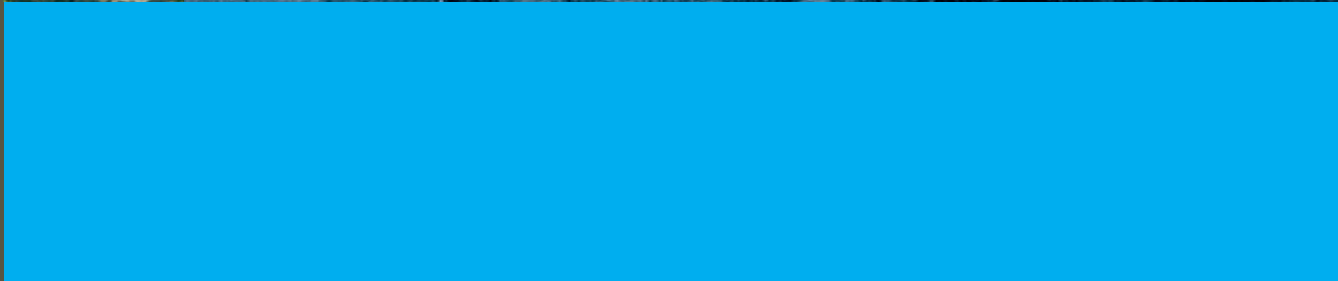


NCCARF

National
Climate Change Adaptation
Research Facility

National Climate Change
Adaptation Research Plan

Indigenous Communities



Writing team

Marcia Langton (Chair)
Meg Parsons
Sonia Leonard
Kate Auty
Damein Bell
Paul Burgess
Shaun Edwards
Richie Howitt
Sue Jackson
Vic McGrath
Joe Morrison

NCCARF Secretariat:

Jean Palutikof (NCCARF Director)
Marie Waschka (NCCARF Knowledge Adoption Manager)

Published by the National Climate Change Adaptation Research Facility
Email nccarf@griffith.edu.au
Website www.nccarf.edu.au

The National Climate Change Adaptation Research Facility hosted by Griffith University is an initiative of, and funded by, the Australian Government, with additional funding from the Queensland Government, Griffith University, Macquarie University, Queensland University of Technology, James Cook University, The University of Newcastle, Murdoch University, University of Southern Queensland, and University of the Sunshine Coast.

The role of the National Climate Change Adaptation Research Facility is to lead the research community in a national interdisciplinary effort to generate the information needed by decision-makers in government and in vulnerable sectors and communities to manage the risks of climate change impacts.

Disclaimer: The views expressed herein are not necessarily the views of the Commonwealth, and the Commonwealth does not accept responsibility for any information or advice contained within.

This publication should be cited as:

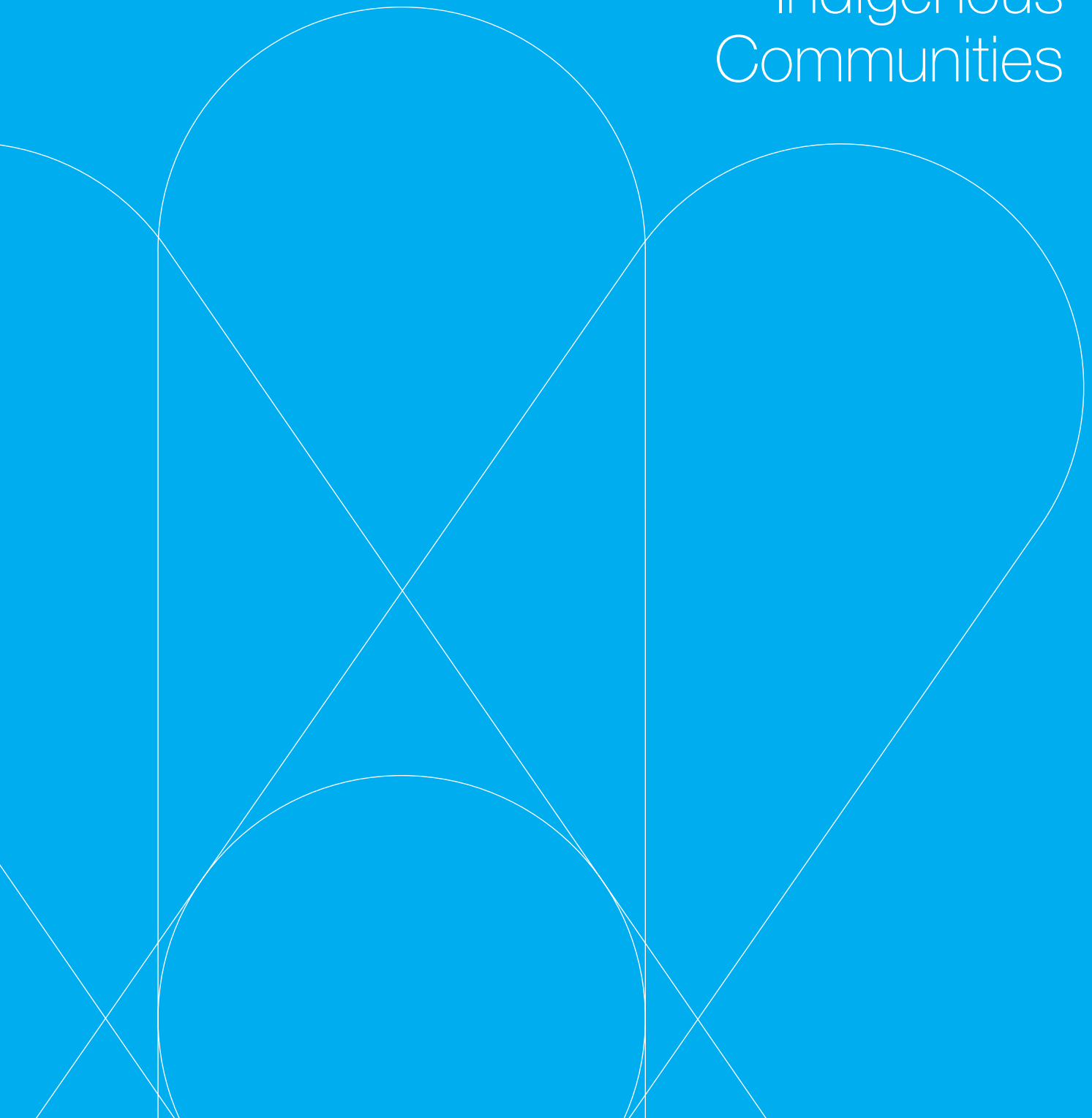
Langton M, Parsons M, Leonard S, Auty K, Bell D, Burgess P, Edwards S, Howitt R, Jackson S, McGrath V, Morrison J, 2012: *National Climate Change Adaptation Research Plan for Indigenous Communities*, National Climate Change Adaptation Research Facility, Gold Coast, 50pp.

ISBN 978-1-921609-37-4

© Copyright National Climate Change Adaptation Research Facility 2012

National Climate Change
Adaptation Research Plan

Indigenous Communities





Contents

Executive summary	4
1 Context and objectives	6
1.1 Background	6
1.2 National policy context	8
1.3 Development of this National Climate Change Adaptation Research Plan (NARP)	9
1.4 Scope of this NARP	11
1.5 Links to, and synergies with, the other NARPs	14
2 Information needs and research context	15
2.1 Overview	15
2.2 Research needs of key stakeholders	23
3 Research priorities	26
3.1 Identifying climate risks and the implications of climate change for Indigenous populations	26
3.2 Identifying Indigenous vulnerability and adaptive capacity	27
3.3 Identifying the constraints and limits of adaptation	28
3.4 Integration of adaptation into policy	28
3.5 Extreme weather events and emergency management	29
3.6 Indigenous population movement, displacement, community relocation and severe climatic variation	32
3.7 Climate change adaptation and Indigenous biodiversity management	33
3.8 Indigenous livelihoods and community planning	34
3.9 Indigenous health and climate change	35
4 Prioritisation process	36
5 Implementation issues	37
5.1 Engagement	37
5.2 Additional funding sources	37
Appendix 1: Research prioritisation	38
References	44



Executive summary

This National Climate Change Adaptation Research Plan (NARP) identifies the research that is needed to enhance understanding of climate change adaptation for Australia's Indigenous communities. For the purposes of this NARP, Indigenous communities include both discrete Aboriginal and Torres Strait Islander communities and Aboriginal and Torres Strait Islanders living in other locales, whether remote, regional, peri-urban, or urban. This NARP outlines priority research areas that will inform decisions about adaptation to produce effective, efficient and equitable strategies and outcomes. Identification of priority areas will enable local, state/territory and Australian governments, as well as other research investors, to fund research over the next five years, which will deliver the maximum benefit to Indigenous communities throughout Australia and provide a broad framework for longer-term research planning.

This NARP is designed to be cross-sectoral and incorporates key research areas not identified in the other eight NARPs, which are of critical importance to the future climate change adaptation planning needs of Australian Indigenous communities.

Research on climate change and Indigenous communities, including the impacts – factors affecting vulnerability and adaptive capacity – and adaptation for Indigenous communities has been limited. Most existing research has focused on identifying the biophysical impacts of climate change. Few studies have explored the vulnerability and adaptive capacity of Indigenous individuals, households, communities, businesses and institutions. Accordingly, there is a need for research that expands knowledge about these and other dimensions of Indigenous adaptation to climate change. The development of a theoretical and empirical knowledge base will inform decision-making about adaptation by individuals, households, communities, businesses, institutions and governments.

This NARP identifies five broad categories of information necessary to enhance decision-making about climate change adaptation for Indigenous Australians. There is a need for research that enhances understanding of:

1. The sensitivity and exposure of Indigenous individuals, households, communities, businesses and institutions to climate risks
2. The vulnerability and adaptive capacity of Indigenous individuals, households, communities, businesses and institutions to climate change
3. Extreme weather events and emergency management planning for Indigenous communities
4. Indigenous population movement, displacement, community relocation and severe climate variation
5. Climate change adaptation and Indigenous biodiversity management.

Within these five categories, thirteen research topics have been identified. As with all National Climate Change Adaptation Research Plans, these research topics are prioritised according to:

- The severity of the potential impact to be addressed
- The degree of potential benefit that could be derived
- The immediacy of the required intervention or response
- The degree to which the research will lead to practical and achievable interventions or responses
- The potential to produce benefits beyond informing climate change adaptation strategies
- The extent to which the research addresses more than one issue or sector
- The extent to which the research addresses the needs of the most vulnerable groups.

The following research topics were identified as high priorities through applying these criteria:

Research Topic 1

Understanding how interactions between social, cultural, institutional, economic and biophysical processes make Indigenous individuals, households, communities, businesses and institutions sensitive to climate risks, and the identification and evaluation of strategies to reduce this sensitivity.

Research Topic 4

Understanding how and why different Indigenous households, communities, businesses and institutions are vulnerable to the impacts of climate change, and the identification of strategies to reduce this vulnerability.

Research Topic 5

Understanding the capacity of Indigenous individuals, households, businesses and institutions to adapt to climate change, and the identification of strategies to enhance this capacity.

Research Topic 8

Understanding the capacity of Indigenous individuals, households, communities and institutions to prepare for, respond to, and recover from extreme weather events, and the identification of strategies to enhance adaptive capacity.

Research Topic 9

Understanding the relationship between Indigenous population movement and severe climate variation.

Research Topic 11

Understanding how the use of marine, terrestrial and freshwater biodiversity resources by Indigenous peoples and groups will be affected by climate change.



1. Context and objectives

1.1 Background

Climate change is widely acknowledged as a global problem that requires concerted and coordinated efforts from nations, communities and individuals. Adaptation and mitigation are the two responses commonly applied to address the impacts of climate change (IPCC 2007). Both contribute towards limiting the risks of climate change. Mitigation refers to efforts to reduce greenhouse gas emissions in order to moderate or stabilise changes in the global climate. Adaptation refers to planned adjustments to reduce, moderate or take advantage of the impacts of climate change; a formal definition is provided in Section 2.1 (Swim et al. 2009; IPCC 2007).

The focus of this National Climate Change Adaptation Research Plan (NARP) for Indigenous Communities is adaptation, rather than mitigation. This NARP identifies important gaps in the knowledge of adaptation to climate change that are relevant to Indigenous communities and sets adaptation research priorities based on these information gaps. It differs from other NARPs, which generally identify sector-specific research priorities, and it takes a cross-sectoral approach to consider the risks, vulnerability and adaptive capacity of Aboriginal and Torres Strait Islander communities to the impacts of climate change, as well as the factors that contribute to successful or ineffective (maladaptive) adaptation responses by and for those communities.

Aboriginal and Torres Strait Islander people, according to the 2006 Australian Census, account for 2.5 per cent of the Australian population, with a total of 517 000 people (ABS 2006). The Indigenous population of Australia is comparatively young with a median age of 21 years compared to 37 years for the non-Indigenous population. Despite popular representations of Indigenous people's settlement patterns, the majority of Aboriginal and Torres Strait Islanders live in non-remote areas, either in regional areas (43 per cent) or major cities (32 per cent). Just 25 per cent of the Indigenous population (combined Aboriginal and Torres Strait Islander populations) live in remote areas (Biddle 2009a; ABS 2010).

Numerous factors influence, interact and drive Indigenous communities, the majority of which lie outside of the field of climate change; however, all sectors and systems (social, economic, institutional, environmental) are experiencing or will experience the impacts of climate change. Many Indigenous communities, especially those in remote locations, have inadequate health and educational services, deficient infrastructure and housing stock, and limited employment opportunities. Such social disadvantage may reduce or limit the capacity of Indigenous individuals, households, communities and institutions to adapt to climate change (Hennessy et al. 2007; Green et al. 2009). The direct biophysical impacts of climate change may cause significant indirect impacts on the social, cultural and physical wellbeing of affected individuals, households, and communities (Hennessy et al. 2007). However, the climate risks posed to Indigenous people are not uniform and will vary between locations and socio-economic status (Adger et al. 2009; Barnett and Campbell 2010).

The NARP for Indigenous Communities provides an outline to steer climate change adaptation research funding decisions, and provide directions for Australia's research community. Many stakeholders need improved knowledge about how, when and where climate change adaptation strategies will need to be introduced to minimise or prevent adverse impacts of climate change on Indigenous communities, including with respect to social and economic systems, institutions and the built environment.

The aims of this NARP are (a) to identify important gaps in current knowledge about Australian Aboriginal and Torres Strait Islander communities' vulnerability and capacity to adapt to climate change, and (b) to set adaptation research priorities based on these information gaps.

Box 1: Impacts of climate change

Direct biophysical impacts:

- Increased severity and/or incidence of extreme weather events
- Increased temperatures over most land areas, fewer cold days and nights, more frequent warmer days and nights
- Heavy precipitation events; frequency increases in many areas
- Increased incidence of extreme high sea level
- Area affected by drought increases

Indirect impacts:

- Disaster-related injuries
- Damage to crops, settlements and infrastructure
- Increased incidence of heat stress and heat-related mortality
- Decreased incidence of cold exposure related mortality
- Reduced agricultural yields in warmer regions
- Spread of infectious diseases (mosquito-, water- and food-borne)
- Increased incidence of infectious diseases (i.e. dengue fever and gastroenteritis)
- Salinisation of freshwater systems
- Freshwater scarcity
- Land degradation
- Damage to crop and livestock
- Reduced food yields and affordability
- Increased risk of poor nutrition
- Loss of biodiversity

References: 'Climate Change Impacts, Adaptation and Vulnerability – Summary for Policy Makers of the Working Group II (World)', IPCC, <http://www.ipcc-wg2.org/>



Damage from Cyclone Monica, 2006. Image: Newspix

1.2 National policy context

The political debates on climate change, both nationally and internationally, have in the past focused principally on mitigation of greenhouse gas emissions. Although mitigation remains the main goal of international climate change negotiations, academics and policy makers are increasingly recognising the critical importance of adaptation to the impacts of climate change. Australia, a signatory to the United Nations Framework Convention on Climate Change (UNFCCC), has agreed to adopt a national programme for mitigation and adaptation (UNFCCC 2002).

In April 2007 the National Climate Change Adaptation Framework was endorsed by the Council of Australian Governments (COAG) as the basis for government action on climate change adaptation over the next five to seven years (COAG 2007). The Framework recognises potential measures to help vulnerable sectors and areas, including human health, water resources, settlements and infrastructure, as well as coastal locations, to adapt to the impacts of climate change. It also records the need for further research into climate change adaptation and improves national coordination of that research in Australia. The Australian Government agreed to provide \$126 million over five years towards the implementation of the Framework.

State, territory and local governments are also taking into consideration the current and future impacts of climate change on their core services, specifically on infrastructure and emergency management, and how adaptation can be mainstreamed. Similarly, industry and professional groups such as mining companies, health agencies and providers, the legal profession and insurance companies, are also considering the impacts of climate change on their operations.

The National Climate Change Adaptation Research Facility (NCCARF) is an initiative of the Australian Government, hosted by Griffith University, to coordinate and direct the Australian research community to generate the necessary biophysical, social and economic knowledge and tools to enable adaptation to climate change. Research outputs will be focused not only on the needs of government decision-makers but also on needs in vulnerable industries and communities. A key aspect of NCCARF is the development and coordination of National Climate Change Adaptation Research Plans (NARPs), which initially addressed eight priority areas:

- Emergency Management
- Human Health
- Marine Biodiversity and Resources
- Primary Industries



Sydney busker. Image: Alessandro Casagrande

- Settlements and Infrastructure
- Social, Economic and Institutional Dimensions of Adaptation
- Terrestrial Biodiversity
- Freshwater Biodiversity.

Subsequently, this list was extended to include the Australian Indigenous Communities NARP in recognition of the specificities of research needs for Indigenous Australia. The Indigenous Communities NARP is intended to be a cross-cutting plan, which will refer to the eight priority areas as they apply to Indigenous communities.

NARPs are intended to identify the critical gaps in current information about climate change adaptation and to set priorities for research which will assist individuals, communities and governments to adapt to the impacts of climate change both in the short and longer terms. Each research plan identifies priority areas for research that can better inform decision-making about adaptation to ensure equitable and effective outcomes. Identification of these research priorities is of critical importance as it forms a basis for local, state/territory, and Commonwealth governments, along with other research investors, to identify and prioritise research over the next five years that will deliver the maximum benefit to the Australian community. In addition, it provides a basis for longer-term research planning. The principle aim

of the information generated from the NARPs is therefore quite specific – it needs to be of use to decision-makers and key stakeholders. Up to \$27 million is being invested in the priority research areas identified by the nine NARPs, which are developed in partnership with governments, stakeholders and researchers.

1.3 Development of this NARP

The development of this NARP is led by the writing team:

- Marcia Langton (Chair)
- Meg Parsons
- Sonia Leonard
- Kate Auty
- Damein Bell
- Paul Burgess
- Shaun Edwards
- Richie Howitt
- Sue Jackson
- Vic McGrath
- Joe Morrison

The writing team developed a consultation draft NARP following a national online survey of key stakeholders and researchers held in October-November 2010. There were over two hundred respondents to the survey, from a wide range of stakeholder groups, including Indigenous

The Indigenous Communities NARP is intended to be a cross-cutting plan, which will refer to the eight priority areas as they apply to Indigenous communities.

Box 2: Climate change terminology

Weather is typically defined as the atmospheric condition in a particular location in terms of air temperature, humidity, pressure, precipitation and wind-speed.

Climate refers to weather averaged over time (usually 30 years).

Climate variability describes variations in the mean state of climate on all spatial and temporal scales (between places and times) beyond that of individual weather events. Examples of climate variability include conditions resulting from periodic El Niño and La Niña events, and extended drought and floods.

Climate change is often defined as shifts in the mean state of the climate or shifts in its variability, which persist for an extended period (several decades or longer) due to human activities altering the atmospheric composition.

Vulnerability to the impacts of climate change is defined as a function of exposure to climate conditions, sensitivity to those conditions and the ability to adapt to changes. In other words, vulnerability refers to the degree to which a person, or a community or even ecosystem is at risk of harm or injury due to exposure to a hazard or stress (such as a tropical cyclone, earthquake, heatwave), and their ability to cope, recover or adapt to the hazard.

Adaptations are actions taken to help communities and ecosystems cope with, moderate, or take advantage of, current or future changes in climate conditions. Or alternatively, practical steps to protect communities from damage and disruption associated with climate change.

Adaptive Capacity refers to the ability of a community or system to adjust to change (including extreme weather events, climate variability, and climate change), limit damages, take advantage of opportunities and cope with the consequences.

Sensitivity describes the degree to which a system or community is affected, either positively or negatively, by climate variability and climate change. The effect may be direct (decreased crop yields due to declining rainfall) or indirect (increased damages to infrastructure as the frequency of coastal flooding events increases as sea level rises).

Reference: IPCC 2007; National Research Council 2010



River crossing. Image: Hayden Bromley

representative bodies, Aboriginal ranger groups, Indigenous health providers, regional authorities, representatives from the Commonwealth, state and territory governments, local government, non-government organisations, researchers from universities and CSIRO. Respondents were asked to identify areas of crucial concern in terms of current and future impacts of climate change on Indigenous communities, and potential opportunities for those communities. The results confirm the cross-sectoral focus of this NARP, with key areas of concern identified including environmental and human health, human security, communication strategies, legislation and policy, traditional knowledge, emergency management, settlements and infrastructure, food and water security.

The writing team incorporated the survey results into the consultation draft NARP, which was subject to an extensive round of public consultation. The draft was sent to key stakeholders, distributed throughout the NCCARF theme networks and made available on the NCCARF website for a five week period. In addition, three public consultation information sessions were held in Canberra, Darwin and Cairns. Follow-up phone calls and emails were made to a range of stakeholders and the Writing Team sought input from key stakeholders during face to face meetings. Submissions were received from Indigenous institutions,

including Indigenous land councils and community groups, as well as state, territory and Commonwealth government agencies, researchers, industry groups, and non-government organisations. These submissions were carefully considered by the writing team in the production of this final NARP.

1.4 Scope of this NARP

The NARP for Indigenous Communities identifies critical gaps in existing information about the potential impacts of climate change on Australia's Aboriginal and Torres Strait Islander communities and considers the factors that contribute to successful adaptation responses. The main aim of this NARP is to set priority research areas that will guide the research agenda in this area for the next five years. The identification of priority research areas will enable the generation of knowledge about climate change adaptation for Indigenous communities. This knowledge will in turn inform adaptation policy- and decision-making as well as investments by Australia's governments, industries and businesses, organisations, communities and individual residents.



Bushfood. Image: Tatiana Geris

In this NARP an Indigenous ‘community’ is defined as a group of people who are members of a group who share a common identity as Aboriginal and/or Torres Strait Islander, and on the basis of this engage in joint action. When considering the impacts of climate change on Indigenous communities, it is important to acknowledge the great diversity of Aboriginal and Torres Strait Islander communities, which range from urban centres to very remote outstations, and to ensure as far as possible that adaptation research encompasses this diversity.

Certain groups of people, the IPCC Fourth Assessment concluded, are at particular risk from climate change (IPCC 2007). Within Australia, inequalities exist between classes, ethnicities, males and females, age groups and places. Inequalities between Indigenous and non-Indigenous Australians are amongst the worst in the western world (Anderson et al. 2006; Sutton 2009). For many Aboriginal and Torres Strait Islanders – particularly those living in remote communities – access to, and opportunities for, education and employment is limited. The provision of basic services, infrastructure and healthcare is deficient, and social problems are endemic (ABS 2006; Biddle 2009a). The impacts of climate change threaten to exacerbate these social, economic, institutional and health problems in Indigenous communities. For both ethical and practical reasons, it is critical that we understand these inequalities and seek adaptation options that have equitable outcomes. Equitable adaptation is more likely to be effective and enhance the ability of society as a whole to adapt (O’Brien et al. 2004; Smit and Wandel 2006; Barnett and Campbell 2010).

Research on climate change and Indigenous communities, including impacts, vulnerability and adaptation, has been limited. Most past research in Australia has focused on identifying the biophysical dimensions of climate change. Indigenous communities’ choices in adapting to climate change are limited at present by insufficient knowledge of adaptation and strategies specifically related to climate change. This NARP suggests a broad research agenda and will seek to expand Australia’s knowledge about:

- The risks posed to (and new opportunities created for) Indigenous communities;
- What factors can contribute to, or hinder, effective climate change adaptation responses in Australia’s Indigenous communities;
- Existing methods of managing climate risks in Indigenous communities and the viability of these methods for the future.

This NARP will support the climate change adaptation efforts of Indigenous communities around Australia by identifying research priorities of relevance to stakeholders. The identification of research areas provides a guide for enhancing decision-making about adaptation across all levels of government, Indigenous representative bodies, Indigenous natural resource management units, social service agencies and providers, community groups, non-government organisations, the private sector, investors and various other stakeholders. This NARP will draw upon past and current research into climate change impacts, mitigation and adaptation, specifically concerning Australian Indigenous communities.

Many research topics of relevance to Indigenous communities often blur the boundaries between measures to reduce greenhouse gas emissions and measures to adapt to the impacts of climate change. While there is no direct attempt to prohibit mitigation issues that interrelate with those of adaptation, this NARP remains primarily focused on adaptation strategies rather than mitigation. Moreover, a great array of research into Indigenous land and biodiversity management techniques and mitigation activities (including carbon abatement, and carbon sequestration) is already underway (see West Arnhem Land case study), whereas climate change adaptation for Indigenous communities remains largely under-researched. Yet, adaptations that result in increasing amounts of greenhouse gases being emitted into the atmosphere can be considered maladaptive as they increase the risks posed by climate change (Kovats and Hajat 2008).

Links to, and synergies between, this NARP and other NARPs are addressed below. Section 2 provides an overview of the knowledge and specific research challenges related to climate change adaptation for Indigenous communities, identifies key stakeholders for this NARP, and

Box 3: Climate change mitigation — carbon offsets and Aboriginal fire management

Australia's tropical savannas are naturally prone to burn every dry season and the most effective way of preventing fire is fire itself. Aboriginal people have long held this knowledge and have used patched burning and firebreaks during the early dry season (when the weather is cooler and fuel loads are smaller) as a method to prevent larger uncontrollable wildfires in the later part of the dry season (when the weather is hotter, drier and the fuel loads larger). However, these Indigenous land management practices were abruptly interrupted in the twentieth century as Aboriginal people were moved (voluntarily or forcibly) into centralised communities (towns, missions and other settlements). Without people on the land to manage it, the newly emptied landscape began to experience a destructive pattern of frequent large fires, which often started in more settled areas of the lowlands. This new fire pattern negatively affected local ecosystems and cultural heritage sites such as rock art, and resulted in greater greenhouse gas emissions than earlier fire patterns. At present, approximately 40 per cent of the Northern Territory's greenhouse gas emissions are caused by wildfires.

The West Arnhem Land Fire Abatement project (WALFA) uses traditional Aboriginal fire management techniques combined with western scientific knowledge in Australia's fire-prone tropical savannas as a method to reduce greenhouse gas emissions. The West Arnhem Land Fire Abatement Agreement signed in 2006 is a partnership agreement between traditional owner groups, Indigenous land management rangers, Darwin Liquefied Natural Gas, the Northern Territory Government and the Northern Land Council. Under the agreement, Darwin Liquefied Natural Gas contributes A\$1 million per year for 17 years to employ Indigenous rangers to implement strategic fire management practices across 28,000km² of Western Arnhem Land in Australia's Northern Territory. The intent of the agreement was to offset the greenhouse gas emissions (100,000 tonnes of carbon dioxide per year) from the Liquefied Natural Gas plant located in Darwin city. The agreement was a consequence of the Northern Territory licensing arrangement, which required natural gas plant to offset its greenhouse gas emissions. The WALFA example highlights the collaborative research partnerships already operating in the field of climate change mitigation in Australia and demonstrates the potential for climate change adaptation research to be similarly collaborative and provide valuable co-benefits for Indigenous communities, government, businesses and researchers alike.

Carbon farming, which includes both carbon abatement and carbon sequestration projects, is one of the key areas of mitigation research and policy formation in Australia. In mid-2011 the Commonwealth Government announced, as part of its Clean Energy Future policy, an Indigenous Carbon Farming Fund to assist Indigenous participation in the Carbon Farming opportunities such as are embodied in the WALFA scheme. The Indigenous Carbon Farming Fund will provide \$22 million over five years to fund research, the development of reporting tools and the employment of specialists to work with Indigenous communities on carbon farming projects. The Carbon Farming Initiative offers the potential to create new economic opportunities for Indigenous communities. In this way mitigation activities, which include but are not limited to carbon farming, may serve to provide more diverse and sustainable livelihoods for Indigenous communities, and enhance the capacity of Indigenous individuals, households, institutions and communities to adapt to changing climate conditions in the future.

References: Russell-Smith et al. 2009; NAILSMA 2010

defines the research agenda. Section 3 outlines the research questions in further detail. Section 4 describes the prioritisation process whereby the research questions were assessed by a set of criteria to determine those of highest priority. The complex prioritisation for all research questions is included in Appendix 1. In conclusion, Section 5 discusses the implementation plan.

A number of examples highlighting climate change impacts, vulnerability and adaptation relevant to Australian Indigenous Communities are provided in nine boxes throughout this NARP. These are wide-ranging, and one case (Box 3, Aboriginal fire management) is related perhaps more to mitigation than to adaptation. However, the interface between adaptation and mitigation is increasingly blurred, and the fire management example is considered of sufficient importance to the Indigenous and wider community to be included.

1.5 Links to and synergies with the other NARPs

The eight other National Climate Change Adaptation Research Plans have been developed to guide climate change adaptation research in Australia across a spectrum of sectors. In many instances, the recommendations and priorities contained in the Indigenous Communities NARP interrelate with the other Research Plans. Indeed, early NARPs explicitly considered adaptation and Indigenous Communities in their particular sectors. Thus, the Human health NARP has a specific research priority related to Indigenous people. However, once the decision was made to prepare a NARP specific to Indigenous Communities, later NARPs make reference to the Indigenous Communities NARP rather than considering Indigenous Communities explicitly.

The implementation plans for all NARPs are designed to ensure that the research priorities are mutually supportive and avoid unnecessary duplication of research effort. That being said, this NARP addresses dimensions of adaptation that are of cross-sectoral relevance, but are also of national importance in their own right.



Storm, Alice Springs. Image: Stephen Barnett

2. Information needs and research context



2.1 Overview

Over millennia, Indigenous peoples have survived in Australia's diverse and sometimes harsh environments. Archaeological and anthropological evidence indicates that traditional Australian Indigenous societies possessed a high degree of resilience to environmental change and variability (Hiscock 2008; Langton 2003). On the reverse side of this, since the beginning of British settlement in Botany Bay in 1788, Aboriginal and Torres Strait Islander cultures have experienced profound changes to their societies, economies and landscapes (Carter 1988; McGrath 1995; Kidd 1997). Indigenous groups faced armed conflict, introduced diseases, seizures of land and resources, racially discriminatory government policies and legislation, and economic deprivation (Haebich 2000; Reynolds 1987). In addition, their country was fundamentally altered with land deforested to meet demands for timber and agricultural land; new plants and animals introduced; biodiversity reduced through changed land use practices and introduced species; rivers diverted and dammed for hydropower, irrigation and flooding control; coasts modified to support human settlements and polluted by those same settlements; fish stocks depleted due to overfishing; and land further degraded through unsustainable land use practices (Langton 2003). Despite the destruction, disruption and transformation wrought across the land and its traditional owners by European colonialism, in the twenty-first century hundreds of Aboriginal and Torres Strait Islander communities, built upon countless tribal lineages, persist and grow, bound together by culture, history, family and relationships with country. It is important to acknowledge the strength and resilience demonstrated by Australian Aboriginal and Torres Strait Islander

peoples to the onslaught of colonialism. Yet it is equally important to recognise the present and future climate risks posed to Indigenous communities and the vital need to plan and adapt to a changing climate.

There is strong evidence that anthropogenic climate change is underway in Australia. During the twentieth century, temperatures in Australia increased by 0.7°C (CSIRO and BoM 2007). This warming pattern is predicted to continue and intensify in the twentieth-first century. In Australia, sea level rise, more intense tropical cyclone activity, higher temperatures, greater rainfall variability and more frequent extreme floods, droughts and fires are all identified as outcomes of a changing climate. Wetlands, coastlines and off shore islands are at greater risk of erosion and inundation, and salt water intrusion threatens flora and fauna, and human habitation (Hennessey et al. 2007; Dunlop and Brown 2008). Australia's inland ecological and social systems are also at risk due to changes in climatic patterns and increased incidence of extreme weather events. Several reports have suggested that Indigenous communities, particularly those in coastal locations, are especially vulnerable to the impacts of climate change (Hennessey et al. 2007; Green et al. 2009). Climatic changes have implications for Australia's Indigenous population, particularly those in rural and remote locations, many of whom depend on bush or sea food (hunting, gathering and fishing) for their livelihoods. Climate models indicate that sea level rise and storm surges will affect Indigenous coastal communities across Northern Australia in particular, and Indigenous leaders, communities and organisations have expressed their concern (Mackie and Hanslow 2010; Hunter and Leonard 2010; NAILSMA 2010; Sinnamon 2009).

Climatic changes have implications for Australia's Indigenous population, particularly those in rural and remote locations, many of whom depend on bush or sea food (hunting, gathering and fishing) for their livelihoods.

Box 4: Paruku (Lake Gregory) and the problem of red worms: an exemplar of collaborative research

In 2005 Tjurabalan people, Traditional Owners of Paruku (Lake Gregory), first began to notice that the spangled perch found in the waterways of Paruku, Lake Stretch and Sturt Creek were infested with worms. Spangled perch (Yaku), one of three fish species in the lakes, are an important source of food for the Tjurabalan people. The infestation prompted local people to stop eating the fish for fear of getting sick. Tjurabalan Traditional Owner Veronica Lulu states:

The fish are hurt. They were alright before, long time ago. ... We can't eat them with red worm. It might make us sick inside (KLC 2009).

Spangled perch (Yaku) are not only an important source of food to the Tjurabalan people, but are also imbued with cultural significance. Ms Lulu and a group of women elders recount that the Yaku came from fish dreaming, and fishing for Yaku is intricately connected to country, language, history and story-telling. Nolan Hunter, Deputy Director of the Kimberley Land Council, observes:

This is a... phenomenon that is impacting not only on our environment but threatening the daily social fabric of people's lives. The spangled perch is of monumental importance to the Tjurabalan people and this infection is transforming the way they live. It is impacting on their diet, their culture and their traditional practices (KLC 2009).

In 2008, in response to ongoing concerns, the local community, in collaboration with the Kimberley Land Council, the Department of Water, the World Wildlife Fund and the University of Canberra, initiated a joint research project to investigate the cause of the worm infestation. The project was completed in 2009 and found that 80 per cent of the spangled perch carried the parasitic nematodes (red worm). University of Canberra researcher Sam Walker concluded that the infestation was a result of a combination of factors including the long-term wetting and drying patterns of the lakes, high migratory bird numbers, reduced water quality, and higher water temperatures (Walker 2009). Walker's research findings seem to confirm what elders had been saying all along, that the infestation was tied to the profound drying period. As Ms Lulu states:

We believe the fish will get healthy when we get rain, when the river gets full and is flowing. Big rains will kill all this red worm in the fish (KLC 2009).

While the research project did not provide a solution to the fish infestation, it did improve understandings of the Paruku inland lake system and provides an exemplar of the value of collaborative community-based research which combines traditional ecological knowledge with western scientific methods to improve understanding of environmental change.

The research did not examine the implications of climate change for the Paruku region. However, it is reasonable to assume that changing climatic conditions may have contributed to the worm infestation. Moreover, climate change is likely to increase the incidence of such ecological disturbances in the future.

See KLC 2009: Kimberley Land Council website, Media Statement December 1, Walker 2009, www.klc.org.au.

Most research on climate change and Indigenous people in Australia over the past two decades has focused on four areas: studies of the climate-risk relationship and, via modelling, the estimation of future climate risks; carbon abatement and economic opportunities and Indigenous knowledge of climate change (Altman and Jordan 2008; Green et al. 2009; NAILSMA 2010). Various government and international reports have explored the climate risks to Indigenous Australian populations including those from the IPCC, DCCEE, and CSIRO. The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (IPCC 2007) discussed the impacts of climate change on Indigenous communities in Australia as well as documenting the broader impacts on Australian society (Hennessey et al. 2007). Likewise, the Australian Government commissioned a scoping study of the potential impacts of climate change on Indigenous settlements and communities across Northern Australia, including the Torres Strait Islands and the Pilbara region of Western Australia, which looked at the risks and opportunities generated by climate change (Green et al. 2009). This study explored the impacts of climate change on biodiversity, infrastructure, education and livelihood opportunities, and concluded that despite uncertainty in climate projections for Northern Australia, there was sufficient certainty to enable policy development (Green et al. 2009).

In this NARP we define adaptation as 'actions taken by individuals, groups and systems to avoid the impacts of climate change, or to attain potential benefits arising from climate change' (Parry et al. 2007 p. 869; Swim et al. 2009 p. 102). The process of adaptation is not new to human beings, indeed Australia's Indigenous peoples have adapted to changing climates and environments for thousands of years, including long term changes in climate. However, the speed and magnitude of global warming substantially differs from earlier climatic changes and is unprecedented in terms of most of human history. Ongoing climate change may expose Indigenous communities to conditions outside normal coping ranges and threaten human health and wellbeing. This raises questions such as: To what extent is adaptation possible

and how can adaptation to present and future environmental changes be enabled? Adaptation at its basic level refers to adjustments to changing environmental and social conditions. Understanding adaptation to climate change in the context of Indigenous Australian communities requires careful consideration of two dimensions: Scale (who is adapting to what, and where?) and Purpose (To what are we adapting? What are the aims of adaptation?).

It is widely acknowledged that the impacts of climate change may threaten or damage things people value. The impacts of climate change will not be evenly distributed across Australian society; rather, vulnerability to harm is differentially distributed. In this NARP we use the definition of vulnerability provided by the IPCC, which is 'the degree to which individuals, groups and systems are susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, rate of climate change and variation to which a system is exposed; its sensitivity and its adaptive capacity' (IPCC 2007 p. 883; Swim et al. 2009 p. 106). Vulnerability therefore refers to the extent to which a system or social group is susceptible to harm from an external stimulus or stimuli. Exposure refers to the susceptibility of communities or populations to hazardous conditions. At a local level, vulnerability is conditioned by the interaction between social, cultural, economic, political and biophysical factors which operate on multiple scales over time and space.

Action taken in response to one climate risk may result in increased vulnerability to other climate risks or risks from other sources. This potential for an adaptation to increase vulnerability is called maladaptation. Maladaptation may occur when an action taken to respond to climate change increases the vulnerability of other sectors or groups, increases greenhouse gas emissions, increases social inequity, decreases incentives to adapt, or places limits on the ability of future generations to adapt (Barnett and O'Neill 2010).

There is a distinct difference between being aware of what could or should be done to

respond to climate change and having the ability to implement necessary actions. This ability is termed 'adaptive capacity' (Smit and Wandel 2006). Adaptive capacity refers to the extent to which a community can plan for, and respond to, exposure to hazards. Adaptive capacity is not uniform, rather it is context specific, differing over time and place. The resources that contribute to adaptive capacity include human, social, physical, financial and natural capital. The distribution of these diverse sources of capital varies across society. The ability to access these resources is affected by a variety of institutional, social, cultural and economic factors. The understanding of climate risks, and options to adapt to those risks, is itself a significant determinant of adaptive capacity, as is the awareness of the need to adapt (Adger et al. 2006; Adger et al. 2009).

Indigenous people are often confined to the margins of international, national and local climate change debates, and comparatively little research on climate change adaptation for Indigenous communities has been undertaken, especially research which incorporates Indigenous world views (exceptions include Ford et al. 2010; Petheram et al. 2010; Saik and Ross 2009; Veland et al. 2010). Existing literature on Indigenous peoples and climate change adaptation in Australia is often descriptive

and makes various assumptions based on broad-brush socio-economic data and climate-related risks. Few empirical studies have been conducted on the differential social vulnerability, resilience and adaptive capacity of Australia's Aboriginal and Torres Strait Islander communities and the ways in which the adaptive capacity of Indigenous communities can be enhanced in the context of climate change (exceptions include in the Torres Strait Islands, see Box 6). In light of this, much of the relevant literature on climate change adaptation and Indigenous peoples used to inform this NARP comes from overseas, particularly with respect to Inuit and First Nations communities in North America. Sakona and Denton (2001) highlight the importance of including indigenous and local perspectives in discussions about development for reasons of social equity and justice. Likewise, Ford et al. (2010) advise that in order to ensure the effectiveness of climate change adaptation policy, interventions in Canada's Inuit communities, Indigenous views, beliefs and aspirations for the future must form the cornerstone of adaptation policies.

In consideration of Australia's post-1788 history, it is unlikely that adaptation plans or policy recommendations developed without the engagement and collaboration of local Indigenous communities will have the necessary



Bush track. Image: Yaruman

social legitimacy to gain local acceptance and ensure successful adaptation. Nor are such plans likely to appropriately incorporate Indigenous understanding. Adaptation policies, plans and projects need to draw upon the present-day and historical experiences of Indigenous communities, and should seek to engage or harness the knowledge and skills of individuals, households and communities. What is more, it is of critical importance that adaptation research projects be designed to ensure that communities have access to the research outputs and that information is presented in a form that suits community preferences (which may include such things as the use of translators, face to face meetings, back to country trips, publications in the local language, posters, DVDs and/or online content).

Local and international examples of place-based adaptation case studies highlight the importance of local community involvement in climate change adaptation research and practical projects (Dumarú 2010). Case studies situated

in particular places and cultures allow for a more detailed and nuanced understanding of the dynamic interactions between people and the environment (Ford et al. 2006). The involvement of communities in adaptation research is central to bridging the divide between research, policy and implementation. In this way it is essential that Indigenous communities are involved in designing, undertaking and interpreting research, and in dissemination of research findings. Moreover, adaptation programs and policies designed to reduce vulnerability and enhance adaptive capacity are more successful when developed in cooperation with local representatives, as the community is likely to trust them and find the interventions consistent with local norms and aspirations (Ford et al. 2006; Barnett and Campbell 2010). Working in partnership with community organisations and members enables key stakeholders and institutions to be identified and facilitates knowledge transfer (Huq and Reid. 2007).

Box 5: Traditional ecological knowledge

Indigenous knowledge is commonly held in a community or society, with aspects of it only known by specific members of the group such as specialists, elders, descendants (lineage) or gender groups. The term Indigenous knowledge (IK) is broadly defined as local knowledge unique to a given society or culture, and/or held by Indigenous peoples (Berkes 1998). While some use the terms *Indigenous knowledge and traditional ecological knowledge* interchangeably, in this NARP the term traditional ecological knowledge is used to refer to particular ecological knowledge, and is considered a subset of Indigenous knowledge. Traditional ecological knowledge is defined by Berkes (1998) as:

a cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down from generations by cultural transmission, about the relationship of living beings (including humans) with one another and their environment. (Berkes 1998: p. 8)

Traditional ecological knowledge is critical to understanding the vulnerability and adaptive capacity of Indigenous communities. Moreover, traditional ecological knowledge may assist in the creation of community or clan-group priorities for climate change adaptation through harnessing the knowledge of individuals, households and communities to create efficient, effective and equitable adaptation options, as has occurred for climate mitigation projects (Russell-Smith et al. 2009).

Many Australian Indigenous organisations have been involved in undertaking various small-scale climate change projects over the last decade in collaboration with governments, university researchers and NGOs (Sinnamon and Mango 2010; Mackie and Hanslow 2010). However, the majority of this material remains unpublished or, if published, has not been subjected to the peer-review process. Although useful for reasons of knowledge transfer and engagement, such projects are typically short-term and small-scale and do not provide the communities or governments with the necessary information to inform adaptation planning. The engagement of experienced Australian anthropologists, geographers and scientists in the field of climate change, together with Indigenous people, will substantially strengthen future research. One of the challenges for all parties involved in future Indigenous climate change adaptation research projects will be how to balance the demands of robust biophysical scientific research with community-led and responsive goals of such programs. Research projects will need to be designed to integrate community goals with scientific inquiry. In addition, projects will need to follow established research protocols for working with Indigenous communities, which include common values:

- Consultation and negotiation
- Respect and mutual understanding
- Collaboration and partnerships
- Capacity building
- Outputs, outcomes, benefits and agreements, and
- Cultural appropriateness.

Overall, the general lack of research about the Indigenous dimensions of climate change, including impacts, vulnerability and adaptation studies, presents a barrier to the creation of efficient, effective and equitable adaptation policies and strategies for Australian Indigenous communities. However, this research deficit is not evenly distributed and there are Indigenous communities where a vast array of studies has been undertaken, most notably in the Torres Strait Islands. The Torres Strait Islands provides a particularly telling example of the problems of translating research into action, and the urgent need for governments to implement transparent, accountable, climate change adaptation policies to ensure equitable adaptation outcomes. The Torres Strait Islands case study also highlights the need for short-term adaptation responses, many of which align with social policies, in addition to the longer-term adaptations options currently favoured by policymakers and planners.



Bush honey. Image: Rusty Stewart

Box 6: Community-based adaptation planning in the Torres Strait Islands

The Torres Strait Islands consist of more than 100 islands, with 17 island communities and a total population of nearly 9000 people. There is significant geographical variability between the islands, which range from low mud islands (top-western group), to low coral islands (central group), continental high islands (lower western group) and volcanic high islands (eastern group). Many Torres Strait Island communities are already impacted by severe coastal erosion and sea inundation during high tides, which result in the flooding of houses, key infrastructure and sites of cultural significance.

Likely direct impacts of climate change:

- Increased frequency and depth of inundation
- Increased coastal erosion
- Damage to/loss of key infrastructure and built environment
- Damage to cultural heritage sites
- Saltwater intrusion of fresh water supplies
- Damage to family kitchen gardens.

Likely indirect impacts of climate change:

- Loss of access to traditional land and sea country
- Modification of cultural practices
- Health impacts including water-borne and vector-borne diseases
- Economic impacts due to rising costs of living
- Changes to marine ecosystems including impacts on primary food sources e.g., fish species, turtles and dugongs
- Population pressure due to migration of Papua New Guineans to neighbouring Torres Strait Islands.

Planning for adaptation in the Torres Strait:

Since 2006 the Torres Strait Regional Authority (TSRA), in partnership with the Torres Strait Islands Regional Council and relevant Local, Queensland and Commonwealth Government agencies, has been engaged in a number of adaptation activities through a Coastal Management Committee. In recognition of the inherent links between coastal management and climate change, the committee has developed a regional climate change strategy. This strategy focuses on:

- Identification of adaptation options
- Implementation of the most urgent adaptation options
- Risk science to inform planning
- Enabling community adaptation and resilience building.

Investigations into the impacts, risks and adaptation options have already been undertaken on the islands most at risk from sea level rise. These investigations, undertaken by researchers from James Cook University, TSRA and various other organisations, were designed to ensure that communities had access to the best available science, as well as local knowledge, with research outputs communicated in the local language and made available to communities through face to face meetings, posters, and DVDs. Emphasis was placed on Traditional Owners' right to self-determination. Communities were then able to make informed decisions about preferred options, prioritised and classified into urgent short-term and long-term concerns. From there, funding applications were made for priority adaptation projects.

Several other related projects have been conducted in the region in the past. Others, such as LiDAR aerial mapping surveys and an expanded tide gauge network, are currently underway and

more future studies on targeted high resolution bathymetric mapping, storm surge modelling and other marine focused impacts (for instance coral bleaching predictions) are being considered through the implementation of the Torres Strait Climate Change Strategy.

The TSRA-coordinated climate change investigations in the Torres Strait Islands have been an exemplar of efficient community-based adaptation planning. Several communities were engaged, provided with up-to-date scientific knowledge of coastal processes and climate change, and were able to make informed decisions based on balanced views of the disadvantages and advantages of adaptation strategies. Communities participated in adaptation prioritisation discussions that included:

- Staged relocation of community infrastructure to less exposed locations where deemed necessary
- Ongoing monitoring of sites at less risk of immediate coastal erosion or inundation
- Incorporation of coastal flooding and erosion hazards into land use planning.

Community understanding of climate change adaptation significantly shifted as a result of these research projects. Researcher Scott Smithers (James Cook University) observes that at the start of the research project, communities generally considered fortification (sea walls) as the only response to coastal erosion, whereas by the end of the project communities willingly examined a range of adaptation options from 'doing nothing' to possible community relocation. The latter was completely rejected in most instances as people could not envisage leaving their homelands as an acceptable option.

Despite the commendable adaptation process instituted by TSRA and the willing participation of several at-risk Torres Strait Island communities, the majority of the adaptation recommendations have yet to be implemented. Successive applications for external funding, specifically for short-term adaptation strategies, have been unsuccessful. The lack of tangible adaptation works after the extensive adaptation research and planning process has caused frustration amongst communities and researchers alike. Community support and engagement in the adaptation process is at risk if this situation continues.

The inability to translate research and planning outcomes into direct action is not a result of community or local government inaction, but rather rests firmly with the funding sources to act on the research findings. If governments expect other Indigenous communities to take part in a similar adaptation process, whereby they are recognised as active partners in the investigation, evaluation and informed decision-making about climate change adaptation options, the responsible government agencies first need to ensure that they have the mechanisms in place to address the implementation of adaptation in a reasonable and timely manner. The consequences of failing to address these implementation issues will be considerable. Communities will feel disempowered and potentially lose faith in not only the adaptation process, but also other environmental projects. Ultimately, this may result in the breakdown of mutually beneficial partnerships.

The Torres Strait experience offers an important lesson for governments, researchers and Indigenous communities alike: in order to achieve successful community-based adaptation in Indigenous communities, emphasis cannot be focused solely on planning for future climate conditions, but instead must address the present-day situation in those communities. Long-term adaptation planning therefore needs to be accompanied by a parallel process of short-term adaptation outcomes, including, but not limited to, tangible remedial works, which are currently designed to reduce social vulnerability to natural hazards. Such short-term strategies will in turn enhance the capacity of those communities to adapt to future climate conditions.

References: TSRA 2010; Mackie and Hanslow 2010; Smithers 2010; Foreign Affairs, Defence and Trade References Committee, 2010.

2.2 Research needs of key stakeholders

The value of research on adaptation is enhanced when it is targeted to meet the needs of specific groups of decision makers throughout society (Sarewitz and Pielke 2007). There is a need, then, for science policy and decision support research that focuses on eliciting stakeholder needs through participatory processes, using these needs as design criteria for research programs and projects and partnering, where possible, with stakeholders to undertake research of demonstrated relevance to users.

The key stakeholders in an Indigenous adaptation strategy are:

- Indigenous individuals, households and communities
- Community organisations and service providers including:
 - Land councils and Native Title Representative Bodies
 - Emergency and disaster services
 - Health services.
- Policy makers including:
 - Department of Families, Housing, Community Services and Indigenous Affairs (FAHCSIA)
 - Department of Climate Change and Energy Efficiency (DCCEE)

- Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC)
- State governments
- Local councils.

While these stakeholders have different research needs regarding Indigenous adaptation, their needs are often complementary, and will overlap. For this reason, research conducted in partnership with all stakeholders will increase the likelihood that the research is truly responsive. Significantly, different stakeholders have varying degrees of awareness of climate change impacts, the need to adapt, and potential adaptation strategies (Lorenzoni et al. 2007).

Unsurprisingly, the key stakeholders in Indigenous adaptation to climate change are **Indigenous communities** themselves. These communities are diverse and their research needs are not homogenous. Indigenous communities in **remote and regional areas** often have inadequate infrastructure, health services and employment, complex land tenure arrangements, and consequently demonstrate features of social disadvantage which may reduce or restrict their capacity to adapt (Hennessy et al. 2007). Furthermore, social and cultural cohesion in remote communities is often intimately connected to specific landscapes. Environmental change can adversely affect



Ivanhoe Crossing, Kunnunurra. Image: Ciamabue

community cohesion. As such, these communities will need to know the likely impact of climate change on food and water sources. In the event their communities' locations are at severe risk to environmental hazards, such as sea level rise, there is also a need to understand the options available for relocation and the potential cultural and social consequences of this relocation, be it short- or long-term (see Warmum case study, Box 7).

Indigenous communities in **metropolitan areas** will have similar research needs to other metropolitan communities such as finding out how climate change could affect employment, economic participation, social inclusion, ecosystem goods and services, demographic trends and quality of life. However, Indigenous communities in metropolitan settings are often more socially and economically disadvantaged, particularly in terms of health and educational outcomes. As such, their vulnerability to climate change will be increased and their adaptive capacity potentially decreased. Research that contributes to improved community understanding of risk contexts including, but not limited to, climate risks facing Indigenous communities is needed urgently by the communities themselves as well as by service providers and policy makers.

The marginalisation of Indigenous communities is often paralleled by a lack of information regarding the impacts of climate change. Communities will benefit from a research agenda that is inclusive and consultative, which allows for consultation, negotiation and evaluation of research priorities, processes and outcomes in a way that builds capacity within communities. Climate change knowledge must be effectively and clearly communicated to communities so that they can best articulate their own research needs; these communication strategies need to be designed to address the diversity of Indigenous communities.

Community organisations and service providers work directly with communities and are uniquely placed to identify research needs and facilitate adaptive strategies. Their services are also vulnerable to the impacts of climate change. They will benefit from understanding the distribution of vulnerability within and between communities, including the distribution of adaptive capacity. Community service providers may also benefit from information about the way that climate change could change demands on community services, service delivery and the assets they have available to provide them. In the case of emergency and disaster management in particular, service providers would benefit from research identifying community preferences for disaster preparedness, response and recovery processes.

All levels of government would benefit from research which uncovers how climate change policies and legislation directed at mainstream Australia are experienced by Indigenous communities. For example, how will pricing carbon affect Indigenous households, and how will households be compensated if they are not in the tax system? Policy makers may also be interested in measures to protect cultural heritage that may be adversely affected by climate change. Finally, research may be needed to determine the jurisdictional responsibility of different tiers of government – particularly when extreme weather events cross state or local council borders.

All stakeholders would benefit from research which highlights and unpacks linkages between different impacts of climate change. For example, effects of water shortages on biodiversity, and in turn, food sources; or effects of community relocation on mental health. Research should highlight the indirect effects of climate change beyond obvious and direct effects.

Box 7: Case Study: Warmum flash flood 2011

On 12 March 2011, the remote Aboriginal community of Warmun in the East Kimberley was devastated by a flash flood. Following 24 hours of unusually heavy rainfall, during which 310 mm fell in Warmun, the nearby stream of Turkey Creek quickly rose and broke its banks flooding the community. Community members report that water levels in Turkey Creek increased rapidly at 2pm and within half an hour the water was over the house roofs. Flood levels peaked, the Western Australia Department of Water estimates, at 5.1 m above the height of the bridge deck (located in the middle of Warmun).

At the time, Warmun had no emergency management plan, and there was no one in the community trained in emergency management procedures to assist in the evacuation. Thus community members responded to the situation at hand and self evacuated. They took direction from the existing community leaders, who organised for people to congregate at the roadhouse (located on higher ground), and watched as the waters engulfed their homes. Following the initial evacuation, the community remained isolated for a further two days. Community members were confused as to what they should do next. Flooding had severely damaged roads in the entire East Kimberley region and Warmun could not be accessed by road. In the meantime, supplies and shelter for those community members (approximately 224 people) were severely limited. Damaged infrastructure, inadequate communication and a lack of emergency management planning all combined to delay immediate disaster response. It was difficult for community members to get information to and from state emergency management officials. Eventually, on 14 March, Warmun residents were evacuated by helicopters to Kununurra and placed in the temporary workman's camp. In total, 42 houses were completely destroyed and another 20 houses were deemed unlivable without major repairs. In addition, most residents lost all their personal possessions. Warmun residents remained in the temporary camp in Kununurra until August 2011 after which time they were allowed to return to their community. Work continues on the rebuilding of houses and essential infrastructure in the community.

Housing Indigenous people in a location outside of their traditional lands in evacuation centres set up for only short-term relief, and the levels of services needed to support the day-to-day needs of those people, is of concern. Likewise, the psychological impacts of the flash flood on the Warmun residents who lost their houses and personal possessions, and were forced to live in overcrowded temporary accommodation outside their own country for several months, is troubling.

Remote Indigenous communities regularly observe the difficulties of getting any building, whether housing or institutional, constructed in their areas. Issues of accessibility, resourcing, centralised decision-making processes (chiefly state or federal), native title obligations, and heritage protection, ensure that any building process is incredibly slow and tedious. In the case of Warmun, it seems probable that the recovery phase (rebuilding and planning process) will take longer than ideal. The Warmun flood stands as an example of the sheer enormity of the reconstruction and recovery efforts required to adequately respond to the needs of Indigenous communities following an extreme weather event. It also highlights the importance of developing detailed emergency management plans for Indigenous communities, which take into consideration the cultural, linguistic, and socio-economic specifics of each community, and seek to enhance the capacity of community members themselves to respond to extreme weather events in light of climate change.



3. Research priorities

The interconnectedness of environment and global poverty is becoming clearer as the impacts of climate change manifest themselves. Climate change is likely to exacerbate food, water and fuel costs, affecting the poorest the hardest (Matthew et al. 2010). In Australia, even if global demand for Australia's mineral resources continues, climate change will place increasing constraints on the availability of water, and affect the productivity of industries including fisheries, forestry and agriculture. Australia's Indigenous communities, particularly those in remote and coastal locations, are likely to be amongst the most vulnerable to the detrimental impacts of climate change (Hennessey et al. 2007; Green et al. 2009). Government and non-government efforts to 'close the gap' between Indigenous and non-Indigenous Australians must take account of the changing socio-economic landscape being transformed by the challenges and opportunities of climate change. The links between climate change and other issues – including the political economy – water and environmental planning, goods and services, and migration and demography, necessitate that adaptations be considered with reference not only to the climate but also current and future local, regional, national and global circumstances.

Efforts to reduce the risks associated with climate change are more likely to be efficient, effective and equitable if such adaptation activities are well-coordinated. This will require capacity building, development of institutional frameworks for coordinating adaptation planning, actions across geographical scales and sectors, and decision-making forums. Many adaptation strategies will require cooperation and coordination across jurisdictional boundaries and/or between organisations and agencies with potentially conflicting goals (Adger et al. 2009).

3.1 Identifying climate risks and the implications of climate change for Indigenous populations

This topic calls for research that provides integrated assessments of the social, economic, cultural, psychological and biophysical impacts of climate change and their interaction with

other risks. Such assessments of exposure and sensitivity usually employ hazard/impact models or simulation models, which encounter a variety of empirical and institutional problems. Empirically, such approaches often lead to entirely incorrect findings about vulnerability and adaptive capacity while institutionally, they are often expensive and have the propensity to alienate groups labeled as vulnerable (Barnett and Campbell 2010; Burton et al. 2002). Yet, there remains a vital need to understand which communities are at particular risk, why they are at risk, the characteristics of their sensitivity and exposure, and the options available to improve their adaptive capacity. Specific research is therefore required into how Indigenous institutions have responded in the past to extreme events and conditions, such as droughts, tropical cyclones, floods, heat waves and storm tides, and the ways in which climate change may create new problems not previously considered in planning. Research should nevertheless seek to employ local level and comparative studies in a way that seeks to engage Indigenous communities and provide entry points for the development of equitable, efficient and effective adaptation projects, policies and plans.

**Research Topic 1:
Understanding how interactions between social, cultural, institutional, economic and biophysical processes make Indigenous individuals, households, communities, businesses and institutions sensitive to climate risks, and the identification and evaluation of strategies to reduce this sensitivity.**

Adaptation strategies which Indigenous communities use to respond to climate variability and change are not without their difficulties and limitations, and the capacity of people to adapt does not necessarily translate into individual or collective action. It is therefore important to identify the barriers to adaptation, including at the research-policy interface, in order to devise ways to overcome them. This section therefore focuses on how Indigenous individuals, households and wider social groups understand and perceive climate change. Fundamental to this is an understanding of Indigenous

beliefs and values of climate, weather and the environment. The ways in which Indigenous people understand the environment influence their actions. This includes, but is not limited to, traditional ecological knowledge (defined earlier) as well as the effects of different communication strategies (messages and media) on Indigenous knowledge of, and responses to, risk. This NARP calls for research into Indigenous understanding of climate including what Indigenous individuals and households know about climate change, from where their knowledge was derived (personal experiences, the media and social groups), and how this knowledge influences their behaviour. Research is needed into how the social, cultural, economic, and physical challenges faced by Indigenous individuals, households and communities influence their responses to climate change. In particular, research is needed into the climate risks faced by Indigenous communities in metropolitan areas and their perceptions and responses to those risks, because research and policy often focus on remote and very remote Indigenous communities to the exclusion of metropolitan Indigenous populations. Although the Emergency Management NARP specifically addressed extreme weather events and climate-related risks, this NARP calls for detailed research into the risk landscapes of Indigenous communities in order to better contextualise responses to climate-related risks.

Research Topic 2:
Understanding how Indigenous individuals, households, institutions, businesses and communities perceive and respond to climate risks. This includes:

- **The knowledge, perceptions and emotional responses of people and groups to extreme weather events, climate variability and change**
- **The historic and contemporary responses of people and groups to extreme weather, climate variability and climate change.**
- **The ways in which people and groups conceptualise climate risks relative to other stressors or risks**
- **The degree to which people and groups feel empowered to adapt to climate risks.**

Research Topic 3:
Understanding how Indigenous communities and institutions in metropolitan areas are sensitive to climate risks, and the ways in which those communities and institutions perceive and respond to those risks.

3.2 Identifying Indigenous vulnerability and adaptive capacity

To develop adaptation strategies and policies for and with Australia's Indigenous communities, an understanding of the nature of vulnerability and adaptive capacity is of vital importance. Both vulnerability and adaptive capacity are conditioned by the interaction of social, cultural, economic, political and biophysical factors within complex human-environment systems which operate across multiple scales (local, regional, and national). Accordingly, meaningful assessments of vulnerability and adaptive capacity cannot be undertaken using single proxy or centralised aggregate measures. Rather, research should be designed specifically for the Australian Indigenous context and focus on the collection and analysis of empirical evidence (as opposed to the seeking of evidence based on general theories). In other words, this NARP calls for locally-based stakeholder-driven approaches to understand the vulnerability and adaptive capacity of Indigenous communities. Research is critically needed into the interactions between existing stressors (social, political, economic, cultural and environmental) and the impacts of climate change on Indigenous individuals, households, businesses, institutions and communities. What are the implications of these interactions for the vulnerability and adaptive capacity of Indigenous communities to climate change (both short term and long term)? This question includes developing an understanding of the ways in which government legislation and policies (both current and proposed) influence the differential vulnerability of Indigenous communities.

Research Topic 4: Understanding how and why different Indigenous households, communities, businesses and institutions

are vulnerable to the impacts of climate change, and the identification of strategies to reduce this vulnerability.

The nature of Indigenous governance is an important determinant of adaptive capacity and, in turn, of the success of any adaptation to climate change. It is important to consider the roles of Indigenous organisations in adaptive responses and the institutional arrangements which enable successful adaptation. Therefore, this NARP calls for research into the characteristics of those Indigenous institutions on which capacity to adapt depends (including the capacity to adapt to generic social, economic, political and environmental changes as well as the capacity to adapt to specific changes in climate). In addition, the links between formal and informal Indigenous institutions, as well as the role government agencies, non-governmental organisations and industries can play in building adaptive capacity within Indigenous communities and institutions, need to be explored.

Some key institutions include:

- Native Title representative bodies
- Land and sea management units
- Language, art and cultural centres
- Indigenous controlled health services
- Government health services
- Indigenous legal services
- Indigenous youth services
- Indigenous education providers
- Indigenous housing providers
- Technology and service providers
- Other service providers.

**Research Topic 5:
Understanding the capacity of Indigenous individuals, households, businesses and institutions to adapt to climate change, and the identification of strategies to enhance this capacity.**

3.3 Identifying the constraints and limits of adaptation

Indigenous decision-makers often express frustration at researchers because research outcomes and deliverables rarely benefit the communities through translation into direct

action – whether legislative or policy reforms – or through on the ground projects. There is the potential for adaptation research to follow suit (see TSI case study, Box 6). In an effort to reduce the apparent barriers within the research-policy interface, this NARP calls for research into how the adaptation process can be integrated within the policy-making process, the identification of situations where adaptation may be difficult to implement or sustain and the development of innovations or novel approaches to manage these situations.

**Research Topic 6:
Understanding the constraints and limits to adaptation for Indigenous communities.
This includes:**

- **How shared values, beliefs and practices enable, constrain or limit adaptation options;**
- **How economic factors, including the availability of capital, investment and insurance, enable, constrain or limit adaptation;**
- **How social, educational and employment practices and opportunities enable, constrain, or limit adaptation options;**
- **How institutional arrangements enable, constrain or limit, adaptation;**
- **How local and traditional ecological knowledge can facilitate or present barriers to adaptation planning and practice;**
- **Understanding the effectiveness of adaptation options for sustaining places, objects, properties and relationships of value to Indigenous communities, and the consequences of loss and damage to those things.**

3.4 Integration of adaptation into policy

It is widely acknowledged that successful adaptation to climate change will most likely arise from the integration of adaptation actions into policy processes and planning (Burton and Lim 2005). This approach to adaptation, labelled ‘mainstreaming’, is centred on the view that by linking climate change adaptation actions to existing policy goals such as poverty reduction

and environmental management, the drivers of vulnerability to climate change can be reduced. Mainstreaming the management of climate risks into existing policies raises the potential of a 'win-win' approach or 'no-regrets' adaptation through the creation of policies that reduce vulnerability to the impacts of climate change while simultaneously addressing other policy priorities. Successful integration of adaptation into mainstream policies and planning requires an understanding of how current policy and planning processes may facilitate or hinder the inclusion of adaptation considerations across agencies and sectors. Moreover, research is needed into how policies and plans can provide the necessary flexibility to allow for the development and implementation of locally-responsive climate change adaptation strategies.

For decision-makers and members of the Indigenous communities alike, issues such as poverty, health, housing, education, unemployment, land rights and tenure arrangements as well as the economy, are seen as more immediate and pressing issues than responding to future climate change projections. Indigenous leadership, communities and organisations, both independently and in collaboration with governments and NGOs, are attempting to tackle Indigenous disadvantage and socio-economic marginalisation through a variety of strategies including welfare reforms, educational programs, health provisions, improved housing stock, law and order and development opportunities (Pearson 2009; Sutton 2009; Langton 2010). A key issue for Indigenous communities, therefore, is how to develop national and local strategies for adaptation to climate change that are fully integrated with poverty reduction, environmental management and human development plans.

For climate change adaptation to be efficient, effective and equitable in the Australian context, adaptation planning needs to address the social and economic disadvantages facing Indigenous Australians today. Reducing the vulnerability of Indigenous communities to current environmental and socio-economic stresses strengthens their capacity to adapt to future stresses, including climate change. This NARP calls for research to examine how climate change adaptation

can be integrated with broader Indigenous policy goals to enable successful and equitable adaptation throughout Australia. Mainstreaming of adaptation actions into existing policy goals, including welfare reforms, educational programs, health services, housing and infrastructure improvements, Indigenous land and sea management, as well as economic development plans, requires an understanding of how existing laws, policy and planning processes currently, or will potentially (in the case of carbon taxation and carbon sequestration) enable or impede the integration of adaptation considerations across government agencies and private, public and civic sectors. Successfully mainstreamed adaptation strategies are likely to have co-benefits in terms of improving health outcomes, enhancing capacity development, reducing poverty, decreasing vulnerability to climate stresses and ensuring fiscal accountability.

**Research Topic 7:
Understanding the factors that enable or impede integration of climate risk assessment and climate change considerations into Indigenous policy and planning. This includes:**

- **How current or proposed laws and legal institutions and regulatory instruments support or impede adaptation planning and practices;**
- **What types of information, knowledge, tools and measures are needed to support the incorporation of climate change adaptation into policy and planning;**
- **What the most appropriate avenues are for ensuring that climate change adaptation considerations are incorporated into policy and planning for Indigenous communities.**

3.5 Extreme weather events and emergency management

Climate change is likely to increase the incidence and severity of extreme weather events, including heat waves, storm surges and rainfall events, as well as more gradual changes in climate (CSIRO and BoM 2007). This makes emergency management planning more challenging and

increases the urgency to adapt community level operations to both current climate variability and future change. Indigenous individuals, households and communities vary in their ability to prevent, prepare for, respond to, and recover from, natural disasters. Understanding the factors which contribute to these variations between people and places is particularly critical in light of climate change, which increases the already pervasive uncertainty that confronts emergency management planning by affecting, among other things, inter-annual variability.

Many Australian Indigenous communities are exposed to natural hazards, including

floods, fire, drought, storm surges and tropical cyclones. However, there is limited understanding of the social vulnerability of those communities to hazards, including their sensitivity to hazards, individual's and communities' coping mechanisms and their adaptive capacity more generally (Adger 1999). Practices and governance arrangements that promote Indigenous community preparedness and resilience to extreme weather events will be imperative to ensure the safety, health and wellbeing of affected communities.

Box 8: Kiwirrkurra's flooding

Located approximately 1200 km east of Port Hedland and 850 km west of Alice Springs, Kiwirrkurra was established in the early 1980s as one of the 'Pintupi Homelands' outstations. By living in the community, Indigenous residents were able to live on, or near, their traditional country. However, in March 2001, heavy rainfall caused widespread flooding in the area resulting in the evacuation of the entire community to Kintore. This relocation was not satisfactory and soon afterwards the community moved to Norforce Army Base. This too was only a temporary refuge, and the community was finally relocated to Morapoi Station in the Western Australian Goldfields.

The Kiwirrkurra community regards its time at Morapoi as 'a severe disruption to the social fabric of the community' (Brinkley 2009 p. 68). As a normally dry community, Kiwirrkurra residents had to contend with easily accessible alcohol and reported problems such as 'drunken, violent and aggressive behaviour and domestic violence during the stay at Morapoi' (Brinkley 2009 p. 68). Separation from their traditional country also contributed to social disruption. Over a period of 18 months, residents of Kiwirrkurra left Morapoi to be closer to their homelands. By 2002, almost all residents had returned.

From the Kiwirrkurra experience, several lessons for effective emergency response were identified:

- The importance of fostering and sustaining relationships of trust and respect between communities and emergency services before an extreme event occurs. In Kiwirrkurra, a program of pre-wet season visits strengthened the community's relationship with the Fire and Emergency Services Authority (FESA).
- Strong communication channels between stakeholders and working within existing community decision-making structures.
- Encouraging community self-reliance and empowerment through education and training. Education will also increase emergency planning and preparation for communities.
- The importance of emergency workers understanding the cultural and historical context in which communities exist. For example, understanding the importance of country to Indigenous residents.
- Including community members in the recovery process and important decisions about the community's future.

Box 9: Community resilience within emergency management

Individuals, households and communities vary in their capacity to prevent, prepare for, respond to, and recover from, extreme weather events. Understanding these differences, and using these insights to enhance the resilience of communities to natural hazards, is a key objective of the emergency management community. The Emergency Management NARP has already identified that climate change adds another dimension to emergency management planning in Australia, and identifies the need for research that explores the capacity of communities to adapt to changes in climate-related risks and ways to build community resilience in a changing climate.

Resilience is generally used to describe the capacity of individuals or a community to resist the impacts of a disruption, or the ability to bounce back from the negative impacts of a disruption. In the context of the Emergency Management NARP, the term resilience is used to refer to a community's or individual's capacity to prepare for, respond to, and recover from, emergencies or disasters brought about by climate change. Resilience in terms of the Emergency Management NARP comprises:

- Resources necessary to ensure the safety and stability of core activities
- Competencies necessary to use resources to confront the problems and/or adapt to the consequences of hazards
- Mechanisms to integrate resources to enable social stability and capacity
- Mechanisms to sustain the availability of resources and competencies.

This NARP employs the Emergency Management NARP's definition of resilience in the specific context of emergency management.

References: Pearce et al. 2009; Gow & Paton 2008; Handmer & Dovers 2007.

The degree to which Indigenous communities are vulnerable to extreme weather events depends on a combination of environmental, social, economic and political factors (Ellemor 2005). These include but are not limited to, financial resources, housing and infrastructure, health and educational status and degree of social equity. The flooding of the Western Desert community of Kiwirrkurra in 2001 (Box 8), which resulted in the complete evacuation of the 120-person community for more than eighteen months and considerable social disruption and dislocation, highlights the need for community-based planning and preparation for these communities (Brinkley 2009). It is critical that emergency management plans for Indigenous communities consider the historical and cultural context, including governance structures, distinct languages and customs, in order to avoid the development of inconsistent or inappropriate emergency response procedures (Veland et al. 2010; Ellemor 2005; McLachlan 2003).

A key question, therefore, is how governments can adopt better, more efficient, equitable and effective emergency management practices and plans for Indigenous communities, which take into consideration the increased risks imposed by climate change.

Research Topic 8: Understanding the capacity of Indigenous individuals, households, communities, businesses and institutions to prepare for, respond to, and recover from extreme weather events, and the identification of strategies to enhance adaptive capacity.

This includes:

- **Anticipatory and avoidance behaviour**
- **Modification of the environment**
- **Warning systems**
- **The role of social networks**
- **Historic experiences**
- **Community resilience.**

3.6 Indigenous population movement; displacement, community relocation and severe climatic variation

Environmental change can be seen as a proximate factor in migration or mobility. Population movement, even forced, is not usually just a direct product of an environmental 'push' from a climate process, such as sea level rise or coastal erosion. Except in cases of extreme events (conflict, politically enforced movement, extreme weather events) where people leave for reasons of personal safety, migration requires some kind of 'pull', be it social, economic or environmental. For instance, a study by Taylor and Kinfu (2006) found that Australian Indigenous people are more likely to report housing and family issues as reasons for migration, rather than employment, accessibility or environment. Likewise, Biddle and Hunter (2006) demonstrate that Indigenous migration is crucially affected by social and cultural factors, which are arguably more important than economic factors to Indigenous Australians.

Most population movements associated with environmental degradation are internal movements, either over very short distances or from rural to urban areas (Barnett and Webber 2010). Given that the number of people who will experience the impacts of climate change

is likely to increase in the coming decades, it is reasonable to assume that some of these people will pursue migration, either as an adaptation strategy or to minimise the effects on their rights, needs and values. International predictions of the numbers of migrants due to changing climate conditions, however, seem overly high (Barnett and Webber 2010).

Bearing in mind the high mobility of the Australian Indigenous population and existing patterns of migration, it seems likely in the future that climate change will exacerbate existing migration patterns more so than create entirely new flows (Biddle and Hunter 2006; Biddle 2009b). Where climate change exacerbates population movements, it is likely to be predominantly internal movement away from very remote areas to regional and metropolitan centres. Concern about, or experience of, climate change impacts may result in increasing numbers of Indigenous people moving to seek work. Increases in the intensity and frequency of sudden onset extreme weather events may prompt more Indigenous people to be temporarily displaced. Slow-onset climate changes may exacerbate permanent population movements. In each of these types of population movement, Indigenous people may migrate within regions or to another state or territory. It seems probable that climate-induced mobility in the near future will be almost exclusively a problem for low-lying islands, and that climate change will not be the primary driver



Cheese tree. Image: Tatiana Geris

of Indigenous population movement for the foreseeable future (Barnett and Campbell 2010).

Past environmental migratory movements suggest that being able to migrate away from severe climatic conditions, such as a prolonged drought, requires would-be migrants to have access to sufficient social and financial capital, such as existing support networks in the destination area and the funds to be able to move. The most vulnerable people often find themselves unable to move because they do not have the resources to do so.

Understanding how to manage Indigenous population mobility to promote adaptation to climate change is a key issue which requires further attention. In addition, the effects of climate-induced relocation on both the relocating and receiving communities, including the provision of essential services, needs to be explored further, together with the evaluation of mechanisms to increase the preparedness of both communities. Understanding how climate change may influence mobility patterns amongst the Australian Indigenous population requires an understanding of the relationship between environmental change and migration, how climate change exposes people to risks, and estimates for the present day of the distribution and number of likely climate migrants.

**Research Topic 9:
Understanding the relationship between Indigenous population movement and severe climate variation. This includes:**

- **Understanding the needs of, and options and implications for, Indigenous communities forced to relocate due to severe climate variation**
- **Current, historic and projected Indigenous mobility patterns as well as Indigenous individual's and groups' perceptions and experiences of relocation**
- **Factors influencing the decision to move, or stay, and whether relocation is temporary or permanent**
- **Community preferences for migratory destinations and resettlement schemes**
- **Factors shaping the responses of receiving communities to relocated groups**

- **The social, cultural, economic and psychological consequences of relocation from culturally relevant landscapes and seascapes, and ways to preserve cultural integrity and social cohesion of relocated groups**
- **Assessments of the efficiency, effectiveness, and equity of policy responses to Indigenous population movement, taking into consideration climate change.**

3.7 Climate change adaptation and Indigenous biodiversity management

Indigenous Australians own and occupy vast areas of Australia's landmass, with a considerable portion of the nation's biodiversity and natural resource wealth held in landscapes and seascapes inhabited and used by Indigenous people (Langton 2003). The practices of Indigenous groups over millennia have played a critical role in the development of Australia's environments. At present, Indigenous land and sea management strategies, informed by traditional ecological knowledge, continue to play an important role in the management of many areas of Australia (Berkes 1998; Langton 2003; Russell-Smith et al. 2009). Over the last two decades, against the backdrop of the Mabo decision and mounting national and international recognition of Indigenous land rights, Australian environment management policies and practices have slowly recognised the importance of Indigenous custodianship to the health of Australia's diverse ecosystems. Over this period, Aboriginal and Torres Strait Islander participation in environmental management has increased through the ranger programs, co-management of protected areas and Indigenous Protected Area (IPA) management agreements (Langton 2003). However, little research has been undertaken to understand how contemporary Indigenous land and sea management practices, which draw on traditional environmental knowledge and western scientific knowledge, will be affected by changing climate conditions, or to understand how these practices may need to adapt.

Research Topic 10:
Understanding the ways in which Indigenous land and sea management practices, policies and institutions can adapt to changing climatic conditions.

This includes:

- **Assessments of the efficiency and effectiveness of current land and sea management practices, taking into consideration climate change and other stressors**
- **The identification and evaluation of ways in which Indigenous people and groups can adapt their land and sea management practices to climate change**
- **The knowledge, tools, programs and policies needed to support adaptation in Indigenous land and sea management regimes.**

Many Indigenous communities, particularly those in rural and remote locations, depend on marine, terrestrial and freshwater resources for their livelihoods. The collection of bush and sea food is important for subsistence, as well as for social, cultural and economic purposes. Changes in the availability of marine, freshwater and terrestrial resources due to changing climate conditions, in combination with a range of other stressors, may negatively impact Indigenous communities. However, there are no empirical studies about the ways in which climate change is affecting, or may affect in future, Indigenous resource use. There is a need therefore to understand the impacts of climate change on Indigenous resource use, and the adaptation options available to Indigenous individuals and groups.

Research Topic 11:
Understanding how the use of marine, terrestrial and freshwater biodiversity resources by Indigenous peoples and groups will be affected by climate change.

This includes:

- **The impacts of climate change on collection and use of biodiversity resources by Indigenous peoples and groups, including the collection of bush and sea food**
- **The social, cultural and economic values of biodiversity resources use by Indigenous individuals, households,**

businesses and communities and the ways in which climate change may affect those values

- **Identification of the knowledge, practices, programs and policies necessary for Indigenous individuals, households, communities and businesses to adapt to changes in biodiversity availability**
- **Understanding the benefits, costs, risks and opportunities of different adaptive responses for Indigenous livelihoods.**

3.8 Indigenous livelihoods and community planning

Present land use planning regimes and practices for Indigenous communities vary widely between individual communities and local governments, as well as across state and territory boundaries. In Australia, as is also the case for the Indigenous peoples of other settler societies including Canada, the United States and New Zealand, Aboriginal and Torres Strait Islander communities have been poorly served by urban and environmental planning (Lane 2006). The issue of urban planning for discrete Indigenous communities remains peripheral to discussions of housing and service delivery. Decisions about environmental and land use planning will need to consider the risks, benefits and costs associated with current and predicted future impacts of climate change.

Adaptation to the impacts of climate change will require diverse actions to reduce vulnerability and enhance adaptive capacity of Indigenous individuals, households, communities and institutions. Climate change is likely to require the redesign and/or transformation of settlements, infrastructure, services and industries. Many changes will generate additional benefits for communities in addition to climate change adaptation, such as increasing sustainability. However, there will be tradeoffs, and social and economic costs will inevitably occur. Accordingly, this NARP calls for research to investigate the ways in which climate change adaptation can maintain or increase the sustainability of Indigenous communities.

Research is needed into how climate change adaptation may be integrated with the values, beliefs and aspirations for the future of Indigenous people and groups, most notably the creation of alternate livelihoods and economic opportunities which broaden the economic basis of Indigenous communities in an equitable, effective and sustainable manner.

**Research Topic 12:
Understanding the future planning needs of Indigenous communities under different climate change scenarios, and the adaptation options for community planning. This includes:**

- **Understanding the ways in which climate change may alter the ability of Indigenous individuals, households, institutions, businesses and communities to access goods, services and opportunities**
- **Understanding how climate change risks can be incorporated into urban planning for discrete Indigenous settlements, and the adaptive planning requirements of communities**
- **Understanding the ways in which the built environment and infrastructure of Indigenous communities can be improved to reduce vulnerability and enhance adaptive capacity of communities.**

3.9 Indigenous health and climate change

Indigenous Australians are likely to be disproportionately affected by the adverse impacts of climate change on human health. The existing health deficit in Indigenous communities, including the prevalence of chronic and infectious diseases, poor infrastructure and low socio-economic status, is likely to heighten the vulnerability of Indigenous communities to the direct and indirect impacts of climate change (Burgess 2010). Decreasing biodiversity may impact unfavourably on food availability, for instance bush and sea food, and species once abundant for food may become scarce (Green et al. 2009). This will impact the health of Indigenous households and communities that rely on subsistence hunting and gathering

to meet their nutritional and social needs. In addition, the spread of infectious diseases – particularly vector-borne diseases – as a result of climate change, may present a risk to Indigenous health. However, empirical studies have yet to document this. Accordingly the Human Health NARP identified Indigenous health as an area of high priority, and research has been funded through the National Health and Medical Research Council (NHMRC) into the impacts of climate change on Indigenous health. The Indigenous Communities NARP similarly recognises the importance of research into the impacts of climate change on Indigenous health. However, since research funding has already been made available under the Human Health stream, this NARP gives a lower prioritisation to Indigenous health to enable research funds to be made available to those research topics not currently funded by other NARPs.

**Research Topic 13:
Understanding how climate change and extreme weather events will affect aspects of Indigenous people's physical and mental health. This includes:**

- **Living conditions of Indigenous individuals and households**
- **Incidence of infectious diseases, including vector- and water-borne diseases**
- **Extreme weather events**
- **Heat stress**
- **Health services and infrastructure.**



4. Prioritisation process

Ranking areas for research into high and low priority is difficult, given that many aspects of research are not directly comparable and timeframes for research vary. The writing team have applied the six prioritisation criteria listed below to the lists of research topics identified in Section 3.

As with all National Climate Change Adaptation Research Plans, research is prioritised according to:

- The severity of the potential impact to be addressed
- The degree of potential benefit that could be derived
- The immediacy of the required intervention or response
- The degree to which the research will lead to practical and achievable interventions or responses
- The potential to produce benefits beyond informing climate change adaptation strategies
- The extent to which the research addresses more than one issue or sector
- The extent to which the research addresses the needs of the most vulnerable groups.

Applying the prioritisation criteria, research priorities were ranked from low to very high. The full assessment matrix is in Appendix 1. In Appendix 1, the distinguishing evaluation criteria were: research that was considered to yield knowledge that is important in the short-term (immediacy) and which would be particularly helpful in stimulating adaptation practice (need for intervention/practicality). From these criteria, and taking into account the consensus of opinion that emerged from the consultations to prepare this NARP, the following list of high priority topics emerged.

Research Topic 1:
Understanding how interactions between social, cultural, institutional, economic and biophysical processes make Indigenous individuals, households, communities, businesses and institutions sensitive to climate risks, and the identification and evaluation of strategies to reduce this sensitivity.

Research Topic 4:
Understanding how and why different Indigenous households and institutions are vulnerable to the impacts of climate change, and the identification of strategies to reduce this vulnerability.

Research Topic 5:
Understanding the capacity of Indigenous individuals, households, businesses and institutions to adapt to climate change, and the identification of strategies to enhance adaptive capacity.

Research Topic 8:
Understanding the capacity of Indigenous individuals, households, communities, businesses and institutions to prepare for, respond to, and recover from, extreme weather events, and the identification of strategies to enhance this capacity.

Research Topic 9:
Understanding the relationship between Indigenous population movement and severe climate variation.

Research Topic 11:
Understanding how the use of marine, terrestrial and freshwater biodiversity resources by Indigenous peoples and groups will be affected by climate change.

5. Implementation issues



A detailed Implementation Plan is being developed parallel to the development of this National Climate Change Adaptation Research Plan on Indigenous Communities. This section provides a broad overview of the resourcing issues that are likely to arise in the implementation of this NARP.

5.1 Engagement

It is essential that the needs of research end users in Aboriginal and Torres Strait Islander communities be taken into account early in the design of research projects to ensure that research outputs are useful and of value to a variety of stakeholders. Much of this research involves issues where problem identification and research framing are substantial research issues in their own right: working out the right question is often more important than working out the answer. This process will involve strong participatory engagement between researchers and end users and/or research partners.

The implementation of this NARP therefore requires significant engagement with end users in Indigenous Communities and appropriate government agencies. Projects that respond to priority topics must demonstrate meaningful partnerships with end users before they are funded. This should occur at the full proposal development phase. Commitments of cash or in-kind financial resources should not be the only evidence of the significance of such research/end user partnerships, as there are many end users who have no capacity to contribute in this way (such as civil society groups, disadvantaged communities, and some local governments). Indeed, an inability to fund research may be a defining characteristic of social vulnerability to climate change. Instead, evidence of commitments may be expressed in other ways, such as: letters of support; commitments to contribute to project planning, monitoring, data analysis and review of findings; a willingness to act as broker between groups and to assist in participant recruitment; or a contribution to the dissemination of findings.

5.2 Additional funding sources

The Australian Research Council (ARC) grants program is likely to be the first port of call for

many researchers and research institutions that seek additional support. Relevant grants offered by the ARC include:

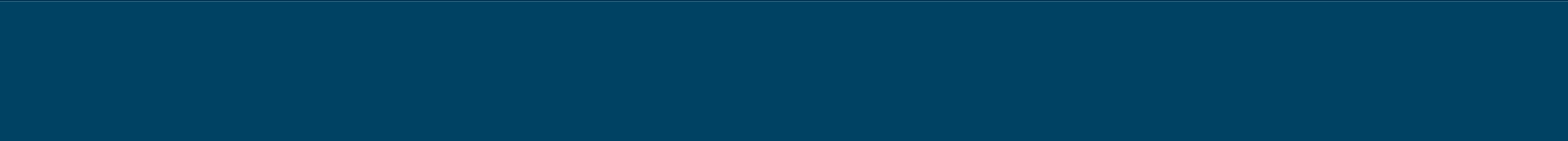
- *Discovery Projects*. A variety of fellowships are offered under the scheme to nurture the talents of Australia's most promising early-career researchers and to support established researchers.
- *Discovery Future Fellowships*. Future Fellowships are offered to promote research in areas of critical national importance by giving world class researchers incentives to conduct their research in Australia.
- *Linkage Infrastructure, Equipment and Facilities*. This scheme fosters collaboration through its support of the cooperative use of national and international research facilities. Essentially, the scheme provides funding for large-scale cooperative initiatives so that expensive infrastructure, equipment and facilities can be shared by researchers in partnered organisations. However, the ARC may fund single-organisation proposals in some circumstances.
- *Linkage Projects*. The scheme supports collaborative research and development projects between higher education organisations and other organisations including within industry, to enable the application of advanced knowledge to problems. In recommending funding for proposals under Linkage Projects, ARC may take into consideration the likely benefit of the research to Australian regional and rural communities.
- Various ARC programs provide support for international research activities.

There is a range of other research funding possibilities that reflect the cross-disciplinary and cross-sectoral nature of adaptation as a research (and policy) challenge and which may be relevant to research into climate change adaptation in and affecting Indigenous Communities. These will be identified during the preparation of the Implementation Plan. One challenge for the future is for the importance of research to inform adaptation to be more widely recognised in the programs of funding across relevant sectors.

Appendix 1 Research prioritisation

Research issue	Severity of potential impact	Degree of potential impact
3.1 Identifying climate risks and implications of climate change for Indigenous populations		
Research Topic 1: Understanding how interactions between social, cultural, institutional, economic and biophysical processes make Indigenous individuals, households, communities, businesses and institutions sensitive to climate risks, and the identification and evaluation of strategies to reduce this sensitivity.	High	High
Research Topic 2: Understanding how Indigenous individuals, households, institutions, businesses, and communities perceive and respond to climate risks.	Very High	High
Research Topic 3: Understanding how Indigenous communities and institutions in metropolitan areas are sensitive to climate risks, and the ways in which those communities and institutions perceive and respond to those risks.	High	High
3.2 Identifying Indigenous vulnerability and adaptive capacity		
Research Topic 4: Understanding how and why different Indigenous households, communities, businesses and institutions are vulnerable to the impacts of climate change, and the identification of strategies to reduce this vulnerability.	Very High	Very High
Research Topic 5: Understanding the capacity of Indigenous individuals, households, businesses and institutions to adapt to climate change, and the identification of strategies to enhance this capacity.	Very High	Very High

Immediacy of required response	Potential co-benefits	Degree to which research addresses more than one sector	Extent that research addresses needs of most vulnerable	Overall priority ranking
---------------------------------------	------------------------------	--	--	---------------------------------



High	Very High	Very High	Very High	Very High
-------------	------------------	------------------	------------------	------------------

High	Medium	Medium	High	High
-------------	---------------	---------------	-------------	-------------

High	Medium	Medium	Medium	High
-------------	---------------	---------------	---------------	-------------



Very High	Very High	Very High	Very High	Very High
------------------	------------------	------------------	------------------	------------------

Very High	High	High	Very High	Very High
------------------	-------------	-------------	------------------	------------------

Research issue	Severity of potential impact	Degree of potential impact
3.3 Identifying the constraints and limits to adaptation		
Research Topic 6: Understanding the constraints and limits to adaptation for Indigenous communities.	High	Medium
3.4 Integration of adaptation into policy		
Research Topic 7: Understanding the factors that enable or impede integration of climate risks and climate change considerations into Indigenous policy and planning.	Very High	High
3.5 Extreme weather events and emergency management		
Research Topic 8: Understanding the capacity of Indigenous individuals, households, communities and institutions to prepare for, respond to, and recover from extreme weather events, and the identification of strategies to enhance adaptive capacity.	Very High	Very High
3.6 Indigenous population movement, displacement, community relocation and severe climate variation		
Research Topic 9: Understanding the relationship between Indigenous population movement and severe climate variation.	Very High	Very High
3.7 Climate change adaptation and Indigenous biodiversity management		
Research Topic 10: Understanding the ways in which Indigenous land and sea management practices, policies and institutions can adapt to changing climatic conditions.	Very High	High
Research Topic 11: Understanding how the use of marine, terrestrial and freshwater biodiversity resources by Indigenous peoples and groups will be affected by climate change	Very High	High

Immediacy of required response	Potential co-benefits	Degree to which research addresses more than one sector	Extent that research addresses needs of most vulnerable	Overall priority ranking
High	Medium	Medium	High	Medium
High	Medium	High	High	High
Very High	Very High	Very High	Very High	Very High
Very High	High	High	Very High	Very High
Very High	Medium	High	High	High
High	Very High	Very High	Very High	Very High

Research issue

Severity of potential impact

Degree of potential impact

3.8 Indigenous livelihoods and community planning

Research Topic 12: Understanding the future planning needs of Indigenous communities under different climate change scenarios, and the adaptation options for community planning.

Very High

High

3.9 Indigenous health and climate change

Research Topic 13: Understanding how climate change and extreme weather events will affect aspects of Indigenous people's physical and mental health.

High

High



Grass trees. Image: Adrian Tritschler

Immediacy of required response	Potential co-benefits	Degree to which research addresses more than one sector	Extent that research addresses needs of most vulnerable	Overall priority ranking
High	Medium	Medium	High	Medium
Medium	High	High	Medium	Medium



Kakadu paintings. Image: Daryl Fritz



5. References

- Adger, W.N. 1999, Social vulnerability to climate change and extremes in coastal Vietnam. *World Development*, 27(2):249-269.
- Adger, W.N., Paavola, J., Mace, M.J. and Huq, S. (Editors) 2006, *Fairness in adaptation to climate change*. MIT Press, Cambridge MA.
- Adger, W.N., Barnett, J and Ellemor, H. 2009, Unique and valued places at risk, in Schneider, S, Rosencranz, A and Mastrandrea, M. (Editors). *Climate Change Science and Policy*. Island Press, Washington DC, pp. 131-138.
- Altman, J. and Jordon K. 2008, *Impact of climate change on Indigenous Australians: Submission to the Garnaut Climate Change Review*, CAEPR Working Paper No. 3/2008. Centre for Aboriginal Economic Policy Research, Canberra.
- Anderson, I, Crengle, S, Kamaka, ML, Chen, T, Palafax, N and Jackson-Pulver L 2006, Indigenous Health in Australia, New Zealand, and the Pacific. *The Lancet*, 367, 1775-1785.
- Australian Bureau of Statistics (ABS) 2006. *Population Distribution: Aboriginal and Torres Strait Islander Australians*. Australian Bureau of Statistics, Canberra.
- Australian Bureau of Statistics (ABS) 2010. *The Health and Welfare of Aboriginal and Torres Strait Islander Peoples* (cat. no. 4704.0). [Available from <http://www.abs.gov.au/AUSSTATS/abs@.nsf/lookup/4704.0Chapter100Oct+2010>]
- Barnett, J. and Campbell, J. 2010. *Climate Change and Small Island States: Power, Knowledge and the South Pacific*. Earthscan Ltd., London.
- Barnett, J. and O'Neill, S. 2010. Maladaptation. *Global Environmental Change*, 20(2):211-213.
- Barnett, J. and Webber, M. 2010. *Accommodating migration to promote adaptation to climate change*. Background Paper Prepared for the World Bank World Development Report 2010, Working Paper 5270. [Available from <http://econ.worldbank.org>]
- Berkes, F. 1998. *Scared Ecology: Traditional ecological knowledge and resource management*. Taylor and Francis, Philadelphia and London.
- Biddle, N. and Hunter, B. 2006. An analysis of migration of Indigenous and Non-Indigenous Australians. *Australian Journal of Labour Economics*, 4:321-341.
- Biddle, N. 2009a. *The Geography and Demography of Indigenous Migration*. CAEPR Working Paper No. 58/2009. Centre for Aboriginal Economic Policy Research, Canberra.
- Biddle, N. 2009b. *Ranking regions: revisiting an index of relative Indigenous socioeconomic outcomes*. CAEPR Working Paper No. 50/2009. Centre for Aboriginal Economic Policy Research, Canberra.
- Brinkley, C. 2009. Kiwirrkurra: The flood in the desert, *Australian Journal of Emergency Management*, 24:67-70.
- Burgess, P. 2010. 'Public health and climate change.' Presentation to Northern Land and Sea Management Alliance Climate Change Adaptation Workshop, 21-22 April 2010. [Available from http://www.nailsma.org.au/nailsma/forum/downloads/100422_NAILSMA_PH_Burgess.pdf]
- Burton, I., and Lim B. 2005. Achieving adequate adaptation in agriculture. *Climatic Change*, 70:191-200.
- Carter, P. 1988. *The Road to Botany Bay: an exploration of landscape and history*. Knopf, New York.
- Council of Australian Governments (COAG) 2007. *National climate change adaptation framework*. Department of the Prime Minister and Cabinet, Canberra.
- CSIRO and BoM (Australian Bureau of Meteorology) 2007. *Climate change in Australia: Technical Report 2007*. [Available from <http://www.climatechangeinaustralia.gov.au/>]
- Dumarú, P. 2010. Community-based adaptation: enhancing community adaptive capacity in Druadrua Island, Fiji. *WIREs Climate Change*, 1:751-763.
- Dunlop, M., and Brown P. 2008. Implications of climate change for Australia's national reserve system – a preliminary assessment. Department of Climate Change, Canberra.

- Ellemor, H. 2005, Reconsidering emergency management and indigenous communities in Australia. *Environmental Hazards*, 6:1-7.
- Ford, J. D., Smit, B. and Wandel J. 2006. Vulnerability to climate change in the Arctic: a case study from Arctic Bay Canada. *Global Environmental Change*, 16(2):145-160.
- Ford, J. D., Pearce, T., Duerden, F., Furgal, C., and Smit, B. 2010. Climate Change policy and Canada's Inuit population: the importance of and opportunities for adaptation. *Global Environmental Change*, 20:177-191.
- Foreign Affairs, Defence and Trade References Committee 2010. *The Torres Strait: Bridge and Border*. Report for the Senate, Commonwealth of Australia, Canberra.
- Gow, K. and Paton D. (Editors) 2008. *The Phoenix of Natural Disasters: Community Resilience*. Nova Science Publishers, New York.
- Green, D., Jackson, S. and Morrison, J. (Editors) 2009. *Risks from Climate Change to Indigenous Communities in the Tropical North of Australia*. Department of Climate Change, Canberra.
- Haebich, A. 2000. *Broken Circles: Fragmenting Indigenous Families, 1880-2000, Fremantle*. Fremantle Arts Centre Press.
- Handmer, J. and Dovers D. 2007. *The Handbook of Disaster and Emergency Management Policies and Institutions*. Earthscan, London UK.
- Hennessey, K., Fitzharris, B., Bates, B.C., Harvey, N., Howden, S. M., Hughes, L., Salinger, J. and Warrick R. 2007. Australia and New Zealand, *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, in Parry, M.L. Canziani, O.F., Palutikof, J.P., van der Linden, P.J. and Hanson C. E. (Editors). Cambridge University Press, Cambridge, UK, pp. 507-540.
- Hiscock, P. 2008. *Archaeology of Ancient Australia*. Routledge, London.
- Hunter, N., and Leonard, S. 2010. *Indigenous Weather Knowledge and Biotemporal Indicators of Climate Change*. Conference Paper, presented at the 2010 International Climate Change Adaptation Conference: Climate Adaptation Futures, 29 June-1 July 2010, Gold Coast Australia.
- Huq, S., and Reid, H. 2007. *Community-based adaptation: a vital approach to the threat climate change poses to the poor*. International Institute for Environment and Development, London, UK.
- IPCC, 2007. *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Parry ML, Canziani OF, Palutikof JP, van der Linden PJ, Hanson CE (eds). Cambridge University Press, Cambridge, UK.
- Kidd, R. 1997. *The Way We Civilise: Aboriginal Affairs – the untold story*. St Lucia: University of Queensland Press, St Lucia, Queensland..
- Kovats , R.S., and Hajat, S. 2008. Heat Stress and Public Health: A Critical Review. *Annual Review of Public Health*, 29:41-55.
- Lane, M.B. 2006. The role of planning in achieving indigenous land use justice and community goals. *Land Use Policy*, 23:385-394.
- Langton, M. 2003. The 'wild', the market and the native: Indigenous people face new forms of global colonization, in Adams, W. M., and Mulligan M. (Editors). *Decolonizing Nature: Strategies for Conservation in a Post-colonial Era*. London, Earthscan Publications, pp. 79-107.
- Langton, M. 2010. The Resource Curse: New outback principalities and the paradox of plenty. *Griffith Review*, 28:47-63.
- Lorenzoni, I., Nicholson-Cole, S. and Whitmarsh L. 2007. Barriers perceived to engaging in climate change among the UK public and their policy implications. *Global Environmental Change*, 17(3):445-459.
- Mackie, W. and Hanslow D., 2010 *Climate Change Issues and Adaptation: A Torres Strait Islander Perspective*, Conference Paper, presented at the 2010 International Climate Change Adaptation Conference: Climate Adaptation Futures, 29 June-1 July 2010, Gold Coast Australia

- Matthew, R., Barnett, J., McDonald, B. and O'Brien K. (Editors) 2010, *Global Environmental Change and Human Security*. MIT Press, Cambridge MA.
- McGrath, A. (Editor) 1995. *Contested Ground: Australian Aborigines under the British Crown*. Allen & Unwin, Crows Nest, NSW.
- McLachlan, E. 2003. Seagulls on the airstrip: indigenous perspectives on cyclone vulnerability awareness and mitigation strategies for remote communities in the Gulf of Carpentaria. *Australian Journal of Emergency Management*, 18:4-12.
- National Research Council 2010. *America's Climate Choices: Adapting to the Impacts of Climate Change*. The National Academies Press, Washington D.C.
- North Australian Indigenous Land and Sea Management Alliance (NAISMA) 2010, NAISMA Climate Change Adaptation Workshop Report. [Available from http://www.nailsma.org.au/forum/forumclimate_change_workshop.html]
- O'Brien, K., R. Leichenko, Kelkar, U., Venema, H., Aandahl, G., Tompkins, H., Javed, A., Bhadwal, S., Barg, S., Nygaard, L. and West J. 2004. Mapping vulnerability to multiple stressors: climate change and globalization in India. *Global Environmental Change: Human and Policy Dimensions*, 14(4):303-313.
- Pearce, T., Handmer, J., Higgins, J., King, D., McDonald, J., Pagano, F., Schneider, J., Whetton, P. 2009. *National Climate Change Adaptation Research Plan for Emergency Management*. National Climate Change Adaptation Research Facility, Gold Coast, 44 pp.
- Pearson, N. 2009. *Up From the Mission: Selected Writings*. Black Inc., Melbourne.
- Petheram, L., Zander, K. K., Campbell, B. M., High, C. and Stacey N. 2010. Strange changes: Indigenous perspectives of climate change and adaptation in NE Arnhem Land (Australia). *Global Environmental Change*, 20(4):681-692.
- Reynolds, H. 1987. *Frontier: Aborigines, settlers and land*. Allen & Unwin, Sydney NSW.
- Russell-Smith, J., Whitehead, P. and Cooke P. (Editors) 2009. *Culture, Ecology and the Economy of Fire Management in North Australian Savannas*. CSIRO Publishing, Melbourne.
- Sakona, Y. and Denton F. 2001. Climate change impacts: Can Africa cope with the challenges? *Climate Policy*, 1:117-123.
- Salik, J. and Ross N. 2009. Traditional peoples and climate change. *Global Environmental Change*, 19(2):137-139.
- Sarewitz, D. and Pieke, R. 2007. The neglected heart of science policy: Reconciling supply of and demand for science. *Environmental Science and Policy*, 10(1):5-16.
- Sinnamon, V. and Mango P. 2010. 'Climate Change on the Northern Carpentaria Plains', paper presented at the 2010 International Climate Change Adaptation Conference: Climate Adaptation Futures, 29 June-1 July 2010, Gold Coast Australia.
- Sinnamon, V. 2009, Kowanyama Queensland, in Green, D., Jackson, S., and J. Morrison (Editors) *Risks from Climate Change to Indigenous Communities in the Tropical North of Australia*. Department of Climate Change, Canberra, pp. 127-133.
- Smit, B. and Wandel J. 2006. Adaptation, adaptive capacity, and vulnerability. *Global Environmental Change*, 16:282-292.
- Smithers, S. 2010. Practical Adaptation to Climate Change in the Central Torres Strait Islands, Conference Paper, presented at the 2010 International Climate Change Adaptation Conference: Climate Adaptation Futures, 29 June-1 July 2010, Gold Coast.
- Sutton, P. 2009. *The Politics of Suffering: Indigenous Australia and the end of the liberal consensus*. Melbourne University Press, Melbourne.
- Swim, J., Clayton, S., Doherty, T., Gifford, R., Howard, G., Reser, J., Stern, P. and Weber, E. 2009. *Psychology and global climate change: Addressing a multi-faceted phenomenon and set of challenges*. American Psychological Association, Washington D.C.
- Taylor, J. and Kinfu, Y. 2006. Differentials and Determinants of Indigenous Population Mobility, in B.H. Hunter (Editor) *Assessing Recent Evidence on Indigenous Socioeconomic Outcomes: A focus on the 2002 NATSISS*. CAEPR Monograph No. 26, ANU E-Press, Canberra.
- TSRA. 2010. *Torres Strait Climate Change Strategy*. Land and Sea Management Unit, Torres Strait Island Regional Authority, Thursday Island.

UNFCCC (United Nations Framework Convention on Climate Change) 2002. *Annotated Guidelines for the Preparation of National Adaptation Programmes of Action*, LDC Expert Panel, UNFCCC Secretariat, Bonn.

Veland, S., Howitt, R. and Dominey-Howes D. 2010, Invisible institutions in emergencies: Evacuating the remote Indigenous community of Warruwi, Northern Territory Australia from Cyclone Monica, *Environmental Hazards: Human and Policy Dimensions*, 9:197-214.

Walker, S. 2009. *When the Worms Turn: Eustrongylides in Spangled Perch (Leiopotētrapon unicolor) at Paruku (Lake Gregory), Western Australia*. Honours Thesis, University of Canberra.



Fishing, Arnhem Land. Image: Ewan Bell.



Acknowledgements

The National Climate Change Adaptation Research Facility gratefully acknowledges the considerable time and effort invested by the writing team, and by many individuals and organisations, in the development of this Plan.



Griffith University, Gold Coast Campus
Parklands Drive, Southport
QLD 4222, Australia
Telephone 07 5552 9333
Facsimile 07 5552 7333



Australian Government
Department of Climate Change
and Energy Efficiency

