Beach and Surf Tourism and Recreation in Australia: Vulnerability and Adaptation

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Non-technical summary

2010/536	**Beach and surf tourism and recreation in Australia: Vulnerability and adaptation**

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OBJECTIVES:

1. Locality scale identification and assessment of the vulnerability to climate change of assets that are key drivers of marine and coastal tourism and recreation.
2. Valuation of existing income streams due to beach-related tourism and recreation in case-study locations
3. Application of valuation tool (developed in previous stage) in identified sea-change localities to test transferability of results
4. Identify social and behavioural responses to climate change impacts on vulnerable tourism and recreation assets.
5. Report on the net vulnerability of regional locations to climate change.

OUTCOMES ACHIEVED TO DATE

The project outputs have contributed to or will lead to the following outcomes:

1. Case studies of beach and surf-related recreation and tourism activities and values in four coastal locations chosen to represent different levels of development, reliance on tourism revenues, vulnerability to climate change and adaptive capacity.
2. Estimates of the economic values associated with beach and surf recreation and tourism in each of the four case-study coastal locations and the potential losses under climate change scenarios.
3. The project expanded the availability and temporal relevance of estimates of the economic value of beach and coastal assets in Australia, roughly doubling the number of available estimates for use in desktop assessments. The case-study sites were chosen to improve the geographic scope of available estimates and to explore the regional influence of these value estimates.
4. Development of a classification framework to provide an enhanced means of transferring these values to other policy sites, where empirical estimates are not possible due to resource constraints.
5. The economic value estimates and qualitative information regarding the importance of natural and built attributes are currently being used by local government partners in the case-study locations to provide better data for decisions relating to the management of key coastal assets and features in their respective regions. This will ensure that recreation and tourism values are recognised and given appropriate weighting in management decisions.

The Beach and surf tourism and recreation in Australia: Vulnerability and adaptation project has produced estimates of economic values for recreation and tourism related to beach and surf amenities across four case-study locations in Australia. Estimates of the non-market consumer surplus values of beach recreation indicate that beach recreation is worth around: $70 million per annum (p.a.) to residents of the Sunshine Coast (Qld), $32 million p.a. to residents of Clarence Valley (NSW), $6 million p.a. to residents of the Surf Coast (Vic) and $4 million p.a. for residents of Augusta-Margaret River (WA).

In addition to the non-market values, real market expenditures are incurred by tourists in order to visit and stay in coastal locations. The value of this tourism expenditure that is specifically related to beach and surf recreation is estimated to be in the order of: $270 million annually for the Sunshine Coast (Qld), $32 million p.a. for Clarence Valley (NSW), $107 million for the Surf Coast (Vic) and $25 million for the Augusta-Margaret River (WA) region.

Market expenditure specifically associated with tourist use of beach and surf recreation amenities is estimated at between 2% and 13% of gross regional product across the four case study regions.

Potential beach-related recreation and tourism losses associated with climate change may be substantial. Current projections indicate that climate change will result in long-term beach recession and more frequent erosion events in some regions. Resident survey responses to scenarios about beach damage suggest that between 25% and 35% of residents' consumer surplus values for beach recreation could be lost as a result of major erosion events. Loss of recreation values on this scale would equate to a minimum $18 million p.a. on the Sunshine Coast and $10 million p.a. in the Clarence Valley. Tourist responses to similar beach damage scenarios suggest that between 17% and 23% of tourists would respond to major erosion events by switching to other destinations. Loss of tourism receipts on this scale would equate to losses of approximately $56 million p.a. on the Sunshine Coast and $20 million p.a. on Victoria's Surf Coast. The time taken to repair the damage is critical and rapid action by authorities can reduce the duration and extent of these losses considerably.

Coastal managers may utilise a menu of adaptive management strategies to minimise the economic losses associated with climate change impacts on beaches. These include increasing resilience of beaches and increasing beach recreation space through beach nourishment and enhancement of beachside parks; increasing supply of alternative recreation sites such as estuary, river, and reservoir beaches, and; management of user expectations and behaviour through information provision.

KEYWORDS: economics, beaches, climate adaption, recreation, tourism.

List of acronyms

AHD	Australian height datum
A-MR	Augusta-Margaret River
AR3/4	Third/Fourth Assessment Report of the Intergovernmental Panel on Climate Change
BASTRA	Beach and surf tourism and recreation in Australia: Vulnerability and adaptation
BFT	Benefit Function Transfer
BT	benefit transfer
CBA	cost–benefit analysis
CS	consumer surplus
DBT	Direct Benefit Transfer
EGS	ecosystem goods and services
ESD	ecologically sustainable development
GRP	gross regional product
IPCC	Intergovernmental Panel on Climate Change
LGA	local government area
NSW	New South Wales
RO	research objective
SLR	sea-level rise
SLSA	Surf Life Saving Australia
TAR	Third Assessment Report of the Intergovernmental Panel on Climate Change
TCM	travel cost method
TEV	total economic value
TRA	Tourism Research Australia
UNWTO	United Nations World Tourism Organization
UVT	Unit Value Transfer
WTA	willingness to accept compensation
WTP	willingness to pay

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Adjunct Professor Jack Carlsen from Curtin University, Western Australia, facilitated the project case study in Augusta-Margaret River and assisted with survey design and administration.

1 Background

The project 'Beach and surf tourism and recreation in Australia: Vulnerability and adaptation' (BASTRA) aims to improve the understanding of current beach recreation values and how these values might be altered by climate change over the remainder of this century. Further, it aims to develop tools that will assist coastal planners and decision-makers to assess the economic impacts of climate change on recreational use values in their area and make more informed planning decisions.

The BASTRA research team has significant experience in working with coastal decision-makers and stakeholders at local, state and national levels. Discussions with these groups identified a clear need for greater availability of information to facilitate selection of adaptation responses to projected climate change impacts. In particular, municipalities are challenged by how to put in place a transparent decision-making process in order to balance competing social, economic and environmental interests within the coastal zone. The impact of coastal climate change hazards compounds these issues.

The team has recently completed a number of beach valuation projects in Sydney and at the Gold Coast that provide an improved understanding of the economic impact and value of coastal zones to local communities as well as the social and cultural importance of these assets. These projects identified a need to extend this work to better understand the social and economic aspects of selecting adaptation options, including the consideration of innovative funding mechanisms to implement adaptation strategies.

The BASTRA project is designed to address these needs by beginning the development of a nationally transferable classification system for beach and surf tourism and recreation assets. This project identifies and values selected coastal assets in regional locations, identifies social and behavioural responses to changes in the quality and availability of these assets, and ultimately reports on the net exposure of coastal tourism and recreation destinations, including exploration of recreation-specific adaptation options. We believe that the project design and staged process provides results that are nationally or even internationally transferable. The tools used will provide decision-makers and coastal communities with a framework to make better-informed and more inclusive decisions for local communities. We have also received requests for both the results of these studies, and to expand the study to other locations which do not have the resources to pursue similar studies independently.

This project provides a classification of beach and surf assets in key 'sea change' locations chosen for their vulnerability to projected climate changes. It also estimates the existing economic importance of critically vulnerable beach and surf assets. Understanding the economic streams emanating from tourism and recreation linked to these assets, and how changes in resource quality and accessibility will impact on these streams at various time horizons and under different climate change projections will allow communities, industry and decision-makers to make better-informed decisions. This project goes part of the way to answering these questions by exploring: the factors which determine tourism and recreation behaviour, particularly selection of destinations; the economic consequences that flow from changes in behaviour; and the manner in which key stakeholder and user groups might respond to projected climate change scenarios.

2 Need

This BASTRA research project arose from the realisation that coastal resources, and particularly those that contribute to beach and surf tourism and recreation, are facing a number of concurrent threats to both their management and use. These include storm impacts, congestion through rapid population increases in regional coastal locations, and climate change impacts such as shoreline recession and inundation. Understanding the economic importance of recreation and tourism in these locations leads to more-informed decisions about their management and protection for both current users and future generations.

2.1 What are beach and surf tourism resources?

Most of the terms in this paper are in common use and yet there are significant discrepancies between formal definitions. This applies even to geographic features such as 'the beach', despite being an iconic element of Australian culture. According to Short (2006), Australia has 10 685 beach systems incorporating approximately 15 000 kilometres or about half the coastline.

The term 'beach' is typically applied to a shore with a cover of unconsolidated sand or shingle (Shepard, 1937). Most recreation users would relate to the description of a beach as '... a stretch of sand longer than 20 metres and remaining dry at high tide' (Australian Government, 2007), however this is inadequate as a framework for beach management. The geomorphology literature describes the beach as a system that extends '... from the landward limit of the swash to the depth at which wave action ceases to be a component to transport non-cohesive seabed sediment' (Hardisty, 1990). Similarly, Section 4 of the *NSW Coastal Protection Act 1979* describes a beach as '... the area of unconsolidated or other readily eroded material between the highest level reached by wave action and the place where tidal or lake waters reach a depth of 10 metres below Australian Height Datum' (Coastal Protection Act, 1979).

This research focusses on beaches as recreation environments and the potential impacts of climate change on recreational activities and values. Thus, we argue that beaches are part of a dynamic system reliant on both the surf zone, which may extend many metres out to sea, and on the landward coastal dunes for transport and storage of sand (Dugan et al., 2008). The distribution of sand within this dynamic system is almost certain to be affected by changes in sea level and storm activity associated with climate change. Furthermore, as a leisure environment, it is also almost impossible to separate the surf zone from the tidal part of the beach and from the dunes at the back of the beach, because people move freely between these zones while engaging in a broad range of passive and active recreation activities. This paper therefore adopts a definition of the beach as 'a system that extends seaward to the depth at which wave action ceases to impact on seabed sediments and landward to the practical limit of the beach/dune system formed by a vegetation line or built structure such as a wall'. As such, the beach system incorporates a range of environments that supports both active and passive forms of recreation stretching from the near-shore surf zone and swimming areas to the beach and back beach (Figure 1).

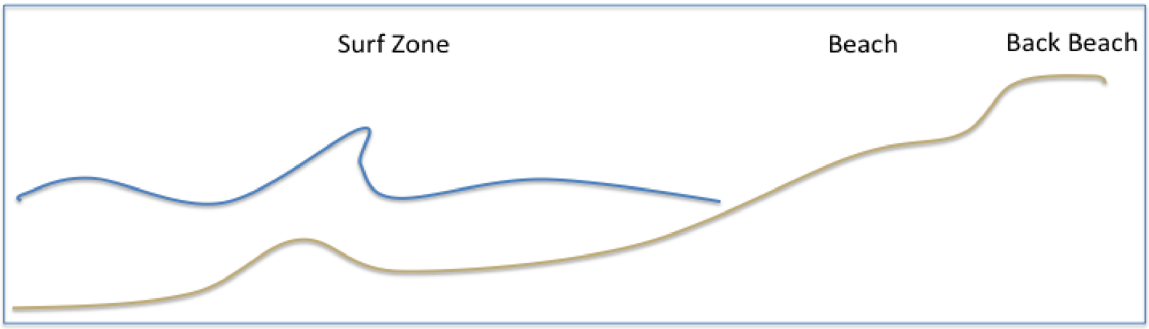

Figure 1 Beach zones and definitions

Key

Surf zone – from the low watermark to the seaward extent of the breaking wave zone

Beach zone – from the low watermark to the frontal dune

Back beach – landward of the frontal dune

2.2 Use of beach and surf resources for recreation and tourism

Defining the difference between residents and tourists is related closely to the difference between recreation and tourism. Recreation activities are those activities undertaken during leisure time (Lynch & Veal, 2006) and the beach system provides a wide variety of active (walking, running and swimming) and passive (sunbathing and relaxing) recreation services. These services are consumed by both local residents and short-term visitors to a coastal region, and are frequently a major motivator of long-term migration into a region and of short-term visitation. Thus, recreation services associated with beaches create substantial economic value and economists look to market and non-market approaches to provide indicators of the economic value of those recreation services.

Although there is no single tourism industry, tourism as an economic activity;

'... comprises all of the inter-related activities that are required to produce goods and services for consumption by tourists. This includes transport, accommodation, education, retailing, cultural and recreational services' (Commonwealth of Australia, 2010).

As tourism services are defined according to who consumes the outputs, a clear definition of what constitutes a tourist is essential for making measurements and comparisons. Most countries have adopted the United Nations World Tourism Organization (UNWTO) standard definition of a tourist as a person who travels outside their 'usual environment' for less than a year for reasons other than employment (United Nations World Tourism Organization, 1994, p. 7). Thus, tourism involves travel for leisure and also for business, employment and education.

To remove the ambiguity of the term 'usual environment', the Australian Bureau of Statistics and Tourism Research Australia (TRA) identify individuals that qualify as tourists by distinguishing between overnight and daytrip visitors. Overnight visitors must travel more than 40 kilometres away from home to be called a 'tourist', and daytrip visitors must take a round trip of more than 50 kilometres from their home to qualify (Australian Bureau of Statistics, 2010; Tourism Research Australia, 2011). Both these categories of tourist, and their associated expenditures, are relevant to beach communities.

2.2.1 *Importance of beach and surf resources to residents*

The services provided by beach systems act as a strong attraction for local residents. Small and Nicholls (2003) estimated that in 1990, 23% of the global population lived within 100 kilometres of the shore and this zone had three times the global average population density. They also demonstrated that densities are highest close to the shoreline and at low elevation (Small & Nicholls, 2003). This was despite the extensive availability of unpopulated, low-elevation land at high latitudes (polar regions) that reduced the weighted densities (population divided by available area at that elevation or proximity) for both low-elevation and coastal lands. Notwithstanding this statistical anomaly, more than 100 million people are thought to reside within one metre of mean sea level (Zhang, Douglas, & Leatherman, 2004).

This effect is even more pronounced in Australia. Australians have a strong geographical affinity for the coast, with approximately 85% of the Australian population living within 50 kilometres of the coast (Australian Bureau of Statistics, 2004). Around 50% of residential addresses are located within seven kilometres of the coastline, and around 6% in the zone that is less than five metres above mean sea level and within three kilometres of the coast (Chen & McAneney, 2006). Net migration to the coast is expected to increase the proportion even more in the future (National Sea Change Taskforce, 2006). Population growth in the coastal zone has also rapidly outstripped that in other areas (Greve, Cowell, & Thom, 2000). This has resulted in rapid coastal development which brings management challenges and also restricts the available climate change adaptation options. To a large extent, the settlement pattern is driven by the recreational opportunities and perceived quality of life benefits associated with coastal areas (Gurran, Hamin, & Norman, 2008). Australia's coastline is arguably our most important recreation resource.

2.2.1 *Importance of beach and surf resources to tourists*

Tourists have long been drawn to the beach and the commercial activities that service tourists needs have become the primary source of regional income and jobs in many coastal locations. The attractive nature of beaches generates substantial tourism earnings, which are concentrated in coastal regions (Y. L. Klein, Osleeb, & Viola, 2004). These income streams are potentially threatened by changes in the quality and extent of the beach systems on which they depend (A. Jones & Phillips, 2007).

The coastline is a major drawcard for domestic and international tourists in Australia. Approximately 22% of all domestic overnight trips (including trips taken primarily for business reasons) involved a visit to the beach or coast (Tourism Research Australia, 2013) and 62% of international visitors to Australia report beach visits/recreation as one of their most important holiday activities (Department of Foreign Affairs and Trade, 2008).

Coastal recreation resources are in the front line of events forecast to occur as a result of climate change. Beaches made from dynamic and easily transported sediments (e.g. sand, silt) are especially vulnerable to sea-level rise, changes in storm intensity and frequency. All of these contribute to erosion. In addition, forecast changes in average temperatures and precipitation will also affect recreation use of coastal assets.

2.3 Impact of climate change on beach and surf recreation and tourism

Climate change is likely to exacerbate existing coastal management challenges and this understanding was a major motivator for this study. Table 1 outlines a range of potential climate change impacts on the coast.

Table 1 Direct and indirect climate change impacts on beaches
(Adapted from Aboudha & Woodroffe, 2006)

Climate change (driver)	Principal direct physical and ecosystem effects	Potential secondary and indirect impacts
Sea-level rise	Increased inundation of coastal zone	Disruption of coastal economy, tourism impacts
	Increased coastal erosion	Displacement of residents in impacted areas
	Increased risk of flooding and storm damage	Damage to coastal infrastructure
	Saline intrusion into surface and groundwater	Health impacts associated with water quality changes
Altered wave climate	Increased wave run-up	Enhanced erosion
	Altered erosion and accretion balance	
Storm frequency and intensity changes	Increased wave heights, run-up and storm surge	Increased storm damage
	Southward shift in cyclone zones	
Ocean acidification	Impacts on reef-building corals	Reduced storm protection function, less resilient and functional reefs

Beaches are complex systems which provide a range of ecosystem goods and services (EGS). Given beaches exist at the interface between terrestrial, marine and atmospheric systems, they have the potential to be influenced by a suite of processes in response to climate change. In Australia, these changes are likely to include increased variability of rainfall, an overall reduction in rainfall, increased air and water temperatures, changes in ocean circulation and wave direction patterns, and increased storminess (Aboudha & Woodroffe, 2006; CSIRO, 2002; Ranasinghe, McLoughlin, Short, & Symonds, 2004). Indirect impacts could include increased algal growth, changes to terrestrial nutrient inputs to estuarine systems and disruption of the symbiotic relationship essential for the formation of coral reefs (Aboudha & Woodroffe, 2006). Each of these is associated with different ranges and degrees of uncertainty (IPCC, 2007b), which is a complicating factor for any climate change adaptation strategy (CSIRO, 2002).

2.3.1 *Sea-level rise*

In 2007, the Intergovernmental Panel on Climate Change (IPCC) released the Fourth Assessment Report (AR4). It predicts that global sea levels will rise between 18 and 59 centimetres by 2090–2099 compared to 1999 levels (IPCC, 2007c). As is widely reported, this does not include the inputs due to melting of terrestrial ice sheets, because the climate science community could not agree on the magnitude or timing of this contribution. The IPCC estimates this will add approximately 10–20 centimetres to global sea levels (IPCC, 2007a).

Superimposed on global eustatic sea-level rise[1] (SLR) is regional variability, but although it is important in determining local impacts, projections are subject to greater uncertainty (Christensen et al., 2007). In the case of south-eastern Australia, strengthening of the East Australian Current is likely to lead to a contribution of around 12 centimetres of additional global SLR, relative to the global average (McInnes et al., 2007). These additional amounts bring the upper end of the global SLR projection envelope for the New South Wales (NSW) coast to around 91 centimetres.

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[1] Eustatic sea-level rise is the change in global average sea-level attributed to changes in the volume of the world's oceans.

On the east coast of Australia, this may be coupled with an increased frequency and intensity of large storm systems (Australian Government, 2009). These are expected to have a range of impacts, including shoreline recession and more frequent coastal flooding. This is likely to be enhanced by an increased variability and overall reduction in rainfall, which will reduce the extent of coastal systems such as saltmarsh, and their capacity to mitigate flood impacts (AGO, 2006).

Work by prominent author Stefan Rahmstorf on the most recent IPCC report has suggested that SLR may be significantly underestimated by current climate models. The results of his semi-empirical analysis suggest a global eustatic SLR of between 0.5 and 1.4 metres by the year 2100 (Figure 2) (Rahmstorf, 2007).

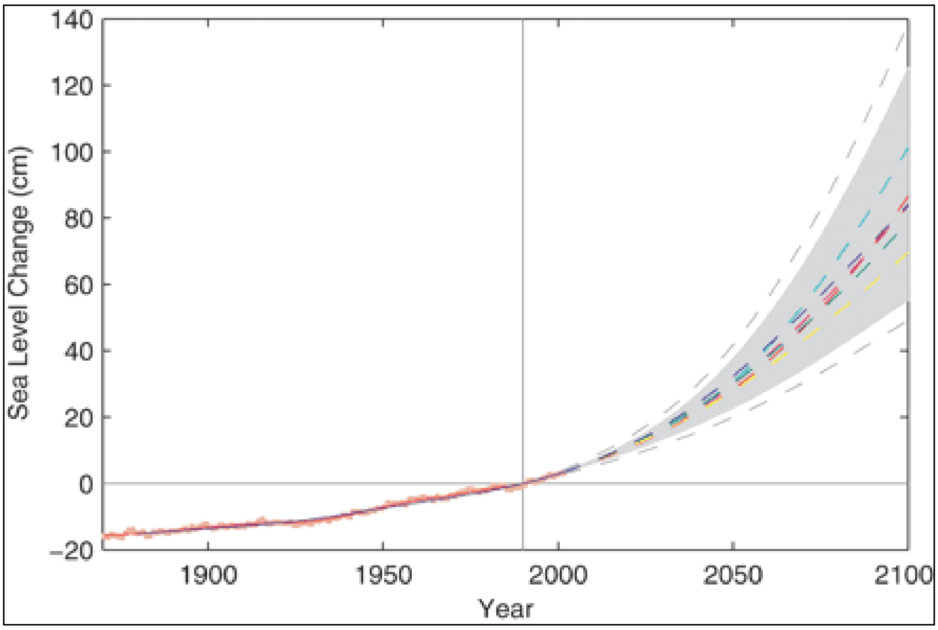

Figure 2 Sea-level rise projections based on the temperature change scenarios of the IPCC Third Assessment Report (TAR).

(Dashed lines – different temperature scenarios of the IPCC TAR, red line – trend of observed sea level, grey area – range)

This was further updated by Grinsted et al., who extended a semi-empirical approach to the past 200 years, and also estimate future SLR by 2100. Their estimation (see Table 2, p. 469 in Grinsted et al., 2010) is that IPCC estimates of SLR may be only one-third of the possible rate by 2090–2099, (Grinsted, Moore, & Jevrejeva, 2010). This rate of SLR can only be explained by the rapid decay of large ice shelves posited for Greenland based on paleoclimatic records (Overpeck et al., 2006). Another recent study estimated the physical constraints on glacial supply of water to the ocean based on the cross-sectional area of the glacier and potential flow rates, and found bounds that are consistent with these higher rates of SLR (Pfeffer, Harper, & O'Neel, 2008).

This range appears to be supported by recent observations of sea level which indicate that the rate of rise is accelerating (Church & White, 2006; Rahmstorf et al., 2007). The observed SLR (shown by the red trendline in Figure 2) indicates that sea levels are already tracking towards the upper end of the range of projections from the Third Assessment Report (TAR) (Rahmstorf, et al., 2007). This is cause for some concern, as the thermal inertia of the oceans means that SLR will begin slowly and then accelerate (Walsh et al., 2004). Thus we may experience greater rates of SLR than we are currently anticipating, even under the most pessimistic emission scenarios.

However, some reports show that SLR may not be tracking as projected by IPCC modelling. Records from Australian tide gauges do not generally reflect the projected acceleration of SLR (Watson, 2011), although there is some debate about the statistical methodology employed in the analysis (Baart, van Koningsveld, & Stive, 2011).

Despite uncertainty about the exact magnitude of SLR, the direction of change is clear and the precautionary principle requires action even in the absence of scientific certainty (Brundtland, 1987). This principle is a critical component of ecologically sustainable development (ESD), which is a key objective of much environmental legislation pertaining to coastal management in Australia, and hence there is a legislative requirement to respond to SLR.

2.3.2 *Implications for coastal resources*

One of the most likely and immediate climate change impacts is an increase in sea level, which has the potential to critically impact the state and function of coastal systems (Australian Government, 2009; CSIRO & NSW Government, 2007). Although there are current investigations and reports on a number of aspects of marine tourism (e.g. diving, fishing and whale watching), there is no national study on the tourism and recreation values of beaches, arguably the most valuable and threatened coastal tourism asset.

Previous work in Sydney and on the Gold Coast has highlighted the social and economic importance of beaches for tourism and recreation in Australian coastal cities (Anning, 2012; Lazarow, 2009, 2010; Lazarow, Miller, & Blackwell, 2008; Lazarow, Raybould, & Anning, 2013; Raybould, 2006; Raybould & Lazarow, 2009; Raybould, Lazarow, Anning, Ware, & Blackwell, 2011; Raybould & Mules, 1999), but the recreation and tourism values are related to the condition of these assets.

2.3.3 *Implications for coastal tourists and recreational users*

In order to fully understand the impact of climate change on beach users and tourists to coastal locations, it is important to understand the factors that are critical in their decisions about when, where and how often to use these resources. Climate change projections suggest a number of potential outcomes for beach users, and these are summarised in Table 2.

Table 2 Climate change impacts on coastal tourism and recreation

Climate change projection	Hazards	Consequences	Implications for recreation
Precipitation	Drought Increased intensity	Water scarcity Temporary inundation	Increased costs for asset managers may result in reduced service quality and availability
CO_2	Ocean acidification	Loss of biodiversity	Reductions in fish stocks accessible to recreational fishers Reductions in marine flora and fauna encounters for scuba divers
Sea surface temperature	Algal blooms	Coral bleaching Eutrophication	Reduced water quality limiting direct water contact activities Reductions in marine flora and fauna encounters for scuba divers
Sea-level rise	Erosion	Coastal	Changes to beach width and profile

	Inundation	recession Infrastructure damage	Changes to sediment availability for bar formation impacting on surf quality Increased costs for asset managers may result in reduced service quality and availability
Wind and wave	Erosion	Beach rotation Coastal recession Infrastructure damage	Nuisance of increased wind and sand to beach users Changes to wave quality for surfers
Storm intensity	Infrastructure damage		

2.4 **Policy definition of climate change impacts and adaptation responses**

Regardless of the level of certainty and accuracy about climate change projections, coastal managers and decision-makers must respond to the policy context in which they operate. This typically occurs at the state government level, where policy definitions of planning zones and management processes that must be adhered to in order to obtain funding typically dictate the response to climate change projections at the local level. In response to these challenges, some difficult decisions must be made about the use and management of coastal resources. In terms of the response to SLR and associated shoreline recession and increased impacts of storm-induced erosion, these decisions are typically framed as a choice between the options of protection, adaption or relocation (IPCC, 1990; Klein et al., 2001). Each choice brings with it costs and benefits, hence there must be a clear consideration of both before a good decision can be made (Walsh, et al., 2004), and thus information about these costs and benefits is required.

For a number of reasons, ranging from the political to the practical, some form of coastal protection is likely for urban coastlines in Australia (Lipman & Stokes, 2003). Given the large investments required, in many cases this will involve the use of formal decision support tools, with the most prevalent in Australia being cost–benefit analysis (NSW Government, 2007). This method requires quantification of all the costs and benefits in monetary terms such that the process adequately addresses environmental and social issues (Hanley, Shogren, & White, 2001). Valuing environmental resources such as beaches is a potentially controversial issue, particularly given the strong cultural association of Australians with the beach (Australian Government, 2007). Nevertheless, all decisions require trade-offs, and where these decisions involve environmental resources, logic would dictate that it is best practice to ensure that these trade-offs are made with a sound understanding of the benefits and costs of each potential course of action.

2.5 Assessing the adaptation options – need for economic information

In Australia there is very little data on how people use the coast for recreation, and the extent to which they value this asset, and even less data on how these values might be threatened by climate change. Current projections by the IPCC (IPCC, 2007a) and CSIRO (CSIRO & NSW Government, 2007) indicate that coastal communities will be forced to adapt to changing climatic conditions this century.

In Australia, adaptation decisions relating to the coast and beaches are frequently made at the local community level by local governments which have primary responsibility for shoreline management. Currently there are gaps in recreation value information and few case studies of adaptive responses that can guide local communities in coastal planning and management decisions.

In order to adequately consider the importance of recreation and tourism in coastal policy decisions, estimates of the economic value of beach recreation are required. However, few empirical studies of beach recreation in Australia exist, and hence values are typically transferred from previous studies conducted elsewhere. This is known as the benefit transfer (BT) process.

2.6 The benefit transfer process

The BT process essentially involves transferring values from one or more studies in other locations (study site/s) to the location under consideration in the policy appraisal process (the policy site). There are four stages in the process:

1. **Identification of impacts that need to be valued**. This step is critical in the BT process, as it is important to ensure that the correct valuation metric and method is chosen. For example, a planning decision relating to coastal rating processes may be most appropriately valued with a hedonic pricing approach, whereas a decision about investment in beach access points would typically be valued through a site-specific travel cost survey.
2. **Identification of existing estimates of value.** This process has been greatly assisted through the development of BT databases. Examples of such databases relevant to beach valuation include the Environmental Valuation Reference Inventory (EVRI, https://www.evri.ca/Global/Splash.aspx) maintained by Environment Canada (with assistance from other government partners such as the US EPA and Australian Government), and the National Ocean Economics Program (NOEP, http://www.oceaneconomics.org/) maintained by the Monterey Institute of International Studies.
3. **Assessment of the suitability of existing studies.** This is an assessment both of the quality of the original study, and also the similarity between the study and policy sites. Quality assessment may require some technical expertise in non-market valuation, although the aforementioned databases do provide some comments on data and study quality, or peer-review submission processes designed to uphold quality standards.
4. **Calibration of existing value estimates**. If there is sufficient information on the key factors influencing the value estimates in the original study, it may be possible to adjust the values for the policy site, based on differences in things like the local socioeconomic context or distance from a major city. Calibration of this type is not always possible, and is often overlooked.

The three main forms of the BT process are briefly discussed in the subsequent sections. For a more detailed introduction to the BT process, interested readers are directed to http://www.ecosystemvaluation.org/benefit_transfer.htm for example applications and a more comprehensive overview.

2.6.1 *Direct Benefit Transfer/ Unit Value Transfer*

The simplest and most commonly applied BT process is the unit method. In the context of recreational values, this is most often the transfer of unit-day values, that is, the value of a day engaged in a particular activity. This approach assumes that the value of a beach day is consistent in the two locations, and is referred to as Direct Benefit Transfer (DBT) or Unit Value Transfer (UVT). Often a range of values is used to provide some measure of sensitivity to variation between sites. Interestingly, the use of a range of values is an implicit admission of both the variability in benefit estimates and the lack of precision in the process.

2.6.2 *Benefit Function Transfer*

An alternative form of BT process is a more involved method that takes the benefit function estimated in the original study and allows for adjustments at the new site based on differences in the attributes or parameters employed in the value function. This is referred to as Benefit Function Transfer (BFT), and has been found to be the more accurate of the two methods. It was first proposed by Loomis (1992). The method still assumes that the preference structure of the relevant population is the same between the study and policy site. The application of BFT is dependent upon sufficient information being available about the key parameters found (in the original study) to influence willingness to pay (WTP). It is also dependent on the original study being sufficiently accurate in describing and reporting the measures used (Boyle & Bergstrom, 1992).

2.6.3 *Meta-analysis*

An alternative, more detailed method of BFT is meta-analysis, the collative analysis of functions derived in previous studies to identify the general influence of attributes on consumer surplus estimates (Brouwer, Langford, Bateman, & Turner, 1999). Meta-analysis was first proposed by Glass (1976) and was first applied in the field of economics in the late 1980s (Stanley & Jarrell, 1989); environmental valuation applications followed soon after (Walsh, Johnson, & McKean, 1989).

Given the analytical complexities involved in meta-analysis, it is rarely applied in a policy setting (Moeltner & Woodward, 2009). Applications of meta-analysis in the coastal context have focussed primarily on coral reefs, mangroves and wetlands (Brouwer, et al., 1999). To the best knowledge of the authors, there has not been any such study conducted on beaches or surf assets. This is in part because the dependent variable (e.g. WTP for a beach day) is not defined consistently across different studies, and hence it is not possible to estimate the 'effect-size' of independent variables such as price changes, beach width changes or demographic differences such as age and gender. It is also rare for published studies to contain sufficient data for inclusion in meta-analyses (Boyle & Bergstrom, 1992). Smith and Kaoru analysed 200 studies and found that only 77 were detailed enough to include in their meta-analysis (Smith & Kaoru, 1990).

There are insufficient estimates for a meta-analysis of beach valuation studies in Australia. International applications of BT are possible, but they introduce an additional layer of complexity in terms of historical comparisons of currency exchange rates and purchasing power (Ready & Navrud, 2006). The assumption that either the physical or social context is comparable between the study and policy sites is less likely to be valid in international transfers.

2.7 When is benefit transfer used?

BT is often resorted to when there are no existing estimates of the value of a resource or feature likely to be affected by a policy choice, but these values are required for an economic appraisal tool. This tool is typically cost–benefit analysis (CBA), which performs best as a decision-support tool when all costs and benefits can be monetised.

The BT process is employed when time and resources are not available for empirical studies, or where the degree of accuracy required for the appraisal process is relatively low. For example, if the benefits of a proposed action are expected to be orders of magnitude greater than the cost, indicative figures from studies conducted elsewhere may be sufficient.

BT is most appropriate when the original study site and the current policy site are similar in context and character, as outlined in Figure 3.

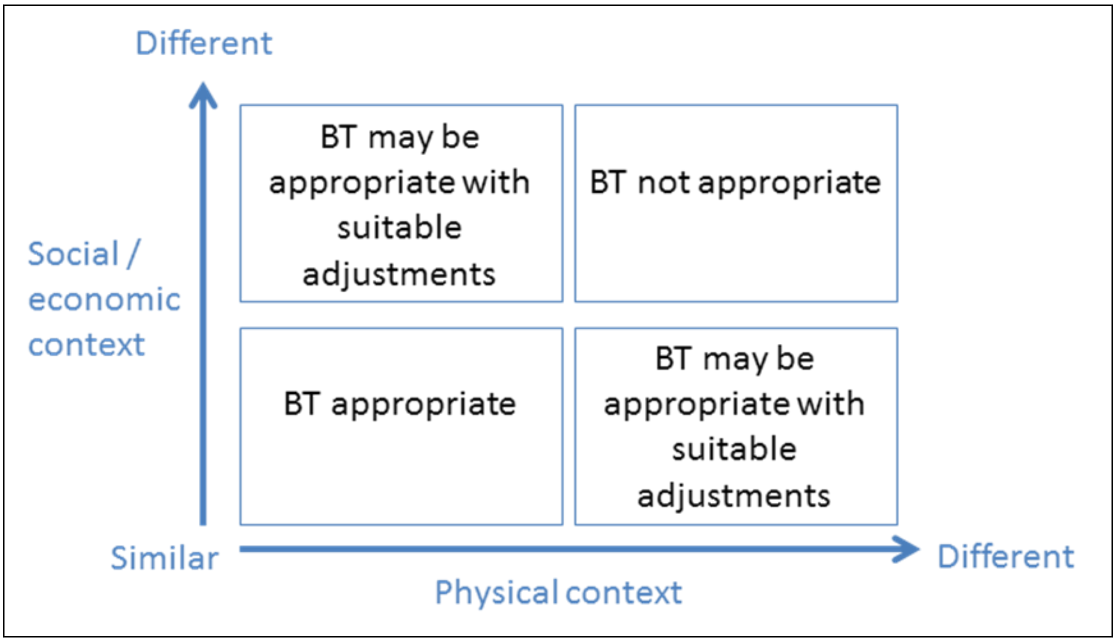

Figure 3 Suitability of benefit transfer (BT) for environmental valuation

2.8 Case study of BT in coastal recreation valuation

This section presents some inter-site tests of the BT process by drawing on previous work by the BASTRA project team. It compares the travel cost survey results of Blackwell (2007) from Mooloolaba on the Sunshine Coast, Raybould et al. for the Gold Coast (Raybould, Anning, Ware, & Lazarow, 2012), and Anning (2012) for Manly and Collaroy–Narrabeen in Sydney.

Each of these analyses examined a number of models to test for sensitivity to the selection of statistical models or inclusion of different travel cost components (fuel costs, vehicle depreciation, on-site expenditure and the opportunity cost of travel time). For comparison, the most consistent model has been selected; this is the minimum bound model that only includes the direct costs associated with vehicle use. The regression model used in each case takes a truncated negative binomial form, adjusted for the biases of both truncation and endogenous stratification where appropriate. Truncation refers to the bias in surveys conducted on site that exclude those who do not visit the resource. Endogenous stratification refers to bias resulting from the most avid visitors being more likely to be encountered in intercept surveys than those who visit less frequently. The studies conducted by Blackwell (2007) and Anning (2012) suffer explicitly from these biases. That of Raybould et al. (2012) does not, as it was conducted as a mail survey of residents, although it is likely that more avid beach users are more willing to complete and return a mail survey. The figures used in the comparison are shown in Table 3.

Table 3 Consumer surplus of a beach day – Australian studies

Location	Gold Coast	Sunshine Coast		Manly (Sydney)	Collaroy–Narrabeen (Sydney)
Sample	Residents	Residents	Tourists	Combined	Combined
Beach value per trip (2008 A$)	10.44	3.26	16.20	9.20	2.72

To test the appropriateness of transferring benefits between locations, an internal comparison was undertaken between these study sites. Table 4 shows the results of the comparison of results from the different studies. Each row examines the proposed transfer of the consumer surplus figure from the study site (the row label) to the new (policy) site denoted by the column heading. In each case, the figure from the original study is assumed to approximate the true consumer surplus (CS) in the study location. The alternative figures from the other study sites are compared to this figure, and the percentage variation is determined.

Table 4 Test of benefit transfer suitability between study sites

			New policy site				
	Proposed benefit transfer – from horizontal to vertical		Gold Coast	Mooloolaba		Manly (Sydney)	Collaroy–Narrabeen (Sydney)
			Residents	Residents	Tourists	Combined	Combined
			Per cent variation between policy and study site (policy estimate – study site estimate/study site estimate x 100)				
Original study site	**Gold Coast**	Residents	0	220	−36	13	284
	Mooloolaba	Residents	−69	0	−80	−65	20
		Tourists	55	397	0	76	496
	Manly (Sydney)	Combined	−12	182	−43	0	238
	Collaroy–Narrabeen (Sydney)	Combined	−74	−17	−83	−70	0

*Green boxes indicate that the use of figures from the location in the study would overestimate the value of recreation at the policy location. Red indicates that the recreation values would be underestimated.

Even between Australian beaches in relatively similar physical locations (Mooloolaba on the Sunshine Coast, and the Gold Coast) there can be substantial variability between the CS values. For example, transferring the resident CS values from Raybould et al. (2011) from the Gold Coast to Mooloolaba would result in an overestimate of per-trip value of around 220%, When this is multiplied by the annual visitation figure of around 185 000 visits to Mooloolaba beach, it gives a variation of $1.3 million in annual value. Capitalised over a 30-year project life at a discount rate of 7%, as is typical in assessments of coastal protection works, this results in a difference of $17.43 million over 30 years (the expected assessment period of a protection project), assuming that the value of a beach visit and the visitation rate remain constant over the period (which is highly unlikely given recent patterns of coastal development and outdoor recreation participation rates). This BT figure would probably change the outcome of a benefit–cost analysis of coastal management options, making a project appear more desirable than it would have done using site-specific data.

There can be a high degree of variability between the resident and tourist estimates, with tourist estimates typically around four times that of local residents. This potentially has substantial implications, where the study and policy sites differ in their patterns of visitation. As can be seen in Table 4, substantial caution should be applied in the selection of appropriate studies for BT, and indeed the application of the process. The assumption of transferability does not appear to hold except in limited cases, and can have broad implications for coastal management and adaptation decisions. The method should be applied with caution, and empirical surveys or studies are always preferable when time and resources permit. This leads into the next section that describes the objectives of this study including further empirical testing of the BT process.

3 Objectives

Given the need for economic information to inform the coastal adaptation response to projected impacts on coastal resources in Australia, and the reliance upon the inherently questionable practice of BT, the BASTRA project had the following key research objectives (ROs):

RO1 – Locality-scale identification and assessment of the vulnerability to climate change of assets that are key drivers of marine and coastal tourism and recreation

RO2 – Valuation of existing income streams due to beach-related tourism and recreation in case study locations (Section 5.5)

RO3 – Application of valuation tool (developed in previous stage) in identified sea-change localities to test transferability of results (sections 4.3–4.5)

RO4 – Identify social and behavioural responses to climate change impacts on vulnerable tourism and recreation assets (Section 5.6)

RO5 – Report on the net vulnerability of regional locations to climate change

The next section describes the methods adopted to achieve these objectives, and subsequent sections explore the implications of the research findings.

It should be noted that since the original research proposal was submitted in 2010, there has been a considerable move in climate science research away from merely identifying and ranking the vulnerability of locations and infrastructure, to exploring adaptation interventions and the capacity of those affected to respond to and offset these impacts. There also remains a considerable level of uncertainty about the site-specific impacts of climate change on coastal resources.

There is substantial disagreement between models of future storm activity and those of SLR, both in terms of frequency and magnitude (Australian Government, 2009). These storm impacts are typically much more dramatic and immediate than gradual shoreline recession, but predictions about their severity and return intervals are hampered by the short climatic records (Gourley, Harper, Cox, Stone, & Webb, 2004). Hence, there is considerable uncertainty about the future state of the beaches, which presents problems for those wishing to estimate the avoided costs from these states. For this reason, site-specific vulnerability assessments were not possible in this research project. This resulted in an increased focus on the existing economic benefits associated with coastal recreation and tourism and on attempts to understand how residents and tourists would respond to a likely change in the state or quality of this resource.

4 Methods

This section describes the methodology applied to fulfil the project objectives. It begins by outlining the means of selecting case-study locations to partner with over the various stages of the project. It then provides a brief introduction to the methods necessary to estimate the economic value of recreation and tourism in coastal locations. The administration of the survey is also detailed, as well as the development of a classification framework to identify the key features of beaches that are drivers of holiday destination, residential location and beach choice.

4.1 Site selection

Given the national scope of the project, it was necessary to identify locations which were broadly representative of the range of coastal locations and settlement types seen in Australia. The National Sea Change Taskforce facilitated a call for expressions of interest in participation to member councils in June 2011. A total of 16 potential case-study locations were nominated for consideration. The time and resource constraints of the funding program meant that a maximum of four locations could be chosen. Therefore, we attempted to choose a selection of sites that best represented both those nominated, and the broader range of beach recreation and tourism sites in Australia. Four local government areas (LGAs) were selected to join existing partners, Gold Coast City Council and Sydney Coastal Councils Group, to participate in the BASTRA project.

Table 5 describes the characteristics of the partner LGAs selected to ensure that the research team could scope out a portfolio of studies which would be representative of a range of:

- coastal environment types, as defined by the National Coastal Risk Assessment – first pass assessment (Australian Government, 2009)
- coastal settlement types as defined by the National Sea Change Taskforce (Gurran, Squires, & Blakley, 2005)
- progress on embedding climate change adaptation planning within coastal management.

Table 5 Portfolio of LGA partners

LGA	State	Settlement type	Coastal environment	Key issues for climate change adaptation and coastal management
Gold Coast (scoping stage)	Queensland	Coastal city	Region 3 – Eastern Headlands and Bays: small tides, quartz sands, moderate wave energy, many bays	Highly developed coastline with a history of engineering intervention with intensive tourist and recreational use
Sydney Coastal Councils Group (scoping stage)	New South Wales	Coastal city (study within 15 LGAs)	Region 3	Intensively developed coastline with multiple uses where recreation may not be adequately considered due to conflicting infrastructure priorities.
Sunshine Coast	Queensland	Coastal city/Coastal getaway	Region 3	Rapidly developing area highly dependent on tourist and recreational use values
Clarence Valley	New South Wales	Coastal lifestyle destination	Region 3	A number of small settlements where planned retreat is currently being considered as an adaptation strategy
Augusta-Margaret River	Western Australia	Coastal hamlet	Region 2 – The Limestone South and West: small tides, carbonate rocks, high wave and wind energy	Implications of low development and majority national park shoreline and diversified tourism brand across beach, farm, food and wine
Surf Coast	Victoria	Coastal getaway	Region 2	Significant role of surfing both economically and culturally

In addition to the requirements set out above, the selection of this portfolio will further enable the project to explore variation in implications of climate change on beach and surf tourism and recreation across various:

- governance arrangements

  – independent public land manager at Surf Coast, National Parks manages most coastal land and access at the Shire of Augusta-Margaret River (A-MR) and Clarence Valley, local government responsibility for Sunshine Coast

- stages of the tourism life cycle

  – by selecting three councils in a similar climatic zone at very different stages of development from Clarence Valley through to Sunshine Coast to the Gold Coast at the most developed stage of the tourism destination life cycle

- sites of national and international cultural significance

  – A-MR, Surf Coast and Clarence Valley are all home to national surfing reserves (Margaret River, Bells Beach and Angourie, respectively) and are recognised for their significance to the international surfing community.

- representative jurisdictions from which nominations were received

  – an LGA for each state from which a response to the call for expressions of interest was received.

Following site selection, the next stage of the project was to develop estimates of economic value for beach and surf recreation and tourism activity in each case study region. This leads us to a discussion of how this valuation is undertaken.

4.2 Introduction to non-market valuation

It is easy to estimate how much people are willing to pay to visit a cinema by looking at the effect of ticket prices on the number of people attending. If people purchase a ticket for $15, it is because they assume that they will get at least $15 of benefit or value from the experience. Economists term this benefit ‘utility’; however, there are no charges to access a beach in Australia, and therefore there are no market transactions to indicate how important recreation is to beach users, or how much they value the utility gained from the visit.[2] We must therefore use alternative

[2] There are also no reliable visitation records for beaches, which presents challenges in estimating the aggregate value of recreation at a given location or within a region.

methods to determine how people value beaches. These are called non-market methods.

There are two main classes of non-market valuation methods: those which rely on relationships between the good to be valued and other marketed goods, and those that require the construction of a hypothetical market. These are known as revealed preference approaches, and stated preference approaches, respectively.

Stated preference methods are also known as direct valuation methods, as people are directly asked about their WTP for a desired change, or their willingness to accept compensation (WTA) for deterioration in the quality of a good. Revealed preference methods are also known as indirect methods, as they enable the calculation of non-market values from the values of market goods consumed in order to access the resource. Revealed preference models rely on actual behaviour, and are therefore not subject to the same degree of theoretical criticism as stated preference models. They are, however, not able to capture non-use or existence values, and therefore provide an estimate of the lower bound of the value of a resource. This approach is considered appropriate for management, as it provides a conservative estimate that can form the basis of robust economic decisions.

4.3 Estimation of economic values

4.3.1 *Residents' values*

Beach recreation values for residents were estimated using non-market valuation techniques, specifically the travel cost method (TCM). The TCM approach uses visitation behaviour of users of a resource of interest (in this case the beaches in the respective regions) as the basis for estimating the value of the use of the resource. By estimating the relationship between travel costs incurred to get to a site and the frequency of visitation, it is possible to estimate how users would respond to a change in access costs (analogous with an increased entry fee for a site), and hence their maximum WTP for the trip undertaken. The application of the TCM provides estimates of a per person consumer surplus — a measure of the difference between actual expenses incurred in a beach visit and maximum WTP per person for a beach visit. (For further information on the estimation process, please refer to http://www.ecosystemvaluation.org/travel_costs.htm)

4.3.2 ***Visitors/tourist values***

Expenditure analysis of beach recreation related to tourism was undertaken in response to requests from council officers in partner councils for details of direct expenditure associated with beach recreation to augment the resident consumer surplus estimates.

The expenditure analyses used data from the TRA domestic and international visitor surveys, which include estimates of tourist visitation, per night expenditure and percentage of tourists that visit the beach. The beach-user survey data collected as part of the current project and the length of stay data from the TRA data were used to estimate beach visitation per night for visitors to each region.

4.4 **Contingent behaviour**

Previous TCM studies have suggested that changes in visitation frequency in response to erosion events or beach nourishment projects are more economically significant than any changes in consumer surplus (Whitehead, 2005; Whitehead et al., 2008). This project therefore asked respondents about how they would respond to erosion damage at their chosen coastal location. Respondents were asked to consider a hypothetical situation in which they visited a location and found that there was '*no usable beach due to erosion damage'*. They were asked about their willingness to travel to an alternative location.

Understanding this response is critical to informing coastal adaptation options, as the various behavioural responses dictate the economic impacts for the different classes of people affected by the decision. For example, if the beach user does not consider the sand to be important in their decision to visit a coastal location, then they are unlikely to change their trip, and hence there is no net economic impact due to erosion. If, however, they indicate that they would travel to an alternative destination (i.e. interstate travellers from Melbourne may choose to travel to Noosa rather than to Margaret River), then there are potentially large losses to the original beach location and the regional economy.

It should be explicitly noted that this was framed as a single beach closure and one where suitable substitutes were readily available, whereas climate change impacts have the potential to result in permanent closure of some beach locations or coastal areas. The duration of closure is a key factor which is often neglected in stated preference surveys that ask about WTP to avoid beach closures, despite recognition in the travel cost literature of the importance of temporal substitution (Smith & Palmquist, 1994).

4.5 Survey administration

The survey was administered using a multimodal strategy, and included on-beach intercept surveys of site users, a mail survey of local residents, and an online survey that allowed for responses both from residents within the case-study locations and the broader community. A number of means of survey promotion were also employed, including traditional print media, radio and television interviews, online articles and discussion forums, social media and blogs (http://mybeachmysay.com).

4.5.1 *Survey modes*

Intercept surveys were structured as self-completion forms for beach users. Researchers conducted the surveys at a range of beaches across the case-study regions, with the majority of surveys completed in May 2012. Researchers worked from one end of the beach to the other, approaching each group of beach users and requesting a single representative from the group to complete the survey. Researchers recruited participants by explaining that the survey would be presented to the council to assist it in managing coastal resources in the region. Appendix 3 includes a copy of the beach intercept survey instrument and the participant consent form.

We distributed the mail-out survey of residents using a geographically stratified sampling approach. It was directed to a sample of residential addresses chosen to represent the pattern of population distribution by proximity to the beach. The envelope containing the survey was marked 'to the resident'. It included a letter of invitation to participate, the self-complete survey instrument and a reply-paid envelope. The invitation to participate also directed people to the online survey in the event they preferred to respond electronically. Appendix 4 includes a copy of the resident mail-out survey instrument, and the invitation letter/participant consent form.

The online survey was an electronic replica of the mail-out survey, with an additional question to identify how respondents had found out about the online survey. The online survey was hosted at the BASTRA project website (www.mybeachmysay.com). We recruited respondents using a national and local media campaign which targeted traditional and social media channels.

4.6 **Framework development**

This section introduces a proposed classification framework that identifies the characteristics of beaches that contribute to recreation values. Identifying those features that create value will allow researchers to forecast the impact of climate change on each of those features and values independently. This is important as climate change may have negative impacts on some features and the associated values, but positive impacts on other features and associated values. This classification framework is a working document and it is anticipated that the frameworks proposed here will evolve following further analysis.

4.6.1 ***Ecosystem services and the recreation values framework***

Two commonly used models are relevant to the beach recreation values framework proposed in this section: the ecosystem services model (Costanza et al., 1997) and the total economic value model (Pearce & Turner, 1990).

Costanza et al. (1997) clearly identified recreation services among the ecosystem services provided by natural capital. Based on this, we conceptualise a model in which recreation values are derived from the combination of physical natural capital, climatic natural capital and built capital. This model is summarised in Figure 4 and enables the researchers to investigate the extent to which each of these capitals is vulnerable to climate change and how changes in any combination of these inputs might affect recreation values associated with beaches.

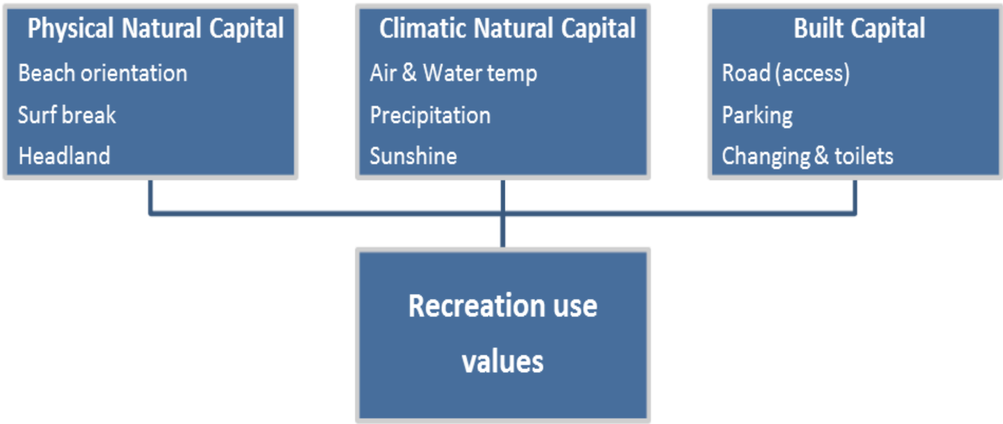

Figure 4 A recreation ecosystems service model

(after Costanza et al., 1997)

Ecosystems such as beaches are capable of supplying a number of different services, some more tangible than others (Bingham et al., 1995; deGroot, 1994). In order to value the services provided by an ecosystem, it is necessary to first identify the full range of services and classify them in a way that aids measurement. The total economic value (TEV) model, described by Pearce and Turner (1990), attempts to classify all of the anthropocentric values (human instrumental values) and ecocentric values (intrinsic values of nature that are independent of human activity). The TEV model is presented in Figure 5. On the first level it distinguishes between use and non-use values. At the second level, the framework takes into account an individual's motives for valuing an asset.

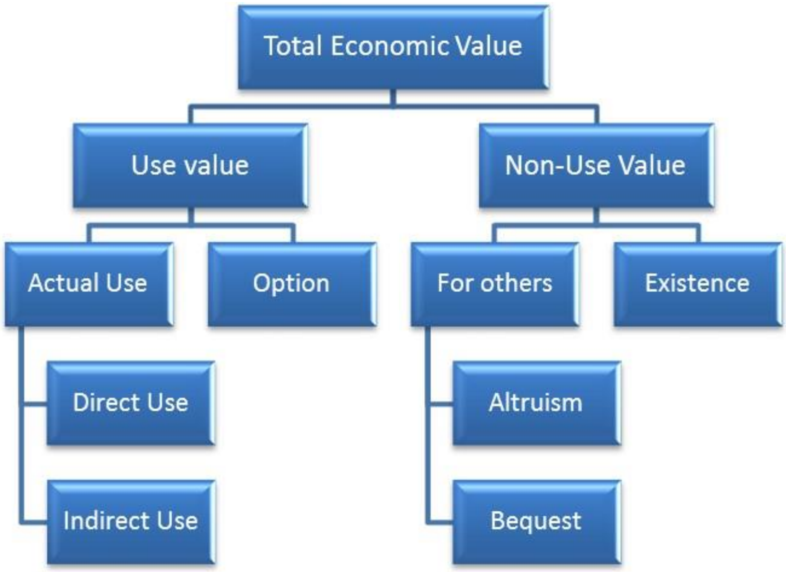

Figure 5 The total economic value (TEV) model

Adapted from Pearce, Atkinson, & Mourato, 2006; p. 87

Use values are attributed to individuals who use an environmental asset for recreation activities or who indicate a desire to have the option to use it for recreation in the future (Pearce and Turner, 1990). Bateman and Langford (1997) add an indirect use category to this framework to describe those who do not physically visit the site, but derive benefits by looking at photographs or film of an environmental asset. Together the direct, indirect and option use values comprise the instrumental total use-value of an environmental asset.

Non-use values are attributed to individuals who do not currently use, or intend to use, an environmental asset but still indicate that they would feel a loss if the asset were damaged or lost completely. According to Turner (1999), non-use values do not have well-defined boundaries, since the existence value components may be defined in different ways depending on one’s motivation. Some observers may see non-use values in terms of anthropocentric instrumental values only, whereas others may accept that environmental resources have intrinsic values in their own right. Turner (1999) identified three motives that contribute to anthropocentric instrumental values: intra-generational altruistic motives (altruism), intergenerational altruistic motives (bequest), and motives associated with stewardship (existence).

Specific examples and motivations relating to each of these value classes in the context of beach recreation are provided in Table 6.

Table 6 The total economic value framework for beach and surf assets

Direct use	Indirect use	Option	Altruism	Bequest	Existence
Swimming Surfing Walking Fishing Beach activities	Watching surf contests Watching surf videos	I don't currently surf or go to the beach, but I might want to in the future.	I don't surf or go to the beach, but friends do and if they enjoy it, the resource has some value to me.	I don't surf or go to the beach, but I would like the resource preserved for future generations.	Nature has intrinsic value independent of humans. Stewardship motives

4.6.2 *Classification and value framework*

Given the time and resources required for empirical valuation studies such as those conducted as part of this project, many appraisals of coastal management options rely on transferring values from previous studies. These values are typically expressed in terms of the WTP for a beach day (Pendleton, Atiyah, & Moorthy, 2007).

This BT process can either involve Direct Benefit Transfer (DBT), or calibrated benefit transfer, typically referred to as Benefit Function Transfer or BFT (Robinson, 2001). The process has a number of underlying assumptions which lead numerous academics to question the validity of the approach (Spash & Vatn, 2006). In DBT, the assumption is that the sites are similar in both the biophysical and socioeconomic context. This assumption is highly dubious in the case of appraisals conducted in Australia, as the majority of prior beach valuation studies have been completed overseas, primarily in the United States (Pendleton, et al., 2007). Australians have an affinity to the beach that is both geographical (Chen & McAneney, 2006) and cultural

(Australian Government, 2007), suggesting that the preferences for beaches and their amenities is unlikely to be consistent internationally.

The BFT process attempts to correct for differences in socioeconomic context between the original study location (study site) and the site where the appraisal is being conducted (policy site). It is typically assumed that WTP is a function of the socioeconomic attributes of the respondent/s. A stylised representation of this relationship is presented in the following equation.

WTP(beach day) = f(recreation preferences, demographic and socioeconomic variables, availability of substitutes etc.)

In applying BFT, the relationship from the study site is transferred to the policy site, but adjusted for differences in the independent variables contained within the brackets in the equation above. It still assumes that preference structures take the same form in both locations (Downing & Ozuna, 1996). Empirical tests conducted in nearby sites in Costa Rica (Barton, 2002) or in Texas (Downing & Ozuna, 1996) do not support the assumption; hence the validity of transferring between countries must again be questioned.

The Beach Recreation and Surf Asset Valuation Framework suggested in this document is a new means of determining the visitation and value a site is likely to provide. It is considered to have greater theoretical validity than existing BT approaches. All previous BT methods ignore the differences in the natural and built assets of beaches in determining their attractiveness to visitors, and hence their value. This is a curious omission, as it is these features that are frequently used in tourism materials, and site choice models based on random utility theory are built on the assumption that it is these features which drive site choice and visitation (Lew & Larson, 2008; Parsons, Massey, & Tomasi, 2000). Given the increasing prevalence of these models in the academic literature on non-market valuation of recreational assets, this absence is considered to be a major deficit. The framework described in the next section attempts to address this key theoretical issue.

5 Results

This section provides a summary of the results of the survey component of the research project. It focusses on comparisons between the case studies to demonstrate clear differences, rather than a full presentation of all data points. Readers interested in more information about individual case-study locations are directed to summary reports included in Appendix 3.

5.1 Framework testing results

This section presents results of testing the relationship between visitation estimates and indices of natural, built, climate and context dimensions separately. Then it goes on to combine these four dimensions in an integrated model to explain the combined effects of the dimensions on visitation.

Each subsection includes the criteria and scoring employed in the model and the changes made since submission of the framework and classification milestone report. These changes represent the results of initial testing and screening processes.

5.1.1 *Framework components*

The classification and value framework provides a structure that can be used to identify and measure the characteristics of a beach and surf recreation location that provide anthropocentric value. By populating the classification framework for each of the case-study sites, it will be possible to evaluate the effect of the various characteristics of a location on recreational values. The relationship of site characteristics to values can subsequently be used to project how changes to the characteristics of a site, as a result of climate change, will alter recreational values.

The framework thus comprises two broad dimensions: capital and context. These dimensions were adopted to align with the travel cost approach to estimating recreational value, where the total recreational value for a site is a function of the per-person consumer surplus and visitation. 'Capital' describes the features directly related to the beach that create value, and 'context' describes the characteristics of the surrounding area that affect demand for recreation associated with the beach. The context dimension has received considerable attention in the BT literature, whereas capital has been largely ignored. This project will provide a means of testing the relative importance of the two dimensions, with the assumptions that the capital dimension is the greatest driver of per-person WTP and the context dimension is the driver of visitation.

Anthropocentric beach recreation use values (see the TEV model) are expected to be represented by some function of natural, built and climatic capitals combined with the context surrounding the beach; that is:

Beach value = *f*(natural capital, built capital, climatic capital, context)

This relationship was tested using data from the case-study sites. The dependent variable, beach value, might be expressed in terms of gross visitation for a given beach or estimates of consumer surplus derived from a travel cost model (either average consumer surplus or gross consumer surplus).

The sites most attractive for recreation are those for which individuals are willing to pay the most to access. The capital dimension will identify how natural and built features of a site combine for a given site. This can then be compared with total WTP to visit a site to identify the characteristics which determine a site's attractiveness for recreation. This knowledge can be used to predict how changes to the location, through either management intervention or climate change impacts, will impact on recreation values. It also informs adaptation and management investments.

The context dimension will identify the surrounding characteristics for a site which influence visitation, focussing on the number of potential visitors and the suitability of the geographic location for beach and surf recreation (climatic attributes). Estimates for recreation values have shown that sites with the greatest total value are the most highly visited sites. For most sites, there is very little data available on visitation. For such sites, the context dimension will be used to identify relationships between visitation and characteristics of a location's surrounding population to assess how these can be used to estimate visitation. At this stage, the context dimension deliberately ignores the socioeconomic characteristics typically assumed to drive differences in WTP for recreation at particular locations. This allows for rigorous tests of the components of the proposed framework in determining value. It is expected that some of these socioeconomic factors will re-enter later iterations of the model. Most important of these is assumed to be income, as demand functions are related to 'ability to pay' as well as WTP.

Tables 7 to 10 summarise the measures associated with each of the four dimensions. As an example, one of the measures of natural capital is beach width. Each measure will be scored on a scale from 1 to 5 based on the draft descriptors shown in the respective table. For example, looking at Table 5, the beach width measure will be scored 1 if beach width from 0 metres Australian height datum (AHD) to the vegetation line or rock wall (practical landward extension of the beach) is less than 10 metres or more than 100 metres. It will score 5 if the beach width is an optimal 40–50 metres.

5.1.2 *Relationship between natural capital and visitation*

The attributes which make up natural capital and the scoring system are presented in Table 7. Shaded data indicate those criteria for which reliable objective information is available for all locations.

Table 7 Natural capital data and scoring system employed in BASTRA framework

			Score				
	Description	**Unit of measurement**	**1**	**2**	**3**	**4**	**5**
Natural capital	**Beach width**	Metres from 0 m AHD to vegetation	<10 or >100	10–20 or 75–100	20-30	30–50	50–75
	Swimming	SLSA hazard rating	10	8–9	6–7	4–5	0–3
	Surfing	Reputation	None	Local – Minor	Local – Major	National	International
	Fishing	Reputation	None	Local – Minor	Local – Major	National	International
	Open space /foreshore	Area (m^2)/ Beach length (m)	0	5	20	50	100
	Biohazards /Pollutants	Beachwatch style water quality ranking	D	C		B	A
	Aesthetics	Reputation	None	Local – Minor	Local – Major	National	International

SLSA – Surf Life Saving Australia

Ratings of surf quality can be objectively verified by the presence of surf competitions and listing within systems such as the National and World Surfing Reserves.

The subjective rating of beach aesthetics is based on reputation, and prevalence of beach images in promotional material.

A score out of 5 is allocated for each attribute. Attribute scores are then summed across the dimension (e.g. natural capital) and divided by the number of attributes. This results in an index score out of 5 for each dimension. This index score is compared to the annual visitation estimate for 2011, as provided by Surf Life Saving Australia (SLSA), and shown in Figure 6.

Visitation estimates for Bondi and Manly beaches are outside of the range for the other beaches within the sample. Their unique nature is likely to be explained by the international reputation of the beaches, proximity to the largest city in Australia, and a terrestrial climate conducive to beach recreation.

To address these unique beaches for each regression, the trendline is plotted twice, initially with the entire sample and again with these outliers removed. Performing this exclusion from the final model is not theoretically valid; however, it provides a means of exploring the key drivers of the underlying trends.

R-squared (R^2) values describe the explanatory power of the beach attribute indices, in this case natural capital on beach visitation. For the index of natural capital attributes, the R^2 value is quite high, indicating that approximately one-quarter of variation in visitation is due to the different natural attributes of the sampled beaches. Removal of outliers improves the explanatory power of the index to around 32%. This increase suggests an interaction between the natural features of these two sites and other variables which is different to that in the other sub-sample.

For example, in the case of Manly Beach, a trip to Manly via ferry (the source of approximately one-third of all visits) is a travel experience in itself, and hence the beach may merely define the journey rather than being the driver of visitation. The international reputation of Bondi Beach is likely to be an order of magnitude above that of the other beaches, and may not be adequately captured by the existing criteria. One means of more rigorously assessing the ‘reputation’ factor would be through a tourism image analysis study looking at the frequency with which images of particular beaches are used in destination marketing materials by local businesses or council. Some initial exploration of this field was undertaken in the site-selection phase of the project, but this remains a potential avenue of future study.

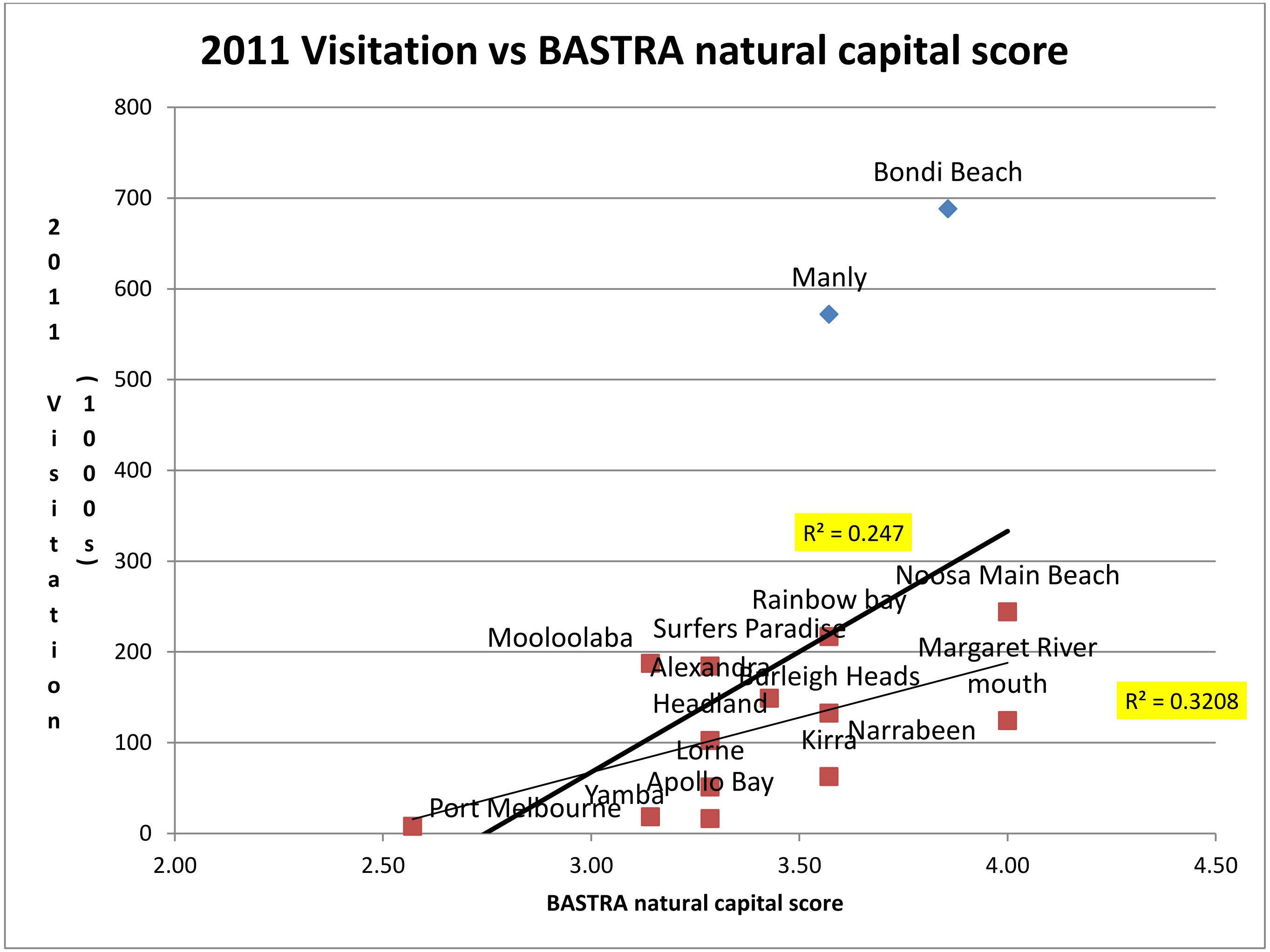

Figure 6 Comparison of beach visitation and BASTRA natural capital score

5.1.3 *Relationship between built capital and visitation*

The attributes comprising built capital and the scoring system are presented in Table 8. Shaded data are those criteria for which reliable objective information is available for all locations. Figure 7 shows that the built dimension index explains approximately the same proportion of variation in visitation estimates as the natural dimension index. This demonstrates that both natural and built dimensions contribute to the attractiveness of the beach.

Interestingly, the removal of outliers reduces the explanatory power of the built attributes. This is presumably due to the fact that some of the attributes (namely parking spaces and available accommodation type) can be considered as both demand side (as tested here) and supply side variables, given that they limit the number of people who can get within a reasonable distance of the beach. Future models may have to consider moving some built capital attributes to the context dimension, and incorporating the availability of public transport.

Table 8 Built capital data and scoring system employed in BASTRA framework

			Score				
	Description	Unit of measurement	1	2	3	4	5
Built capital	Safety services	Patrol days/year	0	30	60	120	365
	Amenities	Presence	Nothing	Drinking water, toilet, showers	Grassed area/ Seating /Shelter	BBQ	Playground
	Commercial	Beach reserve licence holders per km beach	0	1	2	3	>3
		Off-beach commercial business within 300 m/beach length (km)	0	1	2	3	>3
		Accommodation (<500 m)	Nothing	Camping	Caravan /Holiday letting	Unit	Resort
	Access	Beach access paths/km beach	0	1–3	4–5	6–9	10+
		Parking spaces /km beach	Street only	5	20	50	100
		Metres from car park to shoreline	>500	250–500	100–250	50–100	<50
		Visibility from car park	none		partial		Full

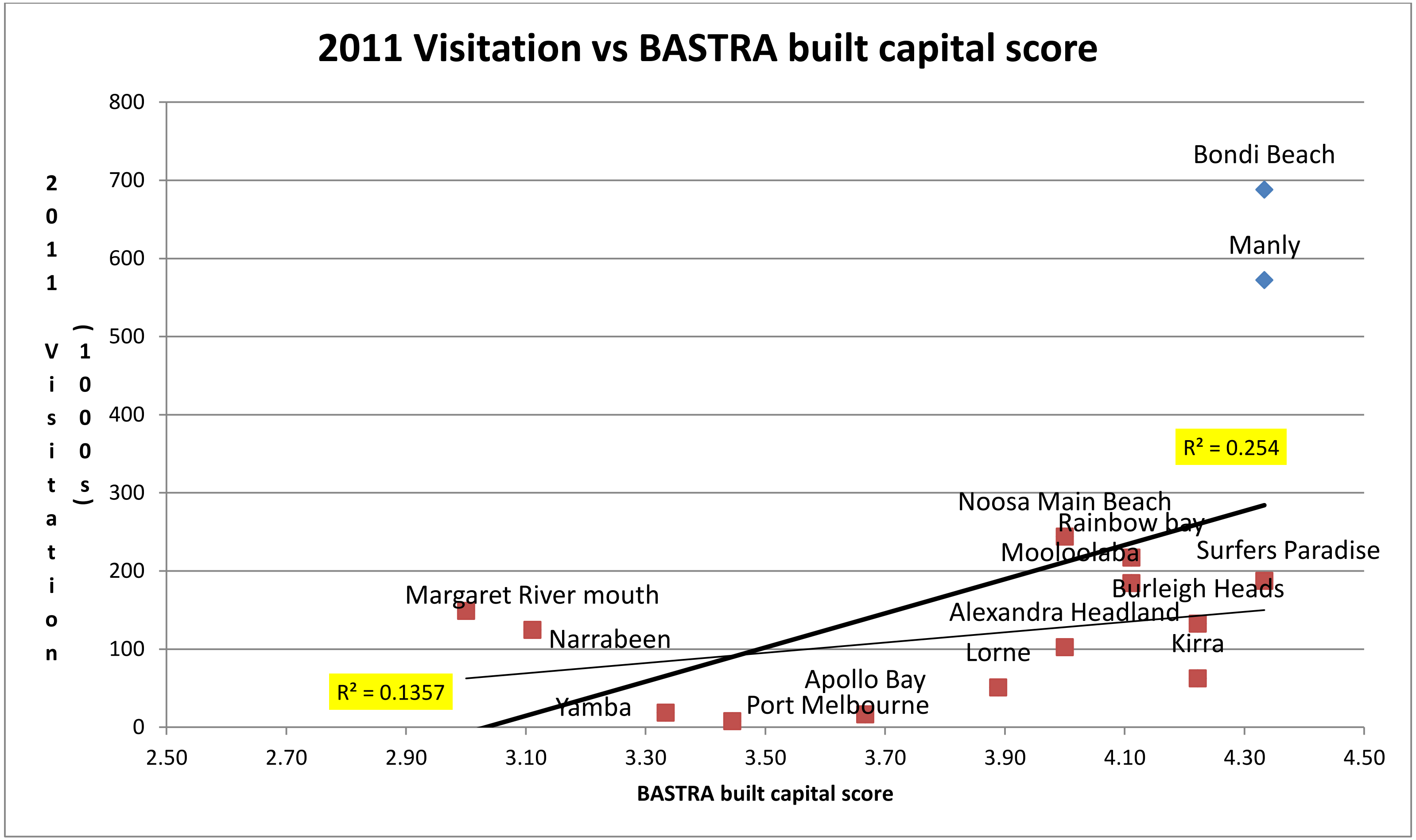

Figure 7 Comparison of beach visitation and BASTRA built capital score

5.1.4 ***Relationship between climate capital and visitation***

The attributes that make up climate capital and the scoring system are presented in Table 9. There is objective information available for all of the attributes within this dimension. Figure 8 shows that our climate dimension index is a poor predictor of the visitation estimates with the outliers included. This may be because our index fails to capture acclimation, as a beach day may be defined differently by the resident population in each area.

Removal of the outliers increases the explanatory power of the climate dimension index. This suggests that the proximity of Bondi and Manly to such a large population overrides the influence of climate on visitation estimates.

In Australia, the historical settlement patterns mean that the greatest population centres are in the southern states, hence the influence of climate on resident beach visitation is artificially restricted. Climate variability is a factor only for those with complete mobility in site choice, that is, tourists.

This provides the first evidence in support of weighting of classification framework dimension indices. True testing of beach visitor sensitivity to climate factors will be explored through other means, such as the responses to the survey component, and potentially through analysis of beach visitation records and images to explore patterns with respect to weather variability.

Table 9 Climate data and scoring system employed in BASTRA framework

	Description	Unit of measurement	Score 1	2	3	4	5
Climate capital	**Beach days**	Number of days above 25 °C	0	25	50	100	150
	Sunshine	Average sunshine hours/day	2	4	6	8	10
	Water temperature	Water temperature – months above 21 °C	0	2	4	5	6
	Summer air temperature	Average temperature Dec–Feb	12	15	18	21	24

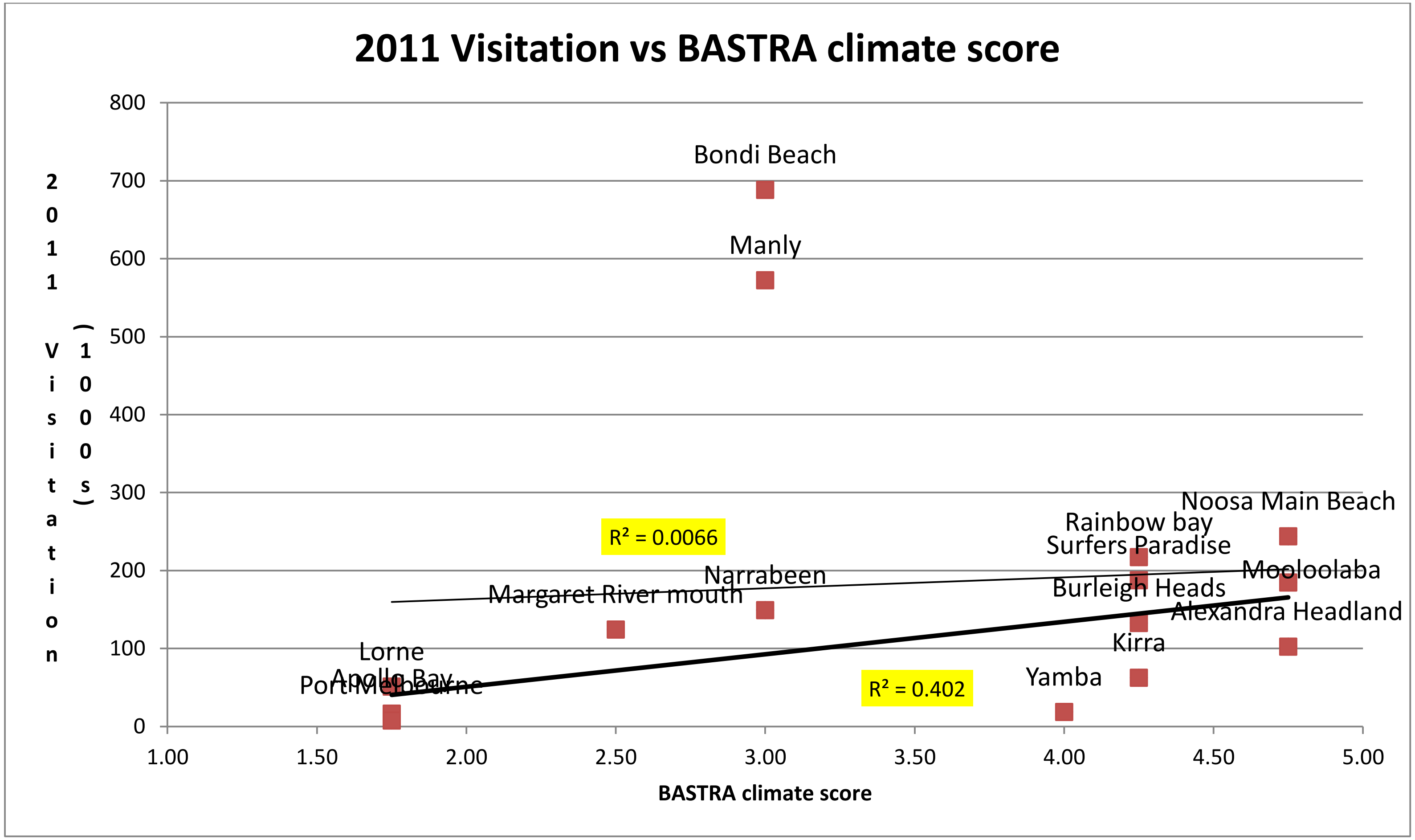

Figure 8 Comparison of beach visitation and BASTRA climate capital score

5.1.5 *Relationship between context and visitation*

The context dimension index represents the level of development in the adjacent area. Given the negative relationship between frequency of visitation and distance typically found in beach valuation studies, it is assumed that higher development of the local area will result in higher visitation.

The attributes that make up context and the index scoring system are presented in Table 10. There is objective information available for all attributes within this dimension. Figure 9 shows regression results for the relationship between the contextual dimensions index and beach visitation estimates. When all sample beaches in the model are included, the context index explains almost 38% of variation in visitation estimates.

If the two outliers are removed, the explanatory power of the contextual index falls to 16%. This suggests that the context is critically important in determining the high levels of visitation for urban beaches. This is consistent with the underlying theory of the TCM, whereby visitation decreases rapidly with increased travel time/costs. It is also consistent with attribute theory, such as is used in the hedonic pricing method. It suggests that two otherwise identical beaches, one located close to a major centre and one 100 kilometres away, would experience greatly different levels of visitation. Although intuitive, this is important information in allocation of resources for coastal adaptation measures.

Table 10 Contextual data and scoring system employed in BASTRA framework[3]

			Score				
	Description	Unit of measurement	1	2	3	4	5
Context	Potential local users	Population density in adjacent Census Collection District	0	500	2000	5000	10000
	Potential day-visitor users	Day visitors to LGA	240	180	120	60	20
	Potential overnight-visitor users	Overnight visitors to LGA	0	20	50	100	200
	Substitutes	Similar beaches within 10 km	10+	5	2	1	0

[3] Source for Sydney figures: http://archive.tourism.nsw.gov.au/Sites/SiteID6/objLib18/Sydney-YE-Sep-11.pdf

Port Melbourne figures sourced from the City of Port Phillip Tourism Strategy Plan: http://www.portphillip.vic.gov.au/default/o24739.pdf

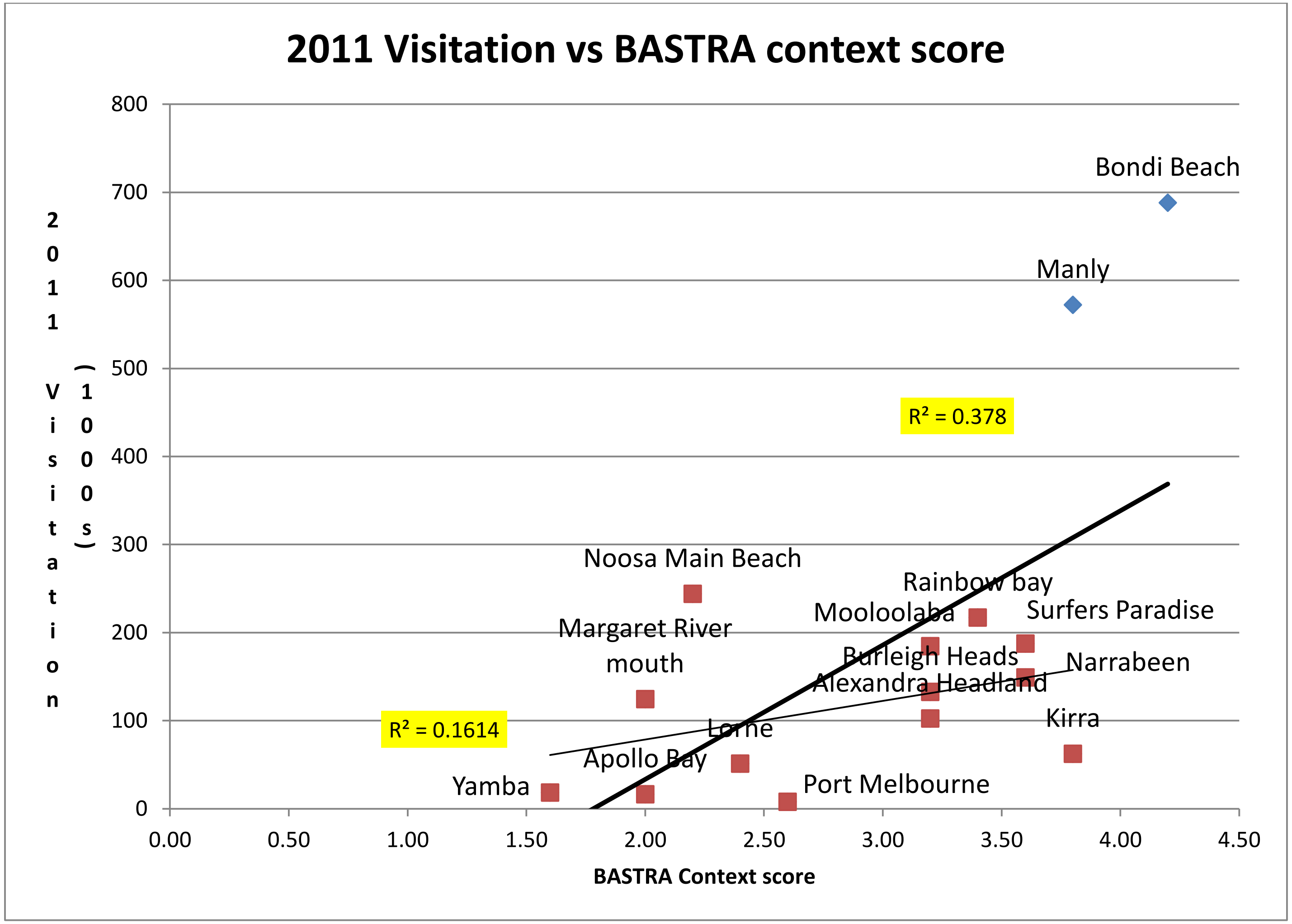

Figure 9 Comparison of beach visitation and BASTRA contextual score

5.1.6 ***Relationship between combined index and visitation***

This section combines the natural, built, climate and context dimension indices into a single index and compares this combined index with visitation estimates at the sample beaches. It can be assumed that the attractiveness of a beach is some function of the natural and built attributes located at the beach. The demand for these beach attributes will be some product of the number of people nearby (e.g. context), and the number of beach days (recognising that different populations may define this differently).

The results presented in Figure 10 are for a simplified model in which scores for the four dimensions are summed such that:

Visitation = f (natural + built + climate + context)

Figure 10 shows that, by using this simple additive function, the draft classification framework explains at least 25% of the variation in visitation estimates. Removing the outliers increases the power to almost 50%. This suggests that beach attributes and context are highly important in determining visitation (and hence value) of beach recreation sites. This finding supports the underlying need for this research to quantify the relationship between recreation values and beach attributes given the potential for climate change and subsequent adaptation decisions to affect these attributes.

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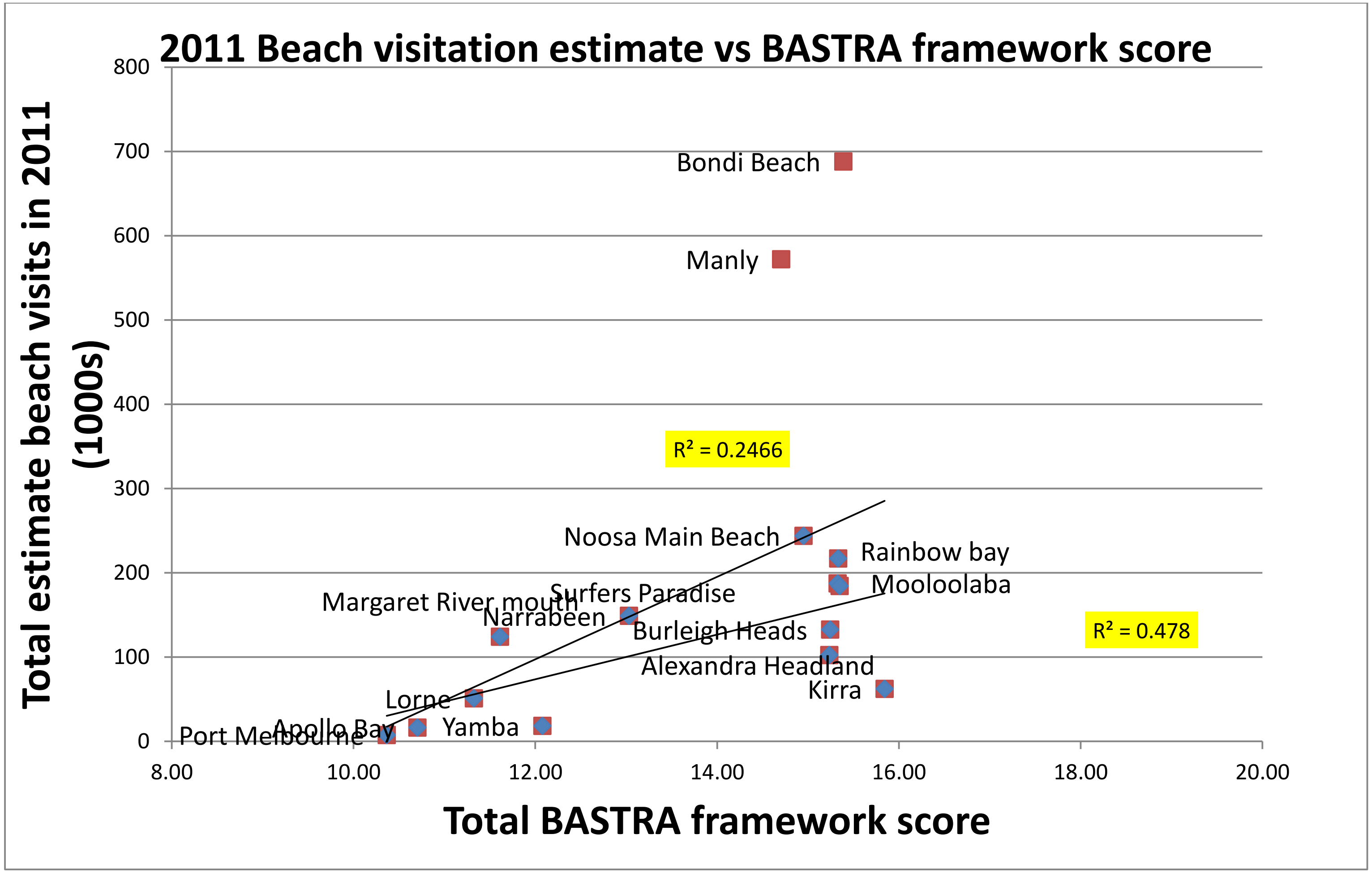

Figure 10 Comparison of beach visitation and BASTRA total framework score

5.2 Recreation and tourism values survey

5.2.1 *Response rates*

This section is the first in this report to present results from the empirical valuation surveys conducted in the BASTRA project. The content is categorised into resident and tourist sub-samples and provides details of: beach visitation behaviour including preferred time of day, duration, the economic values associated with tourism and recreation, and the behavioural response to beach closure due to erosion. The data for residents is taken from the mail survey of residents. The data for tourists is derived from the beach-user survey. As the beach-user survey contained both residents and tourists, the responses were segmented under these categories and only the tourist responses are reported for this category.

5.2.1.1 Resident mail surveys

Overall, approximately 14 000 resident surveys were distributed, with a response rate of approximately 8%. This response rate is typical for this style of survey. Response rates appear to have been moderated by the style of delivery, with significantly higher rates for those that were delivered by Australia Post mail services than for those that were delivered by leaflet distribution services. This explains the variability in response rates between the case-study locations. An online version of the survey was also developed and promoted through radio, television, print and online media. For further detail of response rates see the case study reports in Appendix 3.

The differences in response rates, user groups and demographics between the modes of promotion and survey delivery represent an interesting case study in survey delivery. This will be developed into a technical paper that is likely to be of use to all practitioners seeking to conduct surveys relevant to coastal management.

5.2.1.2 Beach user surveys

Table 11 presents a summary of the responses collected through onsite surveys of beach users. Response rates are not as meaningful in this context, although refusals were recorded, and were typically around 3–5% of those beach users approached.

Table 11 Recorded responses from beach intercept surveys

Case-study location	Resident	Tourist	Total	Proportion of tourists
Sunshine Coast	83	152	235	64.7
Clarence Valley	50	100	150	66.7
Margaret River	74	55	129	42.6
Surf Coast	23	225	248	90.0

The Surf Coast sample is primarily tourists, as surveys were conducted at visitor concentration points, namely lookouts and parking areas. This was necessary due to the limited number of people who were on the beaches when the surveys were conducted. The resident survey highlights the importance of surfing to the region, and it is likely that many of the beach users were actually in the water rather than on the sand. For the Sunshine Coast and Clarence Valley samples, around two-thirds of respondents were tourists, whereas for A-MR there were more residents than tourists.

5.2.2 *Resident visitation patterns*

All case-study sites showed that visitation was very high among residents responding to the survey, with over 90% of resident respondents stating that they had visited the beach in the previous 12-month period. Median visitation frequency is 80-140 visits per annum, which is much more frequent than that observed on the Gold Coast in a survey with a much higher response rate (Raybould, 2006). It is likely that this is a biased sample of frequent beach users.

Table 12 Beach visitation patterns – residents

Case-study location	Visited a beach in previous 12 months (% of respondents)	Mean annual beach visits	Mean time spent on beach (minutes
Sunshine Coast	93	84	98
Clarence Valley	94	102	115
Margaret River	98	138	98
Surf Coast	99	123	84

Resident beach users typically spend between 80 and 120 minutes on the beach per visit. These visits occur at different times of the day throughout the year, reflecting variations in temperature. Figure 11 shows the visitation frequency of residents at two-hour intervals for summer and winter, pooled across all samples. Visitation in the middle of the day drops off in summer but peaks in winter. This suggests that there is in fact an ideal temperature range for beach visitation, and climate change may affect this temperature range.

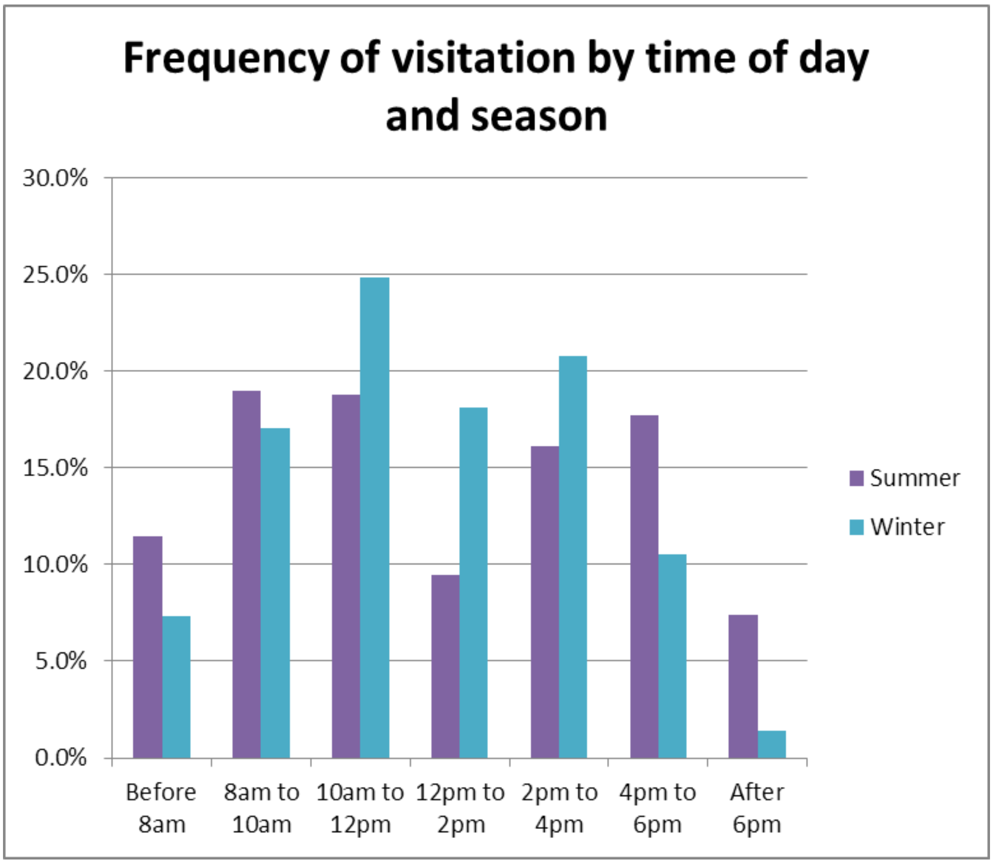

Figure 11 Visitation by time of day and season – residents (all samples)

More than half of beach visits are made by private vehicles, but the proportions vary between locations (Figure 12). Beach users in A-MR and the Sunshine Coast were more reliant upon vehicles, with around 90% visiting beaches by car.

This in part reflects the set-back development pattern of the A-MR region (need to drive), and also that people who visit the beach frequently tend to locate themselves as close as possible to the beach (in order to walk or ride).

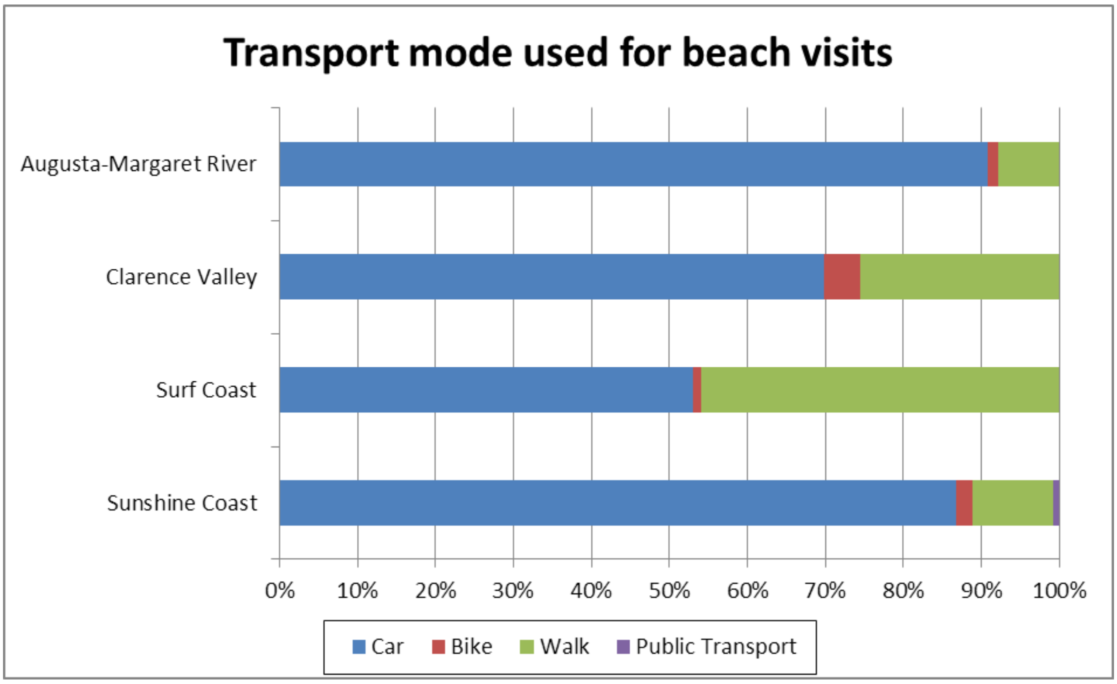

Figure 12 Beach visit travel mode – resident sample

Participation in the workforce varied by location, with around half of respondents in the Clarence Valley and Sunshine Coast regions being retirees (48% and 52% respectively). This compares with Census figures of 47% and 37%, respectively, for people not in the workforce. In contrast, the retiree proportion was 39% for A-MR and 36.4% for the Surf Coast shire, compared with 15%[4] and 31% for the Census statistics. This is despite the relatively consistent age distribution, with a mean age of 57–60 years for all case studies.

Responders to the surveys were largely long-term residents of the respective regions (Figure 13). Around 68% of respondents had lived in the Surf Coast and A-MR regions for over 10 years, whereas for the Sunshine Coast and Clarence Valley regions this proportion was around 75%.

[4] A-MR statistics include an additional 13% of people who are employed for less than 15 hours per week.

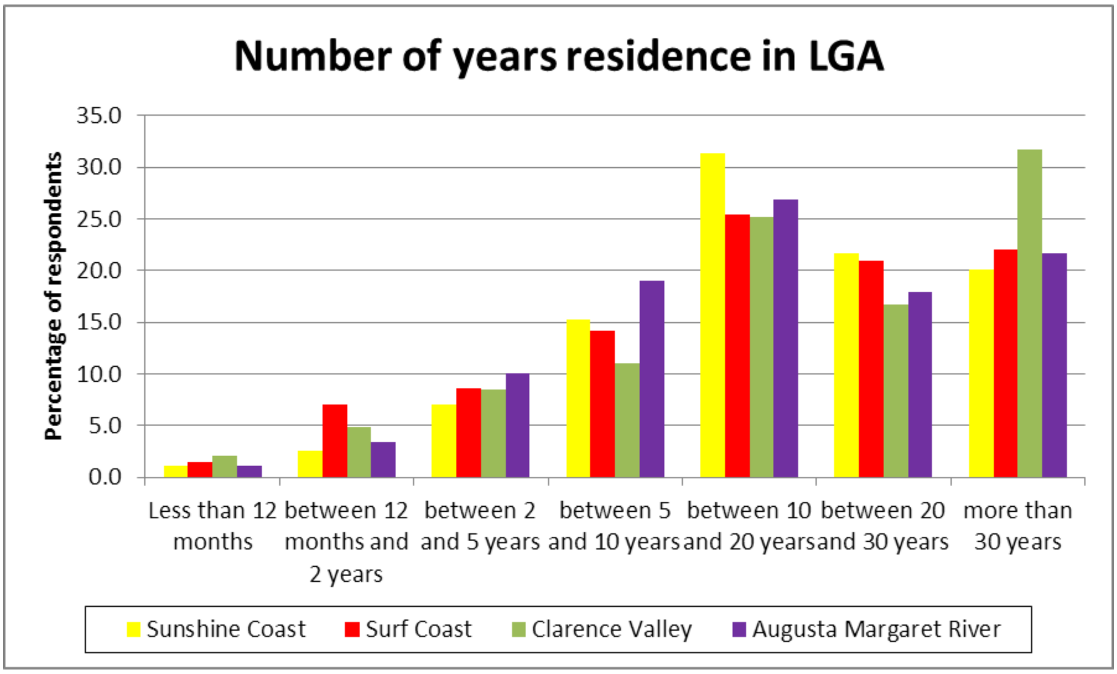

Figure 13 Years in the LGA

5.2.3 *Beach user survey results – tourist subsample only*

Visitors to case-study beaches spend slightly longer on the beach than residents, with an average trip duration of 120 minutes.

There is a high degree of repeat visitation, with visitors taking between 1.3 and 2.5 visits to the region per annum over the past three years (Table 13). On average, visitors to the Sunshine Coast region spend far longer in the LGA than in the other locations. This indicates that the Sunshine Coast LGA is likely to suffer a larger economic impact than other locations if beach visitors cancel their trip due to beach erosion. This is moderated by the importance of the beach in their decision to visit a region, which is explored in Section 5.6, and the extent to which their beach usage is affected by erosion, which is explored in Section 5.5.

Table 13 Repeat visitation and duration of trip

Case-study location	Other trips (p.a.)	Nights
Sunshine Coast	1.40	14.15
Surf Coast	2.51	3.06
Clarence Valley	1.83	4.88
Augusta-Margaret River	2.11	9.40

These visits occur primarily in the middle of the day, though it should be noted that this is biased by the time of survey data collection. Also influencing these results is that the majority of surveys were collected in April and May when the weather was slightly cooler. The visitation pattern is therefore more consistent with the resident visitation pattern for winter. (For regional variation in temporal visitation patterns, see Appendix 5 for case study reports.)

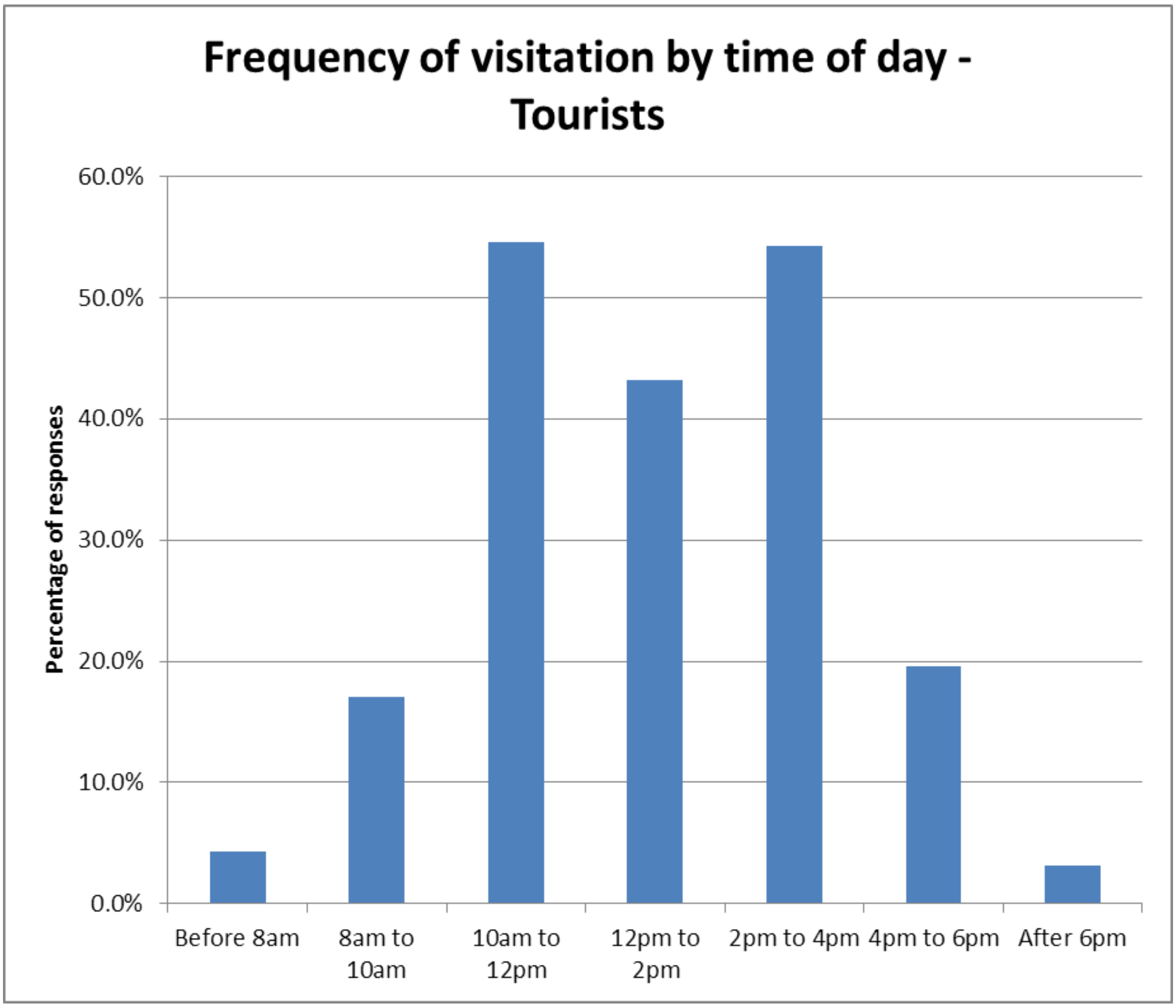

Figure 14 Tourist beach visitation by time of day – pooled sample from all case studies

5.3 Economic values of beach and surf tourism and recreation

This section describes the techniques and findings of the economic valuation component of the project. The objective is to provide a monetary estimate of the economic value of beach and surf tourism and recreation for each case-study region. This valuation was based on the data collected by this project as described above and also drew on existing datasets from TRA, SLSA and previous work of the authors.

5.3.1 *Resident beach recreation values*

Beach recreation values for residents were estimated using the Travel Cost Method. This method was explained in Section 4.3.1. Table 14 shows the range of estimates for consumer surplus for resident recreation values based on the inclusion or exclusion of the cost of travel time in the TCM analysis.

Table 14 Resident beach recreation consumer surplus estimates

	Consumer surplus per adult per visit ($/person/day)	
Case-study location	Fuel only model	Fuel only plus time @40% of hourly rate
Sunshine Coast	3.36	8.50
Surf Coast	3.27	5.15
Clarence Valley	6.10	9.30
Augusta-Margaret River	3.28	12.21

Most management actions are concerned with the gross value of all beach recreation at a location or within a region, rather than the individual per person value. To estimate the gross value of beach recreation at a given location it is necessary to aggregate this individual value by the total number of beach recreation trips by all beach users. Data availability for total beach visitation for most beach locations in Australia is currently very limited and low quality.

To develop total beach visitation estimates for the regions, the resident survey responses were used to estimate average annual visitation rate. This average visitation rate was applied to the population of the respective regions to estimate total resident beach visitation per year.

Given the relatively low response rates in the BASTRA mail surveys, a comparison with previous work is shown in Table 15 to provide a benchmark for the visitation estimate. The benchmark used was a survey of Gold Coast residents with a response rate over 60% (Raybould, 2006). This illustrates the implications of variation in the average visitation rate on the total beach visitation volumes.

Table 15 Resident beach visitation estimates

	Gross annual beach estimate – visits p.a. across LGA			
Case-study location	Regional population (2006 Census estimate, persons over 15)	Mean number of visits p.a. from BASTRA resident survey	Using visitation estimate from BASTRA resident survey	Using Gold Coast estimates from Raybould 2006 (48 visits p.a.)
Sunshine Coast	254 112	84	21 345 408	12 197 376
Surf Coast	18 245	102	1 860 990	875 760
Clarence Valley	37 536	138	5 179 968	1 801 728
Augusta-Margaret River	9 288	123	1 135 044	442 944

Using the BASTRA estimate of visits per year, we estimate the total value of beach recreation to residents of case-study locations. This estimate is shown in Table 16.

Table 16 Aggregate value of resident beach recreation value to case study locations

Case-study location	Annual value (million $A) of resident recreation	
	Fuel only model	Fuel only plus time @ 40% of wage rate
Sunshine Coast	69.59	197.23
Surf Coast	6.09	9.58
Clarence Valley	31.60	48.17
Augusta-Margaret River	3.72	13.86

The choice of travel cost components is also clearly critical in estimating the total resident recreational value.

5.3.2 *Tourist expenditure analysis*

Expenditure analysis of tourist beach recreation was undertaken in response to requests from council officers from all LGAs for details of direct expenditure associated with beach recreation to augment the consumer surplus estimates.

The expenditure analysis used data from the TRA domestic and international visitor surveys, which includes estimates of tourist visitation, per night expenditure and percentage of tourists that visit the beach. The beach-user survey data and the length of stay data from the TRA data was used to estimate beach visitation per night for visitors to the region.

Table 17 shows total annual estimates of beach visitation volumes in the A-MR region by each of the three categories of tourists recognised by the TRA data.

Table 17 Tourist beach visitation estimates – process

Visitor type	Number of visitors p.a.*	Proportion using beach *	Estimated number of beach visits during trip	Total annual beach visits
Domestic overnight (average stay = 4 nights)	350 000	0.4	2	280 000
International (average stay = 6 nights)	61 432	0.87	3	160 338
Day	234 000	0.25	1	58 500
Total	645 432			498 838

* Visitor data from TRA (Average 2009, 2010, 2011)

The same process is undertaken for each of the case-study locations. Total beach visitation estimates are shown in Table 18 below. Data is again sourced from TRA estimates.

Table 18 Tourist beach visitation estimates (annual)

Case-study location	Total visits to LGA per annum	Estimated beach visits p.a.
Sunshine Coast	7 588 200	4 677 956
Surf Coast	3 041 096	2 127 872
Clarence Valley	922 000	643 260
Augusta-Margaret River	645 432	498 838

Table 19 shows the gross travel costs of daytrip tourists to the case-study region who went to the beach. This is calculated by multiplying the travel cost per adult for daytrip tourists to the regions by the number of beach visits by day visitors from the previous step. The per adult beach visit expenditure for daytrip tourists is calculated using the mean travel distance, group size and vehicle type from the BASTRA beach-user survey.

Table 19 Tourist day-tripper beach recreation expenditure estimates

Case-study location	Average driving distance for return trip (km)	Number of adults per vehicle	Expenditure per adult beach visit (A$)	Annual gross expenditure – daytrippers (A$)
Sunshine Coast	220	2	12.10	13 849 176
Surf Coast	200	2	11.00	8 224 920
Clarence Valley	200	2	11.00	1 669 800
Augusta-Margaret River	400	2	22.00	1 287 000

Table 20 shows the gross beach visit related expenditure for the case-study regions for each of the TRA tourist categories. For Domestic overnight and International Tourists expenditure per visit is based on 50% of average daily expenditure for each day of the trip that they visit the beach. This assumed expenditure value is only included on the days on which they are estimated to have visited the beach and hence is likely a conservative measure.

Table 20 Tourist gross beach visitation expenditure

Case-study location	Annual value (million A$) of tourist value			Total
	Daytrippers	Domestic overnight	International	
Sunshine Coast	13.85	227.45	28.87	270.17
Surf Coast	8.22	93.45	4.95	106.63
Clarence Valley	1.67	29.33	1.13	32.13
Augusta-Margaret River	1.29	19.04	4.25	24.58

5.3.3 *Summary of recreational and tourism value*

Table 21 summarises the results presented in the previous sections to provide an overview of the magnitude of importance of beaches and coastal assets to the case-study locations.

Table 21 Summary of BASTRA value estimates for recreation and tourism

Case-study location	Annual value (million $A) of resident recreation	Annual value (million $A) of tourist expenditure related to beaches
Sunshine Coast	69.59	270.17
Surf Coast	6.09	106.63
Clarence Valley	31.60	32.13
Augusta-Margaret River	3.72	24.58

The estimates for the value to tourists represent actual expenditure, rather than CS. The figures were derived by combining trip characteristics from the BASTRA surveys with expenditure measures sourced from TRA. It therefore represents the 'realised' economic importance of beach-related recreation in each location. Consumer surplus estimates would be in addition to these figures.

5.4 Contingent behaviour - beach user responses to changed conditions

Survey respondents were presented with a scenario of an erosion event which meant that there was no usable beach at their preferred beach location. They were asked how they would respond and how much time or money they would be WTP to travel to another location that provided the same benefits or not making this outlay. The responses are separated into those from residents in the mail survey, and those from tourists in the onsite beach-user survey.

5.4.1 *Resident response to erosion*

Approximately two-thirds of all residents across all case-study sites indicated they would be prepared to travel to another beach, or pay for erosion prevention measures to make this travel unnecessary. Figure 15 shows the response of residents to this question.

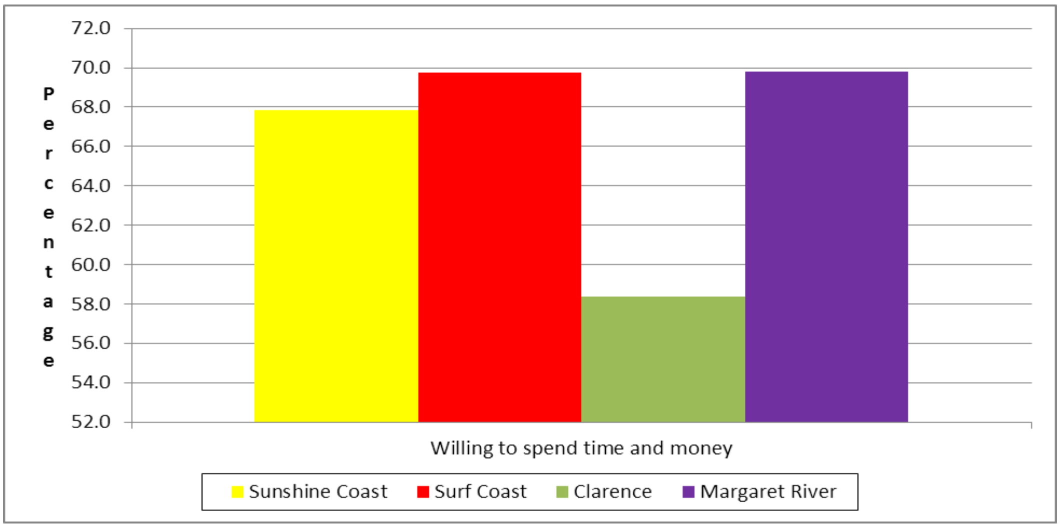

Figure 15 Resident willingness to travel or pay to avoid erosion impacts

The proportion willing to outlay time or money was noticeably lower for respondents from the Clarence Valley region. Possible reasons for this variation are discussed in the next section. Figure 16 shows the reasons respondents gave for their unwillingness to make these extra outlays.

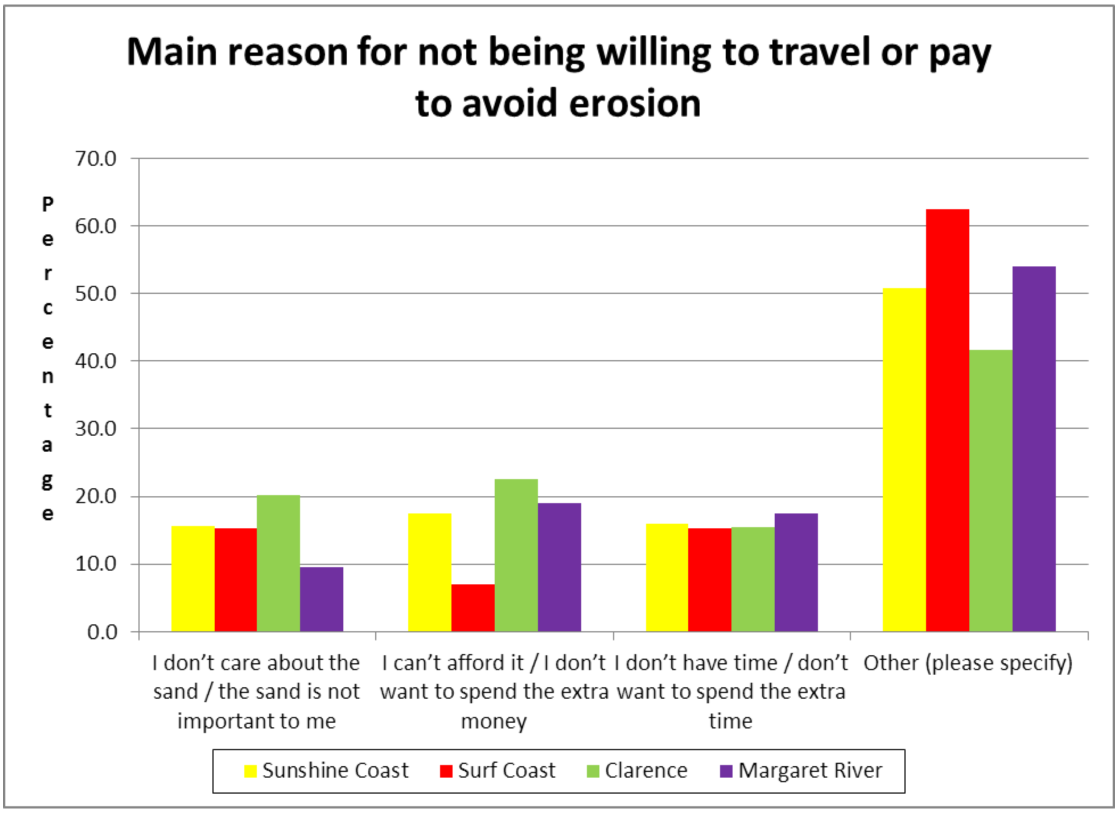

Figure 16 Reason for unwillingness to pay – residents

The responses are generally consistent between the sites when considering outlays of extra travel time, although Clarence Valley residents were most likely to be unaffected by sand loss, and Surf Coast residents were least likely to be willing to incur additional costs to avoid erosion impacts.

Figure 17 shows the categorical responses relating to the additional round-trip travel time that residents would be willing to spend in order to travel to an alternative (possibly hypothetical) beach location. A consistent pattern can be seen between the sites, with most respondents indicating that the maximum additional travel time would be in the order of 20 to 30 minutes.

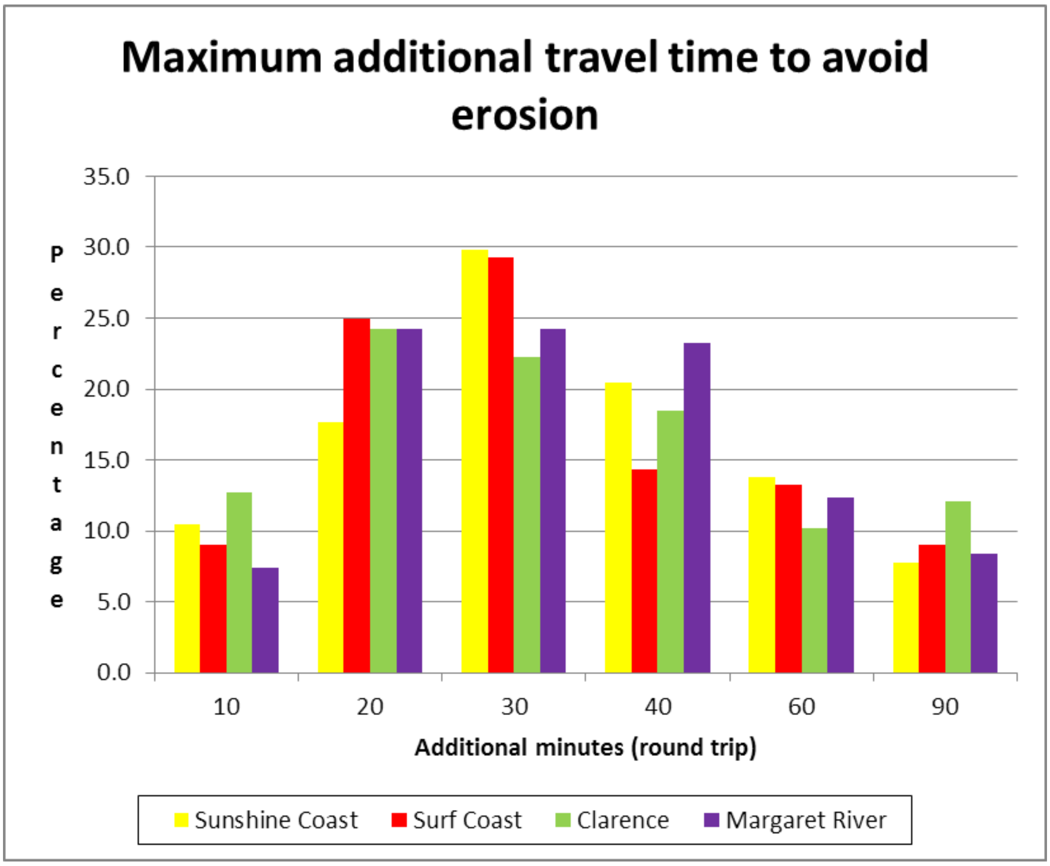

Figure 17 Resident willingness to travel to avoid erosion

For those residents who answered that they were willing to spend additional time or money finding an alternative beach, the amount of money they were willing to take getting to another location is shown in Figure 18. A consistent pattern of responses can again be identified between sites, with most people suggesting they would be willing to spend between $5 and $10 to go to another beach which is not closed due to erosion impacts. This parallels very well with the consumer surplus estimates identified in the previous section, which ranged from $3.27 to $12.21 per beach visit, depending on case-study site and model inclusions. This suggests theoretical validity for the consumer surplus estimates, as they align well with the stated WTP to access the beach for recreation.

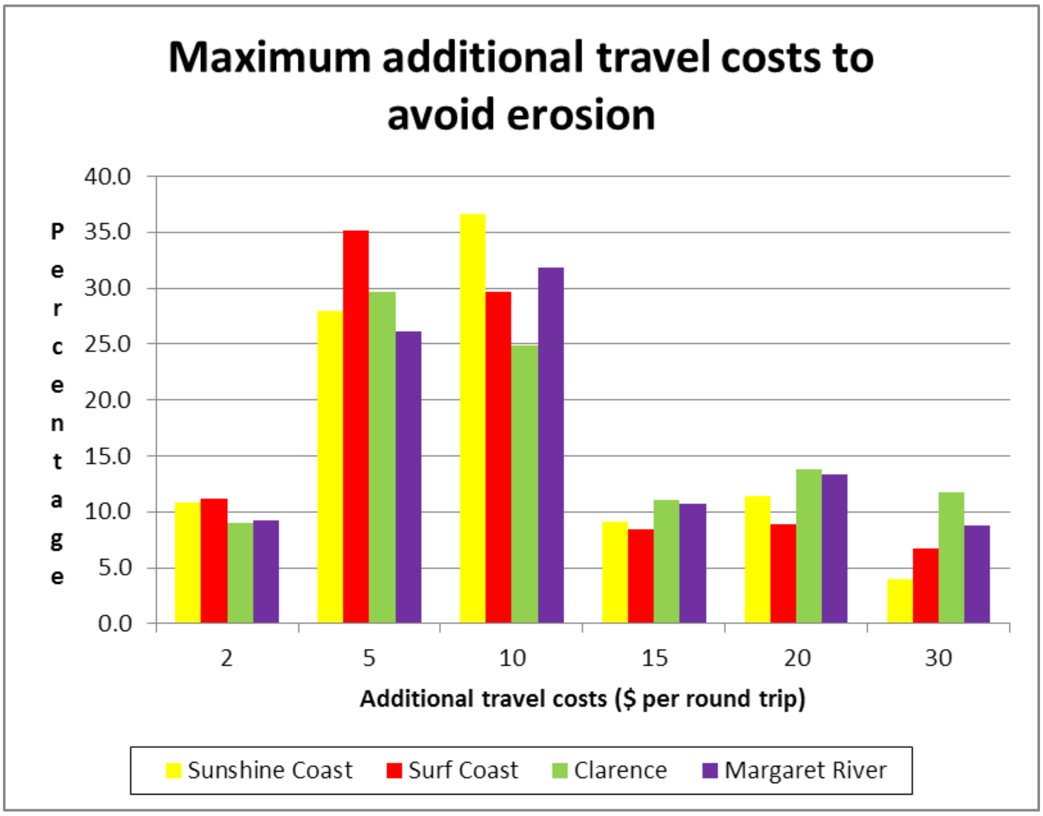

Figure 18 Resident willingness to pay to avoid erosion

5.4.2 *Tourist response to erosion*

Figure 19 shows the response of tourists surveyed on the beaches of each case-study site to the question about their response to the loss of a usable beach. In general, tourists were more likely to be WTP to avoid erosion impacts than the residents. This perhaps reflects that tourists have more substantial sunk costs and are therefore chasing their losses, or that they tended to be more wealthy than the residents sampled at the same location. Notably, visitors to Clarence Valley beaches are much more likely to be willing to incur time or monetary costs to maintain their beach experience than residents of the same location.

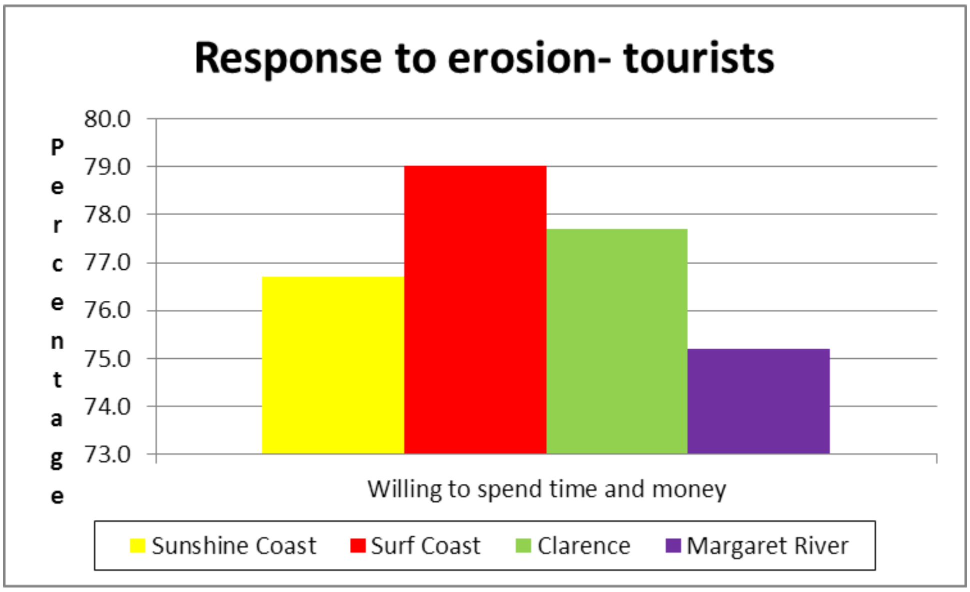

Figure 19 Tourist willingness to travel or pay to avoid erosion impacts

Figure 20 shows the reasons given by tourists for not being willing to outlay time or money to avoid the negative impacts of beach erosion. Clarence Valley residents were least likely to care about the presence of sand, with 25% of respondents unaffected by the loss of sand, and thus their reduced overall WTP to avoid erosion impacts is a logical response. A-MR residents were most likely to cite a lack of desire to spend the money as the main reason for not being WTP to go to another location, whereas Surf Coast residents were most likely to cite a lack of time.

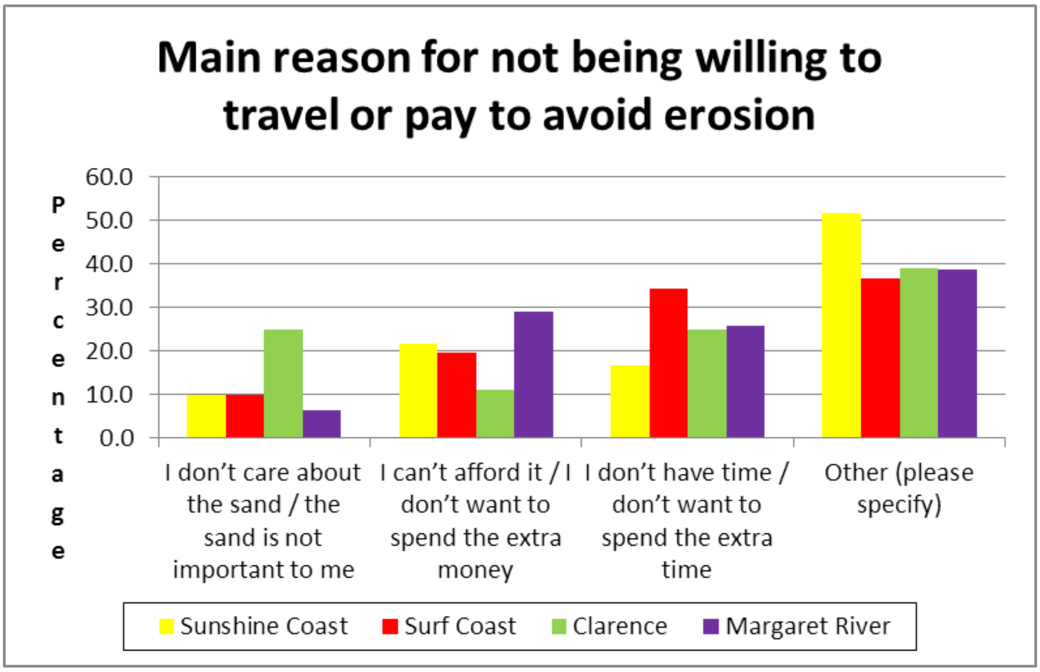

Figure 20 Main reason for unwillingness to pay – tourists

Figure 21 shows the willingness of tourists to travel to avoid erosion impacts, or to reach an alternative destination with comparable facilities and amenities. It can be seen that there is a flatter 'curve', with tourists being more likely to travel long distances than was seen in the resident responses.

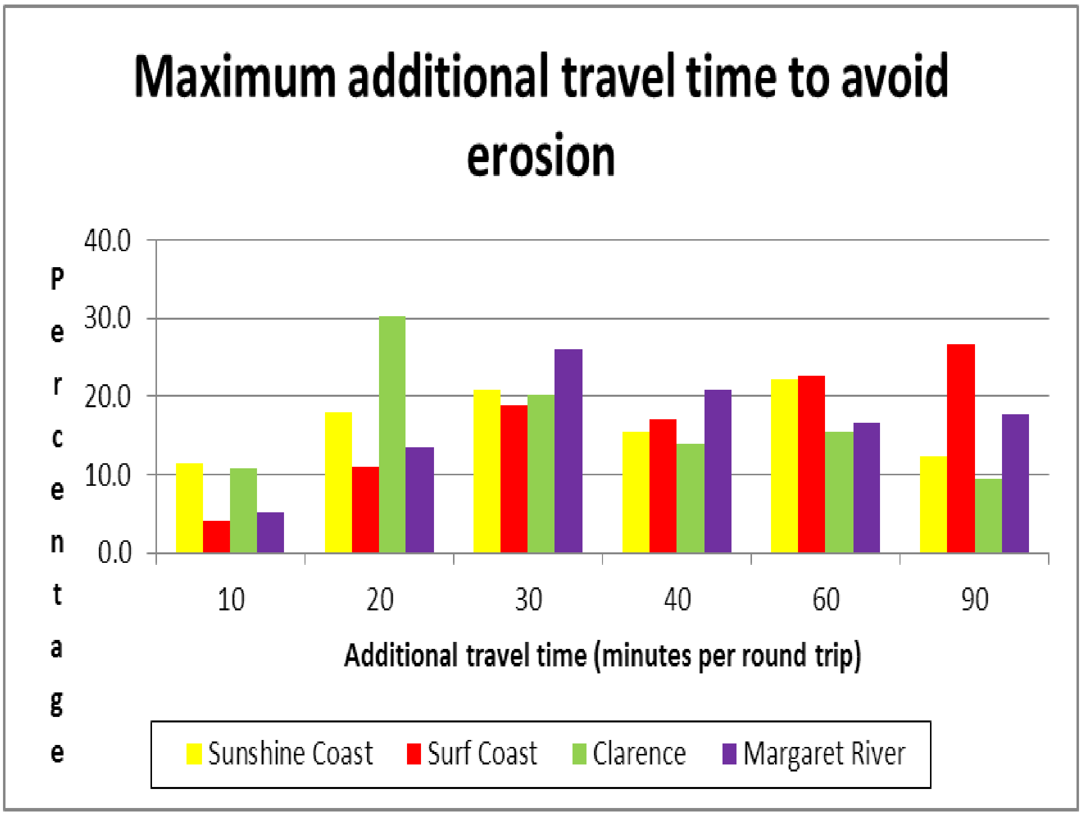

Figure 21 Tourist willingness to travel to avoid erosion

Figure 22 shows the willingness of tourists to pay to visit an alternative beach location in the event of erosion closing their first-choice beach. Resident responses were clustered around the lower figures, whereas the tourists sampled indicate a willingness to travel further than the residents. The distribution is bimodal and indicates that some visitors are willing to travel long distances.

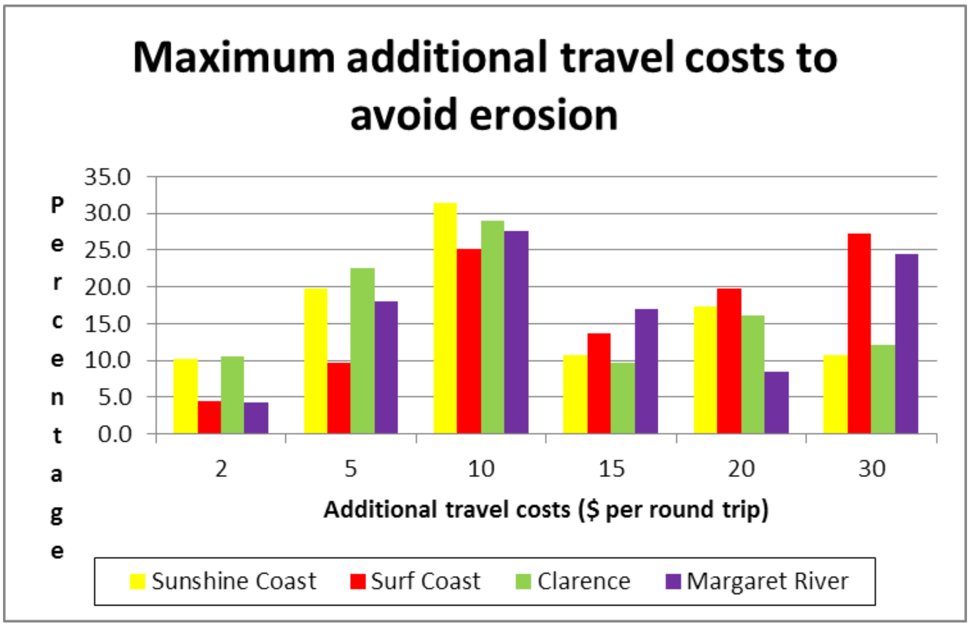

Figure 22 Tourists willingness to pay to avoid erosion impacts

This shows that tourists are willing to spend more than residents to access an alternative beach. This stems from the fact that the suggested increases in travel costs represent a relatively small proportion of their existing trip costs, whereas for residents it may represent a more-than-doubling of trip costs. It therefore represents a measure of theoretical consistency in the survey responses, a 'scope test'.

5.4.3 *Valuation of the opportunity cost of travel time*

Respondents were asked to provide answers to their contingent behavior response in two ways, outlining both how much additional travel time they would be willing to spend to get to an alternative location. Looking at the way in which people trade these two alternative cost specifications allows us to infer the internal valuation of the opportunity cost of additional leisure time. This is a simple yet novel approach that has not previously been reported in the published literature, and provides a number of key insights that are likely to be critical in BT studies on similar assets.

Table 22 presents the comparison of extra travel time and costs for residents in response to erosion. There is considerable agreement between the case-study sites, with Sunshine Coast and Surf Coast samples valuing their time slightly less than those from Margaret River and Clarence Valley.

It is interesting to note that this figure is both relatively consistent between the sites, and substantially higher than the figure employed in the travel cost estimates. Those estimates used a proportion (40%) of the average wage rate for the region, with figures typically in the vicinity of $5/hr. This implies that, although around two-thirds of the respondents indicated that they would be prepared to travel the extra time associated with visiting the new location, it is considered a substantial impost. The respondents therefore require more compensation in order to consider this an appropriate substitute.

Table 22 Opportunity cost of leisure time – residents

Case-study location	Maximum round-trip travel time in minutes (weighted mean)	Maximum round-trip travel cost in dollars (weighted mean)	Implied valuation of travel time ($/hr)
Sunshine Coast	36.96	10.13	16.45
Surf Coast	36.54	10.00	16.42
Clarence Valley	37.20	12.08	19.48
Margaret River	37.18	11.57	18.67

Table 23 shows the internal assessment of the opportunity cost of extra travel time to tourists undertaking a beach visit. It can be seen that tourists value their time slightly more highly than residents visiting the same locations. This is possibly due to the fact that the tourists may be taking advantage of limited leisure time, and do not wish to waste it on travel to alternative locations.

Table 23 Opportunity cost of leisure time – tourists

Case-study location	Maximum round-trip travel time in minutes (weighted mean)	Maximum round-trip travel cost in dollars (weighted mean)	Implied valuation of travel time ($/hr)
Sunshine Coast	41.58	12.59	18.16
Surf Coast	52.62	14.65	19.54
Clarence Valley	36.43	12.55	20.66
Margaret River	45.31	15.35	20.33

5.5 Choice of destination or residential location

This section presents an assessment of the importance of coastal resource features in determining the preferred locations for recreation and tourism. The results are presented at three spatial levels:

- regional level – the importance of LGA features in choice of a place to live or visit
- suburb level (residents only) – the importance of local features in choice of where to live
- site level – the importance of beach or coastal asset features in choice of where to recreate.

Analysing the answers to the first two of these questions provides information about how geographically mobile tourists and residents may respond to climatic changes in the longer term, whereas the third component provides information about which aspects of sites require the greatest management attention if the existing economic streams from coastal recreation and tourism are to be preserved under changing environmental conditions.

5.5.1 *Regional level*

Given that the BASTRA project's focus is on the importance of beach and coastal assets to 'sea change' locations, it is interesting to explore the importance of these assets in the choice of where people live and visit.

5.5.1.1 Residents

Beaches were critically important factors for at least 80% of residents in their choice of residential location at the regional level (Figure 23). The availability of fishing spots was also a key driver, with at least one-third of respondents at each location citing their presence as a key drawcard, with a higher level of importance placed on this feature by residents of Clarence Valley and A-MR (45% and 55%, respectively). Similar figures were recorded for the availability of surf breaks, though this was most important to residents of the (aptly named) Surf Coast.

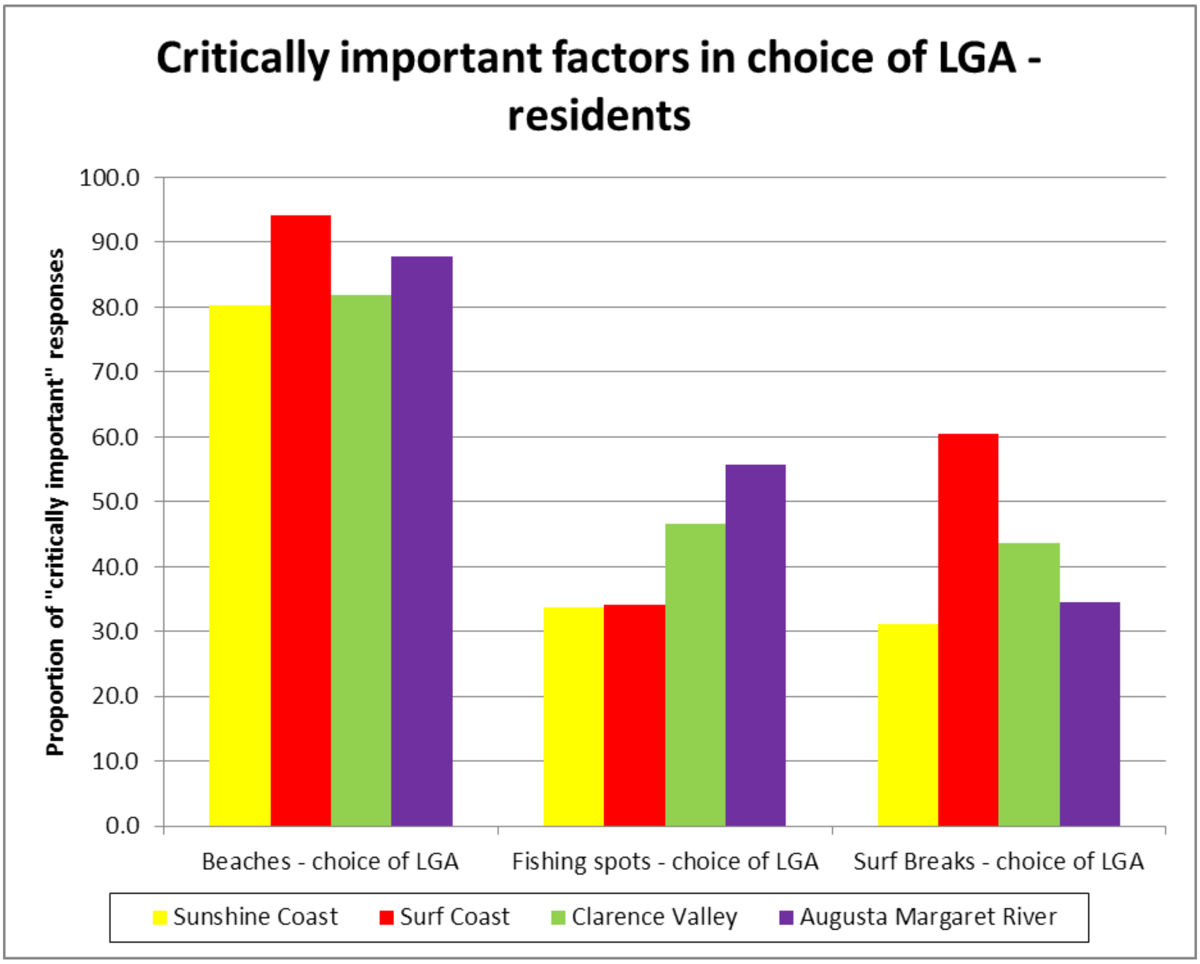

Figure 23 Regional-level drivers of residential location choice – residents

Given the potential for noticeable changes in climatic conditions, it is also interesting to examine the extent to which climate is a driver of residential location choice (Figure 24).

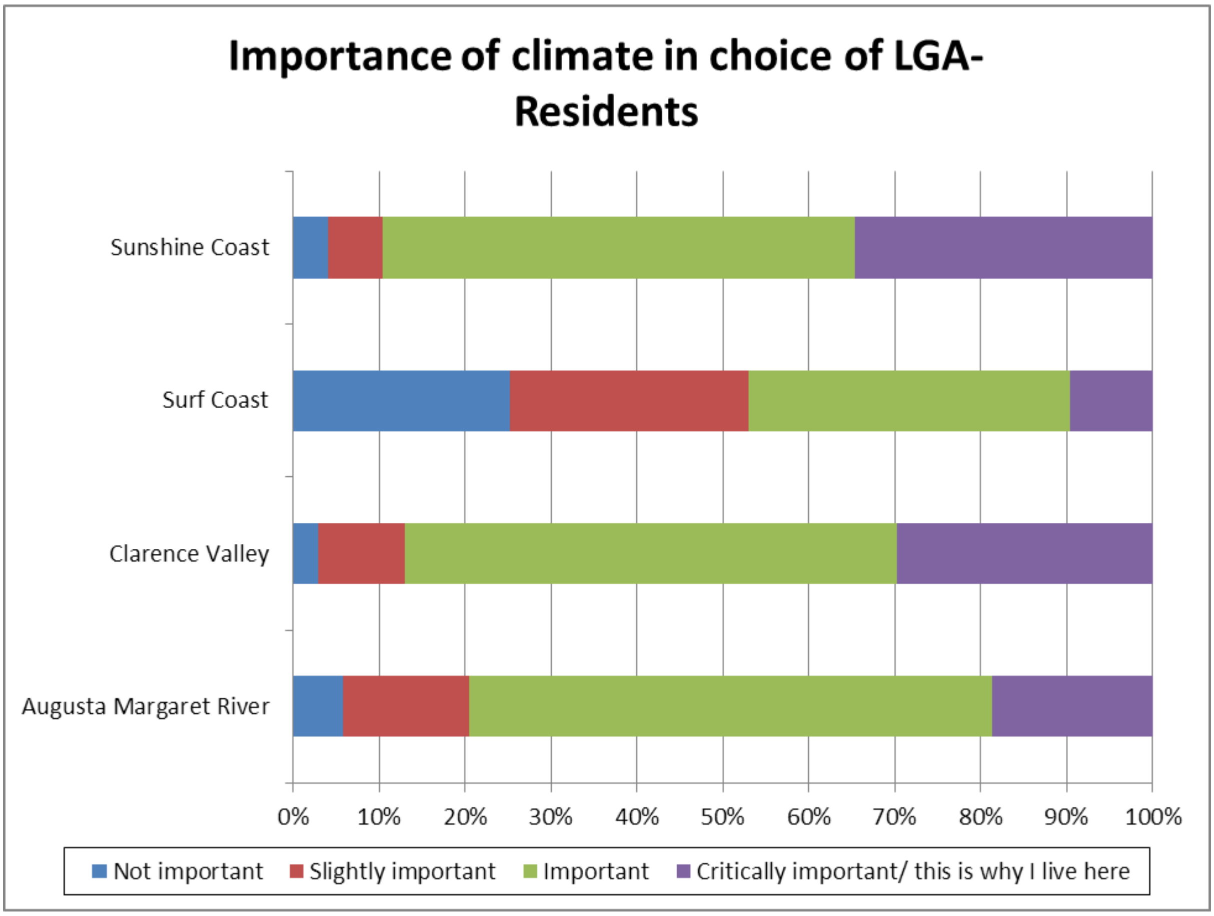

Figure 24 Importance of climate in choice of LGA – residents

Interestingly, the pattern of importance approximately aligns with the measures of thermal comfort outlined in the Classification Framework climate component. That is, people who consider climate important or critically important are most likely to be found in warmer locations with benign climate conditions (Sunshine Coast and Clarence Valley). More than half the residents in the Surf Coast region suggested that climate was either 'slightly important' or not important in their choice of location. Thus the macro-scale response to changes in climate may be demonstrated by people locating themselves based on the prevailing climate, as well as by their level of sensitivity to changing conditions.

5.5.1.2 Tourists

Beaches were highly important in the choice of travel destination, with between 50% and 100% of tourists indicating that it was a critical factor in their selection process (Figure 25).

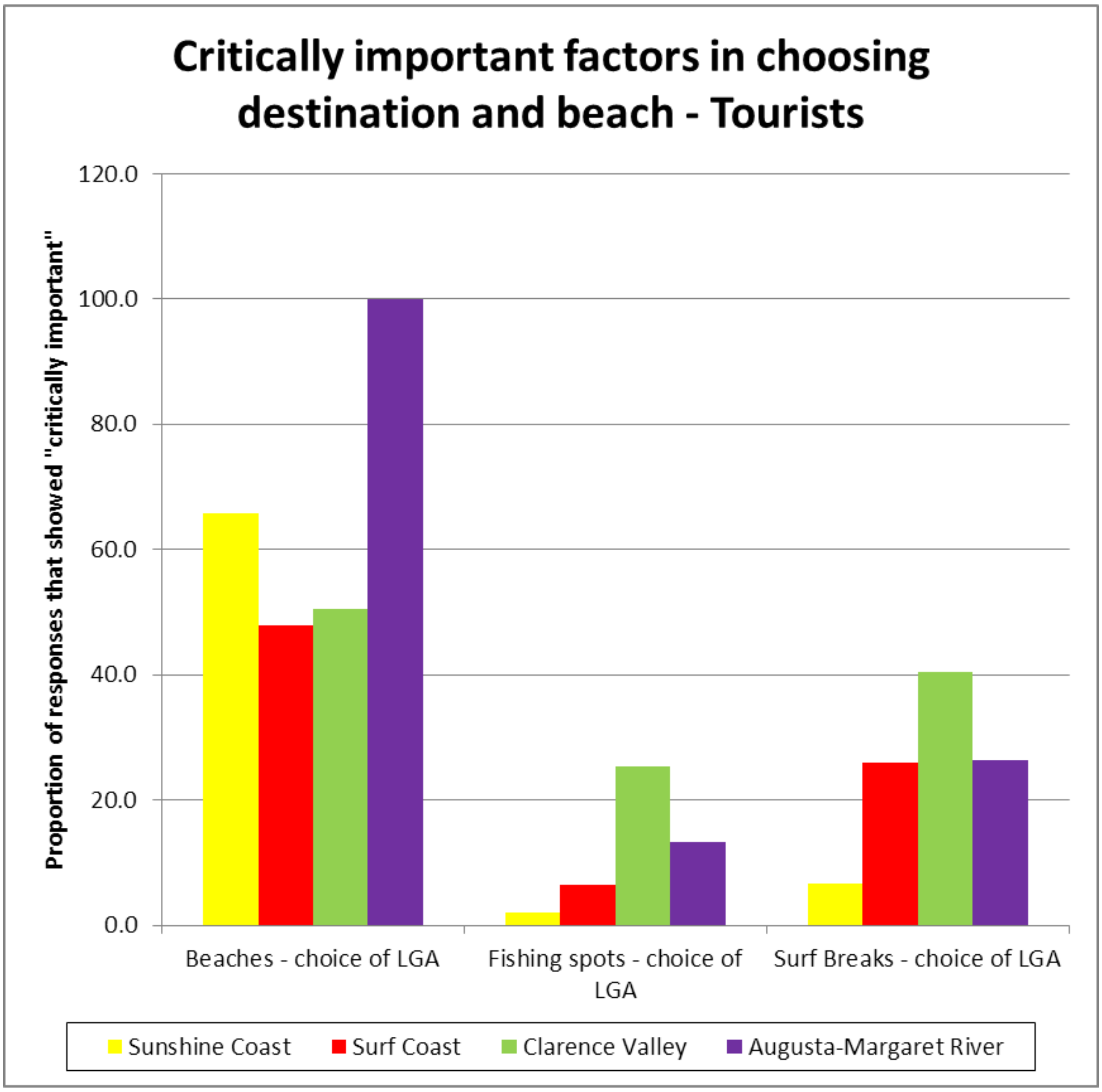

Figure 25 Importance of regional features in site selection – tourists

The figures were not generally as high as those for residents, indicating that other factors moderate their destination choice. Cost is likely to be one of these factors. This result is worth noting, given that the sample was taken from people interviewed in the very act of visiting the beach. Interestingly, it was a critical factor in destination choice for all tourists surveyed on the beach in A-MR. This suggests a highly stratified sample of regional visitors, as only 25% of daytrip visitors to the region visit the beach, and the highest level of visitation (among international tourists) was 87% of total visitors, and may only refer to a single visit in a six-day trip (Table 17). Fishing spots and surf breaks were about half as likely to be critically important for tourists to a region than for the residents, with Clarence Valley tourists ranking both features most highly.

The importance of climate in site selection was highly variable, as seen in Figure 26. Overall, the climate of a region was more important for tourists than for residents. This suggests that the more mobile tourist population will respond more rapidly to changes in climate and beach conditions.

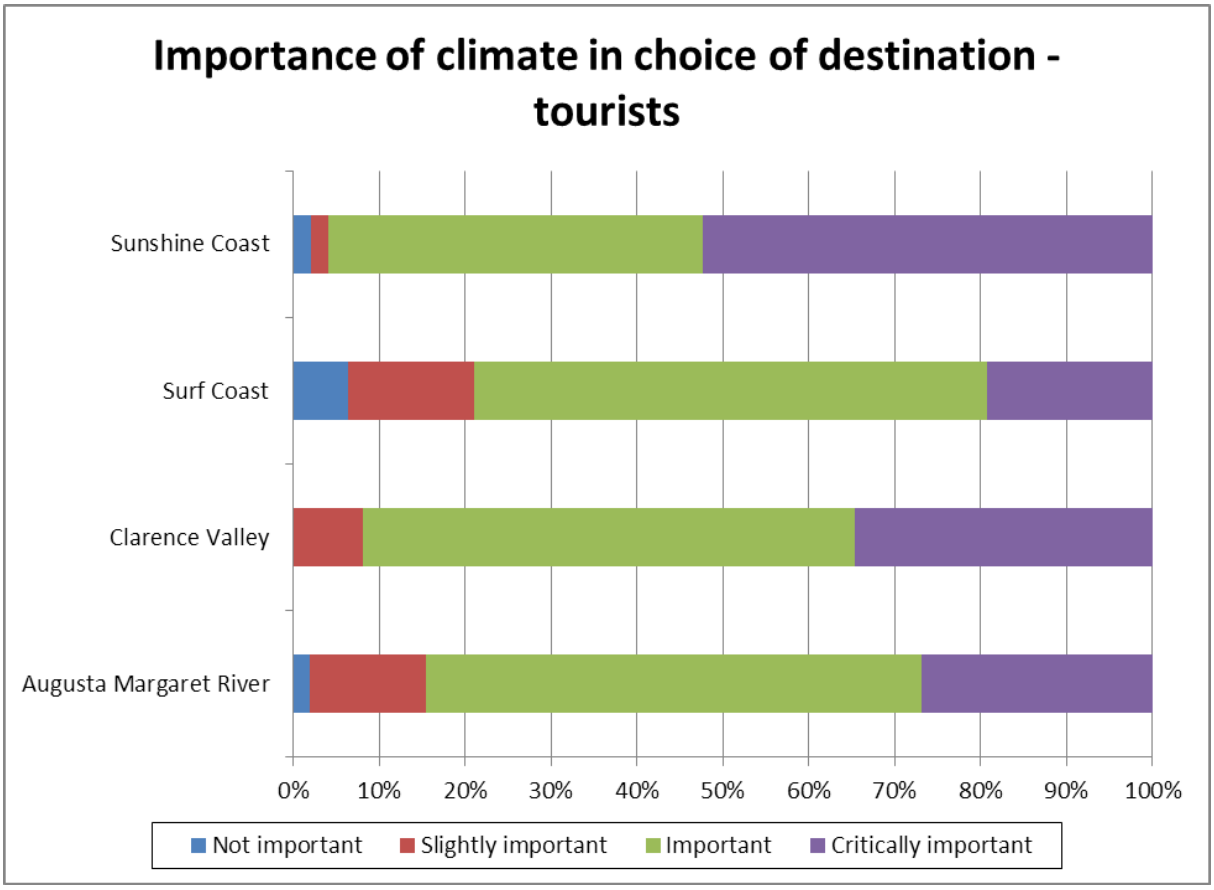

Figure 26 Importance of climate in destination choice – tourists

5.5.2 ***Suburb level***

The importance of beaches in the choice of residential location varied substantially between case-study locations (Figure 27). Around 70% of residents on the Surf Coast stated that proximity to beaches was either important or critically important in their choice of where to live. This figure is around 40% for the Sunshine Coast and Clarence Valley samples, and slightly over 50% for resident respondents from A-MR.

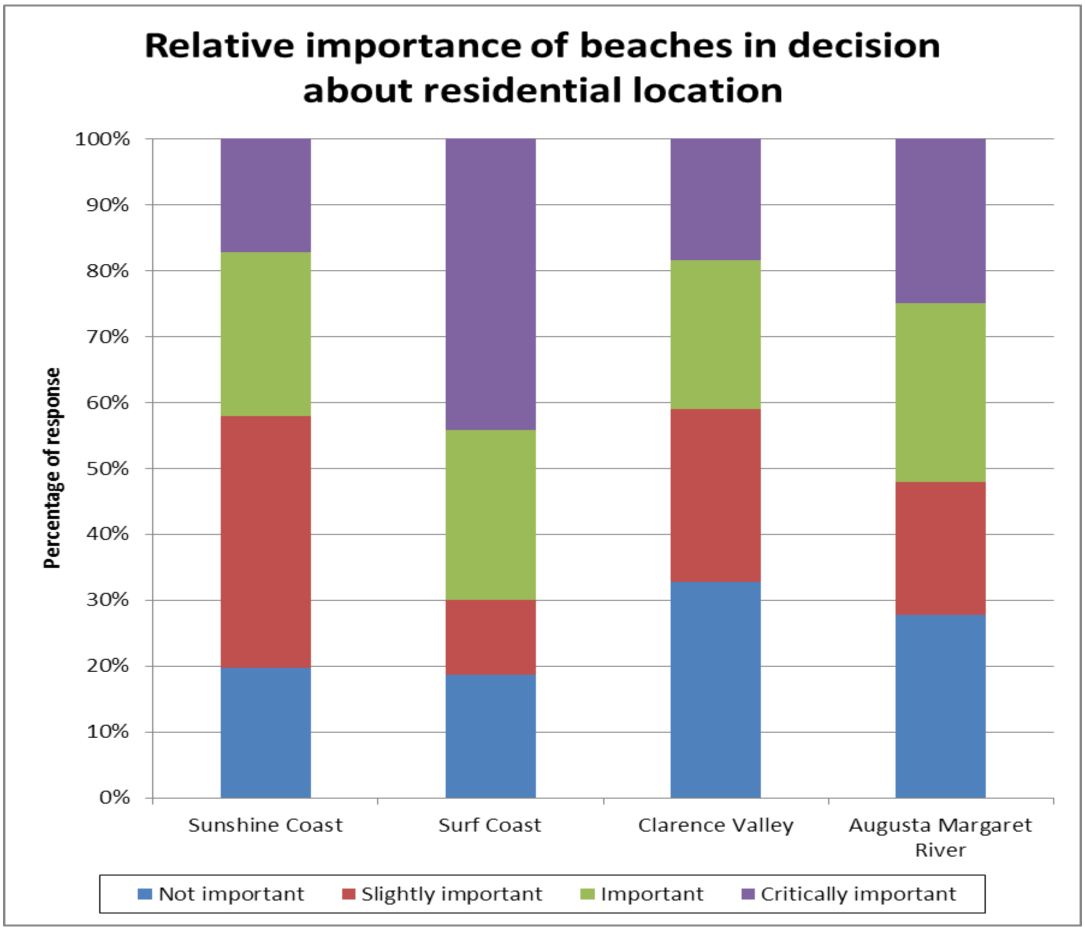

Figure 27 Importance of beaches to residents in choosing where to live

There is also a noticeable difference in the importance of surf breaks between the case-study locations (Figure 28), with very similar proportions as displayed in the question relating to beaches.

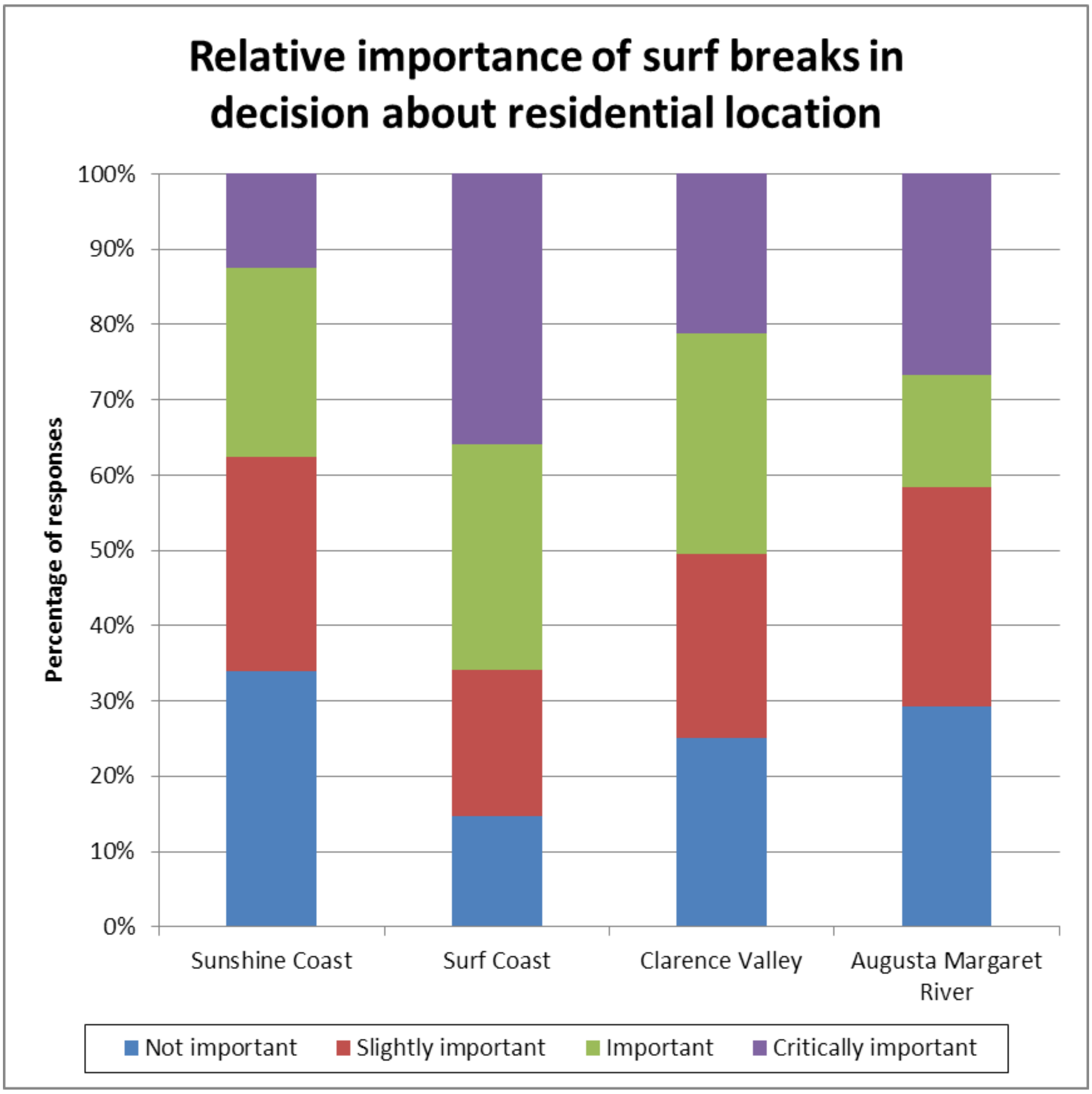

Figure 28 Importance of surf breaks in choosing residential location

Tourists were not specifically asked about the importance of beaches in their choice of location within an LGA, but their responses about proximity in beach choice suggest that is a factor when choosing where they stay. Figure 29 shows the responses by tourists to the importance of proximity.

Two-thirds of visitors to the Sunshine Coast state that proximity to their accommodation is important or critically important in their choice of which beach to visit. The figure is substantially lower for the Surf Coast, with only one-third of tourists highlighting proximity to their accommodation as of importance or critical importance to their choice of beach. This can be somewhat misleading, however, as the linear nature of the Surf Coast means that it is difficult to be more than two kilometres from the coast. Around 40% of tourists to

A-MR highlight beach proximity as important or critically important; this presumably reflects the fact that the main township is set back from the beach, and hence almost all visitors will be conditioned to travelling further for beach access. It is likely that proximity to restaurants and wineries are other key factors in accommodation selection. Approximately half of tourists to Clarence Valley highlight beach proximity in their choice of which beach to visit. The next section highlights the importance of fishing to Clarence Valley tourists, which may serve as another key driver of accommodation choice.

Two other factors cloud the analysis of these responses. The first is that accommodation locations tend to be clustered around popular beach locations, and hence the desire for proximity is reflected more in the choice of destination than in the choice of location within that town or suburb. The second is that the tourism sample includes daytrippers, for which the primary destination is the beach itself. This visitor grouping, by definition, is travelling from outside the LGA and returning home the same day. Unless they are merely travelling a short distance across a jurisdictional boundary from an adjacent coastal location, they are clearly demonstrating the fact that they are not greatly influenced by beach proximity, as they have already chosen to live away from the beaches at which they were surveyed.

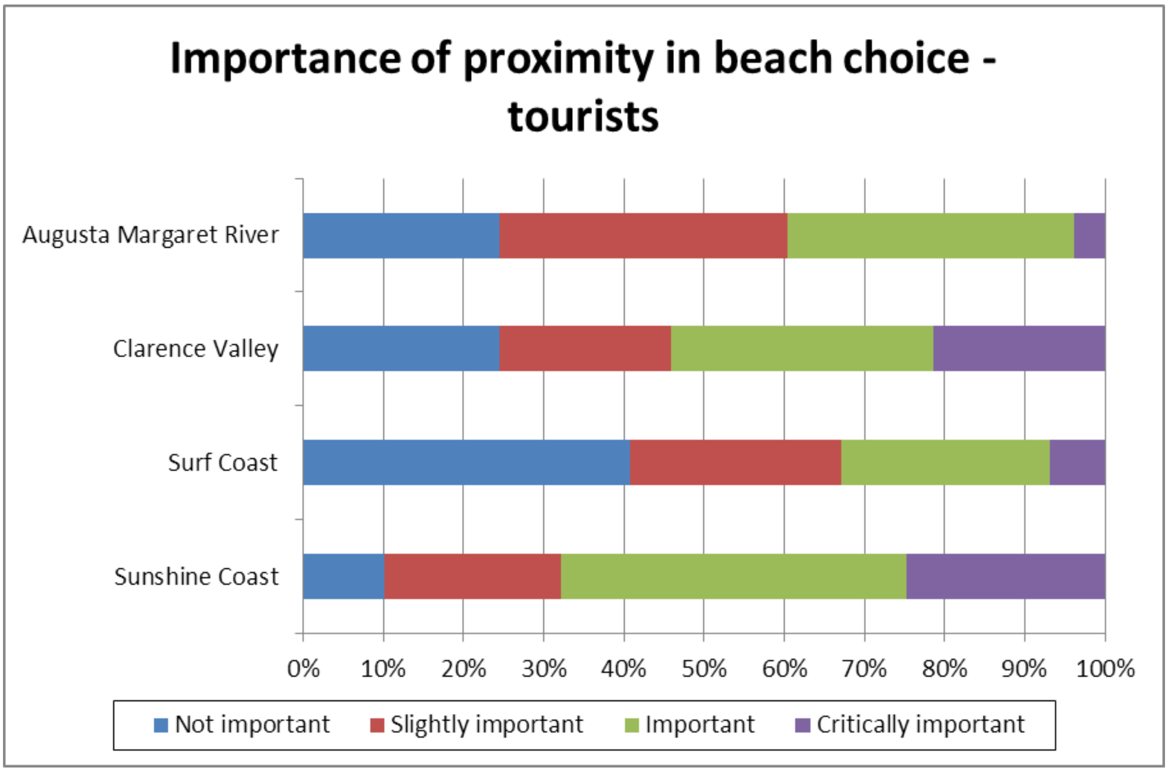

Figure 29 Importance of beach proximity in choice of beach by tourists

5.6 **Beach choice**

This section presents the results of survey questions relating to the importance of site attributes in the choice of beach to visit at the local level. Understanding the relative importance of these attributes allows for weighting of the framework components in Section 5.1. It should be noted that due to the need for site-specific consumer surplus estimates and the selection of an appropriate means to balance tourist and resident responses, this weighting process has not yet been undertaken, and is identified in Section 8.

5.6.1 ***Natural features***

Figure 30 shows the importance of the natural features of a beach in the choice of which beach to visit by residents of each case-study LGA. It can be seen that the key attributes are linked to cleanliness and visual amenity, with aesthetics, clean water and a sandy beach all ranking as critically important factors for 80% or more of respondents. The importance of fishing and surfing features varies by location, but is substantially less important. It should be noted that at least 25% of respondents cite these as critical factors in beach choice, so these are not minority concerns, at least not within the sampled population. Fishing is most important to residents of Clarence Valley and A-MR, and surfing is most likely to be critically important to Surf Coast residents.

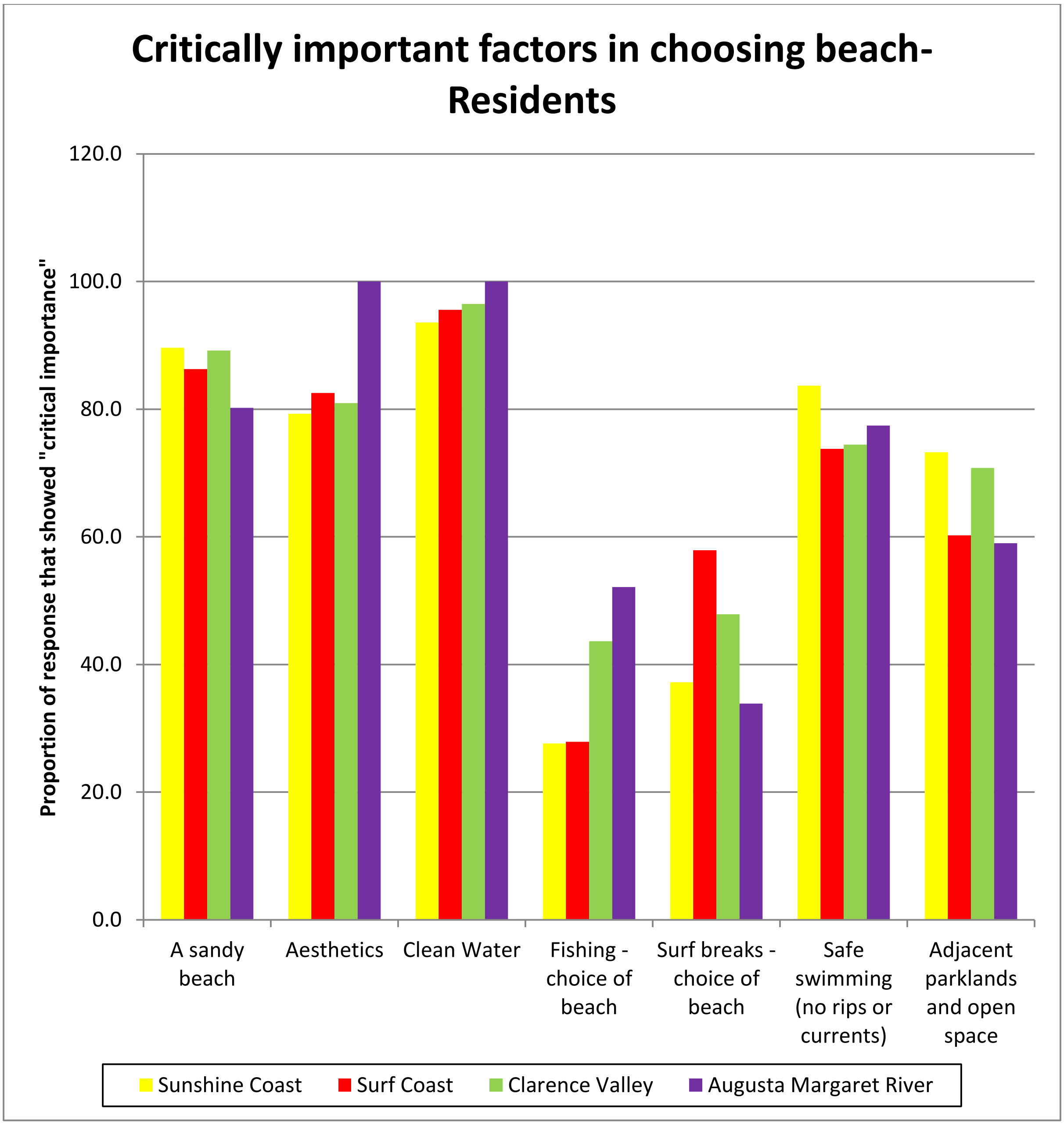

Figure 30 Importance of natural features in choosing – residents

Figure 31 shows the responses to the same questions about natural features, when posed to tourists interviewed on site. There are some markedly different responses to those recorded by the residents. Fishing is again important to visitors to Clarence Valley and A-MR beaches, with all respondents who entered a response stating that fishing was critically important in their choice of beach. This was a somewhat surprising outcome for the Clarence Valley sample, given that very few respondents were fishing at the time of the interviews, and those that were fishing were typically unlikely to complete the interview. Aesthetic factors rate substantially lower than in the resident sample, whereas safe swimming conditions and the availability of adjacent parklands and open space are more important for tourists than for residents. This may reflect the fact that residents are less likely to spend long periods at the beaches close to their place of residence, preferring to return home.

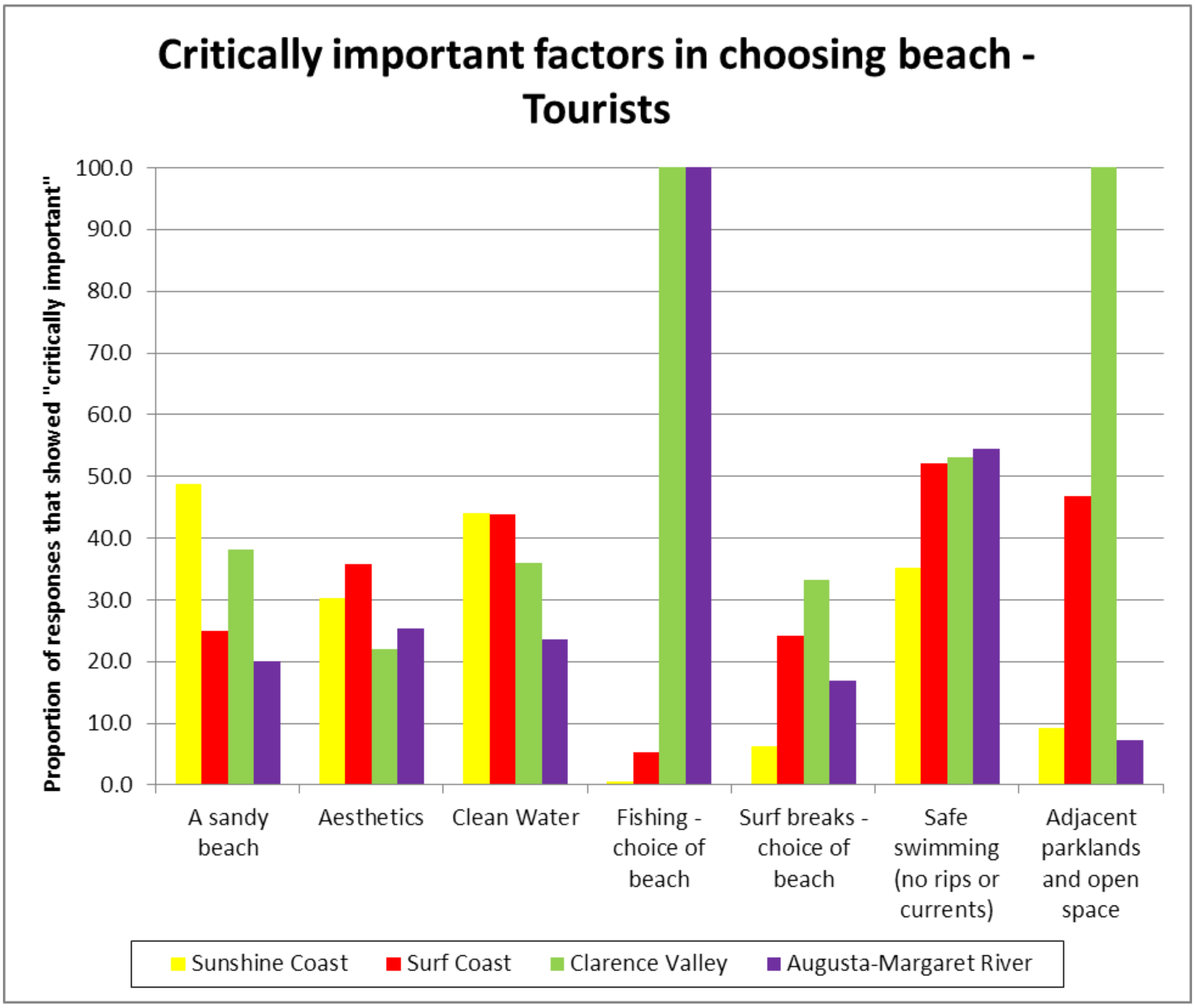

Figure 31 Importance of natural features in choosing beach – tourists

5.6.2 *Built features*

Overall, the importance of built features was considerably lower in determining beach choice than were natural features, although there was a high degree of variability between the case-study locations (Figure 32). Sunshine Coast residents attached a higher overall level of importance to built features, which perhaps reflects the fact that the main survey beaches (Kings Beach, Mooloolaba, Noosa) are highly modified beach locations with a high level of service provision. A-MR beaches are the least modified in the set of case-study sites, and it is interesting to note that none of the A-MR residents listed amenities as critically important factors in their beach choice. The availability of nearby shops and cafes was a relatively insignificant factor in beach choice at all locations, which could be seen as conflicting with the 'Build it and they will come' philosophy that prevailed in tourism destination management in the 1990s. An alternative explanation is that residents, by virtue of their proximity, are able to shop or visit cafes and restaurants independently of their beach visits.

Lifesaving patrols were critically important in beach selection for around 1 in 4 residents of the Sunshine Coast, around 1 in 6 of the Surf Coast respondents and 1 in 10 or fewer for Clarence Valley and A-MR residents. This aligns relatively well with the availability of lifeguard services at the case-study locations. That is, people for whom lifeguards are an important factor will be more likely to be surveyed at patrolled locations.

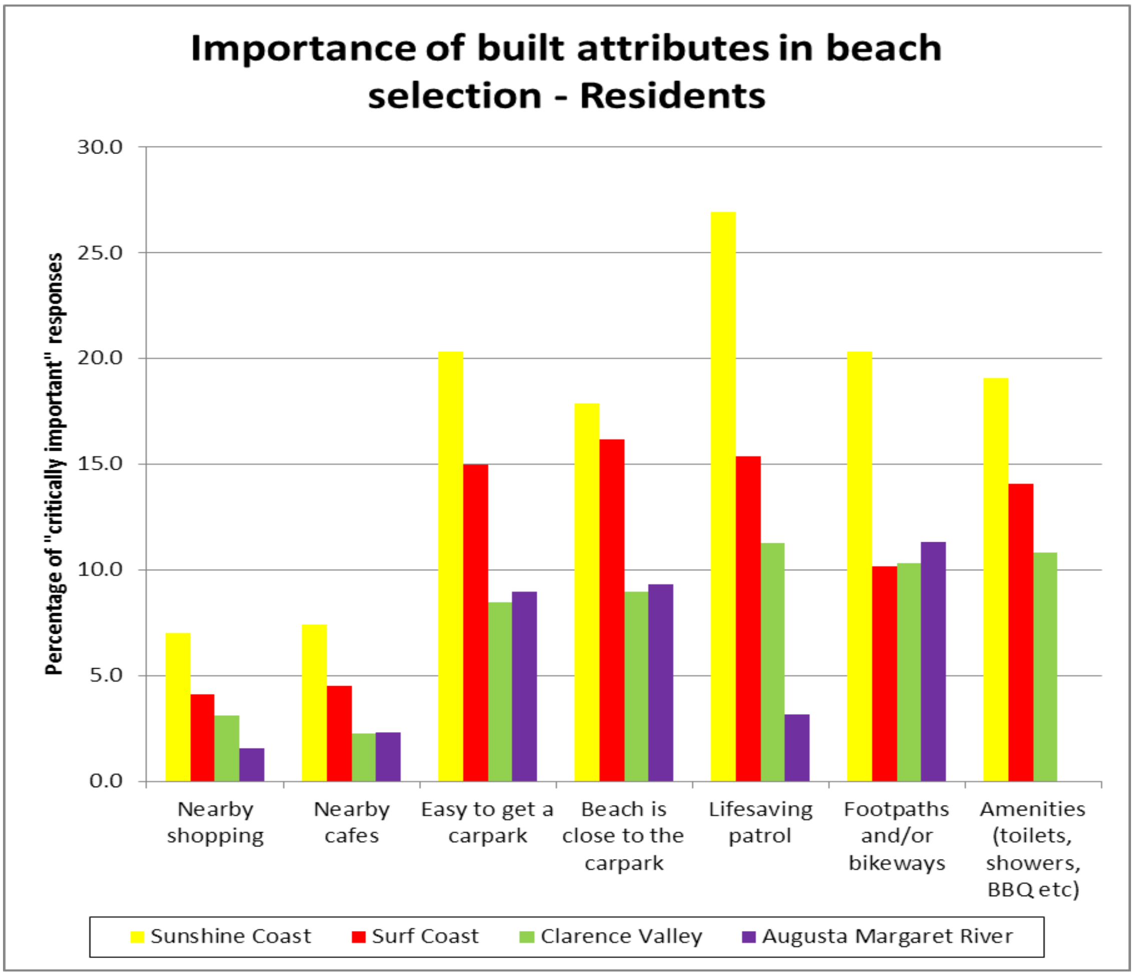

Figure 32 Importance of built features in beach choice – residents

Figure 33 shows the tourist responses to questions about the importance of built features in site selection. Interestingly, tourists are less likely to consider these features to be critically important.

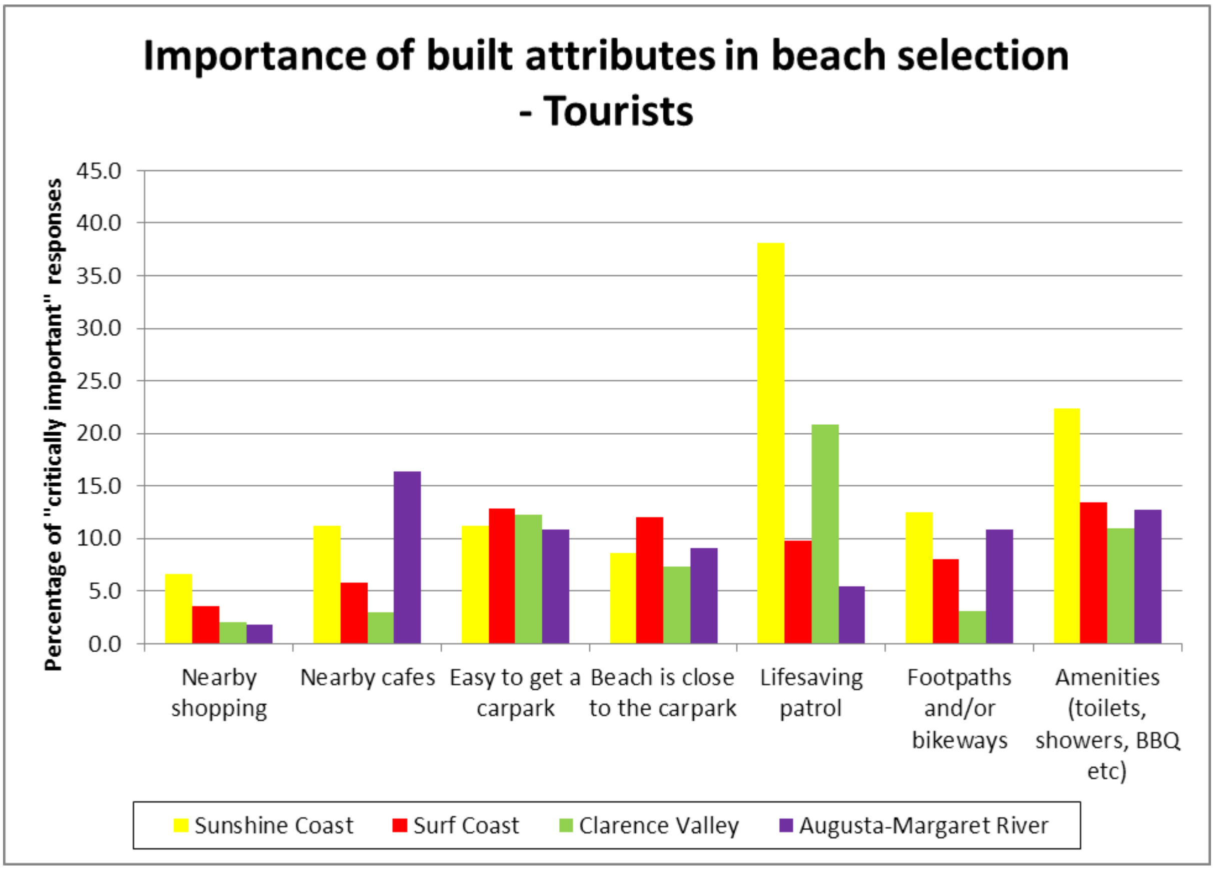

Figure 33 Importance of built features in beach choice – tourists

5.6.3 ***Proximity***

Given the importance of beaches in choice of residential location, it isn't surprising to see that 60 to 75% of respondents in all locations list beach proximity as either 'important' or 'critically important' in their choice of where to live (Figure 34).

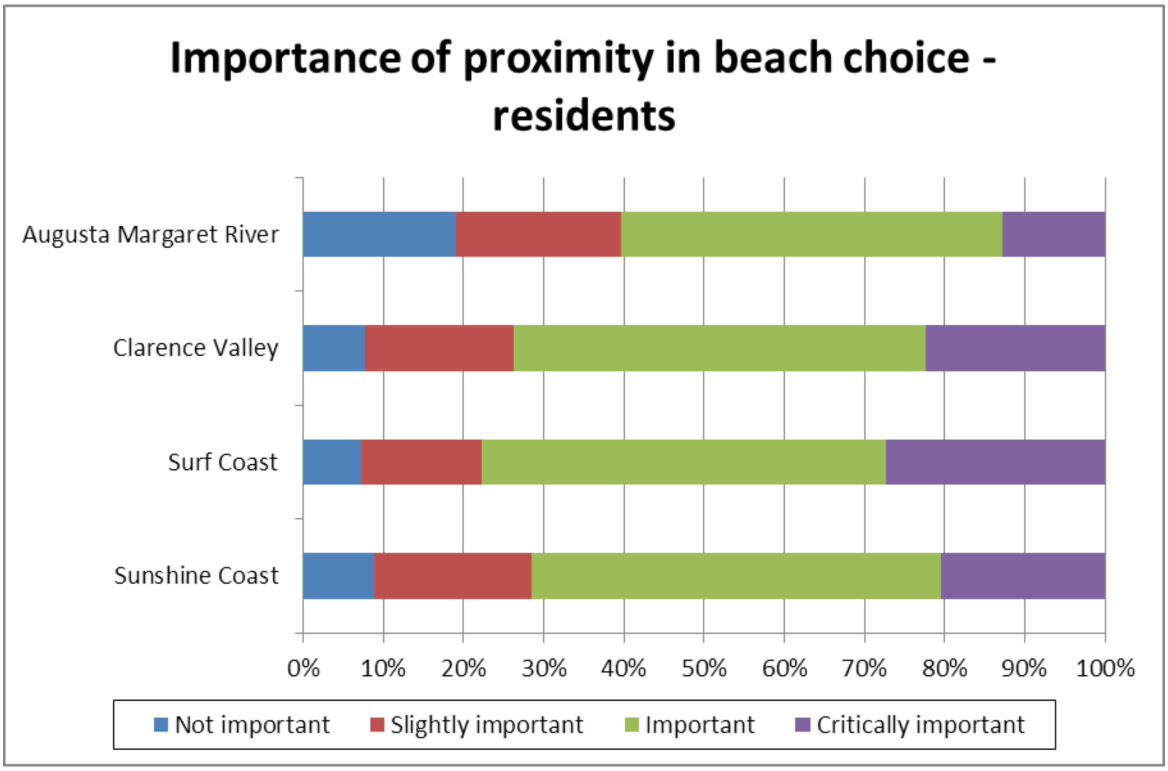

Figure 34 Importance of proximity in beach choice – residents

6 Discussion

This section discusses the key findings of the BASTRA project and their implications. It begins with a summary of the economic value estimates produced by the project. These values are then compared to the gross regional product (GRP) for each region to give some perspective of scale. The risks to these values due to a single climate change impact are then outlined. The section also provides a suite of adaptation responses which are more specific to preservation of the recreation and tourism values identified by the BASTRA project. This leads into Section 7 which outlines the benefits flowing from the BASTRA project and its contribution to the field of coastal climate adaptation.

6.1 Summary of BASTRA economic values

Before considering the suite of adaptation options for management of coastal recreation and tourism resources in response to climate change threats, it is necessary to consider the scale of the threat to these resources. Economic values of coastal recreation and tourism are summarised in Table 24. It is important to stress that these figures cannot be added together, as the resident figures represent the non-market value of utility derived from recreation, whereas the tourist expenditure estimates is a measure of real market-based transactions.

Table 24 Summary of BASTRA value estimates for recreation and tourism

BASTRA case study	Annual value of resident recreation (million A$)	Annual value of tourist expenditure related to beaches (million A$)
Sunshine Coast	69.59	270.17
Surf Coast	6.09	106.63
Clarence Valley	31.60	32.13
Augusta-Margaret River	3.72	24.58

These figures, though substantial, have little meaning without a clearly understood reference point. The tourism expenditure estimates are compared with the GRP in Table 25[5].

Table 25 Site-specific beach recreation values compared with GRP

Location	Annual value of tourist expenditure related to beaches (million A$)	Gross regional product (million A$)	BASTRA value as % of GRP
Sunshine Coast	270.17	10 000	2.7%
Surf Coast	106.63	823	13.0%
Clarence Valley	32.13	1600	2.0%
Margaret River`	24.58	1220	2.0%

These figures indicate that the presence of attractive coastal assets is a key factor in the continued economic prosperity of the case-study locations, and is of critical importance for the Surf Coast. This has substantial implications for strategic planning, operational expenditure and sustainable tourism planning, as the loss of this income would have severe implications for the LGAs.[6]

6.2 Local impacts of climate change on case study locations

This section introduces a local-level assessment of the likely impacts of projected climate change on each of the case-study areas. These impacts will manifest both in changes in the quality and availability of coastal recreation and tourism resources.

[5] GRP figures are sourced from the following locations, respectively:
http://www.sunshinecoast.qld.gov.au/Investment/sitePage.cfm?code=growth2
http://www.clarence.nsw.gov.au/cp_content/resources/Clarence_Valley_Economic_Monitor_June_2011.pdf
http://www.surfcoast.vic.gov.au/For_Business/Surf_Coast_Economic_Overview
http://www.amrshire.wa.gov.au/library/file/6Business/EconomicDev/WP1CapesRegionalEconomicProfilefinaldraftv2.pdf

[6] However, it is unlikely that there would be a total loss of these benefits due to projected climate change impacts, as these impacts will be unevenly felt across beaches and regions. There will also be a proportion of people for whom these impacts (shoreline erosion, increased variability and intensity of rainfall, increased temperature) will have no appreciable effect on their recreation or tourism experience.

Considerable uncertainty remains about the likely impacts of climate change at the site level. The uncertainty associated with climate change impact assessments also increases with the move from the biophysical to the socioeconomic, as shown in Figure 35. This is known as the ‘uncertainty explosion’ (Jones, 2000). This provides challenges for managers and decision-makers.

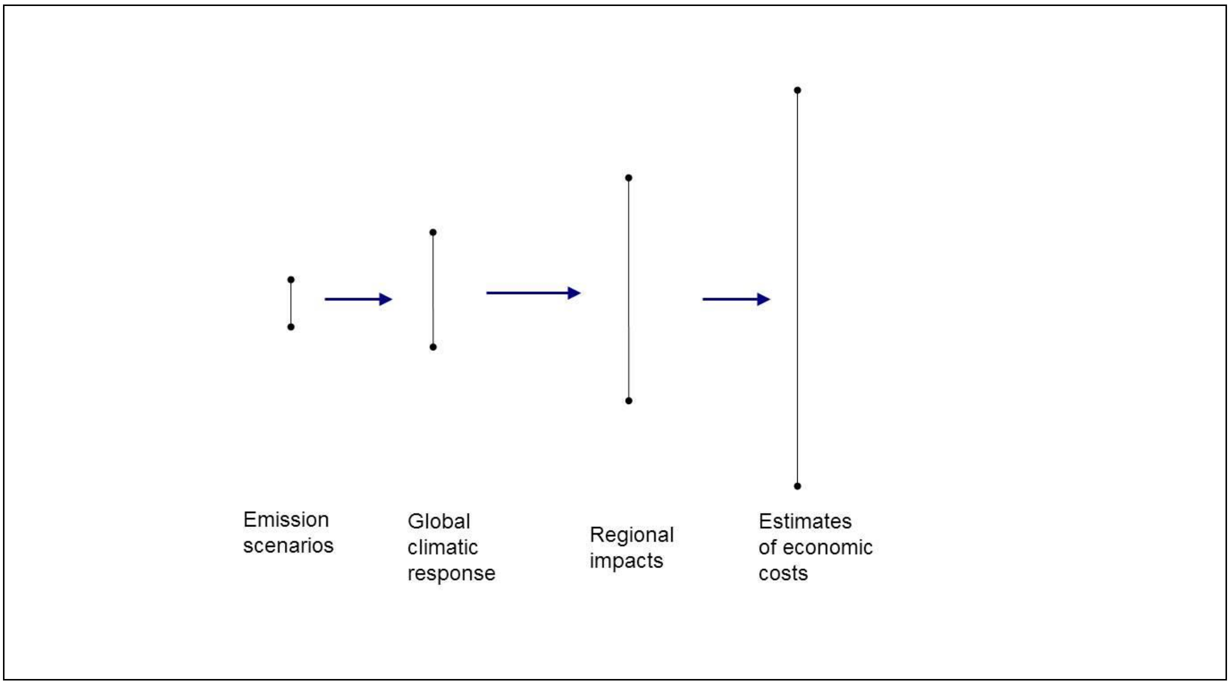

Figure 35 Range of uncertainty in climate change impact assessments

Adapted from the 'cascading pyramid of uncertainties', edited after (Schneider, 1983).

Table 26 outlines climate change impacts that are likely to affect either the quality of the coastal environment in the location, or external influences on tourist visitation. It also looks at the likely impacts of key coastal hazards on the availability of beaches and coastal foreshores for recreation, on shoreline recession and on inundation.

This uncertainty notwithstanding, the next section attempts to determine the potential losses associated with a single climate change impact, namely the loss of usable beaches due to storm-related erosion. Storm events are predicted to become more intense under climate change scenarios, and the impacts of these events are increased substantially by elevated still-water levels due to SLR.

Table 26 Climate change impacts on recreation features by case-study region: Summary

		Impact by case study location – qualitative assessment			
Hazard	**Consequences**	**Clarence**	**Sunshine Coast**	**Surf Coast**	**A-MR**
Overall reduction in rainfall	Water scarcity	Likely to be broadly positive – reduction in rainy days may promote beach visitation Bushfire risk increased			Potential impacts on wine industry, reduction in multipurpose visits Bushfire risk increased (largely an issue for other land managers e.g. CALM)
Increased intensity of rainfall events	Temporary inundation	Flooding events restricting access during peak visitation periods	Water quality issues at Noosa Main Beach, highway access restrictions (e.g. Gympie flooding 2013)	Access restrictions via flooding at Aireys Inlet and Anglesea, landslides and cliff instability increased	Erosion at the main tourist swimming location, Margaret Rivermouth Beach – hazards and reduced access
Ocean acidification	Coral bleaching, loss of biodiversity	Likely to be relatively minor compared to other case study locations in medium term	Impacts on local offshore reefs important for dive tourism. Impacts on Great Barrier Reef will have potential indirect impacts	More rapid erosion of limestone stacks forming the Twelve Apostles resulting in reduced transitory visitation	Impacts on the reefs that form surfing attractions
Algal blooms	Eutrophication	Algal growth will be promoted by higher sea surface temperature. This may result in an increase in algal blooms in coastal recreation locations, particularly near the mouths of estuaries and lagoons. Water quality impacts for swimmers and surfers may be offset by improved fishing opportunities.			

		Impact by case study location – qualitative assessment (continued)			
Hazard	**Consequences**	**Clarence**	**Sunshine Coast**	**Surf Coast**	**A-MR**
Shoreline[7] recession	Coastal recession	Pippies Beach has large supply of sand, Turners Beach relatively protected Main and Convent beaches likely to be substantially eroded – Yamba Surf Club threatened Wooli and Brooms Head at risk	2100 erosion hazard line is landward of Mooloolaba Spit – total loss of Mooloolaba Beach and adjacent parkland Noosa and Kings Beach also at risk of total loss.	Recession of beaches to base of cliff line. Cliff instability and access challenges.	Recession of beaches to base of cliff line. Cliff instability and access challenges.
Inundation **(using upper bound of SLR at 2100)**	Infrastructure damage	Roads in the local government areas of Clarence Valley (between 285 and 443 km at risk) 40 houses at immediate risk in Wooli	200 km of roads at risk, approx. 40 light industrial buildings, approx. 60 commercial buildings 1850 residential buildings within 110 m of 'soft' coast, of which 430 are within 55 m of 'soft' shorelines	Approx. 417 commercial buildings Limited exposure of residential buildings due to setback development	Relatively minor impact due to limited development and setback of buildings 250 residential buildings within 110 m of 'soft' coast, of which almost 80 are within 55 m of the shoreline

[7] http://www.climatechange.gov.au/~/media/publications/coastline/cc-risks-full-report.pdf

http://www.climatechange.gov.au/~/media/publications/coastline/riskscoastalbuildings.pdf

6.3 Economic impacts of climate change on recreation and tourism values

From the contingent behaviour results presented in the previous chapter, it is possible to draw some conclusions about the potential economic impact of the loss of beach recreation and tourism value. If we combine the economic value estimates with the contingent behaviour estimates, we can make some estimate of the scope of impacts possible. The behavioural responses indicated that not all beach users would be equally affected by the loss of a usable beach (Figure 36). Around two-thirds of resident respondents in all case studies indicated that they would be willing to incur additional monetary or travel time costs to visit an alternative location. It is assumed that this substitution would not take them outside their 'home' LGA, and hence there is no net loss to the region. (In most cases, given that people tend to visit their closest beach, there would actually be an increase in economic activity, with a commensurate reduction in CS.) Of the remaining third of respondents (who indicated that they would not be willing to incur these costs), a further 10 to 20% (3 to 8% of the total sample) said it was because the loss of the beach did not affect their coastal recreation experience.

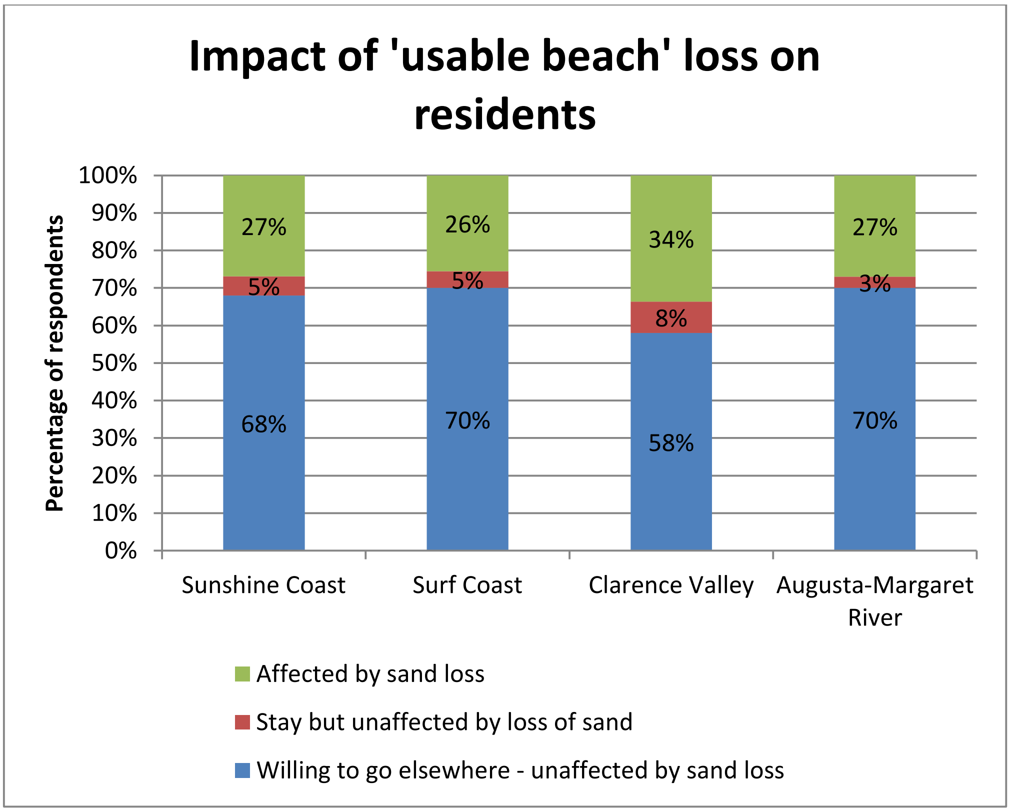

Figure 36 Response to loss of usable beach by residents

To estimate the loss of resident recreation value, the economic estimates presented in Section 5.4 are therefore weighted by the remaining proportion of people who would be negatively impacted by the loss of sand and would not be willing to incur the costs to seek an alternative beach. It is an upper bound limit, as it assumes the total loss of utility from the trip. They may visit but have reduced utility. It also assumes that the beach is eroded every time they visit, although this assumption is not out of line with the projected impacts on many beaches in Australia by 2100 (Australian Government, 2009).

Table 27 Potential economic loss due to resident response to beach erosion

Case study	Annual value (million $A) of resident recreation		Proportion of total respondents affected by loss of sand AND unwilling to incur additional costs to visit alternative location	Potential economic loss (million $A) of resident recreation	
	Fuel only model	Fuel only plus time @ 40% of wage rate		Fuel only model	Fuel only plus time @ 40% of wage rate
Sunshine Coast	69.59	197.23	0.27	18.71	53.02
Surf Coast	6.09	9.58	0.26	1.55	2.44
Clarence Valley	31.60	48.17	0.34	10.62	16.19
Augusta-Margaret River	3.72	13.86	0.27	1.00	3.74

The process for tourists is more complicated, due to the different visitation levels and expenditure patterns of the various visitor classes. For this simple exploration, it is assumed that the tourist sample is homogenous, with identical behavioural responses to beach erosion, and identical expenditure associated with their trip. This is unlikely to be the case in practice, and is an avenue for future work. It is likely that long-distance visitor loss will have the greatest impact on the expenditure in the region, though this is balanced by the much higher number of daytrip visits. Table 28 shows the results of this analysis. Economic losses are substantial, ranging from $5.3 million p.a. for Clarence Valley to $56.6 million p.a. for the Sunshine Coast.

Table 28 Potential economic loss due to tourist response to beach erosion

Case study	Annual value (million $A) of tourist value	Proportion of respondents not willing to substitute their location	Proportion of those not WTP that are not influenced by sand	Potential economic loss (million $A) of tourist value
Sunshine Coast	270.17	0.23	0.10	56.62
Surf Coast	106.63	0.21	0.10	20.19
Clarence Valley	32.13	0.22	0.25	5.30
Augusta-Margaret River	24.58	0.25	0.06	5.70

6.4 Traditional coastal climate change adaptation approaches

In response to the projected impacts of climate change on both natural coastal features and the economic values associated with them, a range of adaptation responses are available. These fall broadly into three response categories. The options of defence, retreat and accommodation have become central to the discourse of climate change adaptation within the coastal zone. Table 29 describes the suite of approaches that fit into each of these broad adaptation response categories. Initially proposed to simplify communication about adaptation to decision-makers (Bray & Hooke 1997), they were included in Chapter 6 of the IPCC AR4 'Coastal systems and low-lying areas' and formed the basis of the adaptation options section for the National Coastal Risk Assessment (Commonwealth of Australia 2009).

To date, 'generic adaptation strategies' have focussed the adaptation agenda on the built environment and isolated coastal ecosystems. This can be seen in the use of development setback lines (NSW Government 1990) and in particular in the components to be considered in their calculation such as 'storm bite', SLR recession, slope adjustment and foundation stability. There is no consideration or allowance made for ecosystem migration within the setback. The impact of the various options on recreation and tourism assets also varies, as shown in Table 29.

The Australian love for the coast suggests that people will continue to live and play on the coastal margins. Around half of the population live within seven kilometres of the shoreline (Chen & McAneney 2006), thus it is possible to draw the conclusion that coastal resources are attractive locations for human habitation. This is both a blessing and a curse — blessing as society places a high value on them but curse in that development restricts their capacity to adapt to climate change.

It seems highly unlikely that retreat from the coast will be a widely accepted adaptation approach, despite the theoretical advantages. The economic values identified in this study alone suggest that much could be lost from such a retreat if the tourism and recreation assets are not managed to preserve their character. There are also serious social equity issues associated with planned retreat that remain unresolved and politically challenging.

6.5 Alternative coastal climate adaptation – adaptive coastal management

Adaptation is starting to be considered differently than it was in the past. Initially adaptation was presented as a new activity and was framed by what is currently known as the hazard impact response model. This is akin to the idea that climate change is a new concept and as a new concept how we react to this is also a new field of endeavour. This thinking often included the notion that adaptation could be a single intervention leading to a state of 'being adapted'. This framing is now giving way to a much more sophisticated and nuanced conceptualisation of adaptation. Within the emerging model we are and always have been adapting. It is therefore important to consider adaptation as a pathway rather than a state of being adapted or not (Downing 2012; PROVIA 2012).

Given limited resources and the twin pressures of congestion (due to a rising coastal population) and climate change, there is a need to consider adaptation options for coastal tourism and recreation locations that are economically practical, socially acceptable, and also achievable for the managing agencies. A strategic approach would be to prioritise adaptation options that already align with existing activities, such as management of coastal resources, tourism destination planning and recreation management.

Table 29 Adaptation responses to climate change impacts

Coastal Adaptation Strategy (definitions below from IPCC AR3)			Implications for recreation
Defend Protection of vulnerable areas especially, population centres, economic activities and natural resources	Hard protection	Offshore breakwater	Negative implications for visual amenity and wave riding, possibly wider beaches
		Groynes	Negative implications for visual amenity and access but possible positive for wave riding, wider beaches between groynes
		Artificial reefs	Implications for wave riding may be positive or negative depending on design. Potential positive implications for fishing and diving
		Seawall	Negative implications for access and beach use as hard structures in the active coastal zone may decrease beach width via scouring
	Soft protection	Nourishment	Positive implications for beach width and maintaining natural process may also enhance wave riding
		Dune rehabilitation	Positive implications for visual amenity and maintaining natural process which may enhance wave riding
Retreat Abandonment of lands and structures in vulnerable areas and resettlement of inhabitants	Planning controls to restrict development within the hazard zone		Possible negative impacts in reduction in accessibility and built services such as toilets, showers and BBQs
	Planning controls to require removal of structures based on proximity to hazard		Maintenance of natural coastal processes and recreation environments
Accommodate Continued occupancy and use of vulnerable areas	Hazard management	Monitoring	Limited direct impact
		Emergency response and planning	Limited direct impact
		Land-use changes	May influence accessibility and visual amenity
		Insurance	May influence the levee
		Revegetation	Positive implications for visual amenity and maintaining natural process which may enhance wave riding
	Structural	Building guidelines	Limited direct impact – may improve/maintain aesthetics
		Drainage	Reduced stormwater erosion impacts on beaches

6.6 **Coastal recreation management adaptation strategies**

Climate change will affect the sectors and levels of the coastal recreation and tourism sectors in different ways. The extent of the impacts on the various user groups will be dependent on the level of exposure of particular sites or features, the extent to which the use is tied to that location, and the availability of substitutes (Table 30). There are a range of options for responding to the impacts of climate change on coastal recreation resources and specific sites. These can be broadly divided into two classes. The first class includes those actions that modify the site or resource in order to reduce its vulnerability or exposure to either climate change impacts, or to reduce the pressures of congestion and increased visitation pressure on the facilities of the resource. The second class includes attempts to reduce the per-capita impact of the increased user pressure through modifying user behaviour or rationing the allocation of the resource or site to reduce conflicts between user groups.

Table 30 Vulnerability assessment of elements of the coastal recreation and tourism system

Stakeholder/Element affected by climate change	Sensitivity	Exposure	Adaptive capacity
Resources	Shoreline recession	Dependent on orientation to dominant or storm swell direction	High in natural locations, low in highly modified locations where terminal structures or buildings are located within the active beach system
Users	Multiple	Varied based on length of stay	High for tourists – switch locations
Operators	Loss of beach space	Linked to level of dependence	Linked to level of mobility – surf schools can relocate, more difficult to relocate accommodation
Destination management organisation	Loss of key tourism beaches	Dependent on physical factors – orientation, geology, sediment type	Need to maintain existing sites or provide alternatives

6.6.1 *Increase supply of beach space and surf breaks*

It is not practicable to increase the number of beaches, but it is possible to increase the width of beaches and thus potentially increase their carrying capacity by reducing the negative impacts associated with congestion (Jakus & Shaw, 1997; McConnell, 1977; Wetzel, 1977). Given the magnitude of shoreline recession projections due to SLR (Bruun, 1962) and challenges associated with the availability and cost of application of sand (AECOM, 2010), this approach is likely to be applicable in the longer term to only the most heavily visited beach locations (such as Sydney and the Gold Coast and Sunshine Coast in Queensland), or those locations where the longevity of the sand placement makes the exercise cost effective.

Artificial reefs and groyne fields have the potential to increase the availability of surf breaks, although they would also change the character of the existing resources where they are located. There is also the potential for adverse impacts on adjacent breaks.

It is also possible to provide additional recreation space in the adjacent coastal strip, through provision of parks and open space behind the beach. In some locations (e.g. Bondi and Manly beaches in Sydney) this open space actually receives greater visitation than the sandy beach itself. In this model of coastal resource management, the beach is actually a sacrificial buffer zone rather than the focal point of recreation.

6.6.2 *Increase supply of close substitutes*

Lakes, rivers, and estuary beaches provide alternatives to ocean beaches as locations for water-based recreation. These locations are relatively under-used in Australia, compared to places such as the inland states of the US. It is likely that this option would be an acceptable close substitute for most passive beach and water users. It may not be accepted by those seeking a wave-riding experience. As reported by Lazarow (2010), there has not yet been any research on the potential for surfers to substitute another activity (e.g. kitesurfing or windsurfing) and maintain their level of utility.

There is also the potential that this spatial transfer of recreation activity will increase the environmental impacts on the substitute sites, which previously were not subject to the same pressures. Chapman and Hanemann (2007) reported in the American Trader case that when a recreation site is closed, the transfer of visits to substitute locations can have significant negative impacts on crowding and user enjoyment in the secondary locations.

6.6.3 *Increase accessibility of substitute beaches*

Access could be provided to alternative beach locations which are currently difficult to access, thereby spreading the beach-user population over a greater range of sites. This has the effect of both reducing consumption of existing locations, and also spreading the risk associated with climate change impacts, as the beaches are likely to display different vulnerabilities and sensitivities. However, these new locations are likely to appeal mainly to those beach users who appreciate a more natural beach setting.

Survey respondents often cited parking facilities and road access conditions as critical factors that limited their enjoyment of a facility. Amenities such as toilets, bins and beach showers were also highlighted as drivers of beach choice, or things that could be improved about the beaches that respondents normally visited.

The availability of lifeguard services was a critical factor in beach choice for a number of respondents. In some case-study locations, very limited services are provided outside the main metropolitan area. In the A-MR region, for example, seasonal lifeguard services are only provided at Margaret River Rivermouth Beach. Tourists are more likely to visit a beach location where they feel comfortable in the water, and hence lifeguard services at some of the other locations (e.g. Gracetown, Augusta) were cited as potential improvements to the existing beach-tourist experience.

6.6.4 *Reduce sensitivity of existing sites to climate change impacts*

Beach nourishment (i.e. providing additional sand to the near-shore system) can increase the resilience of existing sites. This buffer can provide a beach with greater capacity to respond to short-term storm erosion, and also to offset the landward progression of the shoreline due to gradual SLR.

There is some research to suggest that beach grooming (i.e. the movement of sand already in the exposed beach area) can improve the seasonal capacity of beaches to respond to wave attack. Beach grooming achieves this by pushing sand landward and forming a steeper primary dune system, thus changing the beach slope. There is some dispute within the coastal engineering profession about its effectiveness (Bruun, 1983; Carley et al., 2010).

Offshore structures such as breakwaters and artificial reefs can also be designed to reduce the exposure of vulnerable beaches to incident wave action. This can be achieved either through direct obstruction, or by causing the waves to expend most of their energy before making landfall.

6.6.5 *Behaviour management*

Beaches of Australia are typically associated with limited development, white sand and clean water. Australian residents and visitors to the Australian coast are conditioned by previous experience and marketing material to expect a very high quality resource each time they visit the beach. This provides challenges when the conditions do not meet expectations, thus resulting in negative beach recreation and tourism experiences. Expectations of permanent access or high quality beach environments can be moderated by public information and education. Part of this process may require additional measures to promote truth in advertising. Previous studies have shown that moderating expectations in advance is far more beneficial than attempting to reduce the impacts of negative experiences in an ad hoc manner (Moyle & Croy, 2009). This study showed that the use of 'perfect' images of sites at a location (Port Campbell National Park, Victoria) led to unrealistic and unmet expectations by visitors.

Given the dynamic nature of the coast, regular beach users are more aware of the potential for beaches to be affected by storm periods that leave them heavily eroded or covered in marine debris. There was a high level of acceptance among both tourists and residents of beach erosion as a natural part of the dynamics of the coastal environment, particularly in the more remote or natural beach locations (e.g. Augusta, Minnie Waters). This parallels with findings in Sydney, where the visitor responses to beach erosion were moderated by the erosion history of the location, and a visitor's previous experience with beach erosion (Anning, 2012).

These findings suggest that there may be considerable potential to moderate economic impacts of coastal climate change impacts by providing factual information about the current and future state of the beaches and other coastal resources. This could take the form of a Beach Status Report, similar in content to the snow reports issued by mountain resort destinations. It could contain such things as beach width, height of erosion scarps or sand cliffs, and the best time of the day or best location to visit on each day. This approach is essentially untested, and is contrary to the 4S (sun, surf, sand and sex) marketing approach often applied to coastal tourism locations. However, preliminary findings of the BASTRA project suggest that the potential for a negative response from potential visitors and prospective residents may not be as severe as first thought.

A summary of the recreation and tourism-centric options for coastal climate adaptation is presented in Table 31.

Table 31 Recreation management responses to climate change impacts on coastal locations

General description	Actions/Examples	Key benefits
Increase beach space	Beach nourishment, offshore reefs, park development	Provides buffer to erosion, reduces congestion, can reduce exposure

Increase alternative recreation sites	Need to provide facilities and promote alternatives	Can select locations which are 'climate-resilient'
Increase beach access	Provide facilities, manage environmental impacts	
Increase resilience of beaches	Beach nourishment and/or grooming	Maintain usage of existing sites
Behaviour management	Provide current information about beach state, reduce use of 'ideal' images in promotion and marketing	Provides flexibility, a more adaptive beach user group can accommodate a range of potential future scenarios

6.7 Critical assessment of the classification framework

Section 4.6 introduced the beach classification framework, and results of framework analysis were presented in Section 5.1. Even in a basic additive, unweighted form, the variability in beach visitation is explained well by the attributes in the draft classification framework. Further refinement of the scoring system for attributes to distinguish levels of quality as perceived by the beach users, the relative importance of each attribute in driving beach choice, and the way in which the capital and context dimensions combine will further improve the model's explanatory power.

From the preliminary exploration conducted in this study, it appears that site features are greater determinants of visitation than the socioeconomics of the surrounding or 'catchment' area, or the demographics of the tourist population. Coastal managers often do not have accurate statistics on the origin of beach users in their region. In such circumstances, simply adjusting visitation statistics or consumer surplus values for recreation based on the demographics of the immediate location may introduce an additional source of bias if the main user group are visitors to the region.

Sections 5.5 and 5.6 explored the role of coastal resource attributes in determining the level of demand for recreation and tourism activity in different regions, and in the choice between beaches at the local level. Natural assets were considered to be slightly more important than built assets for determining which beach to visit. This suggests that the preservation of these features is important in application of any of the aforementioned management options.

7 Benefits and adoption

This section describes the benefits of the improved economic information on the importance of beach and surf tourism and recreation. It particularly focusses on the benefits to the case-study partners, although the increased availability of such information has benefits for all coastal councils examining their management options in response to climate change. Real management decisions currently under consideration by case-study partners are included in demonstrations of the uptake of this information.

7.1 Benefit of empirical estimates of the value of beach recreation and tourism – general

The primary benefits associated with this project are linked to increased availability of economic information about the importance of coastal resources. This reduces the likelihood of maladaptation or selection of perverse outcomes through undervaluing these resources in the cost–benefit processes typically undertaken in coastal management planning. The following sections use examples to demonstrate the potential for inaccurate assumptions in the absence of these estimates.

An additional benefit of the BASTRA project is that the provision of this information to councils has demonstrated that the suite of adaptation options is not as restricted as originally conceived, with more expensive options remaining worthy of consideration. The scope of economic activity associated with coastal recreation and tourism resources means that consideration of more strategic or long-term approaches may be justified.

7.1.1 *Comparison with benefit transfer estimates*

Table 32 compares the estimates of economic value of resident beach recreation between a BT process using figures from Blackwell (2007)[8] and the estimates generated in this study, as presented in Section 5.3. There is a substantial difference between the estimates in all case-study locations, which strengthens the argument that the use of BT should be treated with extreme caution when making decisions about the long-term management of coastal recreation assets in response to climate change impacts.

The analysis shows that the assumption of applicability of previous estimates of the value of beach recreation has a tendency to significantly underestimate the value of resident

[8] This study represents the most recently published publicly available estimates of resident recreation.

recreation in regional locations. This is true even when the studies have been conducted at the same location, as can be seen by the differences between estimates for the Sunshine Coast. The original study used in the BT process (Blackwell, 2007) was from the Sunshine Coast, specifically Mooloolaba, where around 43% of the Sunshine Coast surveys were conducted in the BASTRA sampling round. Even in approximately the same location, the use of the previous study estimates for recreation value would result in a serious underestimate of the current value of these assets.

Table 32 Comparison of site-specific and benefit transfer estimates of the economic value of beach recreation to residents

Case-study location	Benefit transfer estimate using previous values from Mooloolaba (million A$)	Site-specific estimates generated in this study (million A$)	Percentage difference between desktop and empirical estimates
Sunshine Coast	35.6	69.6	–48.9%
Surf Coast	2.81	6.09	–53.9%
Clarence Valley	5.66	31.6	–82.1%
Augusta-Margaret River	1.35	3.72	–63.7%

The difference between the BT estimates and the site-specific study estimates is even more marked when the policy and study sites differ in biophysical and socioeconomic character. When figures from the original Mooloolaba study (Blackwell, 2007) are transferred to the Clarence Valley region there is an 82% difference if the first pass figures were assumed accurate for the Clarence Valley region. This stems from differences in visitation and expenditure patterns between the regions. This magnitude of variation means that transfer of benefit estimates between locations may lead to inefficient outcomes when selecting foreshore management options. As such, empirical estimates are always preferred.

7.2 Benefits of adoption of BASTRA results – case-study demonstrations

This section presents a summary of scenarios (Table 33) that were presented to councils in internal workshops to explore the use of BASTRA economic information in potential decision-making related to coastal management in their regions. Further detail on each scenario is provided in Appendix 6 for the Wooli Village case study prepared for Clarence Valley Council.[9]

Table 33 Scenarios employed in workshops

Case-study location	Scenario description	Summary of costs	Summary of benefits
Sunshine Coast	Improving access to an unspecified beach in the northern region – Mudjimba area	Car park and access stair construction	Increased visitation
Surf Coast	Surf Coast walk development	Boardwalk and car-park construction	Increased visitation
Clarence Valley	Wooli Village erosion and riverine flooding management plan	Construction of levee, raised access road, relocate South Village houses and water tower infrastructure, beach nourishment, purchase of new land for land swap	Increased security of North Village, maintain beach amenity
Augusta-Margaret River	Improving access to Grunters Beach through car-park development and construction of formalised access stairs to replace limestone path	Car park and access stair construction	Improved access and increase parking availability to key learner surf break

7.2.1 ***Scenario testing – benefit of improved information***

An exploratory analysis was conducted to further examine the management implications of the value estimates in the second pass assessments. The scenario analysis described in the previous section is performed using both the figures found in this study, and those that would most likely have been used in a BT exercise (as per Table 32). This analysis shows how these scenarios would be assessed in the absence of the BASTRA value estimates, and is a means of assessing the usefulness of the time and resources spent on the empirical data collection.

It is assumed for this exploratory analysis that tourist benefit estimates would differ by the same percentage error as the resident estimates. For example, the tourist benefit estimate

[9] Other appendices draw on information that remains confidential at the time of report submission.

for A-MR is adjusted downwards by 82% as per the difference between the resident estimates highlighted in Table 32. The effect on the appraisal criteria (net present value and internal rate of return) is then examined for each scenario. Results are shown in Table 34.

Table 34 Effect on scenario cost–benefit analysis of different benefit estimates

Case study location	Using second pass	Using site-specific estimates	Using BT estimates
Surf Coast	NPV at 4%	329 181	45 452
	NPV at 7%	247 482	3 472
	NPV at 10%	181 844	–30 225
	internal rate of return	24.10%	7.28%
Augusta-Margaret River	NPV at 4%	72 041	–71 508
	NPV at 7%	47 430	–76 024
	NPV at 10%	27 663	–79 631
	internal rate of return	15.62%	–13.68%

NPV – net present value

Using more recent and more locally relevant data reveals a very strong effect. In the case of the A-MR analysis, the project switches from an unfavourable to a favourable project based on the difference in figures, and shows that a beneficial project would be unlikely to proceed in the absence of this improved information. In the case of the Surf Coast analysis, the project is marginal using the BT figures, but has substantial benefits when the BASTRA information is employed. The difference in value is in the order of $12 000 per annum ($120 000 over the 10-year life of the project) for A-MR and almost $25 000 per annum in the Surf Coast example, at the discount rate of 7% (typical for this sort of project).

7.2.2 *Adoption and application by research partner councils*

A key outcome of the stakeholder workshops conducted with each LGA partner is that the councils have indicated that the research has substantially improved their understanding of the coastal management preferences of their local residents and tourists in terms of daily management and in responding to projected climate change impacts. This information is particularly hard to gather for tourists, and hence this is a key benefit of the empirical surveys conducted as part of the project. Understanding where beach users travel from, where they stay and how frequently they visit is also important for tourism management and promotion given the prevalence of coastal imagery used in destination marketing.

Participants in the case-study council workshops have been somewhat surprised to see the scale of values attributable to beach and surf recreation in their regions, particularly as they are shown how these values were derived, and the conservative nature of the assumptions employed in the calculations.

Of particular interest to the council representatives from areas outside the traditional coastal management fields (natural resource management and engineering) has been the estimate of market values (primarily tourism expenditure on accommodation and food) that can be linked to the beach.

8 Further development

This section outlines some of the future directions of research flowing from this project, and persistent knowledge gaps that must be addressed.

8.1 Refining of classification framework

Based on the responses of tourists to the qualitative questions about which attributes of beaches are most important to them, weighting of the attributes in the classification framework should now be possible and is the focus of ongoing research. The exact weighting mechanism is currently being tested, as there is a need to balance the different weightings provided by residents and tourists. Whether this weighting should be linked to visitation (typically favouring residents, except for very highly visited beach locations such as Bondi Beach), economic impact per visit (typically favouring tourists) or jurisdictional responsibilities of the relevant council (thus placing greater emphasis on resident responses) is unclear.

8.2 Testing in further locations

The BASTRA project substantially expanded the availability and temporal relevance of estimates of the economic value of beach and coastal assets in Australia, roughly doubling the number of available estimates for use in BT assessments of these values for coastal management assessments. The sites were also chosen and distributed such that they improved both the geographic scope of available estimates, and also explored the regional influence of these value estimates. The classification framework provides an enhanced means of transferring these values to other policy sites, where empirical estimates are not possible due to resource constraints.

The empirical surveys in this study show that, although there are some consistencies in the results, for example in terms of the opportunity cost of leisure time, there were substantial differences in visitation patterns and frequencies, and users of different beaches were driven by different motives and site features. Thus further empirical estimates of the economic value of beach and coastal assets in other locations are strongly recommended.

8.3 National coastal recreation survey

One of the key knowledge gaps identified in this study, and those previously conducted by the project team, is the paucity of knowledge about how both residents and tourists use the coastal locations of Australia. This information gap makes it very difficult to advise on appropriate specific adaptation strategies for particular locations, as the question must then be posed 'Adapting to what?'. This is because we often do not even know which stakeholder groups would be most adversely impacted by either climate change impacts or management interventions until after the event. Although we will never be certain about the response of stakeholder groups, further exploration of the behavioural responses to the most likely climate change impacts can improve the confidence in economic impact assessments.

In particular, we have very little reliable information about the activities which are undertaken, and the extent to which residents and tourists would accept substitutions for their favourite activities, be they temporal, spatial, or an alternative activity. This information is critical in determining the acceptance, or otherwise, of some of the recreation management approaches suggested in the previous chapter and therefore it requires further research.

8.4 Further exploration of tourist and resident responses to climate change impacts

Understanding the behavioural responses to erosion and beach closure remains key to exploring the way in which climate change will actually impact on coastal communities and tourists to those locations. This is true not just in an economic sense, but also in a cultural and structural sense, as the loss of key features has the potential to affect the desire to be close to these assets, and hence the pattern of development and infrastructure provision. For example, if beaches are frequently eroded or hazardous and become less appealing to coastal residents and visitors, this may result in an increased desire to be close to substitute aquatic recreation sites such as rivers and lakes. This would bring into play a different suite of management challenges and climate change threats.

8.5 Data management

Data is stored and managed under the conditions of research ethics processes of Bond University, Ethics Reference Number: RO1437. All hardcopy and electronic material is securely stored for a minimum of seven years. Access to data may be arranged by contacting the project research team, as listed in Appendix 2.

9 Planned outcomes

This section presents an assessment of the outcomes delivered by the BASTRA project, and the extent to which these outcomes conform to those planned outcomes at the time the research proposal was submitted. It presents the 'Planned outcome' descriptions in bolded italics, followed by the BASTRA research team's assessment of the extent to which these outcomes were achieved.

Phase 1 of this project identifies beach and surf tourism assets in selected locales most vulnerable to climate change, and provides information about the economic importance of each asset, with a tool/framework which can be applied nationally. This aids in prioritisation of limited coastal management resources.

The BASTRA project called for nominations from councils around Australia. A self-selection process identified councils which considered themselves to be most vulnerable to climate change impacts on their coastal resources and associated assets. This was then balanced against a need to represent a range of biophysical environments and differing levels of economic and technical capacity.

The economic values of coastal recreation and associated tourism expenditure in these locations were presented in Section 5.3. The methodology described in sections 4.3–4.5 and the survey instruments presented in appendices 3 and 4 can be applied with only minor modifications to the valuation of coastal resources in any location in Australia.

Phase 2 Tests the use of benefit transfer and point estimates in valuing assets identified as being vulnerable in Phase 1. This has implications for policy development and will test the veracity of a number of the assumptions inherent in environmental economics as it is applied to natural resource management. Improving our understanding of the utility and application of economic techniques supports the academic and policy ambition for continuous review and improvement.

Tests of the BT process were undertaken between the case-study locations both with pre-existing estimates (Section 2.8) and with the empirical estimates generated in the survey stage of the BASTRA project (Section 5.4). Both processes identified substantial potential for error and hence a higher likelihood of maladaptive decisions based on this information, relative to site-specific empirical estimates. Work is currently underway to extend this from the regional level to the site level, given that this is the level at which many decisions are assessed.

Phase 3 of the project will also identify social trigger values likely to determine the public response to proposed climate change and adaptation responses. This information will be used to inform the community, industry and decision-makers on the selection of appropriate management interventions to reduce vulnerability and enhance adaptive capacity. It is also critical for the successful adoption and implementation of those plans, which may involve large socioeconomic changes.

Significant challenges arose in the attempt to explore key trigger values and scenarios that determine behavioural responses to climate change impacts and management interventions. All LGA partners were reluctant to have 'live' management decisions presented to the general public for consideration, as there was some concern that the political ramifications would be negative for the council and hinder true progress towards more effective management and adaptation.

As a compromise, the BASTRA team developed realistic coastal management decision scenarios for internal consideration. An example for the management of Wooli Village is presented in Appendix 6. These scenarios are currently being refined based on further consultation with LGA partners and provision of information about project decisions. The distribution of this information is not possible due to confidentiality arrangements, although this will change in the near future as real decisions employing BASTRA information are announced.

Overall, the project will advance scientific understanding of the relationship between climate change, coastal communities and the management of built and natural coastal resources.

The results of this project will be widely promoted through a range of channels, including technical reports for key stakeholder groups, conference papers, academic journal articles, and the use of traditional, online and social media. A knowledge portal to provide for contact with the research team will also be maintained at http://mybeachmysay.com.

10 Conclusion

As can be seen in the previous section, one of the key take-home messages from undertaking the BASTRA project is that whilst economic information can be highly useful in coastal adaptation decisions, there are a number of other technical and practical hurdles which must be negotiated in making these decisions. The information generated by the project, both in terms of economic values and qualitative preference information, can assist in minimising one area of uncertainty. To this end, the BASTRA project has achieved the stated objectives, but also highlighted the need for further work of this nature.

The BASTRA project demonstrated that the economic value of coastal recreation in regional locations in Australia is substantial. It is estimated that the value of beach recreation by residents of the Sunshine Coast (Queensland) is worth around $70 million p.a. This recreation is estimated to have a value of $32 million p.a. to residents of Clarence Valley (NSW), and annual values of $6 million and $4 million for the Surf Coast (Victoria) and A-MR regions, respectively.

In addition to this non-market CS estimate of recreational value, there are real market expenditures that are incurred by tourists in order visit and stay in coastal locations. The value of this beach-related tourism expenditure is estimated to be in the order of $270 million annually for the Sunshine Coast, $32 million p.a. for Clarence Valley, $107 million for the Surf Coast and $25 million for the A-MR region. This economic activity is the basis of a significant proportion (typically around 2-3%) of the GRP of the case-study locations, even without consideration of the substantial multiplier effect associated with service industries such as tourism.

Many uncertainties remain about the magnitude, nature and timing of climate change impacts on these natural systems, it is certain that all coastal regions will experience some impacts on their key natural tourism attractions. Beaches, surf breaks and adjacent coastal parks and walkways were key features which contributed to the popularity of regional locations for both resident populations and tourists, from daytrippers to international visitors. This is true both in the selection of residential and tourism locations, and also in the selection of which beach to visit each day. It is these natural features that will be impacted soonest and most severely by climate change.

How residents and tourists respond to changes in the quantity and quality of coastal features will be critical to determining the economic impact of these physical effects, at the local, regional and national levels. This project began to explore the behavioural response of tourists and residents by asking them how they would respond to erosion of beaches, which is the most likely and visible impact of climate change on coastal resources. The responses to these behavioural questions provide both cause for optimism and concern.

Residents and tourists both indicated a willingness to incur additional costs and time imposts in order to be able to access beaches which are not affected by erosion. This suggests the potential for substitution of sites, meaning that beach users will move to another beach if their first choice is affected by erosion. This means that councils with limited management and adaptation resources may be able to concentrate these resources on a selection of beaches and still maintain the economic benefits that were identified by this project. Scope for alternative revenue sources such as parking permits are also suggested by the WTP responses. This is a ‘user-pays’ policy option which captures some of the CS currently enjoyed by beach users.

This project also sought to identify the natural features and built amenities that contributed the most to determining the attractiveness of individual beaches. Qualitative questions included in the beach user and resident surveys indicated that natural features of beaches are considered more important in the selection of beaches. This provides critical information for managers of coastal resources, but also a significant challenge, as these features are under substantial threat by projected climate change impacts.

Despite this challenge, the BASTRA project encountered considerable reluctance by decision-makers to engage the community in detailed discussion of the options for management of threatened coastal locations. This must be overcome if regionally appropriate and novel adaptation options are to be identified and pursued.

Another obstacle to effective management is the absence of any reliable information at the national scale about the number of people who use coastal locations, and the activities they undertake. This is a key knowledge gap that should be addressed by the development of a national survey of outdoor recreation participation.

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