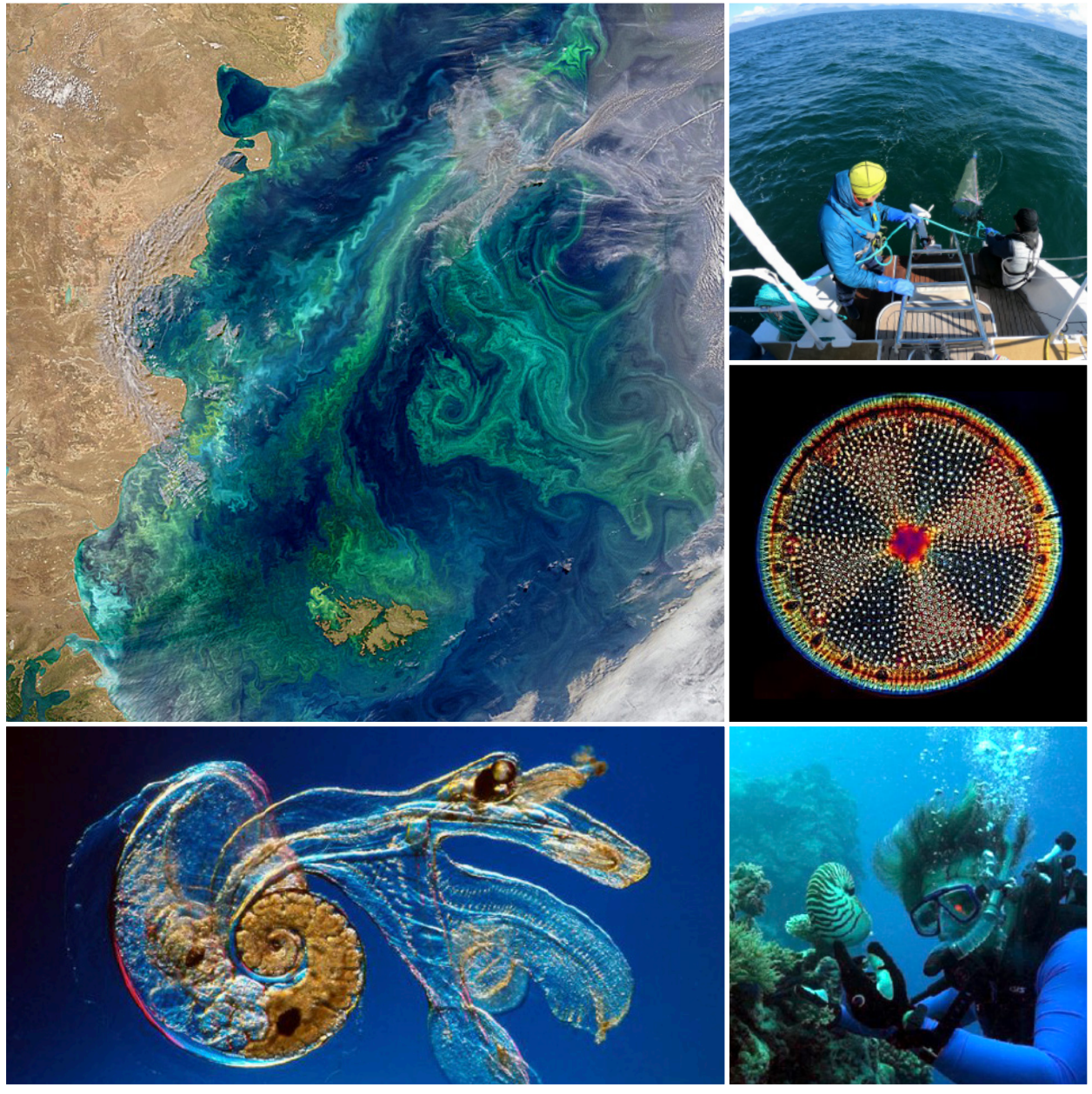
OCEAN GENOME ATLAS PROJECT

A mission to genomically map the full biodiversity of the world's oceans at single-cell-resolution, preserving our planetary heritage for millennia.



OCEAN GENOME ATLAS PROJECT

Primary Contact: Peter Molnar, Co-Founder and Board Chair
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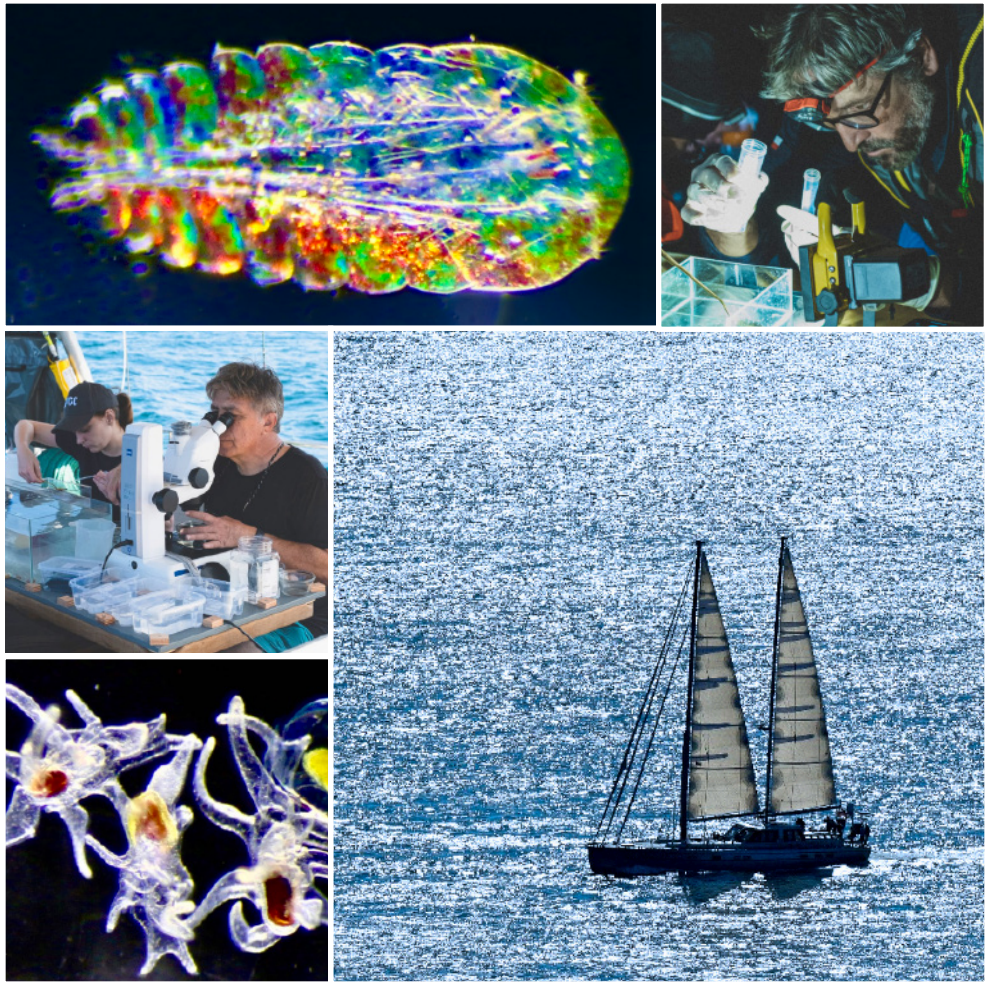
Summary

Ocean Genome Atlas Project (OGAP) will deploy state-of-the-art mobile labs throughout the world's oceans, sample millions of planktonic and benthic organisms, observe, document and perform a full range of genomic analysis (including single-cell transcriptome and 3D genomic sequencing, as well as metabolomics and proteomics microanalyses) and finally employ artificial intelligence (AI) to process the datasets. The results will help predict the dynamics of ocean ecosystems and provide critical insights about planetary health, predictive, evolutionary and fundamental biology, as well as biomedicines of the future. Ultimately, OGAP's work will form the backbone of a dynamic 4D (space and time) Ocean Genome Atlas at single-cell resolution.



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Mission Statement

NOAA reports that more than 80% of the world's oceans are unobserved and unexplored. UNESCO estimates that the marine animal species identified thus far (226,000) are but a small portion of the total. Efforts to capture and molecularly characterize marine species have only just begun.

OGAP aims to fill this void by deploying state-of-the-art mobile labs on various floating platforms, including retrofitted sailboats, specially designed sailing research vessels and multifunctional drones that operate at a fraction of the cost of a traditional research vessel. These labs are capable of deep transcriptome and genomic sequencing, in parallel with metabolomics and proteomics microanalyses, and advanced nanoscience, including nanorobots. Samples can be microanalyzed at sea. Living organisms will be integratively studied in real-time, before they degrade en route to land-based labs.

This work, already underway for nearly a decade **(https://www.ogapvoyage.org/updates-resources)**, is expected to yield:

(1) the discovery of potentially millions of novel biologically active molecules useful for future drug development

(2) insights about predictive biomedicine and bioengineering with prototypes of synthetic living machines

(3) the evolutionary history of major taxa, including previously unknown species, cells and tissues for regenerative medicine

(4) AI and machine learning-based documentation and dynamic monitoring of global baseline biodiversity levels

OGAP's worldwide dynamic sampling missions and genomic analysis of millions of cells and organisms will establish a versatile, AI-based, unbiased baseline for existing ocean biodiversity and allow for ongoing analysis of adaptation to climate changes and stressors. OGAP's work will yield massive datasets that, in essence, are a digital 4D (time and space) representation of the oceans' biodiversity at the single-cell level. Since OGAP will perform deep molecular surveys and microanalyses with nanorobots and AI/machine learning, the results will be more detailed and useful than a mere static digital "blueprint" of a string of genes.

OGAP will make its datasets and analysis available to scientists and researchers around the world through existing and future sharing platforms (e.g., the NIH's National Center for Biotechnology Information, the Smithsonian and the International Oceanographic Data Exchange of IOC-UNESCO).

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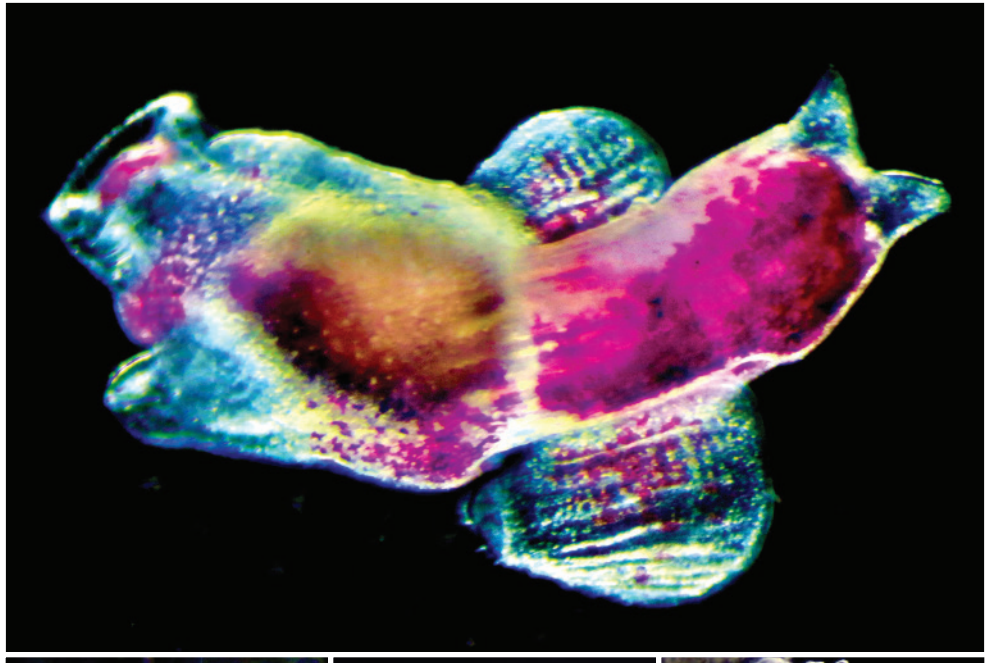
Our Vision and Impact

The oceans hold the greatest biodiversity of the planet; each organismal lineage holds the keys to many millions of novel biological adaptations and processes.

If we do not collect and analyze known and unknown marine species, countless solutions derived by Nature through 3.5 billion years of evolution, key aspects of our planetary heritage, will be lost forever. The rate of species extinction is accelerating with estimates that 50% of extant biodiversity could vanish within a few generations. There is no time to waste.

A genomic/molecular atlas will preserve the fundamental information of the grand design of life in perpetuity. Future generations with advanced AI/nanoscience-based tools can utilize this information in any number of ways even after species are lost to extinction.

The costs and limitations of traditional research vessels are perhaps the largest impediment to marine biology research. With new powerful and compact nanoscience-based laboratory equipment, OGAP can perform full-scale research on medium sized vessels at a fraction of the daily cost of a traditional research vessel. As a proof-of-concept, the sailing and science teams behind OGAP have been sampling in the Pacific Ocean for the past four years, covering 15,000 NM for less than $1,000/day.



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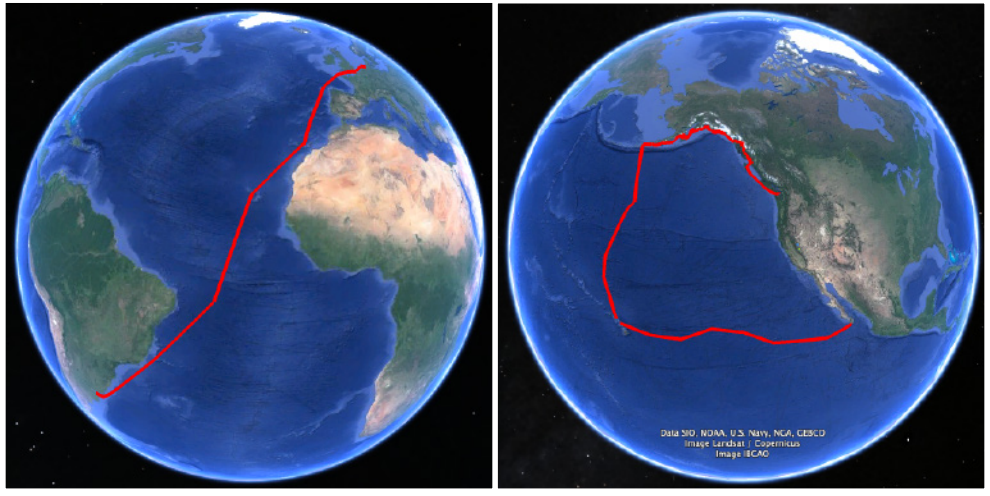
Ongoing Research and Partnerships

In 2021, OGAP has procured cutting-edge lab equipment, undertaken voyages from The Netherlands to Uruguay and along the West Coast of Canada, procured financing to purchase and retrofit another sailing vessel, and commissioned the design of Morpheus, a low cost, low carbon sailing vessel able to conduct genomic, molecular, physiological and developmental research in real-time at sea.

In the spring of 2022, OGAP will conduct extensive sea trails in Puget Sound and the coastal waters of British Columbia to trial various floating laboratory configurations and determine the tolerances of newest generation sequencers and other bio-analytical platforms in coordination with laboratory equipment manufacturers. OGAP has partnered with Friday Harbor Laboratories, the University of Washington's marine biology field station in the San Juan Islands.

OGAP is coordinating research missions with scientists in Europe, Asia and South America. Further, OGAP will coordinate sampling missions with professional and amateur mariners as well as local fishing fleets worldwide with thousands of citizen scientists. Extensive and expanding international collaboration with 60+ laboratories is critical to ensure adequate survey and sample collection (from equatorial to Arctic and Antarctic waters) to build a true high resolution 4D dynamic genomic atlas. Undersampling and lack of integrated deeper molecular and physiological analyses are persistent challenges in current marine biology research.

A core OGAP mission is to train and deploy dozens of international teams of scientists on vessels worldwide. Given the length of the voyages, remote locales and physically demanding nature of the work, most of these scientists will be undergraduates and post-docs, all working under the guidance of professors and more experienced scientists. In April and May of 2022, OGAP lead scientist Dr. Moroz will start training post-docs, professors and undergrads/science citizens from the US, South America, Europe and Asia in his unique approach to sampling, observation, documentation and single-cell genomic sequencing of planktonic organisms.



OGAP Voyages 1917-2021 – 15,000 nm of sampling

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Engaging Scientific and Technological sectors outside of traditional ocean sciences

- Machine learning and artificial intelligence to process, store, and disseminate billions of novel genetic and imaging datasets
- Advanced bio-analytical technologies for molecular mapping of world oceans and its biota
- Drug development for regenerative medicine and predictive systemic biomedicine of the future
- Neuroscience and brain research due to the critical importance of marine species to the study of learning, memories, neurodevelopment, neuroregeneration and neurological disorders
- Nanoscience and advanced nanotechnologies toward making living (self-repairing) synthetic machines and nanorobots with a myriad of fundamental and practical applications
- Novel computational algorithms and modeling of complex processes and emerging properties of complex systems