



Australian Government

Department of the Environment, Water, Heritage and the Arts

Marine and Tropical Sciences Research Facility Milestone Report, 15 February 2010

Program 7: Halting and Reversing the Decline of Water Quality

Project 3.7.1: Marine and estuarine indicators and thresholds of concern

Project Leader: Dr Katharina Fabricius, Australian Institute of Marine Science

Summary

All milestones are on track.

Biofilms: Experiments exposing foraminifera in aquaria to different water quality conditions are completed; one manuscript has been submitted and a second is in preparation. Both foraminiferal growth and C/N ratios well reflect local water quality conditions. Further work investigating water quality and climate change interactions is underway and suggests that for at least one of the species additive effects of the two stressors exist. Work on bacteria as indicators for water quality is ongoing with repeated sampling of sediments and biofilms in the field near completion. A rapid genetic fingerprinting method for the bacterial communities is now developed and will be applied to field and experimental samples.

Corals: All field work for this project is now completed, after a successful nine-day expedition to the Whitsundays. We will now experimentally investigate the role of organic enrichment of fine inshore sediments on the main health indicators in corals, coralline algae and foraminifera. Otherwise the group will focus on data analyses and the completion of manuscripts.

Seagrass: Datasets from the [Reef Rescue Marine Monitoring Program](#) intertidal seagrass monitoring and [Seagrass-Watch](#) programs have been validated and are being used to develop a model for seagrass response to changing water quality along the Queensland coast, using available threshold, trend and critical values. Over the next five months the data will be analysed and the final model proposed.

Estuaries:

Task 1: Evaluation of models. We are about half way through the evaluation procedure working in a new set of estuaries. We have also almost completed testing our indicators by reapplying them to a selection of the previously sampled model estuaries. At this point all indicators are behaving as expected.

Task 2: Finalise and publicise fish metrics of estuary health. One paper on the metrics is in press and another close to submission, and we are moving to finalise the development of standard procedures and associated simple manuals.

Project Outputs / Milestones 2009/2010

Objective	Targeted Activity	Due Date
(a)	Complete development of marine biofilms (bacteria, diatoms, foraminifera) as indicator tools for changing water quality [AIMS]	June 2010
(b)	Complete development and establish application of coral reef organisms and physiological change to indicate changes in water quality and ecosystem condition [AIMS]	June 2010
(c)	Contribution to research on seagrass communities and their responses to changing environmental conditions along the Queensland coast [DEEDI]	June 2010
(d)	Complete the identification of useful ecological indicators of the condition of North Queensland's estuaries [JCU, GU]	June 2010

Project Results to February 2010

Description of the results achieved for this milestone

a. Field testing and analysis of marine biofilms (bacteria, diatoms, foraminifera) for their suitability to indicate changes in water quality [AIMS]

Experimental and field work on foraminifera has now been finalised. Over the last three years, several foraminiferal species have been exposed to different water quality conditions in the Whitsunday region. For the three symbiont bearing model species we could consistently show better growth on reefs less subjected to terrestrial runoff, and C/N ratios in the foraminifera well reflect water column nutrient levels. One manuscript on this work has been submitted and a second is in preparation. We also started investigating the interactions of nutrient increase and global warming on biofilms, corals and foraminifera. One large experiment is completed and a second is underway. Growth for all foraminifera investigated is reduced under higher temperatures, and we could document that foraminifera lose their symbionts (i.e. they 'bleach') under temperature stress similar to corals. Growth of one species was also clearly reduced with the addition of nitrate, and that species suffered distinctly higher mortality when exposed to higher nutrient levels. All data (foraminiferal community composition, sediment chemistry and sediment ageing) for the project investigating temporal changes in foraminiferal communities from sediment cores are now available and being analysed. A statistical analysis comparing foraminiferal communities, coral communities and water quality (all collected in collaboration with the Reef Rescue Marine Monitoring Program) is finalised and a manuscript published.

Bacterial biofilms have now been collected four times along water quality gradients in the Whitsunday area of the Great Barrier Reef and are collected bi-monthly at three sites on Magnetic Island, off Townsville. This collection will cease in April 2010 and data will then be analysed. Development of a method for rapid genetic fingerprinting of bacterial communities (TRFLP – Terminal restriction fragment length polymorphisms) is now completed. This method will be used to measure bacterial community composition from field samples and experiments on the effects of light, nutrient and temperature on microbial communities. A method developed to measure respiration and production has now been used on several foraminiferal species to document temperature and nutrient effects on the photosynthesis of these organisms.

b. Field testing and analysis of coral reef organisms and physiological change tested for their suitability to indicate changes in water quality and ecosystem condition [AIMS]

A nine-day field trip to reef of the Whitsundays was used to investigate the role of organic enrichment in fine inshore sediments on the micro-environmental conditions for calcifying reef organisms. Micro-sensors were used to measure pH and oxygen within the boundary layer over sediments in which coral recruits spend their first years. The field measurements are now being followed up with a laboratory experiment to investigate the fate of corals, coralline algae and foraminifera within the boundary layer of more and less organically rich sediments. Additionally, the group focuses on the statistical analyses and processing of previously collected data and the completion of a major manuscript comparing the effectiveness of the various indicators investigated throughout the study period.

c. Contribution to research on seagrass communities and their responses to changing environmental conditions along the Queensland coast [DEEDI]

In developing an index of seagrass health for the Reef Rescue Marine Monitoring Program, the key indicators proposed/agreed by the Great Barrier Reef Marine Park Authority were seagrass cover, reproductive effort, seagrass leaf tissue nutrients and epiphyte cover. Macroalgal abundance, within-canopy temperature and light were proposed as key modifiers/narratives.

Using the available threshold, trend and critical values, we are developing a model for seagrass response to changing water quality along the Queensland coast. Seagrass morphometrics, sediment state and other parameters (e.g. sulphide concentration, water/wave movement) are also included in the model.

We are currently examining existing data from the Reef Rescue Marine Monitoring Program intertidal seagrass monitoring and Seagrass-Watch programs for relationships between key indicators. Over the past few months, the Seagrass-Watch database has been validated and interrogated to identify possible sites for inclusion in the analysis. Over the next five months, the data will be analysed and the model proposed.

d. Identification of useful ecological indicators of the condition of North Queensland's estuaries [JCU, GU]

Model Evaluation: We are about half way through evaluating the success of our model indicators of estuary condition. This is being achieved by application of the methods and models to estuaries not previously included in our study but known to fall at different places along the pristine-disturbed gradient. We have also almost completed sampling selected model estuaries to increase the length of time series data for those estuaries.

Fish metrics of estuary health: One paper on the metrics is in press and another close to submission, and we are moving to finalise the development of standard procedures and associated simple manuals.

Communications, major activities and events during milestone reporting period

- Several inter-organisational discussions were carried out regarding Reef Rescue Marine Monitoring Program planning.
- Completion of three publications since last reporting in November 2009:

Uthicke, S., Thompson, A. and Schaffelke, B. (2010) Effectiveness of benthic foraminiferal and coral assemblages as water quality indicators on inshore reefs of the Great Barrier Reef, Australia. *Coral Reefs* 29: 209-225.

Shaw, M., Furnas, M. J., Fabricius, K. E., Haynes, D., Carter, S., Eaglesham, G. and Mueller, J. F. (2010) Monitoring pesticides in the Great Barrier Reef. *Marine Pollution Bulletin* 60: 113-122. (This is a product stemming from the [Catchment to Reef Joint Research Program](#))

van Oosterom, J., Codi King, S., Negri, A., Humphrey, C. and Mondon, A. (2010) Investigation of the mud crab (*Scylla serrata*) as a potential bio-monitoring species for tropical coastal marine environments of Australia. *Marine Pollution Bulletin* 60: 283-290.