



How do we make deep-sea technology more relatable to the public? How do we convey the importance of deep-sea tech as we explore our world's largest unexplored environment? Deep-sea technology is the reason why we're able to learn more about the deep-sea, yet on social media platforms deep-sea technology isn't as interesting or engaging as the creatures that reside there. MADISON HEARD is an educators and is working to identify which factors for online deep-sea technology posts are successful in creating an audience that cares for the deep-sea creatures and the technology that helps us understand them.

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A surprisingly high diversity of micro-organisms has been found in deep-sea sediments using DNA sequencing. However, modern DNA sequencing techniques do not differentiate DNA from live viable cells from dead cells. JESSICA BULLINGTON, a PhD student at UNIVERSITY OF HAWAII, MANOA is developing a standard method of removing non-viable microbial DNA from marine sediment samples using viability PCR. This work will allow for more accurate measurements of microbial diversity in deep-sea sediments.

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Even though advances in sensing technology have increased our ability to collect long-term, high-resolution biogeochemical data, there are still mandatory corrections that need to be considered. For instance, sensors have the tendency to accumulate random inaccuracies over time (“gain”), thus causing measured chemical values to drift over time. To correct for these ‘gains’ KYLE CONNOR is a graduate from UC SAN DIEGO and proposes to construct an air calibration system that will be applied to oxygen optode sensors before and after deployment. This is possible since the molar fraction of atmospheric oxygen is accurately known, meaning that we can calculate accurate oxygen values.

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The midwater zone comprises the ocean layer between 200 and 1000 meters depth where light is limited, temperature is cold, and food is scarce. VANESSA STENVERS is a Masters student at UNIVERSITY OF GRONINGEN and is focused on helping to unravel some of the mysteries surrounding live animals in this difficult to reach environment with the help of technology like remotely operated vehicles (ROVs). More specifically, she will be investigating parasitism in two deep-water cephalopods as they are likely to be important vectors transferring parasites throughout the food web.

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“Connecting the Public to the Deep Sea”



“Separating DNA from live versus dead microbes in deep-sea sediments”



“Even Underwater Sensors Need a Breath of Fresh Air.”



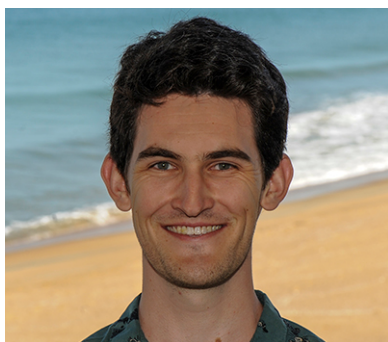
“A Window to Life in the Deep”





MBARI has a rich collection of underwater video and photographs, much of which has been professionally analyzed and curated by researchers. EDGAR REYES, an undergraduate student at CALIFORNIA STATE UNIVERSITY, MONTEREY BAY is exploring and testing automated classification and analysis techniques to detect and classify organisms of interest to MBARI scientists.

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Krill are one of the key organisms that help create and sustain the strong marine food web that supports the California Current marine ecosystem. Despite this importance, we are not certain about how different water masses affect krill growth. NATHAN KEANE graduated from UC SAN DIEGO and will be using a high resolution numerical model to study how the physics of the CCS move krill around throughout their life cycle. This will allow us to see what source water feeds into the growth of krill hotspots and study how sensitive the krill hotspots are to different water masses. This can greatly influence initial conditions for more data driven forward biological models.

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Understanding the effects of climate change is important in mitigating any possible negative effects to marine and human communities. KELSEY NICHOLS is an undergraduate student at UNIVERSITY OF HAWAII, MANOA seeking to understand how the presence of predators and changing environmental conditions affect the physiological response of red abalone (*Haliotis rufescens*)

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MBARI's fleet of AUVs is growing and the next set of experiments plan to use many of these robots working cooperatively to efficiently cover a wide swath of ocean. However, the current simulator capabilities are not able to simulate multiple AUVs communicating with each other, and critically, do not have a visually friendly interface. ETHAN PARK is a Masters student at NORTHWESTERN UNIVERSITY and is building a simulator in Gazebo that will bring this capability to MBARI.

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“Automatic detection and classification for the deep-sea world”



“Krill hotspots: What is affecting them?”



“Saving our marine communities one predator at a time.”



“Simulating swarm robotics with LRAUVs”





NORMAN SWEEN is a undergraduate student at SANTA ROSA JUNIOR COLLEGE and is analyzing the density and distribution of *Munidopsis* in relation to episodic organic carbon fluxes from 1989 to 2017 with a comparison of time periods [1989-2010] to [2011-2017].

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Station M has become a great example of what a time-series can do – processing years of data to gain a better understanding of what is happening on the seafloor 4000 meters down. The jelly *Benthocodon pedunculata* is very prevalent at these depths and may be a good indicator of several factors contributing to life in the deep. APRIL CURNUTT is an undergraduate student at MONTEREY PENINSULA COLLEGE and is studying the change in *B. pendunculata* density over time in relation to food supply, to contribute to ongoing research at Station M.

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MARISOL FIGUEROA is a graduate student at MOSS LANDING MARINE LABORATORIES and is utilizing empirical dynamic modeling to analyse the El Nino related interactions between *Dosidicus* and fish and between *Mitrocoma* and other jellies. She is also creating time series on different oceanographic conditions and species distribution maps surrounding the jellies.

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Marine profiling floats are one of the most rapidly growing tools for collecting worldwide ocean and climate data. These floats, however, lack lateral position control and can drift on/off shore in undesirable ways. CHARLIE WATKINS is an undergraduate student at JOHNS HOPKINS UNIVERSITY and is working on developing a system to use 'inexpensive inertial measurement units (IMUs)' to measure the drift of a float due to ocean currents. With their capability, profiling floats could become far more controllable and effective.

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“Does climate change make crustaceans more frisky down deep?”



“Little red jellies of the deep: a small part to a larger picture”



“Physical vs biological: an everchanging influence.”



“Achieving more robust sensing and control with profiling floats”





We are interested in the microscale movements of small invertebrates and how they correlate with macroscale behavior and ocean flow. To study these multiscale phenomena, a camera with a microscope lens is mounted on a moving stage and keeps a specific part of the animal (e.g. a leg or flagellum) in the frame. AARON RAY is an incoming PhD student in Robotics at MIT and hopes to apply his skills in robotics to augment the research capabilities of marine researchers.

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Environmental DNA is a rapidly evolving method for monitoring biodiversity through the sequencing of DNA shed by organisms. However, as a relatively nascent sampling tool, many uncertainties exist in the applications of eDNA and its accuracy. MARKUS MIN graduated from UC LOS ANGELES and is looking into eDNA samples collected simultaneously with CTD, acoustic, and trawl data. By integrating different data types, he is looking to expand the applications of eDNA and gain new biological insights into the dynamics of Monterey Bay.

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Data collection rates are rapidly outpacing the speed at which it can be analyzed by humans. CONNOR HALE is a senior at CSU MONTEREY BAY and is working on machine learning models to determine the efficiency of a computer compared to a human expert at detecting and classifying underwater species. Data collection will only increase, so we must do something to make the data meaningful.

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Climate change may significantly alter surface productivity, but what effect does this have on the benthic community 4000 meters below? VIRGINIA BIEDE is a deep-sea ecologist starting a PhD program at FLORIDA STATE UNIVERSITY and is using MBARI's Station M dataset, one of the longest running time-series of deep-sea imagery, to investigate and analyze community structure after an influx of carbon from the surface to the benthos. Understanding the effects of a changing climate is vital to sustainable management.

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“High precision tracking of invertebrates in video”



“Ecology in a bottle of seawater”



“Bridging the gap between data collection and practical application”



“Climate and the deep-sea: how does variable surface productivity effect the deep-sea?”





Great white sharks are an important ocean predator and learning more about their migratory patterns and behavior allows us to better inform researchers and policy makers in order to protect and manage their population. There is an area between Hawaii and California where great white sharks gather every year and scientists do not know why. GABRIEL MARCELO SANTOS ELIZONDO is an undergraduate student at CAL POLY SAN LUIS OBISPO and is helping to build a more cost efficient camera that is placed on these charismatic creatures to gain insight into their behavior and maybe solve this mystery.

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Long-range autonomous vehicles are powerful instruments for collecting environmental data but the mission scripts are often too technical for biologists without programming experience to write. For this reason, MBARI has developed TethysC, a domain specific language that is more user-friendly. RILEY RETTIG is an undergraduate at WELLESLEY COLLEGE and is continuing this development and expanding the language to support more data structures.

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The mechanism by which many deep-sea species bioluminesce is unknown. MAGGIE COOPER is a recent graduate from ECKERD COLLEGE and is working on expressing and characterizing the protein responsible for the vibrant glow of *Thalassocalyce* and also will be working to shed light on the bioluminescence of a newly discovered jelly.

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Due to the quantity of information and data shared within VARS, the MBARI Video Lab is looking to create an online portal that allows researchers to easily explore and visualize video lab data. This will facilitate the use of VARS data as well as allow the video lab to better maintain the system. JOSHUA ZAHNER is an undergraduate at ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE and is creating an online data exploration and visualization portal for the VARS database.

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**“Shark Café cam: a look into
great white shark behavior
and migration”**



**“The bridge from science to
technology is open from both
sides”**



**“Bringing light to
the depths.”**



“Needs a title??”





Environmental DNA (eDNA) samples are rarely used to infer abundance of organisms, however by comparing the quantity of DNA filtered from a water sample to population census data, we can assess eDNA as a tool for population monitoring. KAREN BOBIER is a PhD student at UNIVERSITY OF GEORGIA and is using samples from Scotts Creek, CA to assess the quantity of Coho Salmon in the river and assessing the efficacy of eDNA quantification to daily population counts

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“Using eDNA to detect and quantify aquatic species”



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