Submission to the

Inquiry into climate change & environmental impacts on coastal communities.

The House of Representatives Standing Committee on Climate Change, Water, Environment and the Arts.

By

The Reef and Rainforest Research Centre Ltd

Reef & Rainforest RESEARCH CENTRE

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The Secretary
Standing Committee on Climate Change, Water, Environment and the Arts
House of Representatives
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Dear Dr. Sullivan,

Please accept this submission from the Reef and Rainforest Research Centre Ltd (RRRC) to the House of Representatives Standing Committee on Climate Change, Water and the Arts Inquiry into climate change and the environmental impacts on coastal communities.

The RRRC is contracted by the Department of Environment, Water, Heritage and the Arts to provide program management and communications services for the Australian Government's Marine and Tropical Sciences Research Facility (MTSRF) in North Queensland. The submission highlights:

1. the results of innovative, collaborative climate change-related research that is being conducted under the MTSRF, particularly the modelling of likely climatic changes that will occur in the MTSRF region in the coming decades;
2. the implications that the outcomes of this research have for coastal communities and the natural environments of the MTSRF region, particularly the Wet Tropics Rainforests, Torres Strait and the Great Barrier Reef and its associated catchments; and
3. several recommendations for action that can help to mitigate or ameliorate the impacts of climate change on coastal communities and the natural environment of the MTSRF region.

While the submission focuses on some of the world-class, public good research that is supported by the MTSRF, the submission is an independent contribution to the Inquiry by the RRRC and does not, in any way, constitute a submission by the Australian Government.

Yours sincerely,

Dr. David Souter
Research and Spatial Systems Director
Reef and Rainforest Research Centre Ltd.

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1 Introduction

The interconnected ecosystems comprising the coastal regions of far north Queensland – including the Wet Tropics rainforests, Torres Strait, and the Great Barrier Reef and its associated catchments - is worth billions of dollars annually to the Australian economy in tourism, agricultural, fishing and mining revenues. In addition, this region currently provides ecosystem goods and services to support more than 781,200 people (ABS estimate for 2005), a population whose expected 1.29% annual growth will involve significant intensification of coastal land use in the future.

In order to maintain the economic, social, cultural and environmental values of this region despite the rapidly increasing twin pressures of population growth and climate change, sound science must underpin effective management that achieves sustainable used of natural resources. The federally-funded Marine and Tropical Sciences Research Facility[1] (MTSRF) is producing scientific information with the specific purpose of enabling management, policy and practice that achieves more sustainable use and development in this region. The Reef and Rainforest Research Centre[2] (RRRC) is charged with managing the MTSRF's multidisciplinary and integrative research programmes to ensure that they address key environmental management issues and priorities in north Queensland, and, critically, with facilitating the adoption of results by end user organisations in order to enhance sustainability.

The likely impacts of climate change on the region's potential to continue to provide ecosystem goods and services to an increasing population is being examined by several MTSRF research projects. This submission presents:

- A synthesis of new information generated by the MTSRF that is relevant to the current inquiry;
- Management options and tools emerging from MTSRF research that will help reduce or mitigate the impacts of climate change and intensification of human use; and
- Recommendations intended to assist in meeting the substantial management challenges facing the region.

2 Climate change projections for the MTSRF region

Dr Suppiah Ramasamy's research group (CSIRO) is modelling the changes in climate that are likely to occur in the MTSRF region. In addition to the results summarised in Table 1, they anticipate that cyclones will occur at increased frequency and intensity. Cyclonic winds will be stronger, there will be an increase in the duration of activity of each cyclone, and the region of cyclone activity will shift southwards over time (reaching ~300 km south of its present location by 2070). The combination of higher sea levels, greater storm surges, and a likely increase in the variability and intensity of rainfall means that the potential for flooding and cyclone-related damage in the MTSRF region will be markedly increased (Figure 1).

[1] MTSRF was created by the Australian Government in 2005 as a Commonwealth Environmental Research Facility (CERF), aiming to provide scientific research supporting the conservation and sustainable use of the high-value environmental assets of north Queensland, namely the Great Barrier Reef, Wet Tropics rainforests and the Torres Strait. MTSRF uses a participatory research model in which key partnerships and cooperation between end users, scientists and managers drive research, investment and knowledge transfer strategies. Almost $20 million was invested in research projects in MTSRF's first year of operation.

[2] RRRC is a not-for-profit consortium of researchers, industry and community organisations that is committed to achieving the goals of the MTSRF. RRRC has represented MTSRF since winning DEWHA's publicly advertised tender in 2006. For more information about RRRC and MTSRF, please see http://www.rrrc.org.au.

Table 1. Climate change projections for the MTSRF region derived from modelling conducted by CSIRO using both low and high emissions scenarios. Temperature and rainfall projections are given relative to the 20-year period to 1999. Forecasts represent the best estimate (50th percentile), with figures in brackets indicating the range of uncertainty in the model's prediction (10th – 90th percentile of spread of model results).

	2030	**2070** *(low emissions scenario)*	**2070** *(high emissions scenario)*
Average annual warming	0.9°C (0.6 to 1.2°C)	1.5°C (1.1 to 2.0°C)	3.0°C (2.0 to 4.0°C)
Average number of days over 35°C per year (currently 3.8)	6.6 (5.4 to 9.1)	12 (8 to 22)	44 (19 to 96)
Average annual rainfall change	0% (-8 to +8 %)	-1% (-14 to +13%)	-1% (-25 to +25%)
Sea surface temperatures	0.7°C (0.4 to 1.0°C)	1.3°C (0.6 to 2.0°C)	2.3°C (1.0 to 3.0°C)
Sea level rise relative to 1990	13-20 cm	49-89 cm*	
Ocean acidity	increase#	? #	

* There is significant uncertainty regarding the rate at which polar ice will melt. This melting rate will be an important determinant of sea level rise.
# The acidity of the oceans is predicted to increase, but the rate of increase is currently unclear.

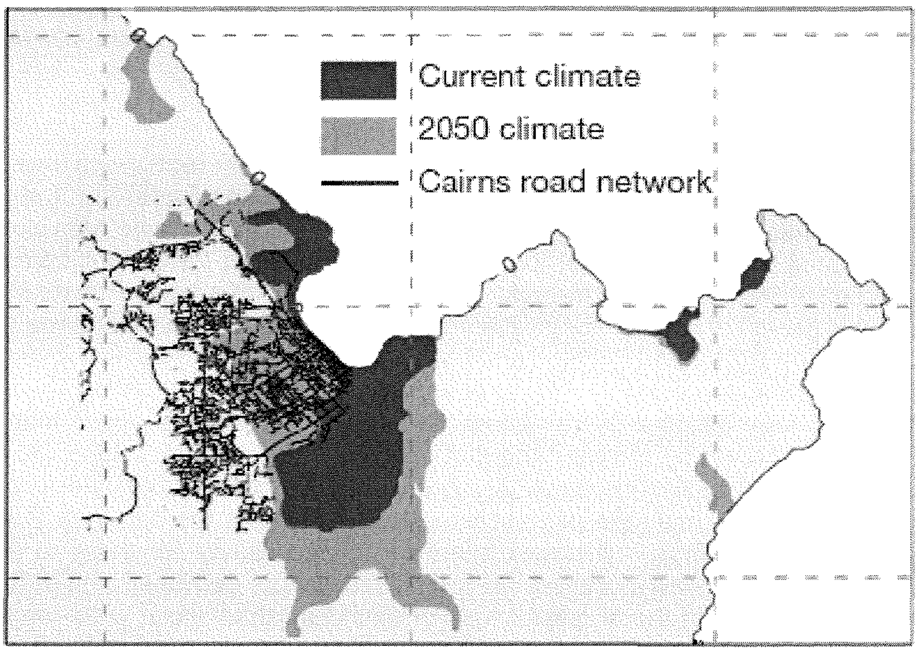

Figure 1. Increased potential for flooding in the Cairns metropolitan area due to climate change. The area flooded in a 1-in-100-year event will increase from 32 km^2 to 72 km^2 by 2050. Figure courtesy of Dr Suppiah Ramasamy, CSIRO.

3 Climate change impacts on the MTSRF region

The MTSRF region is characterised by very strong ecological and social connectivity. For example, human activities high up in the catchments affect coral reefs far downstream, and the region's economy is highly dependent on the ability of the region's ecosystems to continue to supply goods and services to the primary production, fishing and tourism industries (Figure 2). This very complex management landscape is already being impacted by intensification of human use and climate change.

The following discussion of results of relevant recent MTSRF research reflects this connectivity by describing in turn the impacts on terrestrial ecosystems, the catchments, the Great Barrier Reef, and concluding with impacts on the human communities that are dependent on the continued functioning of these ecosystems.

3.1 Impacts on terrestrial systems

Although cyclones are part of the natural disturbance regime for tropical coastal forests, forests in the MTSRF region are now more vulnerable to the impacts of cyclones through human-induced fragmentation (as a result of conversion to agricultural systems, altered fire management regimes, earlier logging practices, urban and peri-urban development and infrastructure projects, such as major roads, powerline corridors and dams). This forest fragmentation has increased vulnerability to storm damage due to edge effects, limited the potential for recovery of animal and plant communities via connective corridors, increased the potential for erosion when thin strips of riparian vegetation are damaged, and decreased the capacity for the coastal zone to act as a storm buffer (Dr Steve Turton, JCU/CSIRO; Dr Allan Dale, Terrain).

The maintenance of native plant biodiversity within a remnant forest patch increases its resilience to threats such as climate change. MTSRF research has found that the presence of exotic species is often associated with a decline in the abundance of rare native species or rare native functional groups in tropical forest remnants, which, in turn, significantly impairs community resilience over long time frames. Therefore, control of invasive pests in remnant rainforest areas is essential if these remnants are to be resilient to climate change (Dr David Westcott, CSIRO).

Preliminary results from studies of rainforest vertebrates strongly suggest that species' distributions are constrained by climate, and that species in the MTSRF region will retreat to higher altitudes as temperatures increase. As a consequence there is considerable concern for species that currently occupy the highest elevations – such as the Atherton Scrub Wren and the Beautiful Nursery Frog – because there is no opportunity for them to escape to cooler altitudes as temperatures increase. MTSRF research has demonstrated that endemic species such as these are at much greater risk of extinction than more wide-ranging, non-endemic species (A/Prof Steve Williams, JCU).

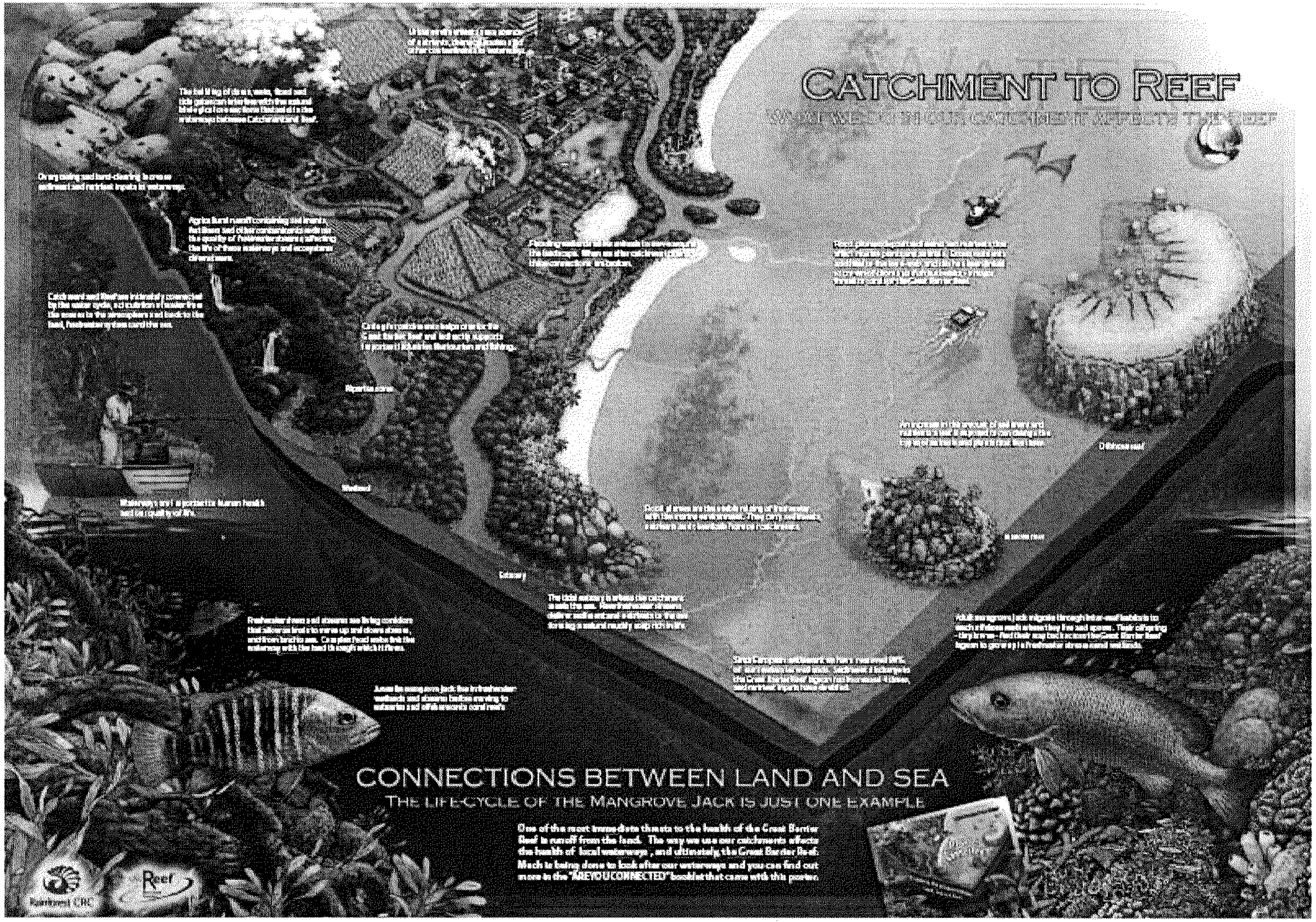

Figure 2. Poster illustrating the ecological and social connectivity between ecosystems and social systems in the MTSRF region. Part of the public campaign by CRC Reef and CRC Rainforest (now amalgamated with CRC Torres Strait into MTSRF) to raise awareness of connectivity and its consequences for the continued health and productivity of the region.

3.2 *Impacts on aquatic systems*

Urban and agricultural expansion in the MTSRF region has significantly reduced the ability of coastal wetlands to filter contaminants from riverine and flood waters, which is a critical function of these ecosystems. Investigations in the Tully-Murray catchment have demonstrated that maintenance of hydrological connectivity between wetlands is important for their ecological condition, and hence their ability to remove pollutants. The loss of functional wetlands throughout the MTSRF region is likely to have contributed to significantly greater quantities of sediment, nutrients and pollutants being delivered to the Great Barrier Reef lagoon during floods such as those in early 2008 than previously estimated. Of particular concern are the concentrations of dissolved organic nitrogen (DON), which occur in floodwaters at nearly twice the concentrations found in normal riverine water. River waters tend to contain far more dissolved inorganic nitrogen (DIN) than DON, but pulses of either can degrade marine water quality. The management responses to try to limit transfer of DIN and DON downstream will therefore differ: minimisation of DIN requires improvement of agriculture practices, while minimisation of DON requires off-farm actions to slow flow and reduce the rate of runoff (Prof Richard Pearson, JCU; Dr Jim Wallace, CSIRO).

The herbicide residues atrazine and diuron have been identified in water samples taken from flood plumes in the Great Barrier Reef lagoon at concentrations that are known to have negative effects on seagrass and corals. These herbicide residues persist in the lagoon at low concentrations even in non-flooding seasons (Dr Stephen Lewis, JCU). The effects of this on marine life are unknown. Intensification of human use of the coastal zone, plus the predicted increase in flooding in the MTSRF region due to climate change, is likely to increase the variety and quantity of pollutants delivered from the land to the inshore waters of the Great Barrier Reef.

3.3 *Impacts on marine systems*

Considerable MTSRF research effort has been directed towards improving understanding of the impacts of climate change on coral reef ecosystems in order to improve the resilience of the Great Barrier Reef through effective management. Climate change is already affecting entire marine food chains in the MTSRF region. For example, increased sea temperatures are affecting the distribution and abundance of food for seabirds, reducing their ability to find enough food to successfully raise their chicks (Dr Brad Congdon, JCU). There are also likely to be direct negative impacts on other marine species of conservation concern, specifically turtles and dugongs. Extreme weather events (including heavy rainfall) appear to have significant negative effects on dugong reproductive success, and changes in temperature and the intensity and frequency of cyclonic activity are likely to significantly affect the reproductive success of turtles. Further elucidation of the complex consequences of climate change for these and similar marine species is needed if they are to be effectively conserved (Prof Helene Marsh and Dr Mark Hamann, JCU).

Mass coral bleaching events – in which corals expel their symbiotic algae and frequently die - are caused by anomalous increases in sea temperature. Repeated coral bleaching and mortality events have already caused significant damage to coral reefs worldwide. To date, the Great Barrier Reef has suffered two significant mass coral bleaching and mortality events (1998 & 2002). However, analyses conducted under the MTSRF predict that the central-southern part of the Reef is at greatest risk of degradation resulting from future coral bleaching events, and that by 2050, the predicted frequency of catastrophic damage (>20% coral mortality) is roughly once every five years In addition, reefs commonly exposed to terrestrial runoff (i.e. coastal and inshore coral reefs) are two to four times more sensitive to bleaching due to temperature stress than those that are not subjected to runoff, and this has resulted in degradation in their condition (Dr Scott Wooldridge, AIMS).

Despite these long-term predictions, additional MTSRF research has improved our ability to forecast the occurrence and impacts of coral bleaching events up to a month in advance by: 1. improving our knowledge of the specific sea temperatures that triggers bleaching in different corals; 2. determining that the likelihood of coral mortality resulting from a mass bleaching event is related to bleaching severity, event duration, and the size of energy reserves before the onset of the bleaching event; and 3. identifying a strong link between up-welling events (cold water intrusions) and the subsequent occurrence of severe bleaching events on the Great Barrier Reef (Dr Ken Anthony, UQ; Professor Ove Hoegh-Guldberg, UQ). This knowledge will be invaluable in enabling managers to employ mitigation strategies and to inform Reef-dependent industries.

In addition, scientific evidence generated within the MTSRF strongly suggests that there has been an increase in thermal tolerance of many reefs after (and possibly due to) the 2002 mass bleaching event (Dr Ray Berkelmans, AIMS). The diversity of the symbiotic algae found in corals is known to play an important role in determining heat tolerance levels of coral reefs(Professor Ove Hoegh-Guldberg, UQ), and MTSRF researchers are currently using multiple approaches to investigate the mechanisms associated with temperature tolerance and adaptation (Dr Madeleine van Oppen, AIMS).

Coral disease has contributed to significant loss of coral cover in some areas of the Great Barrier Reef in the past five years. MTSRF researchers have found that the prevalence of disease increases dramatically in summer compared with winter (up to three times), and are currently investigating links between warm- and cold-temperature anomalies and the incidence of coral disease (Prof Bette Willis, JCU).

Ocean acidification has recently emerged as a potentially serious climate change-related issue for calcifying marine organisms, such as corals. Preliminary studies by MTSRF researchers in two areas of the Great Barrier Reef have uncovered dramatic declines in calcification rates of certain types of coral over the past 20 years (Dr Glenn De'ath, AIMS). Further research is urgently needed to assess the risks posed by ocean acidification to the Great Barrier Reef if these risks are to be managed.

Algae commonly dominate unhealthy reefs, and MTSRF research (co-funded by the ARC Centre of Excellence for Coral Reef Studies) has shown that just a few species of herbivorous fish are responsible for the removal of most of the algae on healthy reefs at Orpheus Island. This indicates that the Great Barrier Reef could be more vulnerable to human-induced stresses such as overfishing than previously thought, and highlights the importance of biodiversity conservation to the maintenance of healthy reef ecosystems (Professor Terry Hughes, JCU).

However, the expected intensification of human use of the coastal zone may pose major problems for the maintenance of inshore marine biodiversity. For example, recreationally-targeted fish species are likely to suffer directly through increased fishing pressure (as the fishing effort increases), as well as indirectly through complex climate change effects on marine ecosystems. Encouragingly, surveys of recreational fisher behaviour and attitudes in the MTSRF region have indicated a high level of compliance with recreational fishing regulations designed to conserve fish stocks (Dr Stephen Sutton, JCU). Recent MTSRF research on the inshore Great Barrier Reef has demonstrated that protection within no-take marine reserves ("green zones") increases both the abundance and size of prized fish such as Coral Trout (Prof Gary Russ, JCU). This provides compelling evidence that human fishing pressure has already substantially reduced populations of targeted species on the Great Barrier Reef, that active management is required for conservation of these species and ecosystems, and that no-take marine reserves are effective mechanisms for species conservation.

Ongoing MTSRF research projects are investigating the potential for "spillover" of fish from protected onto unprotected reef areas; the likely resilience of specific commercially and recreationally important species to climate change; and patterns of connectivity of fish populations between reefs and regions (Prof Geoff Jones, JCU).

3.4 Impacts on social systems

Relative to Townsville or Mackay-Whitsunday, the economy of the Cairns region has been identified as the least diversified and therefore most vulnerable to climate change-related impacts to the Great Barrier Reef. A recent survey revealed that while many businesses in the MTSRF region will be affected by climate change, managers have a low level of awareness of the likely impacts of climate change on their business. Research into the economic costs and consequences of climate change for the businesses of the MTSRF region is continuing (Dr Scott Wooldridge, AIMS).

Communities living on small low-lying islands, such as those in the Torres Strait, are particularly vulnerable to inundation due to sea level rise and storm surges. However, Torres Strait Islanders' capacity to adapt to rapid environmental change is limited by pre-existing social and economic constraints. Cultural issues, such as Islanders' belief in the connections between the health of their 'land' and 'sea' country and their own well-being, significantly increase the complexity of managing climate change impacts on communities in the Torres Strait (Dr Donna Green, UNSW).

Human health in the MTSRF region may be directly affected by changes in climate through geographic shifts in the distribution of diseases such as bacterial diarrhoea, malaria and dengue fever. A key concern for the Torres Strait and far north Queensland is a likely increase in the rate of infected people entering the region from the north, thereby introducing mosquito-borne diseases into local mosquito populations with greater frequency (Dr Donna Green, UNSW). MTSRF research is also investigating the likely effects of climate change on the distribution of dangerous marine jellyfish (such as irukandji) (Prof. Mike Kingsford, JCU) and the prevalence of ciguatera poisoning (Dr David Blair, JCU).

4 Meeting these management challenges in the MTSRF region

While a reduction in global carbon emissions is the only long-term solution to the problems caused by climate change, effective management that is focused on tangible problems and informed by sound science, combined with investment in certain strategic areas will help mitigate some of the risks in the short-term, giving natural communities the necessary time to adapt to a changing environment. MTSRF researchers have focused on developing tools and options that specifically aim to assist decision-makers in the challenging task of managing the region for economic, social and environmental sustainability, despite the twin pressures of climate change and increasing population pressure. The following discussion highlights some of the most serious management challenges facing the MTSRF region, and provides some recommendations for action.

4.1 Degradation of wetlands

It is widely recognised that healthy aquatic systems are fundamental to the ability of both terrestrial and marine systems to continue to provide ecosystem goods and services to the community. Wetlands provide a buffer against coastal erosion and storm surges, mitigate flooding by slowing and absorbing floodwaters, and act as filters for many pollutants, nutrients and sediments.

These roles will only increase in importance as human use of the coastal zone intensifies, and as climate change increases the risk of floods and storm surges in the MTSRF region. However, up to 70% of the region's wetlands have been destroyed since European settlement, due to lack of recognition of their importance, and through lack of coordinated planning and management.

4.1.1 Recommendation: Provide statutory protection for Queensland's wetlands

Queensland is the only Australian state in which wetlands do not have statutory protection. Although they are nominally protected by a range of treaties and legislation (for example RAMSAR, EPBC Act, Nature Conservation Act 1992, Fisheries Act 1994, Coastal Protection and Management Act 1995, Vegetation Management Act 1999, Water Act 2000), a number of weaknesses in the state's Wetlands Decision Support System continue to allow development to occur in and around wetland areas. Dedicated legislation is urgently required to protect what remains of the MTSRF region's wetlands and options for developing such legislation within existing frameworks should be explored.

4.1.2 Recommendation: Implement water quality monitoring programs

The health of the lakes, rivers and wetlands of the MTSRF region are being assessed using a number of complementary research approaches. The ultimate aim of this work is to develop manuals and guidelines for freshwater ecosystem health, including the identification of indicators and threshold values of concern for these indicators (Prof Richard Pearson, JCU). Implementation of monitoring programs designed around these indicators would enable management to identify and respond to specific problems, thereby potentially improving the resilience of the region's lakes, rivers and wetlands over time.

4.2 Maintenance of biodiversity

Diverse ecosystems are likely to be more resilient to climate change than those that have suffered loss of biodiversity through species extinctions, and, as a consequence, are more likely to continue providing the ecosystem goods and services that support the human population. Biodiversity conservation is therefore a necessary component of any attempt to manage the risks posed by climate change and increasing intensification of human use. In this context, serious consideration must be given to making conservation mechanisms for terrestrial and marine species more effective in the MTSRF region.

4.2.1 Recommendation: Incorporate biodiversity conservation as a planning priority

Movements of flora and fauna between remnant patches of forest habitat in the MTSRF region are essential if the biodiversity within these habitats is to recover from disturbances. This is especially the case in the coming era of climate change, as temperature increases and changes in rainfall patterns may require many species to move to cooler, wetter areas if they are to survive. Such movements will require safe corridors between areas of conserved habitats. However, continued clearing of habitat and installation of infrastructure such as roads have created substantial impediments to these necessary movements. Local planning processes should pay urgent attention to the maintenance of safe migration corridors between remnant patches of habitat.

Roads and similar clearings not only increase the vulnerability of forests to cyclone impacts, but have considerable negative effects on these ecosystems, including alteration of habitat surrounding the clearing due to edge effects and disturbance by vehicle movement and emissions; the spread of weeds, feral animals, diseases and biota from other habitats; and mortality of fauna from collisions with vehicles. MTSRF researchers have identified strategies for road design and operation which – if adopted by planning agencies - should ameliorate some of these impacts (Dr Miriam Goosem, JCU).

4.2.2 Recommendation: Protect climate refuges in the MTSRF region

The tropical rainforests of the MTSRF region are characterised by high biodiversity, have important cultural values for local indigenous people and are the focus of an increasingly lucrative ecotourism industry. In addition, healthy rainforest ecosystems are important in maintaining water quality and quantity for catchments. However, many of the species comprising these diverse rainforest ecosystems are vulnerable to the predicted increases in temperature due to climate change. A multidisciplinary research program within the MTSRF aims to identify likely climate refuges for rainforest fauna by testing individual species' requirements and examining distribution patterns during past climate fluctuations. These refuges could act as islands of rainforest biodiversity during periods of warmer climates. Once identified, active protection of these refuges will be needed to reduce the rate of species extinctions and foster ecosystem resilience to climate change (A/Prof Steve Williams, JCU).

4.3 Improving coastal defences

The important role of the coastal zone in defending against inundation during extreme events was highlighted during the Indian Ocean tsunami and Hurricane Katrina: areas with intact natural coastal defences such as coral reefs and mangroves suffered less severe effects than areas in which these natural coastal defences had been modified by human activity. Increases in sea levels, increases in the frequency and intensity of storms and floods, and poorly managed coastal development are all likely to contribute to further erosion of coastal defences in the MTSRF region in future.

4.3.1 Recommendation: Plan for sea level rise

Current planning codes rely on the Australian Height Datum (AHD) to specify height above sea level, and assume that the sea level will remain static, when it is now well established that by 2030 sea levels will have risen by 13-20 cm in the MTSRF region, and will continue to increase after that (Table 1). Rising sea levels need to be accommodated into local and regional area planning. Modeling of the shift in AHD should incorporate real change scenarios that include the rate and magnitude of rise as well as storm surge frequency and intensity (and other extreme events). Building codes should incorporate these modeled predictions. Detailed risk assessments will be needed to drive targeted investment into short-term mitigation measures such as storm walls where important infrastructure is deemed to be vulnerable.

4.3.2 Recommendation: Bolster coastal defences

The Queensland Coastal Protection and Management Act (1995) was designed to protect coastal buffer zones – such as dynamic dune and estuary systems that naturally shift and change position over time – from damaging development. These areas serve as natural coastal defences to inundation and help absorb storm wave energy.

However, there are now many inappropriately sited developments throughout the Queensland coastal zone that are exposed to climate change risks while simultaneously impairing the coastal zone's ability to act as a natural buffer.

Managing to protect populations and coastal processes in the coastal zone despite climate change will require strengthening of the legislation governing the use of the coastal zone. The legislation should be amended to reflect current understanding of the impacts of climate change on the important linkages between the coastal buffer zone and adjacent ecosystems, as well as nearby human activities.

For example, the area considered susceptible to natural coastline erosion processes should be increased substantially from the current definition ("a line 40 m landward of the mean high water mark at spring tides or the plan position of the Highest Astronomical Tide, whichever provides the greatest erosion prone area width"). There is potential within the existing Commonwealth legislative framework (e.g. EPBC Act, 1999) to explore options that would afford these vital coastal areas the protection they require.

4.4 Improving the resilience of the Great Barrier Reef

Most of the climate change- or human population-related risks facing the Great Barrier Reef are known, and plans are already in place (or are being developed) to manage them. However, ongoing investment in research and monitoring will be required so that the effectiveness of these plans and tools can be evaluated and improved over time.

4.4.1 Recommendation: Use existing research, monitoring and evaluation frameworks in the implementation of the Reef Rescue Plan

The health of reefs is inextricably linked to the quality of the water in which they are bathed. Many inner and middle shelf reefs of the Great Barrier Reef have already suffered severe declines in health as a result of exposure to poor water quality - the transport of excess sediments, nutrients and pollutants into the sea. Improving water quality in these inshore environments is essential to improve the resilience to these reefs to the effects of climate change and intensified human use. The federal government's $200 million Reef Rescue Plan is specifically designed to address many of the root causes of poor water quality. However, in order to effectively implement the Plan and each of its specific components, existing research and monitoring frameworks active in the Great Barrier Reef region should be incorporated into the implementation of the Plan.

4.4.2 Recommendation: Invest in ocean acidification research

An increase in the acidity of the oceans is likely to have serious consequences for calcifying marine organisms such as corals. Ocean acidification is probably the major climate change-related risk that we do not currently know enough about to manage effectively. It is recommended that urgent investment be made into research that can generate viable options for managing this risk.

4.4.3 Recommendation: Develop and adopt integrative tools to manage risk

Reef resilience is a complex phenomenon, and managing for resilience will require the development and adoption of integrative tools. A sizeable collaborative effort under the MTSRF is focused on developing a risk, resilience and response atlas for the Great Barrier Reef (the Reef Atlas).

The Reef Atlas will enhance knowledge-based decision making in the MTSRF region by providing access to the data, information and analytical tools to: 1. model and map ecosystem properties such as changes in patterns of biodiversity; 2. identify the major risk and resilience factors influencing the MTSRF region and assess the magnitude and distribution of their biological, social and economic impacts; and 3. enhance management capability to evaluate and improve their strategic planning policy development and operational management by developing process and scenario models to integrate and interpret existing and new data. The application of techniques developed and applied during the production of the Reef Atlas will advance our current understanding of the risks to the MTSRF region considerably and facilitate major improvements in how best to manage such a valuable resource.

MTSRF researchers are currently working on identifying areas of the reef that appear to be naturally resilient to climate change-induced coral bleaching. Further collaborative work within MTSRF will develop a decision support tool that will enable managers to quantify improvements in reef resilience under different land use and water quality scenarios. Incorporation of a climate model will permit temperature changes and resultant frequency of coral bleaching events to be predicted for the years 2010, 2030 and 2050 (Dr Andreas Schiller, CSIRO; Dr Scott Wooldridge, AIMS).

4.5 Facilitating community adaptation to climate change

4.5.1 Recommendation: Provide special attention to the needs of Torres Strait communities

The ~7000 Australians living on the low-lying islands of the Torres Strait are amongst the most vulnerable in the country to sea level rise. Pre-existing social and economic disadvantages, as well as their cultural connections to country, severely limit these communities' capacity to cope with change. Despite this, there appear to be few strategies at federal or state government level specifically addressing the problems faced by communities in the Torres Strait in adapting to climate change. MTSRF researchers are generating information that will be used by the Torres Strait Regional Authority to make integrated climate impact assessments to assist with land use planning for low-lying islands that are already suffering inundations.

4.5.2 Recommendation: Model alternative management scenarios

Socio-economic constraints to and incentives for the adoption of land use and management options for water quality improvement are being investigated by MTSRF researchers using environmental economics models. Effectively, this enables modelling of the effects of different management scenarios on profitability, costs and environmental outcomes. For example, early model results indicate that tillage management and fallow management practices would not increase the cost of production of sugarcane, but would be significantly better for the environment than current practices (Dr Martijn van Grieken and Prof Iain Gordon, CSIRO). Modelling of the likely social, economic and environmental outcomes to climate change-prompted shifts in management strategies is likely to improve their on-ground effectiveness.

4.5.3 Recommendation: Secure landscape resilience to cyclones

Studies of the effects of Cyclone Larry have generated clear recommendations for management actions that will help reduce the impacts of the more frequent, more intense cyclones predicted to affect the MTSRF region in future (Dr Steve Turton, JCU/CSIRO, and Dr Allan Dale, Terrain). In short, more resilient landscapes have a better chance of withstanding cyclone impacts and recovering more quickly. Securing landscape resilience to cyclonic events in the MTSRF region means focusing future natural resource management investments in the following areas:

1) Improving landscape connectivity: a lack of functional ecological corridors between habitats means that rare animals such as cassowaries have limited recovery options following a disturbance;
2) River repair: restoration of healthy native riparian vegetation to minimise degradation of water quality during post-cyclonic flooding;
3) Protecting coastal assets: the coastal zone provides a significant natural buffer against storm events, but this capacity has been reduced by coastal development;
4) Building cyclone resilient farms: grants to landholders to facilitate on-farm cyclone resilience through the adoption of sound management practices;
5) Education for the future: making an investment in the capacity of future generations to sustainability manage the region's natural resources despite an increasing frequency and intensity of cyclones;
6) Avoiding climate change: the MTSRF region needs to play its part in reducing the global impacts of climate change through local reductions in carbon emissions.

4.5.4 Recommendation: Invest in knowledge transfer

The capacity for more sustainable management of the risks of climate change and intensification of human use in the MTSRF region is not currently limited by lack of information. MTSRF researchers are contributing to a large body of data generated from many other organisations worldwide, and while research is still needed, many management implications are already apparent. Instead, the major factor currently limiting sustainable management is lack of incorporation of this information into policy and practice. For example, despite growing awareness of the risks posed by climate change, current policies have failed to prevent development from occurring in areas subject to coastal hazards, or in areas of significance for biodiversity conservation. This major management failure should be urgently addressed by the dedication of substantial resources towards enhancing the success of information delivery to decision-makers and the general public.[3]

[3] RRRC is developing a plan for Enhanced Delivery that specifically aims to facilitate and evaluate the uptake of MTSRF's research results and tools by end users. A large component of the plan will involve RRRC acting as a knowledge broker between researchers and federal, state and local government decision-makers such that the capacity for sustainable management of the region is enhanced.