

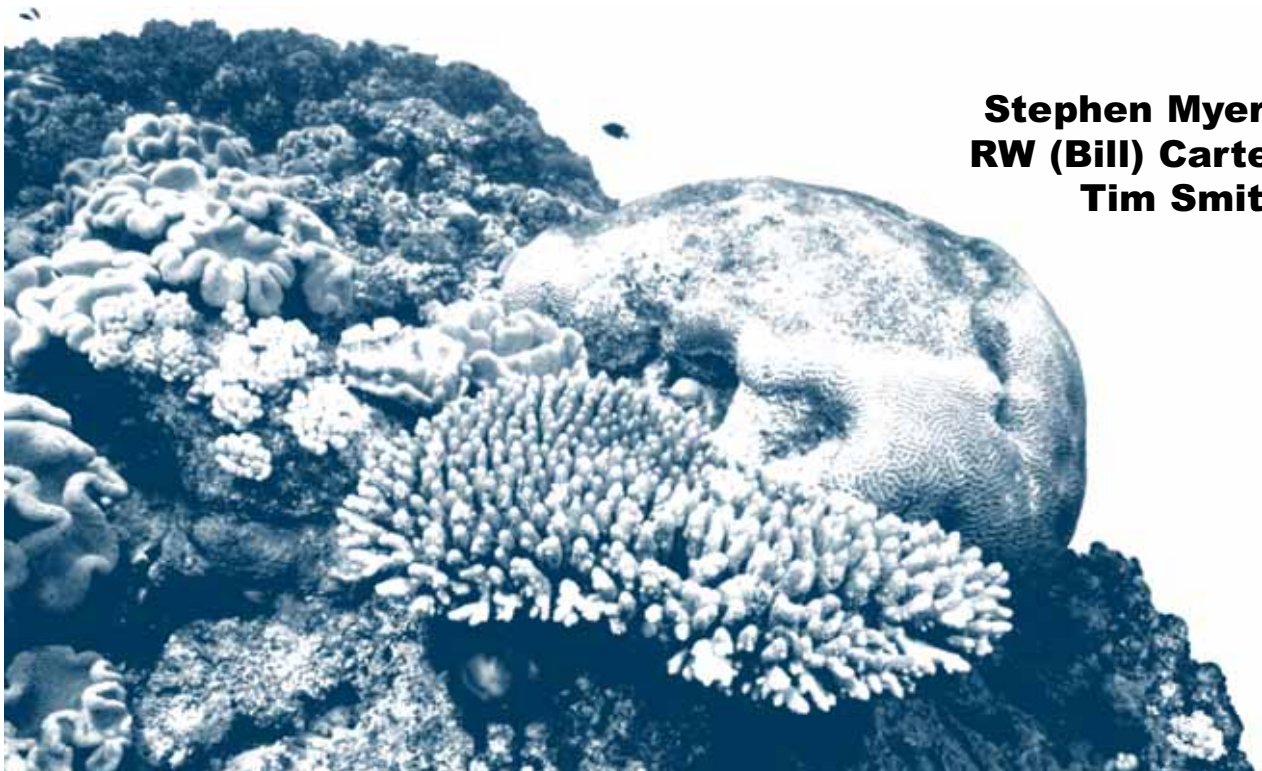


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Great Barrier Reef
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RESEARCH PUBLICATION NO. 106

Climate Change in the Capricorn Coast: an analysis of stewardship potential



Stephen Myers
RW (Bill) Carter
Tim Smith

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Executive summary

Climate change in the Keppel Bay and Capricorn Coast region: an analysis of stewardship potential was a research project undertaken by the University of the Sunshine Coast, Queensland in 2010, in collaboration with the Great Barrier Reef Marine Park Authority (GBRMPA), Townsville, Queensland. The project collected data on ways to increase community resilience to the impacts of climate change through fostering stewardship in the Capricorn Coast. Data were obtained by engaging key stakeholders through an online survey. The research aims were:

- to develop and test a conceptual framework for understanding stewardship in relation to building resilience to climate change in the Capricorn Coast region, and
- to identify barriers and opportunities to successful stewardship to build community-based resilience to the impacts of climate change on the Capricorn Coast.

A desktop review indicated that climate change poses a significant threat to the Capricorn Coast region. Climate change is expected to have a significant impact on marine ecosystems and will negatively influence their capacity to maintain support for marine environments and related economic and recreation activities. Moreover, these impacts will have major consequences for the human communities that depend on these systems for their livelihood. Specifically, the impact of these changes will be detrimental for the many stakeholders that rely on an intact reef system for their income, recreational use, or cultural values.

The survey findings indicate that although stakeholders considered themselves reasonably well-informed on climate change issues and were quite concerned about climate change generally at a community level, almost a third indicated they were uncertain about their vulnerability to climate change impacts on marine resources and on their livelihood. In some cases, there was a high degree of confusion and a lack of understanding about climate change. Moreover, a common theme addressed by the respondents was the lack of trust and leadership roles of industry and governments in promoting community engagement and fostering stewardship in the region. This was considered the result of poor information flow to the community to motivate them towards taking stewardship action. Often the respondents were pessimistic about the level of engagement required to make stewardship changes in the region. Many respondents thought that their contributions were not sufficiently significant to foster stewardship within the community and, as a result, were critical of stewardship in general.

Findings relevant for those interested in supporting or progressing climate change resilience at the community level, and fostering stewardship within Keppel Bay and Capricorn Coast (or other communities) include:

- a need to provide convincing stakeholder-specific information on the impacts of climate change;
- generic information, lacking in details and specifics, is unlikely to encourage attitudinal and behavioural change;
- a need for key organisations/individuals to provide practical and strong leadership in addressing climate change in the Capricorn Coast region;
- a need for community networks and communication channels to facilitate information flows and to foster action to address climate change impacts;
- a need for governments to acknowledge that individual, group, and/or community action is essential for the realisation of stewardship potential; and
- a need to take a coordinated and unified approach to fostering stewardship that engages all of the community, industry leaders and government agencies and promotes the building of trust and connectivity.

Glossary

Adaptive capacity: the latent ability of a system to change in response to environmental challenges.

Capricorn Coast: for the purposes of the research described in this report, the Capricorn Coast region is defined as the coast and islands between Yeppoon and the southern end of Keppel Bay.

Central government: legislature, excluding the regional arms/departments (local, state and federal levels of governance).

Community/communities: groups of citizens of the Capricorn Coast region identifiable by place (e.g. Keppel Island residents) or interests (e.g. commercial fishers).

Government: legislature and regional arms/departments

Information/knowledge transfer: exchange of information and knowledge between and within organisations or communities.

Interconnectivity: degree of linkages between parts of a system and how the parts interact and rely on each other.

Social learning: learning that takes place at a wider scale than individual or group learning, through social interactions between peers.

Stewardship: shared responsibility towards the quality of the marine environment, reflected as a value and practice by individuals, communities, corporations and government organisations.

Resilience: the capacity of communities to withstand, recover from, and respond positively to crisis or adversity

Acronyms

Reef – Great Barrier Reef

GBRMPA – Great Barrier Reef Marine Park Authority

SRC – Sustainability Research Centre, USC

USC – University of the Sunshine Coast

GHGs – Greenhouse Gases

IPCC – Intergovernmental Panel on Climate Change

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1.0 Introduction

1.1 What is climate change?

Climate change can be defined broadly as a variation in the average weather pattern over a long period, typically decades or longer. More specifically, the Intergovernmental Panel on Climate Change (IPCC) refers to climate change as *“a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity”* (IPCC 2007).

Throughout history, Earth's changing climate has contributed to natural phenomena such as the cycles of sea level rise, melting glaciers and the ending of ice ages (Great Barrier Reef Outlook Report, 2009). Similarly, climatic records have shown that large, wide-spread abrupt changes have occurred frequently throughout the geological record (Alley *et al.* 2003). For example, the largest global temperature changes evident in the geological record have typically occurred slowly, over tens-of-thousands or millions of years (Australian Academy of Science, 2010). In contrast, in the last 50 years, anthropogenic-driven influences through the combustion of fossil fuels have had a dominant detectable influence on climate change (IPCC 2007; Karl and Trenberth 2003). Accordingly, it is now indisputable that trends over the last 250 years in atmospheric CO₂, and other greenhouse gases (GHGs), including methane and nitrous oxide, indicate that there is not just a change in the magnitude of the post-industrial increase in GHGs that is unusual, but also the rate at which the emission change has occurred (Garnaut, 2008).

1.2 Causes and extent of climate change

In the past 10,000 years, Earth has undergone many periods of significant environmental change, yet has remained remarkably stable. This period of stability, known in the geological record as the Holocene, has seen human civilizations arise, develop and thrive (Rockstrom *et al.* 2009). Such stability is now under threat. This is evident by the increase in global average air and ocean temperatures, extensive melting of ice and snow, and an increase in the average global seawater level (Bernstein *et al.* 2007).

Since the Industrial Revolution, a new era has arisen, the Anthropocene, in which human impacts have become the major driver of global environmental change (Rockstrom *et al.* 2009). An increase in the dependency on fossil fuels since the Industrial Revolution has led to major increases in GHG emissions (Hillerbrand and Ghil 2008; Louis and Hess 2008). Fossil fuel combustion has resulted in considerable increases in atmospheric carbon dioxide (CO₂) concentrations from a pre-industrial level of 280 parts per million volume (ppmv) in 1850 to 385 ppmv in 2008, with annual increases exceeding 2 ppmv yr⁻¹ (Brierley and Kingsford 2009; Lal, 2008). The direct consequences of post-industrial emissions on global climate change are predicted to be extensive and concomitant with negative environmental and social impacts, including sea-level rise, ecosystem disturbances, species extinctions, human health and welfare issues, and loss of ecosystem services (Coffin *et al.* 2004).

Detailed analysis of climate models and observations suggest that anthropogenic release of GHGs are contributing to climate change (Crowley 2000). Recently, the Intergovernmental Panel on Climate Change (IPCC) reported that greenhouse gases (such as CO₂) are impacting on many physical and biological processes that are already associated with global warming (Kerr 2007). For example, receding glaciers, coral bleaching, ocean acidification, severe heat waves, and butterflies retreating up mountainsides are most likely responses to the escalating GHG emissions that are burdening the atmosphere (Kerr 2007). Moreover, GHG emissions are threatening the stability of the Earth system and have become a major driver of global environmental change (Hillerbrand and Ghil 2008; Rockstrom *et al.* 2009). According to the IPCC, anthropogenic activity has increased GHG emissions since pre-industrial times with an alarming 70% increase between 1970 and 2004, and under a “business as usual” scenario, warming by several degrees Celsius is expected by 2100 (Bernstein *et al.* 2007; Hansen *et al.* 2000). Clearly, climate change is likely to impact on many environmental systems including ecosystem resilience, sea levels, precipitation patterns,

agricultural yields, habitat and species extinction and an increase in the range of disease vectors and human health issues (Florides and Christodoulides 2008; Hillerbrand and Ghil 2008). The threats of climate change to human society and natural resource systems have become preeminent since the release of the fourth Assessment Report of the IPCC in 2007 (Cochran *et al.* 2009). Climate change is predicted to impact negatively across ecosystems, societies and economies (Figure 1).

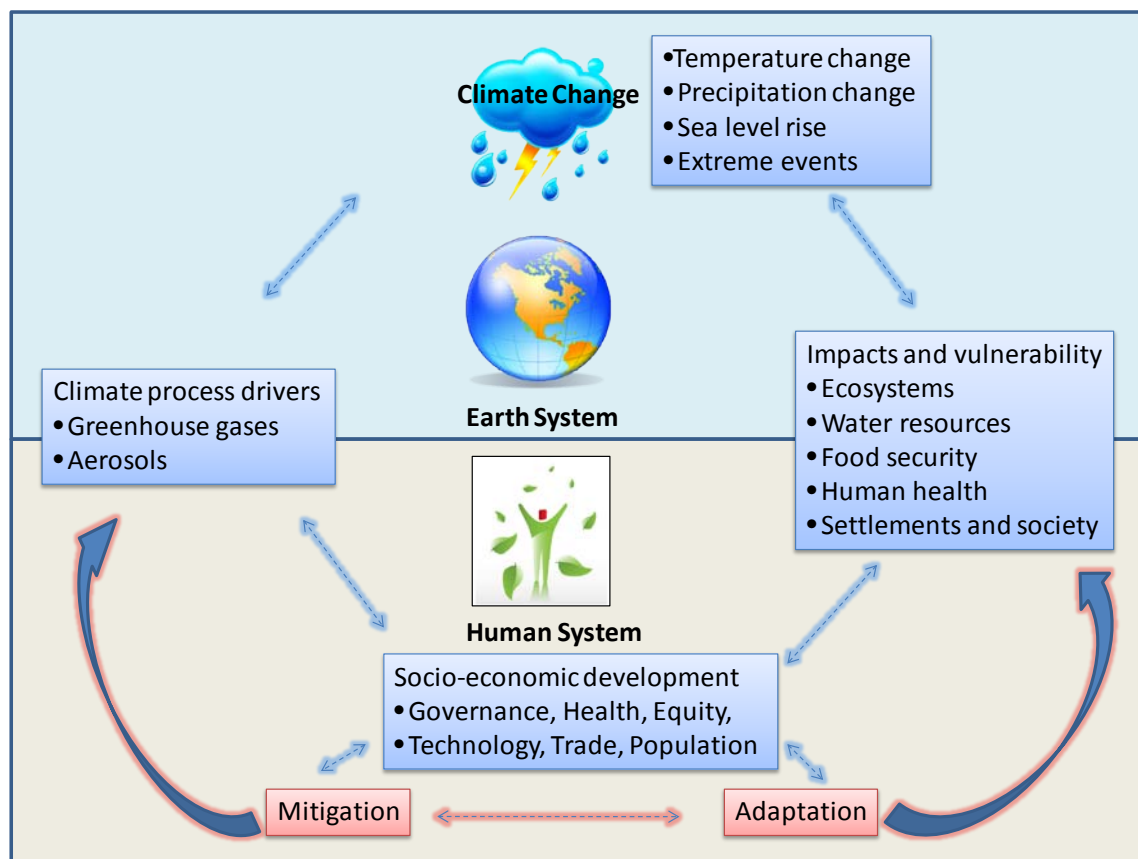


Figure 1: Schematic framework of anthropogenic drivers of climate change and subsequent, impacts and responses, and their linkages. Adapted from IPCC (2007).

1.3 Climate change: impact on marine environments

Climate change is expected to have a significant impact on marine ecosystems and will negatively influence their capacity to maintain support for marine environments, human populations and culture (Grafton 2010; Herr and Galland 2009). Marine ecosystems are among the most vital systems on Earth, providing both socio-economical and ecological services including food, shelter, nutrient cycling and gas regulation, and are major drivers of global weather systems (Hays *et al.* 2005; Herr and Galland 2009). Accordingly, it is anticipated that climate change will induce many changes to marine ecosystems including increases in seawater temperature, acidification, and changes in ocean circulation patterns and precipitation (Grafton 2010). These effects are predicted to alter habitats and shift the distribution, production, and biomass of many marine populations. Perturbations to productivity and ecosystem organization will have a significant impact on fisheries and marine ecosystems at both ecological and socio-ecological levels (Grafton 2010; Schwing *et al.* 2010). Such changes in marine ecosystems will also have consequences for the human communities that depend on these systems. Likewise, how human societies respond to these changes may have reciprocal impacts on marine ecosystems (Perry and Ommer 2010).

1.3.1 The Great Barrier Reef

The Great Barrier Reef (Reef) is the largest coral reef ecosystem in the world, spanning over 2300 km along two-thirds of the east coast of Queensland, Australia (Great Barrier Reef Outlook report, 2009; Olsson *et al.* 2008). It includes approximately 2900 individual reef systems that are separated on average by a few tens of kilometres or less (Hughes *et al.* 2007). Not surprisingly, it is internationally acknowledged as a place of great beauty and of major ecological significance as a Marine Park and a World Heritage Area (Great Barrier Reef Outlook Report, 2009).

The Great Barrier Reef Marine Park (GBRMP) is a multiple use area supporting a wide variety of uses and activities. These include commercial marine tourism, fishing ports and shipping, recreation, scientific research, and Indigenous cultural use (Great Barrier Reef Outlook Report, 2009). For example, in the marine tourism sector, activities and operations are diverse, encompassing live-aboard vessels, cruise ship operators, catamaran and kayaking tours, fishing, and diving. Tourism also contributes to a growing hospitality industry of resort-style accommodations and restaurant services. Between 2006 and 2007, the tourism industry on the Reef contributed \$A5.1 billion to the Australian economy (Great Barrier Reef Outlook Report, 2009). During this period 93.5% of 53 800 full-time positions were directly employed in the Reef tourism sector. As a consequence, the tourism industry plays an important role in providing economic structure, stability, and prosperity to the GBRMP area.

While the Reef provides immense social, economic and cultural value, and is one of the best-managed coral reef systems in the world, climate related impacts have already contributed to significant impacts on the reef system (Great Barrier Reef Outlook Report, 2009).

1.3.2 Climate change: impacts on the Great Barrier Reef

The Great Barrier Reef is projected to change substantially over the next fifty years due to the impacts of climate change. Changes in ocean chemistry, an increase in seawater temperature and sea-levels, and the frequency and severity of storm surges, will severely affect the ability of marine systems to cope, maintain, and generate vital ecosystem services (Great Barrier Reef Outlook Report, 2009). These impacts are expected to have severe repercussions for the communities and industries that depend on these resources and services provided by the marine ecosystem. Therefore, understanding how conservation managers and planners might adapt their practices and create new opportunities for effective intervention strategies to manage these systems is essential. This equally applies to industry and community members.

1.4 Stewardship

Stewardship is shared responsibility towards protecting the quality of the marine environment. Stewardship refers to not only the values held by individuals, communities, corporations and government organisations; but the actions carried out by those bodies (Chapin *et al.* 2010). Current research suggests that existing institutions and traditional 'top-down' decision-making processes are insufficient to achieve ecologically sustainable responses and may not cope efficiently and equitably with climate change outside their range of experience (Adger *et al.* 2005; Dovers 2001; Rojas Blanco 2006; Tompkins & Adger 2005). This is partly due to climate change policies being formulated at the national level, while the underlying effects of climate change are experienced at local, regional, and national levels (Tompkins & Adger 2005). Thus, 'bottom-up' approaches, including community stewardship and its role in policy-making decisions and collective action processes, have the capacity to generate amicable outcomes (Rojas Blanco 2006). The conversion of stewardship potential into collective action is governed by the adaptive capacity of both communities of place (e.g. residents) and communities of interest (e.g. tourism, fishers). A key challenge is to identify opportunities to address and change the key determinants that impede or enhance the promotion of stewardship and adaptive capacity towards a collective approach to build the resilience of communities and industries in the Reef Region to climate change.

In this context, Nelson *et al.* (2007) identifies five categories of capital that contribute to adaptive capacity: human, social, natural, physical and financial. However, adaptive capacity cannot be determined simply by assessing the availability of these capitals. It requires an understanding of the transferability and

interdependence of these capitals within unique socio-ecological contexts to reduce vulnerability. Furthermore, in assessing adaptive capacity, a range of scales within this existing framework of capitals exists. For example, Marshall *et al.* (2009) identified individual adaptive capacity (e.g. perception of risk, the ability to cope with change, the level of interest in change, financial status), and community adaptive capacity (e.g. the capacity to experiment and learn, to reorganize, community assets, flexibility, environmental institutions, markets). A challenge is to identify mechanisms that will motivate conversion of capacity and potential into stewardship action. For example, the tourism industries on the Reef have a strong awareness of the risks associated with climate change and their subsequent enthusiasm to identify and pursue strategies of mitigation and adaptation bestows a strong level of industry resilience (Marshall and Johnson 2007). Therefore, understanding the motivations and influences that drive successful group actions may inform interventions for other community groups to achieve stronger stewardship roles towards increasing community resilience to climate change impacts.

2.0 The research project

2.1 Research objectives and outputs

Commercial marine tourism operators of the Reef are concerned about the impacts climate change will have on their businesses and livelihoods, particularly in the context of the Reef losing its marketing appeal as a major tourist destination (Fenton and Beeden, 2006). However, there is limited literature and research assessing the impacts of climate change on industries, communities, and stakeholder vulnerability, resilience, and adaptive capacity in the Reef area. This is important because the capacity of an individual, group, organisation or institution to learn and modify its response to climate change is essential for the generation of sustainable outcomes. Additionally, social and institutional barriers that act to constrain public involvement (stewardship) in addressing issues related to climate change will have major consequences on how communities respond, adapt and evolve to the impacts of climate change.

Accordingly, the aims and objectives of this project were to identify ways to increase community resilience to climate change impacts in the Keppel Bay and Capricorn Coast region (Great Barrier Reef) (Figure 2) through potential stewardship mechanisms. Community interests will include the tourism and fisheries sector and other stakeholders. **The core research question is: what are the key determinants that impede interconnectivity, information/knowledge transfer, and adaptive capacity as it relates to stewardship potential in the context of climate change and its anticipated impact on the Reef?** Answering this question is of critical importance and timely, given the predicted threats climate change will have on communities and industry that depend on the Reef's natural resources for economic, social and cultural wellbeing.

The project aimed at:

- identifying the perceptions and concerns regarding the impact of climate change on the Capricorn Coast;
- identifying the potential impacts of climate change on the five capitals (human, social, physical, financial, and natural) as described by Nelson *et al.* (2007)
- identifying potential barriers to fostering stewardship action in the Keppel Bay and Capricorn Coast region to the impacts of climate change.

In addressing the research question, it was envisaged that the research would provide:

- a framework for understanding and evaluating the potential for an increase in the shared responsibility towards the quality of the marine environment, reflected as a value and practice by individuals, communities, corporations, and government organizations (marine stewardship) in Great Barrier Reef communities;
- a preliminary evaluation of the marine stewardship potential of the community associated with the Keppel Islands and Capricorn Coast region, identifying barriers and opportunities to effective stewardship of marine resources of the area; and
- exploration of the potential for community marine stewardship to contribute to priority management objectives as described in the Great Barrier Reef Outlook Report (2009).

In summary, this project develops and tests a framework for evaluating the barriers and opportunities to foster and enhance stewardship potential for application in the Reef's communities.

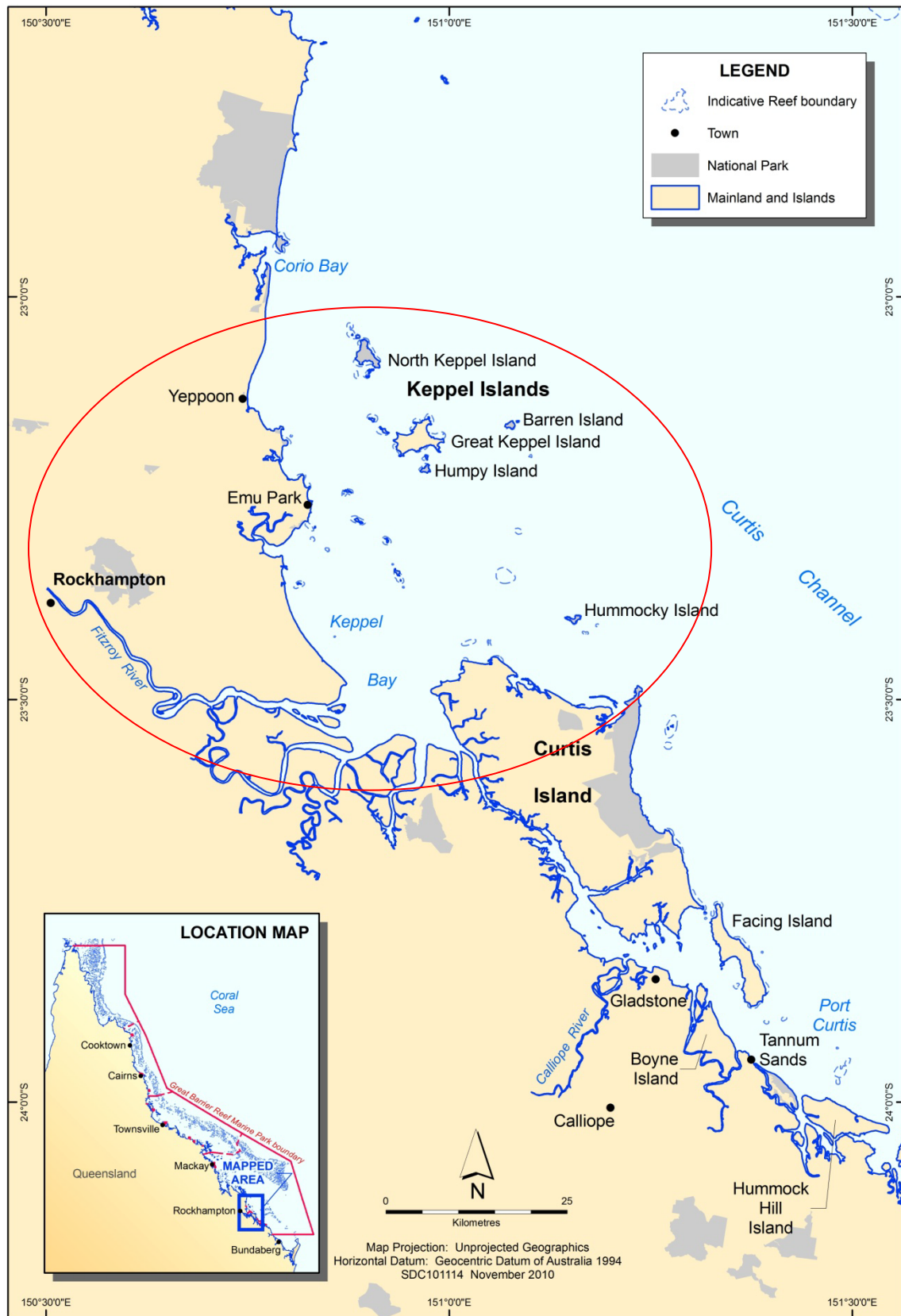


Figure 2: Capricorn Coast region showing the footprint of the project—the coast and islands between Yeppoon and the southern end of Keppel Bay. Map courtesy of the Spatial Data Centre, Great Barrier Reef Marine Park Authority 2010.

2.2 Conceptual framework of marine stewardship

Based on a definition by Kevany (2007), “the goal of stewardship is to encourage good willed people to be at the service of other people’s highest needs and the needs of the Earth”. In this context, stewardship is an action-orientated concept proposed to address and foster the socio-ecological sustainability of a changing environment (Chapin *et al.* 2010). The framework developed for this project (Figure 3) is adapted from Chapin *et al.* (2010) and is further enhanced through emphasis of transformation processes such as sustainability (e.g. Lee 1993; Milbrath 1989; Pahl-Wostl and Hare 2004; Smith and Smith 2006; Tabara and Pahl-Wostl 2007); as well as, sustainability ethics (e.g. Gladwin *et al.* 1997; Smith *et al.* 2007). The various components of the stewardship conceptual framework were tested initially through an online survey in the Keppel Bay and Capricorn Coast region of the Reef.

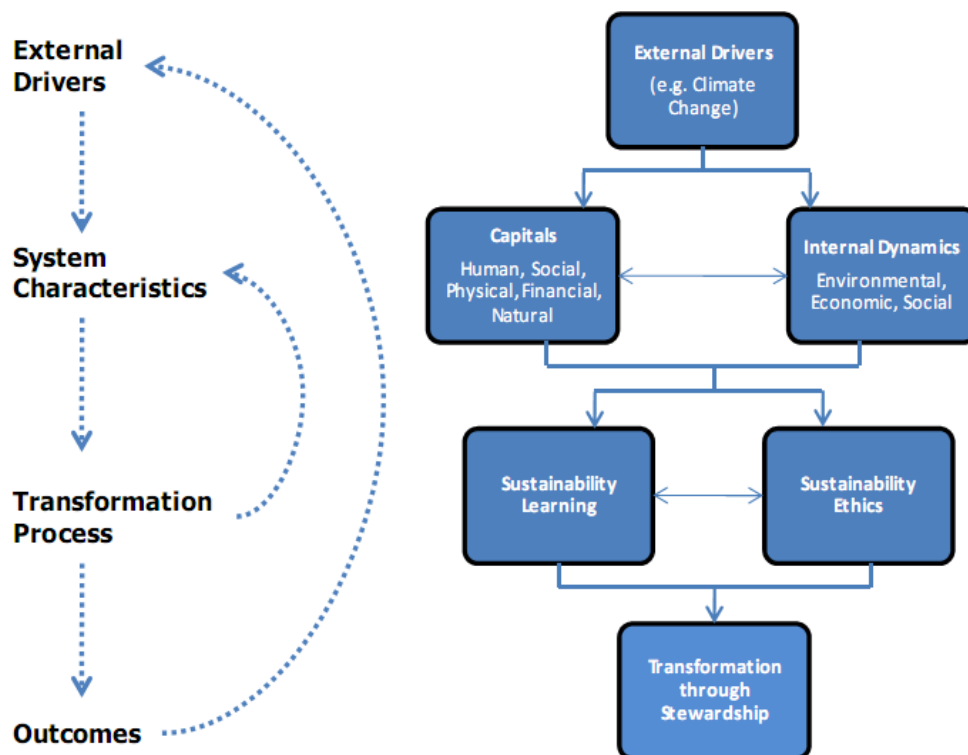


Figure 3: Idealised conceptual framework for marine stewardship (adapted from Chapin et al., 2010).

2.3 Survey instrument

The aim of the online survey was to assess attitudinal and behavioural responses from a sample of marine ecosystem (particularly reef) users in the Keppel Bay Islands and Capricorn Coast communities. The survey sampled across a range of stakeholders and aimed to include some: (i) recreational and commercial fishers; (ii) recreational and commercial divers; and (iii) tourism operators. The survey explored the various dimensions of the idealised conceptual framework for marine stewardship (Figure 3) in terms of conceptions of those components and perceived barriers to their successful implementation. The framing of the barriers is drawn from Ffllliott *et al.* (2003), Kevany (2007), Caldwell *et al.* (2008), and Chapin *et al.* (2010).

2.3.1 Surveying the Keppel Bay and Capricorn Coast

Methods

The research consisted of an online survey (Appendix A) administered to stakeholders in the Keppel Bay and Capricorn Coast region (Figure 2). The respondent pool was not intended to be a random selection of people from the community or relevant stakeholder groups. In this instance, the project aimed to pilot a survey that explored the concepts of stewardship by drawing on a group of people known to have at least some level of interest in the Reef and management processes. The 'master' pool of 67 people consisted of individuals affiliated with various organisations and groups such as BleachWatch, the Local Marine Advisory Committee (LMAC), Queensland Parks and Wildlife Service (QPWS), those involved in the Representative Areas Program (RAP), and others with whom the GBRMPA has liaised. This was not an exhaustive list of contacts, but rather those with whom there had been recent contact. Accordingly, interpretation of the responses (validity and meaning) should proceed with caution, bearing in mind that almost half of the respondents were LMAC members, the context of the non-random, limited selection pool, and potential for bias from any stakeholders with a particular interest or advantage to be gained from the issue (Varvasovszky and Brugha, 2000).

Stakeholders (a total of 67) were contacted by GBRMPA's Regional Engagement staff by telephone prior to the survey being made available to gauge their willingness to participate. Stakeholders included conservation organizations, tourism operators, commercial fishers, government agencies, recreational fishers, diving operators, natural resource management bodies, and Keppel Island residents.

Online survey for stakeholders

The online survey was designed for stakeholders of the Keppel Bay and Capricorn Coast region to capture their perceptions, thoughts and opinions on the impacts of climate change on fostering stewardship action. The survey was open from 24 June 2010 to 9 August 2010. During this time, potential respondents were prompted to complete the survey before the closing date. The Opinio software tool (<<http://objectplanet.com/opinio/>>) was used to format the survey questions and allowed only one response per IP address (Appendix A). All responses remained anonymous. Following the telephone calls made by GBRMPA to potential respondents, stakeholders were invited to participate via emails from the Sustainability Research Centre, the University of the Sunshine Coast.

A desktop qualitative assessment of the comments was examined by identifying emerging themes and responses across a range of respondent's opinions and views. This involved identifying similar comment threads across a range of specific questions types, or collectively across several questions of similar nature.

2.3.2 Research limitations

The research was scoping in nature. A total of 53 respondents participated in this project, of which 33 (62%) fully completed the online survey. Gaining greater online participation in the survey proved difficult even after a third reminder was sent out to potential respondents. Other limitations and cautions in the interpretation of the data include:

- attitudes of the respondents may not reflect the opinions of the whole stakeholder group in question;
- respondents may have been influenced to answer questions according to what they think the researchers were expecting to hear; and
- stakeholders who were either particularly pro- or- anti climate change may bias the results in the context of the role stewardship plays in building community resilience to the impacts of climate change.

Because of the small sample size, only summative statistics are reported. The data are presented in two main ways:

- responses to the survey questions are presented as histograms or in table format showing the number of individual responses and the frequency of responses as a percentage;

- examples of open-ended responses are included to exemplify the thinking involved when responding to the closed-ended questions.

In the presentation of results, those that did not provide answers are omitted to maintain content consistency and conciseness of the histograms and tables. That is, percentages are based on the number of participants that completed the question, not the total surveyed.

To give an indication of the context for responses we have included examples of comments made by some respondents to the question. This information is 'opinion only' as the study did not sample the range of communities present in the Capricorn Coast.

3.0 Results-survey of stakeholders

3.1 Participant profile

3.1.1 Demographics

This section of the results draws on data collected under survey questions 23-27 (Appendix A). A total of 53 respondents accessed the online survey. Of these, 33 fully completed and four partially completed the survey. The remaining 16 opened the survey but did not provide answers to any questions. Responses were from a cross-section of stakeholder groups (Figure 4).

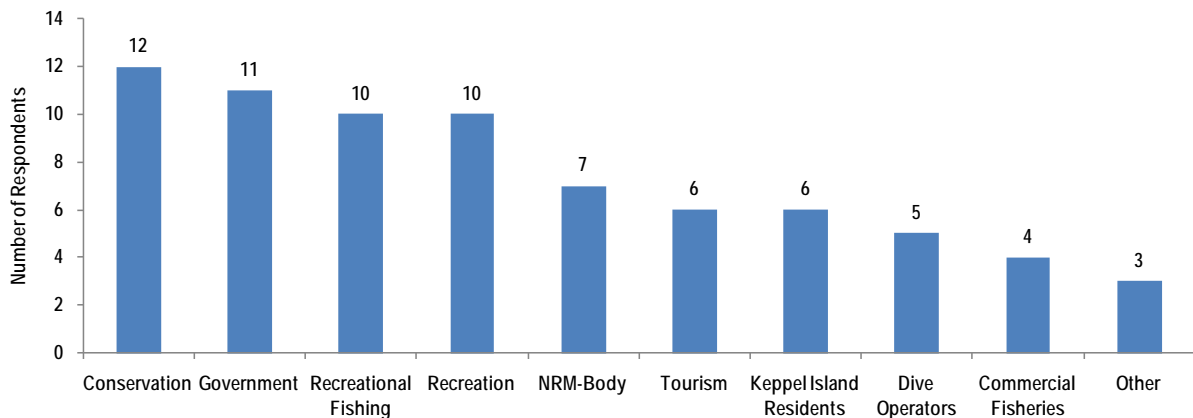


Figure 4: Survey participants based on sector/organization type (N=33)

Of those that answered, 26 were associated with a specific stakeholder group for more than 9 years (Figure 5), while 31 of the respondents were associated with the Capricorn Coast for 9 years or more (Figure 6). That is, respondents generally had a long-term relationship with the region.

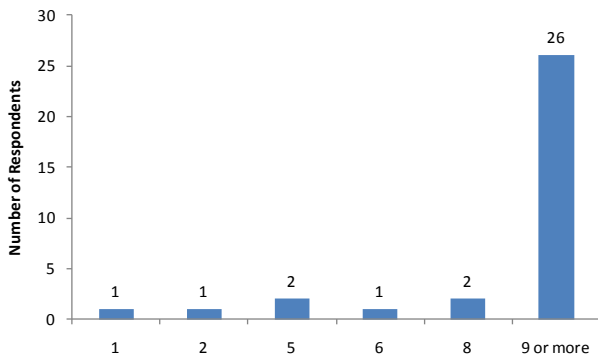


Figure 5: Number of years associated with a specific stakeholder sector (N=33)

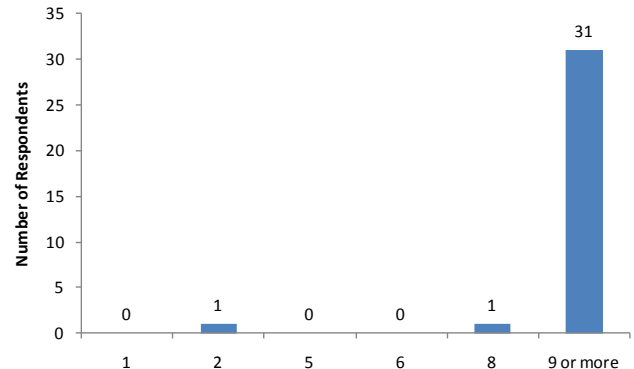


Figure 6: Number of years associated with the Capricorn Coast (N=33)

Many of the respondents also belong to particular organisations or groups within the community relevant to marine environmental management. A large proportion of respondents (14) indicated they were members of the GBRMPA Capricorn Coast Local Marine Advisory Committee (LMAC, http://www.gbrmpa.gov.au/corp_site/management/who_participates/lmac) (Figure 7). Other organisations or groups selected included BleachWatch (6), Regional Council (4), Government agencies (9), and NGOs (8) (Figure 7). Thirteen respondents selected 'other' and indicated membership of organisations and groups such as universities, the Great Keppel Island Environmental Group, Fitzroy River and Coastal Catchments Inc, Traditional Use of Marine Resource Agreement (TUMRA) signatory group, private consultants, Fitzroy

Canoe Club, Emu Park Community Bushcare, Sheel Club, Gladstone Sport Fishing Club and Austrian National Sports Fishing Association, and the Capricorn Reef Monitoring Program (CAPREEF).

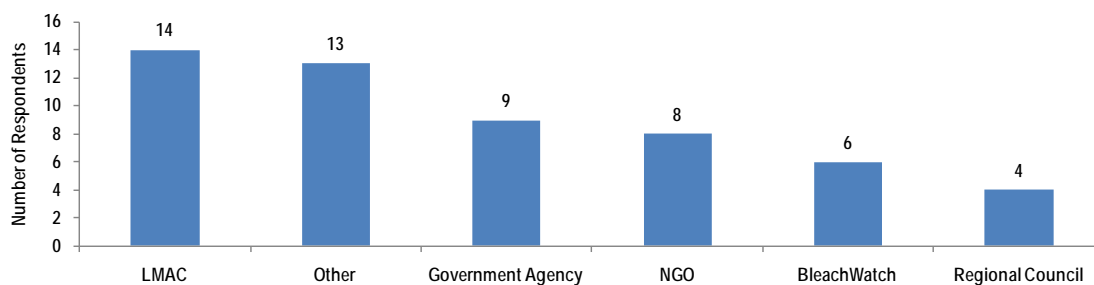


Figure 7: Respondents' Involvement with other organisations (N=33).

3.1.2 Key points of demographics

Respondents generally aligned with the stakeholder groups expected in the context of the respondent selection process.

- The most frequently indicated alignments (multiple selections allowed) were with conservation, government, recreational fishing, and recreation (e.g. sailing, diving, boating). Natural resource management bodies, tourism, Keppel Island residents, diver operators and commercial fisheries were selected less often (11 to 19 per-cent of the time).
- In terms of membership of specific organisations or groups (multiple selections allowed), the most frequently selected by respondents was LMAC. Other organisations described by the respondents themselves included universities, environmental groups and recreational groups.
- Respondents tended to have long-term associations with the Capricorn Coast (31 with 9 or more years) and primary stakeholder sector (28 with 9 or more years).

3.1.3 Information on climate change

This section of the results draws on data collected under survey question 31. Respondents were asked to indicate their source of information on climate change. More than one option could be selected. More than 90% of respondents used more than one source of information, and more than 65% used three or more sources (Figure 8). The scientific literature was the source of information most commonly identified (22 respondents), followed by the internet (18) and television (17) (Figure 9). The least used media forms were magazines (10) and radio (12). Generally, there was an even spread of sourced information across the media forms (Figure 8).

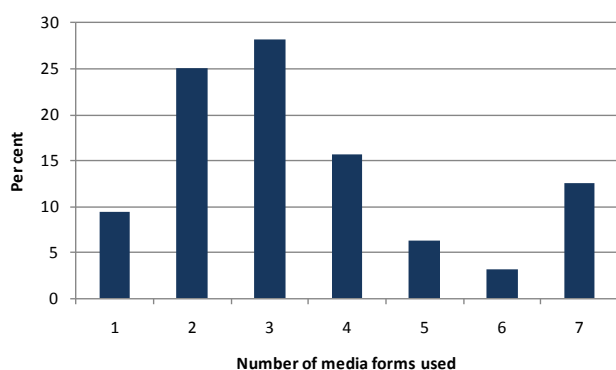


Figure 8: Number of sources of information on climate change used (N=33)

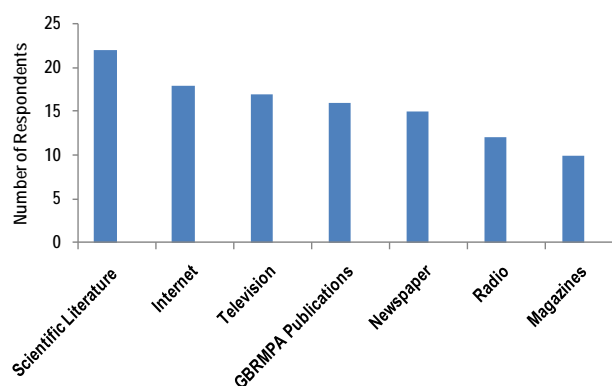


Figure 9: Sources of information on climate change (N=33)

3.1.4 Key points on information on climate change

- The surveyed population draw from a diversity of information sources and formats on climate change issues. They use multiple media forms, including the scientific literature, the internet and television and GBRMPA publications.

3.1.5 Understanding of climate change

This section draws on data collected under survey questions 1-3, and 28-30. Respondents were asked to rate their understanding of the impact of climate change on marine ecological systems of the Keppel region (Figure 10). Of those who answered, 28 respondents rated their understanding as good to very good (21 and 7, respectively) (Figure 10). Similarly, respondents rated their understanding on the impacts of climate change on community interests in the Capricorn Coast as good to very good (20 and 5, respectively) (Figure 11).

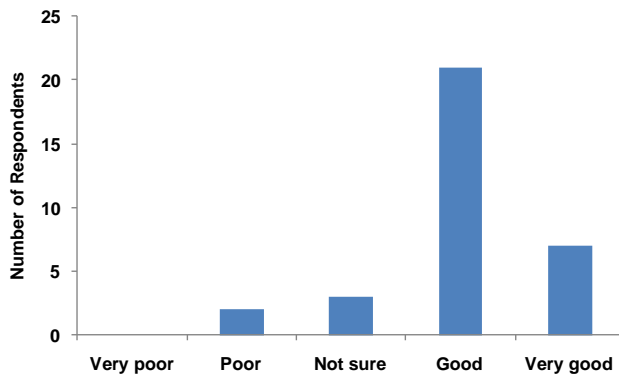


Figure 10: Understanding of the impact of climate change on the marine ecological system of the Capricorn Coast (N=33)

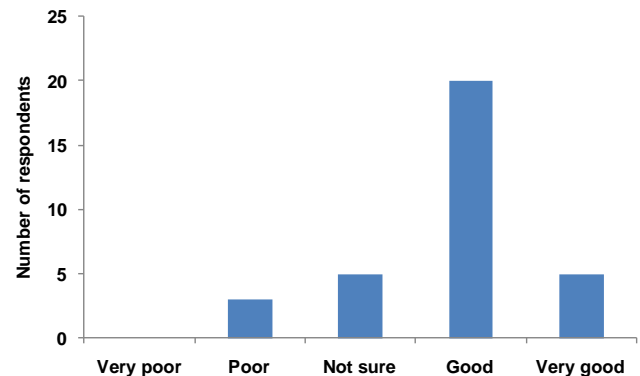


Figure 11: Understanding of the impact of climate change on community interests in the Capricorn Coast (N=33)

3.1.6 Concerns for climate change impact on the Capricorn Coast

Respondents were asked to rate their level of concern for climate change impacts on the Capricorn Coast. While no respondents were “not concerned at all”, of those that answered, 19 were somewhat or moderately concerned (Figure 12) and 26 respondents were either very concerned or extremely concerned about the impacts of climate change (Figure 12).

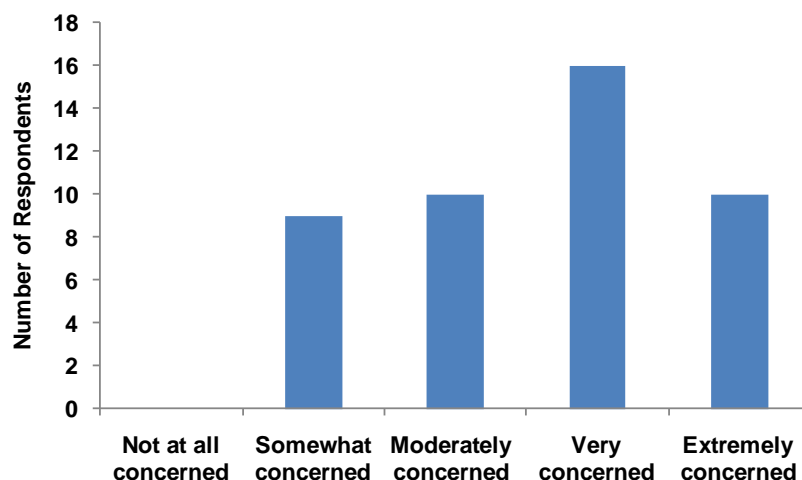


Figure 12: Concerns for climate change impact on the Capricorn Coast region (N=45).

On being asked to record the top three climate change related impacts on the Capricorn Coast, 34 respondents identified the threat of extreme weather events and associated impacts such as flooding, drought, temperature increases, and extreme heat wave conditions. The next most often recorded response (15 respondents) identified sea level rise as a major threat to the region. One respondent suggested a sea level rise of 41 mm and erosion already visible (photos are available); however, it was not clear in what region of the Capricorn Coast these data were recorded. Sixteen respondents identified impacts that either were secondary climate change impacts, or not specifically caused by climate change, including land clearing and development, erosion and loss of habitat. Ten people commented on coral mortality and coral bleaching as major climate change impacts.

The remaining responses included a mix of comments on specific events including:

- increased incidence of three types of stingers, Irukanji, box jelly, and blue bottle,
- increase in pesticides,
- loss of fish stock due to overfishing,
- dredging of Gladstone Harbour,
- ocean acidification,
- oil spills,
- increase in disease, and
- increase in fires

Finally, on being asked to rate their vulnerability as a stakeholder to changes in marine resources as a result of climate change, of those that answered, 17 respondents rated high to very high, nine were not sure, and seven rated low to very low (Figure 13).

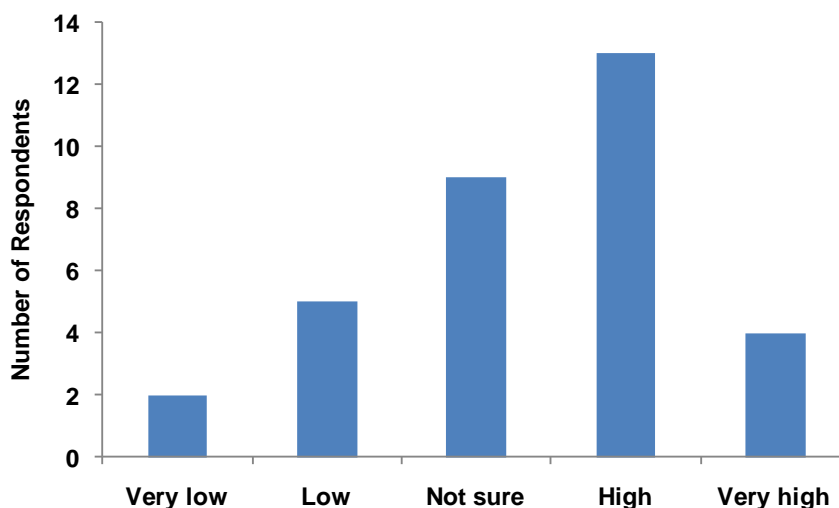


Figure 13: Vulnerability as a stakeholder to changes in marine resources as a result of climate change (N=33).

3.1.7 How might these climate change impacts affect livelihood?

Respondents were asked to identify from a list of impacts of climate change those that would most affect their livelihood. While only four respondents commented that none of the options would affect their livelihood, many people identified several options with weather-related impacts predominating. Increased cyclone activity and storm severity and increased coral bleaching were most commonly identified (Table 1).

Table 1: Impacts of climate change on livelihood

| Options | Number of responses |
|---|---------------------|
| <i>Weather related impacts</i> | |
| Increased cyclone activity | 25 |
| Increased storm severity | 23 |
| Changes in rainfall patterns | 21 |
| Inundation of coastal lands | 20 |
| Increased catchment runoff and sedimentation | 19 |
| <i>Biophysical related impacts</i> | |
| Increased coral bleaching | 22 |
| Loss of coral-associated fish species | 18 |
| Increased acidification of marine waters through carbon dioxide | 17 |
| Reduced density and diversity of corals | 15 |
| Increased erosion of corals | 15 |
| Changes in fish distribution | 14 |
| Southward movement of marine creatures (e.g. box jellyfish) | 12 |
| Changes in spawning patterns | 11 |
| Reduced nesting effects of turtles | 10 |
| Reduced foraging success and nesting failure of seabirds | 9 |

Respondents were asked then to comment on how climate change impacts on the Capricorn Coast might affect their livelihood. Eleven responses were received for this question; examples are provided in Box 1.

Box 1: Responses to how climate change impacts might affect livelihood.

"Cancellation of tourism-lost lots of guests during Cyclone Hamish and Ului threats-even though the cyclones themselves did not affect us much. We had to dismantle our operations and were affected by tidal surge"

"Loss of Indigenous cultural sites"

"All of these events will affect my lifestyle and liveability in some way. None will directly affect my income-but all will indirectly affect it"

3.1.8 Key points on understanding climate change

- Most respondents consider that they have a good to very good understanding of the impact of climate change on the marine ecological system and on community interests in the Capricorn Coast.
- There is considerable concern for climate change impacts (more than half of respondents were either concerned or extremely concerned).
- Weather-related concerns predominate (e.g. frequency and severity of extreme weather events including cyclones), and these can be considered to have been reflected in concerns for biophysical impacts. In this regard, the direct impact of climate change on coral and coral-dependent species dominated concerns.
- Many respondents (17) rated their vulnerability as a stakeholder to changes in marine resources from climate change impacts as high to very high. However, nine respondents indicated that they were unsure of how climate change might affect changes in marine resources.
- Respondents identified a number of climate change impacts that would most likely affect their livelihood, including weather-related impacts and biophysical-related impacts.

3.2 Opinions on resources available to address climate change impacts

This section draws on data collected from survey questions 4-8. Participants were asked for their opinions on a range of statements about the different resource types (capitals) available in the Capricorn Coast region to address climate change impacts. Generally, opinions diverged on the availability of available resources. However, respondents tended to agree that the availability of different resource types (e.g. knowledge, community networks, infrastructure, natural and financial) to address climate change impacts in the Capricorn Coast region were low to medium (Table 2). There were few responses in the high to very high category (Table 2). Below is a summary of the responses, followed by examples of the particularly articulate or expressive responses for each question (in consecutively numbered boxes).

Table 2: Options on resources available to address climate change impacts

| Question | Number of responses | | | | | N |
|---|---------------------|----------|----------|---------|-----------|----|
| | Very low | Low | Medium | High | Very high | |
| Capacity of the reef to accommodate biophysical impacts of climate change | 3 (8%) | 9 24(%) | 18 (49%) | 4 (11%) | 3 (8%) | 37 |
| Knowledge to respond to the impacts of climate change | 4 (11%) | 13 (35%) | 10 (27%) | 8 (22%) | 2 (5%) | 37 |
| Community networks available to facilitate action to address climate change | 2 (5%) | 14 (38%) | 10 (27%) | 8 (22%) | 3 (8%) | 37 |
| Infrastructure available to accommodate climate change impacts | 4 (11%) | 18 (48%) | 11 (30%) | 4 (11%) | 0 (0%) | 37 |
| Finance available to address the impacts of climate change | 11 (30%) | 14 (38%) | 11 (30%) | 1 (2%) | 0 (0%) | 36 |

3.2.1 Capacity of the Reef to accommodate biophysical impacts

Of those who answered this question, most respondents thought the Reef was reasonably capable of accommodating the biophysical impacts of climate change (Table 2). Eighteen people responded that the Reef had a medium capacity to respond to climate change impacts, while seven people considered the Reef to have high to very high capacity. Twelve respondents though the Reef had low to very low capacity to accommodate the biophysical impacts of climate change.

Box 2: The capacity of the reef to accommodate the biophysical impacts of climate change

"Some areas of the Keppel's appear to be suffering from the impacts of coral bleaching. The increased human impact (population increase) does not support the reef's capacity to accommodate impacts of climate change. Some local resources and actions are supporting this-trial of no anchoring areas"

"I am not convinced the reef can't adjust to progressive changes. It will all depend on how rapidly any changes occur"

"We have unique coral species able to cope with temperature change-quite resilient"

3.2.1 Knowledge to respond

Of those who answered this question, 17 respondents considered the availability of knowledge to respond to the impacts of climate change to be low to very low (Table 2). Others were more optimistic with 10 people responding that the knowledge to respond was high to very high. However, these more positive responses were not reflected in the additional comments provided (Box 3). In fact, most of the comments from the respondents suggested a degree of uncertainty about the knowledge available to respond to the impacts of climate change.

Box 3: Responses of knowledge on how respond to the impacts of climate change

" People on the Capricorn Coast are in denial because the mining boom is insulating us from these effects- until climate change starts to affect the economy then people won't really take notice or care-they'll just be

annoyed"

"It's the typical thought process where 'it will not happen to me' or I'll wait until it happens then react"

"Silly question-how do we fix the reef? Or stop tidal surges, or prevent cyclones-we're sitting ducks-right on the water's edge, dependent on fishing and tourism"

"As an individual I feel my response would not be as significant as say an industrial company of large enterprise"

"Very little government leadership (i.e. lack of training)"

"Too busy trying to measure future impacts and not plan for response to climate change"

"Knowledge is the key to making informed decisions and managing risk, adapting and mitigation. Knowledge is very poor locally"

"No education system available or known about other than standard cyclone preparedness information"

3.2.2 Community networks to facilitate action

Respondents tended to be tentative on the availability of community networks to respond to the impacts of climate change (Table 2). Sixteen people considered community networks to facilitate action as low to very low, while 10 respondents considered it to be medium. Others were more positive, with 11 people considering high to very high levels of networks available to assist in taking action on the impacts of climate change.

Box 4: Community networks available to facilitate action to address climate change

"Most people think this is someone else's dilemma and doesn't relate to them"

"Another stupid question. No community can "Address" climate change impacts-and we're fast running out of time to prevent the impacts"

"Networks may exist but what can they REALLY achieve"

"The combination of the GBRMPA, Central Queensland University, Rockhampton Regional Council, DERM, Fitzroy Basin Association and many other active groups and community members would make it possible. Generally, people who live and work in this community are very passionate about the Capricorn Coast"

3.2.3 Infrastructure to accommodate climate change impacts

Respondents questioned the availability of infrastructure to accommodate climate change impacts (Table 2). Twenty-two people thought that the availability of infrastructure in the region to accommodate change impacts were low to very low (Table 2). Only four people considered it to be high, while no responses indicated very high. Others considered it to be medium (11 people), which was not reflected in some of the comments provided. In fact, the majority of comments were either negative towards of the availability of infrastructure, or were not aware of any infrastructure available to accommodate the impacts of climate change (Box 5).

Box 5: Infrastructure available to accommodate climate change impacts

"Getting better however have been building infrastructure to outdated specifications"

"Governance and economic systems are archaic focussed on last century"

"Low lying areas continue to be built in and upon. Building standards do not seeming allow for possible impacts"

" To my knowledge there is nothing in the area"

" Nothing in the local community that I am aware of"

"Local government planning schemes need to better consider it"

3.2.5 Finance to address impacts

Respondents were not convinced that there were the finances available to address the impacts of climate change (Table 2). Twenty-five people considered that there were low to very low levels of finances available to address climate change impacts. Only one person thought the region had the finances available, while 11 respondents considered the financial capacity to be medium. This was clearly reflected in the comments provided from the respondents, where the majority considered finances to address these issues as poor (Box 6). However, there were some positive responses that addressed the availability of finances but thought that the way they were being used was not efficient to address the impacts of climate change.

Box 6: Finances available to address climate change impacts

"We, personally, have no finances to "address" climate change impacts. The rich countries have better finance than poor countries-but even Australia will soon learn how poor it is in the face of such monumental stupidity as not preventing this coming catastrophe"

"If we had more support from Local Government we would do lots more"

"At this point I am yet to see true leadership from the government around climate change. I fear that things may not be action until we see major catastrophes"

"There are a lot of financial programs out there to lessen the impact of climate change but they are heading in the other direction when it comes to this issue"

"There appears to be money if you know where to look as far as relevant research and monitoring"

3.2.6 Key points on available resource types

- Almost 50% of respondents considered the capacity of the reef to accommodate the biophysical impacts of climate change to be medium: few thought its resilience to be high.
- The majority of respondents thought the availability of community knowledge and networks, and infrastructure and finances to address climate change issues were low to very low, with many taking the option of medium. However, some (no more than a third of respondents) rated the availability of these resources as high or very high.
- While there is a considerable level of pessimism about the capacity to address climate change issues with available community networks and knowledge, infrastructure and financial resources, there are some who are optimistic, except in the area of availability of financial resources.

3.3 Opinions on knowledge and commitment to inform action and respond to the impacts of climate change

This section relates to data collected under survey questions 9-11. Participants were asked for their opinions on a range of statements about community capacity to inform action and respond to the impacts of change impacts. Generally, participants thought that the availability of knowledge in the community to manage environmental impacts of marine activity was medium (Table 3). Similarly, respondents believed that the capacity of the community to learn from experience towards taking action in response to climate change impacts was medium to high (Table 3). However, there was a mixed response in the level of community commitment towards conservation in the region. Below is a summary of the responses, followed by examples of some of the particularly articulate or expressive responses for each question (in consecutively numbered boxes).

Table 3: Options on knowledge and commitment to inform action and respond to the impacts of climate change

| Question | Number of responses | | | | | N |
|--|---------------------|----------|----------|----------|-----------|----|
| | Very low | Low | Medium | High | Very high | |
| Knowledge to manage the environmental impacts of marine activity | 5 (14%) | 11 (31%) | 16 (44%) | 4 (11%) | 0 (0%) | 36 |
| Capacity to learn from experience towards taking action | 3 (8%) | 6 (17%) | 12 (33%) | 14 (39%) | 1 (3%) | 36 |
| Level of community commitment towards conservation | 2 (6%) | 8 (22%) | 12 (33%) | 9 (25%) | 5 (14%) | 36 |

3.3.1 Knowledge to manage environmental impacts of marine activity

Respondents either doubted, or had medium confidence that there was the knowledge in the Capricorn Coast community to manage environmental impacts of marine activity (Table 3). Sixteen people considered the knowledge in the community to be low to very low. While no respondents recorded a very high response, others (16 respondents) had a medium level of confidence, while four were highly optimistic that the knowledge existed in the region. Even though 44% of respondents thought that the availability of knowledge to manage the environmental impacts of climate change on marine activity was medium, it was not reflected in the majority of comments given. In fact, most of the comments were concerned about the level of knowledge in the region.

Box 7: Knowledge in the Capricorn Coast community to manage environmental impacts of marine activity

“Very little education is being provided”

“Poor general awareness and local engagement. GBRMPA and EPA are the only ones with decent understanding at present”

“Too hard and too much conflicting information-industry and political ‘leaders’ bent on the status quo”

“If you don’t have the structured science research in place with no co-ordinated strategy then how can community be part of the “solution” let alone be informed or abreast of all the impacts”

“We have some coastal community groups that actively seek knowledge to better manage coastal and marine environments”

3.3.2 Capacity to learn from experience towards taking action

Respondents reacted positively to the capacity of the community to learn from experience towards taking action in response to climate change (Table 3). Fifteen respondents considered the capacity to learn from experience to be high to very high. Twelve respondents considered the capacity to learn from experience as medium, while nine people thought it was low to very low. These responses were clearly articulated in the comments provided by the respondents (Box 8).

Box 8: The capacity to learn from experience towards taking action in response to climate change

“People build bigger and bigger houses with an individual air-conditioner to each room, most houses have too many cars and a lot of electrical items that are in use”

“Because no one actually believe climate change is a problem-most of the general public, who unlike us, don’t live on an island with fringing coral reefs haven’t really seen the impacts of coral bleaching and erosion, and aren’t really exposed to the full brunt of likely cyclones-so thus far most people haven’t had any experience in response to climate change”

“As long as the message(s) are properly articulated to them, there is a strong interest and desire in the local community to do something proactive about climate change”

“Community members are interested, informed, and willing to adapt lifestyles for climate change”

3.3.3 Level of community commitment towards conservation

Respondents were mostly positive about the level of community commitment towards conservation in the region (Table 3). Twenty-six respondents believed that the level of community dedication towards conservation was medium to very high. This was reflected in the comments made by many of the respondents (Box 9). Others were less optimistic with regard to the level of community commitment (10 respondents) and believed that there were a few committed people in the region, but not sufficient to make a difference.

Box 9: Level of community commitment towards conservation in the region

“A neutral answer, because most people speak commitment towards conservation, but I see a hell of a lot of new fuel hungry vehicles-and everyone I talk to is flying more and more, for more and more frivolous reasons. And the number of people I talk to who now have more than one fridge and large screen TVs in their house is astonishing-so people claim to be committed to conservation-just lip service I believe”

“Too busy making money and surviving, mostly pensioners are involved in all these projects”

“The community is highly committed in conserving in the region what is realistic and achievable”

“Most residents spoken to are keen to conserve and protect their area. Many do so on an individual basis”

“ We have many proactive conservation groups, local business, individuals and researchers working on all aspects of conservation and environmental management”

“Some are highly committed, others show no commitment at all”

3.3.4 Key points on knowledge, learning capacity and commitment to respond to the impacts of climate change

- The majority of respondents considered that the knowledge in the Capricorn Coast community to manage environmental impacts of marine activity to be either medium or low to very low.
- Respondents considered there to be considerable commitment to conservation in the region and were mostly positive on the capacity within the community to learn from experiences in managing impacts.

3.4 Opinions on the major barriers to fostering stewardship on the Capricorn Coast

This section draws from data collected under survey questions 12-22. Participants were asked for their opinions on a range of statements about the barriers to fostering stewardship on the Capricorn Coast. Generally, participants strongly thought that the lack of agreement on the seriousness of climate change was a major barrier (Table 4). Respondents also agreed that there was a lack of awareness or understanding of the connection between people and the environment. Similarly, participants agreed that a major barrier to stewardship was the reluctance to make individual changes and a lack of accountability and responsibility to accommodate stewardship behaviours. There was a mixed response from respondents on trust issues between the community and government, and the potential to acquire information, become motivated, and empowered to take action. Below is a summary of the responses, followed by examples of some of the particularly articulate or expressive responses for each question (in consecutively numbered boxes).

Table 4: Opinions on the major barriers to fostering stewardship on the Capricorn Coast and Keppel Bay region

| Question | Response (%) | | | | | N |
|--|-------------------|----------|----------|----------|----------------|----|
| | Strongly disagree | Disagree | Not sure | Agree | Strongly agree | |
| The seriousness of climate change | 1 (3%) | 5 (14%) | 2 (5%) | 15 (42%) | 13 (36%) | 36 |
| Awareness of the connection between people and the environment | 2 (6%) | 6 (18%) | 3 (9%) | 15 (44%) | 8 (23%) | 35 |
| Ineffectiveness of small individual actions | 4 (11%) | 12 (34%) | 3 (9%) | 10 (29%) | 6 (17%) | 34 |
| Reluctance to make individual changes | 1 (3%) | 3 (9%) | 7 (20%) | 17 (50%) | 6 (18%) | 34 |
| Lack of accountability and taking responsibility | 2 (6%) | 4 (12%) | 8 (23%) | 15 (44%) | 5 (15%) | 34 |
| General feeling of apathy towards climate change impacts | 1 (3%) | 9 (26%) | 2 (6%) | 15 (44%) | 7 (21%) | 34 |
| Lack of trust between the community and the government | 1 (3%) | 8 (23%) | 6 (18%) | 11 (32%) | 8 (24%) | 34 |
| The absence of cooperative networks | 2 (6%) | 9 (26%) | 3 (9%) | 15 (44%) | 5 (15%) | 34 |
| Lack of knowledge about impacts and responses | 0 (0%) | 7 (21%) | 4 (12%) | 14 (41%) | 9 (26%) | 34 |
| Government understanding of community needs | 2 (6%) | 1 (3%) | 8 (23%) | 16 (47%) | 7 (21%) | 34 |
| Potential to be informed, motivated, and empowered | 2 (6%) | 4 (12%) | 8 (23%) | 13 (38%) | 7 (21%) | 34 |

3.4.1 The seriousness of climate change

The majority of respondents were adamant that the existing lack of agreement about the seriousness of climate change was a major barrier to stewardship (Table 4). For example, 28 respondents agreed or strongly agreed to this question, which was also consistent with the comments made (Box 10).

Box 10: A major barrier to stewardship is the lack of agreement on the seriousness of climate change

"If governments can't agree then their voting public won't either"

"People do not take climate change seriously"

"Ask the scientists and governments to come to a consensus"

"Because if even GBRMPA doesn't believe in climate change, why should anyone else"

"The cause and effects seem to change as the science improves. It is difficult to get a consensus when the goalposts keep changing"

"The community looks to its leaders for direction on this issue. When the leaders do not agree among themselves, it is difficult for the community to maintain its focus"

3.4.2 Awareness of the connection between people and the environment

The majority of respondents thought a barrier for their community was a lack of awareness or understanding of the connection between people and the environment (Table 4). Twenty-three people either agreed or strongly agreed that this was an issue. Eight of the respondents were more optimistic and either disagreed or strongly disagreed with this statement. Many of the comments were generally negative

on this issue with several identifying a reluctance to compromise and make lifestyle changes in accord with understanding of the connection (Box 11).

Box 11: A major barrier to stewardship is the lack of awareness or understanding of the connection between people and the environment

"Yes, a number of people still think that food grows in the supermarkets and we have a higher right to our existence than that of native flora and fauna"

" I think people are more and more aware of this connection, however to make changes that may compromise their current lifestyles is challenging"

"People do not realise that we can not survive, the earth supplies all our food and lifestyle"

"Most people share some concern about the environment but most don't feel confident speaking out, unless they are about to be directly affected"

" Poor general understanding, acceptance, and engagement by the people"

3.4.3 Ineffectiveness of small individual actions

Respondents appeared divided over the importance of belief that small individual actions are ineffective (Table 4). In this context, there may have been some confusion over what the question was asking in this case. While many respondents (16) disagreed with this statement, equally 16 agreed. Notwithstanding, the comments by the respondents were either positive or negative to this statement. Several people believed that small individual actions are the first step in achieving success, while others viewed these actions as insignificant (Box 12).

Box 12: A barrier to stewardship is the belief that small individual changes are ineffective

" People in CQ are really only interested in taking action if they can see a benefit for themselves"

"Collectively, individual actions can mean a lot"

" I think that it is these small individual actions that are the first steps towards stewardship"

" Every bit counts and can set positive examples"

"While individual actions may be deemed ineffective in the scheme of things, these actions are still viewed by the community as part of the way forward and keeps the issue in the communities eye"

"Problems appear so big and the global effort needs to be greater, thus people thinking that small individual actions are of little value on a global scale"

3.4.4 Reluctance to make individual changes

Respondents were adamant that a major barrier to stewardship is the reluctance to make individual changes to accommodate stewardship behaviours (Table 4). Although seven people were not sure, 23 respondents considered the reluctance to make individual changes to be a major barrier to stewardship. This was also reflected in some of the comments by the respondents (Box 13).

Box 13: A major barrier to stewardship is the reluctance to make individual changes to accommodate stewardship behaviours

" Unless people are forced to make changes, I don't think they will"

" People get comfortable with their lives and change is hard"

" Communities do make changes if leadership provides guidance on particular cultural changes"

" People will change if there is an economic incentive"

" We do not like to give things up generally"

3.4.5 Lack of accountability and taking responsibility

Respondents strongly identified a lack of accountability and taking responsibility for climate change impacts to the reef (Table 4). Twenty people were of the opinion that the lack of accountability and taking responsibility was a major barrier to stewardship. Others (six respondents) were more optimistic and considered this statement to be incorrect. Notwithstanding, several comments provided by the respondents were notably positive; for example, the community are aware of the impacts of climate change to the reef but lack the knowledge to take accountability and responsibility (Box 14).

Box 14: A major barrier to stewardship is the lack of accountability and taking responsibility for climate change impacts to the reef

" I believe community accountability is growing (slowly) and needs a ramp up of government leadership"

"Too many fingers in the pie. Too many groups with differing objectives wanting to take control of the agenda"

" It would seem no particular person or organisation wants to commit to responsibility but would rather push it onto others"

" I think people understand they are accountable and they would take responsibility if they understood the implications of not acting"

" I don't have enough knowledge and therefore an opinion on this question"

" Lack of understanding in some sections of the general community"

3.4.6 General feeling of apathy towards climate change impacts

Respondents felt strongly that a major barrier to stewardship was the general feeling of apathy towards climate change impacts on the Reef (Table 4). Of the respondents that answered this question, a greater proportion was of the opinion that there was a general feeling of apathy within the community towards the impacts of climate change to the reef. While two respondents were not sure, ten people disagreed with this statement. The comments made by the respondents reflected the strong opinion that apathy within the community was problematic (Box 15). Several respondents were of the opinion that apathy was caused by a lack of agreement and leadership at the higher levels of organisations.

Box 15: A major barrier to stewardship is the general feeling of apathy towards climate change impacts on the reef

" People feel strongly about the reef"

" People may only change when they themselves notice a change in the environment"

" Apathy is an issue in government bureaucracy, science and community"

"Most people here are only interested in me and my"

" Again it comes down to disagreements at a high level, conflicting points of view based on conflicting interpretations of presented scientific data"

"Apathy is an issue in government bureaucracy, science and community. No party, institution, agency or community is free of apathy...this is human nature"

" The community needs more leadership, education and practical on the ground solutions"

3.4.7 Lack of trust between the community and government

Just over 50% of respondents noted that a major barrier to stewardship was a lack of trust between the community and government organisations (Table 4). For example, several people were of the opinion that there was a lack of support and leadership from the government. Others considered the lack of communication and engagement from the government with the community as a barrier to stewardship (Box 16). Notwithstanding, several people were positive that the lack of trust between the government and the community was not a barrier to stewardship; however, this was not reflected strongly in comments provided by respondents.

Box 16: A major barrier to stewardship is the lack of trust between the community and government organisations

" I don't think that this is right, as most concerned people are united in their efforts to help"

" Mixed and confused messages from Government, politicians and industry leaders"

" Government organisations are seen as ineffective, not trustworthy"

"No real support and leadership from any level of government. The local government does not listen to the majority of people"

" The community has seen a general lack of leadership from the government about climate change"

"Government organisations need to engage more meaningfully and pro-actively with the community"

3.4.8 The absence of cooperative networks

The majority of respondents considered that a major barrier to stewardship was the absence of cooperative networks that foster communication and learning (Table 4). Several people commented on the fact that networks are in place to foster communication and learning; however, they are not well-supported, or are not obvious to the community (Box 17). Notwithstanding, several people were positive that networks to foster communication and learning do exist but need to be managed more effectively.

Box 17: A major barrier to stewardship is the absence of cooperative networks that foster communication and learning

" There are networks already in place that foster communication and learning however they all have different agendas that may not be aligned with addressing climate change directly"

" Proper supervision of networks are needed, everything at present is haphazard"

" There are actually networks like this in place but they need more support from policy settings"

"Networks exist but they need to get better at linking and engaging"

" I don't think the networks have been made obvious, so they are not being exploited"

"There are cooperative networks which are increasing communication and learning, such as GBRMPA and CapReef and the barriers are diminishing but very slowly"

3.4.9 Lack of knowledge about impacts and responses

Respondents considered that a major barrier to stewardship was the lack of knowledge about climate change impacts and possible responses (Table 4). For example, some people were of the opinion that there was a limited understanding of climate change and global warming within the community and the lack of consensus within the science community (Box 18). Although the majority of respondents agreed with this statement, there were a small number of comments provided.

Box 18: A major barrier to stewardship is the lack of knowledge about climate change impacts and possible responses

" Climate change is the symptom, how do you respond to the symptom we should be tackling the cause"

" Uncertainty and campaigns by sceptics/industry lobbyists"

" We don't know, please tell us more"

" Again, where is the consensus within the science and also the global strategy to deal with the real issue...climate change"

" We have the knowledge with no coordination or the leadership to achieve that"

3.4.10 Government understanding of community needs

The majority of respondents felt that a major barrier to stewardship was the lack of higher (central) government understanding of regional community needs to implement practical responses to climate change (Table 4). There were no comments provided by the respondents to this question.

3.4.11 Potential to be informed, motivated, and empowered

The majority of respondents thought their community had strong potential to be informed, motivated and empowered to take action in relation to stewardship potential (Table 4). This was reflected in several of the comments made by the respondents. For example, some people were of the opinion that education and communication were critical for empowerment and community action (Box 19). Some considered community action to be somewhat unlikely, or could be enhanced within the community.

Box 19: Community potential to acquire information and be informed, motivated, and empowered to take action

"The community demonstrates a high level already in environmental issues they deal with"

"Could be enhanced more"

"There are many educated and innovated people living in this region. It just needs a mentor and a leader to get things going, be this individual or organisation"

"I believe that there is always the potential for the community to become empowered to take action if there is a strategic approach to education"

"There is great community potential with the right education and communication programs targeted to raise individual awareness and the success of one's own actions"

"We are a long way from reaching a 'critical mass' of people who want to think about and engage in impacts and action"

3.4.12 Key opinions on the major barriers to fostering stewardship potential

- There was a high level of agreement that major barriers to developing effective stewardship were:
 - lack of agreement on the seriousness of climate change and the general feeling of apathy towards climate change impacts on the reef.
- These barriers may be related to:
 - the generally agreed lack of awareness or understanding of the connection between people and the environment, lack of knowledge about climate change impacts and possible responses, reluctance to make individual changes to accommodate stewardship behaviours, and the lack of accountability and taking responsibility for climate change impacts to the reef.
- The majority of respondents agreed that a major barrier to stewardship is the lack of trust between the community and government organisations, and particularly the lack of higher (central) government understanding of regional community needs to implement practical responses to climate change.
- With respect to the Capricorn Coast community, the majority considered absence of cooperative networks that foster communication and learning to be an existing barrier.
- The majority of respondents thought the Capricorn Coast community had a medium to high potential to be informed, motivated, and empowered to take action.

3.5 Overall stewardship potential and comments on helping the Capricorn Coast community

This section draws from data collected from survey question 32. Respondents were asked to give some final comments on how to help the community respond to the impacts of climate change through fostering

stewardship in the Capricorn Coast. Below are examples of some of the particularly articulate or expressive responses.

Box 20: How to help the community respond to the impacts of climate change through fostering stewardship in the Capricorn Coast.

" I think the community needs to be guided on what they can do and then shown how this has made a difference, something tangible that proves their actions are working"

"This whole concept is a spurious notion that somehow the community can mitigate against the effects of climate change. While the coal mines continue to increase the carbon load of the atmosphere, the fuel industries and big emitters continue to work as usual, and the GBRMPA continues to print its innocuous little pamphlets, the atmosphere will continue to warm and dry and the sea temperatures will continue to rise, with more cyclones and rising sea levels. The reef will bleach more often and we will see more coral and fish death. This is an absolute certainty. Do you think it is even fair or honest to expect the community to take stewardship of the reef that is being killed by government or industry? It is disingenuous. If you have children-be very worried".

"Increase funding to coordinate knowledge and provide education and the building of networks through a central group".

4.0 Discussion and key findings

The IPCC has identified Australia as among the developed nations most at risk from the effects of climate change (Turton *et al.* 2010). Similarly, key tourism destinations and the tourism sector have also been identified as particularly at risk (Great Barrier Reef Outlook Report, 2009). In this context, the Great Barrier Reef Marine Park is vulnerable and projected to change substantially in the next 50 years from the impact of climate change. Changes in seawater levels and temperatures, and increases in the frequency and severity of storms and cyclones will impact on the ability of the Reef marine ecological system to cope, and maintain vital ecosystem goods and services. These impacts will also affect the communities that depend on these services for their livelihoods. Accordingly, the ability to increase community resilience to the impacts of climate change on the Reef through stewardship mechanisms will create opportunities to learn from experience, adapt, and respond to these impacts.

4.1 Understanding climate change

The acknowledgement and understanding of climate change requires a consideration of individual experience and knowledge of the environment and the ecological systems and the institutional and organisational arrangements that are associated with the management of these systems (Fenton and Beeden, 2006). To understand how stakeholders might prepare for and respond to the impacts of climate change, it is important to identify how climate change is conceptualised and understood. For the most part, the respondents in this study considered their understanding of climate change was good to very good, particularly as it related to impacts on the marine ecological systems and on community interests in the Capricorn Coast. This is possibly reflected in the kind of information that respondents sourced, predominantly the scientific literature. However, it should be noted that almost half of the respondents are members of LMAC. The fact that scientific literature was sourced on climate change information suggests an unequal representativeness of community members. Other noteworthy sources of information that may have contributed to a greater understanding of climate change were publications from the GBRMPA.

4.2 Concerns for climate change impact on the Capricorn Coast

Concern for climate change impact on the Capricorn Coast resulted in responses that ranged from somewhat concerned to extremely concerned. This was reflected in the diversity of responses in terms of how climate change may affect the Capricorn Coast. Nevertheless, an increase in extreme weather events and concomitant impacts of flooding, temperature increases, and extreme heat wave conditions were of major concern to most respondents. Previously, Fenton and Beeden (2006) researching stakeholder beliefs about climate change in the Great Barrier Reef catchment identified similar concerns. For example, Fenton and Beeden (2006) found that respondents believed that rising sea temperatures would contribute to a diverse range of potential downstream ecological impacts including, impacts to biodiversity, the inundation of coastal mangrove regions, impacts on turtle breeding and reproduction through increase in sand temperatures, and changes in the abundance, distribution, and diversity of many marine species.

Although respondents were concerned about climate change impacts on the Capricorn Coast generally, they were clearly more concerned about livelihood issues and the impacts on particular marine resources. In identifying how climate change impacts may affect their livelihood, increased frequency and severity of weather conditions and cyclone activity were most commonly cited. Undoubtedly, extreme weather conditions would severely affect many tourism operators and commercial fisheries in the region. For example, as one respondent stated, *we lost lots of guests during both cyclone Hamish and Ului and had to dismantle our operations after they were affected by tidal surge*. Similarly, there were major concerns for inundation of coastal lands and increased catchment runoff and sedimentation.

Many respondents were also concerned that biophysical processes, including ocean acidification, coral bleaching, loss of coral-associated fish species, and changes in fish distribution patterns, would affect livelihoods. For example, a decrease in coral growth rate of 14% since 1990 has already been observed on corals of the Reef (Veron *et al.* 2009), which would ultimately lead to a loss of fish species associated with these corals.

4.3 Opinions on resources available to address climate change impacts

Respondents were asked their opinions of the resources available to address climate change impacts on the Capricorn Coast. These resource types were adapted from the five categories of capital identified by Nelson *et al.* (2007): human (knowledge), social (community networks), natural, physical (infrastructure) and financial.

Respondents generally believed that the knowledge (human capital) to respond to the impacts of climate change was low. Respondents commonly indicated that limited organisation and leadership were issues that lessened knowledge transfer within the community. Similarly, many indicated that the community networks (social capital) to respond to the impacts of climate change were also limited. Respondents were clearly concerned that the urgency of climate change impacts was not realised by the public, and perhaps there was a greater need to foster community action groups. One criticism that was often discussed was the lack of awareness of community networks within the region, and how to gain access to them. The majority of respondents felt communication in general was a valid problem within the local community and with government.

Respondents were also critical of the available infrastructure (physical capital) to accommodate climate change impacts. Several were concerned for continual coastal development and construction in low-lying coastal areas prone to flooding. Moreover, several expressed concern that existing infrastructure was old and that existing building standards are not suited to probable impacts. This also correlates with perceptions of the available finance to address climate change impacts. Many respondents were critical of the government's lack of expenditure on funding programs to address climate change impacts, and there were concerns that in the event of a disaster, government finance would be "stretched" to deal with the impact(s). Fenton and Beeden (2006) suggest that many organisations responsible for the management of resources at the regional level have short-term funding constraints that make it exceedingly difficult for them to address long-term issues associated with climate change. Similarly, Kinnear *et al.* (2009) identified that several business operators would rely on support mechanisms (such as funding) to assist them in managing and adapting to climate change impacts.

4.4 Opinions on the knowledge available to inform action and respond to the impacts of climate change

Respondents were asked about the knowledge available to inform action and respond to the impacts of climate change. Generally, participants were confident that there was sufficient knowledge available and that the community had the capacity to learn from experience towards taking action in responding to climate change. Notwithstanding, there was a mixed response on the level of commitment within the community towards conservation in the Capricorn Coast region. While many of the respondents were positive on the availability of knowledge, and the ability to learn from experience, several participants indicated a level of helplessness in relation to commitment towards taking action in the conservation of the region. For example, some respondents commented on the lack of resources (including finance and training schemes) to reinforce and support government commitment to the issue in the region. Thus, community engagement between the stakeholders and government agencies was an important issue for respondents and considered to be vital to achieving mutual commitment to responding to the challenges of climate change.

4.5 Opinions on the major barriers to fostering stewardship potential on the Capricorn Coast

The study particularly explored perceived barriers to fostering stewardship in the Capricorn Coast. The findings indicate that major barriers relate to perceptions of climate change and supporting evidence, individual efficacy, community awareness and understanding, and leadership.

Issues associated with perceptions of climate change and supporting evidence included concern over the lack of agreement on the seriousness of climate change within and between stakeholder groups, and many respondents commented on the perceived inconsistencies of scientific opinion at the global level and questioned the availability of consistent (reliable) information. Similarly, many respondents agreed that lack of awareness or understanding of the connection between people and the environment was a major impediment to stewardship and noted a general lack of knowledge within the community regarding climate change impacts and/or how to respond to these impacts.

Despite concerns over climate change knowledge, respondents suggested that the community was becoming more aware of the connection between people and the environment. Nevertheless, there was concern over the reluctance of community members to make changes that might affect their lifestyles. In particular, there was concern over the perceived unwillingness to make individual and voluntary changes to accommodate stewardship behaviours.

Related to the issues associated with limited knowledge, acceptance, and motivation to act, a mixed response to questions regarding perceptions of individual efficacy also suggests that this is a key issue for fostering stewardship. For example, some respondents believed that individual actions were insignificant in the context of catastrophic events and climate change impacts at the global scale. On the other hand, other respondents were more optimistic, suggesting that collectively, individual actions can achieve results and are the first steps to stewardship.

The responses indicated that a key driver of many of these issues relates to limited leadership from government bodies, industry and community leaders, which is exacerbated by poor communication between all stakeholders and limited trust between the community and government organisations. Of particular note are concerns related to approaches to community engagement, where the responses from government organisations, politicians, and industry leaders were not seen as heeding the community voice, despite the consultation. As one respondent said, “if the rationale is poorly communicated to the community and consultation is poor, then there will always be a reactive nature to stewardship”. This also appears to have led to a situation where there is limited accountability and responsibility for responding to the impacts of climate change on the reef system.

In the absence of effective and cooperative networks to foster communication, learning and stewardship, suggestions were raised regarding the potential of incentives for increased community participation, although it was unclear what these may involve. Despite concern over limited networks, it appears that there are existing and cooperative approaches that could be built upon. For example, CapReef (a community-based Capricorn Reef Monitoring Program that works together with governments and scientists) was cited as a good example of a learning network with significant potential to foster stewardship.

4.6 Fostering stewardship in the Capricorn Coast community towards addressing the impacts of climate change

4.6.1 Impediments to stewardship

While the sample size of this study was small (33 completed surveys) and would not be directly indicative of the Capricorn Coast in general, the participants were well acquainted with the region and hence can be expected to reflect community opinion. Based on the collective responses from the survey, and the analysis of the survey questions, several issues were identified that impede the realisation of stewardship potential in the Capricorn Coast region. These included:

- scepticism about climate change;
- a lack of knowledge on how to respond to climate change impacts;
- a lack of knowledge transfer to the community to encourage communication and learning on climate change impacts;

- limited opportunity to become involved in programs that address the issues of climate change impacts on the Reef;
- ineffectual government leadership on the issues of climate change;
- a lack of accountability;
- trust issues between the community and government organisations;
- limited government understanding of the community needs; and
- uncertainty surrounding how to achieve action through various mechanisms of motivation and empowerment.

4.6.2 Fostering stewardship

The framework used for this study (Figure 3) provides a model to enhance stewardship potential for application in the Great Barrier Reef communities. It integrates three broadly overlapping approaches to achieving sustainability: (1) addressing the system characteristics that include the five-capital model of Nelson et al. (2007); (2) fostering the transformation process, which includes sustainability learning and ethics; and (3) realising desired outcomes through stewardship. More specifically, the aim is to address stewardship potential within the community to (i) reduce vulnerability to expected changes, (ii) foster resilience to sustain desirable conditions in the face of perturbations and uncertainty, and (iii) transform the undesirable trajectories when opportunities arise (Chapin et al, 2010).

In the context of the framework, the external drivers in this case are the impacts from climate change. Sustainability learning (e.g. learning, coping, innovating and adapting) in response to the impacts of climate change can alter the environmental and socio-economic interactions and various forms of capital in the system (e.g. human, social, physical, financial and natural). Therefore, increasing the availability of resources within the community would be beneficial from a community perspective. For example, increasing the knowledge-base of climate change impacts within the community and widening community networks to facilitate action will facilitate the learning process to cope, innovate and adapt. Equally important for community success will be the availability of infrastructure and finances to accommodate and address climate change impacts.

Accordingly, the following approaches might aid in encouraging stewardship in the Capricorn Coast region.

1. There is a need for proactive and strong leadership to address climate change impacts in the Capricorn Coast region.
 - Leadership may be found and encouraged across a community and is not limited decision-makers with formal positions of responsibility. A diversity of leaders from government agencies, industry bodies, community organisations and respected individuals should be supported.
 - Approaches to effective engagement should be targeted and enhance awareness of the impacts of, and appropriate responses to, climate change that are context specific and applied to particular community sectors.
 - The uncertainty of climate change impacts needs to be clarified and embraced across all levels of government in the interests of developing a common understanding.
 - Training programs and open dialogue between stakeholders and government bodies is necessary to increase the level of commitment towards stewardship and conservation.
2. There is a need for community networks and communication channels to facilitate action to address climate change impacts.
 - The united action of industry leaders, government bodies and other active groups and community members is needed to facilitate this action.
 - Informing stakeholders about the impacts of climate change, the effects on their livelihoods, and effective response strategies will play a role in achieving behavioural changes.

- There is a need to address the issues of climate change across a diverse range of stakeholders with different ideologies and belief systems about climate change impacts.
 - Open channels of communication should be established to facilitate two-way or multiparty learning to access, share and develop a more comprehensive account of the impacts of climate change on the Reef. This would also assist in the development and refinement of effective response mechanisms. The use and acceptance of a variety of media is necessary to provide and receive information from the community on the impacts of climate change on the Reef. Where information is provided to the community, regular evaluation of relevance is necessary.
3. There is a need for governments and industry bodies to acknowledge that individual, group, and/or community actions are necessary to achieve the sustainable use of Reef resources and conservation.
 - Governments are addressing individual actions with programs such as solar energy strategies and the Climate Smart Program; however, proactive natural resource management programs are less developed.
 - Incentives are a potentially useful approach for fostering stewardship among the Capricorn Coast community.
 - Governments and industry bodies need to provide convincing stakeholder-specific information of the impacts of climate change. Generic information, lacking in details and specifics is unlikely to influence attitudinal and behavioural change.
 4. There is a need to take a coordinated and unified approach to realising stewardship potential.
 - Government agencies should work in partnership with stakeholders to promote stewardship.
 - A greater connectivity and harmonious relationship needs to be fostered among the community, industry leaders, and government organisations to provide mutually beneficial outcomes, and clear goals in the development of stewardship.
 5. There is a need to explore the potential for community marine stewardship to contribute to priority management objectives as described in the Great Barrier Reef Outlook Report (2009). These include:
 - education and community awareness programs that inform and motivate members of the community towards protection and management of the Reef;
 - fostering partnerships with stakeholders and the community that provides an opportunity for contributions to protection and management;
 - ensuring that stakeholders, the community, and industry are effectively engaged in the ongoing management and planning processes of Reef management; and
 - the communication of outputs and outcomes to stakeholders to improve their knowledge-base about the Reef, particularly to climate change impacts.

4.6.3 Strategic interventions

Ultimately, fostering of stewardship will require strategic interventions to stimulate behavioural change in individuals, stakeholders and communities of place and interest. This will require a change in individual and community priorities. Interventions to facilitate behavioural change and priorities notoriously lacks precision. All that can be done is raise human capital and social capacity and provide stimulus to shift behaviour in a desired direction. This will probably need more than a short-term intensive effort and will best be achieved in partnership with stakeholders.

Kelly (1955) provides a theoretical frame for considering the development of behavioural intentions in individuals, whereby, for the purposes of this discussion, behavioural intentions might be modified by providing information and learning experiences that alter beliefs about climate change, its impact on the reef and the effectiveness of individual and collective action (Figure 14). However, Moscovici's (1973) concept of social representations indicates that behavioural intentions will not be transferred, necessarily,

to action because these must pass through a socio-cultural screen or a socialisation process partly driven by the strength of social capital (Figure 14). This framework suggests three principal areas for interventions.

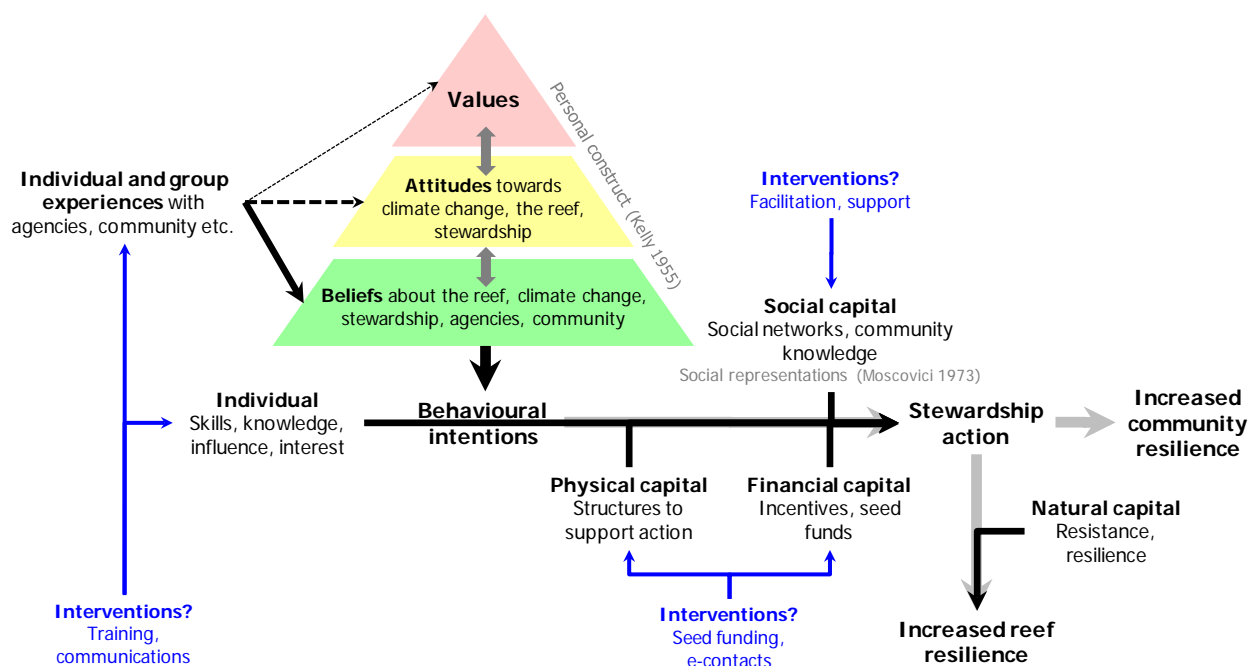


Figure 14: A psycho-sociological framework for facilitating stewardship

a. Individual knowledge enhancement

Increasing the knowledge base in individuals about climate change and its impacts on the Reef and communities is an essential step to overcome the impediment of beliefs built on inaccurate and incomplete information. This can be used to develop mutual trust through sharing of experiences and the development of a common understanding (conceptualisation) of issues relating to climate change and what is needed to address these issues. At the same time, such information sharing will contribute to the building of social capital and a common social representation of climate change and actions necessary to address impacts.

b. Developing social capital

While building the knowledge base of individuals in a community also builds social capital (if sharing occurs), facilitating and supporting community sharing of information will foster the development of a common conceptualisation of climate change issues and solutions; including the role stewardship might play in the solution. Stewardship requires group action, so identifying and empowering relevant stakeholders through mutual acknowledgement of the power of the group is essential, including the facilitation of mechanisms for group stewardship actions.

c. Strategic funding

Interventions to develop individual knowledge and social capital require financial and human resource investments; however, as a show of good-will and to precipitate action, some specific investments may be necessary. This may be in the areas of providing seed funding for developing stewardship groups and start-up and coordinating activity. Given the location of individuals of many key stakeholders, simply facilitating e-contact may be all that is necessary to galvanise group consideration of issues. However, given that email may only target a select group of stakeholders, and the fact that often emails can be easily dismissed; follow-up meetings and different methods to coordinate communication channels with different members of the community are needed. Similarly, if communities are assessed to be vulnerable because of physical limitations of infrastructure (physical capital) then leadership might be effectively expressed through funding support of such infrastructure upgrade or modification.

5.0 Conclusion

Climate change impacts on the Great Barrier Reef are projected to increase in the next few decades. This will have major and wide-reaching impacts on the communities that depend on the reef system for their livelihood. Accordingly, the stakeholders of the Keppel Bay and Capricorn Coast region are vulnerable to the impacts of climate change through their dependency on the continual delivery of goods and services provided by the Reef system (biophysical and socio-economic). Therefore, identifying the processes to increase community resilience through potential stewardship mechanisms will be of critical importance given the predicted threats climate change will have on communities and industry that depend on the Reef's natural resources for economic, social and cultural wellbeing.

Although barriers and opportunities to foster stewardship potential were identified from the study, these should be considered in the context that the sample was purposively selected, small, with a bias towards people in recent contact with GBRMPA.

The barriers to stewardship in the Keppel Bay and Capricorn Coast area exemplify the need to develop clear communication networks and channels between the community and government agencies to foster trust and connectivity. Education also plays an important role in these processes in allowing for information and knowledge transfer across the different stakeholder sectors. To facilitate and reduce these barriers to stewardship, strong leadership, which engages industry and community members, by industry and/or government organisations, is necessary. To do this, stakeholders will need to acknowledge the uncertainty around climate change impacts, yet be provided with unbiased and non-conflicting data, information and knowledge, as well as being encouraged and empowered to make individual changes in the greater interest of the Reef.

The stakeholders of the Keppel Bay and Capricorn Coast region are in a unique position to take advantage of the many supporting facilities (such as Central Queensland University, DERM (QPWS) and the GBRMPA) that are sensitive to the impacts of climate change in the region. However, to facilitate these opportunities, there is a need for continued leadership and engagement from community and industry leaders and government organisations. This will require a continuous benchmarking of the community's awareness of issues related to climate change, and a strong connectivity with the community to ensure amicable decisions are made that benefit the community in general.

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7.0 Appendix A

Survey Questions