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# Valuing climate change impacts on Sydney beaches to inform coastal management decisions

## A research outline

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### Abstract

**Purpose** – The purpose of this paper is to demonstrate the critical need for economic information to inform the selection of coastal management options for the beaches of the Sydney region and to outline the project currently under way to address this information gap.

**Design/methodology/approach** – The critical need for the current case study is framed through presenting a summary of the threats posed by current climate change projections, the legislative requirements for economic valuation of natural resources, and the role which economics can play in selection of appropriate coastal management options in response to climate change impacts.

**Findings** – The paper presents the valuation methods that were selected for use in the Sydney Beaches Valuation Project and outlines the rationale behind their selection.

**Originality/value** – No current, empirical estimates of the economic value of Sydney beaches are available, which means that managers must use estimates from studies which may not reflect the unique characteristics of either the Sydney beaches or the social context. The results of the study, in terms of both unit measures of economic value and lessons learned during the survey design process, will therefore be of great value to coastal managers in the Sydney region. An external link provides details of the mixed mode survey instrument, which can be used to inform the design of other similar studies. Given the critical role of economic appraisal methods in selection of coastal management alternatives, the survey structure is potentially of great use to coastal managers in similarly threatened coastal locations elsewhere.

**Keywords** Climatology, Global warming, Coastal regions, Australia

**Paper type** Research paper

### Introduction

Australians have long held a close cultural association with beaches, which is reflected in both our patterns of development and our most popular holiday destinations. The attractiveness of beaches to residents and visitors can be linked to the range of ecosystem goods and services that they provide (Schlacher *et al.*, 2007). These include protection from coastal hazards, opportunities for recreation, aesthetic beauty and habitat for marine and terrestrial plants and animals (Wilson *et al.*, 2005).

Historically, the greatest threat to beach systems has been rapid and poorly controlled residential and industrial development encroaching on coastal areas from the landward direction (NSW Government, 1997). Over 80 per cent of the population of Australia is located within 50 km of the coastline (CSIRO, 2002; NSW Government,

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1997). A large proportion of these are located within areas subject to coastal processes. Approximately 6 per cent of addresses in Australia are located within 3 kilometres of the coastline, less than 5 metres above sea level (Chen and McAneny, 2006).

More recently, it has been recognised that climate change represents a serious and chronic threat to the continued existence of beach systems, and the services they provide (Phillips and Jones, 2006, Walsh *et al.*, 2004). This situation will ultimately lead to coastal councils choosing between a range of coastal management options, often with incomplete information about the tradeoffs these choices represent. Estimates of the value of the goods and services provided by beach systems are an elusive yet essential component of ensuring that their management is based on a comprehensive understanding of their importance.

This paper provides a brief summary of recent climate change projections from the Intergovernmental Panel on Climate Change (IPCC), and considers the implications for coastal management. The next section then outlines the means by which economic tools can be useful in coastal management decision-making. The following section describes a collaborative PhD research project recently commenced by the Sydney Coastal Councils Group and the University of NSW, which seeks to place an economic value on selected beaches in Sydney, and the anticipated benefits this project will generate at a local, regional and state level[1]. While the results of the project are not yet available, this section provides a framework for how the economic value of the selected Sydney beaches are being estimated, given the relevant case study site and management characteristics. This is followed by a brief conclusion.

## Climate change science: what is going to happen?

Given the location of beaches 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. These changes could 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 (CSIRO, 2002; Aboudha and Woodroffe, 2006; Ranasinghe *et al.*, 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 and Woodroffe, 2006). Each of these is associated with different ranges and degrees of uncertainty (IPCC, 2007), which is a complicating factor for any climate change adaptation strategy (CSIRO, 2002).

For the purposes of this paper, the climate change impacts that are of the greatest interest are those directly associated with sea level rise, namely inundation and shoreline recession. This is in part because of the increased level of confidence in these projections, and also because these threats in themselves are sufficient to warrant concern for coastal managers. Sea level rise also has the potential to exacerbate the other climate change impacts (Church *et al.*, 2006). A brief summary of the current state of science with regards to sea level rise projections follows, to outline the context within which coastal management decisions must be made.

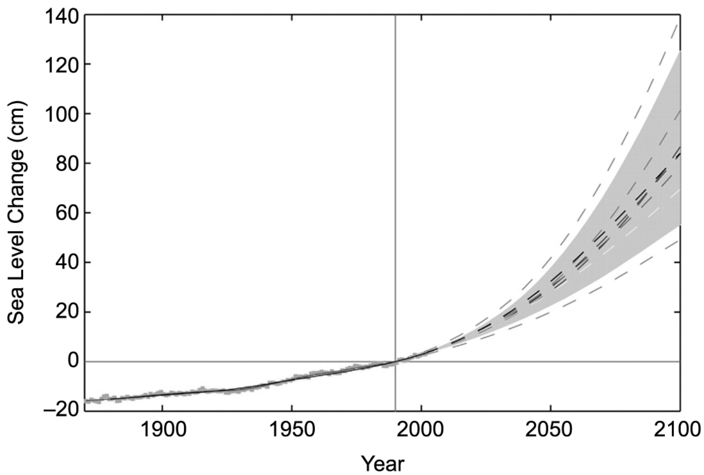
### *Sea level rise*

In 2007, the IPCC released the Fourth Assessment Report (AR4), which predicts that global sea levels will rise between 18 and 59 cm by 2090-2099, compared with 1999 levels (IPCC, 2007). As widely reported, this does not include the inputs due to melting of terrestrial ice sheets, as the climate science community could not agree on the magnitude or timing of this contribution. The IPCC estimates this will add approximately 10-20 cm to global SLR (IPCC, 2007).

Superimposed on top of global eustatic sea level rise, regional variability is also important, but projections are subject to greater uncertainty. In the case of South-Eastern Australia, strengthening of the East Australian Current is likely to lead to a contribution of around 12 cm of additional SLR, relative to the global average (McInnes *et al.*, 2007). These additional amounts bring the upper end of the SLR projection envelope for the New South Wales coast to around 91 cms.

More recent work by a prominent author on the most recent IPCC report, Stefan Rahmstorf, has suggested that sea level rise may be significantly underestimated by the current climate models, with the results of his semi-empirical analysis suggesting a global eustatic sea level rise of between 0.5 m and 1.4 m by the year 2100 (see Figure 1) (Rahmstorf, 2007). This range appears to be supported by more recent observations of sea level, which indicate that the rate of rise is accelerating (Church and White, 2006; Rahmstorf, 2007). Given the observed sea level rise (shown by the dark trend line in Figure 1), sea levels are already tracking towards the upper end of the range of projections from the TAR (Rahmstorf, 2007). This is a cause for some concern, as the thermal inertia of the oceans means that sea level rise 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 emissions scenarios.

Whilst uncertainty about the exact magnitude of sea level rise persists, the direction of change is clear, and the precautionary principle requires action even in the absence of scientific certainty (Brundtland, 1987). This principle, which is a key component of ecologically sustainable development (ESD), is a key objective of much environmental




**Note:** Dashed lines represent different temperature scenarios of the IPCC TAR, the solid black line is the trend of observed sea level, and grey area is the range of sea level rise predicted by semi-empirical analysis
**Source:** Rahmstorf *et al.* (2007)

**Figure 1.**
Sea level rise projections based on the temperature change scenarios of the IPCC Third Assessment Report (TAR)

legislation and policy in NSW, and Australia in general, and hence there is a legislative requirement to respond to sea level rise.

**Translating the science: what are the implications for coastal management?**

Sea level rise represent a chronic and unidirectional threat to coastal management, particularly in urban areas where the management options are restricted. Shoreline recession is directly related to the level of sea level rise. Estimates of shoreline recession on unconsolidated coastlines are generally in the order of 50-100 times the vertical sea level rise (Bruun, 1962,; Aboudha and Woodroffe, 2006). This has been termed the Bruun rule, and it has been used extensively in coastal planning (Cowell *et al.*, 2006). More recently, advanced techniques incorporating technologies such as inshore wave modelling, digital altimetry, probabilistic shoreline translation models and GIS platforms have provided a more precise means of estimating shoreline recession (Hennecke *et al.*, 2004; Hennecke and Cowell, 2000). Nevertheless, the Bruun rule provides a means of rapidly assessing the threat to beaches in Sydney, to understand the importance of managing for climate change impacts.

Using this simple relationship, a sea level rise of between 18 and 91 cm could result in horizontal shoreline recession of between 9 and 91 m. Given that the average beach width in Sydney is less than 100m, this could result in a total loss of some beaches without significant management intervention. Even at the lower end of the spectrum, this would result in significant threats to public infrastructure, private homes, and coastal reserves (Hennecke *et al.*, 2004).

The potential for coastal erosion is much greater during storm events, which may become more likely under climate change scenarios. The effects of these storm events are intensified by sea level rises. Thus it is the very existence of beaches that is threatened, as well as the amenities they provide.

Economic values were estimated for the natural resources of the coastal zone of NSW, as part of the comprehensive coastal assessment. Natural resources considered included fisheries (including aquaculture), forests, mineral resources, beaches, national parks, and water and agricultural resources. This project calculated that these resources had an annual use value of $850 million (NSW Government Department of Planning, 2006). While this included a broad range of natural systems, the values highlight the importance of coastal resources to the NSW economy. The local-level case study conducted at Wallis Lake identified recreation as a significant source of value, which could not be included in the broader-scale study due to a lack of visitation data. Hence the value of coastal and estuarine recreation is likely to have been underestimated. Beaches were among the most highly valued natural resources at all levels (NSW Government Department of Planning, 2006).

*Examining the coastal management options*

In response to the threat outlined above, there are a number of options for managers of coastal resources. These are, essentially, to protect, to mitigate or adapt, or to relocate. Relocation over short time frames is an impractical response for highly developed coastal areas, and where there are extensive built assets. Coastal properties at risk from erosion or flooding over the next century in NSW were valued at $1 billion in 2005 and this figure increases yearly due to property value increases and intensified coastal development (Pyper, 2007).

Rapid increases in coastal land prices in recent years also means that voluntary acquisition of these properties is not a practical response over any significant spatial scale, a weakness identified in the *NSW Coastline Management Manual 1990* (NSW Government, 1990, s5.1 (d), "Voluntary purchase"). There are also legal challenges (both literal and figurative) when land owners hold firm property rights on coastal property, even when subject to coastal planning conditions (Gilmore, 2007).

Adaptation is also difficult. Whilst it is possible to ensure that new structures comply with appropriate design guidelines (Coastal Council of NSW, 2003), it is not often practical to retrofit pre-existing structures. Hence, practical, financial, legal and cultural limitations dictate that protection is the most likely response in Sydney (Lipman and Stokes, 2003).

There are two major classes of coastal protection options; hard and soft. Hard measures include the construction of seawalls, groynes, artificial reefs and breakwaters. Soft options are rehabilitation of natural dune systems, and beach nourishment. For a more detailed discussion of protection options and example images see Section 5.2 of the *NSW Coastline Management Manual 1990* (NSW Government, 1990). Both groups of responses require significant public expenditure, and hence there must be an examination of the benefits and costs of all management options (Hennecke *et al.*, 2004). Importantly from a management perspective, the costs of coastal protection options are often beyond the financial capacity of local governments. This means that applications must be filed for external funding, which requires an additional stage of economic evaluation, with more detailed analysis often required (NSW Government, 1990, 2007).

## Why employ economics in coastal management?

### *Theoretical argument for the use of economics in environmental decision making*

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 tradeoffs, and where these decisions involve environmental resources, logic would dictate that it is best practice to ensure that these tradeoffs are made with a sound understanding of the benefits and costs of each potential course of action.

While the open discussion of environmental valuation will always raise opposition, some form of internal valuation is implicit in the decision-making process. Costanza and Folke (1997, p. 50) note:

> [. . .] we cannot avoid the valuation issue, because as long as we are forced to make choices, we are doing valuation.

Given the complexity involved in comparing options which have potential impacts on employment, public health and ecological systems (for example), a means of converting these impacts into a single unit for easy comparison is highly desirable, to ease the conceptual burden on the decision-maker. This unit is termed a *numeraire* in economics, and could be anything from blue marbles to cases of beer, as long as all benefits and costs can be expressed in the chosen unit (Farber *et al.*, 2002). The most commonly used *numeraire* is money, as most people make daily choices involving monetary transactions and therefore have a better idea of the tradeoffs they are making when stating their willingness-to-pay (WTP) for environmental projects.

*Legislative requirement for environmental valuation in NSW*

As mentioned previously, ESD is a key component of environmental legislation of relevance to coastal management. An essential component of ESD is the need to establish or improve linkages between the economy and the environment. One of the main reasons why valuation of environmental resources is an important component of ESD is because of the prevalent use of economic evaluation methods such as benefit-cost analysis (BCA) in the assessment of investment of state government revenue in Australia. These become important when the costs of coastal protection options are beyond the scope of local councils.

Clear guidelines for BCA are provided by the NSW Department of Treasury, including the appropriate discount rates and project periods (NSW Government, 2007). This method requires quantification of all the costs and benefits in monetary terms in order that the process adequately addresses environmental and social issues (Hanley *et al.*, 2001). Beaches provide a range of ecosystem goods and services, not all of which are captured in existing markets, either in a direct or indirect fashion. Thus the marketed value of beaches represents only a proportion of the total economic value (TEV) of the resource (Johnston *et al.*, 2002; NSW Government, 2007).

Other components of TEV (see Figure 2) include indirect or non-consumptive uses such as recreation and tourism, and values that do not require any form of contact with the resource. These are termed non-use values and the sub-classification of these values is a matter of some debate. Examples of non-use values include deriving utility from knowing that a resource exists even without the intention to visit, knowing that the resource will be available for future generations, and knowing that the resource is available for potential use in the future. These are existence, bequest and option values, respectively (Goodman *et al.*, 1998).

Failure to consider non-market values of natural resources can lead to these systems being undervalued in the decision-making process, which in turn can lead to

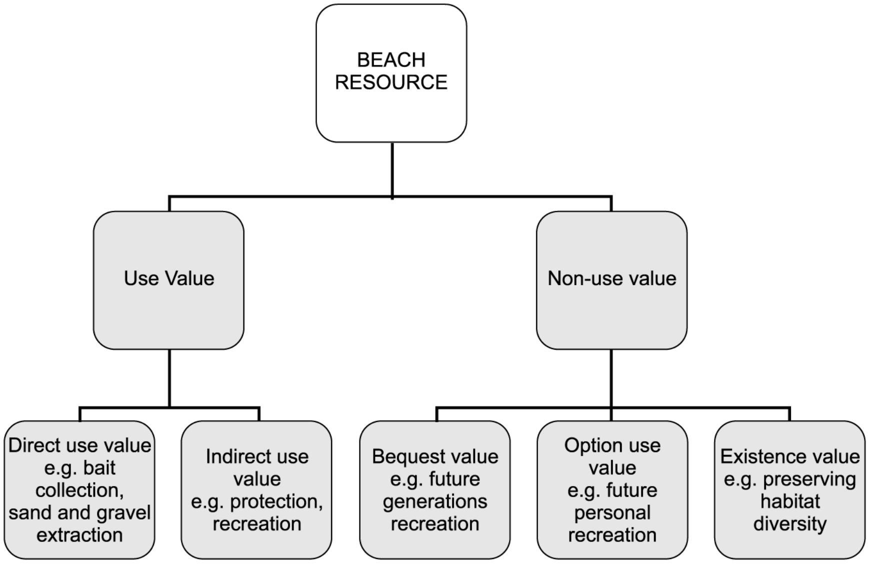



**Figure 2.**
Components of value of a resource

undesirable outcomes such as reduced public access to the beach through private development or continued development of at-risk coastal locations (NSW Government, 1997). The expansion in 2005 of the Coastal Zone of NSW to include metropolitan areas demonstrated recognition of this potential (though perhaps not the underlying cause). This expansion ensured that the coastal zone in Sydney is subject to the planning provisions of *State Environmental Planning Policy 71 – Coastal Protection* (SEPP71) and the *NSW Coastal Policy 1997* (the Coastal Policy), which ensures that a more stringent set of criteria is used when assessing coastal developments. Both of these documents specifically identify the need to "protect and enhance" public access to the coast.

The *NSW Coastal Policy 1997* also explicitly highlights the need to more adequately value coastal resources (NSW Government, 1997, p. 16):

> A significant cause of environmental degradation in the coastal zone is the under-valuation of the environment and the long held belief that use of "commons", such as water resources, is free and unconstrained.
>
> The Coastal Policy promotes the need to fully value all the resources of the coastal zone when making decisions which affect coastal resources [. . .].

## What is this project?

The University of New South Wales and the Sydney Coastal Councils Group (SCCG) are working on a collaborative project which seeks to estimate the economic value of selected Sydney beaches, to assist local and state governments to make more informed decisions on how to protect beaches and related assets and amenities at threat of coastal erosion due to enhanced climate change impacts. This project is being undertaken as a three-year PhD project, and began in December 2006, following the appointment of the PhD candidate, Dave Anning. The working title of the project is: "Quantifying the value of Sydney (NSW) beaches in order to assess cost/benefit of necessary coastal protection / abatement measures as a result of enhanced climate change impacts"[2].

This project is employing a number of economic methods to estimate the value of two ocean beaches and one estuarine beach in the sydney region, in three different local government areas. The ocean beaches chosen are Manly Ocean Beach and Collaroy-Narrabeen. The estuarine beach is a combined site in the Hawkesbury River, incorporating the Brooklyn Baths and the beaches of Dangar Island. Beaches have been chosen to represent different biophysical environments and coastal management issues, which are common to many beach locations worldwide. This will provide a baseline value against which changes (natural or otherwise) may be tracked.

### *Valuing coastal resources*

Wilson *et al.* (2005) state that beaches provide the following ecosystem services: "disturbance prevention, soil retention, biological control, habitat functions, aesthetic information, recreation, cultural and artistic information and spiritual and historic information". Of these services, only disturbance prevention (property protection from storm surges and other natural hazards), aesthetic information and recreation have been valued in detail (Wilson *et al.*, 2005).

It is not the intention of this paper to provide a detailed summary of environmental valuation methods or previous studies. An excellent summary of these methods, accessible to those without an economics background, is available at the Ecosystem Valuation web site (www.ecosystemvaluation.org). The following section outlines the valuation methods to be employed in the present study, including discussion of the rationale behind their selection from the range of options available.

*Valuation methods to be employed*

*Housing market impacts*. Coastal property prices in the Sydney region indicate that there is a strong preference for proximity to the ocean. The Hedonic Pricing Method (HPM) is a surrogate market method that involves calculating the effect of environmental attributes, such as proximity to the ocean or a pleasant view, on property values in the housing market (Lockwood and Tracy, 1995; Pearson *et al.*, 2002). In essence, property prices are regressed onto variables considered likely to influence house prices to examine the significance of this relationship. For example, a house price may be a product of property variables such as floor space, the number of bathrooms, and the proximity to a local school. A general descriptive function with example characteristics would be:

$$V = f(P, A, E)$$

where $V$ represents house value, $P$ represents property characteristics (area, frontage, and zoning), A represents accessibility characteristics (road class), and $E$ represents environmental characteristics (proximity to coast, proximity to shopping centre). This form of analysis has been made substantially easier through the development of geographic information system (GIS) software.

Numerous international studies have investigated the linkage between coastal amenities and the property market (Pompe and Rinehart, 1995; Fraser and Spencer, 1998; Rinehart and Pompe, 1999). Rinehart and Pompe investigated the effect of beach width on the property market in South Carolina, and found that for a 10 per cent increase in width there was a corresponding house price increase of 2.6 per cent. This effect diminished with increased distance from the coast (Rinehart and Pompe, 1994). This has key implications for future beach management decisions, particularly in relation to nourishment regimes and land tax revenues. Recent work examined the influence of coastline protection structures on the price of nearby accommodation (Hamilton, 2007). This method has significant potential to predict the effect on local accommodation and housing prices of coastal management works in response to climate change impacts.

The HPM being employed in this study takes into consideration beach views and proximity to different shoreline types. The land valuation process in NSW lends itself to time-series investigations, as land is valued annually for rating and land-tax purposes, hence the potential to examine the impacts of (past and proposed) coastal land-use policy changes on the value of coastal property in Sydney (NSW Department of Lands, 2004).

*Survey methods: combined travel cost and contingent valuation method*

Previous studies have demonstrated strong linkages between the state of beaches and tourism revenue in coastal cities (Phillips and Jones, 2006). Raybould and Mules (1999) performed a cost-benefit study in 1999 of a proposed beach management program for the Gold Coast (Queensland, Australia), which required large-scale beach nourishment and ongoing maintenance over a 25-year period. In order to determine the economic impacts of beach erosion, they compared tourism revenue in periods immediately after known erosion events with the "expected" revenue based on reference years with no significant erosion. The studies suggested that erosion events with recurrence frequencies of five, ten, 25 and 50 years would result in 2 per cent, 5.5 per cent, 13 per cent and 20 per cent reductions in annual tourism revenue, respectively. The authors suggested that the proposed project would reduce the impact of these erosion events, and hence generate "savings" in lost revenue. These savings were related to the costs of the proposed project, which resulted in a benefit-cost ratio of at least 17 to 1, using relatively conservative factors in the analysis (Raybould and Mules, 1999).

Tourism revenue generated by Sydney beaches is an, as yet, unquantified source of income for the resident communities at local, regional and state level. In the year ending June 2008, Sydney received just over 26 million visitors, with total visitor expenditure of $11.4 billion (Tourism NSW, 2008). In 2001, a survey of international tourists in Sydney determined that, depending on the country of origin, between 20 and 56 per cent (average 36.3 per cent) of visitors visited Bondi Beach. This represented total international visitor numbers of just over 1 million (Battye and Suridge, 2002). This level of international visitation is greater than that for many small countries. It is likely that domestic visitation is also high, as visiting the beach ranks highly as a motivation for travel amongst domestic tourists in Australia. Visiting the beach was the second most popular activity for domestic travellers in the 2002 National Visitor Survey (Riley and Marshall, 2002).

The Sydney Beaches Valuation project uses a mixed-mode survey delivery process; intercepting beach users at coastal locations, and through an online survey hosted on the SCCG web site. The online survey is promoted via email distribution of links in a "snowball-sampling" procedure. This survey combines an individual travel cost (ITCM) questionnaire with Contingent valuation questions, which are discussed more in the next section. The ITCM component asks people how they travel to the beach, how much time they spend onsite and in travel, and how much they spend on all onsite costs (including parking). Travel costs are then calculated based on travel mode. Ticket costs are included for public transport, engine size and running costs are included for private vehicles. The opportunity cost of time is calculated based on a proportion of the individual wage rate, and tradeoffs between choice of travel mode and respective travel times.

Importantly, the travel cost method only captures use values, as those who do not visit the resource have travel costs of $0, and hence are excluded from the value calculations. Thus it is unable to capture existence, bequest or option values and therefore does not provide an estimate of the TEV of a resource. It is therefore important to capture these "hidden values", which may be a combination of use and non-use values as identified in Figure 2. These values can only be captured by the construction of a hypothetical market and the use of surveys. This is termed the contingent valuation method (CVM), often termed the willingness to pay (WTP) method.

*Willingness to pay: cultural and non-use values*. To investigate some of the values that are not captured in any existing markets, or through the methods described above, our survey includes questions about future beach erosion scenarios, and the willingness of the respondent to pay to maintain or achieve their preferred future state.

These erosion scenarios are presented in terms of a loss of "beach days", at different periods into the future. Effective and objective communication of future states is a key component of the CVM. This is hampered by scientific uncertainty on the absolute magnitude and timing of sea level rises. Use of visual aids can assist in communication of these states, although it also has the potential to induce scepticism or strong emotional responses[3].

*Additional investigations*. Innovative methods to estimate visitor numbers, such as use of the CoastalComs system developed by Coastalwatch are also being investigated[4]. This computer software system is able to analyse images taken from surf cameras to determine the number of people in the image. Visitation data and beach attribute preferences may be used by coastal councils to determine the proportion of council funds and other sources of funding which should be spent on beach management, to prioritise spending on coastal reserve management between beaches, and in decisions about the management of public space and development applications which have the potential to impact on coastal amenities.

*Integration of values derived from previous steps*

The results of these valuations will then be combined with estimates of the value of environmental goods and services (using the benefit transfer method) to give an estimate of the TEV of beaches in the three study sites, to be displayed graphically. The spatial distribution of values can be used to identify key privately and publicly owned coastal assets threatened by enhanced climate change impacts, and prioritise sites for allocation of coastal protection resources. The impacts of different management options on the economic values of the beaches can also be investigated. The method/s of coastal asset valuation, including identification of publicly available and controlled information sources, will be transferable between locations and at a number of spatial scales.

*Tests of benefit transfer method*

There a number of situations where it can be beneficial for local councils to be able to rapidly assess the economic value of natural resources under their management control. For example, this information could be used in the decision about preparation of coastline management plans. The empirical studies previously described will present an opportunity to test the assumption that the values derived from previous studies are applicable in the Sydney region. The application of a number of methods at multiple sites in the region will also allow for examination of those methods that are most applicable for benefit transfers to expand results to regional and state-level valuations. Both of these processes have the potential to lead to significant costs savings.

## Conclusion

Climate change represents a chronic threat for the sustainable management of the coastal zone. Management responses to this threat will often involve large investment decisions, which must be based on the best available information. Currently, information about the economic value of environmental goods and services is lacking, which is an impediment to achieving the goal of sustainable management of coastal resources. This project will provide this information for selected beaches in Sydney and identify a means by which the valuation process can be applied and translated to larger-scale assessments, which has a range of benefits at local and regional levels.

The results of the valuations, including identification of stakeholder preferences for coastal attributes, will be key knowledge inputs to the future management of the NSW coastal zone, particularly in the decision of how to protect coastal assets in response to sea level rise and other enhanced climate change impacts. It may also be useful in the daily management of these resources.

From a stakeholder perspective, the survey design and implementation process will enhance community understanding of likely impacts of climate change and available coastal protection measures in the Sydney region. The survey-based methods will also facilitate greater community consultation in the coastal management process. Essentially, environmental valuation is the translation of social and environmental concerns into a language that is of greater use in economic evaluation. This is a key step in the progress towards the objectives of ESD in the coastal zone.

This project is expected to be completed in mid 2009. More detail about the project partners and methodology, as well as regular updates, is available from the SCCG web site: http://sydneycoastalcouncils.com.au/documents/SYDNEYBEACHVALUATION PROJECT.pdf

An online survey related to this project can also be accessed via the following link: www.unipark.de/uc/sydneybeachesvaluation

## Notes

1. Further information on this project can be found at the Sydney Coastal Councils Group web site: http://sydneycoastalcouncils.com.au/documents/SYDNEYBEACHVALUATION PROJECT.pdf A link to an online beach valuation survey being undertaken as part of this project can be found here: www.unipark.de/uc/sydneybeachesvaluation
2. The Sydney Beaches Valuation project employs a survey which combines CVM questions with an Individual Travel Cost Model, and is deployed both online and in personal interviews at beach locations. The survey instrument can be found at the following location: www.unipark.de/uc/sydneybeachesvaluation
3. At this stage the surveys do not incorporate imagery, although testing the impacts of including this imagery on the survey responses is something that will be investigated at a later stage in the project.
4. See http://coastalcoms.com for more information on this technology.

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