PhD Dissertation Defense

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Title: The Microbiology And Molecular Ecology Of Tissue-Loss Diseases Affecting Acropora Cervicornis In The Upper Florida Keys

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ABSTRACT

The combined effects of anthropogenic stressors and threats associated with global climate change, including increased coral disease occurrence and frequency, duration of coral bleaching, and impact from ocean acidification, put coral reef ecosystems at a high risk of collapse. Tissue-loss diseases (white-band diseases and rapid tissue loss) have caused dramatic declines in Acropora cervicornis (staghorn coral) populations across the Caribbean and tropical western Atlantic Ocean. As a result, the species is listed as threatened under the United States Endangered Species Act and critically endangered on the International Union for Conservation of Nature Red List. Bacterial infections have been suggested as causative agents in many coral diseases worldwide, but identifying specific pathogenic microorganisms remains inconclusive. Reef sediment may play a role, as the characteristic upward progression of white-band disease often begins where branches touch sediment. Tissue-loss diseases affecting A. cervicornis were investigated using histopathological examinations and bacterial 16S rDNA next-generation sequencing. The microbiomes of apparently healthy A. cervicornis, affected A. cervicornis, and adjacent sediment samples were compared. Taxonomic and phylogenetic analyses found Proteobacteria to be the dominant phylum present in all marine-sediment and coral-tissue samples. Sediment associated microbial communities were significantly more diverse than those associated with coral tissue, and microbial communities associated with apparently healthy A. cervicornis were more diverse than communities associated with affected coral

tissue. This study confirmed the presence of Vibrionaceae and Rickettsiaceae, both of which have been associated with coral diseases. Linear Discriminant analysis revealed that communities associated with the tissue-loss margin of a disease lesion were significantly more enriched with Vibrionaceae than apparently healthy communities. Histopathological examinations of all coral tissues, even apparently healthy tissues, revealed moderate to severe hypertrophy in epidermal mucocytes, dissociation of mesenterial filaments, necrosis of cnidoglandular bands, and atrophy of the calicodermis. This study provides histological and molecular evidence that A. cervicornis health was in decline prior to the presentation of a tissue-loss lesion. More conservative approaches should be adopted when assessing disease prevalence, and the progression of disease needs to be examined molecularly using more specific tissue sampling. This work also supports prior observations that coral tissue-loss diseases are polymicrobial diseases associated with an imbalance of residential bacterial populations and proposes that the increase in bacteria of family Vibrionaceae is an early biomarker of disease in A. cervicornis prior to gross tissue loss.