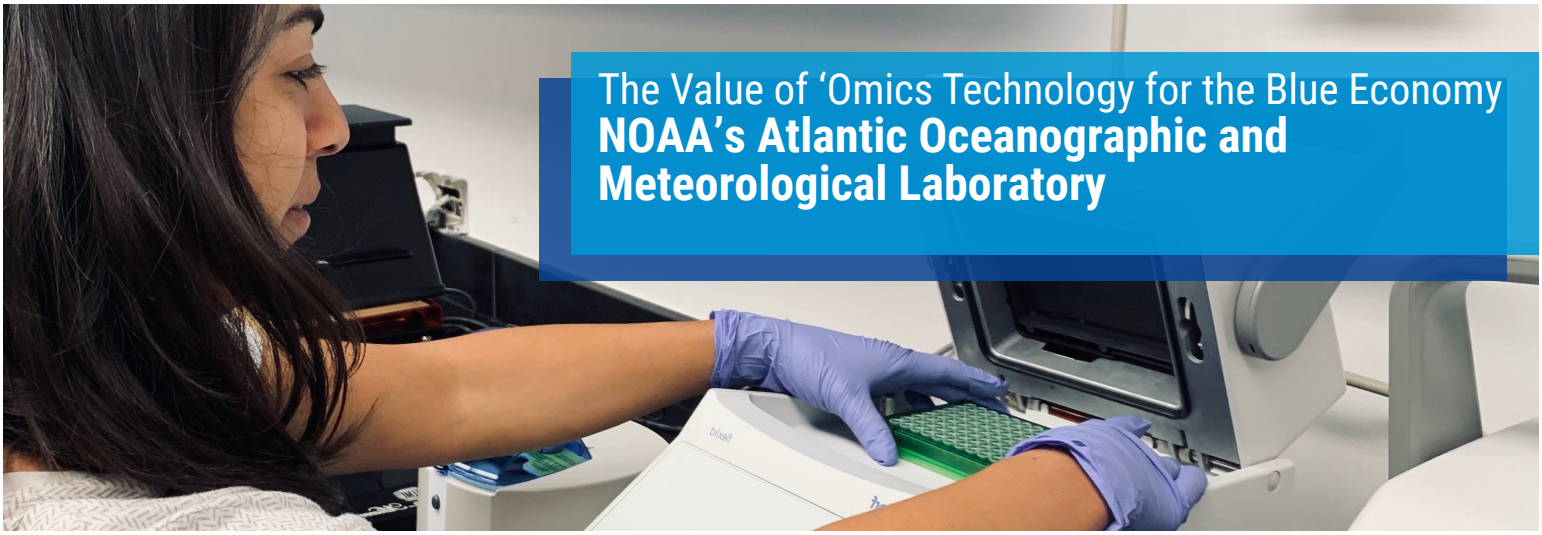

The Value of 'Omics Technology for the Blue Economy
NOAA's Atlantic Oceanographic and Meteorological Laboratory

Scientist at AOML processes samples in the lab. Photo Credit: NOAA AOML

'Omics Introduces Practical Large-Scale Monitoring of Blue Economy Resources

NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML) is helping lead the implementation of NOAA's 'Omics Strategy[1] to support the Blue Economy. 'Omics is a new technology NOAA is using to unlock the mysteries of the marine microbial realm through the analysis of DNA, RNA, proteins, and metabolites. For example, 'omics technology can be used to identify organisms in a community, how they function, and how they might adapt to changing conditions. These tools have revolutionized biological study, benefitting public health, medicine, agriculture, and conservation. 'Omics techniques are faster, cheaper, and more informative compared to traditional methods and thus improve delivery of products and services. NOAA is employing these tools to understand how to sustain and grow the benefits we receive from our oceans and Great Lakes. The U.S. Blue Economy is estimated to be worth over $300 billion per year to the United States[2], and coastal counties contribute 57.5 million jobs and produce over $9.0 trillion in goods and services[3]. AOML's 'omics research engages expertise in corals, fisheries, microbiology, and bioinformatics across NOAA and with national and international partners.

1 Goodwin, K., Davis, J., Strom, M., & Werner, C. (2020). NOAA'Omics Strategy: Strategic Application of Transformational Tools.

2 NOAA Office for Coastal Management. 2019. " NOAA Report on the U.S. Ocean and Great Lakes Economy." http://coast.noaa.gov/digitalcoast/training/econreport.html

3 https://coast.noaa.gov/states/fast-facts/economics-and-demographics.html. Accessed December 7, 2020.

Innovating with Allies Builds Sampling Capacity with Autonomous Underwater Vehicles

'Omics approaches can be paired with autonomous platforms to magnify what we can achieve with normal boat operations, for example, by extending our reach to areas that are deep, under ice, or too sensitive for normal trawl sampling. In collaboration with partners, AOML is testing autonomous underwater vehicles (AUVs) that can collect, filter, and process water samples to track harmful algae and their toxins and to investigate microbiome-fisheries connections. Partners include the Monterey Bay Aquarium Research Institute (MBARI), Great Lakes Environmental Research Laboratory (GLERL), National Centers for Coastal Ocean Science (NCCOS), Marine Biodiversity Observing Network (MBON), and Southwest Fisheries Science Center (SWFSC). AOML has also developed inexpensive subsurface auto-samplers (SAS) for the collection and preservation of environmental DNA (eDNA) from shallow underwater areas.

Scientists deploy underwater autonomous vehicles to test environmental sampling for 'Omics research in Lake Erie. Photo Credit: NOAA, GLERL.

NOAA's Atlantic Oceanographic and Meteorological Laboratory
4301 Rickenbacker Causeway, Miami, Florida 33149
www.aoml.noaa.gov

'Omics Technologies Map Marine Ecosystems for Informed Resource Management

The marine microbiome – viruses, bacteria, phytoplankton, etc. – form the base of the food web and perform critical tasks such as recycling nutrients, decomposing pollutants, and helping regulate atmospheric chemistry. Although tiny, these hidden treasures hold large-scale benefits for the health of humans, animals, and ecosystems. Environmental DNA research is an extension of microbiome analysis that holds great promise. In addition to detecting microbes, higher trophic levels, such as fish or marine mammals, can be detected by analyzing just seawater – this tissue-free detection is achieved by analyzing DNA obtained from sloughed or excreted cells. eDNA is a practical approach to large scale monitoring of the biodiversity of life in the sea. AOML and partners are investigating whether eDNA can provide information about protected and commercially valued species without the need to process tissues or trawl through sensitive habitats.

Illustration credit: Rán Flygenring.
Done for the AORA Marine Microbiome Working Group.

Creating Sustainable Fisheries Management Plans Informed by 'Omics and eDNA

Atlantic Bluefin Tuna. Image Credit: NOAA Fisheries.

Our ability to effectively manage fisheries is limited by our understanding of fishery populations and their dependence on environmental conditions. Including genomic information into fisheries management may improve the decision-making process and thus the sustainability of fisheries. AOML and NOAA's Southeast Fisheries Science Center (SEFSC) have formed a collaborative partnership with a clear path to transition results into fisheries management plans. In addition to genomic investigations of fish populations, sustainable fisheries require holistic ecosystem understanding, and eDNA offers a cost-effective way to gather comprehensive biodiversity information.

Sequencing the Marine Genome with Bioinformatics

Success in these endeavors requires having the proper expertise and tools. AOML is dedicated to modernizing our infrastructure and fostering expertise in molecular biology and bioinformatics. The NOAA 'Omics Strategy and Implementation Plan, in collaboration with other Science & Technology Focus Areas, charts the course for us to harness technological advances to address priority needs.

Illustration credit: Rán Flygenring.
Done for the AORA Marine Microbiome Working Group.

NOAA's Atlantic Oceanographic and Meteorological Laboratory
4301 Rickenbacker Causeway, Miami, Florida 33149
www.aoml.noaa.gov