Valuing Beach Recreation Across a Regional Area: The Great Barrier Reef in Australia

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Abstract

The focus of the research reported in this paper has been to estimate recreation values for beaches over approximately 1400 kilometres of coastline along the Queensland coast. The study is notable at an international level because it assesses recreation values to a general type of recreation asset rather than to a specific site, and because it focuses on the values of the local resident population. Negative binomial models have been used to estimate both the visit rate and recreation values associated with beach visits in different regional areas. The value of a single beach visit was estimated per person at $35.09, which extrapolates to $450 million in beach recreation values per annum. These values are likely to be conservative because opportunity costs incurred to live closer to the beach (e.g. housing premiums) have not been assessed. Contingent behaviour models were used to estimate the values of potential declines in water quality, with marginal effects assessed at $1.30 per recreation trip to avoid each 1% decline in water quality.

Keywords: Recreation, Travel Cost Method, Beach, Contingent behaviour

1. Introduction

In Australia, as in many other countries, beaches are some of the most important recreational assets available, providing services to local residents, domestic tourists and international tourists. Retschlag (1999, as reported by Blackwell 2007) estimated that in 1999 Australians took approximately 171 million day trips to the beach, or approximately 9 day trips per person annually, while Beeton *et al.* (2006) and DEWHA (2006) reported that Australian residents took about 17.6 million overnight trips to the beach in 2004. The maintenance of beaches in good condition and appropriate access and safety are important goals for local authorities and other public bodies responsible for natural assets and public safety. While beach recreation is a core activity in the Great Barrier Reef (GBR) area (GBRMPA 2009), no studies of beach recreation values for the GBR can be identified that would allow policy makers to assess the values of changes in beach access or beach condition.

Some estimates of the value of beach use have been generated with non-market valuation techniques in other locations. There have been a number of north American studies valuing saltwater beach recreation as summarised in Lew and Larson (2008). For example, Bell and Leeworthy (1990) identified the daily consumer surplus for tourists to visit Florida beaches was $34/day (in US 1990 dollars), Leeworthy and Wiley (1993) estimated values at different Californian beaches between $8.16 and $146.07 per person per day (in US 1989 dollars), Bin et al. (2005) estimated the value of day trips to seven North Carolina beaches to be between $11 and $80 (in US 2003 dollars) and Lew and Larson (2005) estimated the mean value of a beach day in San Diego to be $28.27 per day (in US 2001 dollars). In Australia, Blackwell (2007) reported an application of the travel cost method to beach visits along the Sunshine Coast in southeast Queensland and in Western Australia, where the mean annual visit rate to beaches was 48 visits. Consumer surplus for beach trips by residents (locals) was estimated to be $17.51 per person per visit (in Australian 2000 dollars).

Travel cost methods are most easily applied to discrete and well patronised sites that lie some distance from population centres, so that the visiting population can be easily identified along with the opportunity costs incurred to access the site. In contrast, beaches are usually a common feature along coastlines with some adjacent to major population centres, meaning that it is often difficult to identify the visitor groups and the access costs for specific beaches or groups of sites, and to deal with the heterogeneity in visit and use patterns. As well, beaches are a recreation asset where avid users often prefer to live closer so that they have lower access costs, meaning that the full opportunity costs of access are difficult to assess (Randall 1994, Bell and Leeworthy 1990). Additional challenges are to identify how visit rates and recreation values may be sensitive to beach conditions (Ballane et al. 2000).

In this study, the challenges of valuing beach access have been addressed by conducting a survey of residents within 50km of the shore along more than 1,400 kilometres of the Queensland coastline. The area of interest is along the coastline adjacent to the Great Barrier Reef (GBR), so that the survey allowed estimates of beach access values for the local population in the region. Key challenges are to estimate visit rates and values for this visitation to beaches adjacent to the Great Barrier Reef at the local and regional level.. An additional challenge was to estimate contingent values for hypothetical possible changes in beach condition in the near future.

The paper is organised as follows. In the next section, the estimation methods are outlined, followed by details of the case study and data collection. The models to estimate participation and recreation demand are reported in sections four and five, and contingent behaviour models to assess values with changed water quality in section six. Final conclusions are presented in section seven.

2 Methods

2.1 Travel cost method

As the prices of many recreation activities are not revealed directly in market transactions, non-market valuation techniques have been developed to assess the consumer surplus involved. Since the development of the TCM in the 1960s, the collection of information about the opportunity costs of visiting recreation sites has been widely used to assess the recreation values at those sites (e.g. Hanley and Spash 1993; Garrod and Willis 1999; Ward and Beal 2000, Haab and McConnell 2002; Shrestha *et al.* 2002; Rolfe and Dyack 2010). Two basic variants of the technique depend on whether the visit rate to a recreation site, as the dependent variable, is defined in terms of a population group (the zonal model) or as an individual (the individual model). The zonal model is appropriate for sites that have very low individual visitation patterns, while the individual model is appropriate for sites that have high individual visitation rates (Haab and McConnell 2002). The TCM is often preferred over other approaches, such as stated preference techniques, because it uses real data from market transactions, and there is less potential for different biases to be involved (Haab and McConnell 2002).

Earlier applications of the TCM employed standard regression techniques to identify the relationship between visit rates and independent variables such as travel costs and population characteristics. Because the visit rate data is typically composed of non-negative integers that are left-truncated at zero visits, count data models such as the Poisson and Negative Binomial (which are non-negative and are integer-valued) are more appropriate ways of modelling the data (Creel and Loomis 1990, Hallestein and Mendelsohn 1993, Haab and McConnell 2002). In the Poisson model, the probability of an individual taking y trips can be modelled as (Hellerstein and Mendelsohn 1993; Haab and McConnell 2002):

$$\text{Prob}(y = n) = \text{Exp}(-\lambda) * \lambda^n / n! \qquad \ldots(1)$$

where λ is specified as a linear function of travel, site and respondent characteristics (*x*) and their associated coefficients (β). This accepts integer valued dependent variables and embodies the often restrictive assumption that the expected value of the counts is equal to their variance (Cameron and Trivedi 2005). An attractive feature of the model is that by assuming that the coefficient on travel cost is representative of cost tradeoffs, the consumer surplus per trip can be estimated as:

$$\text{CS/trip} = -1/\beta_{TC} \qquad \ldots(2)$$

The demand function for trips can be expressed simply in the following variate:

$$\lambda = \text{EXP}(\beta_0 + \beta_{TC} + \ldots \beta_n X_n) \qquad \ldots(3)$$

The equivariance assumption of the Poisson model is often violated in practice (Cameron and Trivedi 2005; Greene 2008), in particular because of over-dispersion (a wide range of costs associated with a single trip frequency). Negative bionomial models are a more general form of a count data model than the Poisson model, where the assumption about the equality of the mean and variance is relaxed by incorporating an additional error term to account for systematic differences (Haab and McConnell 2002). The quadratic-variance Negative Binomial model called the NB2[1] is the most widely used form in the TCM literature, and can be derived as a mixture of Poissons, or directly from Random Utility Theory (Cameron and Trivedi 2005). Tests for over-dispersion in the Poisson model are most easily undertaken via estimation of the NB2 model and undertaking a log-likelihood ratio test on the significance of the over-dispersion parameter, alpha.

Where data is collected from a population that includes both users and non-users (positive and zero visits), standard count data models can be applied. However data that is limited to users, whether it is collected on site or drawn from a population sample, is effectively truncated because it excludes the non-visitors.. The truncation of observations for which no trips are reported requires modification of the probability functions associated with the count

[1] The most common alternative, the linear variance NB model is referred to as the NB1 and is more common in the bio-statistics discipline than the NB2 model (Greene 2008)

process modelled, using the zero-truncated Poisson (ZTP) and the zero truncated Negative Binomial (ZTNB) models for the Poisson and NB2 models respectively.

2.2 Contingent Behaviour Models

Count data models can be extended with contingent behaviour data to estimate values for hypothetical changes in the conditions that impact on recreational activites (Englin and Cameron 1996, Cameron et al. 1996, Huang et al. 1997, Whitehead et al. 2000, Bhat 2003, Hanley et al. 2003 Rolfe and Dyack 2011). CB models can elicit information about scenarios that lie outside of observed historical values (Eiswerth *et al.*, 2000), while asking for a behavioural response may be more realistic to respondents than those involving cost tradeoffs (as in a choice experiment) (Rolfe and Dyack 2011). There are also advantages in that behaviour variables such as visit rates do not generate the payment vehicle problems involved in establishing WTP mechanisms, and there is more opportunity for tests of convergent validity between revealed preference and contingent behaviour data than for stated preference data which generally lacks a revealed preference comparison (Grijalva *et al.*, 2002; Rolfe and Dyack 2011).

The contingent behaviour data can be collected by asking respondents of a recreation survey about how their future visitation rates would change if there was some variation in the quality or quantity of the recreation asset. The resulting data set is in a panel format with multiple observations on each respondent varying by the environmental condition and the future visit rate. Pooling this contingent visit data with data on current visit rates and estimating subsequent count data models allows the analyst to estimate values for the marginal changes in the amenity provision and to elicit information about scenarios that lie outside of observed historical values (Eiswerth et al. 2000, Grijalva et al. 2002, Rolfe and Dyack 2011). Estimates of value for changes in environmental condition can be generated with the following formula :

$$\text{Marginal effects} = \beta_C \; * -1/\beta_{TC} \qquad \ldots(4)$$

where β_C is the estimated coefficient for the change variable of interest, and β_{TC} is the estimated coefficient for the travel cost variable.

3 Data collection and travel cost calculations

The population groups of interest in this study were those along the Queensland coast adjacent to the GBR (Figure 1). They included six regional cities (Bundaberg, Gladstone, Rockhampton, Mackay, Townsville and Cairns), as well as other smaller towns and settlements. Approximately 838,000 people are resident of the area, with 643,000 aged between 15 and 74 (OESR 2011), and have access to a number of different beaches along the coast. The valuation study involved a web-based survey of 1101 residents drawn from the relevant population groups. The web-based survey was conducted though a commercial market research firm with an appropriate database of residents in the region of interest. Previous research on recreation in Queensland (Fleming and Bowden 2009) and values for the GBR (Windle and Rolfe 2011) have validated data from on-line surveys as consistent with data from other collection methods. The survey collected data about beach visitation rates, the opportunity costs involved, the characteristics of respondents, and other relevant issues.

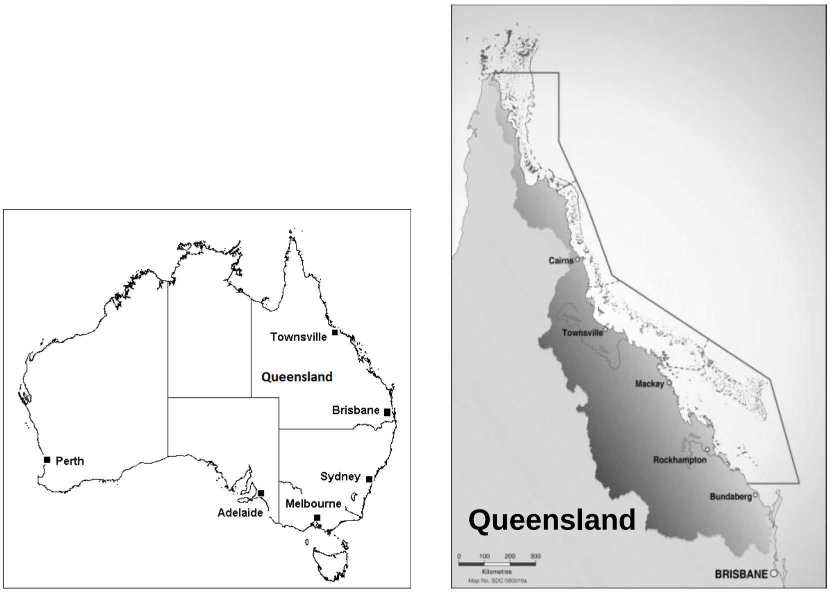

Figure 1: **Great Barrier Reef**

Data on beaches were collected by asking respondents to indicate their first and second most preferred beaches, andtheir visit rate to each over the past two years. For the last visit to each beach, they were also asked to provide additional details about their visit experiences and the travel methods and costs involved. In the contingent behaviour questions beach users were asked to identify if different environmental factors, facility issues or crowding had reduced their visit rates in the past, or would do so in the future.

The individual visit rate was used as the dependent variable in the travel cost models. As respondents were only asked to indicate visitation rates by ordinal visit categories (e.g. once a month), it was necessary to convert the data to a cardinal form for use in a count data model. Treating the data as being censored at multiple points, the conversion was applied at the midpoint between the direct extrapolation and the previous conversion point, as shown in

Table 1. As the data was collected from the population, rather than on-site, potential problems of over-sampling of frequent visitors (i.e. endogenous stratification) were avoided.

Table 1: Extrapolation of visits for categorical responses

Response Category	Likely number of trips a year	Visits/year (midpoint)
Every day	*Between 260 – 365 trips*	313
Most days of the week	*Between 104 – 260 trips*	183
More than once a week	*Between 52 – 104 trips*	79
About once a week	*Between 27 – 52 trips*	40
About once a fortnight	*Between 13 – 26 trips*	20
About once a month	*Between 7 – 12 trips*	9
A few times a year	*3 trips*	3
About once a year	*1 trip*	1
Don't know/No response		0

Travel costs were estimated indirectly by using information about travel distance and method of travel for each respondent to calculate an expected travel cost, based on the following formula:

$$TCi = 2 \times Distance \times mi \times ci \qquad \ldots(4)$$

Where:

TCi = Travel cost for a travel party (one survey response)

$Dist$ = the one-way distance travelled to the beach

mi = "1" if travel method i was used and "0" otherwise

ci = the cost per kilometre for travel method i (Table 2)

Expected fuel costs for the different vehicle types were obtained directly from, or extrapolated from, ABS[2], with a summary shown in Table 2.

Table 2 Fuel costs by travel method for beaches trips

Travel method	Cost per km
Walking	$0.00
Bicycle	$0.00
Motorbike*	$0.50
Small Car	$0.68
Large Car	$0.74
4WD	$0.74
Bus*	$0.20
Boat*	$0.80

* Travel costs estimated from the published ABS data

[2] http://www.ato.gov.au/individuals/content.asp?doc=/content/33874.htm, accessed 14/04/2011.

Many case studies of recreation activities (e.g. Feather and Shaw 1999, Rolfe and Prayaga 2007, Lew and Larson 2008, Rolfe and Dyack 2010) have included travel time as a cost, using some proportion of standard wage rates (e.g. one-third) to allow for respondents having some recreational value associated with the travel experience. It is normal that values for recreation time at the travel site are excluded from the analysis. In this study both travel time and recreation time have not been included as a component of travel costs because (a) time issues may not be so important for local residents, (b) the trip may be part of the recreation experience, (c) travel time is not always a significant component of travel costs (Rolfe and Dyack 2011), and (d) travel time is often complicated to measure and assess accurately.

Multi-destination and multi-purpose trips complicate the estimation of travel cost models, as they require a sub-set of total travel costs to be apportioned to the case study of interest. However local residents are more likely to make single purpose trips to beaches than more distance visitors, so issues around multi-purpose and multi-destination trips in this study are expected to be limited. In the survey, data was collected about features and activities of visits, as well as distance travelled and time at the sites, in order to help identify if multi-destination or multi-purpose trips were likely to be an issue.

The count data models were fitted using Limdep and the R statistical computing programs. As the data was characterised by over-dispersion, negative binomial models were employed. For the estimation of visit rates for each population group, all data, including the non-visitors, were included in the models. For the estimation of recreation values at each site, only data from users were included, with some observations excluded because of missing values or extreme outliers (for travel costs).

The survey was conducted by a market research company in September and October 2010. A total of 1101 responses were received, with 52 surveys omitted because of incomplete responses. This left 1049 completed responses for use in the analysis. Key demographic and location characteristics of respondents are summarised in Table 3.

A range of different activities were identified within beach visits, with ‘being with family and friends’, ‘relaxing’, ‘walking’ and ‘boating’ being the most popular (Figure 2). Responses indicate that many beach visits are multi-purpose, but can be broadly categorised as recreation activities.

Table 3: Respondent socio-demographic characteristics

City / Region	Bundaberg/ Burnett	Gladstone	Rockhampton/ Capricorn	Mackay / Whitsundays	Townsville	Cairns
# Respondents	173	114	149	137	289	187
Average age	47.1	43.0	43.3	42.2	41.7	43.9
% Females	65.3%	71.1%	69.8%	68.6%	68.9%	66.3%
% with dependent children (<16)	31.2%	36.0%	42.3%	34.3%	38.4%	36.3%
Education:						
Post-school qualification	52.0%	46.5%	53.7%	47.4%	53.3%	55.6%
Tertiary education	19.1%	18.4%	27.5%	16.1%	23.2%	25.7%
Household income#	$46,820	$69,686	$57,064	$66,649	$59,761	$60,659
% owning house	60.1%	63.2%	51.7%	55.5%	50.2%	62.0%
Years living in house	8.7 yrs	9.9 yrs	11.5 yrs	7.9 yrs	8.6 yrs	8.4 yrs
% chosen to live at address to be close to the beach or boating facilities	37.0%	21.1%	16.1%	28.5%	19.4%	35.3%
% visiting beach in past 2 years	80.9%	71.7%	89.2%	90.2%	87.6%	94.6%%
Different beaches visited in region	26	18	28	31	58	13
Average distance of beach from home	15.2 km	15.4 km	31.0 km	9.7 km	12.2 km	16.8 km

\# 179 missing responses were coded as having Queensland average income of $63,096.80.

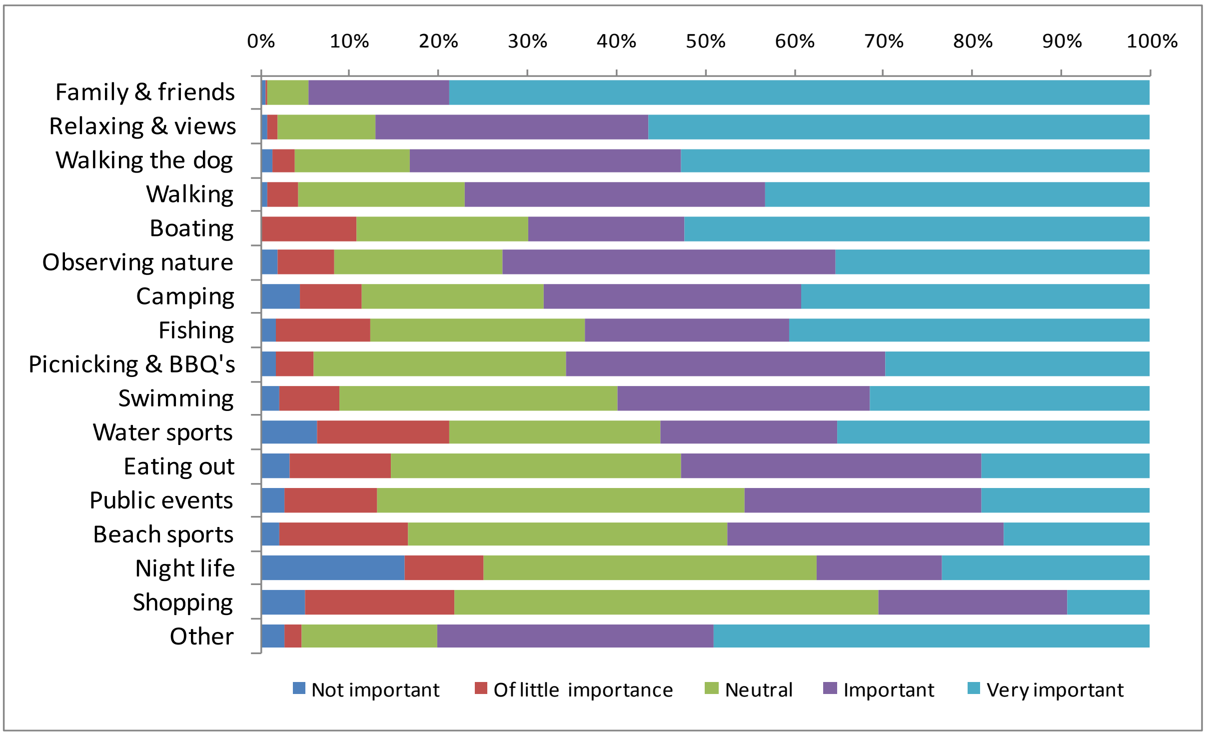

Figure 2: Respondent assessment of activities at beaches

4 Rates of beach visits

The first task in the analysis was to predict the rate of beach visits by population group. While data was collected about visit rates to the most preferred beaches, it was not feasible to capture data on all beaches visited in a survey format. A total of 174 beaches in region were identified in the survey as receiving visits with varying frequency. The estimation of total visit rates was done by fitting a count data model to the visit rates for the 'most preferred' and 'second most preferred' beaches, and then using the results to predict the number of visits across all beaches. The results (Table 4) show highly significant models for each population group, with each coefficient significant at the 1% level.

Table 4. Negative binomial models to predict annual beach visit rates# by regional group

	Bundaberg	Gladstone	Capricorn	Mackay	Townsville	Cairns	All
Models							
Constant	4.458***	3.788***	4.267***	5.130***	5.194***	5.324***	4.458***
Preferred beach (x)	-1.046***	-0.975***	-0.945***	-1.266***	-1.483***	-1.359***	-1.046***
Alpha	2.304***	3.041***	1.993***	2.206***	2.258***	2.390***	2.304***
Sample size#	346	228	296	276	578	374	2098
LL	-1288.92	-702.69	-1107.63	-1120.04	-2202.79	-1516.96	-7978.96
AIC	7.47	6.19	7.5	8.14	7.63	8.13	7.61
Psuedo R^2	0.8063	0.7641	0.8064	0.8595	0.8408	0.8822	0.8472
Chi-2 (1 DoF)	10731.9	4551.2	9229.8	13707.1	23266.5	22729.4	88453.0
Predicted visit rates							
Preferred beach (x)	Visits	Visits	Visits	Visits	Visits	Visits	Visits
1	30.33	16.67	27.70	47.64	40.88	52.72	37.65
2	10.65	6.29	10.76	13.43	9.28	13.55	10.70
3	3.74	2.37	4.18	3.79	2.11	3.48	3.04
4	1.32	0.90	1.62	1.07	0.48	0.89	0.86
5	0.46	0.34	0.63	0.30	0.11	0.23	0.25
6	0.16	0.13	0.25	0.08	0.02	0.06	0.07
Total	46.66	26.69	45.15	66.31	52.87	70.93	52.56

There were two observations for each respondent in the data set.

The average number of visits to each beach (Bx) was estimated by applying Equation 3 to the coefficients for the intercept term and beach number (x). The average visit rates to Beach 1 and Beach 2 were provided directly from the survey data, and visits to the remaining beaches are estimated from the negative binomial models (Table 4). The results show that the average total number of beach visits per adult are predicted to vary between 26.7 and 70.9 visits per annum (Gladstone and Cairns residents respectively) (Figure 3). Average beach visit rates were lower in the southern part of the GBR region (Gladstone, Bundaberg and Capricorn regions), and higher in the northern part (Mackay, Townsville and Cairns). The average number of annual visits by locals across the regional area was estimated at 52.56 visits per annum.

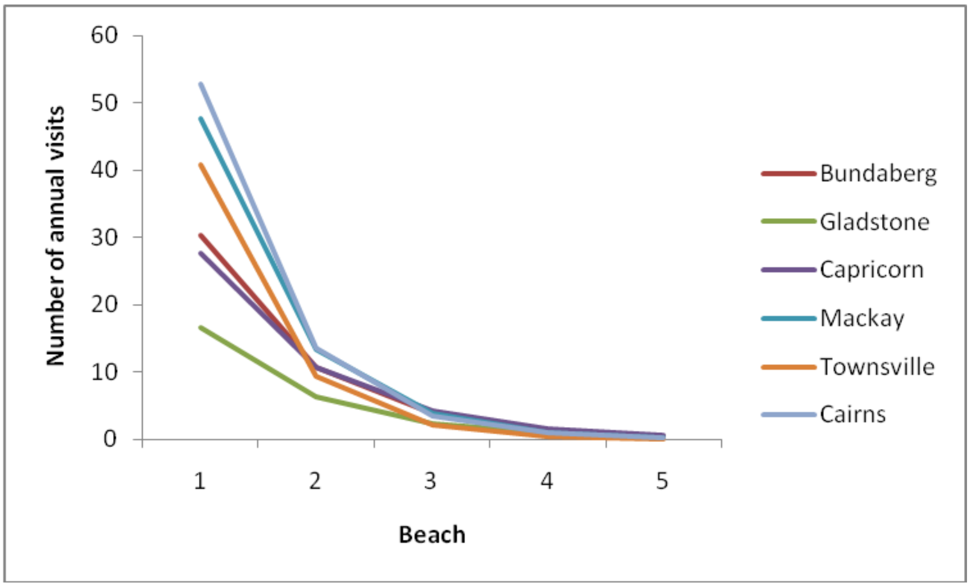

Figure 3: Annual visits to preferred beaches by regional population

Total visits per population group to beaches in the regional area (Table 6) were estimated with the following formula where an adjustment by group size has been made to avoid double counting:

Total beach visits = individual visit rate/group size * population …(6)

The results show that each person is expected to make approximately 20 visits per year (a total of 16.7 million beach visits annually over the 838,368 people in the region). This is a more conservative estimate of individual local annual beach visit rate than Blackwell (2007) made for the Sunshine Coast (average of 48 visits/person/annum) or Raybould and Lazarow (2009) made for the Gold Coast (average of 10 visits/month in summer and 6 visits/month in winter = 96 visits/annum).

5 Values of beach visits

The second task in the analysis was to estimate the average value of a beach visit by the different population groups. For this analysis only data on actual beach visits were used, and negative binomial models were applied. The models were left-truncated at zero visits to take account of the omission of non-visiting respondents. An example of the relationship between the trip visit rates and trip costs is shown in Figure 4, demonstrating both that there is a substantial non-linear relationship and that the data is characterised by over-dispersion (multiple trip frequencies for different costs). In addition, there was significant variation in travel party sizes and expenditures. This is largely due to the fact that multiple recreation sites are being valued rather than a single site, as is normal in travel cost applications. In order to reduce the confounding effects of travel party size and the amount of over-dispersion, trip costs were estimated as per-person trip costs. This both facilitated interpretation of the estimated model coefficients and improved the degrees of freedom in the models.

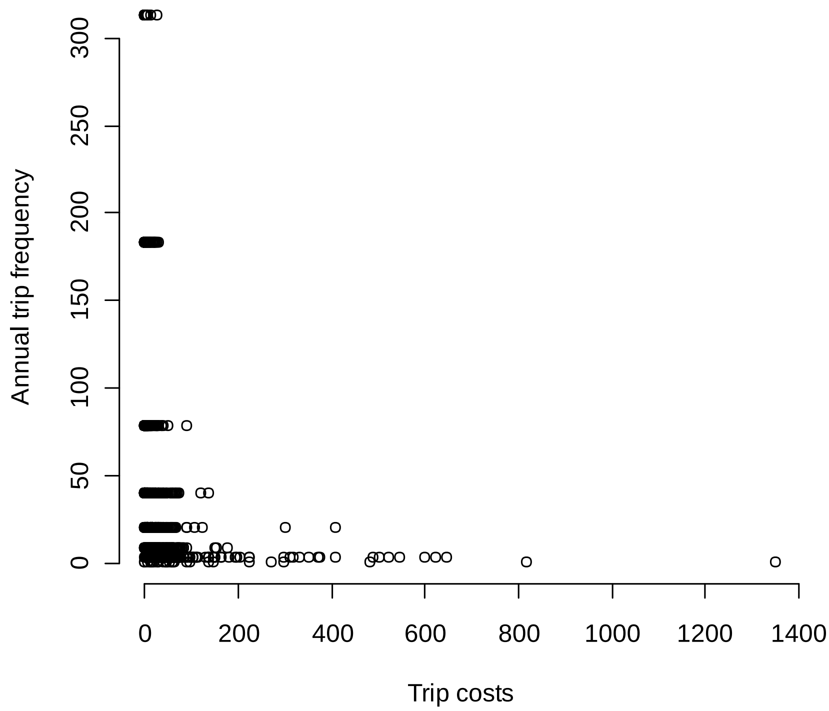

Figure 4: Scatterplot of trips versus trip costs (Beaches)

The exclusion of data from respondents who did not visit a beach (or a second beach) reduced the sample size. A total of 123 observations were trimmed from the data set because of missing data or responses that were not consistent (i.e. travel times were not feasible).This left 1440 valid observations across both beaches. The zero-inflated negative binomial models were estimated for the data for each regional group (Table 5). All models were significant, as well as the intercept and trip cost terms. The Alpha coefficient was also significant at the 1% level in each model, confirming that heterogeneity was present in the models and that the negative binomial specification was preferred over the Poisson. Other explanatory variables had limited influence and significance. For example, beach visits by Cairns residents were significantly higher if respondents were older, owned their own house, and were more recent arrivals in the area.

Table 5: Travel cost ZTNB models for beach data by regional area

	Bundaberg	**Gladstone**	**Capricorn**	**Mackay**	**Townsville**	**Cairns**	**All**
Models							
Intercept	3.753***	3.2115***	2.982***	4.458***	2.826***	2.699***	3.213***
Cost/person	-0.027***	-0.0210***	-0.018***	-0.032***	-0.030***	-0.042***	-0.029***
Hours spent	-0.004	-0.0538	-0.027	-0.002	0.001	-0.022	-0.001
Income	-0.000	0.0000	0.000	0.000	0.000*	-0.000	0.000
Edu. Post-graduate	0.065	-0.4345	0.002	0.035	0.103	0.273	0.066
Gender (m=0)	-0.050	0.3301	0.061	-0.691**	0.333*	-0.082	-0.017
Age	0.004	-0.0029	0.005	0.005	0.006	0.020**	0.007**
Own house (n=0)	-0.006	0.3095	-0.195	-0.546	-0.115	0.430*	-0.086
Yrs lived in area	-0.0389***	-0.027*	-0.007	-0.025***	-0.006	-0.037***	-0.017***
Alpha	1.599***	1.5581***	1.965***	2.479***	2.487***	2.926***	2.627***
Sample size	237	132	212	185	411	263	1440
Ln Likelihood	-930.61	-459.08	-762.00	-795.07	-1678.90	-1043.42	-5732.23
deg. Freedom	226	121	201	174	400	252	1429
AIC	1881.22	938.17	1544.00	1610.14	3377.80	2106.84	11484.46
AIC/n	7.94	7.11	7.28	8.22	8.22	8.01	7.98
Chi-squared crit. val.	3.84	3.84	3.84	3.84	3.84	3.84	3.84
LR test value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Reject poisson?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Per Trip WTP	$36.60	$47.66	$56.98	$31.21	$33.08	$23.79	$35.09
Lower (95%)	$29.17	$31.89	$37.75	$20.39	$26.17	$17.54	$31.74
Upper (95%)	$49.10	$94.28	$116.14	$66.50	$44.93	$36.96	$39.24

The estimates of per trip values were derived from the travel cost parameter in each model (WTP/person/trip = $-1/\beta_{Cost/person}$). Values ranged from $23.79/person/trip in Cairns to

$56.98/person/trip in the Capricorn region. Across all respondents in the data set the value was estimated at $35.09/person/trip. All confidence intervals are overlapping, indicating that there is no significant difference, at the 5% level of significance, in the value of beach visits across regional population groups.

The separate estimates of the rate of beach visits and the value of each visit can be brought together to estimate the total recreation values of beaches by local populations aged between 15 and 74 in each regional area (Table 6). This demonstrates substantial variation in total values, from $18.48 million per annum in the Gladstone region to $114.11 million in the Cairns regional area.

Table 6. Estimated annual beach visit rates by regional area

	Bundaberg	Gladstone	Capricorn[2]	Mackay[2]	Townsville[3]	Cairns[4]	All
Annual respondent beach visits	46.66	26.69	45.15	66.31	52.87	70.93	52.56
Average group size	2.49	3.19	2.76	2.56	2.64	2.41	2.633
Population[1]	72016	46341	85991	118418	157140	162973	642879
Total beach visits	1,349,505	387,725	1,406,701	3,067,304	3,146,967	4,796,546	12,833,164
Per trip WTP	$36.60	$47.66	$56.98	$31.21	$33.08	$23.79	$35.09
Total annual value ($M)	$49.39	$18.48	$80.15	$95.73	$104.10	$114.11	$450.32

1. 2010 population aged between 15 and 74 years estimated from Queensland Regional Profiles, Queensland Office of Economic and Statistical Research
2. Rockhampton LGA population
3. Includes Mackay and Whitsunday LGA populations
4. Includes Burdekin, Townsville populations
5. Includes Hinchinbrook, Cassawary Coast and Cairns populations

6 Contingent beach visits

A key aim of the study was to identify how visit rates and trip values may be influenced by various characteristics of beaches and visits. Data was collected in the survey about factors that people identified as important to their visit experience (Figure 6). Results show that the most common factors identified by respondents were having a ‘clean beach’, ‘public areas’, ‘BBQ facilities’, and ‘lack of crowding’. Other factors such as ‘shade’, ‘good water quality’, ‘lifesavers’ and ‘stinger protection’ were not identified by as many respondents but were rated as very important by those who did nominate them.

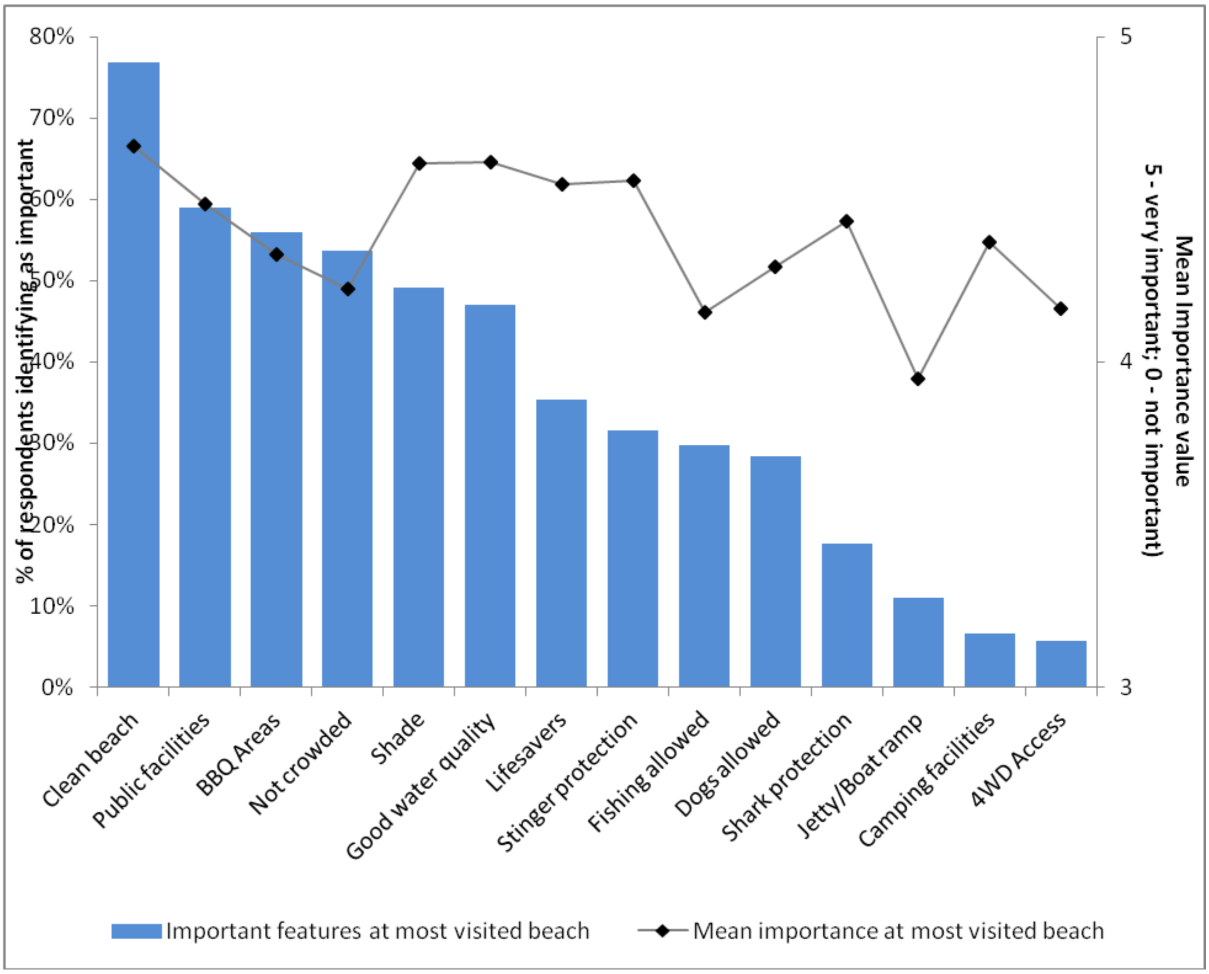

Figure 6: Factors that contribute to beach visit rates and trip experience

Data was also collected about factors that would negatively impact on visit behaviour. Respondents were asked whether different factors had reduced visit rates in the past two years, and whether any might in the next two years. The most common reason that respondents have not visited the beach in the past has been natural conditions, the weather and the presence of stingers (Box Jellyfish) (Figure 7). Human influenced characteristics such as parking, dirty water and crowding have also deterred respondents from the beach. People's attendance at the beach in the future seems to be much more influenced by these conditions, suggesting that people will be deterred from the beach if any of these conditions decline in the future.

The contingent behaviour experiment focused on the change in future visits if water quality at the beaches deteriorated. Respondents were asked about future visit rates focused on two levels of potential deterioration in water quality: 'water quality gets slightly worse by about 10%', and 'water quality gets considerably worse by about 20%'. They were asked first to report their expected number of trips to their preferred beach over the next two years. Respondents who expected to go to beaches in the future were then asked to indicate the amount by which they would *reduce* their expected travel to beaches under a scenario of a 10% and 20% decline in water quality.

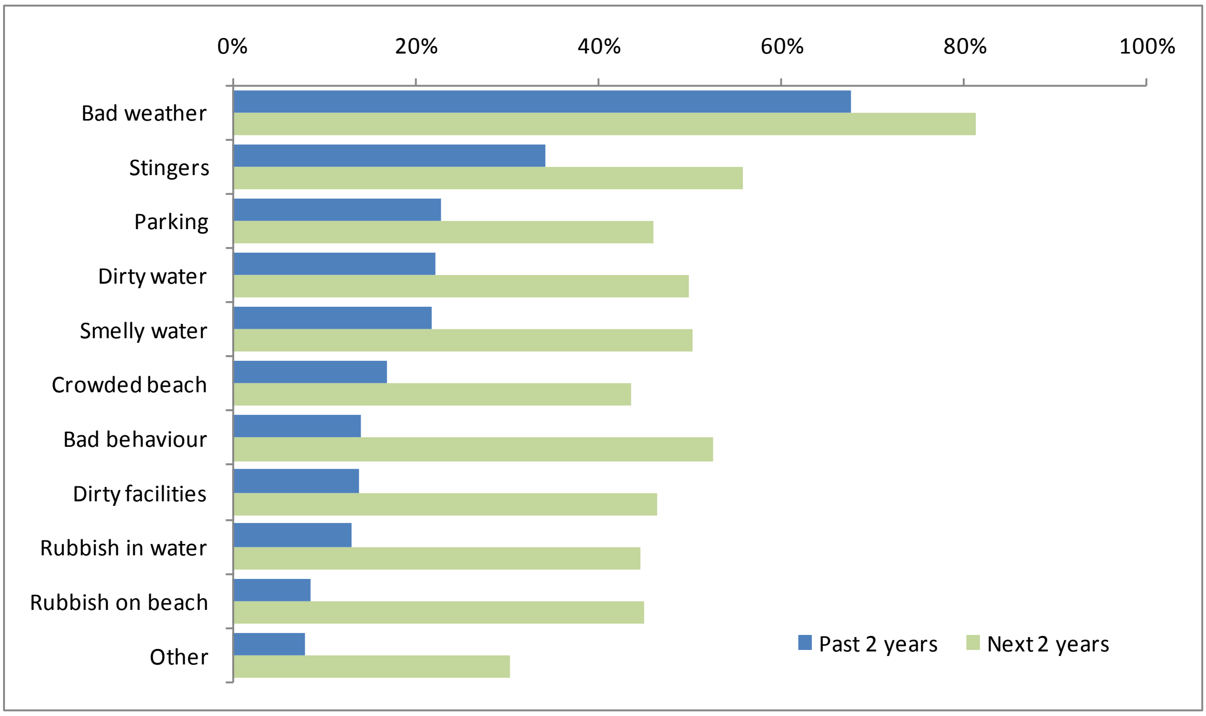

Figure 7: Factors that reduce visit rates both past and future

Data from the respondents about the three future visit rates (no change, 10% decline, 20% decline) was pooled. The dependent variable was specified as expected future trips, and a quality change variable was introduced as a continuous variable to allow consideration of part-worths at points other than the 0%, 10% and 20% declines[3]. Travel costs were again expressed in terms of travel costs per person to aid in inference. Truncated count data models were not estimated because a number of respondents indicated they would reduce activity to zero in the future even though they stated a positive frequency of expected activity over the next two years.

The results of the contingent behaviour model for the 'most preferred beach' scenario outlined above are presented in Table 7. Water quality had a significant effect on beach-goers expected frequency of visitation over the next two years, as shown by the significance

[3] Although the models were estimated with the quality variable as a single continuous variable, it was also tested by introducing it as a dummy variable for each level of quality. No significant differences in estimated parameters were observed and log-likelihood values were similar. The continuous specification ensured that the quality effect was monotonically increasing/decreasing for improvements/declines respectively (for a positive parameter estimate) and had a convenient marginal effect interpretation.

of the water quality term in the model. The mean WTP was estimated at $31.25 for the NB2 count data model. Marginal effects have been estimated with equation 5 at $1.30 per recreation trip to avoid each 1% decline in water quality, ranging between $1.11 and $1.69 per 1% change across different regional communities.

Table 7: Contingent behaviour models for "most preferred beach" trips in the future

	Bundaberg	**Gladstone**	**Capricorn**	**Mackay**	**Townsville**	**Cairns**	**All**
				Models			
Intercept	4.4592***	4.0963***	2.2921***	3.4369***	3.4205***	2.8492***	3.1581***
Water Quality	0.0529***	0.0495**	0.0503***	0.0384**	0.0419***	0.0428***	0.0416***
Cost/person	-0.0313***	-0.0137	-0.0198***	-0.0346***	-0.0322***	-0.0346***	-0.0320***
Hours spent	-0.0029	-0.0902	-0.0131	-0050	0.0012	-0.0555**	-0.0011
Income	-0.0000	0.0000	0.0000	0.0000	0.0000	-0.0000	0.0000
Edu. Post-graduate	0.1716	-0.2347	0.1563	0.1900	0.3011*	0.5306	0.3027***
Gender (m=0)	-0.2642	0.1796	0.2662	-0.1625	-0.0226	-0.1685	-0.0583
Age	0.0007	0.0075	0.0190*	0.0211	0.0046	0.0301***	0.0162***
Own house (n=0)	-0.1017	-0.4190	0.1019	0.3134	-0.0242	0.4368	0.1009
Yrs lived in area	-0.0346***	-0.0365	-0.0074	-0.0233**	-0.0029	-0.0344***	-0.0134***
Alpha	2.6558***	2.7771***	2.7940***	3.2020 ***	3.2719***	3.3820***	3.2605***
Sample size	390	222	336	285	699	414	1999
Ln Likelihood	-1363.85	-748.09	-1089.39	-1115.18	-2664.41	-1516.73	-8566.50
deg. Freedom	378	222	324	273	687	402	1987
AIC	2738.69	1507.18	2189.78	2241.36	5339.81	3044.47	17144.01
AIC/n	7.02	6.79	6.52	7.86	7.64	7.35	8.58
Chi-squared crit. val.	3.84	3.84	3.84	3.84	3.84	3.84	3.84
LR test P-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Reject poisson?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Per 1% change in water quality	$1.69	Not Sig.	$1.69	$1.11	$1.30	$1.24	$1.30
Lower (95%)	$1.29	NA	$1.29	$0.69	$0.98	$0.86	$1.14
Upper (95%)	$2.45	NA	$2.45	$2.90	$1.95	$2.20	$1.51

7 Conclusions

The focus of the research reported in this paper has been to estimate recreation values for beaches over approximately 1400 kilometres of coastline along the Queensland coast. The study is notable because it assessed recreation values to a general type of recreation asset rather than to a specific site, and because it focused on the values of the local resident population. Beaches in the GBR region are potentially used by more than 800,000 people in regional cities along the Queensland coast, and local recreation values are an important product of natural and human capital assets in the region. However little prior research is available to provide value estimates.

Data about beach visits to the favourite and second most favourite beaches have been collected from 1049 respondents in regional areas with an internet panel. Respondents from six regional areas along the Queensland coast identified 174 different beaches that were being visited regularly for recreation purposes. The negative binomial models used to estimate the number of beach trips by population group identified that beaches in the northern regions had higher visit rates than those in southern areas, with an average annual visit rate of 52.54 visits predicted. Extrapolation across the population of the region indicates that up to 12.8 million beach visits are being made annually by 643,000 local residents aged between 15 and 74.

Zero-truncated negative binomial models were used to estimate the value of beach trips by active users, with an average value of $35.09/person/visit estimated. Extrapolation across the number of beach trips generates predictions of $450 million in beach recreation values per annum. Some variations in both visit rates and recreation values were identified across regional populations. The Cairns region in the north of Queensland generates 23.4% of all local beach recreation values, while the Gladstone region in the south generated only 3.8% of beach recreation values.

There is evidence that recreation experiences are dependent on a number of beach characteristics, and that visit rates would decline if beaches had poorer environmental standards or other problems. Contingent behaviour models were used to estimate the values of potential declines in water quality, with marginal effects assessed at $1.30 per recreation trip to avoid each 1% decline in water quality. However, beaches also appear to be very substitutable, so a decline in condition at one beach may simply cause recreational users to go to another site. Any substitution effects, where a decline in recreation values at one beach are offset by increases in recreation values at other beaches, would need to be considered in any evaluation of conditions at particular sites.

It is important to note that the study is likely to undervalue recreation activities in two important ways. First, the value of travel time has not been included within the analysis. This is in part because respondents may have treated access time as part of the recreation experience, and because it also allows for that time to account for other activities or trip purposes. Second, the analysis does not capture the likelihood that people have deliberately chosen their residence to maximise their recreation experience (Randall 1994, Bell and Leeworthy 1990). Those respondents are likely to have incurred higher housing costs and other travel costs in order to live close to beaches and/or boating facilities and have lower per visit travel costs.

The results indicate that populations with more respondents choosing to live closer to the beach have lower trip values. The Capricorn residents, with only 16.1% choosing to live close, have the highest trip value per person of $56.98, while Cairns residents where 54% choose to live close to beaches had the lowest trip value per person of $23.79. Assuming that all local residents have beach trip values of at least $56.98, but that those choosing to live closer have other opportunity costs, the total annual value of beach access by local residents in the GBR is assessed at $731 million. Further research is needed in the future to explore these issues further.

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