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TITLE: Detailed Mapping of Hydrothermal Vent Fauna: A 3D Reconstruction Approach Based on Video Imagery

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ABSTRACT:

Active hydrothermal vent fields are complex, small-scale habitats hosting endemic fauna that changes at scales of centimeters, influenced by topographical variables. In previous studies, it has been shown that the distance to hydrothermal fluids is also a major structuring factor. Imagery analysis based on two dimensional photo stitching revealed insights to the vent field zonation around fluid exits and a basic knowledge of faunal assemblages within hydrothermal vent fields. However, complex three dimensional surfaces could not be adequately replicated in those studies, and the assemblage structure, as well as their relation to abiotic terrain variables, is often only descriptive. In this study we use ROV video imagery of a hydrothermal vent field on the southeastern Indian Ridge in the Indian Ocean. Structure from Motion photogrammetry was applied to build a high resolution 3D reconstruction model of one side of a newly discovered active hydrothermal chimney complex, allowing for the quantification of abundances. Likewise, the reconstruction was used to infer terrain variables at a scale important for megabenthic specimens, which were related to the abundances of the faunal assemblages. Based on the terrain variables, applied random forest model predicted the faunal assemblage distribution with an accuracy of 84.97 %. The most important structuring variables were the distances to diffuse- and black fluid exits, as well as the height of the chimney complex. This novel approach enabled us to classify quantified abundances of megabenthic taxa to distinct faunal assemblages and relate terrain variables to their distribution. The successful prediction of faunal assemblage occurrences further supports the importance of abiotic terrain variables as key structuring factors in hydrothermal systems and offers the possibility to detect suitable areas for Marine Protected areas on larger spatial scales. This technique works for any kind of video imagery, regardless of its initial purpose and can be implemented in marine monitoring and management.

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