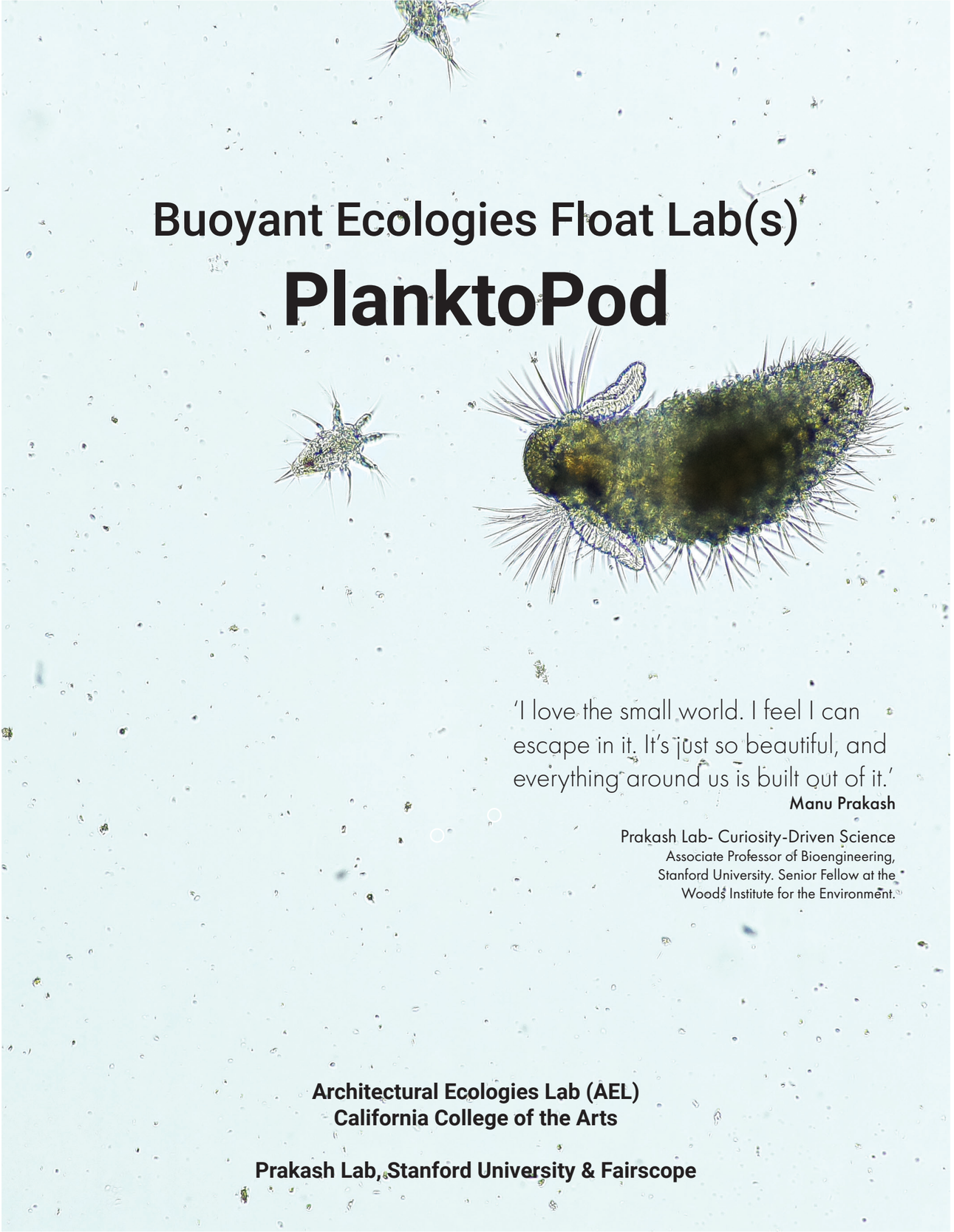



'I love the small world. I feel I can escape in it. It's just so beautiful, and everything around us is built out of it.'

**Manu Prakash**

Prakash Lab- Curiosity-Driven Science
Associate Professor of Bioengineering,
Stanford University. Senior Fellow at the
Woods Institute for the Environment.

**Architectural Ecologies Lab (AEL)**
**California College of the Arts**

**Prakash Lab, Stanford University & Fairscope**

# PlanktoPod

Evan Jones & Adam Larson Ph.D.

**The PlantoPod is an autonomous floating platform** designed to provide agency to local communities to test water quality and monitor ecological health. A buoyant enclosure houses a "Planktoscope", an open-source imaging platform for citizen oceanography adapted to transmit visual data to local coastal communities.

It is comprised of two main parts: an ecologically designed portable floatation enclosure embedded with illuminating, environmental sensors communicating geolocation and status—and within it the 'PlanktoScope', an open and accessible modular imaging platform for citizen oceanography that enables individuals to sample water quality from their own shoreline. The internal PlanktonScope is designed to enable the community to engage through hands-on learning, customizable construction, and individually adaptable platforms to expand its functionality.

**The PlanktoPod is portable, thus enabling multiple locations**—schools, neighborhoods, towns— to sample and monitor water quality, understand environmental niches, address issues of environmental justice, and expand our understanding of biodiversity and ocean health.

**By making the study of plankton more accessible, efficient, and non-invasive, autonomous imaging platforms are opening up new frontiers in marine science.** They offer a powerful tool for monitoring the health of our oceans, tracking the effects of climate change, and developing strategies to protect these vital ecosystems. By making the invisible visible, these pods can spark the imagination, nurture a sense of wonder in anybody who has looked out into the open waters, and galvanize support for protecting the ocean's most vital and vulnerable miniature inhabitants.

**"The PlanktoScope is also capable of capturing images of microplastic particles that are often found alongside plankton in water samples.** These images can then be analyzed using specialized machine learning algorithms trained to recognize and classify different types of microplastics based on their size, shape, composition, and color. This automated analysis could provide researchers and citizen scientists with a rapid and cost-effective method for quantifying the presence of microplastics in bodies of water, allowing them to track the abundance or accumulation of these pollutants over time and geographic location. Furthermore, the PlanktoPod's ability to be deployed autonomously and collect data continuously could provide a more comprehensive understanding of the spatial and temporal distribution of microplastics, helping to identify potential sources and inform strategies for mitigating their impact on marine ecosystems."

## PlanktoPod Interdisciplinary Team:

PRAKASH LAB
Curiosity-Driven Science

Frugal Science, our work aims to tackle some of the most complex planetary-scale challenges, from climate change to emerging infectious diseases to extreme poverty. We invent, build, and scale-up ultra low-cost, yet powerful, open science tools for ecological monitoring, tropical disease diagnoses, and science education.

FairScope

At FairScope, we are committed to democratising access to observation and measurement tools for studying plankton, thereby making marine research more open, collaborative and sustainable.

We design open, repairable and accessible scientific instruments that enable researchers, educators, associations and citizens to play a part in understanding and protecting aquatic ecosystems.



**Adam Larson (Ph.D.)**
Data Analyst

CCA ARCHITECTURE / ARCHITECTURAL ECOLOGIES LAB



**Margaret Ikeda**
Founder / Associate Professor of Architecture (CCA).
Co-Director (AEL)



**Evan Jones**
Founder / Architect, Sr. Adjunct of Architecture, California College of the Arts. Co-Director Architectural Ecologies Lab

KREYSLER & ASSOCIATES



**William Kreysler**
President, Kreysler & Associates, Inc.
40 years owning and operating Kreysler & Associates, Inc. a custom fabrication firm building composite products for architecture, artists and industrial projects.

*Other contributors to this project during its development team: Ali Farajmandi (Fabrication Specialist); Pam Pascual, Amber Initiative; Beth Ferguson, UC Davis Design; Autodesk Technology Center, San Francisco*

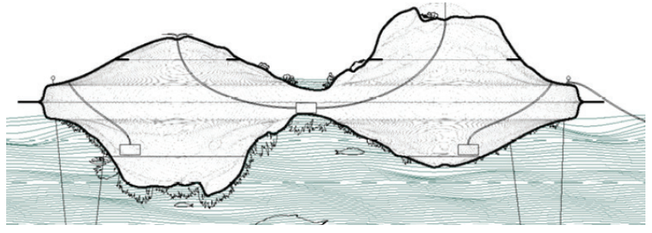




# Background

The Buoyant Ecologies Float Lab is an innovative prototype for a resilient, floating infrastructure that anticipates the existential risks of sea level rise threatening coastal cities. The project builds upon a multi-year research initiative that brings together architects, ecologists, and fabricators to develop new material strategies for constructing resilient waterfront structures. The research advances a paradigm shift to consider communities of organisms found on artificial surfaces as a resource by developing and monitoring contoured, fiber-reinforced polymer (FRP) composite substrates that, through geometric variation, provide hills and valleys that can serve as habitats for various types of species Underwater, the substrate geometry is optimized to control upside-down settlements of invertebrates that contribute to the biological diversity of marine ecology and are capable of becoming effective wave-attenuators, therefore slowing or preventing erosion. Above water, bird activity on the floating structure is studied by ecologists.

CCA ARCHITECTURE / ARCHITECTURAL ECOLOGIES LAB



Buoyant Ecologies Float Lab sectional drawing of a clam shell design (top and bottom the same geometry).

Coastal Conservation & Research, Inc.



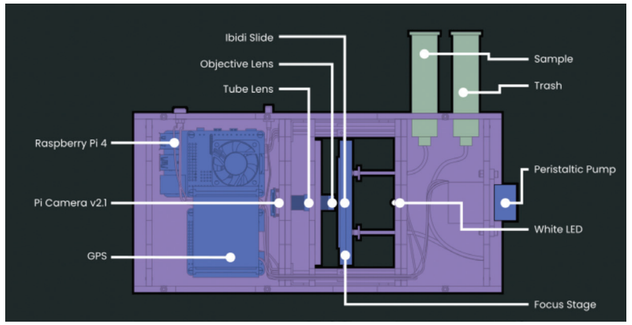
Floating islands formed by aggregation of mutiple floating units for wave attenuation.



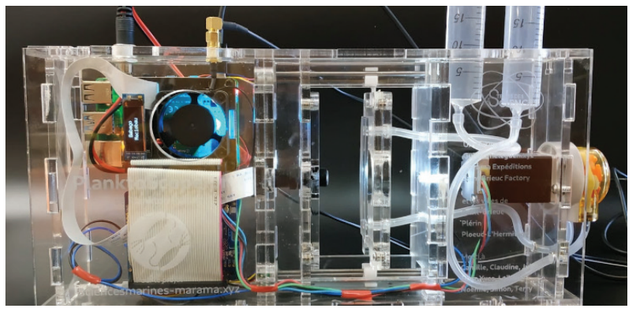

**Imagine a window into the hidden world of our microscopic living oceans**- one that we could all look through. The Planktoscope is an innovative, affordable microscope that allows us to observe and document the diverse microorganisms floating in our oceans and freshwater. This open-source device can capture high-quality images of organisms smaller than a grain of sand, from 10 to 500 micrometers in size. What makes the Planktoscope special is its ability to work anywhere – from a remote beach, to a kitchen table, to the middle of the ocean – automatically identifying and cataloging millions of tiny creatures in each water sample. This technology has already proved incredibly useful for studying harmful algal blooms, which can threaten marine life, human health, and local economies. By making this tool widely available, we are empowering scientists, citizens, and communities to better understand and predict these dangerous blooms while also learning about the microcosmos hiding in each drop of ocean. The PlanktoScope community could revolutionize how we monitor ocean health, detect emerging environmental threats, and protect our waters for future generations.

PRAKASH LAB
Curiosity-Driven Science

FairScope




PlanktoScope Components. https://www.planktoscope.org/

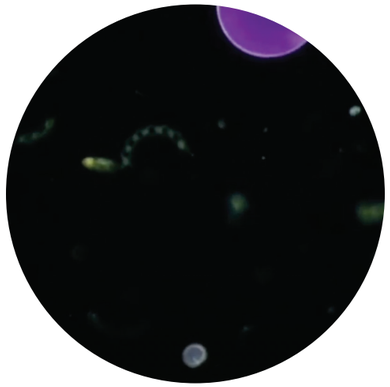


Built by Guillaume Le Guen at Konk Ar Lab - Le Temps des Sciences and Saint Brieuc Factory. https://www.planktoscope.org/

# Problem

A crucial challenge is **monitoring long-term changes** in aquatic ecosystems, such as those caused by climate change and pollution, is analysis of plankton communities across the vastness of the oceans, and the sampling of many different areas at many different times.

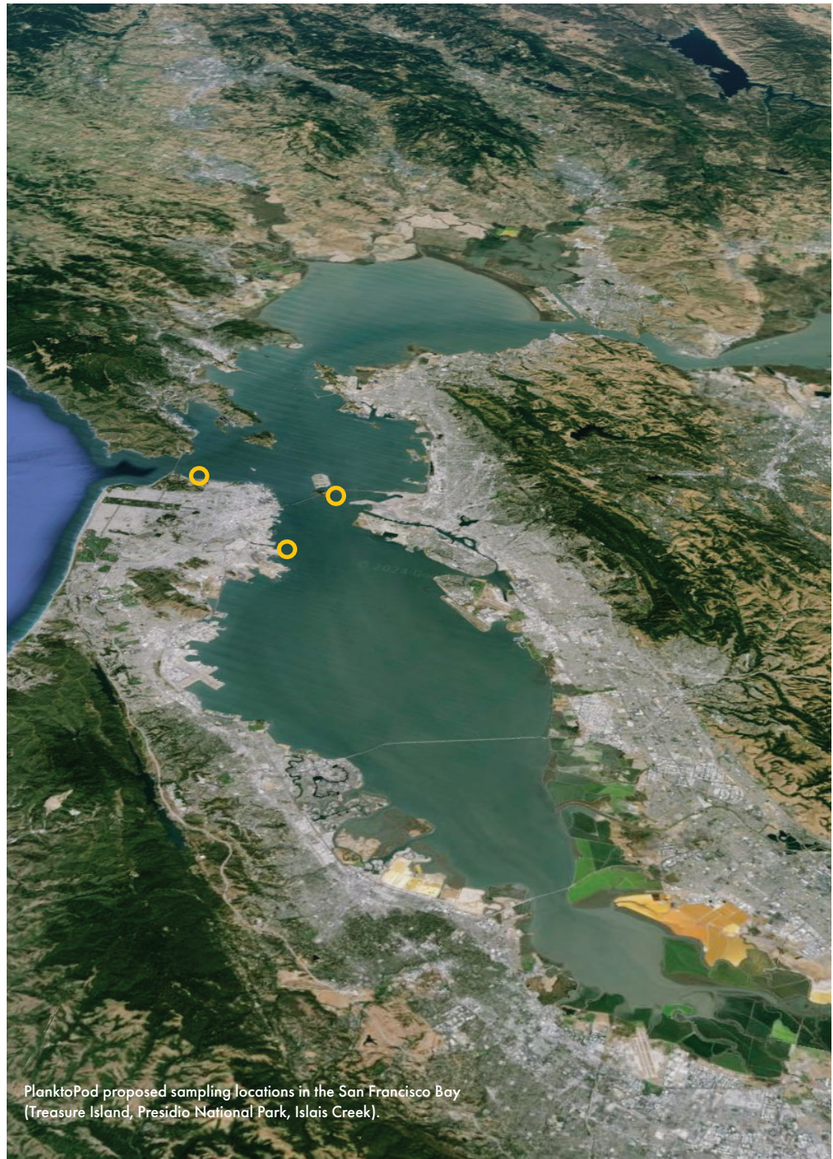
Traditional plankton sampling methods, such as net tows or water samples, are labor-intensive and time-consuming. They also require expensive expeditions that often disturb the ecosystems they are studying.



PlanktoScope micro-plastics and plankton sampling.



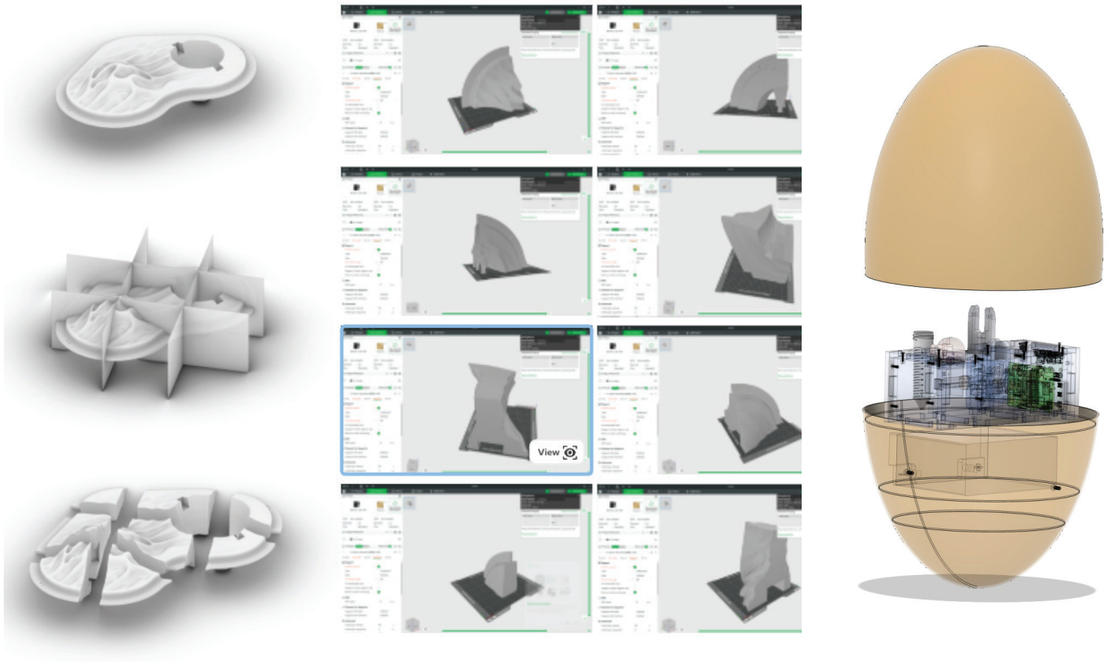
PlanktoScope Cataloging



PlanktoPod proposed sampling locations in the San Francisco Bay (Treasure Island, Presidio National Park, Islais Creek).

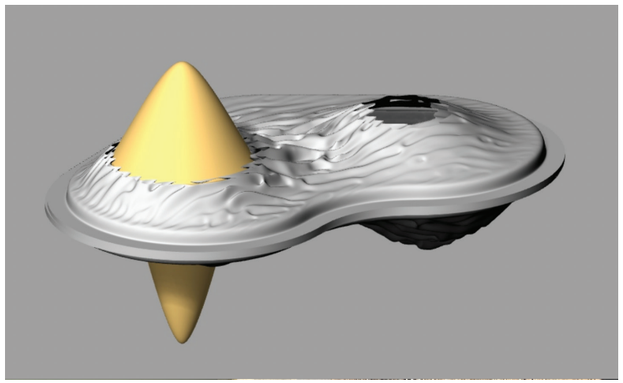
# Design Solution

**Autonomous floating imaging platforms can collect a large volume of data more efficiently and cost-effectively.** Recent advances in fabrication techniques, battery life, and data transmission have made long-term deployments of these platforms a tangible reality. With the ability to make real-time comparisons between different regions of the ocean, scientists can unlock new insights into the complex dynamics of plankton communities and how they respond to changing environmental conditions.





PlanktoPod version 2, wood and glass prototype.



PlanktoPod version 3, testing autonomous data collection.



# Plan of Action

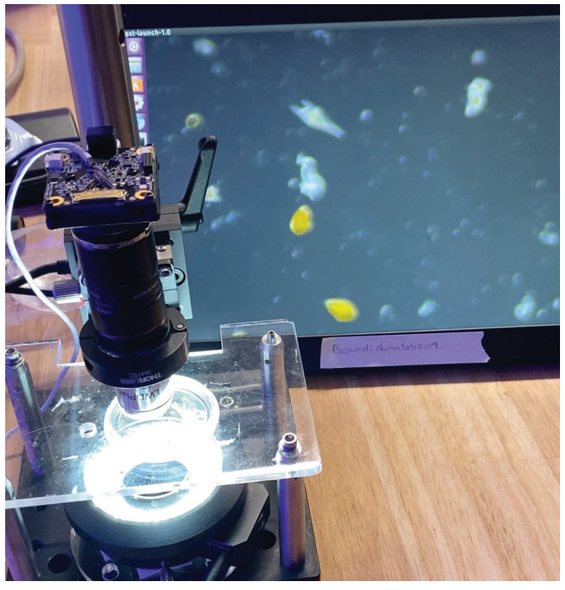
We see a world where **communities have the power to monitor and protect their own waters.** By providing highly capable, affordable, easy-to-use microscopes and real-time data to passionate individuals in coastal areas, we're working to democratize ocean monitoring. Anyone - from researchers to local fishermen - can contribute valuable data using just a PlanktoScope and a mobile phone. This grassroots approach is already generating vast datasets across diverse marine habitats, far beyond what any single research team could achieve. By putting these tools directly into the hands of those most affected, we're not just collecting data - we hope to support communities into building their own initiatives for understanding, predicting, and responding to threats to their livelihoods and ecosystems. **We see the Planktoscope network as more than a scientific endeavor; it's a movement towards collaborative, community-driven ocean stewardship and engagement.**



PlanktoPod testing, Treasure Island 2025



PlanktoScope workshop, Treasure Island Sailing Center, 2021.



PlanktoScope workshop, UC Davis, Nov. 19, 2021.



Plankto Pod e water sampling test, Treasure Island Sailing Center, 2025