.

These exciting results support our intention to expand this research in order to improve methods to forecast PST risks within shellfish.

This work was successfully incorporated into my Spring 2025 BIOL S355 class to improve student research experiences and retention. For this project, students worked in groups to design and conduct their own experiments to explore methods of eDNA sampling, processed and analysed their data, and communicated their results through written lab reports and group presentations. Because of this course-based research experience, I was able to recruit an interested undergraduate student researcher from the class to continue this work with me during the summer of 2025 (whose student salary was supported by this FIF award). As a result of our work, both my research student and I have been able to present at a number of scientific and public forums, and I have been able to secure additional research funding to support future development of this research project (detailed in the “Project Deliverables” section below).

Finally, it has been exciting to expand my network of Alaska-based researchers and collaborators as a result of this work, including with Sitka Tribe of Alaska, various faculty at UAF and UAA, and the Alaska INBRE network.

Lessons Learned

As described above, as a result of this project, I was able to collect data during a HAB event in September of 2025. This unexpected event demonstrates that consistency in sampling is important to produce meaningful results. Because FIF support enabled myself and my research student to carry out weekly sample collection over several months in Juneau, we were able to collect key data that will support future expansion of this project. It is critical that we were able to demonstrate how a spike in ocean eDNA levels of *A. catenella* precede (by approximately one week) high PST levels in shellfish, supporting the relevance of our work as a community forecasting method for PST risks. Additionally, as part of this project, we were able to investigate a number of sampling considerations, such as how water depth and distance to the shoreline impacts our results. We also were able to compare methods of active to passive sampling using PESCA devices designed and sent to us by Dr. Jessica Glass at the University of Alaska Fairbanks. We discovered that phytoplankton eDNA levels were significantly lower when passively sampled over 48 hours, however, passive sampling may reveal different types of microbial and eukaryotic communities compared to active sampling; these results were communicated back to Dr. Glass and may help inform future PESCA designs.

Project Deliverables

Research results have been disseminated in a number of scientific and public forums.

- Student recruitment talk delivered to Juneau-Douglas High School marine biology classes (January 2026 in Juneau, AK)
- Alaska Marine Science Symposium (January 2026 in Anchorage, AK)

- National IDeA Symposium of Biomedical Research Excellence (June 2026 in Bethesda, MD)
- Wildlife Conservation Society's One Health Retreat (June 2026 in Utqiagvik, AK)*
- Southeast Alaska Tribal Environmental Forum (August 2026, Juneau AK)

**Research poster included with this report.*

Additionally, I have met with and communicated results directly with the Sitka Tribe of Alaska, who carry out PST testing on behalf of many communities in Southeast Alaska. I am also in the process of submitting two manuscripts for publication in the peer-reviewed journals *Harmful Algae* and *Environmental DNA*.

Finally, I have been able to leverage work done through this project to secure additional research support, which has enabled me to expand the scope of this project to include additional work with more research students.

- AK INBRE Developmental Pilot Project “*Preventing Paralytic Shellfish Poisonings through the enhanced detection of Harmful Algal Blooms*” (August 01, 2025 – July 31, 2026; \$49,970 in direct costs)
- NSF EPSCoR Interface of Change Research Seed Award “*Investigating environmental drivers of paralytic shellfish toxin biosynthesis using RT-qPCR*” (July 01, 2026- June 30, 2027; \$31,791 in total costs)