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UTILIZING UNDERWATER THREE-DIMENSIONAL MODELING TO ENHANCE ECOLOGICAL AND BIOLOGICAL STUDIES OF CORAL REEFS

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Abstract. The structural complexity of coral reefs profoundly affects the biodiversity, productivity, and overall functionality of reef ecosystems. Conventional survey techniques utilize 2-dimensional metrics that are inadequate for accurately capturing and quantifying the intricate structural complexity of scleractinian corals. A 3-dimensional (3D) approach improves the capacity to accurately measure architectural complexity, topography, rugosity, volume, and other structural characteristics that play a significant role in habitat facilitation and ecosystem processes. This study utilized Structure-from-Motion (SfM) photogrammetry techniques to create 3D mesh models for several Hawaiian corals that represent distinct morphological phenotypes. The orthophotos and digital elevation models generated from the SfM process were imported into geospatial analysis software in order to quantify several metrics pertaining to 3D complexity that are known to affect ecosystem biodiversity and productivity. The 3D structural properties of the reconstructed coral colonies were statistically analyzed to determine if the each species represents a unique morpho-functional group. The SfM reconstruction techniques described in this paper can be utilized for an array of research purposes to improve our understanding of how changes in coral composition affect habitat structure and ecological processes in coral reef ecosystems.

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