A Comparative Analysis of Coral Bleaching Predictive Models and Construction of a Multivariable Reef Bleaching Stress Score Utilizing Oceanic Conditions from Global Coral Reef Systems

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Coral bleaching is a harmful phenomenon where corals expel their symbiotic algae called zooxanthellae caused by global warming induced environmental stressors. Conservation efforts utilize predictive models to identify areas at risk to mass bleaching events; however, most models rely on single variable thresholds and lack the inclusion of early warning signs. This research tested models and environmental stressors across multiple global reefs in order to evaluate feature and model importance. Following this a Multivariable Reef Bleaching Stress Score was comprised and tested to predict bleaching occurrence and early warning instability on a multi reef application. The environmental stressors of salinity, CTS, and chlorophyll-a were tested to construct MRBSS as a weighted index. Additionally, the models of GLM, random forest, gradient boosting, SVM, and neural network were utilized. The predictive ability of variables was tested using RMSE, MAE, and Spearman. The results showcased that the variable of CTS had a stronger predictive influence overall among the stressors utilized at a 0.95 rate of importance. Additionally, the model of Random Forest performed best across evaluative metrics with a SRC score of 0.961, MAE of 0.025, and RMSE of 0.041. Once stressor weights were normalized, MRBSS score was constructed utilizing stress, adaptation, and resiliency scores. MRBSS maintained an 86% accuracy in identifying bleaching risk when compared to historical bleaching occurrences. An automatic application that produces MRBSS scores and reef specific conservation recommendations was constructed, working across over 3000 global reefs.

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