Photogrammetric Analysis Reveals Distinct Topographic Footprints for Stony Coral Genera in Dry Tortugas National Park

Christina Mallica *[1], Vincent Lecours[2,3], and Michael Colella[1]*

[1]Florida Fish and Wildlife Research Institute, Saint Petersburg, FL, USA

[2]Laboratory of Expertise and Research in Applied Geography, University of Quebec in Chicoutimi, Canada

[3]School of Forest, Fisheries, and Geomatic Science, University of Florida, Gainesville, FL, USA

Structural complexity is well understood to influence the biodiversity, productivity, and ecosystem functionality of coral reefs through niche diversification. Conventional *in situ* techniques for measuring rugosity, such as the tape-and-chain method, are insufficient for characterizing reef complexity. Digital surface models (DSMs) created through photogrammetric techniques enable a more accurate reef characterization through raster metrics such as variability, slope, and curvature. Massive reef-building corals are highly susceptible to stressors and are typically replaced by weedier corals post-disturbance that decelerate calcification rates and result in reef-flattening. Therefore, generating topographic footprints of stony corals with these structural metrics is critical to advance our understanding of how disturbances might alter reef function. This study utilizes Structure-from-Motion photogrammetry to create orthomosaics and DSMs of five monitoring sites in the Dry Tortugas, collected as part of The Florida Fish and Wildlife Conservation Commission's Coral Reef Evaluation and Monitoring Program (CREMP). From the models, coral colonies were then identified to genus and annotated as polygons in ArcGIS Pro. This study found that when divided into functional groups (i.e., massive reef-builders vs. weedy opportunistic species), stony corals were topographically distinct with varying levels of contribution to the reefs' overall structural complexity. Massive corals such as *Orbicella*, *Colpophyllia*, *Montastraea*, and *Pseudodiploria* had the highest relative abundance and were also shown to provide the highest structural complexity. Specifically, they had the highest topographic position index, slope, and profile curvature, all of which together are indicative of rugose, steep, and convex forms. We also found that within the massive reef-builders, there was a clear topographic distinction between star corals (*Orbicella*, *Montastraea*) and brain corals (*Colpophyllia*, *Pseudodiploria*) based on their differing growth morphologies. Using this information, we can begin to create 'topographic signatures' for coral genera, which could be utilized in large-scale mapping efforts to efficiently characterize benthic community structure or serve as the foundation for machine learning capabilities to automate species identification in DSMs. With the emergence of stony coral tissue loss disease in the Dry Tortugas in 2021 and a mass bleaching event in 2023, it is also critical to determine how a potential loss of reef-building corals will impact reef functionality and ecosystem services moving forward.