



ZooX Fund Update

July 2011

GREAT BARRIER REEF
foundation



Flood & Cyclone Impact Update

Tropical Cyclone Yasi

Factual Recap

- Occurred February 2nd 2011
- Wind gusts of up to 300km per hour accompanied the cyclone
- 300km of the Reef (13%) from Cairns to Townsville, was exposed to Yasi's destructive winds.
- The areas exposed to wind gusts of 285km/hr and those south of the eye of the cyclone suffered the most damage due to the its clockwise motion.

Monitoring Observations

In the weeks and months following the cyclone, the Great Barrier Reef Marine Park Authority (GBRMPA) and Queensland Parks and Wildlife Service alongside research institutions such as James Cook University and the Australian Institute of Marine Science conducted surveys of the Reef for damage. Observations included:

- In exposed areas coral was broken, torn from the Reef and tossed around. Branching corals, in particular, suffered considerably and in some cases large plate corals were snapped off and dumped into deeper water. This is to be expected given the force of the cyclone.
- Impact on the Reef North East of the Reef the cyclone's path was relatively minor, even at shallower depths.
- Most tourism operators and resorts are functioning again, with the exception of resorts such as Dunk and Bedarra which were hardest hit.

Wet Season Flooding

Factual Recap

- Onset of wet season very early due to La Nina
- Rainfall in almost all coastal areas of Queensland 'Very Much Above Average' or in some cases 'Highest on Record' according to the Bureau of Meteorology
- During the 2011 wet season 'major' flooding occurred in the Fitzroy, Burnett and Burdekin rivers and most rivers in the Wet Tropics region

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- Outflows from the Burnett River and Fitzroy catchments alone covered more than 15% of the ocean surface of the Reef as at the 01/01/11

Monitoring Observations

The runoff generated by flooding has the potential to cause freshwater bleaching of shallow corals, increased algal blooms and coral disease due to high sediment and nutrient loads. Not all of these effects are visible in the short term so ongoing monitoring is important.

The Great Barrier Reef Marine Park Authority (GBRMPA), through the Australian Government's Reef Rescue Marine Monitoring Program, works with James Cook University, Central Queensland University, Australian Institute of Marine Science, Queensland Department of Environment and Resource Management and a group of volunteers, to monitor levels of nutrients, sediments, pesticides and salinity as well as overall health of corals and seagrass beds both in the normal course of events and after extreme weather events.

Initial monitoring reports have found that whilst the effects of flooding visible from the air have subsided and normal fishing and tourism operations have resumed in most cases, there are some parts of the Reef that have sustained damage. For example:

- In some areas of the Whitsundays fine sediment was identified as accumulating on corals. This can be a source of disease however no signs of this are visible at present.
- In some areas of the Wet Tropics and Keppel Islands, freshwater bleaching has occurred due to reduced salinity making Reef waters not sufficiently acidic for some corals.



Research Investment Progress

Assisted Migration and Colonisation

Dr Madeleine van Oppen and her team from the Australian Institute of Marine Science have continued their ZooX Fund supported research of the “genetic coral variances” and “assisted migration”. Recent progress is summarised below.

- *Genetic Variance:*

This research has found a high correlation between thermal tolerance and a particular gene, providing proof-of-concept for this research. Activity will now focus on assessing the usefulness of this gene as a biomarker for thermal tolerance by conducting targeted experiments to examine whether coral colonies harbouring different variants of the gene differ in their thermal tolerance. Successful validation of a biomarker for greater tolerance to water temperature will then allow the identification of populations of tolerant corals and the location of potentially tolerant reefs.

- *Assisted North-South Migration:*

Following an excellent coral spawning in November 2010, more than 13,500 samples of modified juvenile hybrid and purebred corals were deployed on the Reef. Sadly, as a result of the flooding in January 2010, 99.5% of these samples were lost. A revised project has been approved by the Foundation’s International Scientific Advisory Committee to ensure that the important work continues (see below).

- *Revised Project*

Temperature tolerance of corals is to a large extent determined by the *Symbiodinium* (or *Zooxanthellae*) strain they associate with. *Symbiodinium* occur at very high cell numbers within coral colonies, at roughly 1 million cells per square cm of coral surface area. Each cell divides approximately once every two weeks while inside the coral tissue. During cell division, the *Symbiodinium* genome is copied. During the copying process errors can occur resulting in mutants which contain a change in their DNA compared to the original DNA sequence. Depending on where the mutation occurs, it may result in an increase in the temperature tolerance of the *Symbiodinium* cell. With climate warming, such cells would have an advantage and increase in numbers.

This project will test whether mutant cells with increased temperature tolerance evolve in the laboratory and how many cell generations are required for this to happen. Any resulting *Symbiodinium* with increased temperature tolerance could then be transferred on to juvenile corals. This tests whether temperature tolerance of *Symbiodinium* and coral can be increased through genetic adaptation.



Smart State Fellowship Co-Funded Projects

- *Distribution of Zooxanthellae across thermal environments*

Different strains of the Zooxanthellae that live inside coral polyps have varying levels of thermal tolerance. As warmer than average long-term temperatures have been recorded on the Reef over the past 10 years, understanding the varying genetic tolerances to thermal stress across a range of *Symbiodinium* species would have significant outcomes for the management and mitigation of climate-based impacts, e.g. coral bleaching.

So far, a total of 1048 samples have been collected in order to complement the existing database of symbiodinium. These samples were primarily taken from the inshore and outer sites of the Mackay/Capricorn section of the GBR as well as mid and outer sides from the Far Northern area.

Extensive DNA analysis of the samples has identified 42 different subtypes of symbiodinium which are highly linked to their specific host. The ongoing identification of these species is especially important to analysis of the complex responses that are displayed by specific algae/host combinations to heat stress.

- *Improved tools for comprehensive monitoring of water clarity and light availability in coral reefs systems.*

By utilising satellite imaging provided by NASA, the shallow waters of the Great Barrier Reef can be monitored in order to assess water quality. This project hopes to build on this mapping system by applying a set of deep-water algorithms to give reef managers the ability to efficiently and reliably provide measurements of all natural waters of the GBR once implemented.


Monitoring water clarity is essential when assessing coral health, a key Attribute (refer GBRF Research Portfolio) when understanding what makes a reef resilient to climate change.

Most objectives for Phase 1 of this project have been achieved, with assembly of the optical field equipment well underway. The first field trip to assemble a spectral library of substrates has been scheduled for mid 2011. In addition to this, the development and implementation of a key algorithm has begun with simulated data being used for initial testing.

- *Project Summary - Individual Reef Scale Acidification*

The impact of climate change on the GBR is not limited to coral bleaching due to surface temperature rises. CO₂ is easily absorbed by the world's oceans and has a significant effect on the chemistry of the Reef, increasing its acidity. Changes in carbonate chemistry impact the ability of organisms to produce calcium carbonate shells and skeletons, potentially having a devastating impact on worldwide coral reefs due to their reliance on coral polyps producing the hard, carbonate-based shells that make up their structure.

This project aims to observe the effect of acidification on the Reef over long periods using tanks to produce varying levels of acidity and



anticipate a broad range of physiological, ecological and chemical effects on both individual coral samples as well as communities as a whole. Managing ocean acidification and mitigating its effects is crucial in developing a resilient reef.

Aquarium-based systems were constructed on Heron Island during the second half of 2010. These recreate four climate scenarios (pre-industrial, present day, and future conditions based on reports by the International Panel on Climate Change). The first of several long-term experiments has already begun and will run for the next 6 months. During this time no samples will be added or removed from the tanks, however, observations and chemical measurements will be made to monitor the effects of the different environments.

Seals for the Reef

Qantas, in partnership with the Foundation and the Antarctic and Climate Ecosystems Cooperative Research Centre funded the “Seals for the Reef” initiative.

The initiative entails attaching miniature sensors to elephant seals in the Southern Ocean. These sensors send data to scientists through satellite transmission allowing them to track the location of the seals while providing never before collected information on the characteristics of the water through which they travel.

This project provides important oceanic data that can improve our understanding of how climate change may impact on delicate marine ecosystems such as the Great Barrier Reef. Responding to those changes will require the earliest warning possible. Predictions of change will be immensely valuable to the effectiveness of adaptation efforts on the GBR.

The tags placed on the seals in January 2010 came off as part of the normal moulting process when they landed on Macquarie Island for breeding in October/November 2010.

New tags were placed on the seals in March 2011 and data collection continues.

Meanwhile significant progress has been made with the research data generated by the seals. Seal data have been used to determine ocean current patterns and sea ice formation rates along the margin of Antarctica. These observations are from a particularly important area for the global ocean circulation and climate, the Adélie / Wilkes Land coast, where dense Antarctic Bottom Water forms and spreads throughout the deep ocean.

Research Portfolio

eReefs

eReefs, the largest single project in the Foundation’s research portfolio and central to its delivery, is valued at more than \$25m. It brings together partners from across research, government, management and the corporate sector to provide the most comprehensive picture of the Reef as it is, has been and will



be in the future, significantly enhancing the decision making capabilities of Reef managers and policy makers.

A pilot of the project, conducted during 2010 under a partnership by GBRF, Telstra, the Queensland Government and CSIRO, was highly successful and has been very useful in bringing together partners to support this project including the Queensland Government, the Bureau of Meteorology, CSIRO, AIMS and the Great Barrier Reef Marine Park Authority (GBRMPA).

Funding for this project is in progress.

Genetics Workshop

Building on from its current investment in coral genetics research and other major achievements in the coral genetics arena such as the recent sequencing of the coral genome, GBRF is convening a high level workshop to explore how genetics-based approaches to coral reef adaptation might be advanced.

This workshop will bring leading coral reef biologists together with experts from the highly innovative, technology-driven and rapidly advancing fields of medical science, agricultural science and terrestrial biodiversity. We are ambitious to use these avenues and resources to gain new perspectives and insights to address the increasingly urgent threat that climate change poses to coral reefs.

The workshop, which is to be hosted at the Institute of Molecular Biosciences at the University of Queensland, will be chaired by Prof. John Mattick AO, a world renowned international expert in the genomic programming of human development, and Dr Ruth Gates from the University of Hawaii, an expert in the biological mechanisms and traits that drive the ability of marine organisms to respond to changes in their environment.