What's my beach worth? Economic values of NSW coastal assets

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Abstract

Investment in maintaining or protecting coastal assets requires an understanding of the value of the asset being protected. However, many of the benefits from coastal planning and management are not readily observed in the market place. Requirements for cost benefit analysis of coastal projects often requires estimates of these benefits to be made. Common practice is to use estimates of non-market values that have been derived for coastal assets elsewhere, a practice known as benefit transfer. While this is a valid approach, if undertaken correctly, identifying suitable or appropriate values remains a challenge, as relatively few studies of coastal asset values have been undertaken within Australia, and fewer still within NSW.

In 2016-17, a State wide survey of coastal residents was undertaken in order to derive appropriate economic values of coastal assets for NSW. The survey and subsequent analyses involved a range of innovative methods to produce estimates of asset values for a wide range of coastal assets, e.g. from sandy beaches to coastal scrubland, and within the marine environment values were derived for seagrass, rocky reefs and other marine habitats. In total, values for twelve different coastal habitats were derived.

The aim of this paper is to illustrate how these values could be used to aid coastal planning and management and decision making. The paper will also provide an overview of how these values were developed, as well as their limitations.

Introduction

Optimising the use of coastal natural resources and the marine estate requires management. There are numerous uses for these resources, some commercial and others for non-commercial activities. In some cases, management of these assets requires investment in appropriate infrastructure to either protect the resource or enhance its use. Hence management requires balancing uses and users, as well as ensure that the benefits of management exceed the costs.

While the physical cost of conservation and restoration activities are generally understood, the benefits of such activities are less visible. While some benefits of use can be easily quantified in monetary value, many others have non-monetary values that are often overlooked. These include the value to beach goers of beach restoration, or the value of marine parks to residents who are, in many respects, excluded from their direct use but still gain conservation related benefits from their protection.

Requirements for cost benefit analysis of coastal projects often requires estimates of these benefits to be made. Placing appropriate values on these uses and assets is complex, although a range of tools have been applied to address this issue. Most traditional environmental valuation methods (e.g. choice experiments) can only practically estimate a relatively small number of values, while the potential range of assets that need to be considered is substantially greater.

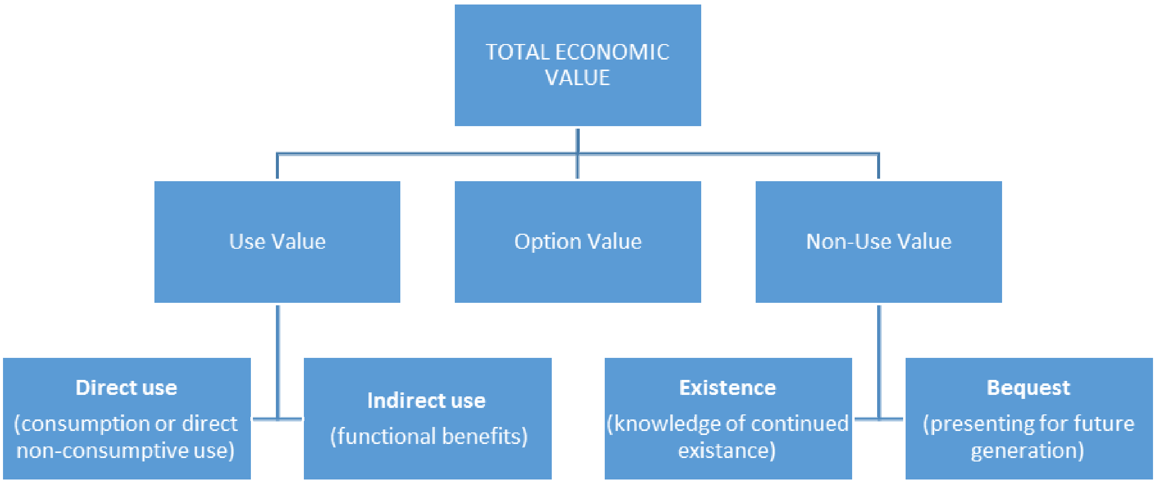
To overcome this limitation common to many non-market valuation techniques, we combine different economic and multi-criteria approaches to estimate a wider range of NSW coastal asset values that can be broadly applicable for coastal planning. The assets that are considered most important in terms of management needs are assessed using standard economic valuation techniques (i.e. by using a choice experiment). The relative importance of other coastal assets are assessed using multi-criteria preference elicitation techniques, which form the basis of the value extrapolation to these assets. From these, we can derive a value of a coastal reserve given information on the composition (in hectares) or each of the different major habitats or features.

In this paper, we provide a brief overview of the methods to derive the values, but focus on the derived values themselves and how they may be used in estimating the value of coastal assets.

Methods

Environmental assets, such as coastal assets, produce a wide range of ecosystem services (ES). These can largely be considered to provide either use values or non-use values (Figure 1). Use values are benefits that humans derive from the environmental asset through some form of interaction with the asset. Use values may derive from either direct use such as beach visitation, or indirect use such as seagrass habitats supporting fish populations that benefit commercial or recreational fisheries. Environmental assets also produce non-use values (Figure 1). These are usually based around knowledge that the asset exists even if it is never to be experienced directly, or the value given to ensuring an environmental asset continues to exist for use by future generations. This latter value differs from option value, which relates to potential future uses by the current generation.

Figure 1. Total economic value framework



Environmental assets may provide several values simultaneously. For example, beaches provide recreational use, but also provide other ecosystem services such as habitats for some coastal species with conservation values, or may offer protection to sensitive associated habitats from storms. Linking environmental assets to the ecosystem services they generate has become an important part of environmental valuation (Fisher, Turner, & Morling, 2009).

Deriving the economic value of these services requires the use of non-market valuation techniques. The study involved three main techniques, each of which provided different types of information about the values around coastal assets. The first technique – the Analytic Hierarchy Process (AHP) – is an approached developed in multicriteria analysis to determine the relative importance of a range of factors. The second approach – the use of a choice experiment – is a commonly applied non-market valuation technique, and is used to derive economic values associated with a subset of key assets. Finally, the travel cost method is used to estimate use values relating to beach visitation in particular.

AHP has been used in a number of marine and coastal applications to determine management objective importance and assist in decision making (Baby, 2013; Himes, 2007; Leung, Muraoka, Nakamoto, & Pooley, 1998; Mardle, Pascoe, & Herrero, 2004; Nielsen & Mathiesen, 2006; Pascoe, Bustamante, Wilcox, & Gibbs, 2009; Pascoe, Dichmont, Brooks, Pears, & Jebreen, 2013; Pascoe, Proctor, et al., 2009; Soma, 2003; Premachandra Wattage & Mardle, 2005), and is the most common approach used for preference elicitation in a wide range of applied natural resource case studies. AHP is based upon the construction of a series of pair-wise comparison matrices which compare sub-components to one another, and a hierarchical structure that groups similar sub-components into subgroups, and builds the hierarchy with progressive layers of groupings. The pair-wise comparison method makes the process of assigning relative importance values much easier for participants because only two sub-components are being compared at any one time rather than all sub-components having to be compared with each other simultaneously.

The relative weights derived from the pairwise comparisons represent the individual's relative preferences for the different assets. The approach draws upon two well established premises in economics. First, that an individual's relative preference for an asset relates to the relative utility that the individual receives from the asset (Arrow, 1963); and second, that economic value also reflects relative utility (Debreu, 1959). Given these two premises, we can assume that the relative preferences derived from the AHP analysis also reflect the relative value of the assets to the individual.

Quantitative estimates of the economic value of a sub-set of key assets was undertaking using a choice experiment (CE), a stated preference approach. These approaches have been well established for valuing environmental assets (Hanley, Wright, & Adamowicz, 1998) and numerous examples of such approaches in the coastal zone and marine environment exist (Beharry-Borg & Scarpa, 2010; Huang, Poor, & Zhao, 2007; Maguire, Miller, Weston, & Young, 2011; Marre et al., 2015; Wallmo & Edwards, 2008; P. Wattage et al., 2011; Windle & Rolfe, 2005). Participants in a CE make choices from a set of alternatives which may contain varying levels of several assets. Their responses are then used to estimate economic values for various attributes that define each alternative. This methodology is centred on the fundamental microeconomic concept of utility maximization given budgetary constraints.

The use of travel cost models for estimating the non-market use value of environmental amenities is also well established (Mendelsohn & Olmstead, 2009). It has been applied to a wide range of areas, including tourism values of lakes and wetlands (Fleming & Cook, 2008; Gürlük & Rehber, 2008), coral reefs (Ahmed, Umali, Chong, Rull, & Garcia, 2007; Andersson, 2007), biodiversity and national parks (Chae, Wattage, & Pascoe, 2012; Heberling & Templeton, 2009; Larsen, Petersen, Strange, Lund, & Rahbek, 2008), recreational fishing (Alberini, Zanatta, & Rosato, 2007; Prayaga, Rolfe, & Stoeckl, 2010; Rolfe & Prayaga, 2007; Shrestha, Seidl, & Moraes, 2002), and – most relevant to this study – beach visitation (Bin, Landry, Ellis, & Vogelsong, 2005; Blackwell, 2007; Pendleton, Kildow, & Rote, 2006; Rolfe & Gregg, 2012; Windle, Rolfe, & Pascoe, 2017; Zhang, Wang, Nunes, & Ma, 2015).

Underpinning the travel cost method is the estimation of the recreational demand function, from which consumer surplus estimates can be derived. Consumer surplus – the measure of non-market economic benefits to the fisher – is the difference between what the fisher would be (theoretically) willing to pay to go fishing and what they are actually required to pay. The travel cost approach does not ask willingness to pay directly, but imputes it from the observed behaviour of other beach visitors through an estimated demand function, which relates the number of observed trips to the travel cost incurred. The demand function is estimated at an individual level, and assumes that fishers with similar characteristics will respond to the "price" of accessing the beach (i.e. the cost of the trip) in similar ways.

A survey of 1400 NSW coastal residents was undertaken in December 2016 and January 2017 to collect the data for the study. The survey collected information to asset the relative value of 12 coastal and marine assets (e.g. sandy beaches, mangroves and seagrass) using the AHP, and to assess economic values on key shoreline assets (sandy beaches, headland/rocky shore and sand dunes/adjacent scrubland) using a choice experiment. The data were also used to derive travel cost models, from which estimates of use value could be derived.

Results

Relative asset values (AHP)

Twelve different coastal assets were assessed using the AHP framework; three in each of four major groups – Shoreline (sandy beach, headland, rocky shore), Backshore (sand dunes, scrub lands, lakes), Intertidal (estuary, saltmarsh, mangroves) and Aquatic (seagrass, rocky reef, sandy seabed). These twelve assets were chosen during a workshop with key coastal and marine resource managers as priority marine assets for consideration.

The distribution of preferences for the main asset groups is shown in Figure 2. As expected, there was a broad distribution, with a slightly higher preference for shoreline assets and the lowest preferences generally being for the intertidal assets. The final distribution of preferences across all assets is shown in Figure 3. As can be seen, there is considerable variation in the relative weights for each asset, with the greatest absolute variation – and median value – for sandy beaches.

Figure 2. Distribution of preferences for the main asset groups

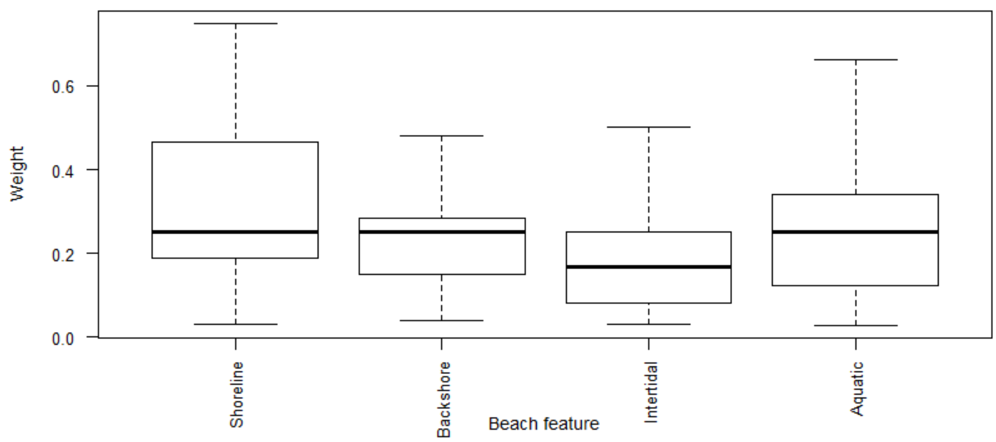
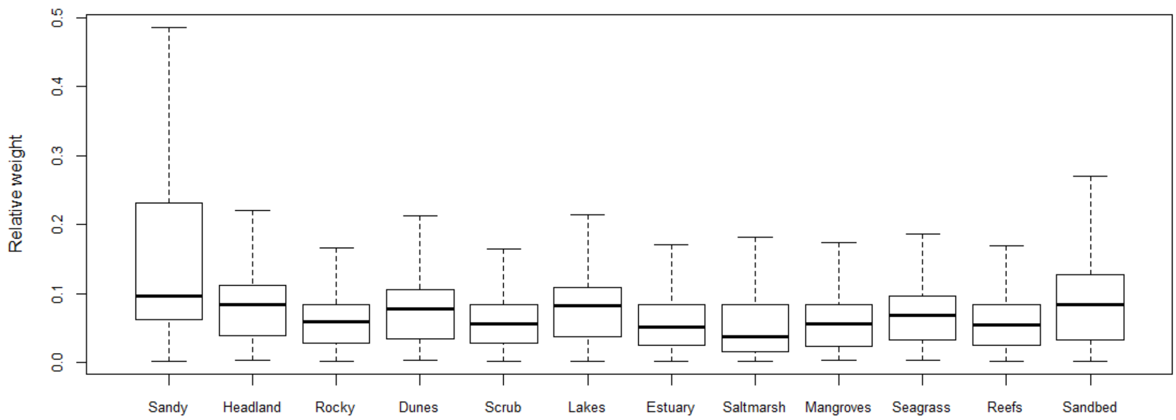


Figure 3. Distribution of preferences for individual coastal and marine assets



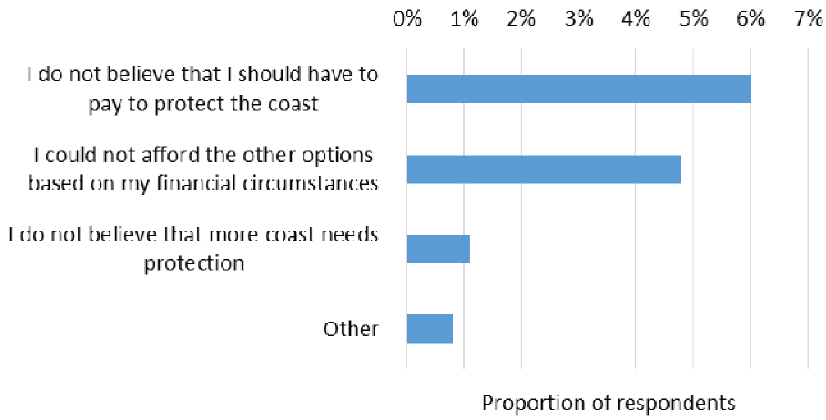
The preference weights derived through AHP represent values between 0 and 1. To derive relative preferences, we divide the weights of each asset by the weight for sandy beaches. As a result, we end up with a preference that reflects the value of the asset relative to the value of sandy beaches. This was chosen as the base asset as it is most familiar to most individuals who have visited the coast, and for this reason is also used as one of the key assets in the choice experiment. It is also the asset that had the highest median preference, and generally a higher preference by most individuals.

Non-use economic values

A choice experiment was also undertaken to elicit economic values for a subset of the assets, including a combination of shoreline and backshore assets as it was considered that these were the types of assets most people would be familiar with. Survey respondents were presented with a hypothetical scenario: the local council was considering creating a new coastal reserve and had several alternative options. Each option involved different combinations of coastal assets to be protected and involved different costs, which would result in a different level of a new levy to be collected through the current council rates system. Respondents were asked to choose between several alternative coastal protection options (including the option of choosing to not develop a reserve), each with different cost implications and different combinations of assets protected. The reserve, if developed, would not change the use of the area, but would ensure its protection into the future. The derived values, therefore, reflect the non-use value of the asset, and also reflects the value of the ecosystem services it generates.

Across the State, 87% of respondents indicated a willingness to contribute to an additional levy collected by local councils for coastal protection. For those who were not willing to contribute to coastal conservation, in the majority of cases this represented a "protest vote", in that the respondent either did not believe they should have to pay to protect the coast or that coastal protection was not needed (Figure 4). Around four percent of respondents, however, claimed to be unable to afford an additional cost for coastal protection. Within a given budget, coastal protection for this group was considered a low priority, reflecting a low (or zero) value.

Figure 4. Reasons why respondents unwilling to contribute to coastal conservation



The derived willingness to pay estimates from the choice experiment modelling are presented in Table 1. A range of variants of the model were assessed. The model excluding protest responses, and with a separate value for Sydney residents, was found to have the best fit to the data. Details on the final econometric model are presented in the Appendix.

The quarterly values in Table 1 represent the amount each household is willing, on average, to contribute to coastal protection each quarter through the current rates mechanism. The net present value (NPV) represents the discounted sum of these values over time, reflecting the full asset value to the households. Consistent with the AHP results, the beach area attracts the highest value. The analysis suggests that Sydney residents place a lower protection value on the coastal assets than non-Sydney residents, all other things being equal.

Table 1. Estimated average willingness to pay from the choice experiment

Coastal Asset	Sydney residents		Non-Sydney residents	
	$/ha/quarter	NPV $/ha/ household	$/ha/quarter	NPV $/ha/ household
Beach	$0.45	$44.67	$1.15	$115.18
Dunes and scrubland	$0.28	$28.16	$0.85	$84.86
Headlands and rocky shores	$0.20	$19.80	$0.64	$64.45

Combining the AHP and choice experiment results

The preferences measured in the AHP reflect relative utility and hence reflect the relative value of the coastal assets to the individuals. These relative value can be expressed as a dollar value by multiplying the relative value from the AHP by the beach value estimated from the choice experiment (Table 1). Only beach value was used to extrapolate for the other values as this was the dominant value for both the AHP and the choice experiment, and the estimated value was relatively robust in the different model estimates.

The final derived values are presented in Table 2. As noted above, Sydney residents place a lower non-use value on coastal conservation than residents outside of Sydney.

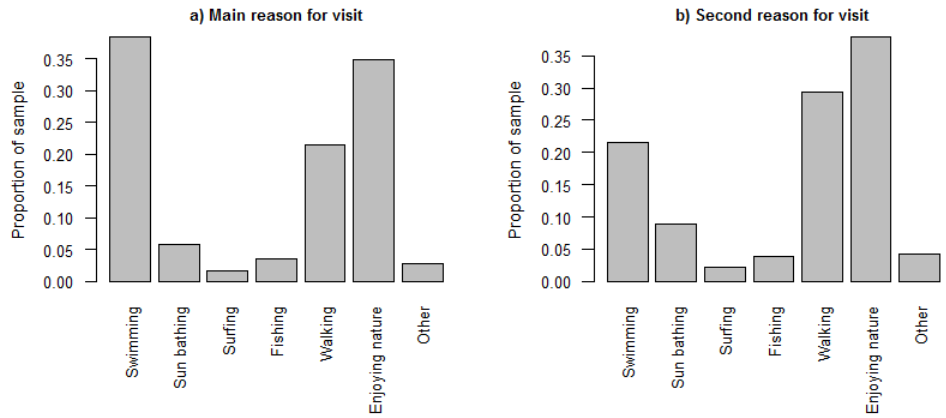
Table 2. Derived values per hectare per household

Basis of value	AHP	Choice experiment: All NSW residents	Choice experiment: Sydney residents	Choice experiment: Non-Sydney residents
Sandy Beach	1.000	$88.47	$44.67	$115.18
Headland	0.794	$70.22	$35.45	$91.42
Rocky shoreline	0.474	$41.96	$21.19	$54.63
Dunes	0.699	$61.87	$31.24	$80.56
Adjacent Scrubland	0.568	$50.27	$25.38	$65.45
Freshwater Lakes	0.777	$68.75	$34.71	$89.51
Estuary	0.467	$41.29	$20.85	$53.75
Saltmarsh	0.358	$31.71	$16.01	$41.28
Mangroves	0.529	$46.78	$23.62	$60.90
Seagrass	0.751	$66.43	$33.54	$86.48
Reefs	0.556	$49.15	$24.82	$63.99
Sandy Seabed	0.801	$70.85	$35.77	$92.24

Use values

The main use values considered in the study were recreational beach use. Survey respondents visited the beach for a range of reasons, the main reasons being swimming, walking and enjoying nature (Figure 5).

Figure 5. Reasons for beach visitation



The economic non-market value of these visits was estimated using the travel cost method, which is based on the frequency of visits and the cost of each visit. A range of different types of models were estimated, including a range of different assumptions about the travel costs. Details on the final econometric model are presented in the Appendix. From these models, the most appropriate values were found to be \$38.41/trip for non-Sydney residents and \$48.20/trip for Sydney residents.

How do we use this information in a cost-benefit analysis?

The implications of these values for estimating coastal asset non-use values in a range of different coastal local government areas (LGAs) of NSW are shown in Table 3. The relatively high values for some regions (e.g. Tweed) are a reflection of both the higher value placed on these assets and a relatively high population. In contrast, an iconic beach such as Clarkes Beach in Byron Bay would have a low non-use value due to the low resident population. Within the Sydney region, iconic beaches such as Bondi also attract a relatively low non-use value compared with other beaches in the Northern Suburbs due to the lower resident population.

The total potential non-use value of a coastal region will depend on the area of each asset being protected as well as the population of the LGA within which it is based. This latter factor reflects the likely willingness of households within the LGA to fund conservation of the coastal area. While this may undervalue the asset to some extent, as households outside the LGA may also gain non-use value from its conservation, it establishes a first level test as to the likely net benefits (or costs) of conservation work undertaken by the council using funds collected from local residents. If conservation costs are less than the non-use values, then a net benefit is obtained to the local residents. If costs are greater than the non-use values of the local residents, then additional funding may be sought if conservation values are believed to extend beyond the LGA.

Table 3. Derived non-use values per hectare in a range of NSW coastal regions ($m/ha)

	Sydney coastal regions			
	Waverly	Manly	Warringah	
Households	32,300	18,050	58,300	
Sandy Beach	$1.44	$0.81	$2.60	
Headland	$1.15	$0.64	$2.07	
Rocky shoreline	$0.68	$0.38	$1.24	
Dunes	$1.01	$0.56	$1.82	
Adjacent Scrubland	$0.82	$0.46	$1.48	
Freshwater Lakes	$1.12	$0.63	$2.02	
Estuary	$0.67	$0.38	$1.22	
Saltmarsh	$0.52	$0.29	$0.93	
Mangroves	$0.76	$0.43	$1.38	
Seagrass	$1.08	$0.61	$1.96	
Reefs	$0.80	$0.45	$1.45	
Sandy Seabed	$1.16	$0.65	$2.09	
	Non-Sydney Coastal LGAs			
	Eurobodalla	Byron	Coffs Harbour	Tweed
Households	16,544	11,197	27,614	35,882
Sandy Beach	$1.91	$1.29	$3.18	$4.13
Headland	$1.51	$1.02	$2.52	$3.28
Rocky shoreline	$0.90	$0.61	$1.51	$1.96
Dunes	$1.33	$0.90	$2.22	$2.89
Adjacent Scrubland	$1.08	$0.73	$1.81	$2.35
Freshwater Lakes	$1.48	$1.00	$2.47	$3.21
Estuary	$0.89	$0.60	$1.48	$1.93
Saltmarsh	$0.68	$0.46	$1.14	$1.48
Mangroves	$1.01	$0.68	$1.68	$2.19
Seagrass	$1.43	$0.97	$2.39	$3.10
Reefs	$1.06	$0.72	$1.77	$2.30
Sandy Seabed	$1.53	$1.03	$2.55	$3.31

Use values provide an additional source of benefits if the coastal assets are actively used by local residents. The travel cost based estimates of consumer surplus per trip can be multiplied by the number of trips to provide an estimate of the annual use value. An example of these values for a range of Sydney and non-Sydney beaches is given in Table 4. An assumption made in the estimation of the total value in Table 4 is that trips to Sydney beaches are made by Sydney residents, while trips to non-Sydney beaches are made by non-Sydney residents. While this is not likely to be true in all cases, the likelihood of beach visitation decreases with distance ((Swait, Ardeshiri, Caire, & Cong, 2017)), so that the majority of visitors will be relatively local.

Table 4. Examples of use values for a range of beaches

	Total visits/year[1]	Average group size[1]	Total trip/years	Value/trip	Total value ($m)
North coast					
Byron Bay	161,337	3.4	47,452	$38.41	$1.82
Lennox Head	62,500	3.1	20,161	$38.41	$0.77
Wooli	18,237	3.0	6,079	$38.41	$0.23
Mid-North coast					
Port Macquarie	170,098	3.5	48,599	$38.41	$1.87
Central coast					
Terrigal	571,250	3.4	168,015	$38.41	$6.45
Sydney region					
Narrabeen	603,932	3.3	183,010	$48.20	$8.82
Collaroy	140,858	3.2	44,018	$48.20	$2.12
Manly	1,925,576	3.4	566,346	$48.20	$27.30
Bondi	3,013,635	3.4	886,363	$48.20	$42.72
South coast					
Batemans Bay	65,377	3.5	18,679	$38.41	$0.72
Moruya	7,696	3.2	2,405	$38.41	$0.09

1. Derived from Swait et al. (2017)

Using the use values in a cost benefit analysis of coastal protection needs some estimate as to how these values will change. For example, if a coastal protection activity does not change the level of use, then no additional use value is generated. Similarly, when considering the non-use values, only those assets that are at risk without the conservation activity need to be included in the cost-benefit analysis. For example, activities that are aimed at protecting sand dunes will have no impact on headlands or seagrass, so the non-use values of the latter would not be included in the benefit estimation. In contrast, coastal erosion protection may result in dunes and in some cases hind-dune features such as scrubland or water bodies being protected (not to mention the real estate which is generally the main goal of the protection), so all of these would be considered in the estimate of benefits.

Conclusions

The aim of the study was to develop values for coastal and marine assets that may be of use for undertaking cost-benefit analysis for coastal conservation and/or protection. These projects are largely undertaken at the coastal council level, so assessing the benefits to the local residents/rate payers is appropriate in the first instance. An assumption is made that all rate payers will benefit from the conservation activities, with LGAs with larger populations having more beneficiaries and also a higher capacity to fund conservation activities through a higher rates income.

The values derived provide a minimum estimate of the asset values, as value is also held by non-residents. A key result from the study is that 87% of NSW coastal residents are prepared to pay for coastal conservation, and not all of these live in coastal councils. However, a mechanism to capture some of this willingness to pay by local councils is limited to their local residents. For projects where the benefits to local residents clearly exceeds the cost, then councils' use of local council revenue is appropriate. For projects where the local benefits do not exceed the costs, but benefits to a broader population are expected, other sources of revenue should also be considered that target non-residents (e.g. bed taxes, parking fees, special rates levies) or, where it is not feasible to target non-residents, through general taxation revenue.

Use values, while considerably larger than non-use values, do not necessarily affect the benefits of coastal protection unless this affects the level of use. For example, the scenarios included in the choice experiment were assumed to not affect the level of use. In some cases, coastal protection may increase or decrease visitations. For example, a marine reserve adjacent to a beach may reduce recreational fishing visits but increase visits of divers. Including these values into the cost-benefit analysis requires some assumptions as to how recreational use will change with the coastal protection activity.

Acknowledgements

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Appendix: Final econometric models

Non-use values: choice experiment

The main econometric modelling approach used was the mixed logit model. A nested logit model was also initially tested, but a Hausman test (Hausman, 1978) for the independence of irrelevant alternatives (IIA) found that this assumption was violated by excluding option 1 ($\chi^2 = 52.68$), suggesting that the nested logit model is problematic. A feature of the mixed logit (or random parameters) model is that it allows for heterogeneity in preferences, and estimates this as an additional set of parameters (the standard deviation around the coefficient). The model can also allow for the panel nature of the data, so that it takes into account the full set of choices of each individual.

Several different variants of the model were estimated. The "best" model was that with an interaction term on the choice variables to capture differences between the values of Sydney residents and non-Sydney residents. The results are presented in Table 5.

Table 5. Mixed logit (Random parameters) model results with Sydney resident interactions

	Coefficient	Standard Error	z	sig
Random parameters in utility functions				
Sandy beach (ha)	0.053	0.002	28.430	***
- Sydney interaction	-0.032	0.003	-10.220	***
Dunes and scrubland (ha)	0.039	0.002	19.960	***
- Sydney interaction	-0.026	0.004	-7.420	***
Headland and rocky shore (ha)	0.030	0.002	14.720	***
- Sydney interaction	-0.020	0.003	-6.290	***
Cost ($/household/quarter)	-0.046	0.002	23.280	***
Non-random parameters in utility function				
ASC	0.917	0.258	3.550	***
Male	0.053	0.116	0.460	
Age	0.002	0.004	0.540	
Sydney	-2.420	0.258	-9.360	***
Income	-0.004	0.001	-3.220	***
NSW National Park annual pass	-0.530	0.211	-2.510	**
Environmental group member	-0.754	0.299	-2.520	**
Distance from beach	-0.002	0.001	-1.800	*
Distribution of random parameters (standard deviations)				
Sandy beach	0.053	0.002	28.430	***
- Sydney interaction	0.032	0.003	10.220	***
Dunes and scrubland	0.039	0.002	19.960	***
- Sydney interaction	0.026	0.004	7.420	***
Headland and rocky shore	0.030	0.002	14.720	***
- Sydney interaction	0.020	0.003	6.290	***
Cost	0.046	0.002	23.280	***

***, **, *: Significance at 1%, 5%, 10% level

Willingness to pay estimates are derived by $WTP = -\beta_i / \beta_c$ where β_i is the coefficient of the attribute of interest and β_c is the coefficient of the cost variable. The model also provides an indication as to which groups are more likely to be willing to contribute to coastal protection. From the model results, older individuals were more likely to choose the "none" options (i.e. less likely to choose one of the reserve options), while the likelihood of choosing one of the reserve options increased with being male, income, national park annual pass ownership and membership of an environmental group.

Distance from the coast was positive but not a significant factor affecting the choice of a reserve option. This suggesting that people further from the coast value it less than those who live closest, but the result was not statistically significant.

Travel cost model

Initial model estimation using the Poisson distribution found significant overdispersion (a common problem with travel cost models), suggesting that a negative binomial model was more appropriate. However, as the proportion of zero trips in the data was high, zero inflation approaches were required. Two alternative approaches are available to estimate the models given a high percentage of zero trips. The first assumes that the excess presence of zeros is a sampling issue, and estimates the probability of a true or false zero as well as negative binomial model (the zero-inflated mixture model). The second approach (the hurdle model) is a two stage model that first estimates the probability that a trip would be undertaken, then estimates the truncated negative binomial for those trips that are undertaken (Zuur, Ieno, Walker, Saveliev, & Smith, 2009).

The hurdle model performed marginally better than the mixture model (based on the AIC). While the survey sample targeted residents who lived in coastal regions (largely defined by postcode), some residents reported living more than 100km from the coast, and it is likely that any trip to the coast from these residents would be atypical of the usual coastal use (i.e. potentially stay overnight, or undertake multiple activities on the trip). Swait et al. (2017) found that the proportion of day-trips to the beach declined substantially after 40km from the coast, with only 30 per cent of beach visitors undertaking a day trip at 100km distance and 15 per cent at 150km; the rest of the beach visitors taking either an overnight or multiday trip. To test the impact of this on the estimated consumer surplus, trips of greater than 100km (each way) were excluded The final model results used in the analysis are given in Table 6.

Table 6. Zero inflated hurdle models restricting observations to within 100km of the coast

	Estimate	Std. Error	Significance
Count model coefficients (negative binomial with log link):			
Intercept	7.381	0.142	***
Travel cost	-0.026	0.006	***
Household size	-0.634	0.014	***
Age	-0.014	0.002	***
Sydney	0.255	0.056	***
Income	0.003	0.000	***
Log(theta)	0.866	0.065	***
Zero-inflation model coefficients (binomial with logit link):			
(Intercept)	1.957	0.207	***
distance	0.040	0.010	***
Sydney	-0.259	0.245	
AIC	6698.98	5.217	
WTP (rest NSW)	$38.41		
WTP (Sydney)	$48.20		

***, **, *: Significance at 1%, 5%, 10% level

The hurdle model implies a two stage process. The first stage is the likelihood that an individual will not take any trips. From the zero inflation model coefficients, this probability increases with distance from the coast, and is lower for residents from Sydney. The second stage estimates the number of trips will be taken (given that at least one trip is taken). From the count model coefficients, this decreases with cost, household size and age of the respondent, and increases with income and for respondents living in Sydney.

Willingness to pay estimates are derived by $WTP = -1/\beta_c$ where β_c is the coefficient of the travel cost variable.

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