

NOAA Omics Strategy Report, FY24 Q1

provided to the NOAA Science Council by the NOAA Omics Working Group

Administrative and Agency Priorities

- **Climate and Marine Heat Waves**

- **DNA in Archived Samples Reveals Shifts in Fish Assemblages Associated with Marine Heatwaves.** [Routine ecological time series enhanced by unlocking DNA information from archived net tow samples.](#) PMEL and partners successfully reconstructed 23 years worth of larval fish dynamics using just the ethanol preservative from archived CalCOFI samples (**Figure 1**). Ongoing work has demonstrated the ability to capture entire zooplankton assemblages. Further research will allow us to generate climate-grade biological time series (>30 years) to understand the impacts of warming, ocean acidification, and hypoxia on zooplankton communities while preserving precious physical specimens.



Figure 1. The DNA contained in ethanol used to preserve net tow samples was analyzed to reconstruct larval dynamics without destroying a valued tissue archive.

- **Technology Transition**

- **Transition Plan for eDNA Autosamplers Highlighted in News Report.** Efforts to develop a Transition Plan for eDNA sampling instrumentation was highlighted in a [recent web article](#). This significant milestone drives awareness and support for broader implementation of eDNA approaches across NOAA. The story also described the R&D process, which includes “smart failure” and rich collaboration across NOAA line offices and with outside partners.

Synergies Across S&T Focus Areas

- **Omics x Artificial Intelligence:**

- Published manuscript on machine learning algorithms for eDNA: Park, H., S.J. Lim, J. Cosme, K. O’Connell, J. Sandeep, F. Gayanilo, G.R. Cutter, E. Montes, C. Nitikitpaiboon, S. Fisher, H. Moustahfid & L.R. Thompson. (2023). Investigation of machine learning algorithms for taxonomic classification of marine metagenomes. *Microbiology Spectrum*, <https://doi.org/10.1128/spectrum.05237-22>.
- **Environmental DNA Used to Understand the Ecological Community of Larval Fishes.** NOAA ‘Omics staff and researchers contributed to a [recent publication](#) drawing connections between eDNA and larval fish habitats. In this study, eDNA data and network analysis was used to assess larval fish communities to reveal potential prey field, predators, and microbiome associates of larval fishes.

Infrastructure

- **IRA Funds for 'Omics Data Acquisition.** [Inflation Reduction Act](#) funding to NMFS under [Climate Ready Fisheries](#) to enhance essential data acquisition will support 'omics data acquisition. Strategic investments in 'omics infrastructure and expertise will accelerate operational collection of biomolecular data to support fisheries management.
- **Robotic Tech Aids 'Omics Investigation of Coral Disease.** AOML incorporated robotic technologies into the Experimental Reef Lab (**Figure 2**). The system reduces risk of contamination and increases replication capabilities, ensuring that each coral fragment tested is statistically independent to provide more data certainty. Resulting data is being used to better understand stony coral tissue loss disease (SCTLD) transmission to aid disease diagnostics and mitigation in support of management decisions of multiple regulatory entities at state and federal levels.

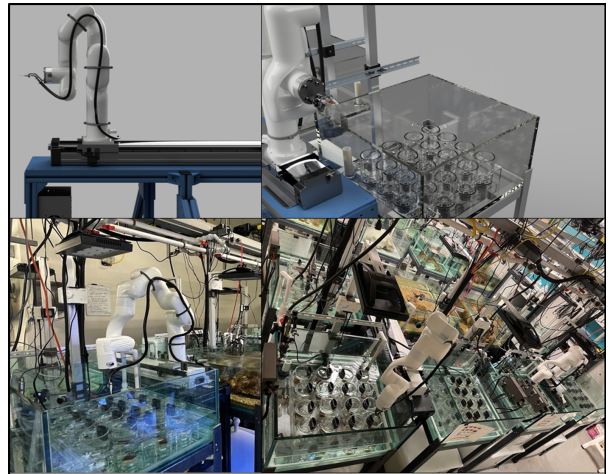


Figure 2. Robotic technologies within the Experimental Reef Lab increase statistical power to enhance coral disease research (credit: Michael Studivan, AOML).

- **Lab and Computational Infrastructure Increase 'Omics Processing Capacity.** PMEL operationalized an [eDNA-clean lab](#), providing access to aseptic lab space and equipment needed to cleanly process samples for molecular analysis. This new capacity is helping address a large backlog of samples (>2,000) caused by the previous lack of space adequate for molecular-grade laboratory processing. In addition, on-premise HPC RAM was upgraded to improve bioinformatics processing speeds. These infrastructure upgrades are allowing scientists to employ the power of 'omics to conduct eDNA biodiversity surveys & characterize stress responses in sentinel species, such as krill and pteropods, from climate change and other anthropogenic threats.

Partnerships

- **National Aquatic Strategy on Environmental DNA Slated for Release in 2024.** Co-chairs of the eDNA Task Team under the Subcommittee on Ocean Science and Technology (SOST) Interagency Working Group on Biodiversity provided an [Introduction to the National Aquatic eDNA Strategy](#) at the December 2023 NOAA 'Omics Seminar Series. The Strategy outlines goals and objectives to harness the power of eDNA to explore, map, monitor, and better understand aquatic life to sustain and restore biological resources into the future. NOAA, ONR, and the Smithsonian, co-chair the National Aquatic eDNA Strategy effort, with partnership of 16 federal agencies. To date, over 100 individuals have been involved with internal review. The response to RFI was enthusiastic, generating over 400 lines of feedback for the team to review.

- **Cross-Line-Office Partnerships Fosters Integration of eDNA into Routine Surveys.** Cross-line collaboration (NOAA Ocean Exploration, GOMO, OA, AOML) has brought eDNA monitoring to several long-standing surveys in the Gulf of Mexico and southeast Florida via MBON, SEAMAP, and GOMECC, and [Bio-GO-SHIP](#). Harmonizing eDNA sampling methodologies among routine surveys is critical to developing F.A.I.R. and trusted 'omics data.
- **A Call for Coordinated Marine Microbiome Research to Catalyze the Blue Economy Across the Atlantic.** A [manuscript](#) in the December 2023 issue of *Frontiers in Marine Science* highlights the importance of marine microbiome research to a sustainable Blue Economy. The article reviews the microbiome and biotechnology goals of the Marine Microbiome Working Group and the Marine Biotechnology Initiative under the Galway & Belém Statements, and it outlines a strategy to implement those goals under the new All-Atlantic Declaration.

People

- **'Omics Interns, Post Docs, & Federal Hires Grow.** 'Omics workforce enhancement increases NOAA's scientific proficiency and capability to support a suite of priority mission applications. The 'omics workforce has been enhanced through opportunities for interns, post-docs, and federal hires (**Figure 3** and **Figure 4**). NOAA internship programs have been pivotal to promoting diversity. PMEL was instrumental in funneling expertise into the agency, hiring two federal research scientists with expertise in molecular biology and bioinformatics in FY23 Q3.



Figure 3. NOAA staff and interns routinely collect eDNA aboard agency vessels for biomonitoring of ocean resources.

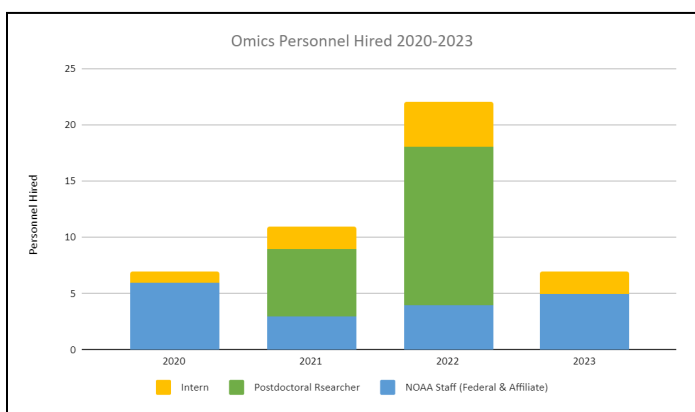


Figure 4. A survey conducted by the NOAA 'Omics Working Group in FY23 Q3 showed an increase in 'omics expertise across the organization. Growth was influenced by opportunities provided to post doctoral researchers and interns.



- **NOAA 'Omics Working Group Increases Network & Advocacy Across the Agency.** In FY24, the NOAA 'Omics Working Group expanded its membership in FY24 from 15 to 29 members to include additional program managers and Laboratory and Science Center representatives. The expanded network will strengthen coordination of 'omics implementation across the agency.

Projects

- **'Omics Identify Coral Tolerances to Inform Conservation Efforts.** AOML conducted a suite of 'omics analyses on urban corals, including during a massive bleaching event in the summer of 2023. Mechanistic research using genetic analyses is ongoing to understand factors that promote coral health and resilience. Results to date revealed thermally-tolerant algal symbionts and unique coral-algal associations. Data collected suggests that urban corals may be warranted for enhanced conservation status and particularly valuable for restoration efforts to repopulate degraded reefs.
- **eDNA Utilized as a Cost-Effective Tool For Biomonitoring.** A [study](#), showcased among multiple [news outlets](#), demonstrated that eDNA can provide a cost-effective tool for monitoring fish biodiversity in surf zone habitats. The eDNA data strongly complemented data from seine and baited remote underwater video (BRUV) surveys. eDNA sampling detected over 50% more species than either seine or BRUV methods and more consistently detected 97% of taxa observed across methods, including species of interest to management (e.g., northern tidewater goby, white seabass, California angel shark). The PMEL study provides foundational data to support eDNA as a cost-effective and minimally invasive method for monitoring commercially and ecologically important fisheries.