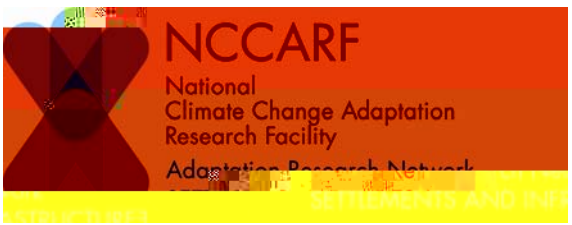
The Economic Value of Natural and Built Coastal Assets

Part 1: Natural Coastal Assets

This paper was motivated by the Australian Federal Government climate change adaptation initiatives. The authors are members of the Australian Climate Change Adaptation Research Network for Settlements and Infrastructure (ACCARNSI), one of eight networks within the National Climate Change Adaptation Research Facility (NCCARF)



In light of climate change uncertainties and the likelihood of increased impacts to our natural and built coastal environment, the aim of this review is to highlight past and recent studies related to the valuation of coastal assets within two papers: Part 1 – natural assets and Part 2 – built assets, with the underlying consideration that these assets are under pressure not only from human population needs but also from a changing climate. This paper (Part 1) will provide a brief overview of environment economic valuation techniques and a discussion of several economic assessments covering a range of coastal ecosystems and uses: coastal and marine ecosystems, marine parks,

residential and commercial buildings;
holiday homes;
ship terminals, ports and harbours;
bridges;
beach protection works such as groynes and jetties;
sand by a

The Australian Government defines economics, in this

planning is an essential tool in dealing with this complexity, which

Direct and indirect uses reflect the value that the society place on an asset (Pendleton et al., 2007). Direct uses are generally easier to calculate as the benefits are observable through, for example, the price paid for the product or experience (World Bank, 2004). Estimating the value of indirect uses is difficult because they are hard to 'price'. For example, the quantities the service provides can be difficult to determine (i.e. how much protection do the mangroves specifically provide) and these services do not usually enter the market place at all (World Bank, 2004). There is further difficulty in determining the option, bequest and existence values of a natural asset. These values generally aren't reflected directly by people's behaviour

change their answer. Additionally, a further limitation is bias in responses and responses that are dishonest or align with a strategy or agenda of the individual (QEPA, 2003; Australian Government, 1995).
www.ecosystemvaluation.org/contingent_valuation

3.2.7 Contingent choice method

The contingent choice method (or choice modelling) asks respondents to make tradeoffs among sets of environmental characteristics, without directly asking them to state

Ecosystem Assessment, 2003). The study found that a majority of the world's ecosystem services are in a state of degradation. An outcome of the assessment was a conceptual framework to assist managers in measuring the impact of ecosystem services against economic and cultural needs to find a balance between protecting the ecosystem service and ensuring that human productivity can be maintained (Millennium Ecosystem Assessment, 2003). An ecosystem services framework is currently being applied in South East Queensland through a project initiated by South East Queensland Catchments (Maynard et al., 2010). This currently on going project has involved the development of an operation framework, a model and a series of maps to prioritise areas based on ecological significance and is currently ongoing.

Within the Millennium Ecosystem Assessment, the coastal environment can be separated into a number of natural asset types such as open ocean, beaches, estuaries, mangroves, and seagrass. Each asset type may provide a number of market and non market services: commercial (market), environmental (non market) and social (non market). The Millennium Ecosystem Assessment separated these services into four broad categories including:

- provisioning services (e.g. food and water (direct benefit
- regulating services

broad

and 2007a) that aim to highlight the contribution of the natural environment to society and human well being.

In a 'landmark study', Costanza et al. (1997) attempted to value the world's ecosystem goods and services, placing a value on 17 ecosystems worldwide using published data (via the benefit transfer method) and further calculations. The assessment included specific coastal environments and concluded that ecosystem services are an important component of human well being.

The coastal ecosystems included in the study were:

- open ocean
- coastal
- estuaries
- seagrass
- algae beds
- coral reef
- continental shelf

The study placed a total value of USD$577 per hectare per year for coastal ecosystems and a total of USD$20,949 billion per year, illustrating a potentially considerable value for the world's coasts.

This study was highly criticised and reactions ranged from direct criticism of the methods to the terminology used (e.g. Herendeen, 1998; Heuting et al. 1998; Serafy, 1998) and further highlighted the debate and difficulty in placing a dollar value on natural ecosystems (Norgaard et al., 1998; Opschoor, 1998; Rees, 1998). However, authors also recognised that this research was a starting point for the conversation and that for future planning and protection of the ecosystem, the environment would need to be recognised with a

KPMG, 2000; Driml, 1997). Several studies also identify the lack of data for valuing environmental goods and services (Anning et al., 2009; Lazarow et al., 2007; URS, 2007; Blackwell, 2005), thus limiting the overall goal of sustainable coastal management (Anning et al., 2009).

These studies have enormous relevance to our settlements due to the significant reliance on open coastal spaces for lifestyle choices and tourism. Recreation opportunity has an important place in our culture and society and Wiegel (1994)

- atmospheric gas and climate regulation
- waste reception, treatment and assimilation
- biological control (predator prey relationships)
- biological support (habitat)
- biodiversity maintenance
- protection of terrestrial and other marine habitats

Hassell and Associates (2001) further provided a description on non use values relevant to this marine region:

- Option values – particularly regarding the opportunity to discover new biological resources in the future
- Existence values – the fact that people donate to conservation organisations illustrates that people value the environment when they may never visit specific places
    - Social values – particularly cultural and spiritual values
    - Artistic values – sale and enjoyment of art and photographs
    - Protection values – region provides a home for endangered species
    - Historic values – for example Macquarie Island provides an example of the earth evolution
    - Intrinsic values – value of ecosystems independent of utility to people, for example providing marine protected areas
- Vicarious use values
- Bequest values

A two part study was undertaken by Blackwell (2007a; 2005) as a component of the Cooperative Research Centre for Coastal Zone, Estuary and Waterways Management (Coastal CRC) project titled 'The economic value of Australia's natural coastal assets'. The project included a macro level assessment based on estimates provided by the

A further study has provided a broad assessment of the coastal environments of the Gold Coast using the benefit transfer method (AECgroup, 2007). Although this document is not yet available to the public, the study applies data from relevant studies that use the contingent valuation and choice modelling techniques, in addition to hedonic pricing method and the travel cost method. The study also recommends the use of 'innovative combinations' by combining choice modelling and a citizen's jury (use of representatives in the form of a jury) or the contingent valuation and contingent behaviour (estimates future visitation behaviour based on a scenario) methods (AECgroup, 2007).

The study highlights the need to understand the total economic value of marine resources to ensure appropriate tradeoffs are made during management decisions. Understanding these values will assist in developing sustainable practices within coastal industries.

Two further studies that relate to marine parks have been

with the average hourly salary rate. It was reported that the Gold Coast beaches were worth $24 million overall per year and $6 million per kilometer (1983 $) (Smith and Piggot, 1989). Although this figure was very much an estimate, the study provided insight into the potential value of the beach.

In another early study, the South Australian Coast Protection Board undertook an assessment of Adelaide's beaches. The travel cost method was applied to beach visitation data (day visitors) from 1986 and using shadow prices from previous studies estimated a value ranging from $2 to $3.60 (1986 $) per visit (South Australian Coast Protection Board, 1993 and references therein). A recently developed strategy titled Adelaide's Living Beaches placed the value of Adelaide's beaches to day visitors at $23 million (Burgan, 2003 cited in DEH, 2005), with nine million visitors per year (McGregor Tan Research, 2003 cited in DEH, 2005)

In recent years, valuation techniques have become more consistent and commonly use survey techniques to directly determine the respondent's wil8sTf.lu/TT11Tf.86890Tsw0IpTj/TT11Tf3.04370TD0Tc852.0023Tc

Recently, Anning et al. (2009) reported on the recreational value of Sydney's beaches. This study included a survey of 530 beach users, using face to face interviews and internet based surveys. The analysis employed the travel cost method to determine the visitor dollar value per person per day and additional on site purchases. Although the full results are yet to be published, a value of approximately $6 per visit for travel costs and $5 for on site purchases has been provided as preliminary results available on the Sydney Coastal Council's website (SCCG, 2011), a major partner of the project.

The data collected in the above studies were also translated into annual travel costs expenditure. For the Sydney study, there were some limitations in determining a reliable number of beach visits for all three sites studied, however, using visitation rates at Manly Beach, the total annual travel expenditure was estimated at $25 million with a further $25 million for on site expenditure (SCCG, 2011). Similarly, Blackwell (2007b) used annual visitor estimates provided by the local council lifeguard service to estimate an annual expenditure of $153 million for residents (2000 $) visiting Mooloolaba's beaches. Raybould and Lazarow (2009) estimated the annual value for the use of Gold Coast's beaches between $21.5 million and $91 million. For the Victorian coastline, the overall recreational use was valued at $1.9 billion per year (URS, 2007). The results are summarised in Table 2, below.

Table 2. Summary of

What does this mean under climate change? These studies provide a convincing argument towards investment, at both Local and State Government levels, in the recreational values of our beaches and coastline. As climate change further increases pressures on our coastline, managers will need to consider adaptation measures to ensure that the recreation opportunities meet the expectations of the community.

5.3.2 Visitation – Tourists

Australia offers endless sandy beaches of world renowned quality and a strong tourism market. There is a high dependency of beaches on tourism economically (Moreno and Amelung, 2009) and in a document published in 2008 by Gold Coast City Council, it was noted that 56% of all overnight visitors and 30% of day trippers visit the beach (GCCC, 2008). Tourism is a major component of the economy, for example one in every five dollars generated on the Gold Coast is directly related to the tourism industry. Tourism is a competitive world wide market with a broad measure of economic activity including being a major employer (Houston, 2008). Tourism is also difficult to offshore, in comparison to many other industries, meaning that much of the revenue stays within the country (Houston, 2008). Tourist destinations are, on a larger scale, unique, however on a small scale if destinations do not meet the expectation of the tourist they may move to another destination taking the revenue inter state or to another country (Stronge, 1994). The management of our beaches is therefore paramount in retaining the tourism dollar that they generate.

Coastal tourism often relies heavily on weather conditions and the consistency of weather (Moreno and Amelung, 2009). Climate change poses a threat to the coastal tourism industry, particularly in the use of beaches. The predicted changes in weather patterns include increased storm activity that will result in increased occurrence of beach erosion and coupled with sea level rise will lead to increased pressure on the coastline. The recent flooding in South East Queensland and destruction from cyclone Yasi in North Queensland have emphasized concerns regarding the impact extreme weather events can have on tourism, with numerous articles currently presented in the media. These concerns were reinforced when the Minister for Resource and Energy and the Minister for Tourism, The Hon. Martin Ferguson AM PM initially announced a $10 million Tourism Industry Support package for Queensland in February 2011 which was later increased, via the Gillard and Bligh Governments, to $12 million (http://www.minister.ret.gov.au/index.html). Tourism is a key component of the Queensland economy, directly contributing $9.2 billion annually (Tourism Queensland, 2010) and an increase in such events will potentially lead to a long term negative impact on this industry.

The economic impact of the loss of beaches (by erosion) was experienced on the Gold Coast (Queensland) after the major erosion events of 1967, when a sequence of seven major storms resulted in the temporary loss of an iconic Australian symbol (Smith, 1994). Furthermore, the sensationalism of the disaster by the media was thought to exacerbate the reduction in visitation to the Gold Coast into the early 1970s (Smith, 1994). Still today, the media sensationalises minor erosion events on the Gold Coast and go to length to print images taken at obscure angles to highlight the erosion scarp (Tomlinson, pers.comm., 2011).

After the Gold Coast's experience of the erosion events of 1967, the Queensland State Government and Gold Coast City Council commissioned an economic appraisal of the capital works required to restore Gold Coast's beaches (GCCM, 2010). This report by Maitra and

Walker (1972) became

visit. The total annual visits were estimated and it was calculated that $205 million (2000 $) was annually spent by tourists.

In 2000 a study of coastline values was undertaken by Byron

between surfing and a proposed economic development and coastal engineering works, respectively (Lazarow, 2007).

These case studies presented by Lazarow (2007) at South Stradbroke Island and Bastian Point provide valuation assessments of surfing to highlight the potential loss

significant non use values associated with surfing sites leaving opportunity for further studies to allow

Part

The Great Barrier Reef is an iconic coral reef system extending over 2000 km in length along the North Queensland coastline. There are over 300 fringing and platform reefs and with its vast size is the largest coral reef system in the world (Hopley 1982 cited in Mooney et al., 1996). The Great Barrier Reef region is also well known as a tourist destination particularly for diving. Approximately 1.1 million people visit the reef annually (Oxford Economics, 2009) and reef tourism provides Queensland with its second largest industry valued at $1.5 billion (Mooney et al., 1996).

the
The Great Barrier Reef has been well studied in economic terms and most Great

A number of studies have been carried out that focus on specific uses such as tourism and fisheries and utilise market values for estimating the overall economic value of the Great Barrier Reef. For example KPMG (2000) presented a study of the direct uses of the Great Barrier Reef; namely tourism, commercial fisheries and recreational fishing and boating (the figures update a previous report by Driml (1997). The assessment considered market values and estimated the gross financial value[3], output effects and employment effects. Tourism was estimated using passenger expenditure accommodation and spending at resorts, etc. Commercial fisheries

on a survey by Henry and Lyall (2003) that calculated average expenditure per person of $407 and an estimated 198,327 recreational fishers (cited in PDP Australia, 2003).

A series of annual economic contribution studies of activities within the Great Barrier Reef catchment area have been undertaken by Access Economics from 2004/05 to 2006/07. These studies focussed on the use values of tourism, commercial fisheries and recreation activity in terms of added value, gross product and employment and consider only market transactions (Access Economics, 2005; 2007; 2008). Social, ecological and non use values were not included. A further limitation when considering the values of the Great Barrier Reef, is these studies cover the entire catchment area and include activities that may not be specifically or directly related to the reef system itself (Oxford Economics, 2009)

Access Economics (2007) provide the most recent results for the Great Barrier Reef Catchment area, these are summarised in Table 4 (bearing in mind these results are for the catchment area, and the values would be smaller for the reef and marine park) (Access Economics, 2007).

Table 4. Direct and indirect value added contributions to the Great Barrier Reef catchment 2006/07 (Access Economics, 2007).

Tourism	$3,344 million
Commercial fishing	$117 million
Recreational fishing	$61 million
Other recreational activities	$36 million
Total contribution	$3,558 million

The methods employed for these assessments used the Tourism Satellite Account[5] and tourism survey data for tourism and recreational use and conventional supply side analysis for commercial fisheries (Access Economic, 2008).

A more recent report by Oxford Economics (2009) assessed the cost of permanent coral bleaching of the Great Barrier Reef within hypothetical scenarios. Unlike previous studies, this assessment more effectively considered the approach of total economic value and included:

- direct use – tourism and fisheries
- indirect use – coastal protection
- non use values – option, existence and bequest; i.e. willingness to pay for continued existence

The total value of the Great Barrier Reef was estimated with a present value[6] of $51.4 billion and the cost of permanent bleaching of corals within the Cairns area was estimated at $37.7 billion (Oxford Economics, 2009). In comparison to several other economic studies of the Great Barrier Reef, this study focussed on values that can be more directly related the Great Barrier Reef itself (as opposed to the catchment or region) (Oxford Economics, 2009).

Table 5 below provides a summary of the estimates provided during this study along with a brief summary of the methods used. In determining the non use values, this study (similar to

[5] Tourism Satellite Account – measures the total inbound economic value of tourism to gross domestic product

[6] Present value – benefits are estimated considering their value into the future

several before) relied on the previous work by Hundloe et al. (1987) in addition to the more recent work by Windle and Rolfe (2005).

The aforementioned studies highlight the immense value of coral reefs systems, namely the Great Barrier Reef, and the goods and services they provide to the Queensland and Australian economy and people. Given that a range of methods has been used and assessments of both direct use (market values) and non use values have been considered, comparison across the studies can be somewhat difficult. Oxford Economics (2009) criticises previous studies where non use values were not included. Non market values, including non use values, are inherently difficult to determine and require time consuming methods such as surveys. This is reflected in the small

development and population growth, particularly via increased

- stabilisation of coastal sediments
- influence on longshore sand transport.

A study of seagrass beds along the coastline of Adelaide highlights the influence seagrass has on coastal sediment transport. The study recorded a reduction in seabed elevation and increased erosion blow outs where seagrass loss had occurred with evidence of the redistribution of inshore sediments (DEH, 2005). Furthermore, the loss of seagrass has lead to increased wave energy reaching the shoreline and a change in the degree of wave refraction (DEH, 2005).

Although these valuable services are recognised from a qualitative view, there seems to be few studies that estimate the economic

likely to be underestimating the overall value of the goods and services provided. However, the figures, overall, provide a convincing argument of the value of our natural assets and a starting point for many conversations.

Population growth within our coastal cities and towns will provide yet further pressures on our environment and an increased need for infrastructure and urbanisation. Many of our State coastal plans and policy recognise the importance of understanding economic, social and environmental values and incorporating them into planning. This emphasises the need for further future research into understanding the total value of our natural coastal assets.

Part 2 of this paper will investigate the value of built coastal assets, with the following key points:

- Increased vulnerability under a changing climate
- Tradeoffs between coastal protection and environmental changes
- Cost benefit analysis
- State coastal management plans – e.g. interim net benefit
- Limitations in economic analysis – cost for small projects
- Hedonic pricing methods and property values related to coastal views
- Value of beach nourishment provided to protect property
- Value of infrastructure that provides a key element in a coastal community and is highly vulnerable to SLR, e.g. surf lifesaving

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Summary table of values for each natural asset type.

Costanza et al., 1997	World's coastal ecosystems		US$20,949 billion per year US$577 per hectare per year	1995
URS, 2007	Victorian coastline	Annual output value	$2,796 million per year	
URS, 2007	Victorian coastline – recreational value	Consumer surplus Travel cost method	$48 per day $154 per person per visit $1.9 billion per year	
Blackwell, 2005	Marine ecosystems		$1,359.3 billion per year	
Davis, 1996	Non market value use of Julian Rocks (Cape Byron Marine Park)	Travel cost method	$4 million per year	1992
Blackwell, 2005	Beaches	Willingness to pay (from		

Raybould & Lazarow, 2009	Gold Coast Beaches (QLD) (residents)	Travel cost method	$0.05 7.66 per trip $21.5 91 million per year	2006
	Gold Coast beaches (QLD) (tourists)	Travel cost method	$15 45 per visit $106 319 million per year	2006
Blackwell, 2007b	Mooloolaba Beach (QLD) (residents)	Travel cost method	$0.49 $2.39 per visit costs $3.58 17.41 per visit incl. time costs $153 million per year	2000
Blackwell, 2007b	Mooloolaba Beach (QLD) (tourists)	Travel cost method	$11.86 107.75 per visit $205 million per year	2000
Anning et al., 2009	Sydney's beaches		$6 per visit $5 for onsite purchases	
	Manly Beach (NSW)		$25 million per year travel $25 million per year onsite purchases	
Lazarow, 2009	South Stradbroke Island (Gold Coast – QLD)	Travel cost method	$4,365 per year on surfing $1,775 per year at this site $20 million per year at this site	
Lazarow, 2009	Bastion Point	Travel cost method	$4,398 per year on surfing $3,078 per year at this site $230,850 per year at this site	

Lazarow, 2009	Gold Coast (QLD)	Travel cost method	$18.67 30.36 per surf session $1,950 per surfer per year $126 233 million	
Costanza et al. 1997	World's coral reefs		US$6,076 per hectare per year US$800 billion per year	1995
Cesar et al. 2003	Australia's coral reefs		US$168 billion	
Hundloe et al. 1987*	Research & control of Crown of Thorn Starfish (Great Barrier Reef, QLD)	Contingent valuation method	$98 million per year	2003
Gazzani & Marinova, 2007	Non use value at Ningaloo Reef (WA)	Choice modelling	$26.12 to increase conservation	
Carr & Mendelsohn, 2003	Great Barrier Reef	Travel costs (air travel)	US$700 million to US$1.6 billion per year US$350 800 per person per visit	

			fisheries $108 million – recreational fishing/boating
PDP Australia, 2003	Great Barrier Reef	Tourism expenditure Value added Gross value product	$274

Blackwell, 2007a	Australia's wetlands – tidal marshes and mangroves		$1,796,364 per km^2 per year $39.1 billion per year	2005
Morton, 1990	Mangroves of Moreton Bay (Qld) based on market value of fish	Market value	$8,380 per hectare	
Clouston, 2002	Non market values of Moreton Bay (Qld) wetlands	Contingent valuation method	$11.41 $19.22 as a one off payment	
Costanza et al., 1997	World's estuaries		US$22,832 per hectare per year $US4,110 billion per year	1995
Blackwell, 2007a	Australia's estuaries		$4,105,563 per km^2 per year $68.1 billion per year	2005
Blackwell, 2007a	Australia's estuaries	Willingness to pay (from previous studies) Consumer surplus (from previous studies) Market value (from previous studies)	$2,063,060 per km^2 per year $32,125 per km^2 per year $27,072 per km^2 per year	1995
Robinson, 2001b	Estuaries through value of estuarine fish	Market value of estuarine fish (dependent of estuaries) Market value of partially dependent fish species Market value of recreational fishing in estuaries	$432 million per year $40 million per year $528 million per year ($1000 per year per fisher)	

Windle & Rolfe, 2005	health (Fitzroy estuary, Qld)	Choice modelling	$3.21 per household per year	
Watson et al., 1993	Value of seagrass	Market value of commercial prawn species dependent on seagrass	$1.2 million per year	
McArthur & Boland, 2006	Value of seagrass in South Australia	Market value of seagrass dependent fish species	$114 million per year	
Costanza et al., 1997	World's seagrass		US$19,004 per hectare per year US$3,801 billion per year	1995
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