

Indigenous women's preferences for climate change adaptation and aquaculture development to build capacity in the Northern Territory

Final Report

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**Indigenous women's preferences for climate change adaptation
and aquaculture development to build capacity in the Northern
Territory**

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The role of NCCARF is to lead the research community in a national interdisciplinary effort to generate the information needed by decision-makers in government, business and in vulnerable sectors and communities to manage the risk of climate change impacts.

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TABLE OF CONTENTS

ABSTRACT	1
EXECUTIVE SUMMARY	2
1. OBJECTIVES OF THE RESEARCH	4
1.1. PROJECT CONTEXT	4
1.2. PROJECT OBJECTIVES.....	5
2. BACKGROUND	6
2.1. INDIGENOUS PEOPLE’S DEPENDENCE ON MARINE RESOURCES AND SUBSISTENCE HARVESTING PRACTICES.....	6
2.2. ADAPTATION TO CLIMATE CHANGE	9
2.3. AQUACULTURE IN REMOTE COASTAL COMMUNITIES.....	11
3. RESEARCH ACTIVITIES AND METHOD	14
3.1. CASE STUDY SITE	14
3.2. CONCEPTUAL FRAMEWORK AND THEORY	19
3.3. FIELD ACTIVITIES	20
4. RESULTS AND OUTPUTS	4
4.1. BACKGROUND CONTEXT.....	4
4.2. DEPENDENCE ON MARINE RESOURCES.....	5
4.3. CLIMATE CHANGE	9
4.4. PERCEPTIONS AND RECEPTIVITY TOWARDS AQUACULTURE	12
5. DISCUSSION AND SUMMARY	16
5.1. UNDERSTANDING AND OBSERVING ‘CLIMATE CHANGE’; A FOREIGN TERM?	16
6. GAPS AND FUTURE RESEARCH DIRECTIONS	23
6.1. IMPROVED COMMUNICATION AND INDIGENOUS INVOLVEMENT IN DECISION-MAKING	23
6.2. SUPPORT FOR ADAPTATION AND AQUACULTURE ENTERPRISE DEVELOPMENT	23
6.3. MEASURING ECOLOGICAL CHANGE.....	23
6.4. CONNECTING LOCAL PARTICIPANTS WITH OTHER INDIGENOUS AND ISLANDER COMMUNITIES... ..	24
6.5. FURTHER SCIENTIFIC TESTING AND SCOPING OF AQUACULTURE TECHNIQUES FOR THE REGION.....	24
6.6. ECONOMIC AND INSTITUTIONAL FEASIBILITY AND RISKS OF AQUACULTURE.....	24
6.7. DEVELOPMENT OF THEORY RELATING TO ADAPTATION, PLANNING, RESILIENCE AND WELLBEING	24
7. KEY LEARNINGS FOR NORTHERN TERRITORY GOVERNMENT POLICY ON AQUACULTURE	25
REFERENCES	26
APPENDIX 1: AUSTRALIAN BUREAU OF STATISTICS DATA	37
APPENDIX 2: AQUACULTURE AND CLIMATE CHANGE GAME	39
APPENDIX 3: CLIMATE CHANGE EDUCATIONAL BROCHURE	42
APPENDIX 4: RESEARCH PROJECT BROCHURE	43

List of figures

<i>Figure 1. Map of the location of South Goulburn Island and the community of Warruwi</i>	14
<i>Figure 2. Warruwi community store</i>	15
<i>Figure 3. A child picking up a giant clam shell (commonly eaten) on a local beach, South Goulburn Island</i>	16
<i>Figure 4. Participatory drawing/mapping of South Goulburn Island</i>	21
<i>Figure 5. Participants carrying out ranking exercises</i>	21
<i>Figure 6. Diagrams depicting climate change impacts and preferred adaptation options</i>	21
<i>Figure 7. Sustainable livelihoods framework (stones represent current situation, marbles preferred)</i>	21
<i>Figure 8. Participants looking at pictures relating to aquaculture</i>	21
<i>Figure 9. Participant playing the aquaculture, climate change board game</i>	21

List of tables

<i>Table 1. Techniques used during workshops and interviews in this research.</i>	22
<i>Table 2. Details relating to each of the workshops conducted during this research.</i>	23

List of abbreviations and acronyms

ABS	Australian Bureau of Statistics
ACIAR	Australian Centre for International Agricultural Research
AIATSIS	Australian Institute of Aboriginal and Torres Straight Islander Studies
ANU	Australian National University
BOM	Bureau of Meteorology
COAG	Council of Australian Governments
CDEP	Community Development Employment Projects
CDU	Charles Darwin University
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCCEE	Department of Climate Change and Energy Efficiency
FAO	Food and Agriculture Organisation of the United Nations
GI	Goulburn Island
HREOC	Australian Human Rights Commission
IPCC	Intergovernmental Panel on Climate Change
NAILSMA	Northern Australia Indigenous Land and Sea Management Alliance
NARP	National Climate Change Adaptation Research Plan
NCCARF	National Climate Change Adaptation Research Facility
NLC	Northern Land Council
NT	Northern Territory
ORIC	Office of the Registrar of Aboriginal Corporation
PAR	Participatory Action Research
SCRGSP	Steering Committee for the Review of Government Service Provision
SLF	Sustainable Livelihoods Framework
VET	Vocational Education and Training
WALFA	West Arnhem Land Fire Abatement
WASC	West Arnhem Shire Council
WWF	World Wide Fund for Nature

ABSTRACT

Research was carried out on South Goulburn Island, Northern Territory, to improve understandings of local, Indigenous people's dependency on marine resources, and of their perspectives on climate change, and aquaculture as a means towards adapting to climate change. Workshops and interviews were carried out mostly with women, but also some men with an emphasis on the use of participatory and visual techniques to encourage discussion of the future.

Customary knowledge, particularly of the marine environment, appeared to be an integral part of people's construction of identity. The collection of 'bushfoods' had importance in improving and maintaining people's wellbeing, well beyond nutritional benefits. Participant discussions indicated very limited understanding of western concepts of climate change. Many reported noticing patterns of environmental change in their 'country'. These observations, combined with movement away from certain customary practices and loss of local knowledge, caused worry to many participants, particularly older generations.

Participants demonstrated a worldview strongly dominated by social and cultural links to the past and present but with weaker linkages to western concepts of 'the future'. Thus, discussions around planning for adaptation did not fit easily into conceptualisation by many participants, especially when focused on climate change. People's preferences to adaptation usually concerned building general community capacity, drawing from customary knowledge, being more involved in government decision-making and learning more about scientific knowledge. Enabling greater collection of bush foods and associated interaction with the landscape was also considered key to improving community independence, resilience and wellbeing.

Participants showed strong interest in aquaculture as an option to help diversify food sources and minimise reliance on store purchased foods and provide income for the community – especially under future climate uncertainty. Many older participants saw aquaculture as a way to encourage greater involvement of younger generations in sea management and consequently building autonomy and skills. People preferred low maintenance aquaculture, carried out in a way respectful to culture, directed by community, with support from scientists. Many participants indicated they would feel strong pride if a community enterprise based on customary knowledge could be developed. There was considerable faith in the local corporation in managing decisions relating to aquaculture and adaptation. However, people had limited understanding of aquaculture practices, technology and logistics and capacity involved in establishing and maintaining enterprises. And although people desired greater employment and skills, conventional employment was not a high aspiration except where work was closely related to the natural environment.

Implementing programs of 'aquaculture for adaptation' will require improved communication and learning among all stakeholders. This involves developing long-term relationships built on trust, awareness of different worldviews on adaptation, planning, resource management and development. Supporting aquaculture development on Goulburn Island may help adaptation by expanding livelihood options and enhancing collection and local consumption of bushfoods. However, logistics of implementation will be complicated, and will need to be part of a wider set of options. An adaptive management approach that involves community, decision-makers and researchers planning and testing ideas and developing workable solutions could provide the inclusiveness that local community desire.

EXECUTIVE SUMMARY

Objectives of the project

This research project investigated Indigenous dependence on marine resources and people's perspectives on climate change and adaptation. A secondary objective of the project was to explore Indigenous perspectives and preferences for aquaculture as an option in adapting to future climate change uncertainty and marine related impacts. The research was conducted primarily by carrying out workshops using a range of participatory tools and activities with Indigenous women. Semi-structured interviews, and informal conversations and discussions were held with mostly women and some men, and observations of the broader community on South Goulburn Island in West Arnhem Land, Northern Territory (NT). The research had a strong focus on women, as most studies of resource use and planning for the future, especially relating to climate change adaptation and fisheries (nationally and internationally) have tended to focus on men.

Understanding dependence on marine resources

Participants showed strong (but varying) connections to nature, particularly through the considerable time they spent in fishing and hunting practices. Most appeared to strongly value their natural surrounds, and have intricate and complex connections with various aspects of the environment. Harvesting marine resources is important in providing fresh food for families and extended kin groups; promoting physical exercise and emotional and mental health; and maintenance and transfer of customary knowledge. Understandings of customary knowledge, particularly relating to the marine ecosystems, appeared to be an integral part of people's construction of self and identity.

All participants practiced harvesting to different degrees but also had a strong dependence on purchasing large proportions of food from the local store that imports commonly refined (and expensive) foods. There was variation in the amount and frequency of harvesting, between different families, genders, age groups and seasons. Harvesting was believed to be practiced much less today than 50 years ago, but there was still a strong desire by many participants for greater opportunity to harvest more. Barriers to harvesting included lack of transport, poor health and mobility, and family and work commitments.

Perspectives of climate change

Discussions with participants indicated very limited understanding of western concepts and language associated with climate change such as global warming and greenhouse gases. Many thought climate change was a phenomenon occurring only elsewhere in the world. However, in deeper conversations, many people said they had observed unusual patterns of environmental and climate change that they could not explain by other means. It was only after lengthy discussions that many participants made the connection between their observations and western concepts of climate change they had heard about in the media. Changes that people had noticed included beach erosion, sea level rise, new weather patterns, and changes in distribution, abundance and taste of some plant and animal species. These observed changes, combined with movement away from certain customary practices and loss of local knowledge in recent years, worried many participants, particularly among the older generation. Future unpredictability relating to the environment was very concerning and potentially disempowering to many people.

Although initially most participants stated they did not know why climate change was occurring, and many thought it was only happening elsewhere – once discussions progressed during workshops and later interviews, the idea that climate change was resulting from human impacts on the environment appeared to be a very easy concept for most participants to grasp. This fitted well with the way that participants framed their environment as highly interconnected, with dynamic inter-connections between all components, involving humans and the whole world. Strong interest was shown by most participants in learning more about climate change and in understanding why it was occurring, and what other communities are doing to deal with it (or to ‘adapt’).

Future aspirations and adaptation

Participants appeared to have a very strong link to present and past temporal relations, but a less obvious link to the future. It became evident that participants’ views of the future contrasted strongly with more typically western, linear views of the future. It also seemed that decision-making and planning for the future was for a relatively short term timeframe among the community. Thus, western discussions around planning and future adaptation did not come very naturally to a lot of participants, especially when focused specifically around climate change. Preferences for adaptation to the future usually related to building of general capacity among the community, and the ability to draw on customary knowledge. However, there was also acceptance of incorporating western scientific knowledge where appropriate into management and planning. Aspirations for the future most often centered on independence, community empowerment and autonomy.

Ideas for adaptation mentioned that were related more specifically to climate change tended to address tangible changes that were occurring, such as beach erosion. People expressed desire for greater communication with the community, more education among adults and at the school, and involvement of the community in decision-making processes concerning adaptation to climate change. Participants were also interested in developing links with other coastal communities in Australia and the Asia-Pacific that were dealing with climate change, so as to share ideas and knowledge. Participants were not aware that adaptation policies are currently being developed by the Government and many expressed a strong desire to be involved in decision-making around adaptation for their region. The research also highlighted the need to consider the way adaptation at different scales can impact on community and individual wellbeing, as well as the role of agency people have in negotiating adaptation strategies.

Aquaculture and enterprise development

There was a strong receptivity towards aquaculture as an option to help diversify food sources and offer prospects of income for the broader community – especially in the light of future uncertainty due to climate change. However, there was very limited understanding of aquaculture or the logistics and capacity that it would entail. All participants had a strong preference for low maintenance aquaculture carried out in a way that is respectful to culture and primarily directed by the community, with some support from NT Fisheries and other scientists. Many participants mentioned they would feel strong pride through being able to develop a community-based enterprise that drew on customary knowledge of the natural environment. There was a strong faith in the newly established Yagbani Aboriginal Corporation to deal with all decision-making matters relating to aquaculture and adaptation, and strong confidence in the ability of fisheries scientists in helping provide advice. However, it became apparent that communication between communities and fisheries scientists carrying out current trials needed to be improved.

The research indicated that aquaculture could provide a diversified livelihood option, if carefully introduced and aligned with cultural values and preferred aspirations for the future. Success in combining aquaculture development with adaptation to climate change would depend on external stakeholders being very aware of local Indigenous conceptions of the interconnections between environment and culture, and differences in worldview around the future, climate change and enterprise development. Such a (combined) process will also need attention paid to developing trust and communication, genuine support and engagement and Indigenous involvement in decision making. Because there are no 'off-the-shelf' designs of aquaculture systems for remote NT Indigenous communities under future climate change uncertainty, a project to support aquaculture development should be based on principles of 'adaptive management'. This approach would entail the community working with aquaculture specialists and social scientists to test best-bet ideas for culturing marine species and enterprise management. This would need flexibility to accommodate changing circumstances to suit the situation, and ultimately to develop enterprises that would provide food and work for the community, provide resilience against unexpected events, help maintain identity and other flow on benefits for community adaptation.

1. OBJECTIVES OF THE RESEARCH

1.1. Project context

This project addresses the National Climate Change Adaptation Research Plan (NARP) Priority Research Question '*Climate change adaptation and Indigenous biodiversity management*', Topic 11, by providing an understanding of the way Indigenous people living on Goulburn Island depend on coastal food resources and ways this may change in the future. The project also addresses the NARP's Priority Research Question '*Identifying Indigenous vulnerability and adaptive capacity*', Topic 5. It does this by exploring the adaptive strategies identified by Indigenous women as a means to adapt to climate change and preferred options for dealing with climate insecurity and associated food shortages, including their views on the adoption of coastal zone aquaculture enterprises.

Tropical coastal and islander and Indigenous communities are believed to be among the most vulnerable to dangerous impacts of climate change (Intergovernmental Panel on Climate Change [IPCC] 2007). Coastal Indigenous communities in Australia will be particularly vulnerable because of their existing social and economic disadvantage (Braaf 1999) and their high dependence on their environment for food (Altman 2004; Meehan 1977), physical health (Buchanan & May 2012; Burgess et al. 2008) and culture (Hunt et al. 2009; Povinelli 1994). Remote communities in the Northern Territory (NT) are at the end of long, vulnerable food supply chains, the vulnerability of which is highly likely to be exacerbated by amplified climate variability, more intense and extreme weather events, longer periods with roads cut due to flooding, sea level rise in the intertidal zone, and rising energy prices (Australian Commonwealth Government 2010). There is an increasing imperative to produce more food close to where people live, increase money generation and create more local jobs. Options for coastal communities are considered to include developing commercial fisheries and community based aquaculture industries. It is suggested that this could be an important part of improving food security in remote Aboriginal communities and could play an important role in 'closing the gap' particularly in infant mortality, life expectancy and educational attainment (Council of Australian Governments [COAG] 2009).

Initial community consultations and aquaculture trials conducted by the NT Government in partnership with Indigenous groups in recent years have shown that some community leaders in this region are highly receptive to community-based

4 Indigenous women's preferences for climate change adaptation and aquaculture development to build capacity in the Northern Territory

aquaculture enterprises as an option to supply fresh, local and affordable food to their families and to provide local job opportunities for their children and community youth. This current project was built upon this known preference for aquaculture enterprises in this region. It was developed in partnership with the Warruwi community of Goulburn Island, where the NT Government has focused scoping of aquaculture enterprises over the past three years (2009-2012). This project was primarily focused on local women's perspectives; thus workshops were carried out with women participants. However, interviews with men were also carried out to obtain insight into broader community perspectives.

The research focused on women, as most studies of resource use and planning for the future, especially relating to climate change adaptation have tended to focus on men (Allison 2013 pers. comm.). There was also a gap in research globally (Harper et al. 2013) and from Northern Australia concerning women's participation in fisheries (Henry and Lyle 2003). So in this study perspectives were deliberately sought from women and a special focus was placed on understanding ways emergent forms of collective action among women can be built through the research process.

This project was one of a suite of current and proposed research and enterprise development projects intended to help meet food security needs of Indigenous people in remote coastal communities of northern Australia under a changing climate. This research has been designed to improve understandings of Indigenous tropical, coastal community perspectives on climate change adaptation and aquaculture to help guide policy and decision makers across the north of Australia.

1.2. Project objectives

The objective of this research project was to investigate Indigenous dependence on marine resources and people's perspectives on climate change and adaptation. A secondary objective of the project was to explore Indigenous perspectives and preferences for aquaculture as an option in adapting to future climate change uncertainty and marine related impacts.¹

The project was focused around four main research questions:

- 1) What is the level of dependence on coastal, marine resources as food sources?
- 2) What is the perceived impact of climate change on this region, including effects on Indigenous women's dependence on coastal marine resources?
- 3) What are women's perspectives, perceptions and preferences for adaptation to climate change?
- 4) What are key considerations for socially/culturally viable aquaculture?

¹ The precise objectives evolved somewhat throughout the course of this project, thus some of the wording has been modified here from the original proposal. It should also be noted that some of the terminology and approaches initially proposed changed during the course of the project. For example, it was decided not to adopt the term 'Participatory Action Research' as this is considered by some as a form of research that requires research participants to be involved in research design from the onset of the project. As this approach was not possible due to the short duration of the project, remote location and limited resources available this type of (PAR) research was not adopted, but instead participatory studies in an action research framework were adopted (see 'Research activities and methods' for more information). It was also decided not to focus on aquaponics as a form of aquaculture due to logistical difficulties this option would have in the region.

2. BACKGROUND

The following section provides a summary review of international literature on three topics: Indigenous people's dependence on marine resources and subsistence harvesting² practices, community based aquaculture and adaptation to climate change.

2.1. Indigenous people's dependence on marine resources and subsistence harvesting practices

There is a wide and varied body of research literature on the subsistence activities³, practices and economies among contemporary indigenous hunter-gatherer societies across the world including in particular North America, Asia and the Pacific where Indigenous people have ownership and access to their traditional lands. This includes research on the contribution of subsistence harvests to health and nutrition (Berkes & Farkas 1978; Kuhnlein et al. 1991, 2009; Usher 1976), quantifying subsistence harvests and their contribution to local economies (Berkes 1990, 1993; Berkes et al. 1994, 1995; Hogarth et al. 2013, Tobias & Kay 1994; Usher et al. 2003), cultural practices and values associated with hunting (Barnes 1996, 2005; Freeman 1993; Luzar et al. 2012) and issues associated with consumption, sustainability and management of natural resources arising from hunting (Huntington 1992; Mack & West 2005; Pangau-Adam et al. 2012). Subsistence fisheries are important to many peoples across Canada and detailed studies have shown the high per capita contribution of fisheries to annual food consumption of around 60kg of whole fish per year per person (Berkes 1990). The contribution of food harvested from the environment as part of hunting and gathering activities to local economies among the Cree, a group of native American/First Nations peoples living in Canada, was reported to account for one-third of village income (Tobias and May 1994).

In Australia, Indigenous people comprise 26.8 per cent of the Northern Territory's (NT) population (Australian Bureau of Statistics [ABS] 2012) and the majority live in remote or very remote locations, much of which is part of the Indigenous estate - Aboriginal owned and managed land and sea, which is currently about 23 per cent of the Australian continent (Altman 2012). The Northern Territory is unique in that 85 per cent of the coastline, including the intertidal zone, is owned by Indigenous people (Northern Land Council [NLC] 2011).

Despite receiving little direct economic benefits from working with natural resources (as recognised through western systems), many Indigenous people in the NT are believed to contribute essential environmental services, and also depend on their environment for a multitude of purposes. In particular, the harvesting of plants and animals for food or ceremonial or celebratory purposes (community feasts), art production or income through natural and cultural management work, or maintaining social and economic relationships, play an important and central role to Aboriginal livelihoods, belief systems and wellbeing in the NT (Altman 2005; Brimblecombe 2007; Buchanan & May 2012; Ganesharajah 2009; Gould 2010; Jackson et al. 2012; Meehan 1977, 1982; Povinelli 1994).

The harvesting of natural resources is considered an important process in maintaining and transmitting Aboriginal law; language; skills and knowledge about country and plants and animals; and spiritual beliefs between adults and children (Gould 2010;

² For ease, this report refers to hunting, gathering, fishing and harvesting as 'harvesting' (and sometimes 'hunting' depending on the context). Harvesting in an agricultural (plant or crop) sense is excluded from this definition unless specified otherwise.

³ This literature does not include exploitation of domesticated plants or animals.

⁶ Indigenous women's preferences for climate change adaptation and aquaculture development to build capacity in the Northern Territory

Povinelli 1994; Buchanan & May 2012). Many Indigenous people place a strong emphasis on the role of bushfood⁴ collection in teaching young people about country and their responsibilities under customary law (Jackson et al. 2012; Povinelli 1994). In the remote communities away from larger provincial centres of population and infrastructure such as supermarkets and local produce markets, bushfoods can sometimes supplement refined, processed and takeaway foods purchased from stores, but this varies among communities and those living in outstations (Altman 1987; Povinelli 1994). Although the data is not conclusive and will vary among locations, it has been suggested that between 80 and 95 per cent of all food eaten in Aboriginal communities is purchased at the local store and takeaway (Saethri 2011). The cost of these store foods in Indigenous communities is usually extremely high (Buchanan & May 2012). In Northern Australia, customary harvesting activities are thought to critically contribute to local food security (Altman 1987) and provide important sources of protein, micronutrients (e.g. vitamin A, calcium, iron and zinc) and lipids (Allison 2011; Rouja et al. 2003; Smyth 2004). Despite this widespread acknowledgement, there have been few detailed studies into the subsistence practices of Aboriginal peoples and their contribution to food security (Busilacchi et al. 2013).

Overall, there is underreporting of women's participation in fisheries – in terms of actual activities and species collected, and contribution to household and livelihoods and food security. The recent global review of women and fisheries from Africa, Asia, North and South American and Oceania on subsistence fisheries, hunting and gathering, the trade in small scale fisheries and food security does not include Australian Indigenous or non-Indigenous women's participation in fisheries (Harper et al 2013). There is also a paucity of studies on women and fisheries from Northern Australia and the Northern Territory. The only detailed published study is Meehan's 1982 monograph based on research conducted in the early 1970s with coastal Anbara people of northwest Arnhem (to the south of Warrawi) on daily food and shell fish gathering principally done by women and girls (Meehan 1977, 1982). In the Australian National recreational and Indigenous fishing survey conducted in 2000, (Henry and Lyle 2003), gender disaggregated data was provided for non-Indigenous and overseas recreational fishers, but not for Indigenous fisheries and participation in Northern Australia.

2.1.1. Trends and benefits of customary harvesting

In Australia, the results of a 2008 National Aboriginal and Torres Strait Islander Social Survey (NATSISS) indicate that approximately 60 per cent of Indigenous people over 15 had partaken in the harvest of wild resources in the past 12 months. In remote communities the percentage of people who had participated in harvesting wild resources was 72 per cent of the population (Altman et al. 2012). In a study in Cape York Peninsula in Queensland wild resources were found to represent about 80 per cent of people's protein intake (Asafu-Adjaye 1996).

The main reason people participate in hunting and gathering according to results of the 2008 NATSISS was for food (91 per cent) (Buchanan & May 2012). Buchanan and May (2012) draw attention to government programs designed around (out-dated and generalised) statistics from the early 1990s that estimate that 95 per cent of food consumed in Aboriginal communities is food purchased from stores, with the small remainder obtained through traditional hunting and gathering activities. It is argued that figure may be originated from 'vague estimates and extrapolations from as far back as the 1970s and 1980s with the most recent likely source dating from the early 1990s' (Buchanan and May 2012, p. 75). It is argued that in many remote areas, consumption

⁴ Bushfood/s is a term used in Australia that refers to fauna or flora that are used for culinary or medicinal purposes.

of food derived from hunting and gathering activities is likely to be much higher, particularly on outstations. For example in 1985 it was estimated that 70 per cent of homeland/outstation residents' food came from non-market sources. It is argued that in many remote areas, the food derived from hunting and gathering activities is likely to be much higher, particularly on outstations. For example among an Aboriginal community in the West Kimberley it was reported that the contribution of bushfoods amounted to 11 per cent of average household income. It is possible that in recent decades the contribution has decreased. In 1985 it was estimated that 70 per cent of homeland/outstation resident's food came from non-market sources (Esk 1985 cited in Buchanan & May 2012).

The NATSISS data as well as other regional studies strongly indicate that living on one's homeland and being involved in customary harvest are positively correlated and also relate to high levels of self-reported good health and happiness (Altman et al. 2012; Buchanan et al. 2009; Burgess et al. 2008; O'Dea et al. 1988). Harvesting is suggested to provide emotional and physical benefits from exercise associated with these activities (Buchanan & May 2012). However the contribution of consumption of bushfoods is not generally considered in health and nutritional programs or studies of consumption patterns in remote communities, as it is considered difficult to collect comprehensive household level socioeconomic data over a long period of time (i.e. one year) (J. Brimblecombe, Menzies School of Health Research, 2012 pers. comm) and these forms of surveys are often invasive to Aboriginal people.

In a National Recreational and Indigenous Fishing Survey (Henry & Lyle 2003), it was found that among 37,000 Indigenous people living in communities in northern Australia surveyed, 91.7 per cent participated in fishing during the survey year (a 12 month period between June 2000 and November 2001, inclusive). It was found that people living in coastal regions of the NT fished more than in other states and that there was a higher level of effort in saltwater compared to freshwater environments. Indigenous fishers in northern Australia reported using line fishing methods (53 per cent), hand collecting (26 per cent), nets (12 per cent) and spears (9 per cent) as their primary fishing methods. For South Goulburn Island, a variety of methods are used by locals to fish, mostly from the shore. Hand gathering, spears, lines and nets are most common used; unfortunately, specific data are not available.

Since colonisation, the hunting, fishing and collecting practices of Aboriginal people have altered due to ecological, demographic and technological changes (Povinelli 1994). An illustration of this change in technology among some communities is seen from the Belyuen community near Darwin in the NT where Povinelli (1994) reported that people use cars, trucks and small boats with outboard motors to access hunting grounds and often use nets, guns, buckets, sacks and eskies to transport products during the activity or back to their homes (Povinelli 1994). Developments on the land have also altered the environment and, in some areas, the grounds once accessed for hunting have changed due to feral species, pastoral activity and other factors. Despite such changes, evidence such as that from the Balyeun community suggest many Aboriginal populations have a strong desire to collect 'bushfoods' (e.g. Povinelli 1994). Subsistence harvest practices are also vulnerable to changes in the natural systems that provide the ecosystem goods (Jackson et al. 2012).

2.1.2. Economic benefits from natural resource activities

Harvesting is often undertaken while land and sea rangers undertake various land and sea management activities, and during Community Development Employment Program (CDEP) activities (Buchanan & May 2012). Altman et al. (2012) highlight that wage employment in CDEP programs helps facilitate people's participation in customary harvest of bushfood, contributing to health and wellbeing. Subsequently, the

8 Indigenous women's preferences for climate change adaptation and aquaculture development to build capacity in the Northern Territory

Government focus on work readiness and conventional mainstream employment in priority communities and 'growth towns', and the dismantling of CDEP programs and reduced government support for outstations, has been criticised by many (Burgess et al. 2008; Garnett et al. 2009).

It has been argued by many researchers that, given the centrality of harvesting to Aboriginal livelihoods, this activity should be recognised and accommodated in any government funded land and sea management programs (Buchanan & May 2012). Austin and Garnett (2011) explain that Indigenous engagement in conventional economic activity has been limited with most development focusing on mainstream industries, such as mining (Connell and Howitt 1991), tourism (Tremblay and Wegner 2008) and arts and crafts (SECITA 2007), and, in recent years, payment for environmental services (Luckert et al. 2007). However, as Altman et al. (2012, p. 166) argue, there are some forms of production that do not *'fit neatly into the categories of public or private sector or state or market sector because they might be informal or un-marketed'*. In previous work by Altman (1999) this customary sector was described as part of the 'hybrid economy' – which articulates the market and state sectors. Altman and other authors argue the customary sector contributes a significant component to Indigenous livelihoods especially when there are limited employment opportunities available in many remote Indigenous communities in the NT (Altman 2003; Austin & Bradshaw 2012; Kerins & Jordan 2010). However the sector is thought to be undervalued in western economic terms. The sector includes the cash and non-cash exchanges within and between households, for example the sharing of 'bushfoods'.

Indigenous Australians have lower life expectancies; poorer health, literacy and numeracy; and higher levels of unemployment and poverty compared to non-Indigenous Australians (SCRGSP 2009). One of the main determinants of disadvantage is believed by many to be a lack of involvement by Indigenous Australians in the workforce (Austin & Bradshaw 2012; Pearson 1999; Altman 2001; SCRGSP 2009) – especially by those living in remote regions. In the NT there has been little involvement of, or opportunities for, Indigenous people in conventional western economies living on the Indigenous estate, apart from a long history in the pastoral industry (Austin & Garnett 2011). This lack of involvement has been for a number of economic, environmental, political and social reasons, including the fact that much of this land has limited potential for conventional market-based economic growth (Altman 2001; Altman et al. 2007; Austin & Bradshaw 2012; Woinarski et al. 2007). Successful Indigenous enterprises are rare and have often been short-lived (Austin & Garnett 2011; Schaper 2007). Consequently, economies in remote areas are under-developed, and people face high unemployment and dependence on welfare (Pearson 1999).

There is a growing recognition internationally, as well as in Australia, that nuanced measures of wellbeing in development need to go beyond a narrow focus on per capita income and material wealth (Sanhga et al. 2011; Sen 1999; Weeratunge et al. 2013). Some authors argue that government policy provides little recognition of the environmental services and benefits (e.g. provisioning, regulating and cultural services) of production of Aboriginal bushfoods from the Indigenous estate (Altman 2001; Luckert & Whitehead 2007). These benefits can include biodiversity conservation as well as harvesting of bushfoods for social, psychological and physical benefits (Berry, et al. 2010; Garnett et al. 2009; Sangha et al. 2011).

2.2. Adaptation to climate change

With growing recognition of the immediacy and seriousness of the consequences of anthropogenic climate change, there has been a strong shift in international debates

from focus of research and other work on mitigation of climate change, towards adaptation for climate change (Smit et al. 2000; Adger et al. 2005; Liverman 2009). Adaptation is a process by which individuals, communities and/or countries seek to adjust natural or human systems in response to actual or expected consequences of climate change and variability. In the context of climate change, adaptation is a *precautionary* or *anticipatory* adjustment(s) to shifts already occurring or that may happen in the future. Although there is strong emphasis in current global debates on the need for adaptation, this is not a new challenge; humans have always adapted to climatic variability and also made management decisions and strategies to deal with variability. However, rarely have communities or countries incorporated long term dangers such as future climate risk into planning or policy-making. The literature on this topic shows that worldwide, adaptation presents difficulties because it involves accommodating very different world views and perceptions of concepts such as change in general, climate change, uncertainty, scale, governance, power and control (Pelling et al. 2008).

According to Nelson et al. (2007) and Green et al. (2012) the unpredictability and complexity of human-environment systems means that creating accurate models and predictions on which to base adaptation decisions is impractical. Yet a strong drive continues to develop more accurate models to assist in making single 'optimal' climate change adaptation solutions (Dessai et al. 2007). The benefit of this approach is widely debated. Many are concerned that adaptations may lead to dangerous mal-adaptations if based upon misleading models. Some researchers and practitioners suggest that models should not be used prescriptively, but instead as exploratory decision aids to provide broad, robust scenarios that acknowledge uncertainties in modeling and allow flexible options. Despite these calls for a change in approach, adaptation efforts in Australia and internationally continue to place a strong emphasis on data gathering and modeling for prescriptive purposes and hence on the need for collection of more quantitative data.

In contrast to the proponents of quantitative modeling, some researchers and practitioners advocate the use of social-science based and qualitative approaches in exploring and developing practical options for adaptation to climate change by vulnerable communities (e.g. Petheram et al. 2010). Such qualitative approaches are particularly valid in remote and vulnerable communities where few quantitative data exist, and where little is known of Indigenous customary relationships with, and perceptions of environment, cultural concepts or preferences relating to adaptation to future change. The present study of an Indigenous community interacting with a complex marine ecosystem region with little available data and facing future uncertainty would seem to be best studied by means of qualitative and adaptive research methods, rather than by means of quantitative modeling.

2.2.1. Indigenous adaptation – the Australian context

Although Indigenous people comprise only 2.5 per cent of the Australian population (ABS 2012), they own and occupy approximately 23 per cent of the land; vast expanses of the country's remote areas (Altman & Kerins 2012). Their predicament in relation to climate change and the adaptation strategies they adopt could therefore have a significant impact on the nation's environment and economy.

Predictions for changes in climate in Northern Australia include higher temperatures, sea level rise, more extreme cyclonic events and associated storm surges. Sea levels rose 7–10 mm/year along Australia's northern coastline between 1993 and 2009 – about three times the rate on southern and eastern coastlines (CSIRO and BOM 2010). Many off-shore islands, wetland areas, and coastlines are believed to be vulnerable to

erosion and salt water intrusion (Green et al. 2009). Furthermore, significant impacts are expected on the future abundance and distribution of plant and animal species (Dunlop & Brown 2008).

Various reports have forewarned that remote Indigenous communities, particularly in coastal areas, will be highly vulnerable to climate changes (e.g. Altman & Jordon 2008; Green 2008; Hennessy et al. 2007; Zander et al. 2013). Several have also discussed negative impacts on health of Indigenous communities (e.g. Braaf 1999; Green 2006) and difficulties in emergency evacuation (Veland et al. 2013). Many Indigenous leaders, communities and organisations have publicly expressed their concern about these future changes (Mackie & Hanslow 2010; NAILSMA 2010; Sinnamon 2009).

In Australia, much adaptation work occurs at local and regional levels – and there is little coordination by national agencies. Although Australia was categorised by the IPCC as having 'high adaptive capacity' (Hennessy et al. 2007), this national-level assessment hides the considerable heterogeneity among the population (Green et al. 2012). In particular, remote northern Indigenous communities differ significantly from most Australian (urban) communities, in terms of most social and economic indicators (Carson 2007). To date there has been little research conducted or action undertaken with Indigenous people to engage them in efforts towards adapting to climate change (Green et al. 2012; HREOC 2009; Wiseman & Bardsley 2013).

Despite limited Indigenous engagement in adaptation to climate change, one mitigation approach of merit being carried out in some parts of the Northern Territory is the West Arnhem Land Fire Abatement Project (WALFA). This project uses traditional Aboriginal fire management techniques combined with western scientific knowledge in tropical savannas as a way to reduce greenhouse gas emissions (Russell-Smith et al. 2009). The WALFA Agreement was signed in 2006 as a partnership between traditional owner groups, Indigenous land management rangers, Darwin Liquefied Natural gas, the NT Government and the Northern Land Council. In 2011, the Government also announced an Indigenous Carbon Farming Fund as part of its Clean Energy Future policy, which aims to support Indigenous participation in Carbon Farming opportunities (Australian Commonwealth Government 2011). Despite these initiatives, remote natural resource management regions in Australia generally receive much less Federal Government funding compared with other regions closer to centers of power (Robins & Dovers 2007; Wiseman & Bardsley 2013).

2.3. Aquaculture in remote coastal communities

Population growth and socio-economic development are contributing towards a worldwide increase in demand for fishery and aquaculture products. As a result, global aquaculture production has increased by 34 per cent since 2006, to 63.6 million tonne per annum in 2011 (FAO 2012). During the same period wild fisheries production has remained steady at around 90 million tonne per annum (FAO 2012). As wild fisheries are approaching (or have exceeded) maximum sustainable exploitation levels, it is anticipated that the relative proportion of seafood derived from aquaculture will continue to increase. This steady rise in aquaculture food output is faster than global population growth and this has resulted in record global 'availability' of fish per capita; from 17.4 kg per person in 2006 to 18.8 kg per person in 2011 (FAO 2012).

The intensity and type of environmental impacts of aquaculture are dependent on the species farmed, the intensity of production and on the farm location. The more intensive farming methods, if not managed well, have the potential to cause environmental damage (through nutrient, disease or genetic effects) compared with less intensive farming where the impacts can either be negligible or have no lasting

environmental footprint. Concerns over the environmental sustainability of intensive grow-out aquaculture systems have in many cases diminished as developments in knowledge, technologies, and policies has led to improvements in environmental management practices. Increasingly, public pressure for eco-friendly farming methods has pushed producers to improve their environmental credentials, with many seeking environmental certification as a means to demonstrate their sustainable practices and to gain a social license to operate. Today many conservation NGOs, such as the World Wildlife Fund for Nature, are working to facilitate better farming practices globally through certification programs that seek to engage stakeholders in agreed standards (WWF 2012). The WWF also works in developing countries focusing on key unsustainable farming methods where past pressure for rapid development has overridden environmental concerns in the absence of effective government policy.

Interestingly in recent years the policy emphasis within many international agriculture and fisheries-based research and development organisations has shifted, or broadened, to a stronger focus on food security (and a shift from protein to micro-nutritional outcomes) as well as income generation (Allison 2011; Aquaculture for Food Security, Poverty Alleviation and Nutrition [AFSPAN] 2012). As fish prices have risen, export markets have grown, and in some cases reduced the availability of affordable seafood amongst the poor (Allison 2011). In addition, as the impacts of climate change on communities in developing countries becomes more apparent, the vulnerability of poor coastal communities to future food insecurity is driving the need to identify viable adaptive strategies to ensure local food outputs are climate resilient (Bell et al. 2011). Adaptation has been a focus of recent international climate change negotiations and Australia has made strong pledges to help developing countries respond to the climate-related changes ahead. Australia is well aware of the potential effects of climate change on yields from agriculture and fisheries and has voiced its commitment to helping its Pacific Island neighbors (Bell et al. 2011), Asian neighbors (Network of Aquaculture Centers in Asia-Pacific 2012), and its own Indigenous citizens (Langton et al. 2012) understand the vulnerability of their resources to these changes, and how best to respond.

The most successful policy approach to lifting Indigenous Australians out of extreme disadvantage has been where Indigenous people have drawn on their customary practices and knowledge, often linked directly or indirectly to their natural resources and homelands, to create a marketable service or product. There is a solid body of evidence that suggests that success can be achieved if the work opportunities and business developments: reflect people's aspirations, values and world view; build on individual and community strengths; harness Indigenous people's enduring attributes, such as passion, creativity, and knowledge; and are truly selected, controlled and directed by Indigenous people themselves (Austin-Broos 2011; Martin 2006). Thus there has been a shift in policy focus, at least in some quarters, from the traditional western economic policy framework to a social framework that focuses on people's and communities' present needs (such as nutrition, wellbeing and appropriate workforce participation) and cultural aspirations (such as autonomy, pride, traditional knowledge, work on country and self-determination). Such a shift suggests a better alignment with current international development policies that are focused not only on reducing poverty through economic opportunity, but also increasing food security and improving health (including mental health) and nutrition.

Aboriginal ownership of the intertidal and coastal zone in the NT is extensive and the nutritional, social, cultural and economic contributions of subsistence practices around seafood, and the role of women in providing food to households are important. Hence, fisheries and low intensity, sea-based aquaculture enterprises offer realistic potential

for Aboriginal people to develop local economies and improve local food security in the face of climate change.

Past attempts to facilitate aquaculture enterprises have not been successful, primarily due to a lack of community control and partly due to technical and market failures (A. Fleming, 2012 pers. comm.). In light of this, the Aquaculture Branch of NT Government Fisheries developed a Draft Aquaculture Enterprise Development Policy in late 2011, to guide how government and other external facilitators can effectively work together with remote and Indigenous communities to develop and manage marine-based enterprises. The policy seeks to bring together, within a systems framework, all the known success factors of past successful and unsuccessful economic development attempts. These elements for success would then inform the government's aquaculture and fisheries research and facilitation programs across three key program output groupings, which are:

- 1) Indigenous Engagement (communication and relationship building, clarifying aspirations and valuing/utilising traditional knowledge in the planning and development process),
- 2) Business Development (Research and Development into enterprise viability, capacity building both at the community governance level as well as the individual level, and Infrastructure needs/supply chain and land tenure arrangements) and
- 3) Market Drivers (internal and external market demands, government development policies and Indigenous standpoints on self-determination and cultural primacy).

This holistic framework requires a cross agency, cross discipline collaborative partnership approach, where each partner is responsible for implementing and delivering against specific programs that, when combined, address all elements of success within the policy system. This approach has been formed and applied in a 'policy test case' on Goulburn Island (see section 3.1 below).

The work by the NT Government is supporting partners on developing community capacity to own and operate seafood enterprises that aim to provide local seafood to the community with the capacity to export to regional seafood markets in the longer term (A Fleming 2012, pers. comm.). These initiatives are engaging with sectors of the community that seek to drive community development, often these are the traditional owners and especially the women (See section 3.1). A growing body of literature is driving a policy shift towards gender transformative approaches to fisheries and aquaculture development (Harper et al. 2013; Weeratunge et al 2010; Williams 2010). Such gender-centric initiatives may also offer culturally appropriate, community driven Indigenous opportunities for addressing projected food insecurity as a consequence of climate change in tropical northern Australia.

3. RESEARCH ACTIVITIES AND METHOD

3.1. Case study site

The research was carried out in Warruwi, a small settlement on South Goulburn Island (also known as Mardbalk in the Maung language). South Goulburn is about 280km northeast of Darwin, and 3km off the West Arnhem Land coast (Figure 1). The island lies between two other Indigenous communities, Minjilang (Croker Island) and Maningrida. A daily 'mail plane' connects the community to Darwin. The island automatically became Aboriginal freehold land following the Aboriginal Land Rights Act in 1976 (Gould 2010). However, it has since been under freehold lease by the NT Government. There are about 391 Indigenous people based in the community of Warruwi⁵, with about 95 per cent of the population being Indigenous (ABS 2012; Appendix 1). There is a high degree of movement of people to and from the mainland. For most of the population of Warruwi, English is not usually the first language spoken and members of clans may speak up to two or three different Aboriginal languages; Maung is the most widely spoken (Gould 2010) followed by Walang, Gunwinggu and Galpu. The basic social unit is the extended family or 'clan' and membership is either through paternal or maternal lines. Outstations on the island are inhabited for short periods only throughout the year, and include Ararlagu; Illiaru (Weira, North Goulburn); Injalatparri; Waminari (Waminara Bay); Wigu; Ngijipin; Armorran; Ngarlu.



Figure 1. Map of the location of South Goulburn Island and the community of Warruwi

North and South Goulburn Islands lie on Maung territory, but there are strong cultural links with other West Arnhem groups, particularly Gunwinggu, Walang, and Iwaidja language groups and more recently Galpu in East Arnhem Land. During the dry season there is a high degree of mobility to and from other regions, particularly in Arnhem Land and Darwin. However, during the wet season there is less movement. Other smaller groups of individuals or families also reside in Warruwi (through marriage and business/education) and are from other parts of the NT, the Central desert, Katherine, Borroloola, Torres Strait Islands, Papua New Guinea and other areas (Gould 2010).

There is one store located on the island, which provides basic goods. The store is community owned, but managed by the Arnhem Land Progress Association (APLA). A

⁵ There are four people that identify themselves as Torres Strait Islander, four that identify as both Torres Strait Islander and Indigenous and 22 non-Indigenous people on the Island (ABS 2012).

local school provides primary and high school education. The community also has a crèche which is run by the women's resource center and a 'meals on wheels' service that provides food for the elderly – and is run largely by volunteers. Other services and facilities on the island include a Centrelink office, Mardbalk Arts and Craft Centre, church services, garden nursery, and a ranger program. Most of people's incomes come via social security payments. Some people receive extra 'top up' wages above their social security payments. Health data were not available, but the Heath Centre staff (Department of Health, NT Government) consider the major health problems to be diabetes, heart disease and obesity - all thought to be related to poor diet and little exercise (see also Gould 2010).



Figure 2. Warruwi community store

Source: L. Petheram

The natural resources within particular areas on North and South Goulburn Island belong to clans who hold ownership over that land, estuaries, beaches, sea and offshore reefs and islands (see Gould 2010 p. 174 for a detailed description of clan estates in land and sea areas). People view the seas and coastal environments as part of their 'sea country' or 'saltwater country'. Some of the important features of this relationship relate to identity, ownership of traditional clan estates and marine resources under traditional law and state, territory and commonwealth legislation (e.g. NT Land Rights Act of 1976, Native Title Act of 1993). The application of traditional laws and practices for access and use of the sea and land, spiritual belief systems and cultural sites of significance are fundamental to Aboriginal systems of creation, ceremony and religion and cultural traditions from the distant past (Smyth, 2004). People on Goulburn Island follow a patrilineal descent system, which gives clans (*nguya*) people ownership for particular areas (estates or country) of land or sea. There are five major clan groups for Goulburn and the area is part of one large estate called 'Madjugurr' (Gould 2010:p 24). Rights to country are also obtained through matrilineal affiliations where people are classified as *jungai* (loosely translated as 'managers') for particular estates. Both owners and managers are normally consulted in relation to any issues concerning that land or its resources. All people at birth are assigned to a moiety – Dhuwu or Yirritja (everyone or everything is classified as either one or the other). People are associated with a totem (usually a plant or animal) which may play a factor in what they can and cannot hunt (Gould 2010) and eat (Henry & Lyle 2003). A matrilineal skin system also exists.

On Goulburn, permission to access others assets or resources can depend on relationship to mother's country, *nguya* or clan affiliation, relationships through marriage and interpersonal agreements (Gould 2010). Relationships and traditional

systems of obligation and reciprocity inform how resources are accessed, shared and redistributed (Gould 2010). For example products can be 1) given away and distributed to reflect social norms; 2) senior members of a community can give to other community members to show their generosity and capacity for giving; 3) young people give to old people out of respect 4) people accumulate and repay social debt (Gould 2010).



Figure 3. A child picking up a giant clam shell (commonly eaten) on a local beach, South Goulburn Island

Source: L. Petheram

The saltwater peoples of the region today continue to rely on coastal and marine environments and resources of the region for their cultural identity, health and wellbeing, and their domestic and commercial economies. Despite the severe impacts of colonisation, which have reduced Aboriginal people's ability to maintain their cultural connections and obligations to their sea country, these connections are believed to have remained strong throughout much of the region (Smyth 2004). In recognition of these connections, Indigenous sea-ranger groups have been established in recent years across the NT including South Goulburn, with support from both government and non-government organisations. On Waruwi the Mardbalk Marine Ranger program was established in 2003. A group was supported in previous years by the Garngi Ranger program on nearby Croker Island, due to the strong cultural ties between the two communities. In 2006 the Mardbalk Rangers signed a formal agreement with NT Fisheries to carry out patrols, education and communication activities (NLC 2006). The group have also worked with the neighbouring ranger group, the Maningrida-based Djelk Sea Rangers on various activities.

3.1.2. A brief history of mission times and (western) governance on South Goulburn Island

In 1916, Reverend James Watson established the Goulburn Island Mission on South Goulburn Island; the first and longest standing Methodist mission in the NT (Ellemor 1966). During mission times there was strong emphasis on self-sufficiency and there were attempts to create paddocks for horses, cattle and goats, chicken coops, gardens and rice paddies, as well as the establishment of a bakery and dairy. Many of the agricultural attempts suffered setbacks due to poor soils. Thus the Mission also turned to the exportation of arts, crafts and other products, such as trepang (sea cucumber) and mussels. There were expectations that all adults were to work on the Mission station, and some also travelled to attend trade schools in Darwin and Yirrkala in courses such as carpentry and horticulture (Gould 2010).

In 1963 a 'Village Council' was established in Warruwi (Welfare Branch, 1964), which was replaced in 1972 by a 'Town Council' (Kabida 1998) and then the Warruwi Council from 1976 – 2008. In recent years the Council has been involved in discussions to develop the West Central Arnhem Regional Authority (WCARA) to reflect Indigenous values and relationships between different connected groups of the region (Hunt & Smith 2007). However, in 2007 the NT Government announced it would amalgamate the NT's 63 community councils into nine shires, and so the WCARA was discarded. The West Arnhem Shire currently provides essential services to Warruwi and has a strong presence on the island. Recently there has been the development of a local Aboriginal Development Corporation ('Yagbani') which has representatives from each local group on the Island, with men and women members as well as Traditional Owners and younger members being represented.

Yagbani Aboriginal Corporation was registered with the Office of the Registrar of Aboriginal Corporations (ORIC) in Nov 2011. Yagbani is a social enterprise organisation that was established to strengthen the Warruwi community's voice and foster and support local enterprise development and decision making. It currently has around 60 members. The amalgamation of the Warruwi Community Council into the regional West Arnhem Shire Council (WASC) as part of NT local government reform process in 2008 left the broader Warruwi community with a greatly diminished capacity to participate in local decision making processes. Addressing this imbalance was a significant motivating factor for the community to organise and formalise a representative structure.

Warruwi community is culturally strong and maintains strong cultural structures and responsibilities. Yagbani is designed to be built on these structures, strengths and commitments. Yagbani's 'board' consists of three members of each of the five language groups and clans that now live in the Warruwi community. This is a contemporary traditional structure that has been used at Warruwi in a number of organisations to equitably convey community ideas and wishes since mission times. The 'board' has a strong commitment to governance, capacity building and process. It meets regularly and is developing a number enterprise and service opportunities including aquaculture and fishing.

3.1.3. Development of fisheries and aquaculture enterprises on South Goulburn Island

Apart from a PhD thesis (Gould 2010), mission records and Welfare Branch Annual Reports, there is scant recorded information on subsistence production among Warruwi societies. People from South Goulburn and other settlements in the West Arnhem region have a history of trading trepang (sea cucumber or beche-de-mer⁶) with Macassans⁷ from Indonesia, who are believed to have visited the Arnhem Land coast from the early-mid 1700s (Macknight 1976; Stacey 2007). In the early 1900s permits were introduced which had a large impact on the trade and by 1907 (Macknight 1976), Macassans had stopped visiting the NT coastline and trade ceased (Stacey 2007).

A range of seafood and agricultural enterprises were established on South Goulburn during mission times, which ended in the mid-1970s. Trepang as well as oysters and

⁶ A genus of edible holothurians found commonly in the seabed in shallow tropical waters.. Processed sea cucumber has long been considered a culinary delicacy with strong medicinal properties in China and South East Asia (Stacey 2007).

⁷ Macassan is a term used to apply to the trepangers who travelled from South Sulawesi to the coast of northern Australia in the eighteenth and nineteenth centuries to collect and process trepang (MacKnight 1976).

fish (and mussels) were sold to Darwin (A. Perry 2012, pers. comm.). Some 216,000-277,000 lbs (98-125 tonne) of seafood (including dugong) was produced annually on missions and settlements across the Northern Territory from 1963 to 1968 (Stanley 1985). Although limited data is available for Goulburn Island specifically, during 1968 Goulburn Island produced 11,653 lbs fish (5.3 tonne), 2,372 lbs dugong (1.1 tonne) and 3,897 lbs (1.8 tonne) of turtles and oysters (Welfare Branch 1969).

In the 1980s the NT Fisheries established six 'wild harvest license areas' as part of the management framework for the sea cucumber wild fishery (NTG 2012). All six are currently held by the company Tasmanian Seafood's P/L. In recent years this company has invested in sea cucumber ranching and stock enhancement in the NT, and have indicated a willingness to develop partnerships with Indigenous communities to establish sea-ranching enterprises (Fleming 2012). Currently they are trialing sea cucumber ranching in Little Lagoon with the Umbakumba community on Groote Eylandt.

In the early 2000s biologists worked on Goulburn Island to research suitable species for commercial bath sponges for international export (Dobson 2001). The project did not progress beyond the technical and market research stage. Factors cited for its failure are the limited inclusion and direction of local people, lack of suitable capacity development and unsuitable grow-out methods requiring people to dive (A. Fleming 2012, pers. comm.).

In 2004-06 the NLC and the Warruwi community held discussions about development of a trepang farming industry for Warruwi. In 2005 a consultant (Real Fish) was engaged to develop a business plan, including the proposed building of a hatchery and conducting of trials in spawning and grow-out methods. However the project faced a number of issues and challenges around licensing, funding, commercial partnerships and ownership in the context of the Blue Mud Bay decision in March 2007, which gave Aboriginal people exclusive rights over the intertidal zone and water column (Gould 2010). This eventually led to a collaborative project, funded by the Australian Centre for International Agricultural Research (ACIAR), for four years between the NT Fisheries, the Warruwi community and research partners in the Philippines and Vietnam. Sea trials commenced in 2010 for sandfish (*Holothuria scabra*) on an 18 hectare research site at Wigu on Goulburn Island (Fleming 2012).

NT Fisheries are conducting other sea-based farming trials on the fluted giant clam (*Tridacna squamosa*) (Figure 3) and black-lip rock oyster (*Saccostrea mytiloides*) in partnership with the Warruwi community. These low-maintenance native species are showing promise as aquaculture species suitable for low infrastructure, sea-based mariculture that can provide a sustainable food source as well as business development opportunities. The clams and oysters are produced at the Darwin Aquaculture Centre and placed in trial structures at appropriate locations around South Goulburn Island. The local Community Development Employment Program (CDEP) workforce maintains the structures and monitor the animals' growth and survival.

Aside from proving the technical feasibility of the trials, one of the key challenges for the shellfish project includes meeting minimum shellfish quality assurance standards for any products sold for public consumption. Project partners are working to overcome such challenges and facilitate positive outcomes for the community. The Charles Darwin University's VET aquaculture training team work with male employees of the CDEP to provide technical aquaculture training and a community-based teaching

program for a certificate level aquaculture course⁸. It has been suggested that these enterprises could help diversify incomes (and associated employment and skills) for Warruwi people, given a potential demand for products both locally (e.g. both within the community and in Darwin) and for luxury sea products in Southeast Asian markets (Fleming 2012).

The research and development phase to develop these enterprises on Goulburn Island are underway as part of the NT Government's policy test (see Section 2.3). The approach is to begin small and focus on local food supply as a first step, and it is designed to be directed by the community. The definition of enterprise success (as captured within the policy principles) will be based on people's aspirations, affording socio-cultural outcomes equal in value to economic outcomes. Viability of the enterprises, both from a technical as well as a commercial perspective, is being addressed in the first phase of development with activities currently underway to assess potential markets and supply chain needs, focusing on logistically simple supply chains. Once this initial research and development phase is completed in 2013, the community will direct the next phase of development based on their Fisheries Development Strategy currently being developed through the community's governance organisation, the Yagbani Aboriginal Corporation.

3.2. Conceptual framework and theory

As a framework for the research procedures in this study, a form of action research was adopted where both research (understanding) and action (change) were pursued in addressing the research questions. As part of this framework, the research process was guided by the results that emerged from the study. In particular, a 'research oriented action research' approach was followed, whereby change was 'desired but not an essential outcome' (Dick et al. 2002, p. 162). The change was considered to include cognitive change in the minds of participants during learning processes, as well as potential behavioural change as an outcome of learning processes. In this participatory research approach, participants were invited to take part in research activities as co-researchers during parts of the project design, and during data collection and analysis.

This study considers 'learning' as a process that occurs naturally, but can also be encouraged and deepened through skilled facilitation (Leeuwis 2004). The project utilised various tools, with a strong emphasis on visual tools to help facilitate co-learning processes among participants.

In working with participants and also analysing the results, a sustainable livelihoods framework (SLF) was also adopted to guide the process. The 'capitals and capabilities' framework is often used in development work as a means to design research and help organise complex data into a form that can summarise and analyse 'core influences and processes' and interaction between different factors that impact on people's livelihoods (Allison & Horemans 2006; Department for International Development [DFID] 1999). Typically the SLF consists of five types of capital (or assets): natural (e.g. fish stocks, sea and land owned); social (e.g. networks, associations, membership organisations and levels of trust); human (e.g. education, knowledge, skills and health); physical (e.g. boats, gear, housing and roads, infrastructure); and financial (e.g. savings, credit, insurance and cash inflows). In our study we included a sixth category, 'cultural assets' – defined broadly as values, ethics, cultural and social preferences (Cochrane 2006). The use of SLF is further described under 'Limitations of the Research'.

⁸ Certificate II in Seafood Industry/ Aquaculture SFI20111 and Certificate III in Seafood Industry/ Fishing Operations (including Coxswains Certificate).

3.3. Field activities

Ethics approval for this project was granted through both the Australian National University (2012/252) and Charles Darwin University (H12028) ethics committees.

A collaborative approach was adopted across various institutions in providing input into the design of this project (NT Government, Charles Darwin University, Australian National University, West Arnhem Shire, Indigenous Gardens Network and The WorldFish Centre). Three women from the Warruwi community were trained as research participants on this project. One of these women, Anne Perry helped guide the research approach and process and was involved as a key researcher, facilitator and translator. A climate change advisory team (Professor Will Steffen, Australian National University and Professor Lesley Hughes from Macquarie University) provided climate change advice relevant to northern coastal Australia for the project.

Fieldwork in Warruwi was carried out over five visits from February 2012 to February 2013 and involved meetings, five key workshops (attended by women, except one male attended one workshop), 30 semi-structured interviews (12 men and 18 women), informal discussions and participant observation. The field work was largely conducted in English, although during workshops and key informant interviews, participants talked among themselves in language, and a co-facilitator translated to and from several languages.

The workshops were facilitated by the lead social researcher (L. Petheram) and a local Indigenous co-researcher (A. Perry) who acted as co-facilitator and translator. The workshops had an average duration of 2-3 hours, had 4-9 participants in each, and involved women ranging from 18-60 years of age (some of the same participants were in multiple workshops). The Indigenous co-researcher (an elder in the community) as well as other local elders initially suggested a range of older and younger women who would be appropriate to talk about these issues. Other younger and older women who were encountered in the community were later invited to participate. In many cases some women had paid/volunteer work, child-rearing or other family duties that limited them from attending all the workshops.

Before the workshops key stakeholders were engaged to discuss the topic and to talk broadly around the community about the research. A project poster was put up at the local shop about the workshops and the research, and research brochures were handed out to community members at the shop and in the art centre. The first workshop and associated interviews focused on the general context of Warruwi life as well as marine food dependence in the region; the second on climate change; the third on preferences for the future and adaptation to climate change; the fourth on aquaculture; and the fifth on preferences for aquaculture development. During the first workshop (on context of Warruwi life) and second workshop (i.e. preferences for the future and adaptation to climate change) we used the Sustainable Livelihoods Framework with participants to frame discussions around context and future preferences (see Figure 7). During the workshops a strong emphasis was also placed on participatory and visual techniques which have been found to help in engagement and encourage reflection, open discussion and learning on complex topics (Petheram et al. 2011) (See Figures 4-9). The techniques used during workshops are outlined in Table 1 and details relating to the different workshops are outlined in Table 2.



Figure 4. Participatory drawing/mapping of South Goulburn Island (source anonymous participant).



Figure 5. Participants carrying out ranking exercises (source: anonymous participant).



Figure 6. Diagrams depicting climate change impacts and preferred adaptation options (source: anonymous participant).



Figure 7. Sustainable livelihoods framework (stones represent current situation, marbles preferred) (source anonymous participant).



Figure 8. Participants looking at pictures relating to aquaculture (source: L. Petheram).



Figure 9. Participant playing the aquaculture, climate change board game (source: L.Petheram).

Table 1. Techniques used during workshops and interviews in this research.

Technique/activity	Description
Participatory diagramming	During workshops participants drew features of their landscape that are important to them (positive or negative). Participants also drew future scenarios (e.g. greater sea level rise, rising temperatures). See Figures 4 & 6.
Participant generated still photography and video	Participants were given a still or video camera to use freely to record processes during workshops, and to also record features (and changes) of their landscape during workshop field walks- and to later explain these. Some photos and video were used later in interviews and workshops to help remind participants of these images and to also elicit responses from other participants.
Video summaries	During and at the end of workshops, video cameras were used to record participant views, seek feedback and/or verify perspectives on particular topics, e.g. re-occurring themes, controversial opinions, workshop synthesis etc. (Video was taken by participants and/or researcher/s.)
Photo and video elicitation and communication	Photos/video collected by researcher (or taken by participants) were used to explain or demonstrate a concept or to elicit feedback about particular landscapes/practices or to generate discussion about a particular topic. These were used in interviews and workshops. See Figure 8.
Sustainable livelihoods framework	During workshops, participants drew diagrams of six livelihood assets to represent strengths and weaknesses of current (and desired) community characteristics (physical, financial, natural, human, social, personal. See Figure 7.
Ranking exercise	Participants were asked to rank the most positive and negative aspects of life in their community. See Figure 5.
iBook	Photos, video and text summarising workshop and interview results were compiled into an interactive book (iBook) – with input from participants. This iBook was shown during workshops to verify interpretation of results with participants, and to summarise and remind participants of previous workshop conversations. The iBook was also used during some interviews to communicate workshop discussions and to elicit responses from participants.
Board game	A board game on aquaculture and climate change was developed where participant teams chose different aquaculture enterprises and needed to make different management decisions relating to climate change and aquaculture scenarios. See Figure 9 and Appendix 2.

Table 2: Details relating to each of the workshops conducted during this research.

Workshop	Date	No. ppl	Duration	Workshop topics	Workshop activities
1	May 2012	4	2.5 hours	<p>CONTEXT & MARINE DEPENDENCE</p> <ul style="list-style-type: none"> -Introduction to the project - Participant perspectives of Waruwi life (positive and negative aspects) and elements in the landscape that are important - Marine food dependence on South Goulbourn Island 	<ul style="list-style-type: none"> - Ranking exercise (five main positive and negative aspects of community were ranked and discussed) - Rich picture diagramming/mapping (a map was drawn of the island and participants marked on elements important to them) - Photo elicitation (of marine foods and landscapes to encourage discussion) - Video summaries (of workshops)
2	May 2012	8	2.5 hours	<p>CLIMATE CHANGE AND IMPACTS</p> <ul style="list-style-type: none"> - Summary of previous workshop - Had people heard of climate change? - Explanation of climate change and examples around the world - What examples of changes had people been noticing? - Perspectives of impacts 	<ul style="list-style-type: none"> - An iBook was shown to participants to verify results of previous fieldtrip - Rich picture diagramming/mapping to show potential changes under certain climate change scenarios - Photo and video elicitation (of climate and environmental change) - Participant generated video and photography (to show changes) - Video summaries (of workshops)

Workshop	Date	No. ppl	Duration	Workshop topics	Workshop activities
3	May 2012	9	2.5 hours	ADAPTATION TO CLIMATE CHANGE <ul style="list-style-type: none"> - Summary of previous workshops - Summary of climate change - General visions people have for the future - Ways people would like to deal with climate change 	<ul style="list-style-type: none"> - Photo and video elicitation (of examples of Indigenous peoples around the world and adaptation responses) - Sustainable livelihoods framework (to understand preferred future visions) - Participatory diagrams/maps (of preferred adaptations and future visions) - iPad (to show results from previous workshop and climate change material) - Video summaries of main themes from discussions were recorded
4	Aug. 2012	4	1.5 hours	AQUACULTURE <ul style="list-style-type: none"> - Summary of previous workshops - What is aquaculture? - What would people prefer? 	<ul style="list-style-type: none"> - Photo elicitation of aquaculture examples from around the world were shown to participants and discussed.
5	Aug. 2012	5	2 hours	AQUACULTURE AND CLIMATE CHANGE <ul style="list-style-type: none"> - What types of aquaculture enterprises would people prefer under what conditions - What decisions would people make under certain climate change conditions? 	<ul style="list-style-type: none"> - Photo and video elicitation and communication - showing summaries from previous workshops (i.e. explaining climate change and aquaculture) - Game board on climate change and aquaculture (where participants underwent different climate change and aquaculture scenarios)

Participants were encouraged to use still and video cameras during the workshops to record the processes, and at the end of workshops participants usually recorded video summaries of themselves talking about the major themes and reflections from the workshops, to provide a means of review at the next workshops (and for participants to view in their own time) and to be used for other communication material. Participants were also engaged in participatory drawing – particularly when describing their local environment and also visioning future scenarios (Figures 4 & 6). A board game on climate change and aquaculture was also developed by the researchers and used with participants in the final workshop. The objective of this game was to encourage participants (and researchers) to discuss and reflect on the types of choices participants might make under certain climate change and aquaculture scenarios and ways that these decisions might impact on the local community, environment and aquaculture enterprises (Figure 9 and Appendix 2). This tool was chosen (at a later stage) of the study because it became apparent from emergent results that participants were having difficulty imagining future scenarios and the different logistics involved in starting an aquaculture enterprise, as well as ways in which an enterprise might be impacted by climate and other events.

An interactive iBook (for a community iPad⁹) was also developed by the lead researcher with assistance from participants that incorporated photos, video clips and text that summarised the results of the project. At the end of the project a colored brochure on climate change (developed from educational learning's developed from this project) and a summary of the research were printed for participants and given, along with a verbal description, to participants in a fieldtrip in February 2013. A final reporting fieldtrip is planned for late May 2013 to report final results and provide a copy of the report as well as the iPad containing all the media (i.e. report, videos, photos, iBook, brochures from the project, as well as educational material on climate change and aquaculture).

Before and after workshops, interviews were conducted with males and females from 18 – 65 years (both those who had, and had not attended the workshops) from the community. Interviews were focused around participants' understandings of climate change, preferences for adaptation, understandings of aquaculture and receptivity to, and preferences for aquaculture. Sometimes the iBook was used during later interviews to explain to participants some of the discussions that were occurring during the workshops with women to elicit further response from participant interviewees as well as communicate workshop processes, discussions and outcomes.

Brochures explaining climate change concepts (derived from lessons learnt during the workshop about the way certain concepts relating to climate change can be communicated) and a summary of the research project were developed and shared with participants and other community members at the end of the project (Appendix 3). A final field trip also involved reporting back research results through these brochures and the iBook to verify results with research participants.

Following a grounded theory approach, the sampling, data gathering and analysis (coding) in this study were part of a continuous cycle (Elliot & Lazenbatt 2005). The 'data' were the words and meanings derived from verbal responses, and researcher observations. Data from interviews and workshops were recorded by hand and/or on video and later transcribed to a word processor. Visual data, such as photographs,

⁹ To be stored at the School or with the aquaculture trainers.

video and diagrams were also recorded, together with participants' oral interpretations of these (in the form of text). Analysis of data (words) was conducted manually and involved 'substantive' and 'theoretical' coding (Fernandez 2004). Substantive coding led to the identification of main themes and categories, and became the basis for the presentation of results under each research objective and development of theories and frameworks through theoretical coding – to explain people's perceptions as expressed (or grounded) in the data. These results were also analysed in the context of secondary data from the literature.

3.2.1. Limitations

This project has been limited by time constraints and minimal resources. The remoteness of the study site has also sometimes presented problems, with difficulty for the lead social researcher in reaching the field site (from Canberra), especially during the wet season. On one occasion the charter plane could not land on Goulburn Island as there was severe weather conditions from a nearby cyclone and the plane had to return to Darwin. The fieldtrip had to be cancelled and the plane tickets were not refunded.

At the field site the native language of research participants was not English, so at times the researchers relied on translation, especially during group activities. This slowed down the inquiry process, and also the analysis and interpretation of data. It can be expected that a certain level of meaning could have been lost through translations and cultural interpretations, although every effort was made to triangulate data and to verify understandings and conclusions.

Local participants did not always have time to be involved in time-intensive activities and were not all available on subsequent trips as they were sometimes attending ceremonies or involved in other family commitments. Participants also have very strict social rules relating to the type of knowledge they can impart and the discussions they can be involved in. It is likely that this presented limitations during interviews and workshops. The lead researcher tried to be aware of these limitations and respectful of these cultural requirements and norms.

A sustainable livelihoods framework helped participants and researchers understand and analyse influences, processes and interactions that impact on local people's lives. However this framework was at times limiting in its scope, especially in its consideration of power, relationships, politics and historical factors that shape people's livelihood options and strategies. Also, the apparent strength of some assets masked weaknesses in the same asset. For example, many participants believed social capital was very strong in their community, yet when queried further it was found that this strength was in the networks between different Indigenous groups, while networks between Indigenous groups and non-Indigenous groups was clearly seen to be very weak. In retrospect this framework may have been better combined with an analytical lens that draws from social wellbeing (Weeratunge et al. 2013) and resilience concepts (Armitage et al. 2012) to provide a broader conception of social systems— and the ways they may change under future climate change and aquaculture enterprises.

This project had a special focus on women as they have often been excluded in projects on resource use and planning for the future. These results do not cover specifically the difference in perspective between men and women as the project did not spend the same amount of time working with men during workshops. This is a limitation in the research and further studies should involve both women and men (separately if it is deemed culturally appropriate).

3.2.1.1. Role as researcher/s

As researchers we acknowledge that we were involved in the co-constructions of NRM knowledge with the research participants, and recognise that this joint interpretation is not entirely 'local knowledge' *per se*, but is knowledge developed with local people through the research process. However, it is also important to acknowledge that although it is believed in this research that participatory methods might help to address power imbalances between researchers and participants, it would be unrealistic to say that our methods can 'abolish' them completely (Buckingham 2009). We do not believe that power dynamics were overcome during this study, but we were very mindful of these and tried to understand where they might occur and took actions to alleviate these differences and hence enable effective participation and learning. Although participatory approaches have been employed in this research, the researchers' role in helping to facilitate learning can be very important in reaching deep understandings by participants and researchers. As van der Riet (2008, p. 562) explains, researchers need to "actively intervene, deal with discrepancies, and observe and monitor the process of analysis".

4. RESULTS AND OUTPUTS

4.1. *Background context*

Through ranking exercises in workshops women explained that family and clan, beautiful landscape, quiet community and low levels of alcohol and petrol sniffing abuse were positive aspects of living in Warruwi. Initially, women appeared to have difficulty describing the more negative aspects of life on Warruwi. It may be that it was difficult for women to talk openly about these issues with a new person to the island, as at later stages people spoke more freely about issues on the island. During the ranking exercises it was claimed that overcrowded housing; danger of feral dogs; danger and environmental and community infrastructure damage by horses; education problems (e.g. lack of school attendance and engagement at school) and mobile phone bullying were the most serious issues on Warruwi. In later conversations many people, especially older women expressed concern that younger generations were losing their connection to culture and were apathetic and not engaged with life on the island. Many women suggested there needed to be more education and skills training and employment options on the island to engage these younger people. In general older participants seemed very proud of South Goulburn Island and their links to other parts of Arnhem Land and Northern and Central Australia. Many of the women explained that people chose to move there or marry into families because of the quiet, safe and inclusive lifestyle on the island. However, some younger participants explained that they get bored on the island – and some said they would like more employment opportunities on the island.

When using the Sustainable Livelihoods Framework (SLF) in visual form with participants (drawn on butchers paper, with different colored counters to represent strengths and weakness of capital assets) it became apparent that participants believed that natural (e.g. the health of the land and sea environment), cultural (e.g. spiritual connections and language) and social capital (e.g. networks between Indigenous groups) were the strongest assets, and human (e.g. education and health), physical (e.g. housing and roads) and financial (e.g. cash, savings and employment) were the weakest¹⁰ and needed to be strengthened. Although participants believed these assets should be strengthened they said they valued cultural, natural and social assets¹¹ the most.

Many participants, especially those who were older, saw connection to culture, environment and language as essential components in keeping people 'strong', 'healthy' and 'motivated'. When discussing visions for the future, older female participants in particular expressed a strong desire for greater training, skills and employment options on the island for younger people – while also ensuring that connections to culture and language skills were continued. There was a lot of concern that younger people would not be stimulated by life on Warruwi and would have few employment/livelihood options, and would lose motivation and strength through lack of connection to culture and language. Overcrowded housing appeared to be a particular problem to a lot of the older women and these participants expressed a strong desire for more housing options to be made available.

¹⁰ See methods for a discussion of limitations around using SLF.

¹¹ Networks between Indigenous groups were highly valued, but networks with other non-Indigenous groups were not very highly valued.

4.2. Dependence on marine resources

4.2.1. Harvesting practices on Warruwi

All research participants placed high importance on harvesting¹². In speaking about harvesting ['hunting'] one woman explained '*it's more than just the food... it's being on country with our family and clan and also learning*'. There was evident excitement by both younger and older people in the way they spoke about harvesting and consumption of fresh bushfoods. Being 'out on country' and participating in harvesting trips with kin were highly valued and were perceived as 'healthy' (physically, mentally and emotionally) by all participants.

Participants commonly talked of harvesting—predominantly for marine species — and held strong respect for the sea and its interconnectedness with other parts of the ocean, the landscape and their lives. Although some distinctions were made between land and sea, there were (especially when prompted) many conversations about the interconnectivity and flows between the land and sea and the importance of both elements in people's lives.

During workshops, participants commonly stated their favourite food items for collection and eating were commonly oysters (black lipped: *Arrayi* and milky: *Karranarn*)¹³, mud crab (*karnjawarra*), turtle (*inyarlgan*), dugong (*marntingunyuny*), barramundi (*Wirrimu*), crayfish and stingray. But mud mussels (*Ngarlwak*)¹⁴, pipis, giant clams (*Maminga*)¹⁵, and other fish were also cited as popular. Children commonly collected pipis, and sometimes other foods close to home – often on their own. Women commonly collected most shellfish (except for giant clam) and men more commonly collected dugong and larger fish. Men and women both fish and collect mud crabs. People seemed to be very resourceful and flexible in the foods they collected. Trepang (sandfish) is avoided as a food source. They regarded trepang as tasteless – although no-one interviewed admitted having tasted it. Despite a disregard for trepang as a food, people were very proud of their history of trading trepang with the Maccassans, and many talked about the desire to reintroduce trading outside of the community (in Australia and Asia) in the future.

The amount of time spent harvesting and the type of food collected varies widely with age group, family size and background, and the season. During certain times of year, people hunt more for certain types of food, and this depends on seasonal abundance, seasonal conditions, and the family monetary and dietary situation. Most harvesting is carried out away from the Warruwi town. Many older participants expressed concern that the younger generation were not harvesting regularly and had become very dependent on the store foods. Today, there appears to be a lot of variation in hunting frequency by people of different age and gender. Middle-aged people seemed to go hunting more often than younger adults and teenagers – although youth were commonly encouraged by older people. Some said they were worried that the young would not only become unhealthy but would lose knowledge and respect for country and lose 'direction'. Many very old people (over 60) did not go hunting because they

¹² Participants often referred to hunting, fishing and gathering as 'hunting'. In this report, we refer to these three activities as harvesting (sometimes interchanged with 'hunting' depending on the context).

¹³ *Saccostrea mytiloides* and *Saccostrea mordax*

¹⁴ *Polymesoda erosa*

¹⁵ *Tridacna aquamosa*

were physically unable. Many of these very old people received 'meals on wheels', (i.e. meals delivered to their houses), which many people referred to as 'balanda'¹⁶ foods. Some conflicting information was given about sharing food, and bringing harvested foods home for elderly and other people, but this project did not allow for deeper exploration of modern day behaviors and associated beliefs. Importance was placed on such goods, but when prompted some people admitted that sharing did not always happen. People commonly cooked food collected on fires when out 'on country'. Sometimes special types of foods were harvested to provide for ceremonial purposes, and in some cases certain people (e.g. males who are being initiated; *limbidj*) are not allowed to eat particular types of food during ceremony. Only when prompted did some participants mention their totem animals and their roles in management associated with these totems.

4.2.2. Hunting patterns

When discussing harvesting patterns, it was difficult to obtain a precise sense of the time that people spent harvesting. This could have related to the lesser priority placed on this research question in this project, and could have also been because harvesting patterns varied a lot between people and seasons. It also seemed possible that because harvesting was such a highly valued activity that contributed strongly to sense of identity, some people may have given an exaggerated impression of the time spent harvesting. Many participants expressed a desire to go harvesting more often. When prompted, some women and men talked about how it would be good to have people in the community go out hunting more regularly and bring back food for others in the community. Some women talked about a 'healthy kitchen'¹⁷ to provide nutritious foods to the community – especially for those that could not hunt or did not hunt very often. There was some interest among a couple of women on the need to investigate the nutritional level of different types of bushfoods (and store-bought foods) so people in the community would have a better idea of what foods are healthier. One woman interviewed suggested that researchers might want to carry out studies with them on this topic, and was particularly keen to be involved.

4.2.3. Barriers to harvesting today

People commonly stated that the main limitation to increased harvesting frequency was lack of transport. In the past people did not need to travel far for some species and when they did travel further they would commonly walk or use canoes. Many of the middle-aged generation were concerned that their community was not as fit nowadays and were very dependent on motorised cars and boats to get to other locations. Many people suggested that lack of access to cars or motorised boats or money for petrol prevented them from going hunting. Some said that other commitments also prevented them from going out hunting, like work, volunteer work (e.g. 'Meals on Wheels'¹⁸), childcare, and health problems. Some also thought that many younger people did not hunt now because some were 'lazy'. Some women suggested that a bus should be organised to take people out regularly so they had opportunity to hunt more often. Some older participants claimed that abundance of many seafood species had decreased, and that there had been some changes in distribution and behavioural patterns of some species (see Section 4.2.4).

¹⁶ Balanda means non-Indigenous or Caucasian person (believed to have been derived from 'Hollander' – people of Dutch descent).

¹⁷ There is current discussion between Warruwi women, West Arnhem Shire and Remote Indigenous Gardens network about developing this 'healthy kitchen'.

¹⁸ 'Meals on Wheels' is a pre-cooked food delivery service for elderly people.

4.2.4. Perceptions of food and health

When discussing food, people tended to talk almost exclusively about bushfoods, and very rarely about food found at the shop. Conversations only focused on food from the shop if participants were prompted. It appeared as though there is a strong dependence on refined foods bought from the shop. Most workshop participants said they went to the shop many times in a day. From observations during the study, it seemed that the shop was an important meeting and social place that people were drawn to during the day. Community members were commonly seen there, often drinking soft drink and children eating lollies and playing with toys from the shop. When asked whether they thought the community had a healthy diet, people commonly answered 'yes'. However, when questioned further and given time to reflect, participants came to the conclusion that the diet of many people in Warruwi was not healthy, and that the high levels of illnesses such as heart disease and diabetes were related to diet. People knew about this connection, but not many of the details, and many (especially women) expressed a desire for greater community education about nutrition. When delving further into the subject of illness, one person said, '*yes lots of diabetes, I suppose they eat too much sugar*'. Many stated that they knew their diet was a problem, but that generally they feel they are healthy until 'something bad happens' – so people just keep eating unhealthily.

Even though people commonly perceived harvested marine foods to be very healthy, they did not perceive shop food to be very unhealthy – only '*a little bit unhealthy*'. Some older women claimed that they and others in the community knew little about links between diet and health, and they thought there should be more education about this. When asked about the price of food in the shop, participants said they were 'okay' with the price – although from researcher observations the food was much more expensive than in Darwin and other cities (e.g. \$99 for a 2kg tin of instant Nescafe coffee during August 2012, compared to about \$25 in Sydney). Another observation was that 'fresh' vegetables and fruit were expensive in the shop compared to regional centres and towns like Darwin, and not at all fresh.

4.2.5. Marine hunting/consumption practices today and in the past

Older people reminisced fondly of 'mission times' when there were fresh oysters and fish available, as well as fresh eggs, milk from a dairy, and bread from a bakery. They also said that some of the women cooked fresh foods for people to come and eat at the mission. Many older participants suggested it would be good to have fresh foods like that growing and available again. Some people talked proudly of the farm from mission times and were also very optimistic and hopeful about potential aquaculture enterprises in relation to these times. There was a strong interest by these participants in recreating productive mission times when people were also more physically active. A lot of the older generation talked about how they would like more foods to be grown and available on the island in general– for greater self-sufficiency. When prompted, some women and men talked about how it would be good to have a 'healthy kitchen' to provide healthier foods to the community. There is currently a 'Meals on Wheels' service (for older women) which currently provides 'balanda food'. Some suggested this could be modified to include more traditional (and healthier) foods that people from the community collect on hunting trips.

People did not think that hunting practices had changed a lot since mission times. However, when prompted (by using historical photographs as an elicitation tool) participants often talked of changes over roughly the past 60-80 years. Older people were able to talk more about these details, while younger people showed less knowledge about these differences, apart from information gathered from older people's stories and from photographs they had seen in the Art Centre (taken by Axel

Poignant, Swedish photographer who visited Waruwi in the 1950s). Older people talked about how, at the time these photographs were taken (during mission times) and prior to that, canoes were commonly used, and locals also travelled long distances on foot. In those days men and women hunters took very little with them and ate mostly the food they killed or collected when they were out *'on country'*. Today people seldom walk far and usually try to travel by car or motorised boat. People also take a lot of 'gear' with them, and sometimes cook on fires on site, or bring food back to put in the refrigerator. The methods for collecting shellfish are commonly the same as in the past, although those for catching dugong have changed. Twine used to be made from hibiscus bark (into a three strand harpoon rope) and men would travel on canoes to find dugongs. The dugongs were speared in a particular way and dragged into a canoe and tied in a special way to be dragged onto the shore. Today, people use spears and sometimes guns, and commonly use synthetic rope from the shop, although sometimes rope is still made traditionally.

For fishing, people used to use spears, fishing line or string, or nets (*'sometimes with safety pins or bits of wire as hooks'*). Today, people can use hand reels (and sometimes rods) and nets – much of which can be bought from the shop. Many people still use spears, but participants often remarked on how people generally were more skilful with spears in the past. Night hunting in shallow waters for crabs or fish was previously common, and these fishers would burn bark from paperbark trees for a lantern (called *iradj*). While night fishing they would often use hand nets or folding nets in two ways, both as a trap and as a scoop. These had small mesh made of fibre string (with pliable sticks of equal length threaded through the edges – to create a hinge). Many older participants explained that today there are many more crocodiles and *'many people are afraid to go into the waters'*. Sometimes people fish at night now – but usually with battery operated torches. One woman commented that many people were needing to resort to night fishing *'some of the fish are getting too hot during the day now and going deeper into the water, and coming up to the surface only at night'*. Special sticks with sharp ends are made to poke into holes to catch mud crabs – a practice that people said has not changed from the past. The approach to collection of shellfish generally has not changed, except that women often travel by car now, whereas in the past they walked to harvesting locations. Many of the older generation explained that abundance of many seafood species had decreased, and that there had been changes in the distribution of some species, such as some species of fish and turtles.

When discussing traditional seasonal calendars (i.e. based on natural events), the women (even women Traditional Owners) were not very certain of recording details relating to the seasonal calendar in written form. This may reflect a lack of confidence, or unwillingness to represent traditional knowledge in written or visual form when discussing the topic in a workshop. The last seasonal calendar known to have been drawn was in the 1980s by three TO women – and is on display in the school.

4.2.6. Changes people have noticed in marine foods

Most participants had noticed changes in frequency and abundance of marine foods, but it was difficult to gauge when the more significant changes started occurring and their possible causes. Once conversations began on this topic, people mentioned many other changes, such as sea level rise and beach erosion (noticed by all participants). Examples of statements made were: *'the water is coming up and swallowing up the beach'*, *'a lot of trees getting washed away'* warmer air and sea temperatures, e.g. *'sea is hotter – some fish are going deeper into the water to stay cool there during the day, so we need to catch them when they come up at night (maybe when the water is cooler they come up to the surface more)'*; strange weather patterns, e.g. *'Sometimes*

we get early wet or late wet, funny kind of weather. Sometimes really hot and then all of a sudden cold. Seems to be a lot more wind blowing; some plants and shellfish dying unexpectedly or having different characteristics, e.g. *'some oysters and mussels don't taste the same'*, (multiple participant responses from workshops and interviews).

4.3. Climate change

A general lack of (western, scientific) knowledge and understanding about climate change was evident from discussions with participants. During initial conversations it appeared that climate change was commonly perceived as a phenomenon happening 'elsewhere' in the world. Many other misconceptions about climate change were also revealed. Various changes in the landscape (and natural patterns) were reported by participants, but very few people had made connections between those observations and their (limited) knowledge of climate change - until they became involved in these workshops and discussions. Participants expressed a strong desire to learn more about climate change, and to communicate and explain it to the rest of the community in ways that they would understand.

4.3.1 Perceptions of climate change

Most participants initially said they had not heard of climate change, but in deeper conversation they revealed that they had heard many terms through television and radio that they associated with the term climate change, for example, 'ice melting', 'polar bears', the 'arctic', 'sea rise' and changes that were affecting 'eskimos'. However, initially most thought climate change was only happening elsewhere. It became apparent that people were not confident to talk about climate change because they knew little about the topic. One very elderly participant with no access to television claimed not to have heard of climate change at all. No participants could explain what 'climate change' meant, or why it was happening. A few, particularly men, had made connections between the changes they had noticed in landscape and natural patterns (e.g. sea level rise) and the concept of climate change that they heard about in the media. Most had noticed changes, but had made no connections to climate change, or had only speculated about these connections. Many were initially surprised to hear that climate change was occurring on Waruwi, but then after talking further about the changes they had noticed, it seemed quite obvious that climate change was occurring there.

4.3.2. Types of changes people have been observing

During workshops and interviews, once conversations were initiated on possible local changes in natural patterns and phenomena, people mentioned many observations that they had made, such as sea level rise (everyone mentioned this), warmer temperatures, unusual weather patterns, bigger cyclones, plants and some shellfish dying unexpectedly, *'the water is coming up and swallowing up the beach'* *'some oysters and mussels don't taste the same'*, *'the pandanus used for dark colour dye (for baskets) isn't quite the right shade colour'*, *'seasons aren't quite right'*, beach erosion, a lot of trees getting washed away. *'Sometimes we get early wet or late wet, funny kind of weather. 'Seem to be more trees damaged'. 'Billabongs dying out quickly – dead horses and pigs'* (multiple participant responses from workshops and interviews).

The more obvious physical changes, such as beach erosion and rise in sea level and surges appeared to be the most distressing to people. A lot of the older participants explained that their concern was based on the fact that they live on an island, and they were worried the island may disappear. Some people, later in discussions on causes of climate change, mentioned that it seemed likely that climate change was being caused by people in other places, such as big cities. One woman said that it was probably the government's fault.

4.3.3. Responses to the concept of climate change

Although the topic of climate change was introduced in workshops as gently as possible so as not to create alarm, most participants expressed a degree of concern about climate change – particularly the older generation, later in discussions. Younger generations seemed less concerned. However, participants generally had greater concerns about other future issues, such as employment, housing and way of life for the younger generation. When focusing discussions in workshops around the sort of changes that may occur in the future, most participants talked about how their other social and economic problems would become exacerbated by the effects of climate change.

In discussion, people always connected the health of country (land and sea) with people's actions. When asked about stories, spirits and other traditional explanations for environmental change, participants said that they did not have explanations for many of the newer more unusual changes in the landscape. Two women from other locations said that people in other places would have cultural explanations, but on Goulbourn these were not as common. However, it seems possible that some participants would be reluctant to mention local traditional explanations in a discussion run by people from other parts of Australia.

All participants accepted very easily the idea that climate change is the result of the behaviour of humans (i.e. is anthropogenic). This connection came very naturally to everyone involved, and all ages and genders were very concerned about the information learned. However, older people appeared more concerned than younger people about future consequences. Participants were surprised that non-Indigenous people (especially scientists) would be interested in their local knowledge and current observation relating to environmental change. People said there was no discussion in the community about climate change, but people had been talking about the sea level rising. Most people remembered that a PhD student came to the Island in 2009 to talk about climate change – but they did not know what climate change was.

4.3.4. Perceived impacts

In simple 'futuring'¹⁹ exercises conducted during workshops, people initially found it difficult to imagine the future, or what may happen in future years. When a number of scenarios and visual prompts were used to encourage 'future' thinking, participants started to talk quite a lot about the way biophysical changes could impact on people and their health and feelings as a result of the predicted changes in climate (such as more extreme weather and rising seas levels).

When talking about likely future changes, participants mentioned changes to the landscape and plant and animal wildlife within it, as well as people in the community. During mapping exercises, participants showed particular concern about the effects of future sea level rise and talked about threats from worsened beach erosion, significant saltwater intrusion into creeks and billabongs with sea level rise and surges becoming worse during cyclones and storms. One woman said '*the sea may come up and swallow up the island*'. Some people talked about how it was particularly dangerous that they were living on an island, and some parts of the island could become inundated by saltwater which would affect many plant and animal species.

People also talked about how living situations would change, for example one person stated '*houses will become hotter and people would use electricity more*' [Workshop 2;

¹⁹ Imagining the future through scenarios.

¹⁰ Indigenous women's preferences for climate change adaptation and aquaculture development to build capacity in the Northern Territory

2012] . Another stated people would become ‘grumpy’, ‘have more health worry’, and ‘annoyed’ and ‘fight more’ ‘people wouldn’t move around much” from the higher temperatures. There would be ‘sadness’ [Workshop 2; 2012]. People were concerned there might not be enough fresh food or water for their good health, and there might not be enough fresh bush food collected to supplement the shop food - which may lead to more diabetes. Many participants were worried there would be more dependency on the outside world for delivery of food or other resources, and that there would be less money and jobs available on the island – under future scenarios of climate change.

4.3.5. Communication of climate change

Participants were very receptive to videos of climate change that were shown particularly those with examples of local and Indigenous people (e.g. from Australia or other countries) who were talking about their thoughts on climate change, observations they had made, and taken actions in response to those changes. Participants were especially interested in knowing what had happened to those places and people since the videos were taken. They were also particularly responsive to diagrams (e.g. the brochure on global warming), simple videos explaining global warming and also the global cycle of carbon. Talking about other types of gases in the atmosphere often became a bit too detailed for many participants.

4.3.6. Preferences for addressing climate change problems

Initially people talked about adaptation responses being the Government’s responsibility, but after learning that climate change was occurring everywhere, and that there were options for the community to be involved in decision making and action, the participants became inspired about the types of community action that could be taken. They tended to prefer options that were community driven and which allowed greater self-sufficiency and independence. There was also a strong desire for greater communication relating to climate change among the community (e.g. communicating about western and Indigenous perspectives), with other groups such as policy makers and scientists, as well as sharing knowledge and lessons with other indigenous and island peoples.

After work-shopping various aspects of climate change, many people wanted to know how it could be ‘fixed’. For example, participants asked: ‘How do you stop beach erosion?’ ‘Can you stop the water from rising?’ ‘Can you build walls on the beach?’ ‘Are there trees that you can plant that are better for the environment?’

There was a strong desire to learn more about climate change and to investigate options to both mitigate and adapt. In particular, people wanted to address obvious and confronting physical changes, such as beach erosion. People talked about the need to combine western scientific knowledge with customary knowledge. Some expressed the need for enforcing more clearly traditional ecological management, such as traditional fire management (apparently there is some miscommunication and claimed mismanagement). There seemed to be a relatively high degree of respect for both customary and scientific knowledge in seeking to design solutions.

There was also a strong interest in further use of renewable energy in the community, and in other ways to reduce energy – and in communicating these concepts within the community. There was a particularly strong desire to communicate awareness of climate change to the rest of the community, especially children – from both western and Indigenous perspectives. People discussed how they might be able to communicate with other Indigenous and local communities (in Australia and overseas) about climate change, along with the different types of changes and the way people are

dealing with these. When prompted, many people were very receptive to the idea of developing some form of network to connect with these other groups.

No-one seemed aware of the concept or existence of government 'policy' or of the need for policy development relating to adaptation, but once this topic was raised, people, particularly women, expressed a strong interest to be involved in discussions. Some participants, particularly men, expressed the need for more funding to employ people and provide resources for (coastal) land management.

4.3.7. Past adaptation strategies

People talked little, even when prompted, about past adaptations (or ways of dealing with change) by individuals or the community. There was some discussion about ancestors having dealt with change when it occurred (for instance cyclones and the closing of missions), rather than anticipating potential changes long in advance. Most participants talked about mobility as being an important adaptation strategy (i.e. travel to safer areas, or travel to more resource rich locations when needed, caring for country). Generally, participants perceived ancestors as having drawn strongly on traditional knowledge to deal with difficulties. Strong leadership and decision making among the whole community were perceived as important in deciding on ways to adapt.

4.4. Perceptions and receptivity towards aquaculture

Most participants were not very familiar with the term 'aquaculture' – but were more familiar with the term 'fisheries'. Many confused the term aquaculture with agriculture (which for some may be a pronunciation issue). There were relatively positive responses from both older and younger participants relating to 'fisheries' – as an activity and as an enterprise. But there were generally stronger, more formed and previously considered responses from the older generation. Some senior members of the community had previously discussed the need for aquaculture on the island so had already thought through some of the related issues discussed such as what type of species would be preferred and sites that would be appropriate. Many of these participants seemed very positive and optimistic about the idea of aquaculture. Two of the CDEP men involved in aquaculture trials were interviewed and gave very positive responses about their involvement. They stated that they '*were learning a lot and wanted to learn more*'. There was some confusion and contradiction in the community in recalling historical details on past fisheries activities by various government and other agencies in the region.

The older generation especially seemed very proud of their history of trading milky oysters and trepang. Some seemed to like the idea of selling a 'concept' or 'product' that was distinctive for their region and community, e.g. associated with harvesting customary foods, fresh remote food and food with a history. Many people seemed quite proud about the prospect of being involved in work and business relating to these areas.

Most people appeared to perceive aquaculture as natural harvesting of what is already there. Very few understood that it involved 'planting' younger animals in suitable areas, and then culturing or growing them. It became apparent that there was very little knowledge or understanding about lifecycles and young stages of marine species, although there was a strong interest by many participants, especially males, (during interviews) in learning more about these stages.

4.4.1. Perceptions relating to business and payment

When asked, most participants did not oppose the idea of generating money from an aquaculture enterprise. Almost all (except one woman) thought that aquaculture should be designed for community economic gain, as well as providing greater options for the community for fresh foods. Many participants (from both interviews and workshops) believed that some of the food – not sold for economic gain – should be shared or sold (at a cheap rate) among the community.

There did not seem to be any negative connotations associated with an enterprise earning money. People accepted that employed individuals would earn income, but there was emphasis on the need for an enterprise to contribute to community needs as well, such as generating employment, providing skills and knowledge, keeping the younger generation occupied, and providing greater access to freshly harvested foods in the community. This was also demonstrated while participants played an 'aquaculture board game', i.e. participants were interested in earning money. This social acceptability of earning money may arise through the more positive history of enterprises on the island (e.g. fisheries, kava growing and other income generation activities, during mission times), which may have led to greater social acceptance of money generation than in some other communities where earning money often has negative connotations associated with it (McRae-Williams & Gerritsen 2010). Through playing the board game we also learned that participants were interested in ensuring community health and employment needs were met too. Despite this interest in employment and learning skills, it became apparent that many people were not interested in conventional 'office' jobs, but wanted to be involved in jobs that involved the environment, or were aligned closely with what was perceived as more culturally related and defined roles. People did not seem to associate employment strongly with their sense of identity – a finding which is also supported by McRae-Williams and Gerritsen (2010).

4.4.2. Awareness of capacity needed to run a viable enterprise

There seemed to be little knowledge of the capacity and logistics needed by the community to be involved in a viable enterprise such as aquaculture – even among older participants who previously considered and discussed the prospect of aquaculture. This is not surprising given there has been little exposure to community-based enterprises amongst the community. All participants seemed very keen for an enterprise to be an Indigenous run business (and in some cases, especially among the older generation, this was a very important criterion for future enterprise development). But at the same time there was a very limited awareness of the level of expenses, skills, knowledge (and barriers) that might be involved. When prompted about how these skills or resources may be obtained or delivered, many expressed the view that 'fisheries' (i.e. fisheries agencies) may be able to provide this support. Not all participants appeared to be aware of the logistics and other issues involved (e.g. sourcing of seed organisms, food storage, money management, marketing). After playing the board game, the participants talked about how it would be important to learn more about the different logistical issues as well as gain skills and knowledge relating to life cycles of marine species, and other technical and scientific information.

4.4.3. Perceptions of current aquaculture trials

Some of the community, particularly older women, were familiar with current aquaculture trials involving CDEP men and were very supportive of that initiative. Among the wider community there was some confusion about the trials (for trepang, clam and oysters) being conducted by 'fisheries' (i.e. aquaculture specialists); some did not realise the units were only trials, and a few did not know that any trials were being

carried out. Hence it was surprising that participants expressed a relatively high degree of confidence and trust in the work of fisheries scientists and their ability to plan projects that could help the community.

However, even though there seemed to be a degree of trust between community and 'fisheries', the discussions revealed a lack of communication and engagement and liaison by fisheries agencies with the community on the topic of aquaculture generally and about the trials. It appeared that two key intermediaries (one in a community engagement and liaison role from West Arnhem Shire and the other in a technical aquaculture education role from CDU VET aquaculture) were playing an important part in working with the community. However, many participants expressed a desire for more engagement and communication generally between fisheries and the broader community about aquaculture. When prompted, participants expressed that preferred ways of being engaged and involved in communication processes with fisheries were hands on experiences and person-person explanations, as well as visual communication materials (such as videos and photos).

4.4.4. Aquaculture preferences

Through open questioning, most research participants showed no overly strong preference for one marine species over another, although crabs, giant clams, mussels, and oysters were all commonly suggested species. This lack of preference was probably largely related to uncertainty and lack of knowledge about the range of species suited to the area. Suggestions of species were highly influenced by previous experience of eating seafood's, but when prompted, many people thought trepang would also be a good option (despite the current generations never having eaten those species). The inclusion of trepang was probably related to knowledge of the history of trading in trepang, of which their community was very proud. Many people thought that a variety of different products would be appropriate for an enterprise. Some participants said that giant clams would be the most sensitive to changing water temperatures.

When photos of different types of aquaculture technology and infrastructure were used to elicit responses from participants, people consistently preferred simple infrastructure, low maintenance aquaculture options. Some participants talked about the importance of the aquaculture system emulating 'nature'. Because people were not aware of the different types of work involved in an aquaculture enterprise (and how this would differ between species), it was difficult to discuss this topic in any depth. Initially some women thought that females should be involved in sorting and washing tasks, and males in culturing giant clams and other shell-fish. But after a better understanding had been gained of aquaculture, both older and younger women felt they should be involved in culturing tasks as well as men, and that this would be appropriate. Many women stated however, that they would not want to get into the water. Some women said it would be good if women were trained in the same tasks as men, so that they could continue those activities when men became involved in ceremonial or other commitments.

People seemed particularly interested in the way that an aquaculture enterprise could possibly help generate jobs for younger men and women. Some of the older generation talked about how it was also important that people be trained in skills and exposed to knowledge in new areas (e.g. science-based technologies), as well as strengthening their traditional knowledge and sharing some of this with fisheries in appropriate ways.

4.4.5. Management preferences

All participants believed that the board of the newly established community governance organisation (Yagbani Aboriginal Corporation) should be responsible for decision-

making for any proposed aquaculture enterprise – as well as other community decisions. This Board has representatives from each main language group on the Island. There was a lot of faith and confidence in the community board to make decisions, manage new enterprises and handle difficulties. However, there were a lot of differences in opinion by participants over the handling of money and especially income e.g. whether profits be evenly distributed to families working on the enterprise, or be shared amongst the whole community.

4.4.6. *Some historical background*

Older people talked positively of the past 'fisheries' during mission times, and of ancestral trading with Macassan people who visited from Sulawesi (until trading was stopped by the Australian authorities in the early 1900s - Macknight 1976). However, there was considerable confusion in remembering timing of trepang harvesting, the species involved and other details. Memories were very limited, even among the oldest participants, about those activities or the types of roles that different community members and genders took on in seafood enterprises during mission days. Most participants were children during the mission period so were only exposed to historical information through their parents' conversations, or when they helped their parents as children. People generally believed that both men and women took on work types that did not strictly align with traditional cultural roles in harvesting, but that these were appropriate, as the non-indigenous people managing the aquaculture were respectful to customary rules and interactions – and provided flexibility in these needs.

5. DISCUSSION AND SUMMARY

5.1. *Understanding and observing ‘climate change’; a foreign term?*

This research indicated that western concepts of climate change were quite unfamiliar to most local residents on South Goulburn Island, prior to the discussions in this research. Many said they had not heard of the term climate change, but it became apparent during the research process that most participants had heard of the term and associated concepts through the television and internet, as well as from a social researcher who had come to the island a few years earlier to investigate climate change and disaster response. However, many participants felt they could not claim knowledge about the concept, as its meanings and causes were still very foreign to them. One participant explained that the term climate change had not yet been shared in formal ways through community.

Many participants explained that they previously thought climate change was a phenomenon happening largely elsewhere in the world. Even though many had noticed unusual changes in their landscape, they had not considered the possibility that these may be caused by climate change. According to Barber (2011) this is not an uncommon finding from other research with local and Indigenous peoples. This suggests that media communications, as well as exposure by visiting groups discussing this complex topic, can be confusing and misleading to people across different cultural and language backgrounds. It seems likely that the concepts would be especially confusing when the language and terms used relate to very distant symbologies, such as ‘polar bears’ and ‘ice caps’. From discussions with participants it also appeared that local explanations of causal agents among the community may not yet have been developed to explain these changes – especially in relation to broader, worldwide changes being associated with ‘climate change’.

Despite viewing climate change predominantly as an external phenomenon, many participants had been concerned about changes they had observed in their own landscape. This concern varied from a peripheral concern by some, especially younger generations and those who had not noticed many changes, to a deeper more emotive concern, especially by older participants. Many of these older participants seemed relatively confident in their own skills in responding to these changes, but had less faith in the younger generation who they believed had less customary knowledge and skills. Many also expressed particular concern, despite leading relatively mobile lifestyles, that their main place of residence was an island, which would be particularly vulnerable to some of the changes they had observed, such as sea level rise.

Although participants talked about much of the changes they had noted, it appeared that some could not comment on changes relating to specific places, as they did not have ownership over these places. Like other Indigenous groups in Arnhem Land, there were strict limitations on the way individuals could talk about aspects of a landscape (especially the ‘country’ of others). As Barber (2011, p. 93) explains from research in East Arnhem Land with Yolngu people, *‘speaking about places is another means of performing ownership, and therefore conversations about changes in places can be limited by the degree to which people feel it is appropriate for them to comment.’*

Those participants who had not previously made connections between observed changes in landscape and natural patterns, and climate change, did so easily after scientific concepts of climate change were explained to them. Despite western concepts of climate change being mainly foreign to them, basic concepts were picked up relatively easily by participants and integrated with local knowledge systems and

observations which did not seem overly incompatible with climate change explanations given. It must also be acknowledged that these local knowledge systems partly comprise western knowledge systems as well. As Veland et al. (2013) and Deloria (1995) warn – Indigenous and western knowledge's should not be polarised as people live in blended worlds, where different knowledge systems become intertwined.

Contrary to popular rhetoric that concepts of anthropogenic climate change are not compatible with many Indigenous and local people's spiritual beliefs, all participants appeared to easily grasp the concept that humans are impacting upon the environment and contributing to greenhouse gases and consequently greenhouse warming. This ready understanding is in stark contrast to opinion in the wider Australian population. The ready acceptance seems likely to be largely explained by people's closeness to nature, and their highly interconnected view of elements in the world around them, including the belief that human and non-human actors interact to cause environmental change. Barber (2011, pp. 94-95) explains that Yolngu people (in East Arnhem Land) are comfortable in the way *'weather can be a consequence of agency generally and human agency in particular...Nevertheless, the concept that humans can influence the weather is, in Yolngu terms, a relatively unproblematic one, perhaps far less problematic than for those who originally generated this account of the future and are still experiencing such trouble in reaching general social acceptance of it.'*

It was evident through conversations that people had a strong connection to nature and its interrelated components. Many people, particularly middle-aged and older participants, were very intuitive and knowledgeable about their landscape, including some people not originally from the area. For example, one woman talked about a subtle change in taste of oysters, and also the slight change in color seen in pandanus leaves when dying these for weaving. It seemed that to people in this region, observation of environmental change involved more than observing physical change, but also experiencing changes in feeling and sensing, through relationships with the environment, and spirits. These strong, sentient connections with elements of the environment appeared to result in many participants, especially older ones, being particularly concerned about the impacts (of climate change) on a deep emotional level. As components of the environment (including people's animal totems) and their management are an important part of people's identity, it is probable that future environmental changes (and an inability to be involved in their management) could be deeply disempowering to many people of this region. This conclusion is consistent with comments made by Veland et al. (2013, p. 321) in her social research with people in this region *'...people are not separate from changes to country, but experience themselves as a continuation of country, and are acutely sensitive to and aware of its change'*.

Indigenous people's framing of an interconnected socio-ecological world could be helpful in communicating some aspects of climate change. But as this worldview contrasts strongly with many non-Indigenous views of environment and planning, it can present difficulties in the incorporation of Indigenous perspectives and preferences into western based adaptation planning in this region – which generally emphasises dichotomies between humans and the environment. Policy makers and specialists will need to listen and be aware of the different ways of living, knowing and relating to the environment, people and change, in planning for future adaptation response. Hulme (2009, p. xxvi) explains that different outlooks on climate change are *'rooted much more deeply than (merely) in contrasting interpretations of the scientific narrative of climate change'* different outlooks also exist on *'risk, technology and wellbeing, our different ethical and ideological beliefs; our different interpretations of the past and our competing visions of the future'*. Therefore, we need to pay attention to hearing and

understanding these discordant voices (Hulme 2009, p. xxvi). As Howitt et al. (2011) explains, continuing to exclude people from decisions about their future can create new traumas and risks in Indigenous people's responses to both every day and emergency circumstances.

5.1.2. Planning and focusing on the future

Initiating discussion on planning around future climate changes requires a careful and deliberate approach, mainly because there are ethical considerations in introducing confronting information, as well as differences between western and Indigenous ways of viewing the future and planning. Scenario building was used as one technique to help people conceptualise potential future climate changes and uncertainty, and possible ways to address these. Initially it appeared that participants expected government and other agencies to provide significant support in addressing changes. This is not a surprising expectation given that Indigenous people in this region have little voice in decision making and management of their livelihoods (Petheram et al. 2010). Later, when further discussing the potential impacts of climate change on the community and possible types of adaptation (using ideas from other countries), participants became enthused about areas where the community could take action and work together in decision making.

Participants also responded well to positive ideas on ways the community's general capacity could be strengthened and future opportunities realised through adapting to the threats of climate changes. Although participants felt they needed outside support, they seemed particularly inspired by approaches that could encourage community autonomy, independence and empowerment. Many participants were interested in examples where other Indigenous people were involved in land use management and able to integrate aspects of customary knowledge in ways that were recognised in part by other elements of western society, such as through economics and politics. An example was carbon trading in the Western Arnhem Land Fire Abatement (WALFA) project (Barnsley & NAILSMA 2009). During discussions on all topics, many older participants commonly returned to explaining very fondly the way life was during mission times. Older participants suggested there needed to be a return to those productive times, when food was healthier and more abundant, there was greater exposure to other knowledge and skills, people carried out more customary practices and the community was more self-sufficient and independent. Goulburn Island may present a unique situation where mission times are looked upon in a more positive light than in other regions, such as Croker Island where mission policies were apparently more oppressive (A Perry 2012 pers. comm.).

Participants preferred to discuss climate change concepts and potential adaptations in the context of other (higher priority) community issues and aspirations. This was a similar finding to those reported from research in East Arnhem Land by Petheram et al. (2010). Some of these priorities included lack of housing and resources in education, and lack of voice in local decision making. This emphasises the importance of considering other issues being faced by community, in tandem to climate change, that integrates local aspirations and needs, and develops adaptation strategies that would lead toward escape from the 'normalcy' of already low poverty levels. Schipper (2009) and others argue that in working in poverty contexts, there is a need for strong integration of disaster risk reduction (and other adaptation approaches) with development. Adaptation responses will need to seriously take into account how Indigenous voice can be integrated into decision making – in ways that acknowledge often unrecognised threats to remote communities, such as external political and economic factors (Barber 2011; Howitt et al. 2011; Veland 2010).

As mentioned previously, connections to nature and the health of the environment are an important part of people's built identity. It appears that signs of environmental degradation, as well as an inability to be involved in customary management and decisions about 'their country' could lead to disempowerment and loss of identity, and hence in reduced wellbeing. It seems clear that decision making around land and sea management and future adaptation will need to involve Indigenous people in a meaningful manner that acknowledges different ways of viewing the world and responding to it – so they can be active agents in determining their own futures.

There is a danger that implementation of many current and proposed top-down policy reforms in remote communities may negatively affect the resilience of people in remote Indigenous communities. The maintenance of basic infrastructure in remote regions and continued support for currently effective programs in these areas are critical and would play an important role in improving capacity to adapt to future climate change uncertainty.

5.1.3. Relationships with, and perspectives of, temporal space

In the research discussions, participants of different ages talked a lot about the past (their youth and prior to their birth) and about the current time, but rarely about the future. Although participants were encouraged at length to propose and discuss ways that local residents currently (and in the past) planned for the future, few examples were forthcoming. It appeared that community members tended to be mainly reactive to sudden changes in their living or natural environment, or responsive to very slow, progressive and subtle changes in distribution of plant and animal species. Many of the older generation felt a degree of self-efficacy in their knowledge and ability to respond to subtle changes in the landscape, but were concerned about the younger generation who did not have as much knowledge or resilience.

Examples the community gave of more anticipatory responses (i.e. advanced planning) were very rare and usually related to ceremonial and other customary activities. Some philosophers and economists have developed models of rationality and exchange that recognise that people have different relationships with present and future selves (e.g. Zimbardo et al. 1997) and that these can be '*... distinct entities that exist in life space and engage in social interaction*' (Cerulo 2009, p. 537). In some other cases individuals are believed to view '*past, present and future selves as integrated parts of a single whole*' (Cerulo 2009, p. 538). Some research suggests that those who only frame their past or future selves, and do not attempt to inhabit those entities (particularly relating to emotions) '*experience past and future selves as object rather than subject*' (Cerulo 2009, p. 539; Trope & Liberman 2003). The results of this research suggest that many participants in this region had strong relationships with their past and current selves – but less of an (emotional) relationship with their 'future'²⁰ selves. Rose (2004) explains that western and Indigenous story telling use very different temporal reference points and are diagrammatically opposite. Western worldviews present the future in a linear perspective of history where characters live once, and important names and events are recorded in books. Rose (2004) explains that on the other hand Indigenous story telling tends to be directed towards the origins of creation; people come from the earth, and go back to the earth at death, as a circle of life (Christie 1992; Ingold 2006; Rose 1996; Veland 2010). Law (2004) explains that narratives of Indigenous Australia do not have spatial or temporal coherence, and that truth depends on the narrative context. This 'variable worldview' is likely to have important implications for the way climate change adaptation policy is discussed and developed between policy makers and local people, and also for the planning of other community projects such as aquaculture enterprises.

²⁰ 'Future' is used here in a western linear sense of future.

Planning may need to be discussed in ways that acknowledge these differences in cultural framing, and to include carefully designed visioning exercises that align with local Indigenous ways of viewing the future.

5.1.4. Bushfoods for wellbeing and resilience

During the research, many conversations around climate change and aquaculture focused around participants' deep connection to marine foods and the complex interactions between these resources, other elements in the landscape, and humans. It was evident that participants felt a very intuitive connection to the natural environment – and gave strong agency to many elements in the land/seascape, such as their close relationships with plants and animals. This differs markedly from the view of many non-Indigenous Australians. It was clear that maintaining connections to nature, such as through harvesting and eating bushfoods, played an essential role in people's identity and wellbeing; a finding supported by much other literature (e.g. Buchanan and May 2012; Meehan 1982; Povinelli 1994). Many women claimed that approaches that help strengthen general community resilience to shocks and pressures would be appealing as strategies towards adaptation. Some talked about the need for an adaptation strategy to promote and encourage more hunting and gathering. Examples given were the use of a minivan to take people out hunting on a regular basis, and community organisation of bushfood 'cook ups' and school hunting trips.

Re-occurring discussions with participants around the importance of bushfoods, particularly marine foods, to local people's mental, emotional and physical wellbeing, suggest that supporting participants' desire for hunting/collection and eating of bush foods could play a role generally in strengthening community resilience to future shocks. While such support may seem 'trivial' from a western viewpoint, these 'nature-connecting' activities could be an important integral component in adaptation strategies to enable greater resilience to uncertainty for future climate change and food insecurity. However, there are constraints to this among many indigenous communities.

Concepts of wellbeing are commonly derived from development economics (Alkire 2002) and social psychology (Gasper 2004) and are becoming increasingly popular in public policy and international environment and development discourse and literature. In 2005, the synthesis report of the Millennium Ecosystem Assessment (2005) was published and is one of the first attempts to integrate human wellbeing concepts with understandings of ecosystem dynamics. In more recent years other definitions have been developed, such as by Gough and McGregor (2007) and Armitage et al. (2012, p. 17) who describe a '*social conception of wellbeing...as a state of being with others and the natural environment that arises where human needs are met, where individuals and groups can act meaningfully to pursue their goals, and where they are satisfied with their way of life*'. This report follows a similar definition and also emphasises the importance of considering the way adaptation at different scales can inhibit or enhance wellbeing. As Coulthard (2012) explains, there can be tensions between adapting to change and the pursuit of wellbeing, and trade-offs can operate at different scales. Additionally, the role human agency has in negotiating adaptation strategies, and how this feeds back into resilience and wellbeing is important to consider.

5.1.5. Aquaculture as a climate change adaptation

Although not all participants were initially familiar with the term 'aquaculture', most were familiar with the concept often referred to as 'fisheries'. This view seemed to come from a combination of awareness of current 'fisheries' (i.e. aquaculture) trials, as well as past exposure to fishing projects in the region. Although all participants appeared receptive to aquaculture, older people were particularly enthusiastic and it appeared that a core group was responsible for engaging with the NT Government's Darwin

Aquaculture Centre about support for instigating community-based aquaculture. Despite this interest, there was little understanding of different types and forms of aquaculture and of the logistics that would be involved. It became apparent, especially from playing an 'aquaculture board game' that many participants thought aquaculture was similar to hunting, i.e. the collection of marine animals that were already in stock. Once the different types of aquaculture were explained, participants still seemed receptive to the notion, but preferred options that were more 'natural', minimalist and involved simple infrastructure and maintenance. There seemed to be negative connotations (e.g. waste and expense) associated with too much infrastructure and development. Participants were unaware of the type of resources, infrastructure and work that would be needed to go into an aquaculture enterprise and also the fact that it may not be successful.

Many participants expressed interest in being involved in aquaculture and explained they liked the idea of working with the environment and being able to draw on customary knowledge. People explained also that they were interested in aquaculture as it could provide greater livelihood options for the community (especially the younger generation), generate more skills, allow people to work on country and provide extra income as well as fresh bushfood for the community. Most participants preferred a model where aquaculture products are both sold externally and (some) made available to the community. This could help provide fresher, healthy food options for the community, and thus help contribute towards improved wellbeing.

Participants' views support the notion that promoting environmental services schemes and community support groups could offer potential for enhancing general adaptive capacity through improving financial security, and building skills and esteem. This would also align well with preferences for staying on country, and maintaining traditional values, self-sufficiency and sustainability.

Discussions revealed that there were relatively trustful relationships between community and fisheries scientists, and this appeared to have been partly developed and strengthened through key individual mediators. Consideration needs to be taken into the consequences of what may happen if these key individuals leave this social system. There was also evidence of some lack of communication between scientists and community. If aquaculture is to be developed on a larger scale, then clearer and more transparent communication channels and methods will be needed between those working directly in aquaculture and the broader community.

The type of aquaculture suggested by participants in this study offers potential as a means of adaptation to climate change on Goulburn Island, as it could help increase the availability of food supply within the broader community as well as provide an extra and alternative source of income (to the current limited options). However, the viability and sustainability of aquaculture under future climate change is uncertain. Options that included simple infrastructure and low maintenance (as preferred by participants) would be less affected by climatic events and hence would be more resilient. However, poor diversification of markets and the remote location of the community (and therefore high associated travel and equipment and supporting costs, even if supported by a commercial body) may all contribute to an uncertain future.

As mentioned, there appeared to be a lack of many necessary skills, resources and knowledge that would be needed for implementing aquaculture. When it became apparent that new skills would be needed, many participants emphasised the importance for people to develop these skills. When asked about leadership and decision-making relating to the enterprise, people usually stated that the Board should

be responsible for this, as well as other general community decisions relating to other issues. There appeared to be a lot of faith and dependence on the Board for this role. This is encouraging, but is also a little worrying that the weight of so much responsibility will be placed on one Board. Even though people wanted aquaculture to be an Indigenous development, owned and run by locals, it seemed that many participants were hoping there would be external support (e.g. in provision of skills and resources) as well. It is likely that several different management models would need to be presented to the community to enable them to decide on the logistics surrounding the type of enterprise and the way it will be operated. The selected approach would ideally be tested on a small scale and developed in an adaptive manner over time, with strong advisory support mechanisms – and using thorough assessments of sustainability within a flexible approach, such as an adaptive management framework.

Adaptive management in contemporary natural resource management has been suggested by many as an approach to encourage iterative learning and emphasises carrying out experimentation and testing, critically processing results, and re-assessing policy contexts (Stankey, et al. 2005). It has been recommended as a process that can help communities increase their ability to respond to climate change threats, or in anticipation of projected changes. This approach often has aims of trying to address goals of improving ecological stability as well as increasing flexibility of organisations and institutions involved in resource decision-making and management (Tompkins & Adger 2004).

If enterprises could be conducted in a way that draws on and maintains customary practices and knowledge, where people interact with kin and connect with country in meaningful ways, aquaculture may have valuable potential in providing a form of environmental service. Thus aquaculture could help enhance general capacity in infrastructure development and financial management, and build skills and esteem and community pride and wellbeing – while improving adaptation to climate change. This would need to be done in a way that involves local people in meaningful decision making and with clear communication pathways between stakeholders that take into account different ways of viewing and interacting with the world and other people.

6. GAPS AND FUTURE RESEARCH DIRECTIONS

This research project has identified gaps and future research opportunities related to Indigenous climate change adaptation and community based aquaculture development.

6.1. Improved communication and Indigenous involvement in decision-making

The results of this research highlight the importance of improved communication and Indigenous decision-making for both general adaptation to climate change, and the establishment and maintenance of future enterprises. For improved communication and involvement of Indigenous people in decision making, there needs to be a greater recognition of 'other' worldviews and different ways of framing the environment and people – as well as concepts such as employment, income generation, change and future. Greater efforts to understand and share these differences will be valuable in planning adaptation and any future enterprises in this region. Attention will also need to be paid to understanding better ways for knowledge transfer about what adaptation and aquaculture entails. Technical aspects, capacity needed and the business end will need to be considered, as well as scientific knowledge sharing (e.g. animal life cycles and other areas of keen interest). There will also need to be investigation into the best ways to communicate and engage with the community on climate change, adaptation and aquaculture. It will also be important to understand in what ways other groups (and platforms) in the community, in addition to the men employed under the CDEP could be engaged on these topics.

6.2. Support for adaptation and aquaculture enterprise development

Research is needed on working with Indigenous participants to better understand their general aspirations for the future and the ways these might be aligned with future adaptation, and potential aquaculture enterprise development. The Board (representing each language group on the island) has expressed interest in acting as an interface to further explore these community aspirations (W Tupper 2013 pers. comm.). In this process it will be helpful to focus on the strengths and existing capacities of the community and ways these can be built on to improve resilience to future shocks and changes in the community. Further research is needed to understand how Indigenous people want to operate a business and how benefits are to be distributed, incorporating culturally acceptable resource sharing structures and western enterprise concepts of community development. An adaptive management approach that involves local people, researchers and scientists in testing ideas and developing workable solutions would help provide a more inclusive and flexible approach. This would incorporate collaborative scientific input to help develop ideas for testing in the field, and in helping to reduce risk in establishing aquaculture enterprises.

6.3. Measuring ecological change

Collection of data to measure changes observed by participants would be helpful in understanding future local trends in climate change and its affects on marine resources and habitats. Some participants suggested they could be involved in such collection of data, so as to be meaningfully involved in this monitoring process. Recording of the data could be through data loggers or using a mobile phone application specifically designed for this purpose (as an easy to access option, with capabilities for photos, text and audio). Future monitoring of patterns of natural resource use collection and

consumption relative to availability of stocks is also a current gap in research in the region.

6.4. Connecting local participants with other Indigenous and Islander communities

The participants in this study were very interested in developing greater connections with other Indigenous groups and Islander communities to understand impacts other communities are facing and approaches they are taking to deal with these changes. During a workshop some participants suggested a group (or 'network') could be developed to discuss this information and these ideas. Opportunities for developing such connections with other communities should be sought and developed, to take advantage of the enhanced esteem and sense of connection these could provide the community.

6.5. Further scientific testing and scoping of aquaculture techniques for the region

Current aquaculture trials should continue, and be designed to more extensively involve (and train) local participants in exploring different options for aquaculture in the region. This would help to make the techniques and results of trials better known to local people. Harvesting enhancement methods should also be explored. Traditional harvesting practices could be continued with an increase in biomass to be harvested. There needs to be investigation into what species could be grown in walking distance from community and the easiest way to produce in the hatchery. Research should also be generated to understand how local Indigenous people would prefer to integrate traditional knowledge and western knowledge regarding development of seafood enterprises.

6.6. Economic and institutional feasibility and risks of aquaculture

The economic feasibility of different aquaculture options should be further explored. This will require analysis of practicality and costs and benefits of all field trials, under guidance from cooperative scientists and social economists. Additionally, limitations to local, regional and Territory governance for effective community based aquaculture enterprises needs to be explored. Importantly, it needs to be understood whether the local board is up to the expectations of the community, and how support models can be developed for long term independence, community empowerment and autonomy.

6.7. Development of theory relating to adaptation, planning, resilience and wellbeing

This project highlighted some interesting relationships between adaptation, planning, resilience and wellbeing. In particular, the way participants relate to time and the way this impacts on discussing resilience and wellbeing with participants – and ways of planning for the future needs further exploration. Also important to investigate further are the ways that trade-offs between adaptations at different scales arise and how these impact on both resilience and wellbeing in different ways. Application of a modified social wellbeing framework could elucidate new research around material, subjective and relational dimensions of wellbeing for Indigenous groups involved in aquaculture for households, the community or economic purposes.

7. KEY LEARNINGS FOR NORTHERN TERRITORY GOVERNMENT POLICY ON AQUACULTURE

The research project has identified a number of important learning's for the Northern Territory Indigenous Fisheries and Aquaculture development programs under the face of future climate uncertainty. Through these learning's, a number of needs have been highlighted and these will help refine the Fisheries Enterprise Development policy referred to in Section 2.3 and in current activities underway at Goulburn Island and other locations where NT Fisheries are working. In particular these will help formulate the programs to: improve communication and relationship building; value and use traditional knowledge as well as western science in the planning and development processes; and improve how government can best facilitate futures visioning and planning. The needs identified are:

- Incorporation of Indigenous knowledge into enterprise, training and monitoring work
- Development of a communication strategy for information transfer between Fisheries and the community on:
 - Aquaculture
 - The trials
 - What Fisheries is doing and why
 - The employment that will be available
 - What running a seafood business entails
 - Life cycles of farmed species, particularly the early stages
 - Capacity and skill development plans for community involvement
- Engagement of broader community in seafood enterprise work, particularly the younger generations
- Identification of types of enterprise management models – division of business responsibilities between the Corporation and the community, and transfer to community as capacity develops
- Development of local corporation's capacity to plan and manage businesses
- Development of local corporation's capacity to deal with difficulties and failures as they arise (decision-making)
- Development of benefit flow models identified by the community (share of benefits (money, seafood) to clans, the wider community and/or for export)
- Identification of pathways for facilitation of local seafood harvesting and availability, (e.g. healthy kitchen – with clear objectives and implementation plan to be developed by women)
- Investigation to gain deeper and broader understandings of community aspirations – facilitated by visioning with the corporation and researchers to develop a Fisheries Development Plan
- Improvement of alignment of external agencies' facilitation activities with the corporation, better direction of Fisheries activities by the local corporation.

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Appendix 1: Australian Bureau of Statistics data

2006 data

2006			
	Male	Female	Total
Income (weekly)			
Individual Total Gross income			
Negative/Nil income	9	7	
\$1-\$149	5	3	
\$150-\$249	83	72	
\$250-\$399	6	41	
\$400-\$599	5	0	
\$600-\$799	3	3	
\$800-\$999	0	0	
\$1,000 or more	3	3	
Not Stated	7	0	
Household Median Gross income (weekly)		\$724.50	
Household Total Gross income			
Negative/Nil income			0
\$1-\$149			3
\$150-\$249			0
\$250-\$349			4
\$350-\$499			11
\$500-\$649			12
\$650-\$799			13
\$800-\$999			10
\$1,000-\$1,199			6
\$1,200-\$1,399			4
\$1,400-\$1,999			0
\$2,000-\$2,499			3
\$2,500-\$2,999			0
\$3,000 or more			0
Partial income stated			5
Not Stated			0

	Male	Female	Total
Language spoken at home			
Speaks English only	16	15	31
Australian Indigenous Languages	159	166	325
French	4	0	4
Not Stated	5	18	23
Highest level of school completed			
Year 12 or equivalent	18	11	29
Year 11 or equivalent	12	9	21
Year 10 or equivalent	24	23	47
Year 9 or equivalent	21	35	56
Year 8 or below	38	47	85
Did not go to school	0	0	0
Not Stated	7	0	7
Proportion of Indigenous residents			
Aboriginal	164	176	340
Torres Strait Islander	11	5	16
Both Aboriginal and Torres Strait Islander	0	5	5
Non-Indigenous	12	9	21
Individuals			
Median age	22	21	21
Households			
Average household size			5.1
Type of Internet Connection			
Broadband			0
Dial-up			6
Other			0
None			63
Not Stated			0
Labour Force Characteristics (all people)			
Employed:			
Full-time	16	9	25
Part-time	26	27	53
Away from work	3	0	3
Not Stated	3	0	3
Total	48	36	84
Unemployed			
Looking for full-time	3	0	3
Looking for part-time	3	3	6
Not in the labour force	59	81	140
Total labour force	54	39	93
Not Stated	3	6	9

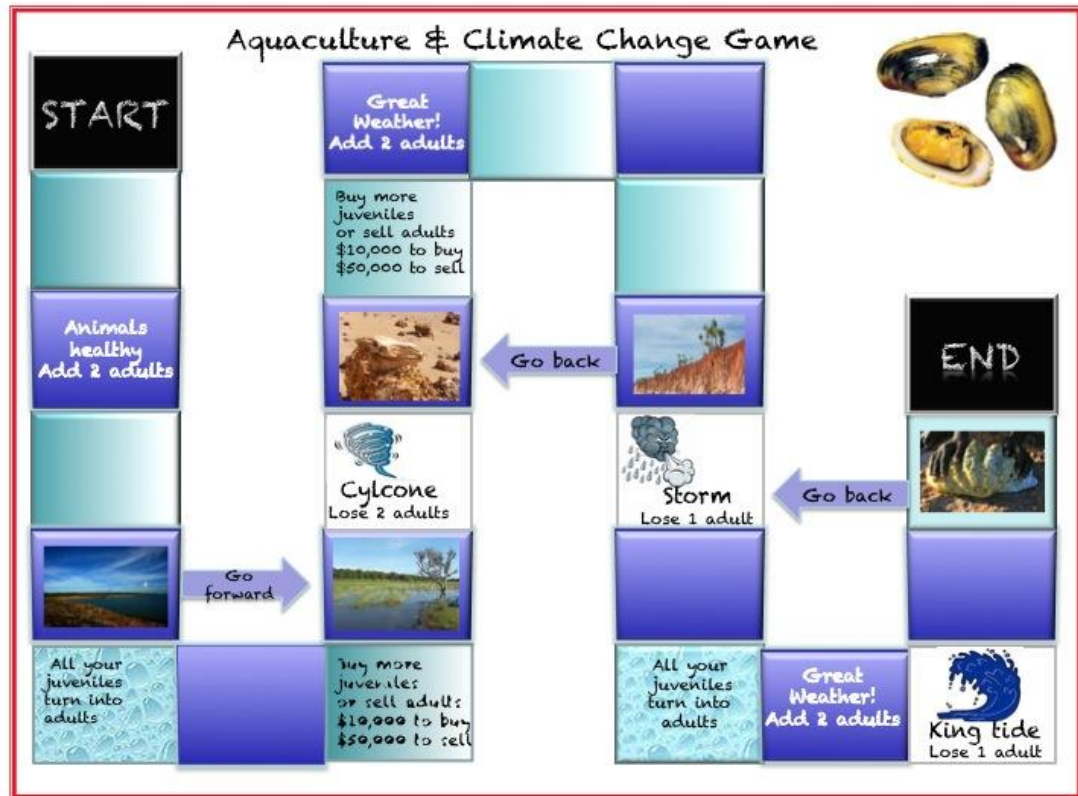
2011 data

2011			
	Male	Female	Total
Income (weekly)			
Individual Total Gross income			
Negative/Nil income	9	9	
\$1-\$199	6	4	
\$200-\$299	58	29	
\$300-\$399	19	36	
\$400-\$599	10	25	
\$600-\$799	8	4	
\$800-\$999	8	5	
\$1,000 or more	0	4	
Not Stated	3	3	
Household Median Gross income (weekly)		\$1,671	
Household Total Gross income			
Negative/Nil income			0
\$1-\$149			0
\$150-\$249			0
\$250-\$349			0
\$350-\$499			0
\$500-\$599			0
\$600-\$799			5
\$800-\$999			8
\$1,000-\$1,249			8
\$1,250-\$1,499			3
\$1,500-\$1,999			18
\$2,000-\$2,499			14
\$2,500-\$2,999			3
\$3,000 or more			3
Partial income stated			6
Not Stated			0

	Male	Female	Total
Language spoken at home			
Speaks English only	14	12	26
Australian Indigenous Languages	203	188	391
French	0	0	0
Highest level of school completed			
Year 12 or equivalent	29	23	52
Year 11 or equivalent	14	21	35
Year 10 or equivalent	25	25	50
Year 9 or equivalent	12	7	19
Year 8 or below	31	43	74
Did not go to school	0	0	0
Not Stated	6	5	11
Proportion of Indigenous residents			
Aboriginal	202	189	391
Torres Strait Islander	4	0	4
Both Aboriginal and Torres Strait Islander	4	0	4
Non-Indigenous	10	12	22
Individuals			
Median age	17	25 to 29	21
Households			
Average household size			5.6
Type of Internet Connection			
Broadband			14
Dial-up			0
Other			12
None			41
Not Stated			67
Labour Force Characteristics (indigenous people)			
Employed:			
Full-time	24	17	41
Part-time	34	21	55
Away from work	4	3	7
Not Stated	-	-	-
Total	62	41	103
Unemployed			
Looking for full time	-	-	-
Looking for part time	-	-	-
Not in the labour force	-	-	-
Total labour force	25	20	45
Not Stated	32	54	86

Appendix 2: Aquaculture and climate change game

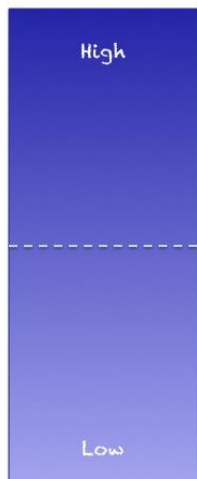
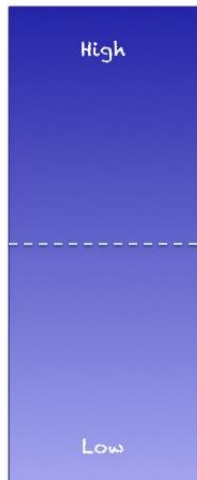
Board game



Participant aquaculture enterprise question sheet

1. What?	9. How look after the animals?	15. Should community get any of the animals to eat, who what and how much?
2. Where grow them?	10. Who is in charge of growing and caring for animals?	16. Who sell the animals to?
3. Where get young from?	11. How long wait until collect the animals to sell?	17. Who gets the money?
4. How choose young?	12. How sort and process to sell?	18. How should the money be divided up?
5. When place young?	13. Who and how many people sort and process?	19. Who manages the money and trade
6. Who and how many in community involved in planting young?	14. Where should collected animals be stored?	20. What organisations should be involved, and how?
7. Who makes decisions about sourcing and planting young?		
8. Should people be trained? How, where and what in?		

***Indicator sheet: to demonstrate consequence (of decision-making)
on environment and community***



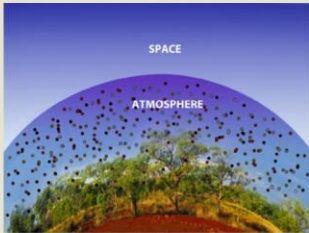
Scenario card questions

<p>Your aquaculture business is making a lot of money. You make \$1000. What do you want to do with the money?</p> <p>A. Make aquaculture business bigger (Pay \$10,000, get two extra animal tokens)</p> <p>B Pay for environmental work (Pay \$10,000 get two extra animal tokens)</p> <p>C. Put the money towards the community (for education, health, arts)(Pay \$10,000)</p>	<p>A disease comes and infects your animals. What do you do?</p> <p>A. Pay scientists to work with community to address disease (Pay \$20,000. Roll dice to see result. Even number means stocks are healthy, odd means 2 animal tokens die)</p> <p>B. Do nothing (Lose 3 animal tokens)</p> <p>C. Other</p>
<p>Your juvenile stock are turning into very healthy and strong adults. Add three adult tokens. Do you want to:</p> <p>A. Keep some or all of these growing in the ocean (Add 1-3 adult tokens)</p> <p>B. Collect some or all of them to sell (Take 1-3 adult tokens away)</p> <p>C. Collect some or all of them for community to eat (Take 1-3 adult tokens away)</p>	<p>Some of the workers aren't working properly? What should happen?</p> <p>A. Do nothing (Lose 2 animal tokens)</p> <p>B. Do something (What?)</p>
<p>Your aquaculture business is doing well. A small group from your community have the opportunity to do an aquaculture exchange for 1 week to another country to learn aquaculture lessons. What do you do?</p> <p>A. Go to the other country (Pay \$20,000, Increase adult tokens by 4)</p> <p>B. Don't go (No change)</p>	<p>A heat wave is predicted to come, and will threaten your animal stocks. What do you do?</p> <p>A. Buy more seed stock after the heat wave (Pay \$20,000)</p> <p>B. Do nothing (Lose 3 animal tokens)</p>
<p>You are growing a lot of animals now and they are very healthy. (Add two animal tokens) What do you want to do with the extra animals?</p> <p>A. Sell the extra animals to make more money (Lose 1-2 adult token make \$50,000 each token)</p> <p>B. Give the animals to the community to eat (Lose 1-2 adult tokens)</p> <p>C. Keep the animals (Add 1 adult token)</p>	<p>There is men's business ceremony for one month, Less men will be available to manage the aquaculture. Who will do the work?</p> <p>A. Pay someone else to do the work (Pay \$10,000)</p> <p>B. Make sure some of the men aren't involved in ceremony so they can work</p> <p>C. Take the risk that some animals may die (Lose one adult token).</p>
<p>There is a big economic recession and people in Darwin have less money to buy your fresh seafood, what will you do?</p> <p>A. Nothing. Leave the animals. (Add one adult token. Lose \$20,000)</p> <p>B. Eat the animals (Lose \$20,000, Lose 2 adult tokens)</p>	<p>What would you do if someone from your family asked you for 70% harvest when it had been decided to sell most of it?</p> <p>A Sell anyway (make \$50,000. Lose two animal tokens)</p> <p>B. Give family 70% harvest (Lose \$10,000, lose two animal tokens)</p>

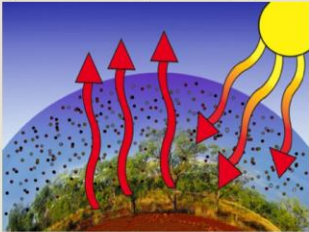
Appendix 3: Climate change educational brochure

GLOBAL WARMING

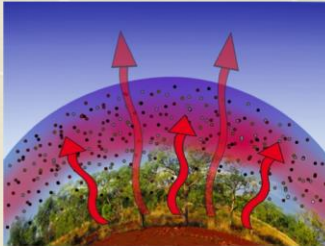
Our earth is surrounded by a *blanket* of gases that make up the 'atmosphere' (air). Some of these gases help keep the surface of the earth the right temperature and make our climate suitable for life. One of these gases is oxygen, which we need to breathe.



The sun's energy warms the earth and its atmosphere. Some of the heat is reflected by the earth and escapes back into space.






Some of the gases - called 'greenhouse gases' - absorb and trap the heat the earth reflects. The heat that is trapped cannot escape back into space and is held close to the earth, making it warmer.




Greenhouse gases are important to keep the earth warm and make our climate stable. Without the greenhouse gases our climate would be too cold for life.

The main greenhouse gases are:

-  Carbon Dioxide (CO₂)
-  Methane (CH₄)
-  Nitrous Oxide (N₂O)

Graphics © NAILSMA, text adapted from the NAILSMA Carbon Project booklet:
<http://www.nailsma.org.au/carbon-network/information-and-videos>

So greenhouse gases occur naturally and are essential for life on earth. The problem today is that things like cars, factories and power stations put more and more greenhouse gases into the air. These extra gases trap more heat like a blanket and make our climate warmer.



For a long time the amount of greenhouse gases on earth did not change much. But now climate scientists believe it is changing dangerously fast.

People around the world and Australia are also starting to notice problems relating to climate change.

These gradual changes will affect plants, animals and people in many different ways - such as high sea surges, and loss of animal and plant species.

What will happen in Northern Australia?

Some changes to climate expected in Northern Australia:

- Warmer temperatures
- Increased sea level
- More intense cyclones & storms
- Bigger storm surge zones

Researchers from this Project have had discussions with Warruwi women about climate change and the way the community can work together to deal with future risks from climate change. One of the ideas the women had was to create a small brochure explaining climate change to the Warruwi community.

In Australia and around the world Indigenous land and sea managers are using a combination of traditional and western knowledge to learn about climate change and develop new ways to prepare for future changes and reduce greenhouse gas emissions.

CLIMATE CHANGE & AQUACULTURE PROJECT

For more information, please contact:

- Lisa Petheram (Australian National University, Canberra: [redacted])
- Anne Perry (Warruwi Community: [redacted])
- Ann Fleming (Darwin Aquaculture Center, Darwin: [redacted])

For other information on the internet about climate change see:

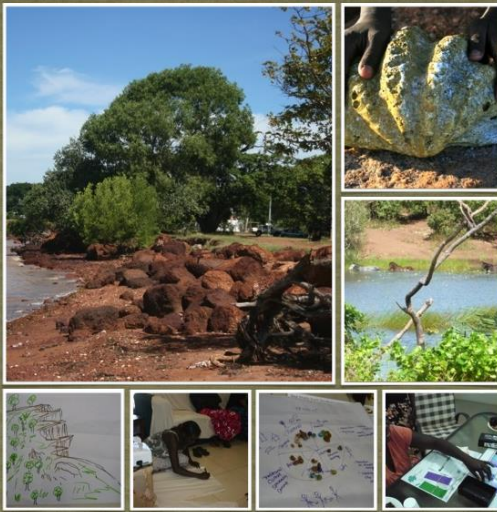
- Cleaner Climate: www.cleanerclimate.com/
- Australian Department of Climate Change: <http://www.climatechange.gov.au/>
- NT Climate Change: <http://www.climatechange.gov.au/climate-change/impacts/national-impacts/nt-impacts.aspx>
- NAILSMA: <http://www.nailsma.org.au>
- UNU Indigenous perspectives of climate change http://www.ias.unu.edu/sub_page.aspx?catID=159&ddID=901

WHAT IS CLIMATE CHANGE?



Beach erosion on South Goulburn Island

Appendix 4: Research project brochure (EXAMPLE OF FIRST TWO OF SIX PAGES)



CLIMATE CHANGE & AQUACULTURE PROJECT

Research report for the Warruwi Community, South Goulburn Island Darwin Aquaculture Center (NT Government) Australian National University (ANU), Charles Darwin University (CDU) Funded by the National Climate Change Adaptation Research Facility (NCCARF). January 2012-April 2013



Warruwi women at a workshop talking about Climate Change, April 2012

What was the research, and how and when did we do it?

In 2012 we carried out research on Warruwi, where Anne Perry and Lisa Petheram held five workshops (in May/June and August/September) with local women. Lisa also carried out 30 interviews with men and women in the community. During workshops and interviews we were trying to understand the way people in Warruwi live and depend on sea country, how climate change might affect their life, and what people think about Aquaculture on Warruwi.

What were the results?

What do people in this community think about climate change?

Many men and women on Warruwi said they did not know what climate change was. Some people had heard about western ideas of climate change on the television, internet or radio, but did not know what it was and why it was happening. A lot of people thought it was only something that was happening in other places, like in the North Pole. Some people thought it was happening on Warruwi, but said they did not know why it was happening and wanted to know more about it. Some people seemed quite worried about it. Many of the women talked about how it would be important to explain to the children what climate change is so that they would understand more about it and not be afraid or worried about it. With advice from some of the Warruwi women we have now made a brochure about climate change for the Warruwi community to learn more about it.



Women discussing Island changes from a diagram drawn during a climate change workshop

