Open Ocean

My Deep Sea, My Backyard Report

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Many nations have deep-sea environments within their maritime Exclusive Economic Zones (EEZs), yet only a small portion have a way to explore them. Lesser economically developed countries have restricted access to their deep oceans despite their occupying substantial parts of their EEZs. This dearth of technological capability and knowledge leads to a lack of exploration, inappropriate or inadequate management decisions, and unaware populations. Our goal was to enable countries around the world to explore their own deep-sea backyards using low-cost technology, while building lasting in-country capacity.

My Deep Sea, My Backyard

My Deep Sea, My Backyard (MDSMBY) was conceived during ‘Here Be Dragons’, a convening of explorers, innovators, artists, scientists, and storytellers to identify the uncharted territories that still exist in ocean exploration and storytelling, and address gaps in our understanding and sharing of the ocean, hosted by K.L.C. Bell at MIT Media Lab in February 2018. From her own experience in Trinidad and Tobago, D. Amon questioned how deep-ocean exploration could be enabled in countries without the means currently. At the same time, R. Rotjan had been trying to enable deep-sea capacity in Kiribati. This led to a self-selected collaborative team coming together to conceptualise and propose potential solutions.

With support from The National Geographic Society (50,000USD) and the Inter-American Development Bank (IDB) (15,000USD), a pilot study was designed to provide deep-ocean access and increased technological capacity in Kiribati and Trinidad and Tobago. These two Small Island Developing States (SIDS) were chosen because of pre-existing relationships between collaborators and/or a need expressed by nationals. The approach had three aims:

1. To build lasting capacity evidenced by country nationals (ideally a scientist, student and communicator) exploring the ocean and then communicating the findings;
2. To enable technology transfer via access to new, innovative, low-cost deep-ocean technology that can be used from any platform;
3. To engage a broad group of stakeholders in deep-sea exploration and science.

MDSMBY’s guiding principles were to collaborate as equal partners, work within the cultural norms and customs of each country, and build each pilot study according to the needs, constraints, and/or interests of in-country collaborators.

Exploring the Deep Ocean in Kiribati

The Republic of Kiribati is a least developed country (LDC) and SIDS, with a lower-middle-income economy by per capita Gross National Income (GNI), located in Oceania. Kiribati consists of 33 islands spanning 46 degrees of longitude across three archipelagos stretched across all four hemispheres, in the equatorial Pacific Ocean. These archipelagos comprise the 12th largest country by ocean area, but the 24th smallest country by land area. Average elevation is only 3 meters above sea level, but maximum ocean depth is >7,000 m. Deep water (>200 m) can be found less than 4-5 km from any point of land, and occupies 99.6% of the EEZ.

The MDSMBY Kiribati case study was jointly undertaken by the Republic of Kiribati, Boston University, the University of Rhode Island, the PIPA Conservation Trust, and the PIPA Implementation Office. The project was co-led by the PIPA co-Chief Scientists, the Executive Director of the PIPA Conservation Trust, and the PIPA Education and Outreach Officer in the PIPA Implementation Office. The MDSMBY Kiribati case study utilized innovative deep-sea technology, the “ReelCam”, which was a custom-built camera system developed at the University of Rhode Island (B. Phillips) and deployed on a deep-sea electric fishing reel [1]. It consisted of a GroupB pressure housing for a GoPro type HD camera, and an LED light (3500 lumens) mounted on an aluminum frame with two commercial spherical trawl floats mounted on the top of the Euro Products frame. Approximately 10 kg of dive weights were hung ~1 m below the camera via a monofilament fishing line. The entire camera and weight assembly was attached to a Lindgren-Pitman electronic fishing reel loaded with a braided Tuf-Line fishing line. The camera package and weights were designed to be negatively buoyant and sink until the weights hit the seafloor. At the same time, the camera with its floats were positively buoyant and designed to hang suspended approximately a meter above the seafloor, thereby allowing for a well-lit view of the benthos. Star-Oddi depth and temperature logger sensors added the potential for basic oceanographic metadata.

This system provided relatively easy-to-assemble deep submergence exploration tools, constructed from commercially available products with an entire cost approximating 10,000 USD. Sofar Trident ROVs were also used as a shallow-water and mesophotic exploration tool, chosen for ease of use and freedom of platform (can be deployed from any platform).

The team conducted over a week of training in the classroom and in the field, for government fisheries officers, University of the South Pacific students, science communicators and outreach officers, and multiple representatives from related government agencies (Ministry of Environment, Land, and Agricultural Development, Tourism, Fisheries). Training on use of the ocean-exploration technology was undertaken onshore and in the field. There was also a stakeholder consultation for individuals representing several arms of the Kiribati Government (e.g., MELAD, Fisheries, Tourism, etc.), the Government Police, several local villages, and the University of South Pacific (USP) Tarawa Campus.

During training, the first successful deployments of the ReelCam were undertaken in true collaboration with in-country partners. The ReelCam successfully captured the first deep-water images in the Gilbert Archipelago in the waters between North and South Tarawa. These images were a proof of concept for the technology, platform, and approach. The Trident ROVs were used by the Ministry of Fisheries to conduct shallow coral surveys, limited exploration, and as a communications tool. Real-time viewing on a handheld tablet provided instant excitement and engagement, which was a powerful tool for participants. The Trident's ease of use, which included deployment from many platforms such as bridges, causeways, small pangas (outboard fishing vessels) and repurposed public sector boats such as police vessels, was a large contributor to its success. In particular, the Trident ROVs were an effective tool for helping participants to become comfortable with ROVs and higher tech equipment and helping to visualize familiar (shallow) and novel (mesophotic) environments with the 100m tether. To our

knowledge, the mesophotic images and video captured by the Trident ROV were the first mesophotic data from the Gilbert Archipelago.

The opportunity to demonstrate and use these deep-ocean tools was key to facilitating communication about the deep ocean. Outreach efforts included engagements with more than 2,500 students from elementary through college-school level, as well as meetings with village elders, fishers, and the highest levels of government. Additionally, this project gained coverage in multiple online blogs and articles, and a national radio interview.

There were, however, also challenges during the Kiribati case study, namely with technology. The ReelCam system lacked real-time feedback while submerged, making it difficult to determine when the system had reached the seafloor. Despite the clear interest in conducting this work by partners and workshop participants, deep-ocean exploration was not conducted in the year following training, primarily because there was no funding for fuel for a vessel to get into deep water. Challenged with the ROV Trident included difficulty facilitating software updates because of the limited internet. Additionally, the ROV Trident would be more successful as a science tool with additional sensors to enable measurements of depth and other oceanographic parameters such as temperature, O₂, and salinity. Finally, the ReelCam instrumentation was lost at sea during the second training period, and COVID-19 has impeded delivery of a replacement. However, interest in the technology and its use in Kiribati has been consistently communicated, which is an indication of the pilot project's success.

Exploring the Deep Ocean in Trinidad and Tobago

Trinidad and Tobago is a developing country, high-income economy by per capita GNI, and a Small Island Developing State. It is the most southerly island nation of the Caribbean archipelago and borders the South American mainland. The island of

Trinidad holds most of the residential population as well as the country's capital, Port-of-Spain. Trinidad and Tobago sits on an extensive continental shelf that stretches 80-100 km from Trinidad's east coast, a much greater distance than those observed within the EEZs of other Caribbean nations. Despite this, Trinidad and Tobago's deep ocean still occupies over 54,000 km² (69.1%) of the EEZ, with depths ranging between 200 to 3500 m.

The MDSMBY Trinidad and Tobago case study was jointly undertaken by the COAST Foundation, Inter-American Development Bank (IADB), MIT Media Lab, National Geographic Society (NGS), the National Institute of Higher Education, Research, Science and Technology (NIHERST), SpeSeas, and The University of the West Indies - St. Augustine (UWI). The MDSMBY Trinidad and Tobago case study utilized an innovative Deep-Sea Drop Camera developed by National Geographic's Exploration Technology Lab (ExTech). This is an untethered free-falling system capable of diving to 6,000 meters and staying submerged for more than a day [2]. A Sofar Trident ROV and a Blue Robotics BlueROV2 ROV, both rated to 100-meters depth, were also used as shallow-water and mesophotic exploration tools for their ease of use and freedom of platform.

One week of training (13-17 August 2018) was conducted with two scientists, three students, a science communicator, and four marine engineers from Trinidad and Tobago. Additionally, two scientists participated from the University of the West Indies Mona Campus and one scientist from the University of the West Indies Cave Hill Campus. Training on use of the ocean-exploration technology was undertaken onshore and in the field. Unfortunately, the training was impeded by the airline temporarily losing the Deep-Sea Drop Camera, leading to its late arrival, preventing the Trinidad and Tobago team from getting enough hands-on time with the equipment to feel comfortable during the training workshop. Nonetheless, within this week of training, the team conducted stakeholder consultations with over 80 individuals representing

several sections of the Government of Trinidad and Tobago (e.g., Ministry of Planning and Development, the Environmental Management Authority), the Coast Guard, the oil and gas industry, local environmental NGOs, National Institute of Higher Education Research, Science and Technology, and academic institutions (e.g., The University of West Indies, University of Trinidad and Tobago). This opportunity allowed communication about the deep ocean, the pilot phase, and identified key priority areas for investigation. In an effort to counteract the lost hands-on training time during the training week, one of the students joined project partners in another expedition in Bermuda after the initial training period.

There were many challenges during the Trinidad and Tobago case study. There were several attempts during the year following training to undertake deployments with the Deep-Sea Drop Camera. Unfortunately, recurring technical issues with the Deep-Sea Drop Cameras, which could not be resolved without the in-person assistance of a ExTech engineer, led to long periods of inactive use. This was further complicated by the need to mobilise ad-hoc teams quickly given the reliance on opportunistic vessels within budget range capable of transiting the long distances to get to Trinidad and Tobago's deep ocean, especially as the Government of Trinidad and Tobago does not have such research vessels. Although suitable vessels were sourced, vessel availability usually aligned with periods when the equipment was not working or key members of the Trinidad and Tobago team were abroad, preventing research trips from moving forward. Despite the clear interest in conducting this work, there were no successful Deep-Sea Drop Camera deployments during the project.

While the training and science goals fell short of what was envisioned, the Trinidad and Tobago team engaged over 250 students from elementary through high-school level. The Trident ROV was used to assist SpeSeas as a communication tool and was an effective tool for helping students and other participants to become comfortable with ROVs and higher tech equipment. Additionally, there was island-wide coverage on

national television, radio, and newspapers, as well as on multiple online blogs and articles.

Lessons Learned & Recommendations

There have been many recently-published insights on the steps needed to achieve genuinely inclusive and equitable ocean scientific research and conservation, including capacity-building initiatives [\[3\]](#)[\[4\]](#)[\[5\]](#)[\[6\]](#)[\[7\]](#)[\[8\]](#). In the interest of propelling the ocean-science community at large to critically assess past capacity-building projects and improve others in the present and future, we have weighed the MDSMBY pilot process and outcomes against our initial objectives to determine the lessons that were learned throughout the process, as well as our recommendations for future capacity-building initiatives. The results of this analysis is currently in review for open-access publication in the *Philosophical Transactions of the Royal Society of London B* [\[9\]](#).

In addition to lessons learned with regard to specific in-country activities, this project also led to much discussion about deep sea capacity worldwide, specifically, *which coastal countries have what kinds of capabilities to conduct exploration and research in the deep ocean?* We quickly realized that there is no globally accepted answer to this question, and in order to scale up the efforts of MDSMBY on a global scale, we needed to address this issue. As a result, the [Global Deep Sea Capacity Assessment](#) was launched in 2021 to create a baseline understanding of technical and human deep sea capabilities worldwide. The results of this new initiative will be publicly released in early 2022.

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