Open Ocean

Open Ocean: Inventing the Future of Ocean Exploration

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Open Ocean was founded in 2017 by [Dr. Katy Croff Bell](#), National Geographic Explorer and former Vice President of the Ocean Exploration Trust. The goal of Open Ocean was to reimagine the future of deep-sea science, a field that today is far too inefficient, exclusive, and expensive to be accessible to many people. Bell selected the Media Lab because of the interdisciplinary nature of the culture, its focus on the intersection of art, science, design, and engineering, and the Lab's aspirational goal of inventing the future.

Open Ocean Team

From the start, Open Ocean worked diligently to build connections within the Media Lab and across MIT and the world. Open Ocean members hailed from numerous Media Lab groups, including Responsive Environments, Object-Based Media, Sculpting Evolution, the Learning Initiative, and several MIT labs and departments, including MIT Sea Grant, Mechanical Engineering, and the Future Ocean Lab. We worked with more than a dozen undergraduate researchers (UROPs) from across MIT and numerous graduate students through activities ranging from workshops and events to project funding and thesis advising.

MIT Students & Researchers

Open Ocean served MIT undergraduate and graduate students in a number of ways. Activities ranged from UROP opportunities and advising, funding student-initiated and led research projects, project management, SCUBA course offering, serving on Master's thesis committee, advocating for individual graduate students' funding, weekly individual mentor meetings with graduate students, fellowship grant writing, networking, and opportunities for publication, undergraduate mentoring, leading workshops, field deployment, field testing, and outreach.

External Collaborators and Funders

Open Ocean worked with dozens of external collaborators on events, research projects, training and expeditions, and other activities. These entities included the National Geographic Society (NGS), NOAA Office of Ocean Exploration and Research (OER), Lindblad Expeditions, New England Aquarium, Inter-American Development Bank, LEGO Education, and many other academic NGOs, federal agencies, and companies. An extensive list of our collaborators is included in the [Acknowledgements](#).

2018: Here be Dragons

In February 2018, six months after Open Ocean was established, we convened 200 explorers, innovators, artists, scientists, and storytellers in collaboration with NGS at an event called [Here be Dragons](#). Our goal was to identify the uncharted territories that still exist in ocean exploration and storytelling.

The first day of the event included short talks and panel discussions on six themes: Exploration and Discovery; Data Analysis and Sharing; Sea Stories; Our Thriving Ocean; Platforms and Sensors; and Democratizing the

Ocean. Throughout, participants were encouraged to imagine and share project ideas that could address challenges identified during panel discussions. They were also encouraged to publicly share resources that they could share or resources needed to solve those challenges. All panels and lightning talks were streamed live on the MIT Media Lab website and a selection of presentations on Facebook Live, increasing participation from the 200 in-person attendees to 31,000 worldwide.

On the second day, in-person participants broke into teams to create projects to address challenges in ocean exploration. The teams worked all day to refine their project ideas and pitched them at the New England Aquarium IMAX Theater that evening. Teams were then required to submit a brief proposal within two weeks of the event. Of the thirteen proposals submitted, eight projects were selected for funding, four by NGS and four by Open Ocean. Additional funding was provided to two of the projects by the Inter-American Development Bank and OER, after submission of proposals directly to those organizations. All projects were presented at [The 2018 National Ocean Exploration Forum: All Hands on Deck](#) the following November.

Four of these projects are complete; others are continuing in various iterations, and have laid the foundation for Open Ocean's focus on low-cost tools and capacity development in deep sea exploration. The [Here be Dragons Report](#) documents the event and projects in more detail.

2018: All Hands on Deck

Once Here be Dragons projects were underway, we turned our attention to hosting the [2018 National Ocean Exploration Forum: All Hands on Deck](#). This was the 6th Forum co-hosted by the NOAA Office of Ocean Exploration and Research, and focused on broadening participation in ocean exploration.

The goal of All Hands on Deck was to imagine creative new ways to make the ocean so pervasive in modern culture that everyone has a positive association with the sea. We sought participants who are passionate about ocean exploration and exemplify diversity regarding gender, culture, socioeconomics, geography, and domain knowledge. At the event, individuals early in their careers received a platform to share their work through lightning talks. Hands-on workshops and our selection of panel speakers consciously represented the diversity of forum attendees.

In addition, 40 Ocean Discovery Fellows were selected through a competitive application process. These individuals are innovators with experience in science, technology, design, recreation, entertainment, storytelling, and community building who share a passion for ocean exploration. Travel expenses were provided for Fellows to enable participation in the 2018 National Ocean Exploration Forum. Our 40 Ocean Discovery Fellows hailed from 11 US states and 17 countries around the world.

We hosted nearly 400 people at the Media Lab for this event, which resulted in numerous collaborations and projects that continue to this day, and put Open Ocean on the map as a leader within the deep-sea exploration community.

By the Numbers

- 370 people registered: 22 countries; 29 US states
- 40 Ocean Discovery Fellows awarded travel assistance: 17 countries; 11 states & Puerto Rico
- 550 livestream viewers
- 500+ attendees at Boston Ocean Day, a public ocean outreach day at the New England Aquarium IMAX Theater
- Participants represented a broad cross section of expertise, ranging from scientists and oceanographers, to comedian paleoanthropologist television presenters.

The Report

Following All Hands on Deck, participants were asked to complete three surveys to get a sense of what they took away from the event, what they planned to do as a result of it, and what they have accomplished in different timeframes (2 weeks, 3 months, and 12 months post-forum). Complete survey results are detailed in the [All Hands on Deck Report](#).

The All Hands on Deck Report offers concrete, actionable recommendations that can and should be made to encourage expanded engagement and participation in a national program for ocean exploration in the US and beyond, including (1) Diversity & Inclusion (2) Passionate Play (3) Immersive Storytelling, and, (4) Expanding the Field. The report also shares the event's impact through the many inspiring stories of attendees who sought out new career opportunities and made choices patterned after the energy of All Hands on Deck and its focus on inclusivity and intersectionality to advance ocean exploration.

2019: Training & Deployments

In 2019, Open Ocean focused on training MIT students on seagoing operations and creating opportunities to make deployments of existing and new technologies. The majority of this work was in collaboration with NGS and Lindblad Expeditions (LEX), and led to a pilot project with the goals of:

1. Training MIT students/staff, LEX Undersea Specialists, and collaborating scientists on seagoing operations, including NG Deep Sea Camera System deployment, recovery, and data download;
2. Executing Deep Sea Camera System deployments in SE Alaska and the Galápagos Archipelago aboard LEX vessels; and,
3. Building a team for future tech development, exploration, community building, and expeditions aboard Lindblad vessels and beyond.

As part of the program, we hosted two training workshops with NGS and LEX staff in Boston, teaching MIT students and collaborators to use NGS' Deep Sea Camera Systems. These training workshops were followed by opportunities for participants to sail on seven LEX/NG expeditions in Alaska, Galápagos, and the Channel

Islands. These experiences were pivotal in some students' careers, guiding some of them toward oceanographic research and conservation.

"Thank you so much for making this happen. Truly, it was the chance of a lifetime. To be a part of a Nat Geo project and to work with such a great team was seriously something straight out of my dream world and something I couldn't have imagined I'd be a part of at 24 years old."

Following the training workshops, 14 of the trainees were selected to deploy the NGS Deep Sea Camera Systems at sea aboard LEX-NG expeditions in Southeast Alaska in late June to early September aboard *National Geographic Quest* and *National Geographic Venture*, and in the Galápagos in September to October 2019 aboard *NG Endeavour II*. Over the course of 12 weeks at sea, 25 trainees sailed on LEX-NG expeditions, deploying the Deep Sea Camera Systems 53 times, and recording 126 hours of video and environmental data. Two MIT students and one Postdoctoral Researcher also had the opportunity to sail aboard *National Geographic Venture* in Alaska and the Channel Islands to field test new technologies that they had designed and built, a [MicroCTD](#), [Environmental DNA \(eDNA\) Sampler](#), and [Radiometer](#).

"I reflected a lot on how science is done, how storytelling is done, and how conservation is done in such a special place."

To date, one paper, led by Salomé Buglass, has been published, reporting on first records of the seven-gilled and six-gilled sharks found in the Galápagos Marine Reserve [\[1\]](#). A complete assessment of this pilot project can be found in the [Training & Expedition Assessment Report](#).

"I know you worked so hard to make it happen and I am so lucky, blessed, fortunate to be here. A million thank you's to you and everyone that made it happen."

2020: COVID-19 & Focus on Development

As a result of the COVID-19 impacts on our team, including cancellation of all field work, Open Ocean pivoted toward more focused research that could move forward with the team working from home. During the pandemic, we focused on: (1) research and development of sensors and platforms, particularly the [Wayfinder](#) and [Maka Niu](#) systems (2) investment in pilot research and a prototype for our [Ocean AI](#) system, and (3) research on [co-design for capacity building](#), user interviews, initiation of the [Global Deep Sea Capacity Assessment](#), as well as continuing to work with our partners remotely.

Several students also completed their Master's work in 2020, including Tyler Schoeppner's [Large Interactive Laser Lightfield Installation \(LILLI\)](#), Junsu Jang's [Tracking Marine Snow](#), and Oceane Boulais' [Emerging Computational Methodologies for Transparency in Fisheries](#).

In addition, we continued and moved the [Open Ocean Seminar Series](#) online, allowing us to invite a broader community of people from around the world. We shifted our focus to discuss new technologies, deep sea

issues, and capacity building approaches for deep sea exploration. This change was overwhelmingly successful with 530 attendees for our seven spring 2020 seminars, which continued through the summer and fall of 2020. Open Ocean Seminar speakers garnered a global audience looking for optimistic solutions for issues and challenges pertaining to ocean exploration, various domains of ocean sciences, diversity and inclusion in ocean research and water-based sports, and ocean conservation. We intentionally included artists, journalists, documentarians, and eco-entrepreneurs as speakers celebrating and acknowledging their ability to evoke change in the public mindset, where sparks of curiosity and the urgency of environmental concern can activate a larger body of ocean stewards. Through diverse speakers and a widening pool of audience members, we aimed to inspire, offer resources, connections, and trigger new ideas within our growing community.

2021: New Horizons at the Ocean Discovery League

Low-cost systems, AI-driven analysis, and capacity building are required to create a new approach to increase exploration efficiency and access to the deep sea. Only now, with recent technological breakthroughs across numerous sectors, is it possible to truly accelerate the pace of exploration by working with people on every coastline to ensure that they have the tools and abilities to explore the deep ocean for themselves.

The culmination of Open Ocean resulted in the conclusion that to make gains in ocean exploration we must invest in three areas:

- Maximizing efficiency of discovery
- Leading a global community of explorers
- Exploring the world's undiscovered places

To maximize the efficiency of discovery, we must invest in the right tools for the job, rather than fitting the jobs to the tools we already have. What if we could maximize discovery efficiency using smaller devices, sensors, and platforms for preliminary exploration and then use larger ships to follow up on identified targets with the full suite of best-available technology? In terms of data needs, the reality is that a spectrum of data gathering is ideal—from widespread reconnaissance at a lower resolution to identify the interesting areas to a focused effort using more fine-grained tools for more intensive investigation and sampling. Exploiting technological developments from outside the field now allows us to tackle many existing and emerging research priorities with low-cost, low-bandwidth, distributed swarms of sensors and platforms (e.g. [Maka Niu](#), [Wayfinders](#)), as well as advanced AI-driven tools for data analysis, access, and archive (e.g. [Ocean AI](#), [LILLI](#)).

The second—and equally important—priority research area is community-driven exploration. Today, ocean exploration is conducted primarily by developed, western nations with large research vessels and other significant assets. We are bringing together a creative network of organizations from cruise lines such as Lindblad Expeditions to the Polynesian Voyaging Society to local communities in developing nations. With them, we are co-designing and deploying new technological systems and programs for individuals to explore their own waterways (e.g. [My Deep Sea](#), [My Backyard](#), [Co-Design](#), [Deep Sea Camera System Training](#)). This

community-driven capacity development work aligns with a new global effort — the UN Decade of Ocean Science for Sustainable Development, which launched in 2021.

Finally, we must seamlessly bring together new technologies and a new community to explore the vast majority of the never-before-seen deep sea. Ultimately, we envision a spectrum of tools for exploration, optimized systems for collecting data globally—from big research vessels and sophisticated vehicles to youth with their very own playful robots deployed on a massive scale that can all contribute their data to an online platform for ocean discovery. That system needs to be intuitive; easy for a user to discover, analyze, and understand the data. The information and insights gleaned from the data must also be societally relevant—available for all kinds of applications from learning to science, storytelling, policy, and the economy—so we can use the ocean without using it up.

In May 2021, the Open Ocean Initiative at the MIT Media Lab ended. Still, the three focus areas—technology, community, and exploration—live on as the founding basis for the new non-profit, the Ocean Discovery League (ODL), which launched in the summer of 2021. ODL's mission is to accelerate exploration of the deep ocean through low-cost, easily accessible systems to enable people historically excluded from the field to explore and understand the deep sea. Expanding the deep-sea exploration and research community while broadening our knowledge of the ocean will allow us to make wise decisions regarding the ocean's use, management, and protection, resulting in humankind thriving on earth now and into the future.

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Open Ocean Core Team

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