ECONOMIC VALUE OF SYDNEY BEACHES

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Introduction

Climate change is predicted to have a range of impacts on coastal regions of New South Wales, including changes in storm frequency and intensity, variability in rainfall, temperature increases and sea level rises. Whilst the other climate change impacts (with the exception of temperature) are associated with varying degrees of scientific certainty, all modelling of future sea levels project an increase of seal level. The only variability amongst these modeling projections is what will be the magnitude of the increase.

The NSW Government recently released guidance on the use of sea level rise (SLR) projections in planning for climate change adaptation, in the form of a Draft Sea Level Rise Policy Statement. This document outlined benchmarks to be used in climate change planning of a 40cm rise by 2050 and a 90cm rise by 2100, relative to 1990 mean sea levels.The absolute magnitude of sea-level rise predicted is not in itself likely to cause major issues for much of the Australian coastline (IPCC, 2007, Walsh et al., 2004).

The greatest danger for coastal and estuarine areas is the interaction of sea level rise with increased frequency and intensity of storm events, which generate destructive waves, strong winds, heavy rainfall, barometric setup and storm surges. This can result in shoreline recession or coastal inundation, or more serious consequences such as the destruction of coastal infrastructure and risks to human life. This means that coastal councils face the likelihood that they will be responsible for some form of coastal management response, in order to protect public and private infrastructure and the amenities they provide (Lipman and Stokes, 2003). Planning for, and responding to, these projections in a pre-emptive manner is likely to result in large long-term cost savings (Walsh et al., 2004). This project therefore aims to inform decisions about how to respond to the predicted impacts, i.e. adaptation rather than mitigation.

Given the costs associated with coastal management actions in response to climate change impacts, there needs to be an examination of the benefits and costs (CBA) associated with each management option(Hennecke et al., 2004). Whilst the construction and ongoing costs of coastal management are relatively easily quantified, there is little available information on the social, environmental and economic benefits that result from management actions to ensure ongoing access to beaches in the Sydney region.

This paper will present a summary of the results from an economic survey of beach visitors in Sydney. These surveys have been completed as part of the Sydney Beaches Valuation Project[1], a collaborative PhD project between the Sydney Coastal Councils Group (SCCG) and the University of New South Wales (UNSW) designed to provide the information necessary for local Councils to critically assess the economic impacts of different coastal management alternatives. Valuations of beaches and related coastal assets will also allow for more efficient allocation of coastal protection resources at a state, regional and local level.

The critical information gaps, which form the research questions for the broader Sydney Beaches Valuation Project, and the **methods being used to answer them**, are:

What would the partial or total loss of beaches mean for:

1. the local property market and rates revenue? (**Hedonic Pricing Method**)
2. tourism and recreation? (**Individual Travel Cost Method**)
3. otherwise intangible cultural and amenity values? (**Contingent Valuation**)

4.
5. How will those factors be affected by the different types of adaptation options?
6. What are the underlying preferences of community members for the design of coastal protection alternatives? (**Choice Modelling**)

This paper does not provide any details of the Choice Modelling or Hedonic Pricing components of the Sydney Beaches Valuation Project. It presents only a selection of results from the survey component, i.e. the component of the project designed to answer Questions 2 and 3 above. Unless indicated otherwise, figures stated are the mean values for all case-study sites. Breakdowns of the results by site have not been included.
The focus of this paper is on outlining trends identified, and discussion of the various challenges that were encountered in design and application of the surveys. These are likely to be common for all similar valuation projects in NSW.

[1] http://www.sydneycoastalcouncils.com.au/documents/SYDNEYBEACHVALUATIONPROJECT.pdf

Methodology

Survey design

Survey administration was multimodal, incorporating online surveys accessible via the SCCG website, and in-person interviews conducted with beach visitors at the three case study sites. These surveys employed a joint estimation survey instrument to assess existing coastal tourism and recreation expenditures, and willingness to pay to prevent beach erosion at the site where the interview was undertaken. This took the form of a combined Contingent Valuation-Individual Travel Cost design.

The Contingent Valuation Method (CVM) asks people about their willingness to pay (WTP) for coastal management measures in order to prevent climate change impacts as described in a hypothetical situation. (This scenario was designed for transferability between sites, and is described in further detail below.)The Individual Travel Cost Method (ITCM) involves directly surveying visitors to determine their travel costs, onsite expenditures and travel times. This represents a minimum value for the utility they gain from the visit. Joint estimation allows for collection of more information from a single individual, and also allows for comparison of different valuation estimates from the same individual. This enables convergent validity testing of the willingness-to-pay (WTP) responses.

It should be noted that it is not possible to directly compare responses from the two methods, as the ITCM values only the use values of the beach visitors, whereas the CVM is a holistic valuation including non-use values. Hence it is assumed that the WTP response will be higher than the travel costs. This is also true because the ITCM model estimates values derived either from a single trip or on an annual basis, whereas the beach user may visit multiple times over many years and answer accordingly in their WTP response.

Translating the science to economics

The SCCG represents 15 ocean and estuarine councils, containing 38 ocean beaches and more than 100 harbour or estuary beaches. Hence it was important to design a survey process which could be easily translated to other sites. It is very challenging to design a survey that is transferrable to different sites, as each site is characterised by different biophysical and socioeconomic contexts, and will be subject to different climate change impacts. This is true both in terms of their spatial extent, and also the time horizon at which critical thresholds or tipping-points will be reached. Ideally, the specification of future states for use in valuation will be informed by site-specific shoreline translation modelling. For example, differences in the design (and presence) of seawalls will result in different shoreline recession patterns. Hence a balance must be reached between technical accuracy for individual sites and a measure which is comparable between sites.

A valuation unit which is consistent between sites allows for greater comparison, while one which is specific to each site will give greater accuracy

for that site. The ultimate solution was to value beach loss in terms of the impact on beach use. This was described as a ten percent reduction in the number of days with exposed sand present at high tide. (The full contingent state description and valuation question is included below.) Importantly, it was a *fixed percentage* reduction in the presence of sand at high tide, in terms of the number of times each respondent visited. Thus, the relative damage is preserved, but the objective amount of erosion is different for each respondent. More simply, a person who visits ten times per year is essentially valuing the absence of sand on one of these days, whilst the person who visits every day is valuing absence of sand for around 5 weeks of the year.

Communicating contingent states

Conveying the contingent state quickly, effectively and objectively is a persistent challenge in the design of contingent valuation surveys. Despite the presence of detailed stochastic shoreline recession modelling for both of the ocean beaches selected as case study sites, it was discovered in pretesting and design meetings with the project partners that these figures were not easily understood. This was true even for survey subjects with many years of experience in coastal engineering and management.

One means of improving communication is to use visual stimulus in the form of still images or videos. This method will be employed in latter stages of the Sydney Beaches Valuation Project, during the Choice Modelling exercise. This component seeks to identify preferences for different aspects of coastal adaptation options, such as the resultant width of the beach or the height of modified seawalls.

> *(Survey instructions)*
> I have asked you some questions about how you currently use the beach and what you like about this beach.
> I'm now going to describe a hypothetical future scenario for the beach, which you should consider in answering the following questions:
>
> *(Erosion scenario description)*
> All Sydney councils are considering the future management of their natural resources, and the potential impacts of climate change. One of the most certain of these for coastal areas is a rise in sea levels. Higher sea levels are likely to result in the gradual but permanent loss of sand from [@Beach] .
>
> In the shorter term, sea level rise is likely to result in the more frequent loss of sand from the beach due to normal storm activity.
> By the year **2050**, this could lead to a situation where
> **10%**
> of the times you visited [@Beach] , there was no dry sand present at high tide.

The symbol [@Beach] indicates a wildcard used in survey programming to allow transferability. This wildcard records the name of the beach entered in the earlier section of the survey and propagates the beach name throughout the remainder of the survey whenever the wildcard identifier occurs. Thus the

survey respondent is only asked about the beach where the survey was conducted. In the case of the online surveys, the case-study beach they visited most recently is used as the wildcard, or their favourite beach if they have not visited a case-study beach in the previous 12 months.

Payment vehicle and administration

The way in which people are asked about their willingness to pay, and the administration of the program, can have a substantial impact on the responses received.

The traditional application of the Travel Cost Method involves assessing the impact of changes in access fees on visitation, and hence revenue. Open access resources such as beaches provide a number of challenges for the selection of payment vehicles, as it is neither legally possible or practical to institute entrance fees for a beach.

A number of different payment vehicles were explored in the survey design process. These included developing different payment vehicle models for different user groups. Examples of the options explored were: rates increases or special levies for local residents, a 'tourism occupancy' tax for tourists staying in the same Local Government Area, and parking fee increases for those who travel by private vehicle.

Discussions with the project partners indicated that there were a number of theoretical issues with some of the payment vehicle alternatives. For example, parking fees are applicable only to those who travel in a private vehicle, do not have a parking permit, and choose to park within the 'paid parking zone'. This excludes a large number of beach visitors, as evidenced by the patterns of visitation identified in the current project shown in Figure 1 below.

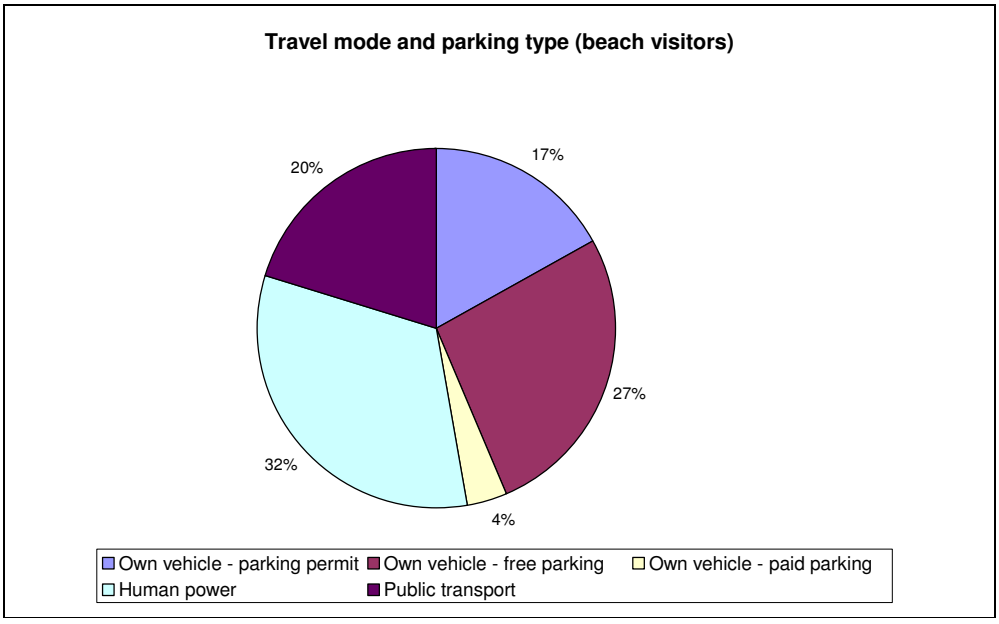

Figure 1: Travel mode and parking

Almost a third of the sample do not pay for their travel in any means, as they travel to the beach under their own power. Only 4% of the beach visitors surveyed paid for parking, hence the use of this payment vehicle would not have been equally received by those who pay for parking, and those who

utilise free parking.. There was also a difference in the parking fees in place at the case-study sites, meaning that any nominal change in fees would represent a different proportional increase.
Tourism taxes were also not considered as useful, given that tourists may spend many weeks in Sydney and only visit the beach once, which means that they would be considering more than just the loss of their beach experience, which may represent a small component of their overall trip.

As a result, the decision was made to use a more generic measure, in the form of a donation to a hypothetical beach fund:

> *(Payment vehicle description)*
> Suppose for a moment that there was a dedicated [@Beach] Beach Management Fund, which could only be used to prevent the erosion described.
> This fund would be administered by a state government agency, and could only be used at [@Beach]. It would be subject to independent annual audit, to ensure that the funds were being spent appropriately.
> *(Principle response)*
> In principle, would you be willing to make a once-off donation to such a fund, if it existed?
> Remember that this is only one of a number of potential environmental projects, that there are a number of other beaches which may not be equally affected, and consider your available budget.

The "In principle…" question was used as a screening process to identify protest voters, who were not asked the valuation questions. Slightly more than half (52.8%) of respondents to the personal interviews indicated that they would give 'In Principle' support to a beach management fund that was designed to prevent the erosion of sand described in the contingent scenario.
Inclusion of protest votes (zero bids for WTP, regardless of the amount offered) has the potential to substantially influence measures of average WTP (mean, median, mode), hence identification of the reasons for negative responses is important. This was aided in the current survey by a follow up question:

> What is the main reason for your answer to the previous question?

The decision was made to use the State Government as the administering agency, to avoid differences in community attitudes towards case study Councils. The beach management fund was also restricted to activities at a single beach, to identify any spatial differences between the case-study sites.
A number of respondents indicated that they would not contribute to a fund of this type, but would consider contributing to funds with a broader approach to management. Reasons for this included that it was not their favourite or local beach, and that they considered other beaches to be more vulnerable or important for preservation.
The approach to be applied in preventing the erosion was also not described, to avoid pre-existing negative (or positive) associations with particular coastal

management approaches. This was particularly important for one of the case-study sites, due to the history of community opposition to seawall construction in the local area. Figure 2 below shows a protest which occurred in November 2002 in response to a proposed seawall construction at Collaroy-Narrabeen.

Figure 2: 'Line in the Sand' protest at Collaroy-Narrabeen (**Source: SMH**)

Valuation question

The valuation question employed a dichotomous choice/referendum model, whereby respondents are asked whether or not they would pay a particular amount (analogous with taxing themselves) in order to prevent the change described.

> Imagine that the [@Beach] management fund has now been established.
> If you were approached by someone seeking donations to the fund, would you be willing to make a once-off donation of **5 dollars** to the fund?

The amounts are varied, and the proportion of people willing to pay each amount is used to construct a bid acceptance curve. Logistic regression is then used to explain the parameters of greatest importance in determining bid acceptance. The amounts were varied randomly between respondents, using a vector of bids from 5 to 500 dollars.[2] As expected, the proportion of people willing to pay the referendum amount decreased as the amount was increased. This is shown graphically below in Figure 3.

This was followed by a question about their *Maximum WTP* under the scenario described. Use of this design allows for collection of more information from each individual. This is termed an anchored-open approach, and has been shown through Monte-Carlo simulation to improve statistical efficiency, even in the presence of strategic behaviour. (de Faria et al., 2007). Single-bounded referendum models only collect a single data point, so large

[2] Amounts for this bid vector were selected via pretesting responses to the Max WTP question.

samples are required for statistical accuracy when estimating measures of central tendency such as Mean and Median WTP (Hanemann et al., 1991).

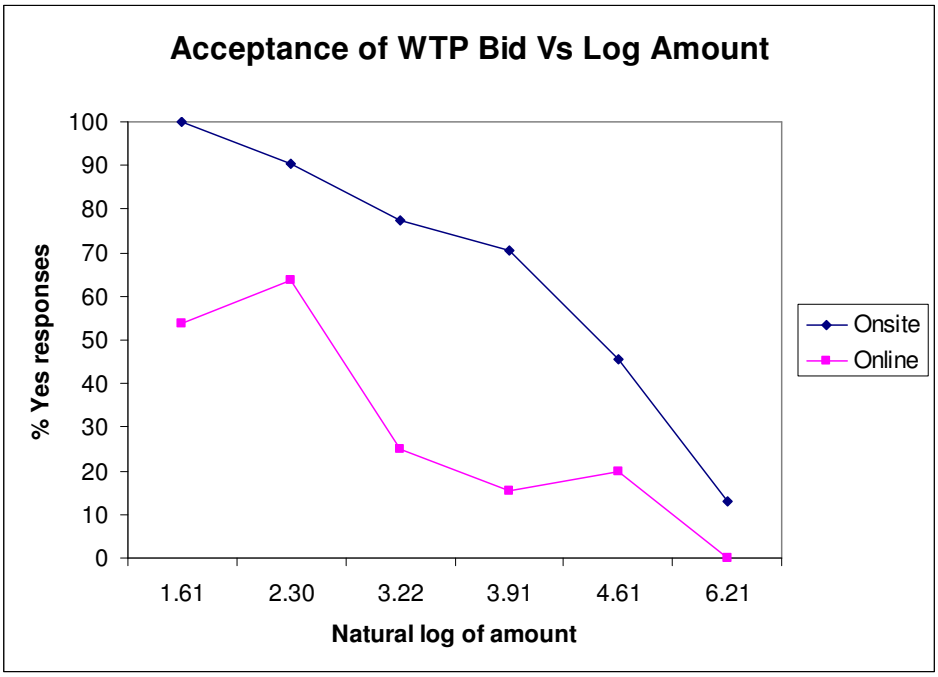

Figure 3: Willingness to pay vs referendum bid amount

A summary of responses to the 'Maximum WTP' question is provided in Table 1. The average maximum WTP in the personal interviews was $117.81. When protest responses are included this is reduced to $66.64. The comparable figures for the online survey (i.e. for the same time horizon) are $111.14 and $69.86, respectively. Median WTP was $50 for the personal interviews and $40 for the online survey.

Table 1: Maximum WTP for erosion prevention

Maximum Willingness To Pay					
	Personal interviews (n=417)	Online survey (n=110)			
Erosion scenario year	2050	Total sample	2020	2050	2100
Average of positive responses (WTP>$0)	117.81	94.55	102.43	111.14	70.75
Percentage with $0 WTP	43.2	39.1	34.9	37.1	50.0
Average including NO responses	66.64	57.59	66.70	69.86	35.38
Median of positive responses (WTP>$0)	50.0	50.0	50.0	40.0	50.0
Maximum	5000	1000	1000	1000	200

Sample selection

Typically a survey sample will be drawn from a known population, using methods such as random or stratified-random sample selection. In the case of beach visitation in Sydney, there is insufficient information on the existing patterns of information to inform this process. Even the number of visitors to beaches is unknown in most cases, notwithstanding estimates available from proxy sources such as parking records and public transport ticket sales. Hence it is almost impossible to design a sample selection process which accurately reflects beach visitation, as this would require detailed socioeconomic information on the current visitors. The authors are currently undertaking an ancillary study which seeks to use software analysis of surf camera imagery to obtain objective and reliable beach visitation data. This will then be used to develop a model of beach visitation

In the absence of this information, a random-intercept model was employed, whereby all groups of beach visitors encountered whilst moving along the length of the beach were approached and asked to participate in the survey. In the case of a group, the person who had the most recent birthday was asked to participate. There are a number of other sources of bias in the use of this sample selection process. Some of these are inherent in the survey process and are common to all surveys, whilst others are specific to surveys of beach visitors.

Self selection poses a problem for surveys, in that only those with sufficient interest in the survey topic will participate, regardless of the mode of administration. This is true even though beach visitors were not interviewed more than once over the survey period, and the online survey could only be completed once per computer IP address.

Frequent beach visitors and those who spend longer at the beach are more likely to be sampled by the random-intercept survey, simply by virtue of the fact that they chance of interception is increased. The proportion of visitors from different zones can be approximated by their travel times, as shown in Figure 4 below. This figure shows a large number of respondents with very short travel times, indicating they are likely to live in the local area and be avid beach users.

This has the potential to bias the results of the survey, as it can be expected that these frequent visitors will have a greater 'attachment' to the beach, and also a greater vested interest in the preservation of the beaches, as the same proportional damage (i.e. ten percent loss of beach days in the erosion scenario) will represent a greater absolute loss of beach days.

Conversely, those who spend the majority of their time in the water are less likely to be sampled, as they pass through the 'survey zone' rapidly. This means that some of the more avid beach user groups, namely surfers and ocean swimmers, are unlikely to be sampled in high numbers. This exclusion is complicated by the timing of beach visitation, as these user groups typically visit in the early morning and late afternoon. This can present logistical challenges for those conducting the surveys.

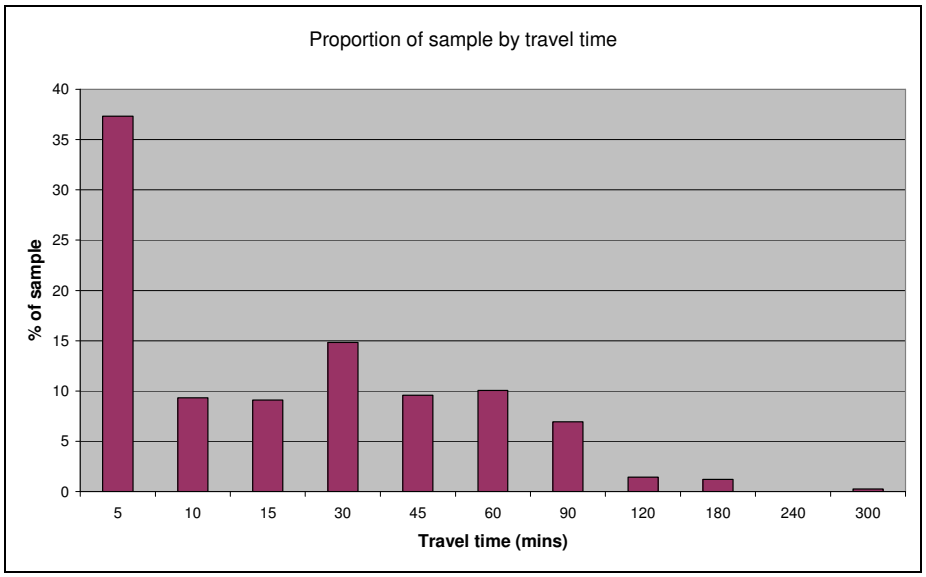

Figure 4: Proportion of respondents to personal interviews by travel time

For ethical reasons, we were unable to interview persons under the age of eighteen. As such, the average age of the sample is likely to have been biased upwards. This is a problem common to many surveys, but it may have a greater influence on the results of surveys relating to climate change impacts, and hence it is worthy of further discussion.

The erosion scenario employed in the personal interviews describes damages occurring in the year 2050. The average age of those who completed this survey was 40.5 years across all sites; hence in 2050 the average age of respondents to this survey will be approximately 81 years. Given the life expectancy of those born in 1965-67 (1968 was the average birth year of those who completed the survey) was 67.63 for males and 74.15 for females (ABS, 2008), it is unlikely that many of the respondents would witness the projected impacts firsthand. They therefore may consider that prevention of this damage is off less personal concern. Conversely, those who are most likely to be actively using the beach, young children, are not included in the survey. Whilst it is not practical to include young children in complex surveys of this nature, this is a serious sampling omission which should be considered in all surveys of climate change related attitudes and consideration of planning and management responses which employ this information.

It is also likely that the active use of the beach by the survey respondents will decline over the intervening time, due to decreased mobility. It can be presumed, therefore, that their Use Value of the beach resource will also decline. This decline may or may not be replaced by an increased personal preference for passive use (i.e. aesthetic appreciation of the beach landscape) or non-use values, such as a willingness to ensure that the beaches are preserved for future generations, including their own offspring.
The online survey instrument randomly allocated respondents to three separate groups which were told that the erosion would occur either in 2020,

2050 or 2100. This permits some exploration of the way in which the timing of the damages influences willingness to pay to prevent that erosion. Results of this exploration are shown in Table 1, although smaller sample sizes mean that the conclusions which can be drawn from these must be treated with caution.

The absence of pre-existing information about beach visitors also provides challenges in terms of the analysis of the results. It is difficult to know how representative a sample is of the broader beach-going population, without first knowing the demographic makeup of the population of interest. Hence the results below are presented in the absence of reference figures.

Administration

Personal interviews with beach users were conducted at the case study sites over the summer of 2008-09. A total of 430 personal interviews were completed at the three case study sites[3]. The numbers completed at Collaroy-Narrabeen, Manly Ocean Beach and the combined Brooklyn-Dangar Island estuarine site were 175, 148 and 96 respectively. These interviews used Mobile Computer Assisted Personal Interviewing (MCAPI) techniques, which involved programming surveys to be conducted on a Palm Treo 750 ® smartphone. The surveys were programmed using Entryware Designer 6.2[4], and deployed via Styletap for Windows Mobiles® in order to emulate the Palm OS® for which the software was developed.

The use of handheld computers is relatively new in environmental economics, although it is gaining popularity in other forms of market research. There are a number of advantages to using handheld computers over traditional paper-based interviewing formats. These include the ability to program branches into the survey based on previous responses. This allows for respondents to be asked only questions of relevance, thus shortening the survey and improving completion rates.

For example, an initial question about the mode of travel used to visit the beach classifies respondents into the following groups: those who travelled in a private vehicle, those who did not use a powered vehicle (walked, cycled etc.) and those who used public transport. Those who travelled in a private vehicle were then asked about their vehicle type and parking costs. Public transport users were asked about the cost of their tickets. Human-powered beach visitors did not get asked either of these question groups, and all then continued with questions about time spent in travel and onsite.

An additional benefit of computer assisted surveys is in greatly reduced times for data compilation and entry into statistical analysis programs. Data was automatically compiled and saved during the survey process, and could be converted and exported in appropriate formats for analysis once the handheld was synchronised with a laptop computer. An additional, unforseen advantage

[3] Not all respondents answered all questions, which is why the sample sizes in the subsequent tables may vary.
[4] Techneos http://techneos.com/content/Entryware-64-specifications

was the ability to undertake surveys in weather which would otherwise be challenging, such as on windy beaches.

A further 130 survey responses were gathered through the use of an additional online survey component, designed to replicate as closely as possible the personal interviews. (Online surveys were programmed and implemented using an academic license of EFS Survey ©)[5] In the online survey, people were asked which of the case study sites they had visited most recently. If they had not visited one of the beaches in the past twelve months, they were asked about their favourite beach. If they had not visited a Sydney beach in the past twelve months they were not included in the survey. This restriction was imposed as their recollection of the beach was likely to be diminished, which can influence the reliability of their responses.

Advances in internet survey software suggest a promising future direction for economic surveying, given the cost benefits of administration. However it is important to ensure that data quality is maintained and to assess whether responses are consistent between survey modes. Mixed-mode administration of the same survey instrument provides an opportunity to assess whether this is the case. Figure 5, below, shows that the samples from the two modes are selecting different beach users, as classified by their visitation frequency.

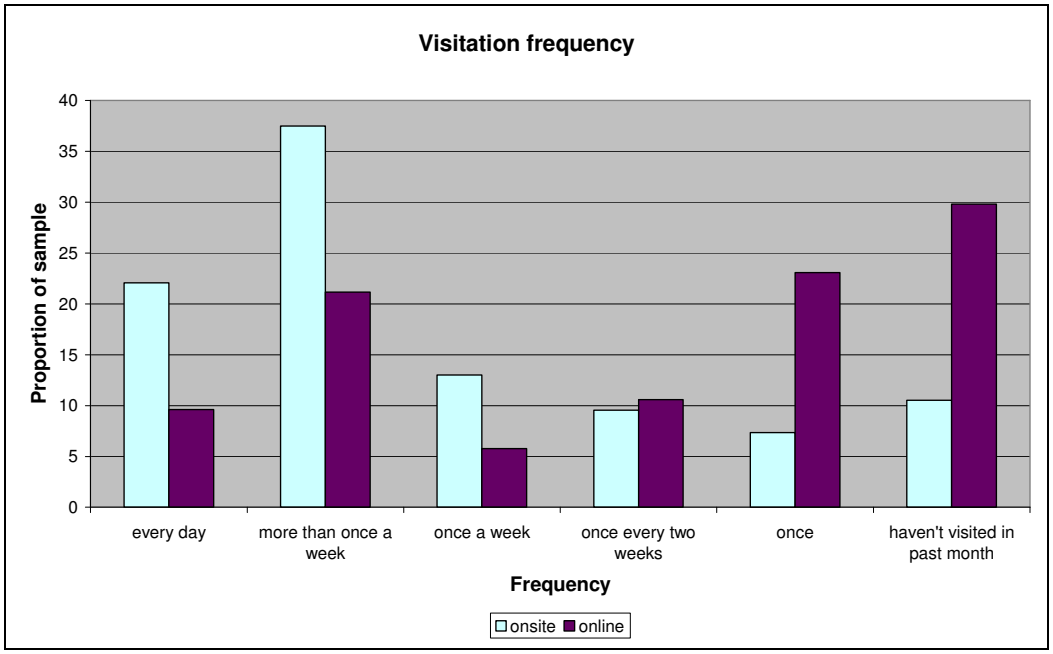

Figure 5: Visitation frequency by survey mode

Online surveys also allow for greater inclusion of supportive multimedia such as graphics and audio. In the case of this survey, links were provided to maps of beaches in the Sydney region, to assist those who could not remember the name of the beach they had most recently visited.

[5] Enterprise Feedback Suite, version 6.0, Globalpark AG http://www.globalpark.com/128-0-EFS-Survey.htm .

Non-economic data

The collection of survey responses allows not only quantitative analysis of existing beach recreation expenditure and willingness to pay to prevent beach erosion, but also qualitative information on the drivers behind these preference positions. Both survey instruments also collected quantitative information such as the motivation for beach selection, the response to visiting an eroded beach, and attitudes and beliefs with regard to climate change and coastal management. Some exemplar information is included in Table 2 below. This information is invaluable in both informing the selection of coastal management options, and also design of the Choice Modelling instrument to investigate these preferences further.

Table 2: Non-economic beach visitor descriptive information

Descriptor	Personal interviews	Online
Travel time (mins)	27.4	35.2
Onsite time (mins)	137.8	133.7
Experienced beach erosion at same beach	56	46.4
Group size (persons)	2.78	1.89
Nationality (% Australian or dual)	52.5	N/A
Gender (% male)	52.2	64.4
Average age (years)	38	44.9
Income (Average $1000 p.a.)	69.7	55
Full time employment (%)	41.9	56.7
Education - most common (%)	Undergraduate degree (30.4)	Postgraduate degree (54.8)

Conclusions

This paper presents a very brief summary of results from a survey of beach users in Sydney. This is the first survey of this nature, designed to be transferrable to other beach locations in NSW.

Preliminary analysis suggests that there is a wealth of untapped information both about the community of beach visitors, and within the cultural knowledge of beach visitors. For example, approximately half of all survey respondents indicated that they had experienced beach erosion before at the survey beach, with a further 37% of online respondents indicating they had experienced beach erosion at other beaches.

Approximately half of those beach visitors surveyed indicated that they would consider contributing to a beach management fund specifically designed to prevent erosion at their beach of interest. This indicates that there is a very strong desire to preserve beaches in response to projected climate change erosion impacts. It also makes the case for further research in this field.

Further analysis of the results of both the quantitative and qualitative information collected in this survey will provide critical inputs into the decision-

making process for selection of coastal management options in response to climate change impacts.

A full report of the results of the survey component, including a non-technical summary and the survey instruments, will be made available via the Sydney Coastal Council Group website in early 2010.

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