THE DEVELOPMENT OF PROACTIVE MONITORING TOOLS FOR CORAL REEF MANAGEMENT

A THESIS SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAI'I IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE

IN

OCEANOGRAPHY

DECEMBER 2008

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ABSTRACT

In this thesis, I first examine the indicators used to diagnose health and assess biological responses to environmental stress in reef building corals. Response indicators are discussed in a temporal framework and categorized as Proactive, Reactive, or Retroactive in terms of their potential management relevance. I provide a brief description of each indicator and discuss its diagnostic potential, ease of application and utility in a management context. The Proactive/Reactive/Retroactive grouping reveals that (1) the biological responses most commonly used as indicators of reef condition rarely document shifts in coral health on a timescale that allows for prevention or mitigation of the stressor prior to coral mortality, and (2) that while more temporally effective biological responses exist and can be measured, their capacity as management relevant indicators is underdeveloped. I conclude that greater research effort, focused on the sub-lethal and proximal impacts of stress responses in corals, is urgently needed to develop further a suite of proactive tools, the application of which will ultimately enhance our capacity to manage coral reef resources effectively.

I next assess the management utility of one such proactive tool, PAM fluorometry, by manipulating fragments from two coral species, *Porites compressa* and *Montipora capitata*, under controlled experimental conditions in a research aquarium system located at the Hawai'i Institute of Marine Biology. Quantum yield (QY), a proxy for photophsyiological performance, was measured at different times of the day for 16 days; treatment group corals were subjected to a sublethal temperature stress beginning on Day 10. Dark-adapted values of QY proved more reliable than light-adapted values,

several days were required before QY values stabilized following collection of corals and transplant to aquaria, and four days were required after the onset of temperature stress before I could measure a statistically significant difference between QY of treatment and control corals. I conclude that despite its potential for Proactive assessment of rapid changes in photophysiology resulting from stress, PAM fluorometry is not an ideal management tool.

Because most coral health monitoring programs rely on simple visual transecting methods, I evaluate a slightly more complex method, demographic analysis, and its potential for more widespread inclusion into monitoring programs. First, I establish that an environmental gradient exists between southern and central Kāneʻohe Bay, Oʻahu, Hawaiʻi, by surveying numerous environmental variables. Then, by measuring the size and frequency of all corals in a series of twenty-seven 10 m^2 transects at nine sites along the gradient, I establish that there are clear changes in the demography of corals along this same gradient, but that these changes are species specific and do not match predicted changes. As environmental quality decreases, *P. compressa* colonies become less numerous and larger while *Montipora capitata* colonies become less numerous but smaller. Together, these two species comprise the vast majority of coral coverage in Kāneʻohe Bay. Demographic analysis thus provides further insight into coral population processes, but underscores the complexity of processes affecting such populations.