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Perceptions of Climate Change and Adaptation Responses in a Local Community: the Barwon Estuary Complex, Victoria

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ABSTRACT *The climate change focus in Australia has shifted from mitigation to adaptation with an emphasis on place-specific case studies. The Barwon Estuary Complex (BEC) on the Bellarine Peninsula, central Victoria, was the focus of this place-specific study in which 37 local stakeholders were consulted through a series of semi-structured interviews on the impacts of climate change on their coastal community. Overall there was uniformity in stakeholder perceptions of the climate change impacts and vulnerabilities pertaining to the BEC. In contrast, discussion on adaptation drew a diversity of responses. While 53 per cent of stakeholders indicated a need to limit the use of hard structures, and rather plan around a changing estuarine environment, opinion amongst the community group was divided. Some believed 'retreat is the only option' whilst others felt 'there won't be much leaving'. The present level of confusion around adaptation highlights the imperative of commencing discussions now to allow sufficient time to develop strategies which are both environmentally and socially responsible. This is important as ultimately it will be the community that will determine whether adaptation strategies are adopted or met with resistance.*

KEY WORDS *Climate change; Barwon Estuary Complex; adaptation; resilience; stakeholder perceptions.*

Introduction

Climate change is recognised as being indisputable (Intergovernmental Panel on Climate Change (IPCC) 2007) and is becoming widely recognised as the key global challenge of this century (Hamin & Gurran 2009). The latest scientific research suggests that we are now locked into a period of unavoidable change for hundreds of years (Newton 2009). Current thinking is that the earth is tracking on the higher end scale or above the worst-case scenario projections of climate change, as reported by the IPCC (2007).

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Both internationally and within Australia the response to climate change has shifted from mitigation to adaptation, in recognition that climate change impacts are unlikely to be alleviated through mitigation measures (Saavedra & Budd 2009). *Mitigation* refers to response strategies that reduce the sources of greenhouse gases (DCC 2010). *Adaptation*, on the other hand, seeks to adjust the built and social environment to minimise the negative outcomes of now-unavoidable climate change (Hamin & Gurran 2009).

In Australia, governments have embraced the need to act on unavoidable impacts of climate change through adaptation measures (Smith *et al.* 2009), irrespective of debate around causes of climate change and mitigation alternatives. This is exemplified in the Australian government's position paper *Adapting to climate change: an Australian government position paper* (DCC 2010). This position paper acknowledges that adapting to the inevitable impacts of climate change is critical to any effective climate change response (DCC 2010).

Nowhere is the adaptation response more crucial than the coastal zone (House of Representatives (HoR) 2009). The coastal zone is home to over 85 per cent of the Australian population, with coastal townships expanding rapidly (Norman 2009a). In Victoria, within this century, the coastline will be impacted by sea level rise with increased frequency and severity of storm events leading to inundation and erosion (Victorian Coastal Council (VCC) 2008). It is also predicted that increased sea temperatures, changing sea currents and further acidification of the ocean will affect the marine environment (VCC 2008).

Estuaries, in particular, are among coastal ecosystems most likely to be at risk from climate change (DCC 2009). Changes to sea levels, intrusion of seawater into wetlands and waterways, loss of intertidal feeding areas for shorebirds, species change, coupled with increasing human pressure on these valuable ecosystems, have potentially dire consequences for estuaries as functioning ecosystems (Rodrigue 2009).

Approximately 60 per cent of all coastal settlements in Victoria are located next to an estuary or on low-lying land associated with an estuary (Coastal Climate Change Advisory Committee (CCCAC) 2009). Developing adaptation responses that are ecologically and socially harmonious presents a significant challenge for coastal managers, planners and communities in these environments (McInnes *et al.* 2009).

While immediate action is required, there appears to a brief window of opportunity to act and adapt to enhance resilience to climate change (Newton 2009). *Resilience* is defined by Chapin *et al.* (2009) as 'the capacity of a social-ecological system to absorb a spectrum of shocks and to sustain and develop its fundamental function, structure, identity and feedbacks as a result of recovery in a new context' (p. 241). In order to build resilience, understanding the dynamics of a local social-ecological system is important (Saavedra & Budd 2009).

In order to develop adaptation responses at the local scale, case studies situated in particular places and cultures are required (Berkes & Jolly 2001). A local case study enables closer examination of how a particular community interacts with its environment and how the social-ecological unit as a whole may respond to changes (Hamin & Gurran 2009). This is a valuable approach given that it is the local people and local governments who have the opportunity to develop adaptation strategies that are best for their specific conditions and impacts (International Council of Local Environmental Initiatives (ICLEI) 2007).

The Barwon Estuary Complex: a local case study

The Barwon Estuary Complex (BEC) was the site for this study. The BEC and the township of Barwon Heads, at the mouth of the Barwon River, have been identified as a 'hot spot' for sea level rise and other climate change impacts (McInnes *et al.* 2009; J. Sherwood, pers. comm. 2009).

The BEC is located on the Bellarine Peninsula in central Victoria, approximately 90 km southwest of Melbourne. Most of the BEC falls inside the Lake Connewarre State Game Reserve (which approximates the BEC); the site occupies an area of 3411 ha (Department of Conservation and Natural Resources (DCNR) 1993). The Barwon estuary is the receiving body for the Moorabool, Leigh and Barwon catchments and meets the sea at Barwon Heads. The total catchment area extends 8590 km^2 and contains some of the most intensively farmed land in Victoria (Dahlhaus *et al.* 2007).

The BEC boasts a plethora of ecological and social values. Ecologically, the BEC is distinguished from other Victorian estuaries by a permanently open river mouth and a number of discrete and recognisable physical units (Dahlhaus *et al.* 2007), which are very different in their physico-chemical properties and biological communities (Sherwood *et al.* 1988). The distinguishing features have been described by Billows and Gwyther (2008) and include: the lower estuary of the Barwon River; Murtnagurt Swamp; Salt Swamp; Lake Connewarre; Hospital Swamp; and Reedy Lake (see Figure 1).

The BEC contains the largest remaining patch of native vegetation on the Bellarine Peninsula, and includes the western most population of the white mangrove, *Avicennia marina* var. *resinifera* (DCNR 1993). The extensive salt-marshes are considered to be of outstanding scientific interest (Yugovic 1985) owing to the large occurrence of *Wilsonia* species, which have a limited distribution elsewhere in Victoria (Dahlhaus *et al.* 2007). The site forms part of the Port Phillip

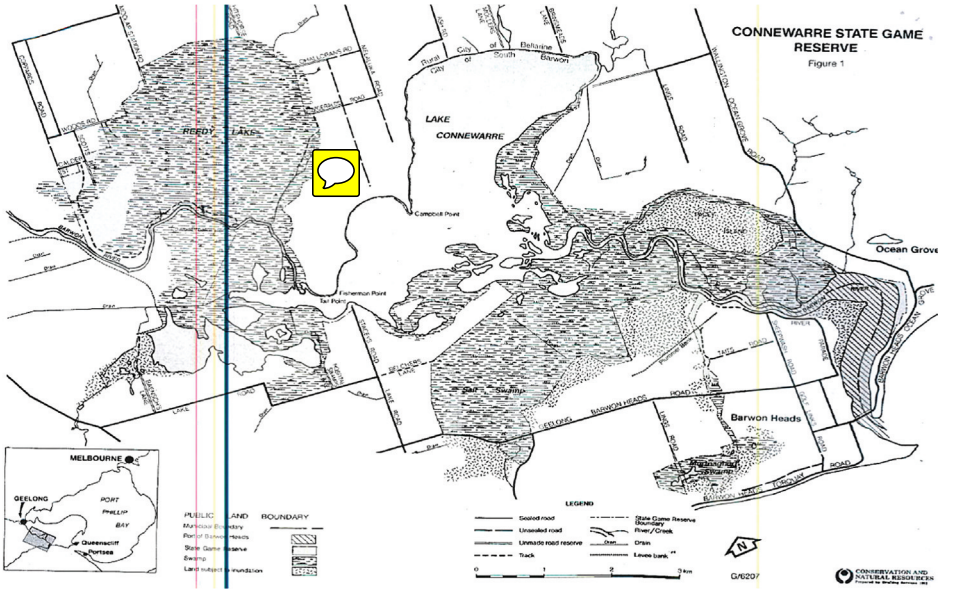

FIGURE 1. Location and composition of the Barwon Estuary Complex (DCNR 1993).

Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site and provides important habitat for the endangered orange-bellied parrot, *Neophema chrysogaster* (Department of Sustainability and Environment (DSE) 2003).

In a social context, the BEC provides important economic, recreational and cultural values. The close proximity of the BEC to Melbourne means that the site attracts large numbers of day and weekend visitors year round. The BEC is renowned for its aesthetic characteristics and has long been enjoyed as a holidaying destination by generations of Australians. The estuary complex is bordered by rapidly growing townships, such as Barwon Heads to the west, Ocean Grove to the east and Leopold in the north. This rapid population growth can be largely attributed to the 'sea change phenomenon' which was made fashionable by the 1998 ABC television series *Sea Change* filmed on the banks of the Barwon estuary. There are a number of active community groups in the region, who have an interest in passive and active recreation, as well as conservation around the BEC.

The BEC is culturally significant to the traditional land owners, the Wathaurung people. Artefact scatters and campsites can be found within the complex which are tangible evidence of human life dating back thousands of years (Testro & Brooks 2009).

Local climate change projections

The future climate of the Corangamite region, in which the BEC is located, is expected to be hotter and drier than at present. An average increase in temperature of 0.8°C is expected by 2030 (DSE 2008). Average annual runoff into the Barwon River is expected to decrease by 5–30 per cent by 2030, and runoff into the Moorabool is expected to decrease by 5–35 per cent by 2030 (DSE 2008). Further, the impacts of erosion and inundation are expected to worsen in areas such as the BEC through the processes of sea level rise and storm surge events (VCC 2008).

Overall, climate change impacts to the BEC have been acknowledged by few studies (see Sherwood 1987; McInnes *et al.* 2009). There are no studies which consider the adaptation response to climate change impacts in the BEC. This is particularly concerning on a number of levels. Firstly, the growing emergence of climate change literature identifies estuaries as vulnerable coastal communities, which are already subject to a plethora of natural and anthropogenic-induced stressors. Secondly, the BEC has been referred to as an area particularly vulnerable to climate change impacts (Sherwood 1987; McInnes *et al.* 2009). A study of southwest Victorian estuaries concluded that the greatest damage caused by rising sea levels will occur at the mouth of the Barwon estuary, where the townships of Barwon Heads and parts of Ocean Grove may suffer increased bank erosion and more frequent overtopping of retaining walls (Sherwood 1987). The chance of flooding is high, with one-third of land in the township of Barwon Heads, and a small part of Ocean Grove, having an elevation less than +2 m AHD (Australian Height Datum) (Sherwood 1987). A high tidal range in the Barwon estuary is likely to exacerbate this problem.

McInnes *et al.* (2009) reiterate the findings made by Sherwood (1987), reporting that the lower reaches of the Barwon River are already vulnerable to inundation under current climate 1-in-100-year storm tide conditions. Further, if higher end sea level rise (1.1 m) scenarios are exceeded by 2100, complete inundation of the

Barwon Heads township may occur in under 1-in-100-year storm tide conditions (McInnes *et al.* 2009).

This paper explores the issues and opportunities associated with responding to local-scale climate change impacts in the BEC, an environment that is rich in both ecological and social values. As such, the outcomes from this study should be of interest to all States and Territories.

Methodology

Measuring the biophysical changes that are likely to occur in the BEC was beyond the scope of this study. Rather, the focus was to generate discussion amongst stakeholders of the BEC about climate change, and, more specifically, adaptation responses. Stakeholder inclusion was deemed to be important in exploring adaptation responses to climate change because ultimately community 'buy-in' and support from those affected by the decision will be required (Tompkins *et al.* 2008) if adaptation responses are to be successful. In the context of climate change, adaptation responses need to be 'owned' by stakeholders and have relevance at the local scale, rather than being devised by experts at a larger scale who are potentially removed from the local social-ecological dynamics (Treby & Clark 2004).

As such, Biesbroek *et al.* (2009) suggest a transdisciplinary approach which focuses on 'the co-production of knowledge including natural and social scientists, policymakers, and the society in general'. This combining of different types of knowledge and an increasing of community participation is broadly supported in adaptation literature (Folke 2006; Norman 2009a; Saavedra & Budd 2009). This study drew on the combined knowledge, experience and interest of three stakeholder groups of the BEC:

(1) *Scientists*—those who have conducted research on the BEC (22 per cent of respondents).
(2) *Managers and planners*—those who have a role in governance and/or planning of the BEC and surrounding urban communities (46 per cent).
(3) *Community*—includes recreational groups, volunteer conservation groups and residents (32 per cent).

A total of 37 stakeholders from across the three groups participated in the research.

Stakeholders were identified through a review of publicly available websites, management plans and technical studies relating to the BEC and the region. Semi-structured interviews were conduced face to face with participants. A semi-structured interview design was chosen enabling additional questions and discussion of topics (Jude 2008). All interviews addressed three key areas: (1) perception of the BEC, including values, threats and future objectives; (2) perception of climate change impacts on the BEC; and (3) consideration of adaptation responses for the BEC and the surrounding built environment. This paper presents the results from the last theme of 'adaptation'.

Stakeholder responses to the first two themes will not be considered in detail in this paper owing to lack of space. In brief, the responses to those themes indicated that overall there was strong appreciation for the ecological values of the BEC. Twenty-eight future management objectives were identified by stakeholders, with

the greatest number of stakeholders (38 per cent) indicating the need to restore and maintain the natural values of the BEC. The climate change impacts identified by stakeholders as a threat to the BEC generally aligned with the broader predictions for the region. Interestingly, however, only a small number (15 per cent) of stakeholders noted ocean acidification as a real threat. Ocean acidification is an impact likely to have profound ecological implications in a system such as the BEC.

The complete set of results for this study can be obtained from the senior author (Scally 2010).

With regards to discussion around 'adaptation' it is interesting to note that in most cases the responses were spread evenly across the three stakeholder groups. There were few examples of one stakeholder group expressing a particular response. As such, the majority of results presented in this paper have been considered in the context of the collective group of 37 stakeholders.

Stakeholder perceptions of adaptation

To retreat, accommodate or protect?

The risk to built assets associated with climate change events can be heightened when they affect low-lying areas such as estuaries (DCC 2009). Therefore, decisions about where humans live—and in particular where new settlements are built—will need to take account of future climate risks (DCC 2010).

The DCC (2009) outlines three adaptation options for buildings: retreat, accommodate or protect.

Planned or managed retreat involves a decision to withdraw, relocate or abandon assets that are in a high-risk area. Accommodation includes a range of minor works to allow continued or extended use of at-risk areas, such as elevated floor requirements. Protection of the shoreline typically involves the construction of seawalls or other defences to maintain coastal assets in their current location (DCC 2009).

With regards to Barwon Heads and the BEC, stakeholders were asked for their thoughts on these planning options. Stakeholder views did not vary significantly across the three target groups. The major points raised by stakeholders were:

- The immediate need for responsible urban planning which considers climate change and an evolving estuarine system. Urban planning in accordance with a changing environment was the preferred primary adaptation option, as evidenced by the response from 17 stakeholders (53 per cent) to limit the use of protective defences. Protective structures were perceived to 'change the natural order' (scientist, November 2009) of the BEC, through constraint of migrating estuarine communities and altering the hydrology of the system.
- Applying the 'precautionary principle' was identified as an appropriate approach by 11 stakeholders (34 per cent). Applying the precautionary principle is a policy direction set by the VCC and implies caution be employed in planning and management decision making around the risks associated with climate change even if full scientific certainty is not possible (VCC 2008). Options such as planned retreat for the built environment may be considered a precautionary approach, which is proactive rather than 'hanging in there just in case' (local planner, December 2009).

- Retreat for the natural environment is an important consideration in the broader adaptation response, according to 22 per cent of stakeholders. As one stakeholder states: 'It's interesting that we're talking about retreat for the built environment, yet we're not seeing a lot of planning for what's starting to happen for the natural environment' (natural resource manager, December 2009). As such there is a need to identify potential areas for migration and retreat of the estuarine communities. In making provisions for a migrating estuary, identifying ecosystems that we value and want to sustain into the future may be an important part of the adaptation process. For example, one stakeholder believes that it is important to ask: 'Do we value those things? Do we want them to be there in the future? And where are we going to allow them to move to?' (Natural resource manager, December 2009).

'Community' stakeholder responses to adaptation

Amongst the community stakeholder group there was a diversity of responses raised in regards to adaptation strategies such as retreat, accommodate and protect. For example, a sense of it being 'too overwhelming' and 'too big an issue' was evident in some responses. Other community interviewees indicated that there would be attempts to protect, while another implied that 'retreat is the only option' (local resident, January 2010).

This mix of responses, illustrated in Figure 2, highlights the various levels of thinking within the community towards local climate change adaptation approaches.

The diversity of responses indicates the need to commence wider community discussions, including introducing terms such as *retreat*, *accommodate* and *protect* so that the community is well informed to participate in the decision-making and planning process. It is recognised that it will take time for the community to digest the implications associated with climate change and which adaptation responses may be most suitable for the BEC and Barwon Heads. As one local planner (December 2009) stated 'sometimes just saying the word [retreat] in 2010 is enough to get the community around to making decisions in 2020'.

Role of the relationship between local government and the general community

The general community was identified to have an important role to play in responding to local climate change impacts. Twenty-eight stakeholders (88 per cent) indicated that a 'community-based response is essential'. A 'community-based response' was perceived to include community responsibilities such as understanding the local climate change risks; identifying and providing feedback on solutions; working with agencies; being involved in the planning process; lobbying government; identifying the natural values of the BEC; and adopting a stewardship role.

The interaction between community and government, particularly local government, was also perceived to be an important part of the adaptation response. Stakeholder comments such as the following indicate the importance of a shared response between government and the community:

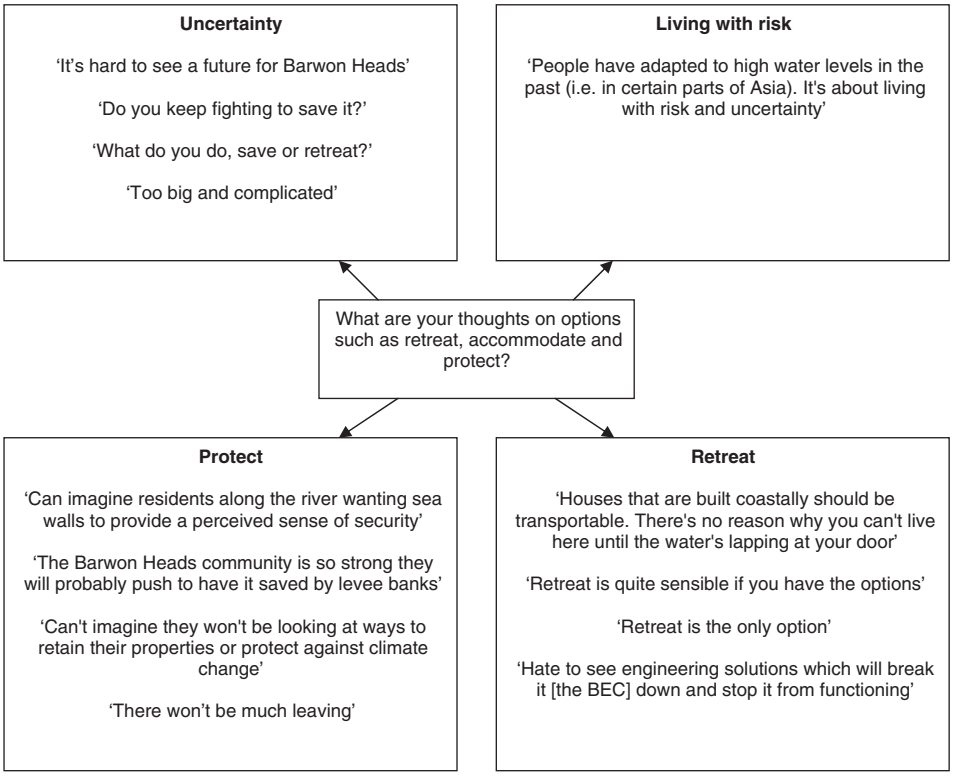

FIGURE 2. A diversity of responses from the community stakeholder group to the question 'What are your thoughts on options such as retreat, accommodate and protect?' ($n = 10$).

> We [management] don't want to be telling community what to do. We want their input as well. (Local planner, December 2009)
>
> We [management] owe it to the community to bring them along, make the information available, answer questions and develop solutions together. (Coastal planner, February 2010)

Although a shared responsibility is implied, a particularly important responsibility remains with local government to engage the community throughout the planning and adaptation process. Nine stakeholders (28 per cent) indicated that local government will be to the fore of coastal climate change and have an important role as the interface with the community. Stakeholders indicated that local government had a number of responsibilities, including identifying local risks; making the relevant climate change information available and accessible to the community; providing leadership; facilitating community engagement and education on local climate change impacts; and working with other natural resource management agencies throughout the planning process to make provisions for estuarine migration. The need for local government to provide leadership and direction is particularly important given the diversity of responses and apparent confusion which exists amongst the community around adaptation options (see Figure 2).

In order for local government to play a prominent role in the adaptation response, stakeholders indicated that greater consistency and coordination from State and

federal governments will be required. There was a sense amongst some interviewees that responding to local climate change has 'just been left to councils to sort through'; however, as one stakeholder expressed:

> Local government is reliant on state and federal government for doing this sort of broader climate change analysis and providing local government with the tools and information to take it to the next step. (Local planner, November 2009)

Four stakeholders (13 per cent) indicated the need for greater direction from the federal government in the form of a 'core set of principles'. At the State level these principles could then be broken down into policy and tools, such as overlays and zones, which local government can select from. It was perceived that this approach would ensure greater consistency across the jurisdictions:

> We need a sea level rise benchmark for Australia, in which principles can be set around and investment aligned with. Then at the state level this can be broken down into policy to provide consistency across systems and a coordinated approach. (Coastal planner, February 2010)

Cost and responsibility

There was widespread support (77 per cent) across all stakeholders for the cost and responsibility of adaptation to be shared across all tiers of government, industry and community. Support for a shared cost and responsibility is exemplified in stakeholder responses such as:

> All government organisations need to work together to develop a future strategic plan. Responsibility doesn't sit at anyone's feet. It's a range of organisations that need to work together. (Natural resource manager, December 2009)

> It resides with every single person utilising the environment in any way, which is all of us. (Scientist, December 2009)

However, three stakeholders (10 per cent) raised the question: 'to what extent is the cost shared through the whole community as opposed to the affected communities?' For example, in the case of the Geelong City Council, should citizens in Lara, inland to the north of the shire where land values are considerably less, contribute rates to fund adaptation responses for expensive coastal homes in Barwon Heads? As one stakeholder put it:

> I can see a lot of issues in rating the people of Lara to build sea walls in Barwon Heads. I don't think it's going to happen. (Local resident, January 2010)

As such, understanding risk is an important part of determining cost and responsibility. Three (10 per cent) stakeholders identified the need to understand risk and how much risk the community is prepared to live with. One coastal planner (February 2010) indicated that living with risk is 'not a new phenomenon' and that climate change is 'just another type of risk'. This leads to questions such as 'how much risk are we prepared to live with?', as stated by one stakeholder:

> Maybe we're prepared to live with a flood once every 20 years. That's probably only four in your lifetime. Do we care that much given that we live where we live? (Coastal planner, February 2010)

Playing an important role in the risk assessment process and issues of cost will be insurance companies. Surprisingly, this was discussed by only three (10 per cent) stakeholders. This group of stakeholders indicated that insurance companies will play an increasingly influential role in accepting or rejecting individual claims to climate change impacts, as well as providing insurance to homes in vulnerable areas. Insurance companies may ultimately be the catalyst that mobilises the community, and, as one stakeholder stated:

> No one is going to lend money to someone to build a house if they can't secure insurance. Ultimately there will be a free market solution to all this. (Local resident, January 2010)

The issue of insurance is one that has been discussed at length in the House of Representative's inquiry into coastal climate change (HoR 2009). A number of submissions to the inquiry noted concerns around insurance coverage for coastal areas and the inevitability of major changes to the extent to which the insurance industry will be prepared to cover properties in the future. In response to this situation the Insurance Council of Australia (ICA) highlights the importance of building community resilience to climate change impacts (HoR 2009).

Limitations to adaptation in the BEC

A number of limitations have the potential to impede the adaptation response in the BEC (see Table 1).

Nineteen stakeholders (58 per cent) indicated that financial and resourcing constraints were a potential limitation to the local adaptation response. In the context of natural resource management, stakeholders implied that the present level of funding is inadequate. Human resourcing was also identified as a limitation. For example:

> Dollars are important, but you need to have the people on the ground to be able to apply those dollars effectively. (Natural resource manager, November 2009)

Confusion and lack of coordination between the management agencies of the BEC was perceived to be a limiting factor by 18 stakeholders (55 per cent). In response to the mix of agencies with some management or planning responsibility in the BEC, stakeholders identified the need for a 'central agency' to coordinate the adaptation process:

> Having a central body that has the mandate to work with other departments and bring them on board is the key. (Scientist, December 2009)

Seventeen stakeholders (52 per cent) identified community attitudes and expectations as a limiting factor. As one stakeholder indicated:

TABLE 1. Stakeholder responses to the question 'Can you identify any factors which may limit the adaptation response to climate change in the BEC?' ($N = 33$)

Limiting factor	Percentage of stakeholders who identified the factor
Finance and resources	58
Management confusion/lack of coordination	55
Community attitudes and expectations	52
Lack of knowledge about climate change	39
Lack of expertise/skilled professionals	15
Lack of coordination between community groups	9
Issues of cost and responsibility	9
The land tenure system	9
Lack of focus on marine and estuary environments	6
The physical composition of the BEC	6

> There are pretty entrenched community attitudes to what they [the community] want the system [the BEC] to be. (Scientist, February 2010)

Lack of knowledge about climate change was perceived to be a limitation by 13 stakeholders (39 per cent). In particular, stakeholders identified a paucity of climate change information and understanding at the local scale:

> You don't know what's going to happen. There's uncertainty out there. As a result of uncertainty, you don't really know what to do, so you just sit tight. (Local resident, January 2010)

These limitations identified by stakeholders have the potential to significantly impede the local adaptation response. While these limitations present a significant challenge to managers, planners and the community, they are not isolated to the BEC. Tompkins *et al.* (2008) note that inadequate knowledge, potentially high costs and lack of local community spirit can limit the implementation of local adaptation responses.

Implications from the BEC study for other local coastal communities

Climate change challenges traditional thinking around natural resource management and planning of coastal settlements and environments (Pizarro 2009). No longer can the coast be considered a static entity for the purposes of planning and management, and the consequences of future climate change must now be considered (McInnes *et al.* 2009).

Accordingly, this study considered adaptation responses to climate change in the BEC. Stakeholder perceptions of climate change impacts and adaptation responses in the BEC have been investigated. This has provided a valuable insight into the current thinking of the local community, researchers, coastal managers, planners and policy makers in regards to climate change adaptation in a local coastal community.

In terms of the built environment, the desire to develop sound, environmentally responsible adaptation plans was evidenced by the response from 53 per cent of stakeholders to limit the use of hard defences and rather adapt to a changing estuarine environment. This is supported by the DCC (2009), which reports that protective

structures can lead to a false sense of security, encourage greater development, and should be considered as a long-term option only as part of a wider management plan for the area. In the BEC, this is particularly important in that the construction of sea walls to protect Barwon Heads from an advancing sea may 'squeeze out' valuable intertidal communities such as mangroves and salt marsh (Erwin 2009).

Planned retreat, identified as a responsible approach by 34 per cent of stakeholders, is often the most cost-effective approach and can involve a mix of regional planning, constraints on property title, financial instruments and insurance incentives (DCC 2009). For environments such as the BEC, planned retreat may be the most 'environmentally harmonious' approach, allowing for the continued natural migration of estuarine communities landward—provided such areas are identified early in the process and can be adequately reserved through planning processes.

However, discussion on the topic of adaptation responses such as retreat, accommodate and protect drew a diverse range of responses from the community stakeholder group. The diversity of responses suggests that community engagement on alternatives of climate change adaptation is critical (DCC 2009) and may well be provocative and confusing.

There is a significant role for local government to play in initiating discussions with the community, as indicated by 28 per cent of stakeholders in this study. This is important so that the community can anticipate change, appreciate a dynamic and changing estuarine environment and be empowered to respond in the most sustainable way (Saavedra & Budd 2009). In order to adapt to the changes through accommodation and ultimately planned retreat, as opposed to more reactive measures such as sea walls, requires careful communication and consultation if they are to gain widespread public acceptance (Jude 2008). Even though early community consultation suggests there could be opposition to the adoption of some responses (DCC 2009), providing the information and discussing potential options now is important if ultimately there is to be community buy-in and ownership (Treby & Clark 2004). As one stakeholder indicated: 'sometimes just saying the word in 2010 is enough to get the community around to making decisions in 2020' (local planner, December 2009).

At present, however, a lack of direction at the State and federal level around climate change adaptation is a significant limitation for local governments and coastal managers, who feel it has 'been left to them to sort through'. Four stakeholders indicated the need for a 'core set of principles' and overall greater direction from the national and State governments. National benchmarks may assist to enhance the confidence and consistency of decision making, and to facilitate more coordinated State and local action (Norman 2009b; Smith *et al.* 2009). This is acknowledged by the DCC (2009), which reports that 'an effective adaptation agenda will need to include national standards and benchmarks, information and tools for decision-makers, better understanding of risks to critical infrastructure and enhanced local capacity to manage on-ground impacts' (p. 8).

At the local scale, the adaptation response in the BEC may be impeded by a number of other limitations, such as financial and resourcing constraints, lack of skilled personnel and community expectations. Confusion and lack of coordination between agencies was also identified as a significant limitation by 55 per cent of stakeholders. This issue seems to be common to many estuaries in central west Victoria; as the Western Coastal Board (WCB) (2005) states: 'there are so many

government agencies making decisions and undertaking activities that affect estuaries that it could be said that they are under the management of almost everyone, but under the guardianship of no one'. In response, the need for a central coordinating body to manage the adaptation response was identified. This is reiterated by Heller and Zavaleta (2009) who indicate that adaptation requires improved regional institutional coordination.

In summary, the adaptation response to climate change impacts in the BEC, which are likely to be common to many coastal communities, requires greater attention for such things as urban planning for future and existing developments in consideration of a changing estuarine environment, direction and support from State and federal governments, and local management coordination. However, the most resounding outcome of this study is the need for greater community engagement on issues of adaptation for the built environment around the BEC. It is particularly important that discussions occur now, as it will take time to build community understanding and ultimately acceptance of adaptation responses which are both environmentally and socially responsible (DCC 2009). It will also take time for the community, in collaboration with local managers, planners and scientists, to frame questions such as 'what do we value?' and 'how much risk are we prepared to live with?' It is important that the community, coastal managers and planners interact to define these questions. The time to start doing this is now.

Conclusion

The results of this research indicate that while there was general agreement on the issues surrounding the impact of climate change on the BEC, there is a lack of consensus at the community level in considering where to next.

The confusion around what steps to take next is illustrated in the diversity of responses from the community stakeholder group. This uncertainty stresses the need to engage the community now on issues of climate change adaptation. As it stands, the present level of confusion will make it difficult for any government responses (whether it be at the local, State or federal level) to be met with support (DCC 2009). Community understanding and support is essential in determining whether adaptation responses will be met with progression or resistance. Hence it is at the local level where considerable education and communication efforts need to be focused, and adaptation actions defined with community input (Hamin & Gurran 2009).

A case-by-case approach allows for greater community contribution, resulting in a more detailed understanding of which adaptation responses may be suitable for that individual environment and community. Adaptation responses, which are devised in collaboration with the community and in consideration of the local environment, are likely to be met with less resistance, and overall greater community acceptance and ownership (Treby & Clark 2004).

Consequently, there is a need for governments to identify vulnerable coastal environments and communities now, so development of adaptation responses at the local scale can commence. Governments will also need to examine methods of approaching and discussing with the community the various options available in a manner which does not inflame local communities. The potential use of non-government organisations and 'network' coordinators (e.g. modelled on the

Marine and Coastal Community Network's regional coordinators) may be useful investigations.

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