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Abstract and Title Booklet

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Using BRUVs to Evaluate Impacts of Offshore Energy Development on Demersal Species

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With the continued interest in offshore energy development in the Northeast U.S., there is a need to monitor the fisheries resources that may be impacted by the installation and operation of permanent, hard structure in a region primarily made of sandy bottom habitat. An emerging survey method in this region is the use of Baited Remote Underwater Video (BRUV) systems. BRUVs are a non-extractive, low-impact fishery survey method that can be deployed in structured habitats difficult to access by larger sampling gear and survey vessels. Our project utilized BRUVs within a multi-method Before-After Control-Impact (BACI) fisheries monitoring survey to assess pre-construction abundance and assemblages of structure-associated species in Ørsted's Ocean Wind 1 wind farm off New Jersey. From 2022-2023, 390 hours of video footage was collected over 42 seasonal survey days. Our initial priority was to develop an efficient method for processing the vast amount of footage collected. To accomplish this, we evaluated the effectiveness of two subsampling methods by comparing MaxN (the maximum number of individual fish for a given species seen in a single frame) results to those obtained from full-duration videos for our 2022 deployments. The methods tested were: 1-minute scored per 5 minutes, and 1-frame scored per 30 seconds. The 1-minute subsampling method yielded results statistically similar to the full-watch

approach, while requiring only one-sixth of the processing effort. Using the identified subsampling method, the remaining deployments were scored to capture different ecological metrics over seasons and site types. We identified 19 taxa across 16 families, with the commonly observed species (COS) being Black sea bass, Spiny dogfish, and Sea robins. Additionally, average arrival and accumulation times for target and COS finfish indicate future BRUV deployment durations can be shortened from their initial 60-minute soak time. Moving forward, we look to increase our BRUV sampling efforts and optimize their effectiveness for these regional applications. These optimizations include modifications to survey and gear design and using existing footage as training data for artificial intelligence machine learning (AI/ML) models that will automate future video scoring efforts.

Paige Hojdar, University of Rhode Island, Undergraduate Student

Distinct Chemosynthetic Symbiosis Patterns in Deep-Sea Mussels from Kick 'Em Jenny Volcano

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Deep-sea mussels of the genera *Bathymodiolus* and *Gigantidas* are foundation fauna able to survive at food-limited deep-sea cold seeps due to their symbiotic relationship with chemosynthetic bacteria. These bacteria, either methane-oxidizing (MOX) or sulfur-oxidizing (SOX), break down the chemicals present in seeping fluids to generate the energy needed for the primary nutrition of their host. Here, we used gene barcoding to survey a collection of deep-sea mussels and their associated bacterial symbionts from cold seeps on the Kick ‘Em Jenny submarine volcano (Grenada). Altogether, we uncovered the presence of two mussel species complexes: *B. boomerang/ B. heckerae* and *G. mauritanicus/ G. childressi*. In the 14 *B. boomerang/ B.heckerae* individuals we surveyed, both MOX and SOX symbionts were consistently present. In contrast, only MOX symbionts were detected in association with the two *G. mauritanicus/ G. childressi* individuals, though the low sample size for this species complex makes it difficult to draw definitive conclusions about symbiont association patterns. Ultimately, our work suggests that, despite co-occurring at the same cold seeps, these two species complexes have distinct patterns of symbiont association and may consequently have

different nutritional dynamics. The purpose of this research is to further understand the distribution and diversity of deep-sea mussels and the symbionts that allow them to survive at deep-sea cold seeps.

Ashly Martinez Rodriguez, University of Rhode Island, Undergraduate Student

How Real-Time Point Clouds Advanced the Exploration of Shipwrecks

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This summer, the NOAA Ocean Exploration Cooperative Institute (OECI), one of the sponsors of the Lake Ontario National Marine Sanctuary expedition (May 17–31, 2025), explored Lake Ontario with a Remotely Operated Vehicle (ROV). The team utilized the HD3 from JM Robotics, which can survey up to 300 meters, to investigate and map historic shipwrecks. We utilized a VOYIS Discovery Stereo Camera attached to the HD3 to generate point cloud models of shipwrecks in real-time. This method allowed us to collect data more consistently and efficiently, enabling surveys of multiple shipwrecks per day—17 in two weeks. The quality of the live point cloud models generated was exceptional, allowing us to immediately see details and identify areas that required additional coverage.

The real-time point cloud generation used a software called VSLAM. This precise tool enabled mapping and localization to build a virtual environment of shipwrecks. Additionally, the software integrates multiple data sensors, such as LiDAR and IMU, to obtain accurate and complete image coverage of the wreck. This research addresses the question of how advanced ROV-based 3D modeling can improve efficiency, resolution, and preservation outcomes of shipwreck surveys in Lake Ontario and elsewhere.

Preservation is vital, as these artifacts have been underwater for decades and are deteriorating. Without proper surveys, much historical information would be lost. Using advanced technology such as the HD3 ROV, also named Rhody, makes it possible to document multiple shipwrecks with high accuracy, resolution, and mobility. These new surveys provide new data and update previous data, giving NOAA scientists the ability to study shipwrecks and their histories more effectively.

Operationally, we first align the research vessel with the shipwreck's mapped location. Before deployment, we complete a checklist to verify the HD3's motor functions and safety systems. The pilot then launches the ROV, navigates to the wreck, and familiarizes themselves with the site's layout before beginning the 3D survey. After the mission, the ROV is recovered, secured, and data management procedures are followed. This includes collecting pilot video, subsonic data, VOYIS data, and telemetry logs, all stored under a standard naming convention.

Onshore, we use software called Reality Capture to process the raw data into high-quality 3D models, which are then delivered to NOAA. These models reveal structural details of the shipwrecks, providing valuable information for marine biologists, archaeologists, and historians.

The significance of our findings is considerable: high-resolution 3D modeling of shipwrecks not only advances historical and archaeological research but also contributes to NOAA's goals of resource preservation, safety hazard identification, and improved survey methods.

Jasper Meagher, University of Rhode Island, Graduate Student

Lessons from the Archive: Standardizing Sampling Efforts for Quantitative Benthic Habitat Mapping

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Benthic habitat mapping is an essential tool for both seafloor exploration and ecological studies as it provides an assessment tool to better understand the distribution of species and habitat. Scientists can use resulting maps to answer questions regarding species diversity, changes through time, and impact assessment, leading to stronger conservation and management efforts. However, between different fields and across individuals, data collection and sampling efforts are widely varied (e.g. difference in area coverage, total hours of video, etc.), often resulting in incomparable results. This challenge becomes even more pronounced due to the cost and time limit of deep-sea benthic mapping missions. Therefore, teams have turned to archived exploratory datasets; but there is concern that there is not enough data to assemble precise and accurate habitat maps that could supplement or replace dedicated efforts. Here, we investigated the utilization of archived exploration data in order to develop a sampling effort metric, in area (m2), for benthic habitat mapping. We applied this investigation to an exploratory dataset of a cold-water coral community off the southwest continental margin of Greenland. We randomly reduced data and compared metrics of interest (species accumulation, Shannon and Simpson's diversity metrics) across each reduced dataset. Given the metrics of interest in a cold-water coral community, we determined that an estimated seafloor area of 3,887.44 m2, about 75% of the total viewed area of the seafloor, was enough effort to capture an accurate representation of the community. We are currently applying this methodology to other exploratory datasets of cold-water coral, cold-water sponge, and hydrothermal vent communities to determine if the 75% standardized sampling effort metric is consistent across a variety of deep-sea benthic habitats. Not only this, but this value may also establish a minimum area of seafloor needed to provide to AI training models to streamline data processing. Finally, this will culminate in a standardized sampling effort that others can use to assess their archived and exploratory datasets and inform their conservation efforts.

Nick O'Connor, University of Rhode Island, Undergraduate Student

Describing Spatial Trends in the Relative Abundance of Fishes Near an Artificial Reef Off Southern New Jersey

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Artificial reefs enhance the productivity of fisheries, promote species richness, and serve as a habitat refuge for commercially and recreationally important species such as Black sea bass (*Centropristis striata*). However, assessing fish communities in these structured habitats can be challenging as traditional survey methods, such as bottom trawls, are difficult to employ. Chevron traps have been used as an alternative survey method in these types of environments, often complemented by underwater video cameras to enhance species detection and ensure traps are fishing effectively. The

objective of this study was to use video footage collected from Chevron traps to examine whether there was a change in abundance of a structure-associated species (*C. striata*) and sand-associated species (sea robin species, *Prionotus spp*.) with increasing distance from an artificial reef site in New Jersey. Chevron traps were deployed seasonally during 2022 at the Atlantic City Artificial Reef as part of a broader fisheries survey. At each deployment, six camera-mounted Chevron traps were set at 200-meter intervals for 90-minute deployments. For three fall deployments, the first 60 minutes of footage were analyzed, and observed species were identified to their lowest taxonomic level. Structure-associated species (*C. striata*) showed higher abundance within 200 meters of the reef, while sand-associated species (*Prionotus spp*.) increased beyond that distance. No significant difference in abundance was detected by trap distance for either species; however, the abundance of *C. striata* varied between deployments ($p = 0.019$), likely due to differences in environmental conditions. These findings inform the design and placement of artificial reefs and future fishery surveys in structured environments.

Philip Yang, University of Rhode Island, Graduate Student

Offshore monitoring: measuring biophysical variables using a small, low-cost autonomous benthic lander at mesophotic depths

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Despite the many technological advancements over the last half-century, measuring seabed conditions in the ocean remains challenging at high-temporal resolutions over long periods (months to years). Currently, typical datasets on abiotic conditions at the seabed are gathered by remotely operated or autonomous underwater vehicles (ROVs, AUVs), long-term moorings, and/or CTD profiling casts. To understand the local environment offshore, measurements are required across different scales of space and time, and oceanographic benthic landers offer unique advantages to solve some of these monitoring problems. Landers range in size and can be utilized as adaptable platforms equipped with advanced sensors to autonomously measure a variety of environmental conditions at high-temporal resolution (seconds to hours). Landers also possess a lower seafloor profile compared to moorings that rise in the water column, can be moved to different locations with relative ease, and leave little impact on the environment where they are deployed in. Here, we present a small (~0.5 m^3) benthic

lander, dubbed CETO (Coral Ecosystem Timeseries Observer), that was designed and built to monitor abiotic conditions in mesophotic (~30 m to 1% surface light depth) coral ecosystems as part of the effort to restore mesophotic and deep benthic communities injured by the *Deepwater Horizon* oil spill. CETO has been deployed and recovered by medium-size ROVs, and future versions could be equipped with acoustic releases that allow recovery without ROVs. From 2024 to 2025, over a 375-day deployment, two CETOs ~1 km apart (at depths of 34 m and 87 m) successfully measured seven ecologically relevant biophysical parameters (photosynthetically active radiation, dissolved oxygen, temperature, pressure, conductivity, and optical fluorescence and turbidity) and tilt-current meters placed ~1 m from the landers measured two more variables: current direction and speed. Several technical lessons were learned from this lengthy deployment, such as how durable ASA 3D printed filament can be under constant immersion. This system, and future ones that could improve upon it, offer great utility and potential for monitoring spatiotemporal conditions offshore.