Spatiotemporal Analyses of the Biological Condition Gradient Model on Florida's Coral Reef

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Historically, Florida has experienced major stressor events that have increased coral mortality through time. Major stressors take the form of either anthropogenic or natural events such as massive bleaching events, disease outbreaks, port expansion projects, and sewage outfalls, which prompt the need for the development of a management tool to can rapidly assess the condition of Florida's coral reefs. A conceptual model known as the Biological Condition Gradient (BCG) was adopted for use on coral reefs as the frequency and scale of these various stressors has been gradually increasing over time making it inherently difficult to track and effectively manage. The BCG relates biological condition to increasing levels of anthropogenic stress and can be used to identify biological attributes and measurable increments of change from biological condition assessments. Narrative qualitative rules from the consensus of grading reef condition by a diverse expert panel provided a framework for developing quantitative rules using long-term monitoring program data from 1996-2024. The expert panel prioritized characteristics related to species size-structured abundance, benthic habitat composition, and community structure that assisted in forming the foundation for the numeric decision-making rules that drive the BCG's scaling system. Numeric rules were then combined in the BCG expert decision model which accurately and transparently replicates the decisions that the experts expressed during review of the coral samples. The BCG model was run on the first set of historical data from 2005-2021, which was graded at each site by the model on a numeric 1-6 scale based on anthropogenic stress levels. Level 1 on the scale is representative of an entirely pristine, undisturbed environment while level 6 reflects sites with extreme environmental stress due to major changes in biotic structure along with major losses of ecosystem functions. This project will be utilizing newly collected monitoring data from 2022 through 2024 and running it through the BCG model to get updated scores for further spatiotemporal analysis of the BCG assessments to elicit broader patterns of reef conditions across the system through time. To help justify some of the differences exhibited in scores, other long term historical environmental data such as temperature and water quality data, will be statistically tested against the BCG scores to help explain some of the differences seen in the scores through time. The historical and current BCG scores will also be spatially analyzed to identify consistent disturbance zones, that otherwise would not have been distinguishable without the use of this model, to better direct restoration activities.