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Valuing local recreation in the Great Barrier Reef, Australia

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Abstract

The aim of this research is to identify local recreational use values for recreation in and adjacent to the Great Barrier Reef Marine Park (GBRMP) using the travel cost methodology, focusing on beach, island, and fishing, boating and sailing trips. Of the 1051 responses to the survey, drawn randomly from households between Bundaberg and Cairns, 87% indicated they had taken a trip to one beach ("most preferred beach"), 73% undertook a trip to a second beach ("second most preferred beach"), 30% undertook a trip to an island, and 42% undertook a fishing/boating/sailing trip over the last two years. Probit models were used to represent the choice to take a recreation activity, while count data models (zero truncated negative binomial models) were used to model the zero truncated positive integer count data. Average values per person per trip per day were estimated at $35 for beaches, $331 for Islands, and $183 for fishing, boating and sailing activities (although the value for the latter group is not significant). Additional information about how variation within population groups may affect the demand for recreation activities has been gained by trailing the use of quantile regression models to estimate recreation values as well as the more standard count data models. The results are likely to represent the lower value of recreation activities because travel time and location investment costs have not been included in the analysis.

1 Introduction

The Great Barrier Reef (GBR), situated on the north-eastern coast of Australia, is the most extensive reef system in the world (Figure 1.1). Recreation is a core activity on the GBR, with recreation activities underpinning a substantial tourism industry. Recreation is important for three broad groups: local residents, domestic tourists and international tourists. Most economic studies on GBR recreation have focused on the size of the financial impacts from domestic and international tourists. For example Bailey et al. 2003 estimated the expenditure by visitors to the region in 2003 at $4.1 billion, Asafu-Adjaye *et al.* 2005 estimated the value of economic activity generated by recreational activities such as fishing and boating in 2005 to be approximately $148 million annually (in 2010 dollars), while Access Economics (2008) estimated that the value added by recreation and tourism activities in 2007 was $167 million and $5.6 billion respectively (in 2010 dollars).

There have been very few studies that have assessed recreation values with non-market valuation techniques. Hundloe *et al.* (1987) (as reported in Hundloe (1990)) and Carr and Mendelsohn (2003) both used the travel cost method (TCM) to estimate consumer surplus for *recreational use values* for both domestic and international tourists to the GBR. Kragt et al. (2009) used the travel cost method and contingent behaviour models to estimate the consumer surplus that divers and snorkellers gained from reef visits at Port Douglas in the north, and the sensitivity to potential declines in coral cover and fish diversity.

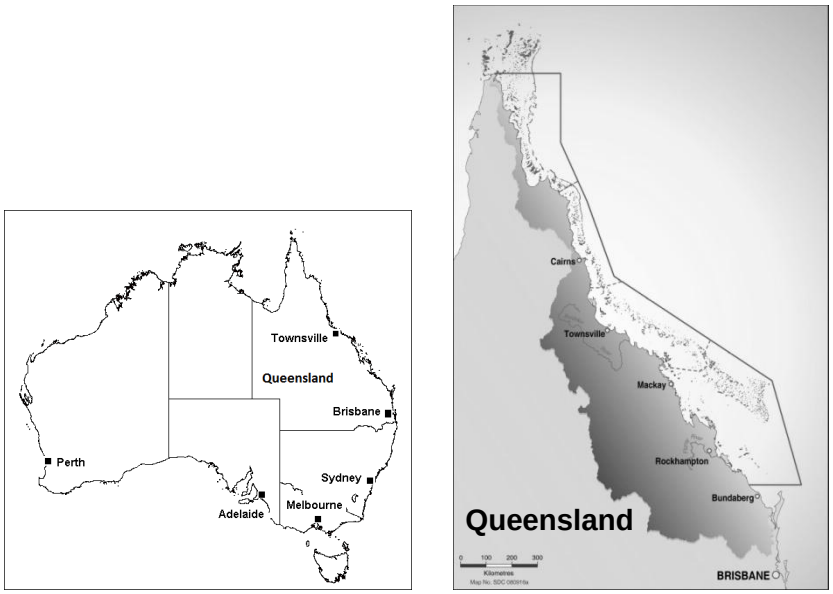

Figure 1.1: Great Barrier Reef

There is little information available about the recreation values that local populations gain from access to the GBR. Given that there are a number of towns and regional cities along the Queensland coast adjacent to the GBR, the sensitivity of this group to potential improvements and declines in recreation activities in the GBR will be important in any economic and policy evaluation of future protection

measures. However, there are a number of challenges in assessing local values for recreation. There are a large number of population centres with access, with the GBR extending for more than 2,000 kilometres along the Queensland coast, diversity in the assets from beaches through to reefs and islands, diversity in recreation activities from beach use through to fishing, diving and boating, and variations in condition and threats.

In this report, a primary valuation exercise is reported where data has been collected from a random sample of households in the local coastal communities, with the TCM applied to assess consumer surplus values associated with recreation and contingent behaviour questions used to assess sensitivity to changed conditions. Respondents to the survey were asked about their activities involving beaches, islands, recreational fishing, and boating and sailing. Results from the study will be useful to policy makers because they will help to identify patterns of recreation use and values relevant to any changes in recreation activity. The report 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 section four, and models to assess values with changed recreation access in section five. Final conclusions are presented in Section 6.

2 Methods

The basic market model of demand and supply provides the foundations for understanding concepts of 'economic value' provided by natural resources like beaches. The benefits accruing from the goods and services supplied in a market place can be measured in terms of consumer surplus and producer surplus. Consumer surplus is the difference between what the consumer is willing to pay and what they actually pay (the market price). Producer surplus is the difference between what the producer receives (market price) and the costs of producing the good or service. The sum of consumer and producer surplus provides estimates of economic value, or the welfare realised by society of providing a particular good or service. The basic concepts of consumer surplus and producer surplus are illustrated with the aid of Figure 2.1 below.

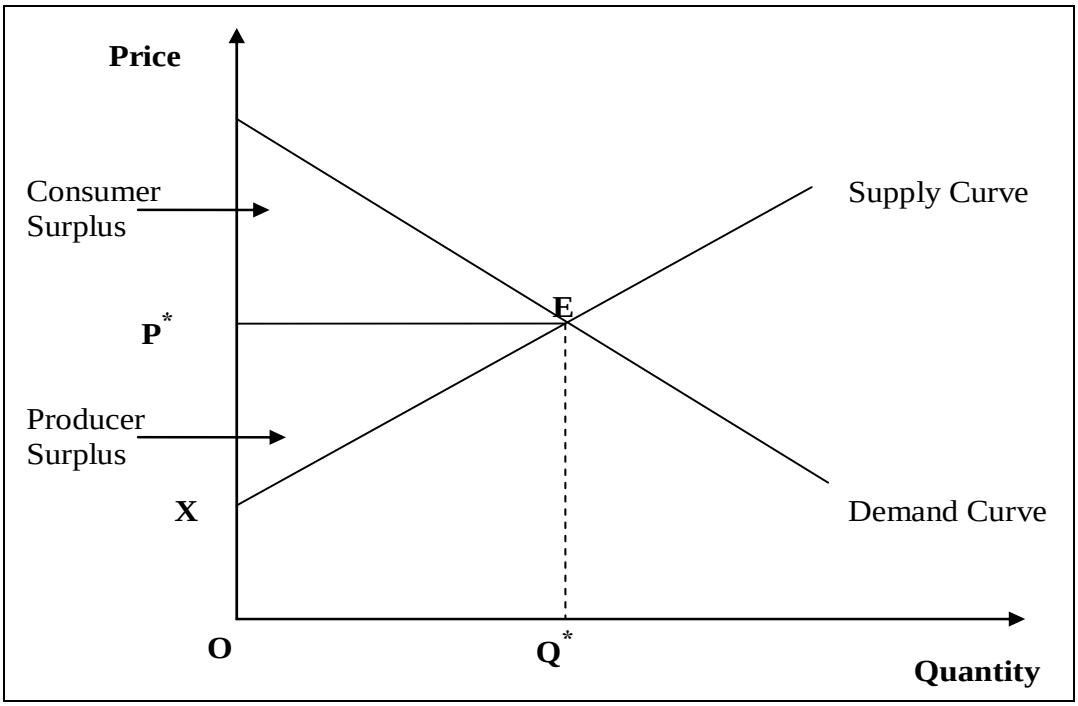

Figure 2.1: Producer and consumer surplus

Consumer and producer surplus are the appropriate measures of economic value to consider when valuing recreation benefits associated with the GBR. Consumer surplus values can be estimated for both market and non-market goods, but producer surplus can be estimated only for market goods. It is inappropriate to use estimates of market turnover or market revenue (P* x Q* in Figure 2.1) as measures of economic value. Nor is it appropriate to use the costs of production (OXEQ) as a surrogate for economic values. Instead, specialised non-market valuation techniques are needed to assess the values associated with recreation activities.

The analysis of recreation data from communities in the GBR region and estimation of recreation benefits is challenging for a number of reasons. The challenges can be summarised into four groups. First, there are a number of different recreation choices, such as between beach, island and water based activities. Selection models are needed to predict how respondents will choose particular recreation options. Second, a random sample of the general population will identify many respondents who do not make visits or engage in certain activities. This means that econometric methods must be capable of analysing data with zero visit rates. Third, there may be substantial heterogeneity in recreation behaviour within population groups, so that more sophisticated models are required to reveal variations in recreation demand. This may be important given the diversity across communities and recreation opportunities along the length of coast involved. Fourth, recreation demands may be sensitive to different environmental factors such as water quality, and some assessment of how environmental variations will influence recreation demand is needed to inform policy analysis. Further details on the estimation techniques used to address these issues are provided below.

2.1 Sample Selection Method

Where data are collected for different groups of recreation activities (e.g. beaches, islands or recreational fishing), then it can be expected that the decision to participate in an activity may be based on different criteria to the decision about how frequently visits should be made. These sequential decisions can be modelled with separate models to reflect the reality that people first choose which recreation activities they will engage in and the frequency of use. In this study Probit models were employed to analyse the first step (the participation decision) for the four key activities of interest:

$$
\begin{aligned}
P[Freq.(Beach\#1 > 0)] &= f(\alpha_1 + x\beta_1) + \varepsilon_1 \\
P[Freq.(Beach\#2 > 0)] &= f(\alpha_2 + x\beta_2) + \varepsilon_2 \\
P[Freq.(Islands > 0)] &= f(\alpha_3 + x\beta_3) + \varepsilon_3 \\
P[Freq.(Fishing > 0)] &= f(\alpha_4 + x\beta_4) + \varepsilon_4
\end{aligned}
\qquad \textbf{Equation 1}
$$

Where:

f = The Probit function

β_i = k x 1 column vector of model parameters

x = n x k matrix of model variables

$cov(\varepsilon_i,\varepsilon_j) = 0$ for all $i \neq j$

As can be seen, Equation 1 embodies the assumptions that the four participation equations both involve separate functions of the variables contained in *x* and that unobserved effects (the errors) are uncorrelated between the outcomes of the four participation equations.

The log-likelihood function for individual *i* and activity *j* can be specified as a probit model:

$$(1)\quad \ln \ell_{ij} = (1 - y_{ij}) \times \ln\left[1 - \Phi(\alpha_j + x_i \beta_j)\right] + y_{ij} \times \ln\left[\Phi(\alpha_j + x_i \beta_j)\right]$$

Where:

Φ = The standard normal cumulative density function

$$y_{ij} = \begin{cases} 1 & if\,(y_{ij}^* > 0 \\ 0 & if\,(y_{ij}^* < 0 \end{cases}$$

y_{ij}^* = The latent (unobserved) utility for respondent *i* and activity *j*

Once respondents had been identified within a particular activity with the probit models, then travel cost models were applied for the second stage of the analysis.

2.2 Travel cost method

Recreation activities are difficult to value because many are not directly traded in markets. Over the past four decades the TCM has been regularly used to value outdoor recreational activities, using information about the direct and indirect costs of visiting recreation sites to estimate demand for the recreation activity (Hanley and Spash 1993; Garrod and Willis 1999; Ward and Beal 2000, Haab and McConnell 2002; Shrestha *et al.* 2002). Estimates of consumer surplus (the value of the recreational activity) can then be generated from the estimated demand functions. Advantages of using the TCM are that it is grounded in consumer theory, uses real data from market transactions, and has the ability to represent consumer choices and preferences accurately (Haab and McConnell 2002). 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).

While earlier applications of the TCM employed standard regression techniques to identify the relationship between visit rates and independent variables such as travel costs, the non-negative integer and truncated nature of the dependent variable (visit rate) means that count data models are more appropriate (Creel and Loomis 1990, Hallestein and Mendelsohn 1993, Haab and McConnell 2002). Count data model specifications have advantages in that the models can be fitted to non-normal data, such as those characterised by large numbers of zero or single visits, and are now used routinely to estimate recreation values (Haab and McConnell 2002). The standard underling process used to model count data is the Poisson model (Cameron and Trivedi 2005) which accepts integer

valued dependent variables and embodies the restriction that the expected value of the counts is equal to their variance:

$$E[\lambda] = \mathrm{var}(\lambda)$$
$$\lambda = \exp(x\beta)$$

where λ is specified as a function of travel, site and respondent characteristics (*x*) and their associated coefficients (β). The equivariance assumption of the Poisson model is often violated in practice (Cameron and Trivedi 2005; Greene 2008) leading to the need to account for variation which is greater than that expected in the Poisson model, usually referred to as over-dispersion. While several methods have been proposed to account for over-dispersion in count data models, the most popular has been the Negative Binomial, and in particular the quadratic-variance Negative Binomial model called the NB2[1]. The NB2 model may be derived as a mixture of Poissons, or directly from Random Utility Theory (Cameron and Trivedi 2005). Thus it has justification both from a generalised statistical modelling perspective, and from an economic-theoretic point of view. 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, rather than at a recreation site, some respondents with zero visit rates will be identified. The censoring of observations for which no trips are reported requires modification of the probability functions associated with the count process modelled, using the zero-truncated Poisson (ZTP) and the zero truncated Negative Binomial (ZTNB) models for the Poisson and NB2 models respectively.

2.3 Quantile Regression Method

A limitation of the TCM based on count data models is that the estimated relationships are assumed to be consistent across the sampled population or recreational users. Koenker (2005) suggests that many econometric analyses would benefit from considering how the influence of covariates changes over different quantiles of the regressand. In particular, Koenker (2005) and others (e.g. Machado and Santos Silva 2002; Koenker and Hallock 2001) suggest that quantile regression (QR) methods provide a far greater level of detail over the distribution of the parameters forming the predictive model for a regressand. QR also provides both a robust and an intuitive alternative to traditional conditional mean models estimated using maximum likelihood methods particularly when the assumptions of maximum likelihood, or OLS are violated. Figure 2.2 below provides an example of applications of the QR approach.

[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)

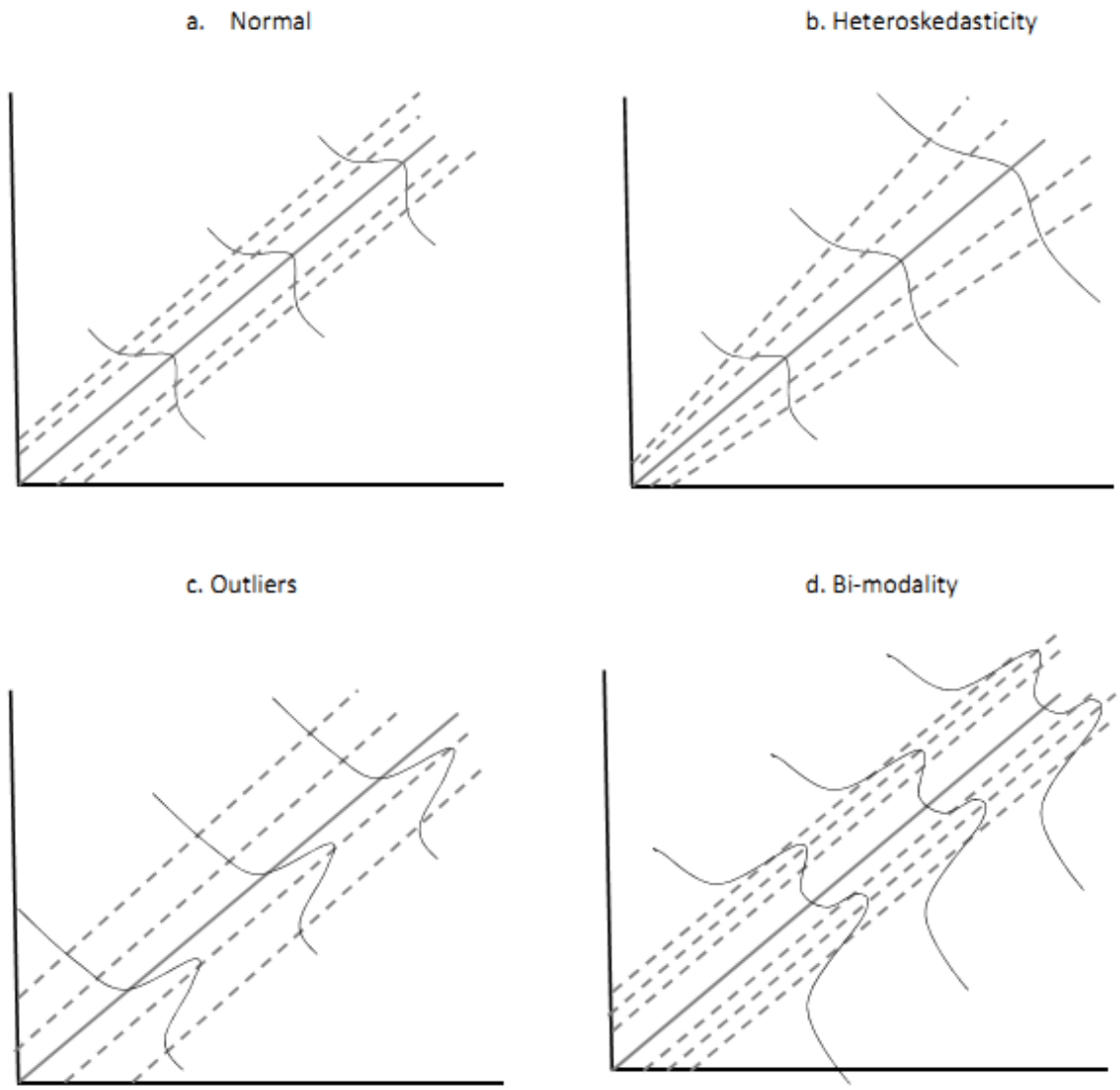

Figure 2.2: Examples of the use of QR regression models under miss-specification or non-normal and iid errors.

Figure 2.2 shows the comparison of the traditional conditional mean models (e.g. OLS, maximum likelihood) against quantile regression models for a correctly specified model with normally distributed errors. In this case the conditional mean models are likely to be satisfactory in summarising the data. In the remainder of Figure 2.2 however, relatively small departures from the assumptions of the models, respectively heteroskedasticity in (b), outliers in (c) and bi-modality in (d), indicate that the conditional mean models are unable to sufficiently explain the additional information contained in the response distributions. In contrast, the quantile regression approach: (1) allows for heteroskedasticity via 'fanning out' of the estimated quantiles either side of the median; (2) is relatively unaffected by outliers as it is invariant to monotonic transformations of the response variable (transformations which do not change the order of the data in terms of magnitude) – thus the median quantile regression line is still a robust indicator of the point of highest density, and; (3) can account for bimodality indicated by clustering of quantile regression lines near the modes of a distribution.

Koenker (2005) presents the basic concepts, approach and intuition behind QR methods whilst Koenker (2005) and Machado and Santos Silva (2002) both provide an overview of how QR methods can be applied to analyse count data. QR is readliy considered as analogous to OLS but instead of minimising the sum of squared deviations the analyst attempts to minimise the sum of *absolute* deviations. This can be shown in the following equation, where x_i is the observed value, β is the estimated coefficient, and y_i is the predicted value:

$$\min : \sum_{i=1}^{N} \left| y_i - x_i \beta \right|$$

In the above case the QR model estimates the conditional median of the data given by xβ, in contrast to the conditional mean of the data obtained from OLS estimators. Quantiles other than the median may be obtained by asymmetrically weighting the residuals to examine the pattern of parametric effects on *y* across the distribution of *y*.

The piecewise-linear nature of the QR estimator means that traditional calculus methods (e.g. numerical maximisation) are not suitable, and linear programming methods are preferred (Koenker 2005). Where the dependent variable (i.e. visit rate) is collected as categorical data, the data needs to be transformed to a continuous format due to the need to order observations when obtaining the QR estimator (Koenker 2005; Machado and Silva 2002). An approach called “jittering” performs this by adding a random uniform constant to each observation. In the example provided by Machado and Silva (2002), using ordinary count data, they simply add a random uniform draw between 0 and 1 to each observation on *y* and estimate their model using the augmented data.

The count data model posits that *y* (the count observation) is an exponential function of *x* (the data) and *β* (the parameters) (Machado and Santos Silva 2002). In order to specify this relationship we simply regress the natural logarithm of the count observations against the observed values of *x*:

$$\ln(y) = \alpha + x\beta$$

The relationship above results in a linear-in-parameters functional form which is analogous to that of the count data models, albeit it is not integer-valued. The count data models estimated using maximum likelihood will be the most efficient if the data generation process is correctly specified and errors are IID normal (Cameron and Trivedi 2005). However, in the case that errors are non-normal and/or non-IID, quantile regression models may prove more reliable due to their robustness in the face of violations of normality (Koenker 2005).

2.4 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). The contingent behaviour data is collected by asking respondents to 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 a panel framework, where each respondents essentially give binary or multiple responses about their visit rates to the site, with dummy variables used to specify the presence of the hypothetical condition. 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).

3 Data collection and travel cost calculations

The data used in this research were collected in August-September 2010 using a web-based survey from 1101 residents located along the Queensland Coast adjacent to the GBR. As well as being aimed at valuing recreational activities in the GBR, the survey collected information on a range of activities and interests relevant to recreation in the region. A copy of the survey instrument is provided as an appendix to this report.

The survey was conducted by a market research firm with an appropriate database of respondents in the area of interest. Previous research has indicated that results of non-market valuation surveys of respondents from online panels are not statistically different from those using in-person, drop-off/pick-up, or telephone based collection methods and offer significant advantages in terms of lower cost and time involved (e.g. Fleming and Bowden 2009, Windle and Rolfe 2011).

The main aim of data collection was to elicit the details of travel trips to allow recreation values to be estimated for beaches, islands and boating trips, as the most relevant recreation activities in the GBRMP. To collect responses across the range of relevant recreation activities in a single survey, respondents were asked about their visit frequency over the past two years to:

1. To their most frequented beach
2. To their second most frequented beach
3. To islands in the GBR area
4. On fishing, sailing or boating trips.

In each category respondents who had visited in the past two years were also asked to provide additional details about their visit experiences and the travel methods and costs involved in their most recent visit. The collection of data about visit rates was simplified by giving respondents visit categories to select, ranging from ‘everyday’ through to ‘about once a year’, consistent with previous studies (e.g. Anderson 2010). The frequency of visits in the different recreation categories allowed the individual travel cost models to be fitted.

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. Recreational fishers were asked about the effect of different catch rates on their current and future visit patterns, while other water users were asked about the effects of decreased water visibility on current and future visit patterns. The final section of the survey involved questions about socio-demographic factors and the area where people lived.

Travel cost models can be sensitive to a number of issues around the way that the relationship between visit rates, travel costs and other variables are framed, and the choice of functional forms to fit the data that is collected (Ward and Beal 2000, Haab and McConnell 2002). Here the most important of these framing and modelling issues are reviewed.

Defining the independent variable

The dependent variable for the travel cost models was the individual visit rate. To minimise the task burden during the conduct of the survey, respondents were asked to indicate which category of visit rates were applicable for each of the recreation areas of interest. The categories were offered in a crude ordinal scale such as 'Every day', 'Once a week' etc. For modelling purposes, it was necessary to convert the data to metric form. As the data was essentially censored at multiple points, the conversion was applied at the midpoint between the direct extrapolation and the previous conversion point, as shown in Table 3.1.

Table 3.1: Extrapolation of visits for categorical responses

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

Where data is collected on-site, then over-sampling of frequent visitors (endogenous stratification) is expected to occur. In this study, potential problems of over-sampling were avoided by surveying a random sample of the population in the region (rather than a sample of on-site recreation users).

Defining travel costs

In the TCM, estimates of travel costs are usually elicited by one of two means: (1) by asking the respondent directly to estimate the total cost, or components of the costs, of their trip (the direct method), and; (2) by asking the respondent about their travel time, distance and method of travel and using these to calculate an expected travel cost (the indirect method). In this study the indirect method was used to estimate travel costs to beaches due to the likelihood of 'zero' cost travellers who walk or cycle to the beach. The direct method was used for islands and water based recreation trips, where many trips involved both land-based and water-based components.

The direct method used to estimate travel costs to islands and for fishing/boating/sailing trips involved summing the expenditure estimates that respondents made for: transport (terrestrial), parking, private boat travel, commercial boat travel, food, accommodation, water sports and activities, entertainment, shopping, and other. The indirect method used to estimate travel costs to beaches was based on the following formula:

$$TC_i = 2\ x\ Dist\ x\ mi\ x\ ci$$

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 3.2)

Expected fuel costs for the different vehicle types were obtained directly from, or extrapolated from, ABS[2], with a summary shown in Table 3.2.

Table 3.2 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**

Opportunity cost of time

The treatment of travel time and on-site time is a contentious area in the application of travel cost methods. There is some argument that participants will be more reluctant to travel to further sites and ones that involve long time blocks because of the opportunity costs of time involved (Feather and Shaw 1999). Many case studies of recreation activities (e.g. Feather and Shaw 1999, Rolfe and Prayaga 2007, 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

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

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) travel time is not always a significant component of travel costs (Rolfe and Dyack 2011), and (c) travel time is often complicated to measure and assess accurately.

Multi-destination and multi-purpose trips

Two difficult issues in the framing of travel cost studies are multi-destination and multi-purpose trips. These are particularly relevant when visitors make long trips to several sites, so that any subsequent analysis involves partitioning the travel costs in some form. For this study, where the focus is on local residents making trips to close recreation sites, it is anticipated that multi-destination and multi-purpose trips will be much rarer. Instead, the close proximity means that most trips should be to single destinations. Issues of multi-purpose trips were also expected to be limited because a recreation destination such as a beach or island could still involve many different activities. 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.

Functional form

Different functional forms summarising the relationship between the visit rate as the dependent variable and a number of independent variables (including travel cost) can produce very different estimates of consumer surplus (Haab and McConnell 2002). For this reason care is needed to select the most appropriate functional form (Prayaga et al. 2006, Rolfe and Prayaga 2007). The key options for functional forms in travel cost analysis include: linear, quadratic, double log, semi-log dependent and semi-log independent functional forms (Prayaga et al. 2006).

Data cleaning and analysis

The final data used in the econometric analysis was checked for consistency. For the descriptive statistics (univariate analysis) and identification of simple relationships (bi-variate analysis) the data was analysed in SPSS. All observations were used in these stages of the analysis. For the multi-variate analysis (sample selection models, travel cost models and contingent behaviour models), all estimations were carried out in the free R statistical computing program version 2.12.2 (available from www.R-project.org). The user-defined routines were maximised using the BHHH algorithm within the maxLik R package (Toomet and Henningsen 2010) for the conditional mean count data and hurdle models and the quantreg package (Koenker 2011) for the QR count data models. For each subset of the data (eight separate models) extreme outliers were deleted as well as cases where travel cost or other data were missing.

4 Survey Results

4.1 Respondents

A total of 1101 survey respondents from the Wide Bay Burnett to the far north of Queensland were asked to detail their recreational use of the Great Barrier Reef. Respondents from six regions were surveyed: Burnett Region, Gladstone Region, Rockhampton and Capricorn Coast, Sarina to Whitsunday's, Townsville Region and Cairns Region. Key demographic and location characteristics of respondents are summarised in Table 4.1 and Appendix 1. Full details of respondent locations are in Appendix 2.

Respondents from the different regions had a simular mix of income bands, with no significant differences ($\chi^2_{1,25}$ = 102.525, P = 0.000) . The Burnett Region had a higher proportion of lower income residents, but when compared with the other regions the difference was not significant ($\chi^2_{1,5}$ = 53.431, P = 0.000) .

Between 55 and 65% of respondents from all areas owned their own homes, and most have lived at their current addresses for 6 years (median). Respondents in Townsville and the Capricorn were less likely to have chosen their location based on the beach or boating facilities (Table 4.1). A higher proportion of respondents from Cairns and the Burnett Region indicated that they chosen to live where they were to be close to the beach. Respondents from the Rockhampton and Capricorn Region on average lived further from the coast than respondents in the other regions (Table 4.1).

Table 4.1: Respondent socio-demographic characteristics

	Burnett Region	Gladstone Region	Capricorn Coast	Sarina to Whitsundays	Townsville Region	Cairns Region
No. of Respondents	199	106	149	158	387	101
Do you own your house?	61.2%	62.6%	54.5%	58.8%	53.6%	63.1%
How long have you lived in your house? (mean (SE) & median years)	9.5 yrs (0.8yrs) 7 yrs	12.7 yrs (1.8 yrs) 6 yrs	12.0 yrs (1.2 yrs) 10 yrs	9.0 yrs (0.9 yrs) 5 yrs	9.3 yrs (0.6 yrs) 6 yrs	8.7 yrs (0.9 yrs) 6 yrs
Have you chosen to live at your address to be close to the beach or boating facilities?	39.2%	20.0%	16.2%	31.4%	17.5%	54.4%
How far is it to the beach where you live? (mean (SE) & median distance)	16 km (1.2km) 13 km	14.3 km (1.4 km) 10 km	31.1 km (1.6 km) 35 km	9.4 km (0.8 km) 5 km	14.3 km (0.9 km) 10 km	11.0 km (4.4 km) 2 km

Community aspects most important to respondents were lifestyle, health services and proximity to family and health services (Figure 4.1). School and educational facilities and access to fishing were identified as the least important characteristics.

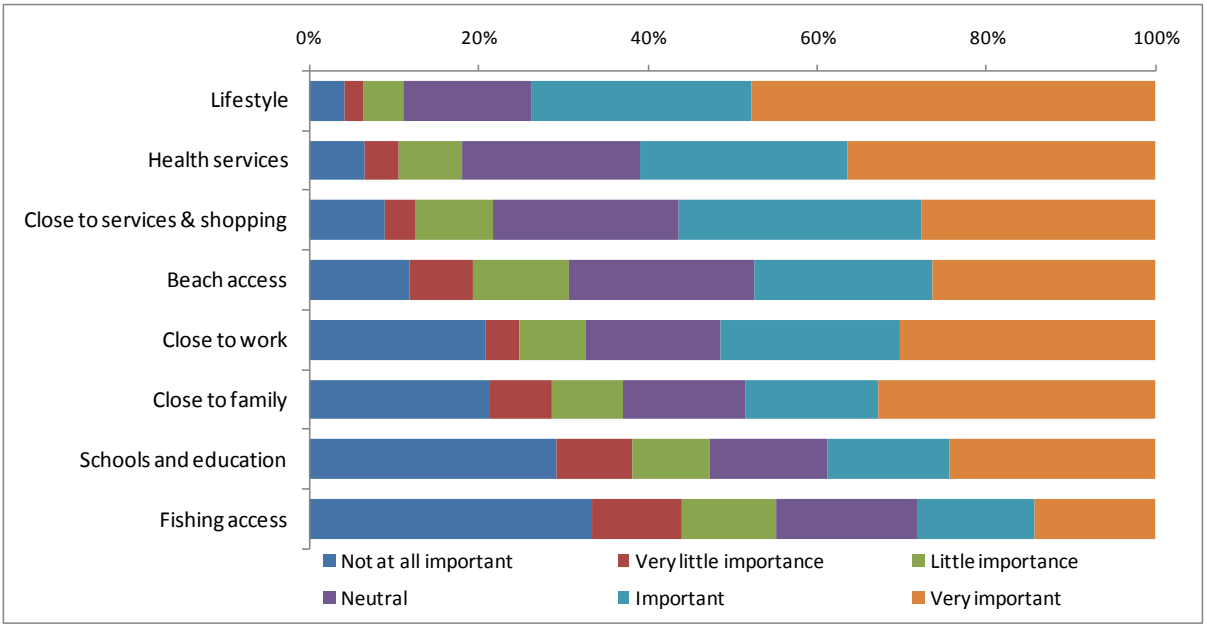

Figure 4.1: Importance of community aspects to respondents

Many respondents listed "other" characteristics as important to their choice of residence, including:

- Weather/climate
- Cost of living
- Housing prices
- Affordability
- Lived in the area all their life
- Wildlife and national parks
- Cleanliness
- Air and water quality
- Not over crowded
- "Small Town" living
- Retirement lifestyle
- Rural lifestyles

4.2 Visiting mainland beaches

Current use

There were a total of 182 beaches visited by 86.1% of the respondents from this survey (Table 4.2). Of these 146 beaches were more favoured. Respondents were less likely to have a second most visited beach with 14.2% less not visiting a second beach. However, those who visit a second beach tend to have a more varied choice reflected in a greater number of beaches listed as a second most visited (Table 4.2).

Table 4.2: Proportion of respondents who visited beaches and the number of beaches visited

Region	Respondents visiting a beach in the last 2 years	Respondents visiting a second beach in the last 2 years	Number of beaches		
			Most visited	Visited by more than 1% of respondents	Second most visited
All regions	86.1%	71.9%	146		182
Burnett	80.9%	69.1%	26	12	34
Gladstone	71.7%	53.7%	18	9	31
Capricorn Coast	89.2%	77.1%	28	13	30
Sarina to Whitsunday's	90.2%	76.3%	31	21	38
Townsville	87.6%	70.4%	58	11	76
Cairns	94.6%	85.0%	13	11	24

The beach preferences of respondents from each region varied, with each visiting a different suite of beaches. The most visited beaches are listed below in Table 4.3 (a to f) and Appendix 3, where beaches visited by more than 1% of respondents are listed.

Table 4.3: Beaches from each region visited by 1% or more of respondents from that region (Appendix 3 lists remaining beaches with <1% of respondent visiting).

a) Burnett Region

	Most visited	Second most visited
Bargara Beach	34.0%	17.6%
Kellys Beach	9.0%	7.1%
Moore Park Beach	7.4%	7.0%
Elliott Heads	6.2%	4.6%
Oaks Beach	4.0%	0.3%
Agnes Water Beach	3.3%	2.4%
Hervey Bay	2.5%	0.8%
Kings Beach	1.7%	-
Coonarr Beach	1.6%	2.0%
Rules Beach	1.5%	0.9%
Nielson Park Beach	1.3%	3.5%
Woodgate Beach	1.3%	2.8%
Other within the region	4.7% (9 beaches)	16.2% (15 beaches)
Other outside the region	2.2% (5 beaches)	3.7% (7 beaches)

b) Gladstone Region

Beach	Most visited	Second most visited
Tannum Sands	53.3%	4.8%
Barney Point Beach	2.7%	3.1%
Yeppoon Main Beach	2.3%	3.7%
Manly	1.5%	1.5%
Farnborough Beach	1.5%	-
Moffat Beach, Caloundra	1.3%	-
Shornecliffe	1.3%	-

Beach	Most visited	Second most visited
Agnes Water Beach	1.2%	5.6%
1770	1.1%	2.7%
Other within the region	1.8% (3 beaches)	24.1% (12 beaches)
Other outside the region	3.6% (6 beaches)	11.2% (13 beaches)

c) Capricorn Coast Region

Beach	Most visited	Second most visited
Yeppoon Main Beach	43.9%	19.2%
Emu Park Beach	9.7%	20.5%
Farnborough Beach	6.4%	1.7%
Kemp Beach	5.3%	8.2%
Lammermore Beach	3.8%	4.0%
Mulumbin	3.6%	0.4%
Keppel Sands	1.6%	1.2%
Bribie	1.2%	-
Bell Park	1.1%	-
Lillys Beach	1.1%	-
Sentosa	1.1%	-
Woodgate Beach	1.1%	-
Kellys Beach	1.1%	-
Other within the region	6.9% (13 beaches)	16.4% (16 beaches)
Other outside the region	1.3% (2 beaches)	5.5% (7 beaches)

d) Sarina to Whitsunday's Region

Beach	Most visited	Second most visited
Mackay Harbour Beach	16.4%	12.6%
Mackay Town Beach	12.9%	6.4%
Airlie Beach	11.7%	5.3%
Far Beach	5.5%	4.7%
Blacks Beach	5.2%	3.6%
Shoal Point	3.6%	2.3%
Cannonvale Beach	3.5%	4.4%
Lamberts beach	3.1%	2.2%
Sarina Beach	2.5%	4.3%
Cape Hillsborough	2.4%	1.4%
Seaforth Beach	2.2%	1.3%
Conway Beach	2.2%	1.2%
Armstrong Beach	2.1%	1.2%
Midge Point Beach	1.9%	0.8%
Bucasia	1.9%	5.1%
Dingo Beach	1.8%	3.2%
Illawong Beach	1.5%	-
Slade Point	1.4%	-
Grasstree Beach	1.2%	0.4%
Palm Cove	1.2%	-
Eimeo Beach	1.0%	3.9%
Other within the region	3.1% (5)	11.3% (18)
Other outside the region	2.0% (5)	1.2% (3)

e) Townsville Region

Beach	Most visited	Second most visited
The Strand	43.9%	10.0%
Plam Cove	4.0%	3.1%
Etty Bay	3.9%	1.5%
Pallarenda	3.3%	9.5%
Yorkey's Knob	2.6%	2.4%
Alva Beach	2.6%	0.9%
Mission Beach	2.6%	3.4%
Bushland Beach	2.3%	5.0%
Rowes Bay	1.9%	1.0%
Holloways Beach	1.5%	0.7%
Trinity Beach	1.3%	3.0%
Other within the region	12.0% (35 beaches)	18.0% (44 beaches)
Other outside the region	3.5% (10 beaches)	9.0% (19 beaches)

f) Cairns Region

Beach	Most visited	Second most visited
Trinity Beach	22.5%	15.7%
Port Douglas	18.2%	2.0%
Plam Cove	13.7%	17.3%
Kewarra Beach	10.4%	1.8%
Yorkey's Knob	7.7%	8.4%
Holloways Beach	6.9%	1.8%
Clifton Beach	5.8%	10.3%
Kurrimine Beach	3.2%	-
Newell Beach	2.2%	2.2%
Buchans Beach	1.6%	2.4%
Mission Beach	1.2%	15.7%
Other within the region	1.2% (2 beaches)	13.2% (9 beaches)
Other outside the region	-	7.0% (5 beaches)

How are beaches used?

The most popular activities of respondents while visiting beaches (Table 4.4) were walking, relaxing, spending time with family and friends, swimming and eating (picnicking or eating out). Only one quarter of respondents used their most frequently visited beach to walk their dogs or to go fishing. Boating and fishing were the two least popular activities. The second most visited beach had the same suite of activities as the most popular for respondents, with the exception of fewer walking their dogs and more going fishing and camping.

Table 4.4: Activities undertaken by respondents while at the beach

Activity	Proportion of respondents undertaking the activity	
	Most visited beach	Second most visited beach
Walking	75.6%	69.1%
Relaxing & views	73.2%	63.8%
Family & friends	59.5%	53.1%
Swimming	50.9%	44.1%
Picnicking & BBQ's	37.7%	31.3%
Eating out	31.7%	27.4%
Walking the dog	26.1%	20.9%
Observing nature	26.0%	25.4%
Fishing	25.7%	22.6%
Public events	16.9%	10.5%
Beach sports	11.3%	11.2%
Shopping	8.5%	10.6%
Water sports	6.0%	5.9%
Night life	5.8%	4.8%
Camping	5.3%	5.5%
Boating	4.1%	4.0%
Other	6.5%	4.3%

Of these activities, the respondents felt some were more important than others. Of the top five most popular activities, people were not as passionate about eating (picnicking and eating out) and swimming as they were about spending time with family and friends and relaxing (Figure 4.2). Activities undertaken by only one quarter of the respondents (walking the dog and fishing) were very important to these respondents (Figure 4.2).

The least undertaken activities, boating and camping, were rated very highly by those respondents involved in them. These activities rated even higher at the second most visited beach (Figure 4.3).

For the purposes of analysis, “other activities” that could be grouped with existing categories were adjusted; BBQ’ing was added to picnicking, all beach sports (inc. motorised) were grouped, spending time with friends was added to spending time with family and photography, filming and snorkelling were added to observing wildlife. Other activities that respondents undertook at their beaches (that weren’t grouped) included: attending private events (parties and weddings), work and school trips and other esplanade activities (for example, playgrounds, markets and cycling/roller blading, etc.).

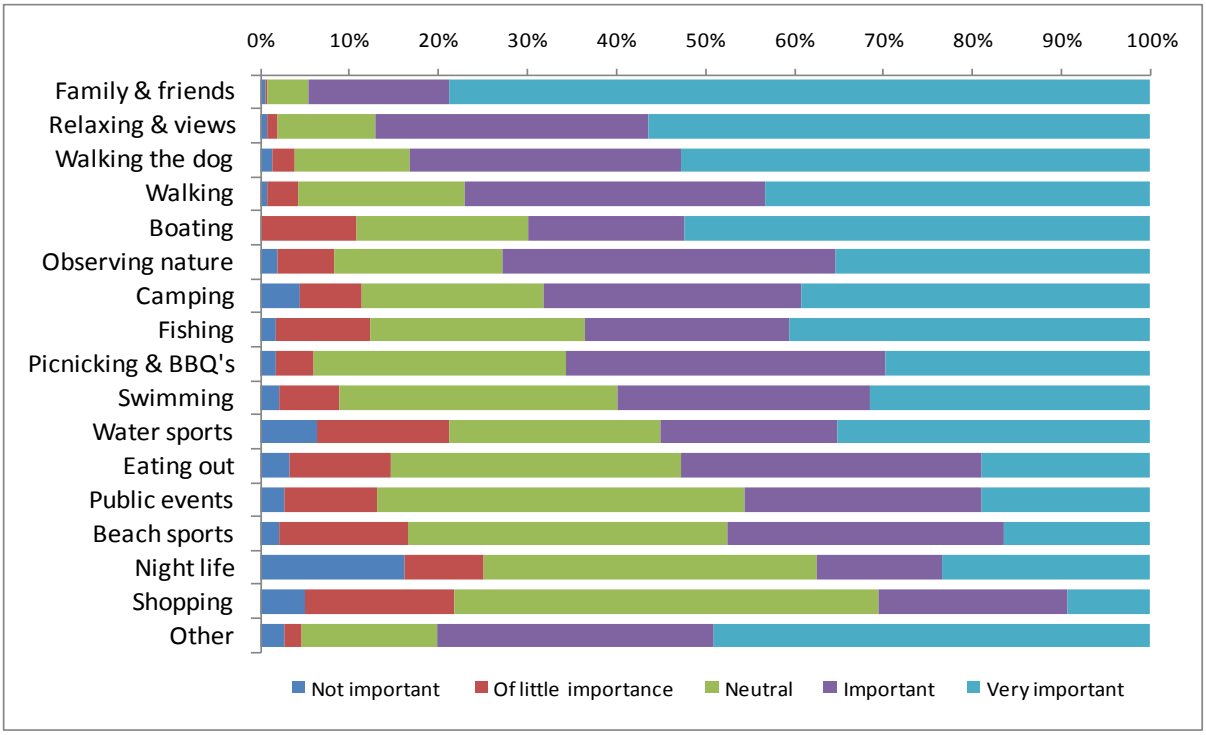

Figure 4.2: Respondents' importance rating for activities undertaken at their most frequently visited beach

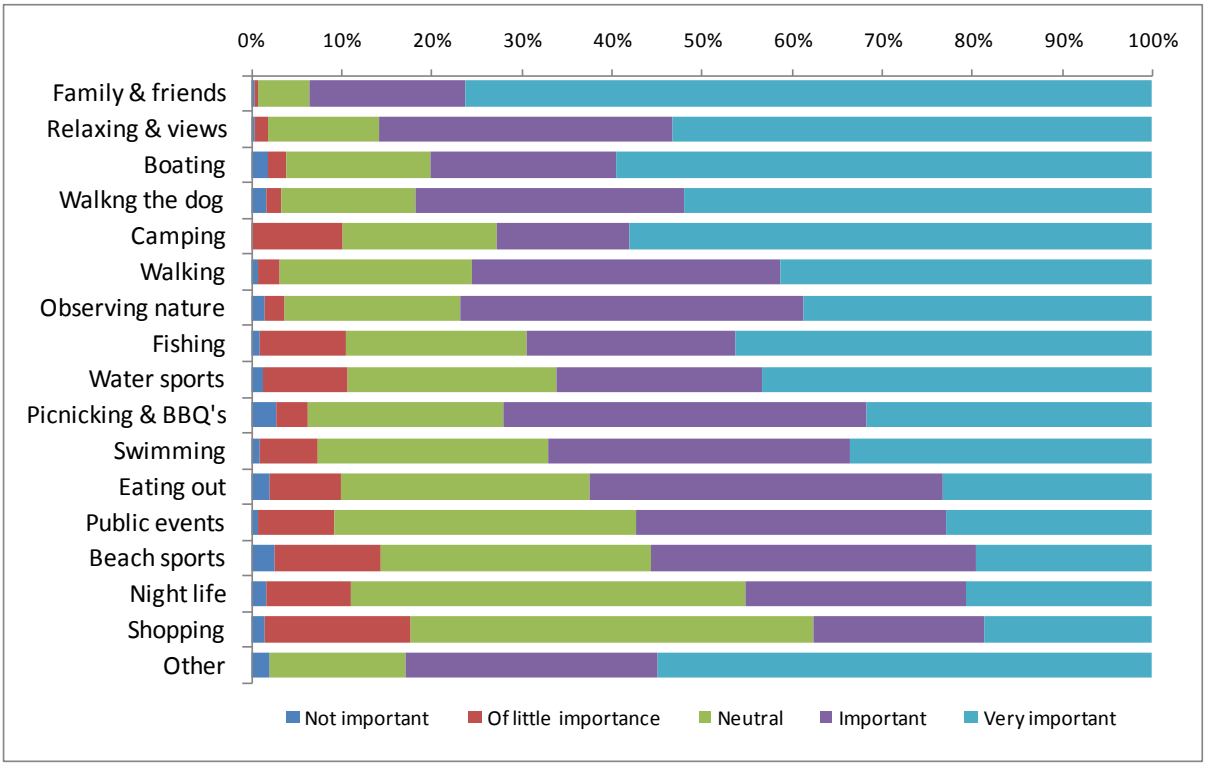

Figure 4.3: Respondents' importance rating for activities undertaken at their second most frequently visited beach

Important features

Features of a beach that are important to visitors are shown below, Figure 4.4. The most important feature was cleanliness of the beach. The next five features, important to more than one quarter of respondents, were facilities, BBQ areas, crowding, and shade and water quality, however, respondents were more passionate about shade and water quality than the others. Lifesavers and stinger and shark protection were important to less than 40% of people, but for those people it was a very important aspect. Those that listed "other" features felt very strongly about them. The most commonly listed "other" features were facilities (including parks) for children, and off beach facilities like walking tracks, café's and restaurants.

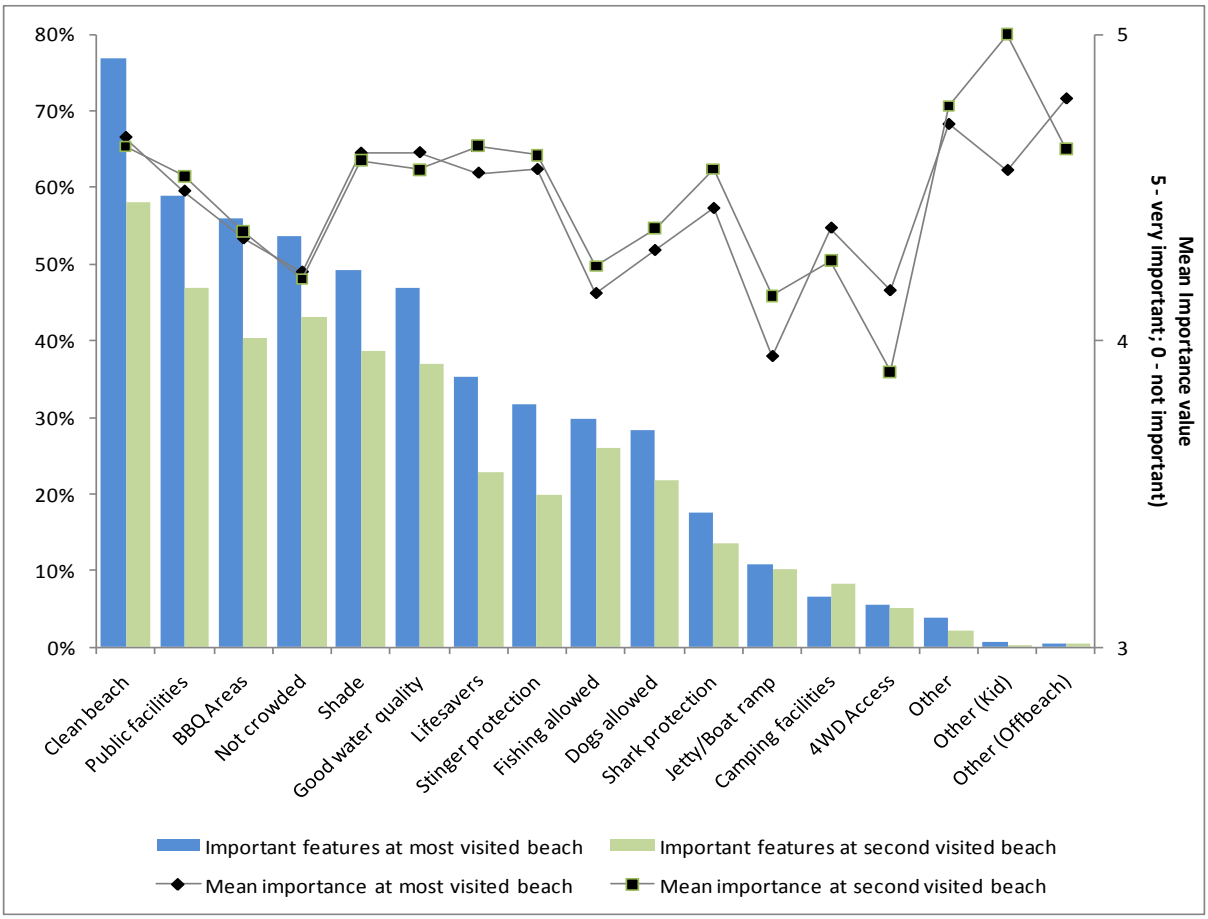

Figure 4.4: Importance of beach features to visitors

Visitation characteristics

The frequency that respondents visited their most visited beaches varied greatly. About one quarter of respondents visited their most visited beach once a fortnight or more, with just over 20% visiting once every month and almost 40% visiting only a few times a year (Figure 4.5). The second most frequented beach as visited by the majority of respondents only a few times a year.

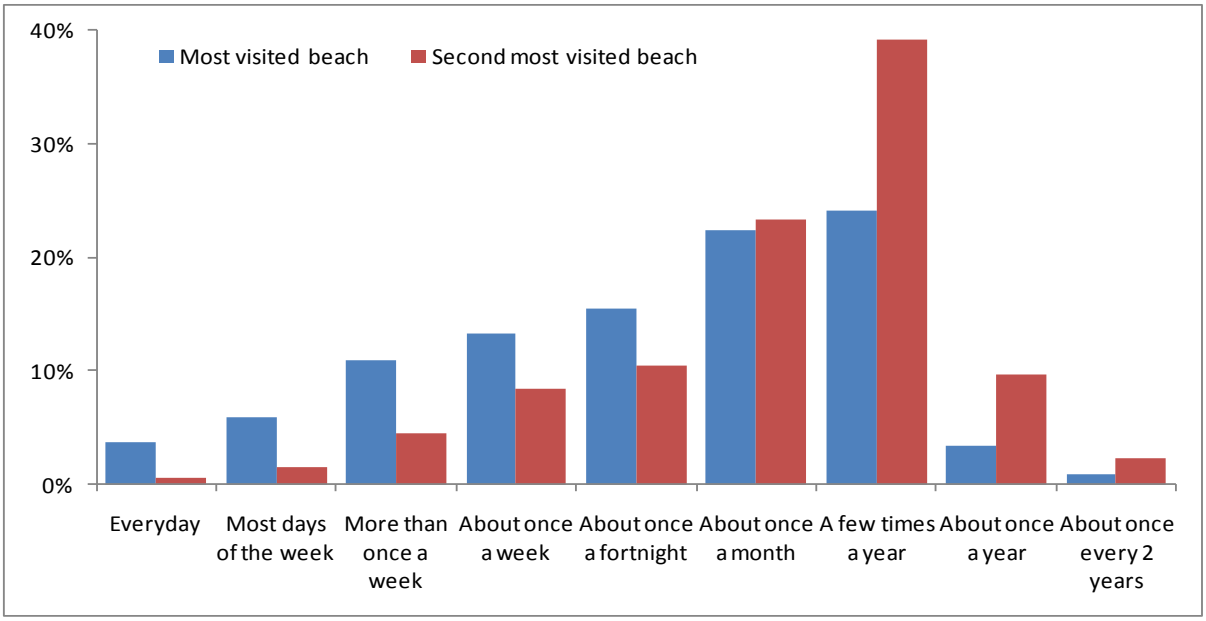

Figure 4.5: Frequency of beach visits by respondents

Respondents were also asked about their future intentions for visiting. Over the next 2 years respondents predicted that they will continue their beach habits, with no significant difference between past and expected future frequency of visits ($\chi^2_{1,64}$ = 3563.727, P = 0.000) (Figure 4.6).

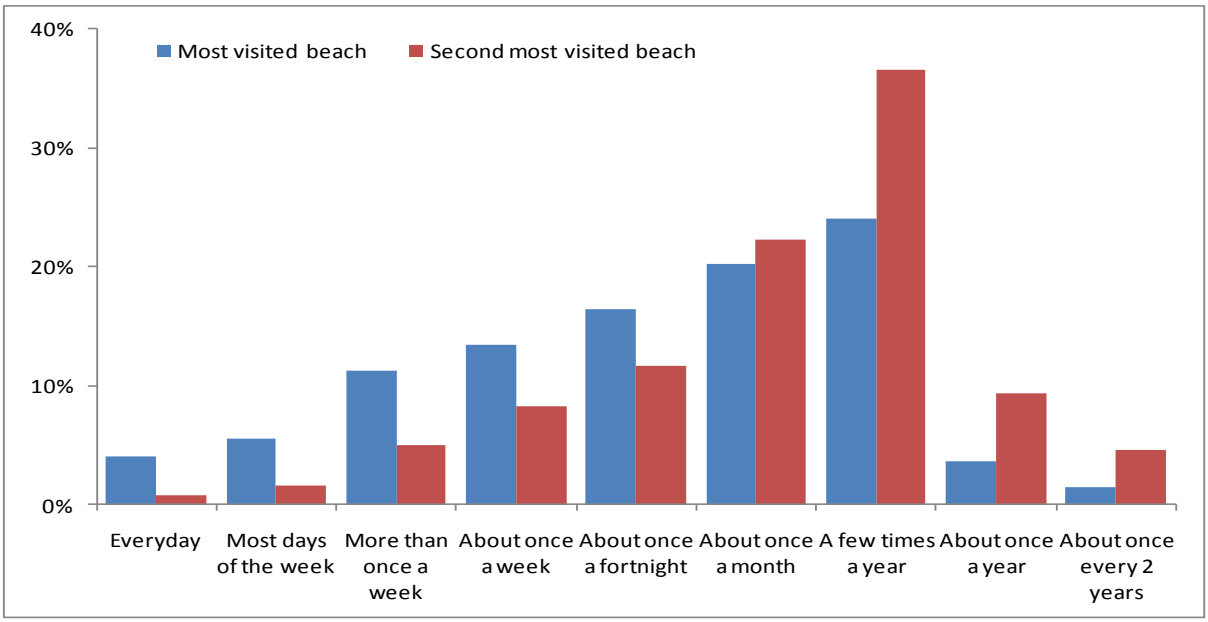

Figure 4.6: Expected future frequency of beach visits by respondents

In each region the distance to the most frequently visited beach was less than the second most frequently visited (Table 4.5 and Figure 4.7). Respondents from the Cairns Region travelled smaller distances to their beaches than respondents in the remaining areas while the respondents from Rockhampton and the Capricorn Coast region travelled the greatest distances to their beaches.

Table 4.5: Distances travelled to, and time spend at, respondents' most and second most visited beaches in each surveyed region

Region	Mean distance to beach		Mean time spent at the beach	
	most visited beach km (SE)	second most visited beach km (SE)	most visited beach hours (SE)	second most visited beach hours (SE)
All regions	33.4 km (2.6 km)	56.5 km (4.4 km)	4.8 hr (1.0 hr)	3.1 hr (0.2 hr)
Burnett	35.5 km (7.4 km)	40.9 km (7.8 km)	5.5 hr (3.5 hr)	2.1 hr (0.2 hr)
Gladstone	42.7 km (21.1 km)	103.8 km (21.9 km)	3.0 hr (0.4 hr)	4.3 hr (1.3 hr)
Capricorn Coast	53.8 km (7.8 km)	75.9 km (13.1 km)	4.2 hr (0.7 hr)	2.8 hr (0.5 hr)
Sarina to Whitsunday's	24.4 km (6.0 km)	30.0 km (7.5 km)	5.1 hr (2.8 hr)	3.2 hr (0.8 hr)
Townsville	31.6 km (4.2 km)	66.3 km (8.4 km)	5.8 hr (1.8 hr)	3.5 hr (0.4 hr)
Cairns	13.2 km (4.8 km)	22.6 km (5.6 km)	2.2 hr (0.3 hr)	2.5 hr (0.4 hr)

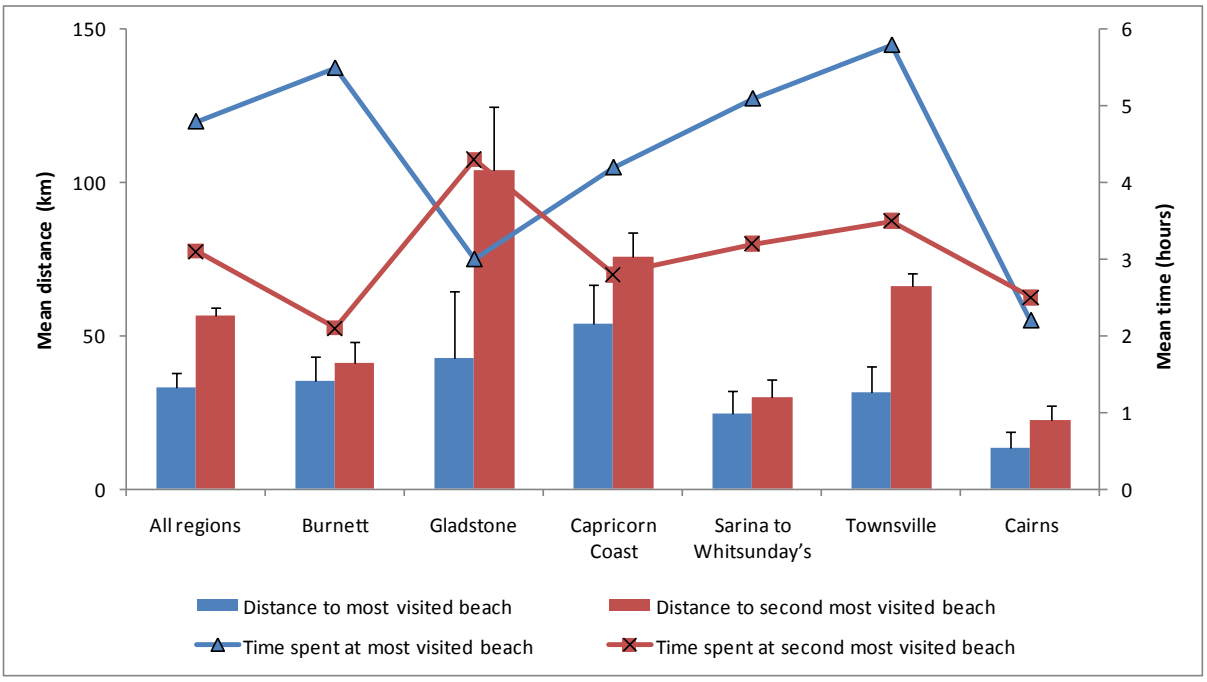

Figure 4.7: Distance and time spent at respondents' most and second most frequented beach overall and in each region

When visiting the beach the majority of respondents went with one or two other people (Figure 4.8). Only around 10% of respondents visited their most and second most frequented beach alone.

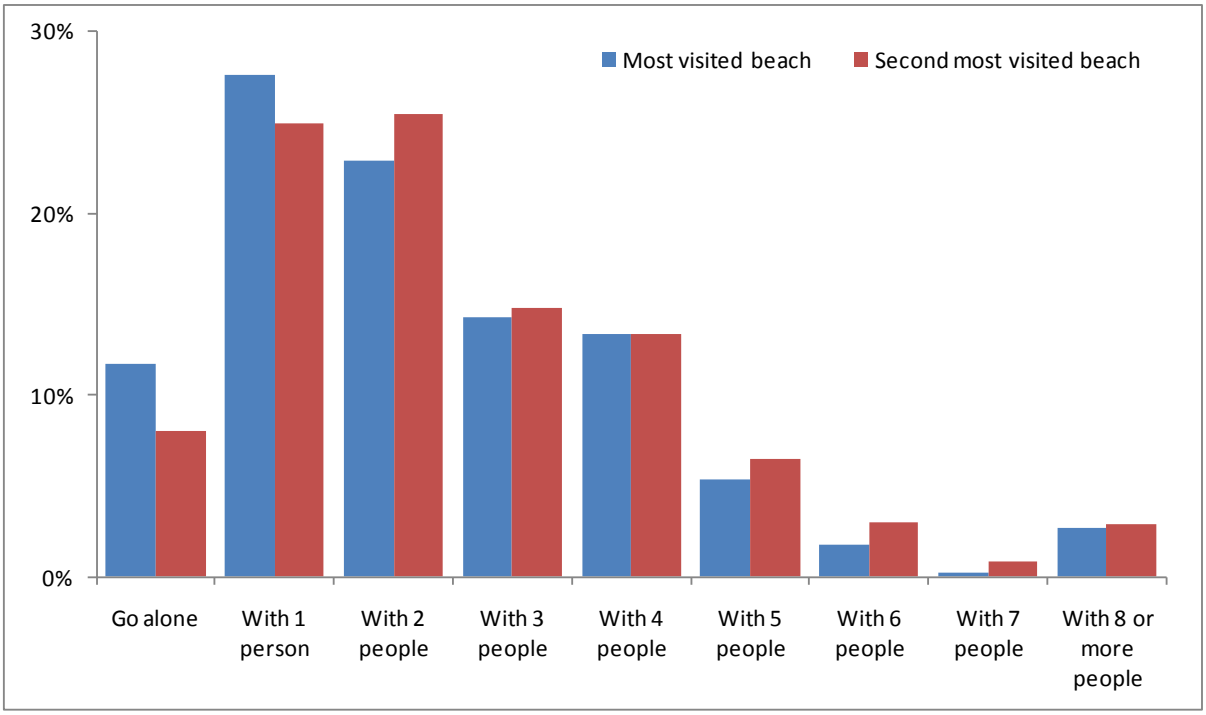

Figure 4.8: Number of people visiting respondents' most and second most frequented beach

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 (Figure 4.9). 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. Within the "other" category of why people would not visit a beach in the next two years, most responses were of a personal nature such as too busy with work, other commitments or people's financial situation, rather than the physical or environmental characteristics of the beach.

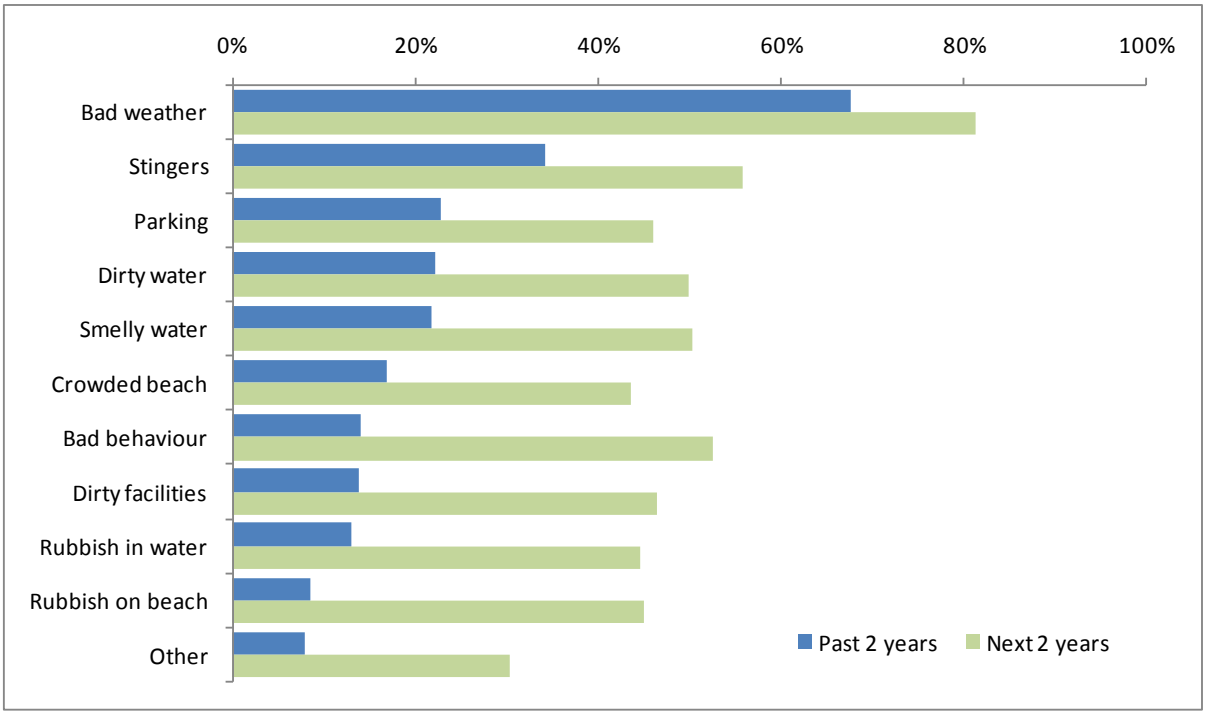

Figure 4.9: Reasons respondents have been or will be (in the future) deterred from visiting the beach

Future water quality

The contingent behaviour questions were focused on identifying how visit rates might be affected by environmental and other conditions. If the water quality at the beaches was to deteriorate, over 50% of respondents indicated that they would not change their beach visiting habitats if conditions were to reduce by 10%, however more people would reduce visits if the condition got 20% worse (Figure 4.10). However, there was no difference between those that would and would not change their visitation (χ^2_1 = 287.258, P = 0.000).

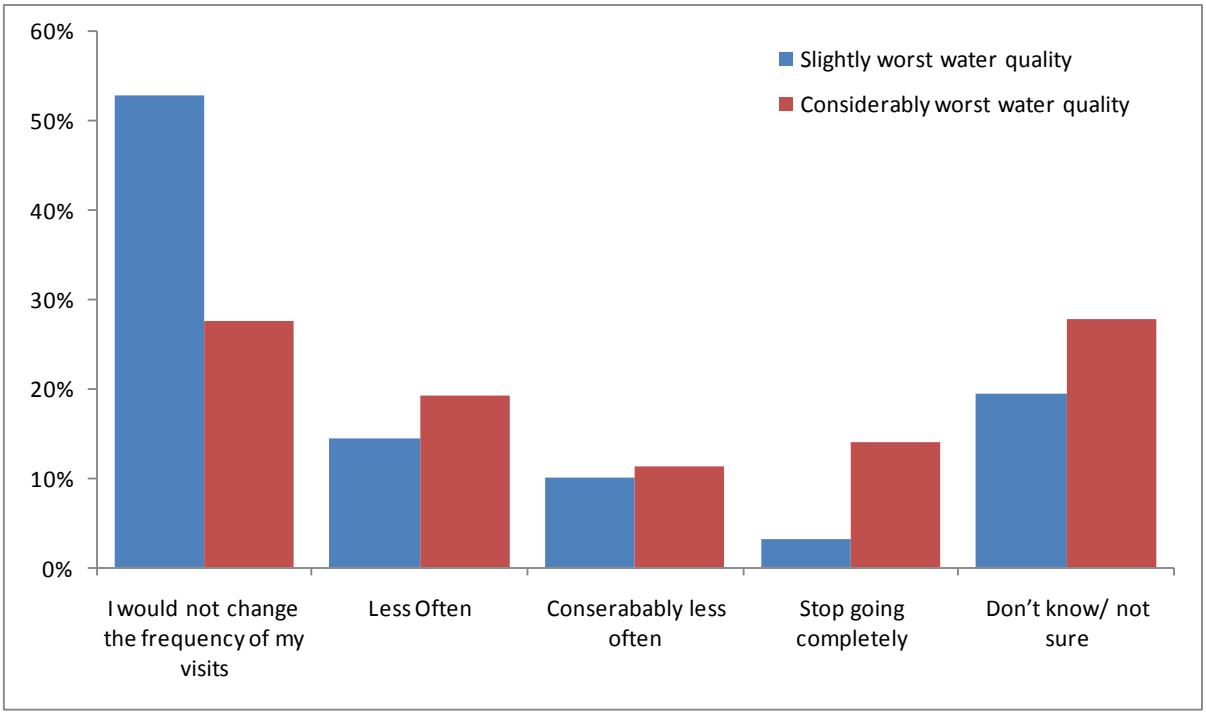

Figure 4.10: Probability of changing beach visits as a consequence of reduced water quality

4.3 Visiting islands

Current use

A total of 365 (33.25%) from the 1101 respondents had visited an island in the last two years (Table 4.6). The islands visited by the most number of respondents as well as the most frequently visited islands include: Magnetic, Great Keppel, Daydream, Hamilton, Green and Whitsunday Islands, see Appendix 4 and 5.

Table 4.6: Respondents visiting islands

Region	Have visited one or more islands in the last 2 years
All regions	33.2%
Burnett	11.0%
Gladstone	19.4%
Capricorn Coast	27.7%
Sarina to Whitsundays	39.6%
Townsville	47.1%
Cairns	35.8%

Respondents visit islands quite infrequently, with most (35.8%) visiting an island less often than every two years. Only 17% visited islands annually and very few (0.2%) visited islands weekly or more

(Figure 4.11). Of those who had visited an island in the last 2 years, most of the visits have taken place more recently (Figure 4.12). Almost 30% of those visiting islands have done so in the last 6 months.

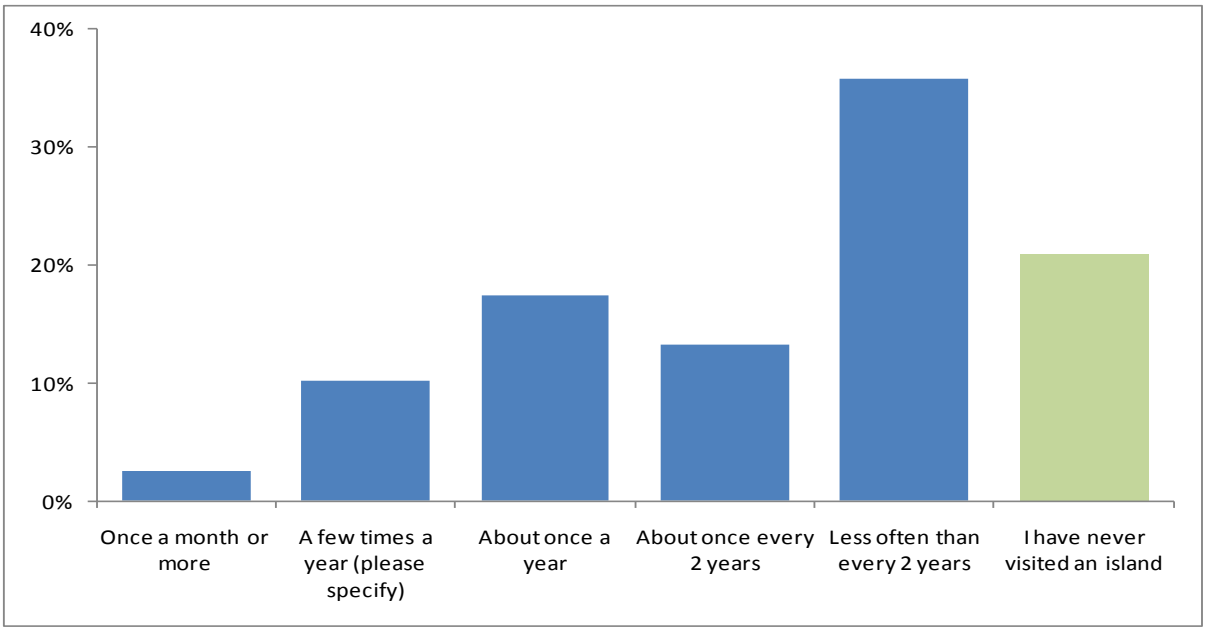

Figure 4.11: Frequency in which respondents visit islands

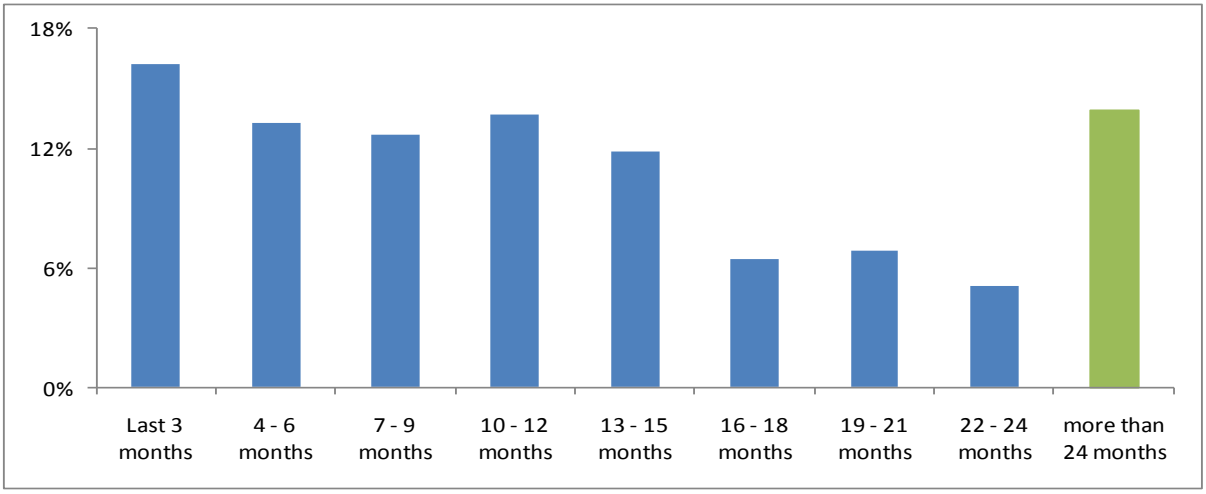

Figure 4.12: Time since respondent's last visit to an island

Island visitations peak in October with 23% of respondents visiting islands in this month (Figure 4.13). Interestingly the summer months of December, January and February only saw 18.8% of respondents visiting islands, less than those visiting in the winter months (20%) (June, July and August).

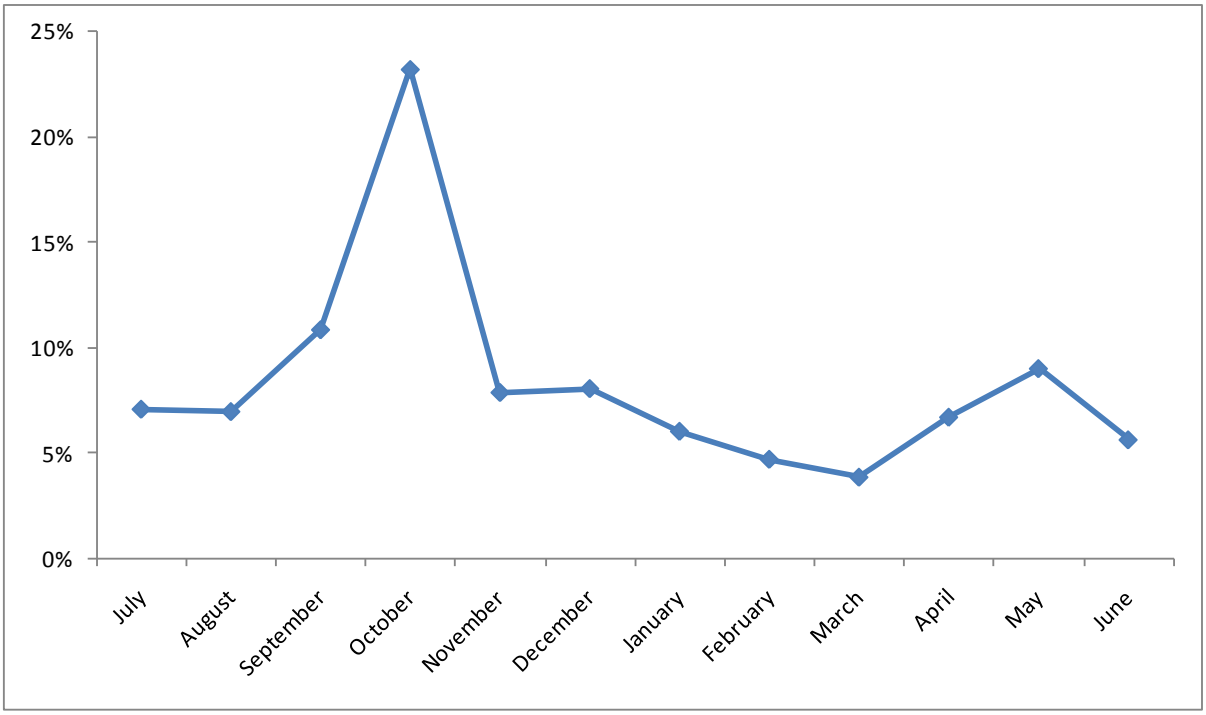

Figure 4.13: Number of respondents visiting islands each month (for the last 2 years)

Visiting an island

Of the respondents who visited an island in the last 2 years, the majority of them (87%) travelled to the harbour by car (Table 4.7). The onward journey to the island was then by ferry or water taxi (62%) or commercial boat (17%). Only about one quarter, 24%, travelled to the islands in private vessels.

The median amount of time taken to travel to the harbour and then onward to the island totalled at two hours or less. The time respondents spent on the island they last visited varied from 1 hour to 60 days, with the average at 1.9 (0.24SE) days (Figure 4.14). Over 40% of respondents spent less than one day on the island they visited most recently (Figure 4.14). When visiting their most recent island, only 6.8% of respondents travelled alone, with the majority (29.2%) travelling with one other person (Figure 4.15). There were almost 8% of respondents who travelled with large groups (more than 20 people).

Table 4.7: Respondents' travel distances and time to their most recently visited island

	Proportion of respondents	Distance Travelled			Time Travelled		
		Mean (km) (SE)	Median (km)	Min & Max (km)	Mean (hrs) (SE)	Median (hrs)	Min & Max (hrs)
Getting to the harbour:							
Car	86.6%	68.1 (6.56)	20.0	1 to 850	2.3 (0.32)	0.5	0.02 to 40
Bus	7.4%	45.5 (18.63)	13.1	2 to 400	1.7 (0.66)	0.5	0.08 to 15
Taxi	2.2%	11.5 (1.55)	10.2	5 to 20	0.3 (0.08)	0.25	0.17 to 0.8
Other	4.4%	87.89 (54.74)	9.5	1 to 800	6.5 (3.35)	0.33	0.02 to 60
Getting to the Island:							
Plane	1.4%	676.4 (322.13)	731.1	20 to 2000	1.9 (0.88)	1.58	0.33 to 6
Ferry/Water Taxi	61.6%	20.5 (2.25)	13.0	1 to 500	2.0 (0.43)	0.58	0.17 to 45
Commercial Boat	17.3%	37.2 (4.87)	26.3	2 to 200	2.4 (0.65)	0.78	0.17 to 30
Own Boat	11.0%	27.0 (4.04)	20.0	3 to 150	6.2 (2.40)	1.00	0.17 to 60
Other Boat	12.9%	42.0 (12.16)	17.4	1 to 450	3.9 (1.85)	1.01	0.17 to 72
Other	0.8%	66.4 (39.42)	60.6	20 to 120	1.2 (0.62)	1.06	0.42 to 2

Note: One respondent (0.3%) travelled to their most recently visited island by Jet Ski; a distance of 30 km taking 1 hour

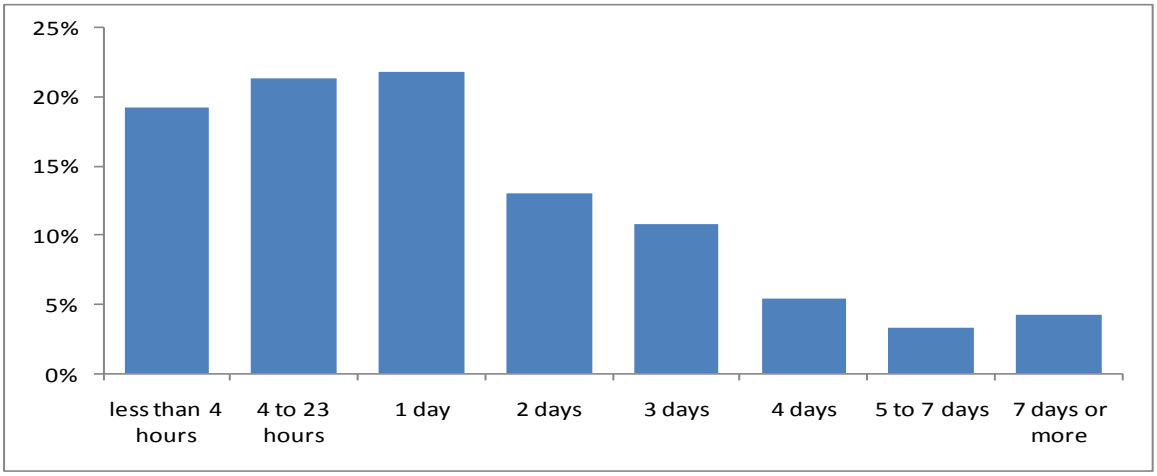

Figure 4.14: Time respondents spent on their most recently visited island

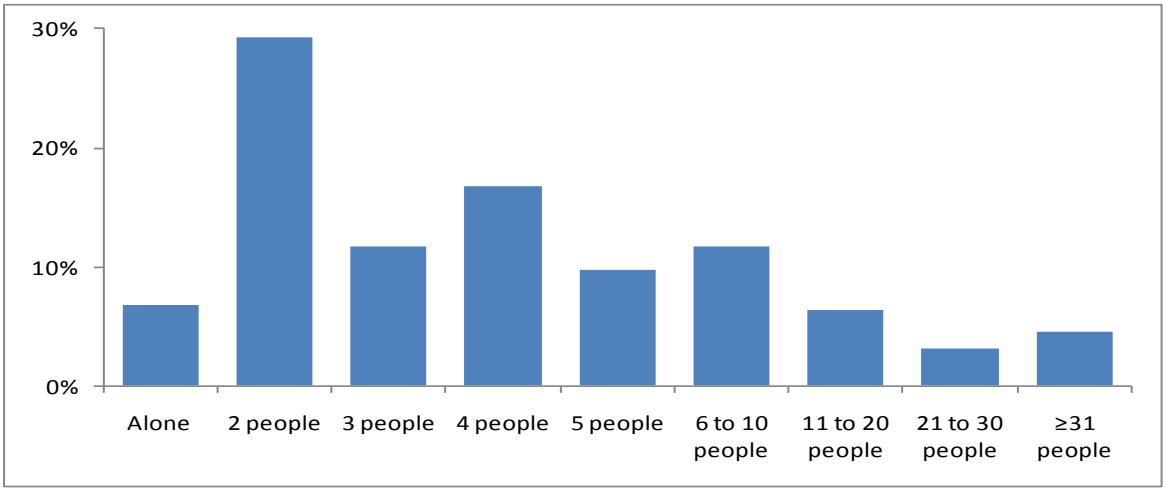

Figure 4.15: Number of people travelling with respondent on their most recent trip to an island

When respondents visit islands they find activities such as relaxing, spending time with family and friends and sightseeing very important (Figure 4.16). Resort activities, shopping, water skiing and eating out/restaurants were not rated particularly highly, with activities related to business having least importance to respondents (Figure 4.16).

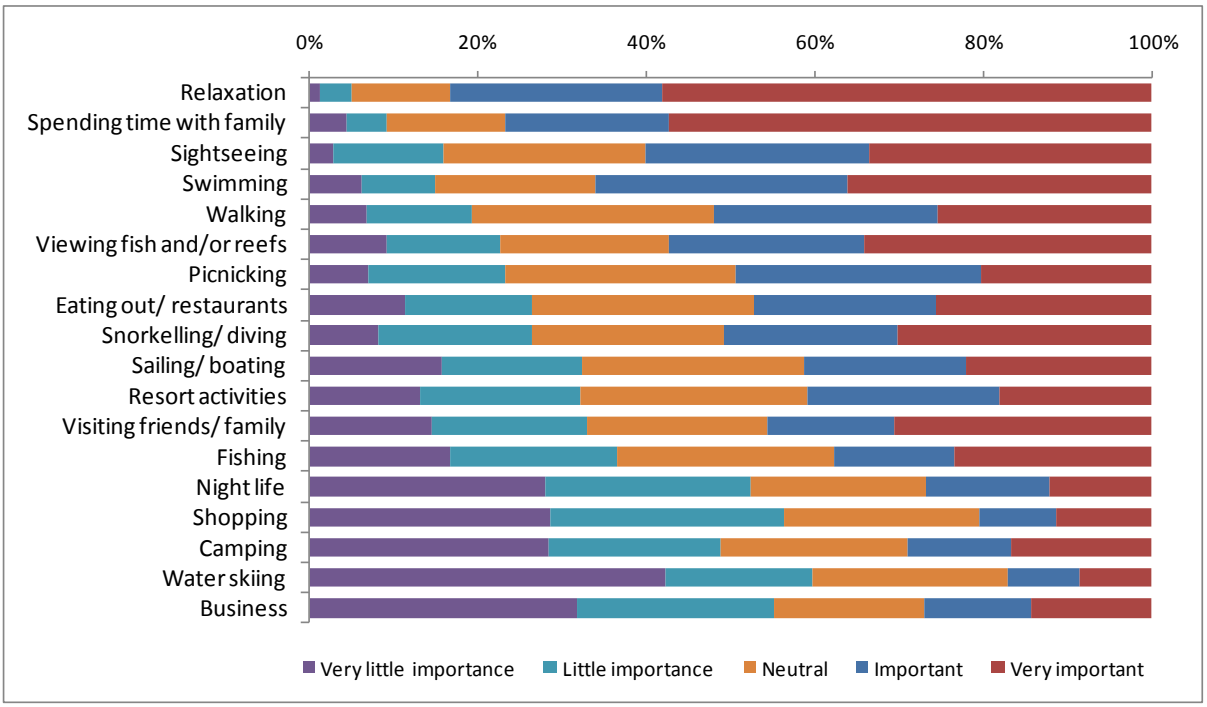

Figure 4.16: Respondents' importance ratings for activities undertaken while visiting islands

Respondents visiting islands spent an average of $136.12 ($13.35SE) on transport getting to and from the island, however the median amount spent was much less at $70 (Figure 4.17). While on the island the average amount spent was $334.36 ($37.87SE) however, like transport, the median amount spent, $80, was much lower than the average (Figure 4.17). Very few (7.1%) travelled for

free with the most spent on transport being $2,535. While on the island over 20% of respondents spent no money at all and the most money spent was $7,000.

As expected the amount of money spent by respondents on their most recent trip to an island is directly correlated to the amount of time they spent there (r_{373} = 0.480, P = 0.000), however, it is not correlated with the number of people in the group (r_{373} = -0.028, P = 0.593).

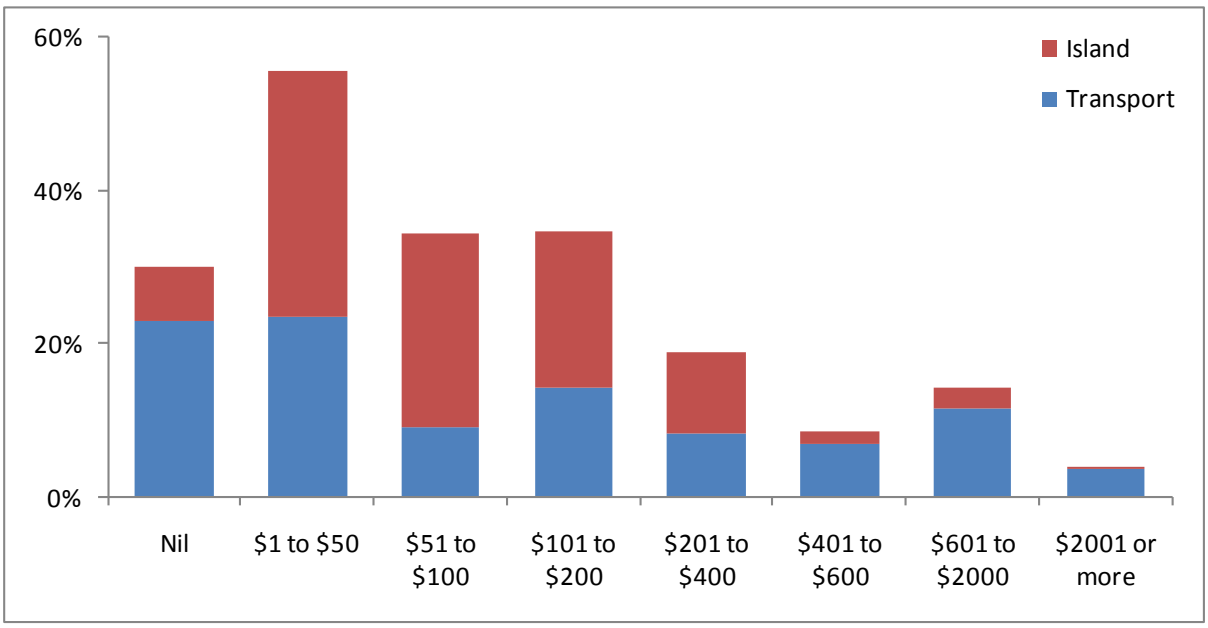

Figure 4.17: Respondents spending during their most recent visit to an island

4.4 Fishing, boating and sailing

Boating activities

The most popular boating activity with respondents was fishing, with over 30% fishing from a boat in the last 2 years (Table 4.8).

Table 4.8: Proportion of respondents boating in the last 2 years - and their primary purpose for the boating trip

	Proportion of respondents
Fishing	32.5%
Sailing	4.8%
Boating	12.2%
None of the above	58.1%

Over 17% of households own a boat of some kind. Almost 15% of households have a motor boat and most of which are valued around $8,000 (Table 4.9). Very few households have a sailing boat (2.7%) but the value of privately owned sail boats is quite high with most being around $20,000 (Table 4.9).

There are many more respondents (56%) that have been sailing in the last 2 years than those that own a boat. There are also many more respondents (33%) who have been fishing or generally boating than those who own a boat.

Table 4.9: Households with boats and their value

	Proportion of households	Mean value of Boat (SE)	Median value of Boat
No boat	82.4%		
Sailboat	2.7 %	$55,000 ($16,000)	$20,000
Other boat	14.9%	$16,000 ($2,000)	$8,000

The frequency of boating activities was generally two or three times a year. There was a higher proportions of respondents that fished more regularly (once a fortnight and once a month) than the other activities (Figure 4.18). Of those respondents who go fishing there was no difference between their current and expected future boating activities ($\chi^2_{1,42}$ = 816.829, P = 0.000). Of the respondents who go boating there was no difference between their current and expected future boating activities ($\chi^2_{1,42}$ = 328.150, P = 0.000), likewise, there was no difference between current sailing and expected future sailing activities ($\chi^2_{1,42}$ = 143.132, P = 0.000).

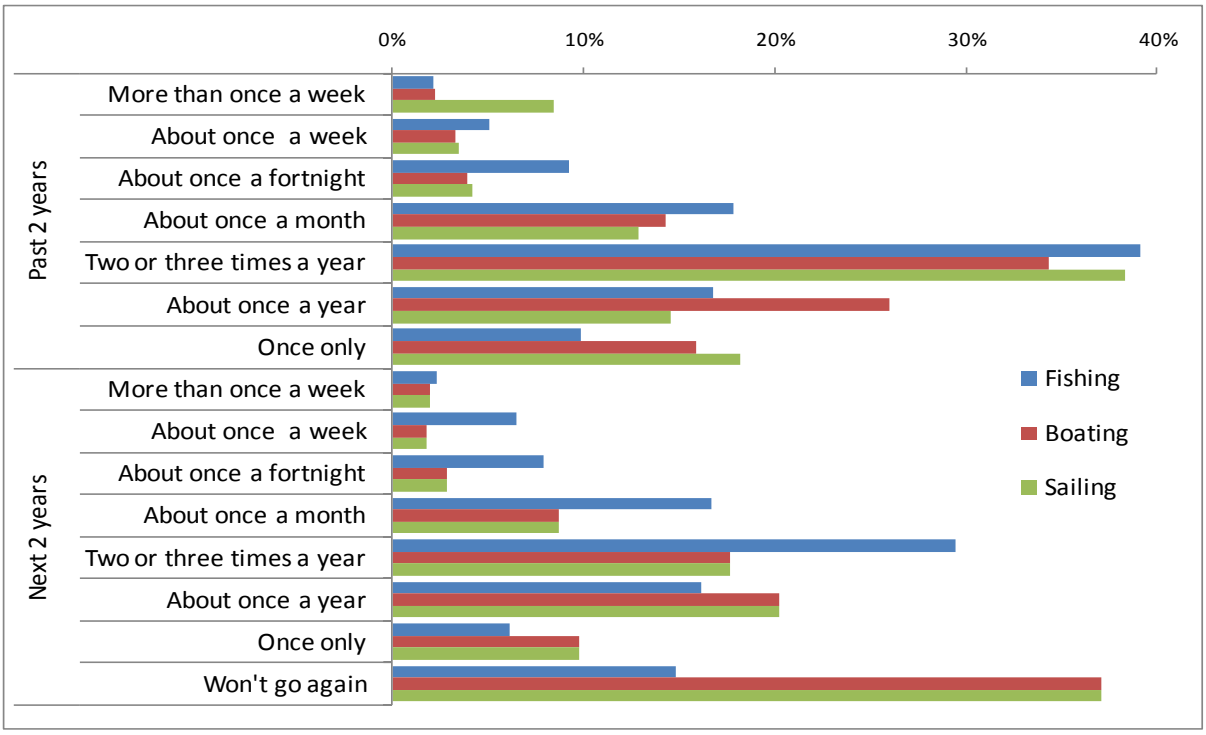

Figure 4.18: Frequency of boating activities undertaken by respondents in the past two years and for the next two years

There was little difference between the time respondents spent boating (regardless of their boating interests), with most spending about 5 hours on the water (Table 4.10 & Figure 4.19). The distances

travelled on the water did vary with respondents on a general boating trip travelling around 300km, while those fishing travelled around 20km (Table 4.10).

Table 4.10: The time, distance and companions on respondents' typical boating trips

		Fishing	Boating	Sailing
Time of trip	Mean (hrs) (SE)	9.5 (1.20)	8.7 (1.15)	15.9 (4.76)
	Median (hrs)	5.0	5.0	5.0
	Min and Max (hrs)	1 to 400	1 to 72	1 to 170
Distance of trip	Mean (km) (SE)	35.65 (2.61)	43.0 (5.82)	51.4 (12.26)
	Median (km)	20	296	20.0
	Min and Max (km)	1 to 600	1 to 800	2 to 400
Number of people	Mean (km) (SE)	3.3 (0.10)	9.6 (1.37)	4.5 (0.41)
	Median	3	4	4
	Min and Max	1 to 20	1 to 99	1 to 20

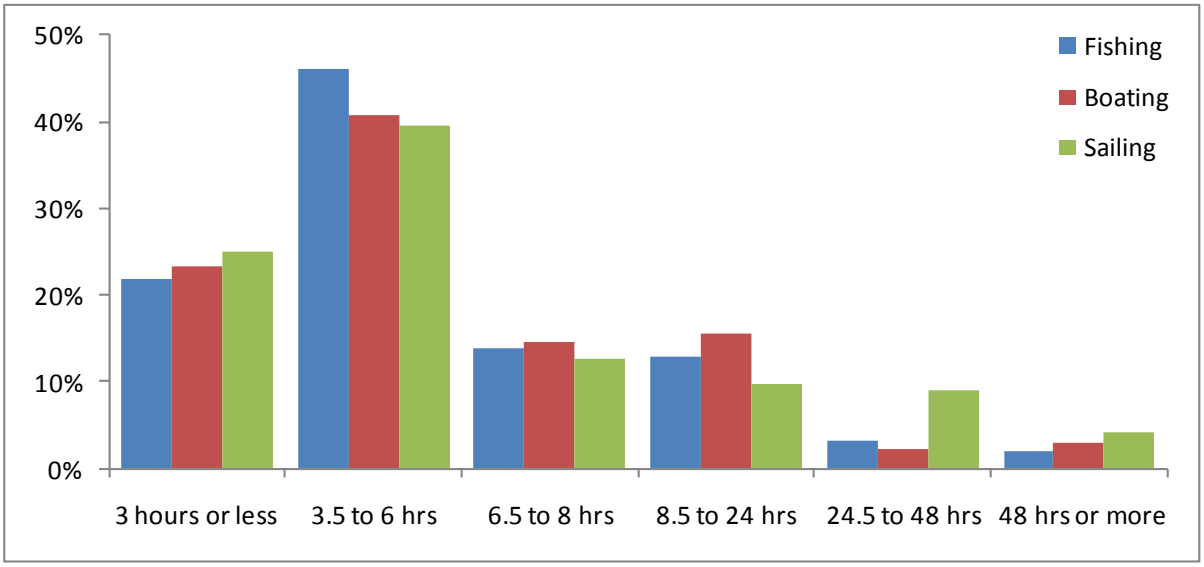

Figure 4.19: The duration of typical boating trips

The typical fishing trip for 60.5% of respondents is less than 20 km (Figure 4.20), while the majority of boating respondents (over 30%) travelled between 40 and 100km (Figure 4.20). Considering that the time on the water was comparable, it demonstrates that a typical fishing trip would involve boating to a location and staying there to fish, while those not fishing travel around much more.

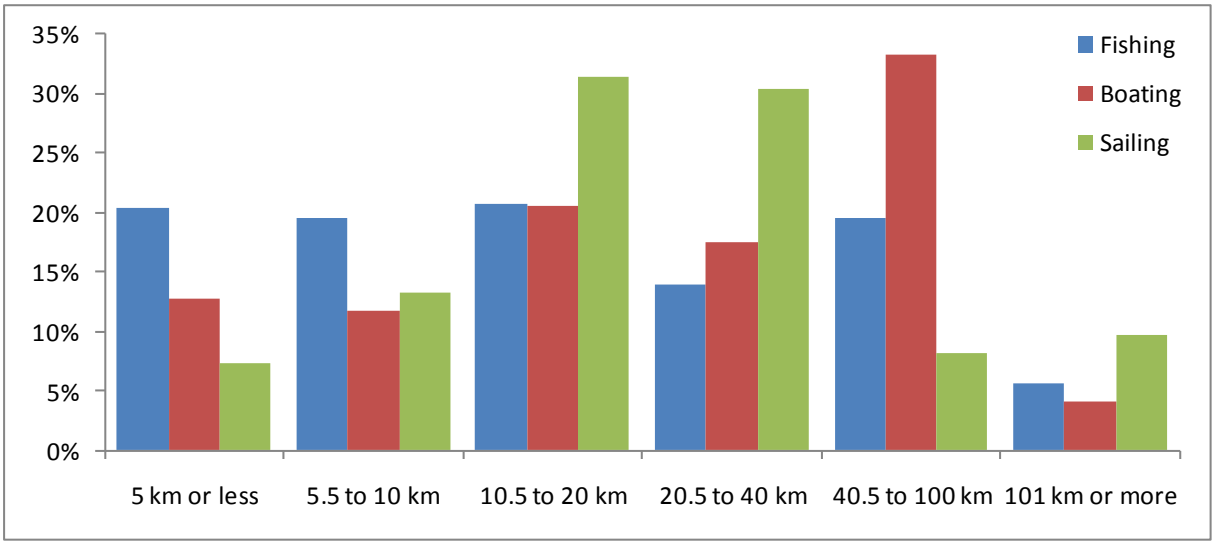

Figure 4.20: The distance of a typical boating trip

The number of people on each boating trip also varied between respondents fishing and those who were not. Close to 60% of respondents fishing were doing so with 2 or 3 people in the boat, while the majority (close to 40%) of those generally boating were with 4 or 5 people (Figure 4.21). Since so few respondents reported sailing (less than 5%) limited comparisons can be made regarding this group.

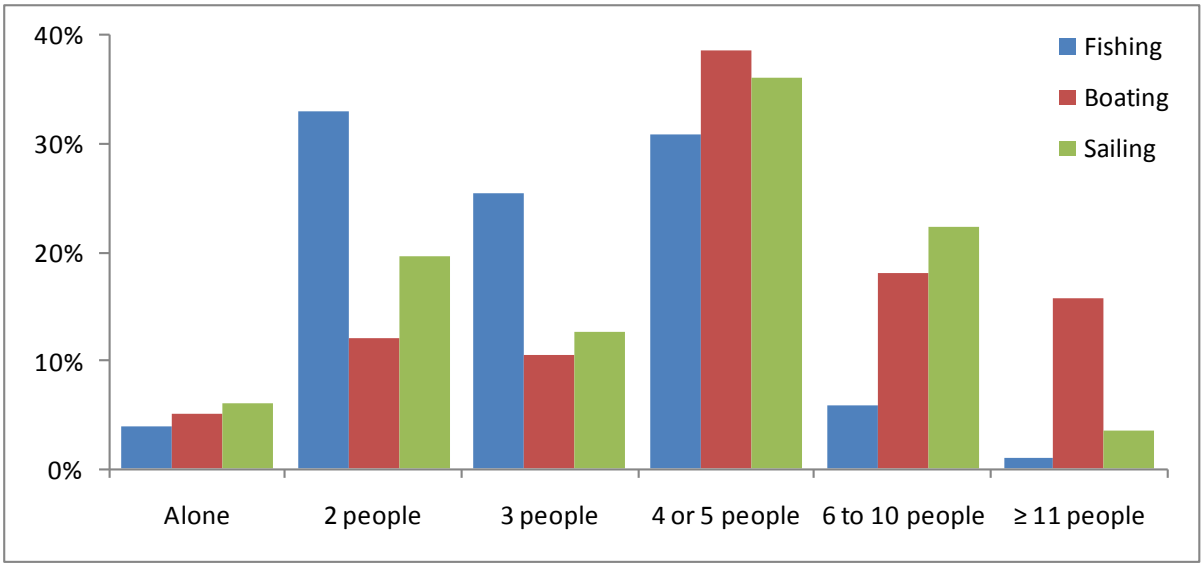

Figure 4.21: The number of companions on a typical boating trip

In general respondents spent more money when boating then they did when fishing (Table 4.11). This was evident by the greater proportion of respondents (15%) spending more than $200 on a boating trip (Figure 4.22). Expenses in Table 4.11 are categorised into three groups: costs of getting to the harbour or water, costs of the boating trip (all inclusive package holidays are included in this category), and personal expenses. Personal expenses included: food, drinks (including alcohol), bait and fishing related expenses, and other items such as ice, insect repellent and sunscreen.

Table 4.11: Costs associated with boating trips

	Mean (SE)	Median	Range
Fishing			
Home to water	$14.62 ($1.25)	$8	$0 to $150
Boating costs	$44.03 ($4.59)	$20	$0 to $970
Personal expenses	$40.31 ($2.09)	$30	$0 to $300
Total	$98.96 ($6.16)	$65	$0 to $1154
Boating			
Home to water	$20.06 ($3.27	$10	$0 to $234
Boating costs	$72.81 ($14.64)	$30	$0 to $1400
Personal expenses	$36.01 ($3.82)	$20	$0 to $300
Total	$128.90 ($17.33)	$80	$2 to $1520
Sailing			
Total[#]	$138.80 ($33.33)	$75	$1 to $1652

[#] Insufficient data to analyse separately

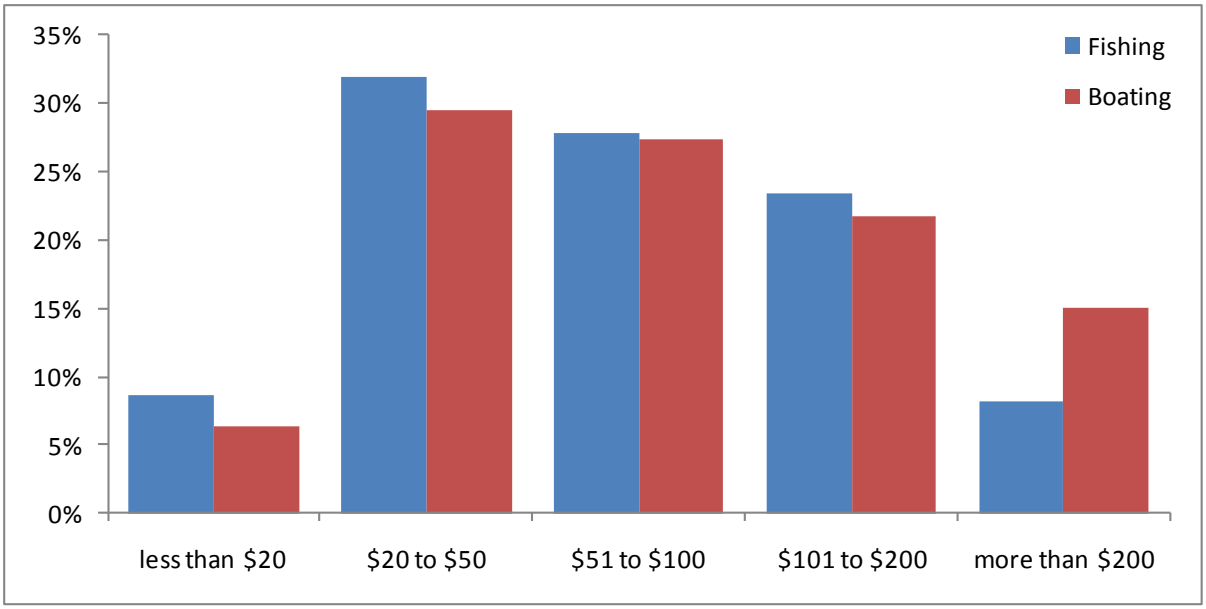

Figure 4.22: Proportion of respondents' spending on boating trips

Water Quality

Respondents were asked about their future boating activities under different water quality scenarios. The aim of these questions was to determine if recreation activities would be sensitive to changes in water quality. Those who fished were asked about their future fishing activities if the catch rate increased by 10% or 20% and then if it declined by 10% or 20% (Figure 4.23 & Figure 4.24).

Although there was between 40 and 45 % of respondents who would not change their fishing frequency for either an increase or decrease in catch rates, there was more uncertainty about future fishing with a decrease in catch rates, with over 15% unsure about their fishing activities in this case (Figure 4.23), apposed to less than 10% unsure with an increase (Figure 4.24). There was no difference in fishing frequencies between a drop in catch rates of 10% to 20% ($\chi^2_{1,49}$ = 1748.799,

P = 0.000), nor was there a difference between fishing frequencies if catch rates increased by 10% or 20% ($\chi^2_{1,49}$ = 1302.328, P = 0.000).

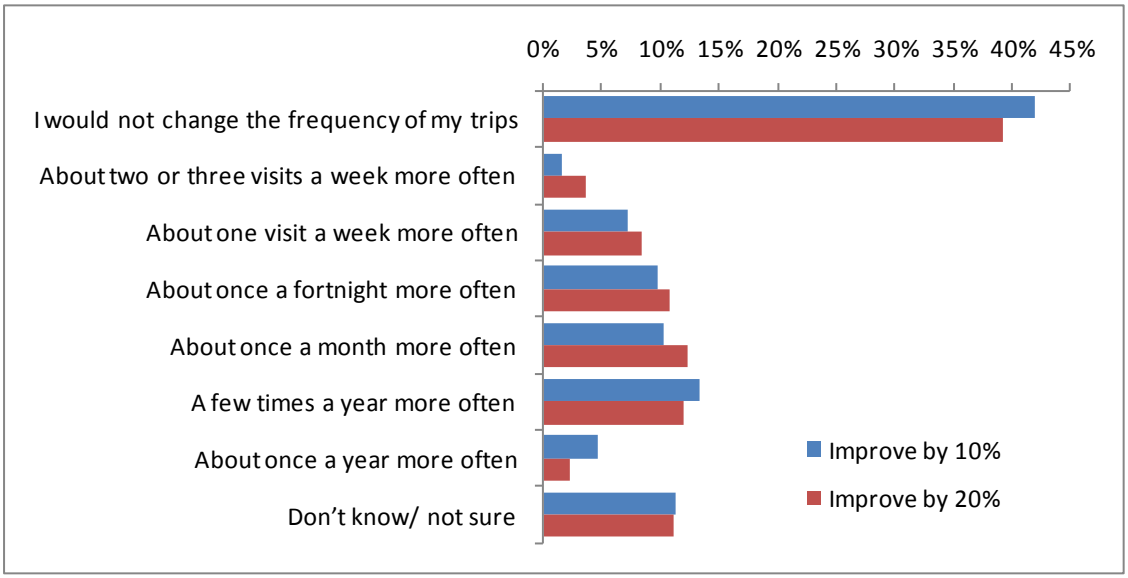

Figure 4.23: Future fishing frequency if there was an increase in the fish catch rates

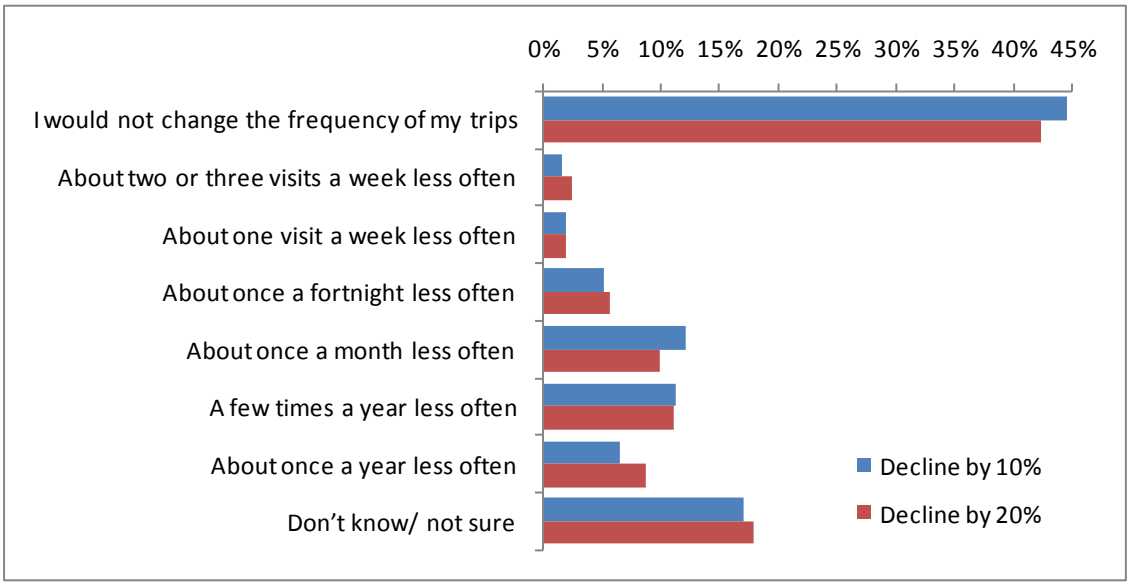

Figure 4.24 Future fishing frequency if there was a decrease in the fish catch rates

For respondents who go boating, if water visibility were to decrease by 10% about 45% would not alter their habits, however, if visibility were to decrease by 20% only 32% would continue their current boating frequency (Figure 4.25). Many respondents (around 30%), were not sure or undecided about their future boating habits with a decrease in water visibility. Close to 10% of respondents would completely stop going boating if the visibility were to decrease by 20% (Figure 4.25). Future boating

frequencies were not significantly different if water visibility were to decrease by 10% or 20% ($\chi^2_{1,64}$ = 392.272, P = 0.000).

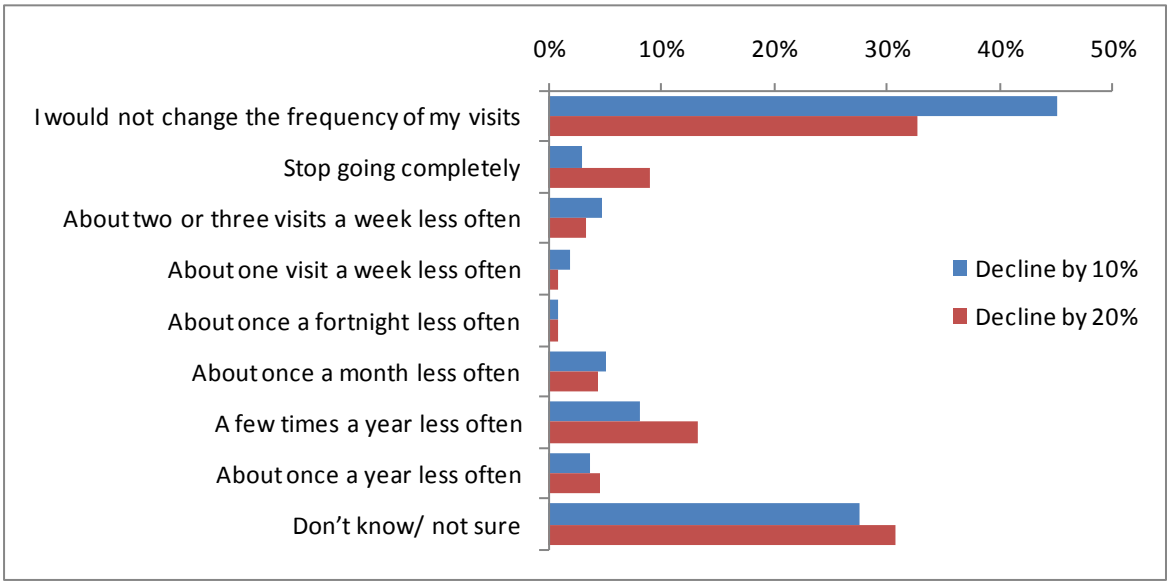

Figure 4.25: Future boating frequencies if water visibility were to decrease

Respondents who sailed would mostly (64%) continue their sailing frequencies if water visibility were to decline by 10%, however, if it were to decrease by 20%, less than 50% would continue their sailing frequency and close to 35% are unsure about their sailing (Figure 4.26). A decline in visibility by 20% would also see a proportion completely stop sailing. However, very few respondents (2.7%) sailed, so the future estimates of sailing frequency must to be reported with caution.

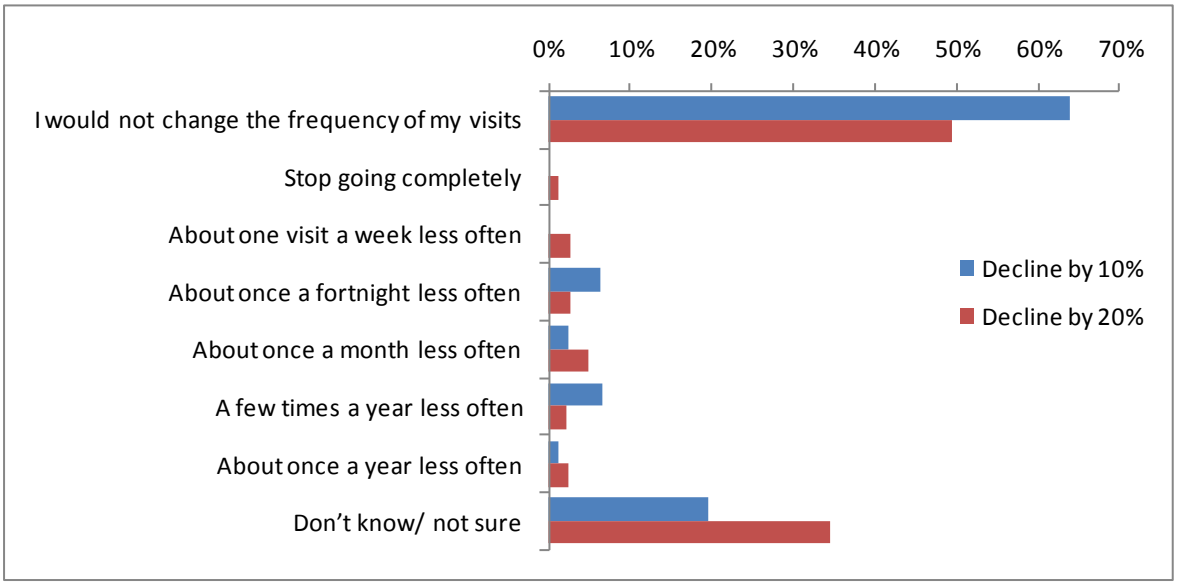

Figure 4.26: Future sailing frequencies if water visibility were to decrease

5 Valuing recreation visits

The recreation data were analysed in two stages. This approach specifies separate processes for the participation decision and for the frequency of participation decision. Modelling the data in this way minimised requirements for data collection from respondents who had zero visit rates for different recreation assets and handled the high proportions of zero visit rates in some categories.

5.1 Participation models

The first stage of the analysis identified participation models, which allowed both demographic variables and factors underpinning respondent location to be included in models. Inclusion of the latter variables is important because recreation users may choose to minimise trip costs by living close to preferred sites (Randall 1994).The results of Probit models for the participation decision in 'most preferred beach', 'second most preferred beach', 'islands', and 'fishing' trips are shown in Table 5.1.

Table 5.1: Probit models for participation decision (hurdle step) for 'most preferred beach', 'second most preferred beach', 'islands' and 'fishing'

Parameter	Beach 1	Beach 2	Islands	Fishing
Intercept	0.0961	0.1741	-1.4565***	-1.049**
Own house? (y=1)	0.0087	0.1141	-0.0211	0.0936
Years lived	-0.0025	-0.0019	-0.0024	0.0028
Distance to Beach	0.0040	0.0022	-0.0037	-0.0013
Chose loc. For beaches or fishing? (y=1)	0.0343	-0.2493*	-0.0908	-0.0871
Num. Adults in house	-0.0275	-0.0196	0.0080	0.0438
Num. Dependents in house	-0.0573	0.0307	-0.1721***	-0.0142
Edu. Grade 10	-0.2078	-0.2315	0.1928	0.1368
Edu. Grade 12	-0.0199	-0.1140	0.3719	0.1864
Edu. Dip./Trade	-0.1408	-0.1514	0.3968*	0.0165
Edu. Tertiary	0.2453	0.0013	0.3607	0.1372
Edu. Postgraduate	0.4772	0.2397	0.6123**	0.1484
Gender (m=0)	0.3280***	0.1994**	0.2031**	-0.3292***
Age	-0.0072	-0.0038	-0.0027	-0.0089*
Income cat. 2	0.1296***	0.1310***	0.0826**	0.1125***
Choose location for:				
Beach access (y=1)	0.4929***	0.2479***	0.1151***	-0.0901**
Fishing access (y=1)	-0.0876**	0.0055	0.0359	0.5204***
Lifestyle (1=not imp. - 5=v. Imp.)	-0.0443	-0.0109	0.0737*	0.0037
Family	-0.0272	-0.0296	-0.0796***	-0.0019
Work	0.0075	0.0137	0.1074***	0.0152
Health serv.	-0.0220	-0.0183	-0.0526	0.0065
Schools	0.0385	0.0289	0.0015	-0.0091
Maj. Serv.	0.0106	-0.0081	0.0142	-0.1229***
LogLik	-290.2539	-534.2071	-577.4776	-446.0321
n	1049	1049	1049	1049
logL/n	-0.28	-0.51	-0.55	-0.43
k	26	26	26	26

In the participation models, gender and the income variables appear to be most significant of the demographic variables in explaining the participation decision for all activities. Generally it appears

that males are more likely to participate in these activities and that income has a broadly positive effect on participation. Results also show that users of various recreation assets have different drivers underlying their location choices. While beach access was a key factor underpinning the location choice of beach users (with fishing access not important), fishing access was a key factor for recreational anglers (with access to major services and beaches not important), and beach access, lifestyle and work were key factors for island users (with family access not important).

5.2 Frequency of participation models

The second stage of the analysis modelled the frequency of participation so that subsequent estimates of recreation values could be made. Three separate econometric models were considered for the four GBR activities examined: zero truncated Poisson (ZTP), zero truncated Negative Binomial (ZTNB), and a Quantile Regression (QR) model for counts. For all four activities the ZTNB model was preferred over the ZTP model based on likelihood ratio tests. (Although the ZTP model parameters are provided in this section as a check of consistency, the significance or otherwise of parameter estimates for the ZTP model should not be considered accurate due to the presence of over-dispersion in the data).

Data on trip frequency for the four GBR activities of interest was used as the dependent variable in the ZTP and the ZTNB models. To modify the dependent variable data (visit rate) for the QR analysis to approximate a continuous distribution, the visit rate variable was augmented using a random number drawn from a uniform distribution with a lower bound of zero and an upper bound of y_{j+1}-y_j (where *j* refers to the interval points for the data). In order that random permutations arising from this addition did not affect estimations 1000 models were estimated using new random draws with results averaged as suggested by Machado and Silva (2002) and Koenker (2005). The conditional quantiles were estimated using a log-linear formulation to allow for comparison of inferences between the conditional mean models and the QR estimates (count data models are derived from an exponential link function: i.e. $y=f(e^{x\beta})$).

The literature suggests that, given the model is correctly specified and assumptions over error terms are not violated, the method of maximum likelihood for count data is most efficient (Cameron and Trivedi 2005). However in the presence of heterogeneity or model misspecification this is not necessarily the case. The quantile regression method places no assumptions over the form of the error distribution and so is generally considered more robust in the presence of violations of normality in the error distribution (Koenker 2005).

An example of the relationship between the trip visit rates and trip costs is shown in Figure 5.1, 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.

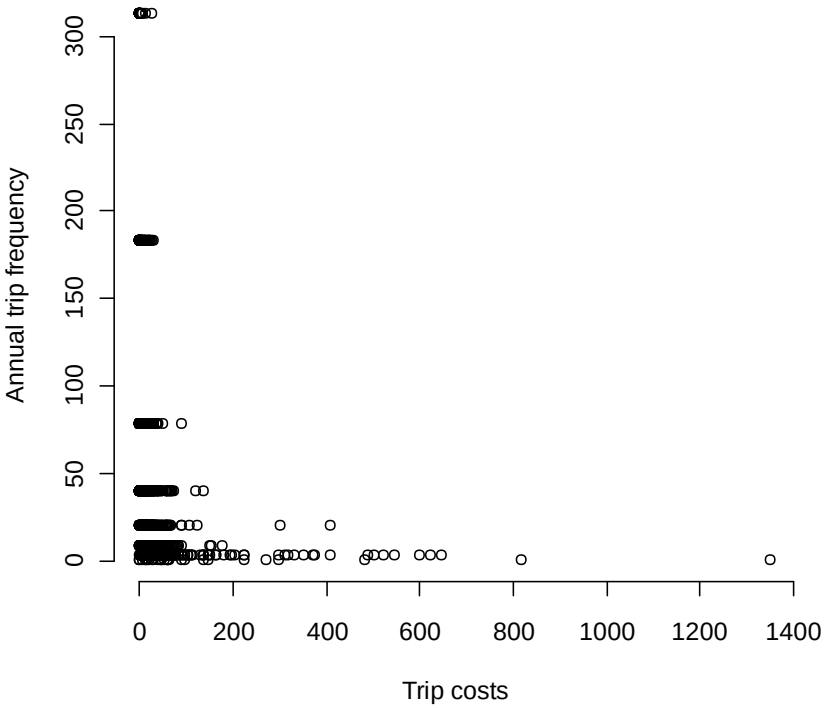

Figure 5.1: Scatterplot of trips versus trip costs (Beaches)

The greatest number of valid positive responses was obtained for travel to a “most preferred beach” over the past two years (n=792). About 123 responses were trimmed from the data set because of missing data or responses that were not consistent (i.e. travel times were not feasible).Table 5.2 presents the results of QR and count data model estimations for the travel cost model for the “Most Preferred Beach”. The intercept term was significant in all regressions. In the QR regression the intercept term is increasing along the estimated quantiles capturing the general tendency for higher trip frequencies in the higher quantiles. In the ZTNB model, the Age and Years in Area of respondents were significant explanators of visit rates, with older respondents and more recent residents likely to have higher visit rates.

The travel cost parameter is significant and negative in all regressions with estimated mean annual WTP (per person, per trip = $-1/\beta_{Cost/person}$) for ‘most preferred’ beach visits of $37.59 in the ZTNB. Values in the Quantile Regression were estimated at $125.75 at the 10% quantile, declining to $47.34 by the 90% quantile. The estimated cost parameter was increasing (WTP decreasing) from lower to higher quantiles, however this was not significant[3].

[3] Although it could be expected that Consumer Surplus will be greater for the higher quantiles, theory is a little less clear on how the cost coefficient, which translates as the marginal willingness to pay for an extra trip, will

Table 5.2: Travel cost models for 'most preferred' beach[4]

	Quantile Regression estimates (for xxx quantile)					Max. Likelihood estimates	
	0.1	**0.25**	**0.5**	**0.75**	**0.9**	ZTNB	ZT Poisson
Alpha	NA	NA	NA	NA	NA	2.1305***	NA
Intercept	2.0279***	2.7439***	3.1218***	3.8855***	5.0357***	3.5370***	3.6480***
Cost/person	-0.0080***	-0.0114***	-0.0162***	-0.0201***	-0.0211***	-0.0266***	-0.0258***
Hours spent	-0.0008	-0.0017***	-0.0010	-0.0006	-0.0007	-0.0014	-0.0012***
Income	-0.0000	-0.0000	-0.0000	0.0000	0.0000	0.0000	0.0000**
Edu. Post-graduate	-0.0021	-0.0444	-0.0451	0.1437	0.1979	0.1372	0.1274**
Gender (m=0)	-0.0376	-0.0180	0.2095*	0.1709	-0.1463	-0.0862	-0.0787
Age	-0.0033	-0.0030	0.0079	0.01034**	0.0050	0.0061*	0.0061***
Own house (n=0)	0.0898	0.0804	0.0029	-0.0280	-0.0357	-0.0342	-0.0317
Yrs lived in area	-0.0102***	-0.0152***	-0.0211***	-0.0188***	-0.0171***	-0.0180***	-0.0173***
Per Trip WTP	125.75	87.69	61.57	49.78	47.34	37.59	38.72
Lower (95%)	89.46	73.79	53.25	43.37	38.46	32.41	35.27
Upper (95%)	211.59	108.04	72.96	58.41	61.55	44.75	42.91
Sample size						792	
Ln Likelihood						-3391.444	-3455.638
deg. Freedom						782	783
AIC						6883	7005
LR test (alpha)						Reject ZT Poisson	

The travel cost model for the 'second most preferred beach' involved 648 valid responses after data trimming (Table 5.3). The intercept terms for this model are again all significant. Respondents who owned their own house and who lived in the area for longer periods tended to travel less to a 'second most preferred' beach. Respondents who visited a second beach had a lower WTP for visitation to this beach than to the 'most preferred beach' – however this effect was not significant. Estimated WTP was significantly decreasing for higher quantiles as it did with the 'most preferred beach model'.

Estimates of WTP between the QR and count data models were significantly different for all but the 90% quantile. This may indicate that the conditional distributions are non-normal and skewed to higher frequencies. The mean value of a beach visit to the second preferred beach was estimated at $37.59/visit from the ZTNB model.

change for different levels of participation conditional on a given set of covariates. One possibility is that large magnitude (negative) values for the travel cost parameter along the quantiles would indicate that people with higher levels of participation have a greater Price elasticity of Demand – or that they are willing to pay less per extra trip than those at lower quantiles. This suggests a satiation or declining marginal utility effect.

[4] "*" in the QR parameters indicates that the 95% confidence bound did not include zero. "***", "**", and "*" in the ML models represents statistical significance at the 1%. 5% and 10% level of significance respectively

Table 5.3: Travel cost models for 'second most preferred' beach

	Quantile Regression estimates (for xxx quantile)					Max. Likelihood estimates	
	0.1	**0.25**	**0.5**	**0.75**	**0.9**	ZTNB	ZT Poisson
Alpha	NA	NA	NA	NA	NA	2.6264***	NA
Intercept	1.2707***	1.8791***	2.5334***	3.3011***	4.3862***	2.7036***	2.9675***
Cost/person	-0.0055***	-0.0083***	-0.0138***	-0.0180***	-0.0216***	-0.0306***	-0.02978***
Hours spent	-0.0010	-0.0001	0.0033	0.0099	0.0036	0.0055	0.0061
Income	-0.0000	-0.0000	-0.0000	0.0000	0.0000	0.0000	0.0000
Edu. Post-graduate	-0.0673	-0.0587	-0.0973	-0.1852	-0.0938	-0.0414	-0.0315
Gender (m=0)	-0.0143	0.0355	0.0689	0.1629	0.1189	0.1405	0.1242**
Age	-0.0018	0.0007	0.0076*	0.0119**	0.0080	0.0091**	0.0083***
Own house (n=0)	0.1750	0.0094	-0.1848*	-0.1581	-0.3074*	-0.1811	-0.1665***
Yrs lived in area	0.0008	-0.0013	-0.0077**	-0.0187***	-0.0170**	-0.0141***	-0.0136***
Per Trip WTP	182.80	120.43	72.40	55.50	46.30	32.74	33.56
Lower (95%)	119.55	87.85	60.51	45.75	38.08	27.84	30.28
Upper (95%)	388.22	191.42	90.10	70.54	59.03	39.72	37.64
					Sample Size	648	
					Ln Likelihood	-2293.799	-2349.073
					deg. Freedom	638	639
					AIC	4687	4790
					LR test (alpha)	Reject ZT Poisson	

Results for the travel cost model for 'islands' are presented in Table 5.4. The estimated models had a generally low number of significant parameters at normal levels of significance (10% or less) suggesting a significant level of heterogeneity in the data.

Despite the suggested presence of heterogeneity in the data for the 'islands' model, the zero-truncated Poisson form was preferred over the Negative Binomial form, although the latter usually accounts for excess variance trip counts. In combination with the generally low level of significance this effect suggests that the response is not overly dispersed but that the demographic information collected is not relevant as predictors of island visitation. In short these results suggest that a wide range of Queensland society travels to GBR islands at some time and that island travellers cannot be forecast according to their common demographic traits.

The marginal effect of travel costs at most quantiles estimated were not significantly different (alpha=5%) from zero for the lower QR regressions (10th and 25th quantiles). WTP was not significantly different between any of the estimated regressions – partly this is likely a function of large error bounds on estimated WTP for all regressions as shown in Table 5.4. There was little difference in estimated trip values per person between the Poisson model ($334.30/visit) and the ZTNB model ($331.36/visit).

Table 5.4: Travel cost models for "islands"

	Quantile Regression estimates (for xxx quantile)					Max. Likelihood estimates	
	0.1	**0.25**	**0.5**	**0.75**	**0.9**	ZTNB	ZT Poisson
Alpha	NA	NA	NA	NA	NA	1.5525***	NA
Intercept	0.1984	0.5496***	0.9359***	1.6355***	2.2549***	0.1456	0.3459
Cost/person	0.0001	-0.0001	-0.0005*	-0.0017***	-0.0020***	-0.0030**	-0.0030***
Length	-0.0090	-0.0081	0.0098	0.0296	0.0237	0.0402	0.0378
Income	0.0000	0.0000*	0.0000	0.0000	0.0000	0.0000	0.0000*
Edu. Post-graduate	0.0219	0.0242	-0.0239	-0.0219	-0.0345	0.1432	0.1412
Gender (m=0)	0.0259	-0.0006	0.0446	0.0106	-0.1640	-0.2553	-0.2447*
Age	0.0044	0.0042	-0.0005	-0.0031	-0.0034	0.0033	0.0028
Own house (n=0)	-0.1257	-0.1120	0.0126	0.1673	0.3833*	0.6212**	0.6096***
Yrs lived in area	-0.0042	-0.0057**	-0.0004	0.0008	-0.0049	-0.0107	-0.0100*
Per Trip WTP	NA	20297.30	2050.51	579.39	489.75	331.36	334.30
Lower (95%)	NA	NA	NA	408.46	330.04	190.79	202.68
Upper (95%)	NA	NA	NA	996.34	948.96	1258.97	953.38
					Sample size	311	
					Ln Likelihood	-576.786	-578.397
					deg. Freedom	301	302
					AIC	1240	1237
					LR test (alpha)	Do not reject ZT Poisson	

The results for the travel cost model for 'fishing, boating and sailing' trips are shown in Table 5.5. Respondents who owned their own boat had greater levels of participation in boating activities than respondents who did not own a boat. This effect was consistent across both the count data models and the QR models and was highly significant. Boat value generally had a positive effect but was not significantly different from zero for either the zero-truncated Negative Binomial model nor the majority of quantile regressions estimated.

Sailors tended to go out more often than other boaters; however this effect was only significant in the zero-truncated Poisson model which may be underestimating the error bounds on parameters (hence increasing the likelihood of a 'significant' parameter). Years of residence had a significant and negative effect on the expected frequency of boating except for in the zero-truncated Negative Binomial model. Travel costs were not significant at the 95% level for any of the regressions other than the 75th quantile regression model. Indeed travel costs were not significant at any standard level for either of the zero-truncated models.

Table 5.5: Travel cost models for "fishing, boating and sailing trips"

	Quantile Regression estimates (for xxx quantile)					Max. Likelihood estimates	
	0.1	**0.25**	**0.5**	**0.75**	**0.9**	ZTNB	ZT Poisson
Alpha	NA	NA	NA	NA	NA	3.5026***	NA
Intercept	0.6539*	1.4502***	2.0964***	2.8293***	3.4240***	1.8952***	2.3390***
Cost/person	0.0035	0.0031	-0.0003	-0.0043*	-0.0065*	-0.0055	-0.0048
Own Boat? (Y=1)	0.5075***	0.6250***	0.5481***	0.8257***	0.8980***	0.9775***	0.8790***
Boat value	0.0000	0.0000	0.0000	0.0000***	0.0000	0.0000	0.0000**
Fishing dummy	-0.0289	-0.2745	-0.1473	-0.0260	-0.2780	-0.4000	-0.3551**
Boating dummy	-0.2160	-0.3676	-0.2828	-0.2324	-0.580	-0.8129*	-0.7108***
Hours spent	-0.0012	-0.0026	-0.0002	-0.0009	-0.0013	-0.0015	-0.00123
Income	0.0000	0.0000	0.0000	-0.0000	-0.0000	-0.0000	-0.0000
Edu. Post-graduate	0.0782	0.0084	-0.0066	-0.0533	-0.243	-0.1245	-0.1205
Gender (m=0)	-0.2015	-0.2420*	-0.26480*	-0.3711**	-0.3537*	-0.4880**	-0.4424***
Age	0.0026	0.0027	0.0012	0.0042	0.0105	0.0060	0.0049
Own house (n=0)	-0.1287	-0.1138	-0.1100	-0.1950	-0.1817	-0.1554	-0.1559*
Yrs lived in area	-0.0074*	-0.0092**	-0.0079	-0.0103**	-0.0083	-0.0127	-0.0113***
Per Trip WTP	NA	NA	3304.97	235.45	154.95	183.13	207.62
Lower (95%)	NA	NA	NA	119.4804	NA	NA	NA
Upper (95%)	NA	NA	NA	8002.3846	NA	NA	NA
					Sample size	372	
					Ln Likelihood	-1116.658	-1146.457
					deg. Freedom (n-k)	358	359
					AIC	2345.77	2399.45
					LR test (alpha)	Reject ZT Poisson	

5.3 Contingent behaviour models

Following the questions on current frequency of participation in the four activities reviewed above, respondents were asked to consider their expected future participation frequency under a range of alternative scenarios:

1. No change
2. Water quality declines by 10% (beaches)
3. Water quality declines by 20% (beaches)
4. Fishing catch improves by 10% (fishing)
5. Fishing catch improves by 20% (fishing)
6. Fishing catch declines by 10% (fishing)
7. Fishing catch declines by 20% (fishing)

The data were analysed as a count data model of expected future frequency of engagement in a sub-set of the activities (i.e. not including islands trips). Respondents were asked first to report their expected number of trips (for each activity) 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. Respondents

who indicated they would go fishing over the next two years were asked to indicate the amount by which they would reduce their travel to beaches under a scenario of a 10% and 20% decline in fishing catch and also how much they would *increase* their travel if fishing catch *increased* by 10% and 20%.

The dependent variable was specified as expected future trips under the scenario of "no change" (all activities), 10% or 20% decline in water quality (beaches) and 10% or 20% decline/improvement in fishing catch (fishing). The quality change variable was introduced as a continuous variable to allow consideration of part-worths at points other than the 10% and 20% decline/improvements[5].

Travel costs were again expressed in terms of travel costs per person to aid in inference.

Log-likelihood ratio tests for the over-dispersion parameter rejected the poisson model in favour of the NB2 model for all the two activities considered. Truncated count data models were not estimated in this section 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.

Table 5.6 presents the results of the contingent behaviour model for the 'most preferred beach' scenario outlined above. Water quality had a significant effect on beach-goers expected frequency of visitation over the next two years, however as expected the effect was lower for the higher quantiles of response than the lower quantiles.

The mean WTP was estimated at $34.11 for the NB2 count data model and at $59.82 for the median QR model. These estimates were significantly different at the 95% level of significance. There were also significant differences in the estimated WTP within the quantiles estimated using the QR method with the only overlap occurring between the 75th and 90th quantiles which were also not significantly different to estimate from the NB2 model. This indicates that higher frequency future visitors have a lower WTP, *ceteris paribus*.

Water quality was positively valued by beach travelling survey respondents as expected. In terms of differences in values, the QR regression results indicate that less frequent travellers value water quality much more highly than frequent travellers, *ceteris paribus*. This result is reflected in the calculated part-worth for water quality which is monotonically declining across the estimated quantile regression models.

The estimates for model parameters from the NB2 model appeared to be located between those from the 75th and 90th quantile regression models. This may suggest that the conditional distribution of travel is skewed to the right.

[5] 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 whilst the continuous specification ensured that the quality effect was monotonically increasing/decreasing for improvements/declines respectively (for a positive parameter estimate).

Table 5.6: Contingent behaviour models for "most preferred beach" trips in the future

	Quantile Regression estimates (for xxx quantile)					Max. Likelihood estimates	
	0.1	**0.25**	**0.5**	**0.75**	**0.9**	**NB**	**Poisson**
Alpha	NA	NA	NA	NA	NA	3.2738***	NA
Intercept	0.8803***	1.4480***	2.7261***	3.6140***	3.9413***	3.11001***	3.1283***
Water quality	0.1714***	0.1342***	0.1395***	0.0576***	0.0336***	0.0409***	0.0409***
Cost	-0.0023	-0.0062***	-0.0167***	-0.0272***	-0.0306***	-0.0293***	-0.0301***
Hrs spent	-0.0004	-0.0003	-0.0006	0.0005	-0.0011	-0.0011	-0.0010**
Income	0.0000	0.0000	0.0000	0.0000	0.0000**	0.0000	0.0000***
Edu. Post-graduate	-0.0255	-0.0390	-0.0013	0.1138	0.3071***	0.2711***	0.2745***
Gender (m=0)	-0.0655	-0.0805	-0.0654	0.1711	-0.0326	-0.0467	-0.0495*
Age	0.0028	0.0035	0.0090*	0.0124***	0.0241***	0.0170***	0.0168***
Own house (n=0)	0.1810**	0.2039**	0.2924**	0.2525**	0.0565**	0.1198	0.1184***
Yrs lived in area	0.0018	-0.0035	-0.0125***	-0.0213***	-0.0150***	-0.0146***	-0.0146***
Per Trip WTP	426.85	160.22	59.82	36.73	32.65	34.11	33.25
Lower	NA	115.85	50.07	32.06	29.64	30.51	31.94
Upper	NA	259.69	74.28	42.98	36.34	38.67	34.67
Part worth WQ Δ	73.17	21.50	8.34	2.11	1.10	1.40	1.36
					Sample size	2349	
					Ln Likelihood	-8587.26	-9536.222
					deg. Freedom	2338	2339
					AIC	17291	19181
					LR test (alpha)	Reject Poisson	

Table 5.7 presents the results of the contingent behaviour model for the expected 'fishing' trips scenario. Fishing quality was a significant factor affecting the frequency of fishing trips respondents intended to carry out over the next two years. The inclusion of positive and negative catch effects in the design of this contingent behaviour question allowed consideration of whether respondents valued positive changes differently to negative changes. The estimated parameters for the *Pos. effect dummy* variable, coded as a "1" against positive fishing quality changes, indicated that in general positive changes had a greater effect on future fishing intentions than did negative fishing quality changes. However this effect was variable for the quantile regression models with it being significantly negative at the 10% level in the lowest two quantile regression models and positively significant at the 10% level for the 90th quantile.

The estimated travel cost parameter was significant at the upper quantiles of the QR models and for the NB2 model. Again, a declining trend in the estimated cost parameter for upper quantiles indicated support for the declining marginal utility interpretation. Differences in estimated values between the quantiles and the NB2 model were not significant for the travel cost parameter.

The fishing quality parameter was positive and significant for all regression models as expected. Again the estimated value for improvements/declines in fishing quality was declining across the quantiles suggesting that infrequent travellers valued fishing quality changes more highly than frequent fishers.

Respondent levels of formal education level appeared to have a negative effect on future fishing intentions as did the number of years a respondent had lived in the area. Boat ownership significantly increased future fishing intentions along with income whilst the value of the boat appeared to have a

negative influence on future fishing intentions in the GBR. There was a strong suggestion that males went fishing more than females.

Table 5.7: Contingent behaviour models for fishing trips in the future

	Quantile Regression estimates (for xxx quantile)					Max. Likelihood estimates	
	0.1	**0.25**	**0.5**	**0.75**	**0.9**	**NB**	**Poisson**
Alpha	NA	NA	NA	NA	NA	1.7094***	NA
Intercept	-0.6929**	0.2820	1.3474***	2.0683***	3.0940***	2.1324***	2.1356***
Fishing quality	0.0668***	0.0584***	0.04534***	0.0227***	0.01234*	0.0209***	0.0206***
Pos. effect dummy	-0.3837*	-0.3733**	-0.2388	0.2100	0.4762*	0.2340*	0.2359***
Cost	0.0018	0.0018	-0.0004	-0.0042***	-0.0079***	-0.0063***	-0.0062***
Own boat? (y=1)	1.0341***	1.0223***	1.4560***	1.4472***	1.3696***	1.3392***	1.3325***
Boat value	-0.0000	-0.0000	-0.0000***	-0.0000***	-0.0000***	-0.0000**	-0.0000***
Hrs spent	0.0005	0.0003	-0.0007	-0.0016*	-0.0031	-0.0005	-0.0005
Income	0.0000	0.0000	-0.0000	0.0000	0.0000	0.0000	0.0000*
Edu. Post-graduate	0.1812	0.0543	-0.12056	-0.1001	-0.2561**	-0.2687***	-0.2602***
Gender (m=0)	-0.2564**	-0.3857***	-0.4973***	-0.4944***	-0.5743***	-0.6679***	-0.6629***
Age	-0.0004	0.0018	0.0015	0.0035	0.0011	0.0009	0.0008
Own house (n=0)	-0.1491	-0.1426	-0.2794***	-0.2660***	-0.2279**	-0.1634**	-0.1689***
Yrs lived in area	-0.0026	-0.0043	-0.0051*	-0.0093***	-0.0124***	-0.0106***	-0.0106***
Per Trip WTP	NA	NA	2329.87	238.31	126.87	159.68	161.30
Lower	NA	NA	NA	179.01	101.32	94.64	111.55
Upper	NA	NA	NA	356.36	169.66	510.54	291.18
Part worth -ve FQ Δ	NA	NA	105.74	5.40	1.57	3.33	3.32
Part worth +ve FQ Δ	NA	NA	NA	55.45	61.99	40.70	41.37
					Sample size	1497	
					Ln Likelihood	-4503.102	-4594.258
					deg. Freedom	1483	1484
					AIC	9116	9291
					LR test (alpha)	Reject Poisson	

5.4 Pooled beach models

The beach recreation data demonstrates substantial heterogeneity and over-dispersion, leading to difficulties in fitting travel cost models. These difficulties are not surprising, given that the study is essentially modelling recreation at a large number of separate sites compared to a normal travel cost application where recreation at a single site is being valued. In this section the results of models applied to the pooled data sets from both beaches is reported to help identify how different factors may be influencing values for beach recreation. The travel cost models for the pooled beach data, similar to the models reported in Tables 5.2 and 5.3, is reported in Table 5.8. This also includes dummy variables to identify which region respondents lived in, with Bundberg used as a reference location. The results (focusing on the zero truncated negative binomial models) show that older people and more recent residents are more likely to have more frequent beach visits. There were few significant differences between population groups, but Mackay and Townsville residents have 0.58 and 0.32 more beach visits per annum than Bundaberg residents.

Table 5.8: Travel cost models for pooled beach data with location variables included

	Quantile Regression estimates (for xxx quantile)					Max. Likelihood estimates	
	0.1	**0.25**	**0.5**	**0.75**	**0.9**	ZTNB	ZT Poisson
Alpha	NA	NA	NA	NA	NA	2.5127***	NA
Intercept	1.6199***	2.2895***	2.8867***	3.7930***	4.4872***	2.9617***	3.1758***
Cost/person	-0.0073***	-0.0100***	-0.0150***	-0.0202***	-0.0217***	-0.0271***	-0.0264***
Hours spent	-0.0004	-0.0014	-0.0012	0.0009	-0.0007	-0.0012	-0.0010
Income	-0.0000	-0.0000	-0.0000	-0.0000	0.0000	0.0000	0.0000
Edu. Post-graduate	-0.0317	-0.0662	-0.1062	-0.0353	0.0675	0.0596	0.0554
Gender (m=0)	-0.0312	0.0026	0.0922	0.1737	0.0650	0.0316	0.0267
Age	-0.0028	0.00006	0.0075**	0.0100**	0.0081*	0.0084***	0.0079***
Own house (n=0)	0.1040	0.0309	-0.0483	0.0078	-0.0714	-0.0176	-0.0213
Yrs lived in area	-0.0037	-0.0087***	-0.0157***	-0.0219***	-0.0182***	-0.0189***	-0.0179***
Bundaberg	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Gladstone	-0.1262	-0.1203	-0.1056	-0.0748	-0.1093	-0.2481	-0.2431**
Rockhampton	0.0908	-0.0234	-0.0770	0.0531	0.1307	0.0872	0.0680
Mackay	0.1871	0.1384	0.2793*	0.3300	0.6419***	0.5781***	0.5352***
Townsville	0.0909	0.1030	0.0754	0.1035	0.2798*	0.3168*	0.2886***
Cairns	0.0462	-0.0844	-0.1754	-0.1291	0.1479	0.1617	0.1572**
Per Trip WTP	137.17	100.49	66.58	49.58	46.06	36.87	37.84
Lower (95%)	105.55	86.25	59.90	44.09	39.06	32.90	35.42
Upper (95%)	195.84	120.37	74.94	56.63	56.12	41.92	40.61
					Sample size	1440	
					Ln Likelihood	-5718.373	-5860.853
					deg. Freedom	1430	1431

Respondents were asked asked to rate the influence of different beach characteristics (Table 5.9). Incorporation of these responses into the models (Table 5.9) show that the most important (significant) characteristics are access to lifesavers (0.07), being able to take dogs on the beach (0.17), being able to fish on the beach (0.6), having clean beaches (0.06), and having beaches with boat jetties (0.1), with the numbers in brackets representing the average increase in annual visit rate.

Table 5.9: Travel cost models for pooled beach data with beach characteristics included

	Quantile Regression estimates (for xxx quantile)					Max. Likelihood estimates	
	0.1	**0.25**	**0.5**	**0.75**	**0.9**	ZTNB	ZT Poisson
Alpha	NA	NA	NA	NA	NA	2.2529***	NA
Intercept	1.0212***	1.5542***	2.1241***	3.1476***	4.1943***	2.5476***	2.7348***
Cost/person	-0.0061***	-0.0100***	-0.0145***	-0.0188***	-0.0208***	-0.0268***	-0.0264***
Hours spent	-0.0003	-0.0012	-0.0009	0.0003	-0.0003	-0.0006	-0.0004
Income	-0.0000	-0.0000	-0.0000	-0.0000	0.0000	0.0000	0.0000**
Edu. Post-graduate	-0.0425	-0.0456	-0.0231	0.1114	0.0530	0.0651	0.0673
Gender (m=0)	-0.1170*	-0.0336	0.0816	0.2306*	0.0368	-0.0092	-0.0128
Age	-0.0028	0.0006	0.0077**	0.0110**	0.0090***	0.0097***	0.0092***
Own house (n=0)	0.09412	0.0241	-0.0337	-0.0897	-0.2755***	-0.1799**	-0.1632***
Yrs lived in area	-0.0048**	-0.0086***	-0.0157***	-0.0210***	-0.0127***	-0.0173***	-0.0166***
Lifesaver	0.0327*	0.0344*	0.0476**	0.0404	0.0499*	0.0680***	0.0640***
4wd access	0.0498	0.0429	0.0288	0.0291	-0.0660	0.0056	0.0043
Dogs	0.0913***	0.1258***	0.11389***	0.1206***	0.1582***	0.1703***	0.1602***
Fishing	-0.0087	0.0030	0.0380	0.0325	0.0612**	0.0559**	0.0526***
Clean	0.0910***	0.07078***	0.0825***	0.0818**	0.0750***	0.0781***	0.07363***
good WQ	-0.0315*	-0.0061	-0.0076	0.00122	0.0082	0.0022	0.0025
low crowding	-0.0185	-0.0014	-0.0079	-0.0416	-0.0279	-0.0394	-0.0343**
ablutions	0.0169	-0.0048	-0.0385	-0.0644*	-0.0673**	-0.0599**	-0.0559***
BBQs	0.0221	0.0359*	0.0383	0.0259	-0.0271	-0.0364	-0.0338**
Shade	-0.0091	-0.0201	-0.0185	-0.0392	-0.0350	-0.0205	-0.0214
Boats Jetties	0.0801**	0.0599**	0.0760*	0.1179**	0.0744**	0.0999***	0.0952***
Camping	-0.0010	-0.0223	-0.0426	-0.0450	-0.0554	-0.0399	-0.0366
stngr nets	0.0526***	0.0414**	0.0140	0.0286	0.0255	0.0170	0.0165
shark nets	-0.0564**	-0.05089**	-0.0295	-0.0350	0.0056	-0.0156	-0.0126
Per Trip WTP	162.99	100.21	68.88	53.23	48.20	37.27	37.95
Lower (95%)	122.22	87.33	61.02	46.95	40.98	33.25	35.27
Upper (95%)	244.59	117.55	79.07	61.45	58.52	42.39	41.07
					Sample size	1440	
					Ln Likelihood	-5681.910	-5795.208
					deg. Freedom	1430	1431
					AIC	11473	11692
					LR test (alpha)	Reject ZT Poisson	

Models where visit rates were also tested against adverse beach conditions were also developed. Respondents had been asked to indicate if different reasons had stopped them from making beach visits in the past two years. The results (Table 5.10) show that the factors that had the most influence were smelly water and dirty facilities. As the coefficient for dirty facilities is unexpectedly positive, it is possible that respondents prefer to visit the more remote beaches without facilities.

Table 5.10: Travel cost models for pooled beach data with adverse beach factors included

	Quantile Regression estimates (for xxx quantile)					Max. Likelihood estimates	
	0.1	**0.25**	**0.5**	**0.75**	**0.9**	ZTNB	ZT Poisson
Alpha	NA	NA	NA	NA	NA	2.4145***	NA
Intercept	2.4996***	3.1314***	4.3800***	4.9333***	5.5499***	4.2509***	4.3584***
Cost/person	-0.0073***	-0.0103***	-0.0151***	-0.0193***	-0.0223***	-0.0279***	-0.0273***
Hours spent	-0.0002	-0.0011	-0.0004	0.0010	-0.0005	-0.0007	-0.0005
Income	-0.0000	-0.0000	-0.0000	-0.0000	0.0000	0.0000*	0.0000***
Edu. Post-graduate	-0.0368	-0.0914	-0.0647	-0.0396	0.1073	0.0698	0.0669
Gender (m=0)	-0.0840	-0.0472	0.0772	0.1922	-0.0040	-0.0165	-0.0176
Age	-0.0028	0.0003	0.0052*	0.0073*	0.0073*	0.0097***	0.0090***
Own house (n=0)	0.1223	0.0396	-0.0350	0.0324	-0.0191	-0.0635	-0.0580
Yrs lived in area	-0.0047*	-0.0089***	-0.0147***	-0.0209***	-0.0172***	-0.0181***	-0.0172***
Stingers	0.0142	0.0716	0.0509	0.1150	0.1672	0.0287	0.0290
Bad weather	-0.1397*	-0.1355*	-0.1771**	-0.0073	0.0476	-0.0074	-0.0091
Dirty water	-0.0681	-0.1317	-0.0807	-0.0278	-0.1973*	0.0200	0.0190
Rubbish in water	0.0299	0.0555	-0.2847	-0.2037	-0.1084	-0.1955	-0.1842**
Smelly water	-0.2981***	-0.32589***	-0.4559***	-0.5250***	-0.4235***	-0.5333***	-0.4974***
Crowded	0.0051	0.0227	0.0779	0.0262	-0.2036	-0.1943	-0.1807***
Rubbish on beach	0.0902	0.0310	0.0943	-0.0293	-0.0486	0.0317	0.0184
Bad behaviour	-0.0718	-0.0800	-0.1650	-0.2872**	-0.1935	-0.1768	-0.1610*
Parking	-0.0668	-0.0664	-0.0186	0.1237	0.1124	0.0078	0.0083
Dirty facilities	0.0356	0.0947	0.1384	0.24056*	0.3627***	0.3586***	0.3473***
Per Trip WTP	137.88	96.82	66.32	51.84	44.90	35.91	36.68
Lower (95%)	110.31	84.17	59.36	46.41	38.37	32.19	34.29
Upper (95%)	183.83	113.94	75.12	58.71	54.12	40.60	39.44
					Sample size	1440	
					Ln Likelihood	-5705.454	-5837.052
					deg. Freedom	1430	1431
					AIC	11520	11776
					LR test (alpha)	Reject ZT Poisson	

Respondents were also asked in the survey to indicate the major reasons why they lived in their area. The models where these variables are used to explain beach visits are provided below in Table 5.11. The results show that the respondents likely to have higher beach visits were those who had beach access, had fishing access, or who lived in the area because major services were available. The respondents who had lower rates of beach access were those who chose to live in the area because of lifestyle, family, work or health service reasons.

Table 5.11: Travel cost models for pooled beach data with location reasons included

	Quantile Regression estimates (for xxx quantile)					Max. Likelihood estimates	
	0.1	**0.25**	**0.5**	**0.75**	**0.9**	ZTNB	ZT Poisson
Alpha	NA	NA	NA	NA	NA	2.0381***	NA
Intercept	1.3767***	1.8843***	2.4881***	3.5439***	4.1634***	2.8592***	2.9886***
Cost/person	-0.0076***	-0.0107***	-0.0136***	-0.0165***	-0.0197***	-0.0238***	-0.0233***
Hours spent	-0.0003	-0.0010	-0.0016*	0.0003	-0.0014	-0.0017	-0.0015
Income	-0.0000	-0.0000	-0.0000	-0.0000	0.0000	0.0000	0.0000**
Edu. Post-graduate	-0.0463	-0.0440	-0.10501	0.0057	0.0427	0.0420	0.0408
Gender (m=0)	-0.0371	-0.0074	0.1025	0.0922	0.1222	0.0443	0.0387
Age	-0.0042	-0.0029	0.0031	0.0017	0.0035	-0.0001	0.0001
Own house (n=0)	0.0492	0.0023	-0.0614	-0.0352	-0.0925	-0.0169	-0.0198
Yrs lived in area	-0.0019	-0.0063***	-0.0121***	-0.0163***	-0.0122***	-0.0133***	-0.0129***
Beach access	0.1022***	0.1510***	0.2603***	0.3346***	0.2840***	0.3397***	0.3237***
Fish access	0.0657***	0.0785***	0.0684***	0.0599**	0.0567**	0.0555***	0.0534***
Lifestyle	0.0039	0.0087	-0.0131	-0.0538	0.0042	-0.049**	-0.0425***
Family	-0.0613***	-0.0686***	-0.0615***	-0.0378	-0.0324	-0.0436**	-0.0412***
Work	-0.0080	-0.0056	-0.0343	-0.0721**	-0.0779**	-0.0742***	-0.0720***
Health services	0.0421	0.0126	-0.0323	-0.0994**	-0.0730**	-0.0925***	-0.0864***
Schools	0.0071	-0.0145	-0.0161	-0.0317	-0.0231	-0.0395	-0.0372**
Major services	-0.0000	0.0295	0.0163	0.0557	0.0033	0.0532*	0.0499**
Per Trip WTP	131.45	93.24	73.77	60.65	50.84	41.97	42.95
Lower (95%)	104.71	80.37	64.44	53.01	43.64	37.39	39.79
Upper (95%)	176.53	111.00	86.26	70.87	60.90	47.82	46.65
					Sample size	1440	
					Ln Likelihood	-5647.238	-5735.846
					deg. Freedom	1430	1431
					AIC	11404	11574
					LR test (alpha)	Reject ZT Poisson	

6. Discussion

The aim of this research is to identify the recreational use values for recreation in and adjacent to the Great Barrier Reef Marine Park (GBRMP) using the travel cost methodology. It focused explicitly on beach, island, and fishing, boating and sailing trips and used descriptive and statistical methods incorporating economic theory to describe the frequency of trips, the demographics of respondents, and the dollar value of recreational use of the GBRMP associated with these types of activity. In addition a relatively newly developed method of statistical analysis has been applied, using the method of quantile regression (Koenker 2006; Machado and Santos Silva 2002).

Data has been collected by using an internet panel, with respondents drawn from Queensland coastal communities and cities between Bundaberg in the south and Cairns in the north. Of the 1051 responses to the survey, 87% indicated they had taken a trip to one beach ("most preferred beach"), 73% undertook a trip to a second beach ("second most preferred beach"), 30% undertook a trip to an island, and 42% undertook a fishing/boating/sailing trip over the last two years.

Willingness to pay was calculated from the estimated travel cost models for a number of points in the distribution (25th and 75th quantiles, median, and the mean) – these are shown in Table 6.1. Note that these WTP estimates are from truncated count data models and so represent the recreational use values *for respondents who participated in each of the activities only*. The results, focusing on the Zero Truncated Negative Binomial models, indicates that the average value of a beach visit is $35 per person per visit, while the corresponding value of an island visit is $331. Values for fishing, boating and sailing trips were not significant, although the coefficient size suggests that values are about $183 per person per trip.

Table 6.1: Estimated WTP for the GBR activities models

	Beach 1	Islands	Fish, boat, sail
Model	**Estimated value** (95% lower-upper)	**Estimated value** (95% lower-upper)	**Estimated value** (95% lower-upper)
25th percentile	**$97**	**$20,297**	**NA**
	($84-$115)	N.S.	N.S.
Median	**$64**	**$2,051**	**$3,305**
	($58-$72)	N.S.	N.S.
75th percentile	**$51**	**$579**	**$236**
	($45-$58)	($408-$996)	($120-$8002)
Mean (ZTNB)	**$35**	**$331**	**$183**
	($32-$39)	($191-$1259)	N.S.
Mean (ZTP)	**$36**	**$334**	**$208**
	($34-$38)	($203-$953)	N.S.

Few significant differences could be identified in recreation patterns between regional areas, although residents in the Mackay and Townsville regions were slightly more likely to make beach visits than residents in the other regions. The beach characteristics that were most important to respondents included access to lifesavers, being able to take dogs on the beach, being able to fish on the beach, having clean beaches, and having beaches with boat jetties. The presence of smelly water was the

one adverse beach condition that would reduce visit rates. Respondents who lived in the area because of good beach access, had fishing access, or because major services were available were identified as being more likely to have higher beach visitation rates.

The results of this study present some of the first estimates of beach and island recreation access in Australia. 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.

It is important to note that the study may undervalue recreation activities for two important reasons. 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. Those respondents, who ranged between 20% and 54% of respondents in the different regions, 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 analysis does not capture the additional investments or sacrifices that people have made to maximise their recreation experiences, and so the analysis will undervalue recreation activities. Further research is needed in the future to explore these issues further.

References

Access Economics 2008. Economic Contribution of the GBRMP, 2006-07, Great Barrier Reef Marine Park Authority,Townsville.

Anderson, D. 2010. Estimating the Economic Value of Ice Climbing in Hyalite Canyon: An Application of Travel Cost Count Data Models that Account for Excess Zeros. *Journal of Environmental Management*, 91(4): 1012-1020.

Asafu-Adjaye, J., Brown, R. and Straton, A. 2005. On measuring wealth: a case study on the state of Queensland, *Journal of Environmental Management* 75(2): 145-155.

Bailey, G., Riley, D., Heaney, L., Lubulwa, M., Barry, T. and Salma, U. 2003. Assessment of tourism activity in the Great Barrier Reef Marine Park Region, A report by the Bureau of Tourism Research for the Great Barrier Reef Marine Park Authority, Bureau of Tourism Research, Canberra.

Bhat, M.G. 2003. 'Application of non-market valuation to the Florida Keys marine research management', *Journal of Environmental Management*, 67: 315-325.

Cameron, A.C. and Trivedi, P.K. 2005. Models of Count Data, Chapter 20 in, *Microeconometrics: methods and applications* Cambridge University Press, New York, pp 665-696.

Cameron, T.A., Shaw, W.D., Ragland, S., Callaway, J. and Keefe, S. 1996. Using Actual and Contingent Behaviour Data with Differing Levels of Time Aggregation to Model Recreation Demand, *Journal of Agricultural and Resource Economics* 21(1): 130-149.

Carr, L. and Mendelsohn, R. 2003. Valuing Coral Reefs: A Travel Cost Analysis of the Great Barrier Reef, *Ambio* vol. 32(5): 353-357.

Creel, M.D. and Loomis, J.B. 1990. Theoretical and Empirical Advantages of Truncated Count Data Estimators for Analysis of Deer Hunting in California, *American Journal of Agricultural Economics* 72: 434-441.

Eiswerth M.E., Englin, J., Fadali, E. and Shaw, W.D. 2000. 'The value of water levels in water-based recreation: A pooled revealed preference/contingent behaviour model', *Water Resource Research*, 36(4):1079-1086.

Englin, J. and Cameron, T.A. 1996. Augmenting Travel Cost Models with Contingent Behaviour Data Poisson Regression Analyses with Individual Panel Data, *Environmental and Resource Economics* 7: 133-147.

Fleming, C. and Bowden, M. 2009. Web-based surveys as an alternative to traditional mail methods. *Journal of Environmental Management*, 90: 284-292.

Garrod, G.D. and Willis, K.G. 1999. *Economic Valuation of the Environment*. Edward Elgar, UK.

Great Barrier Reef Marine Park Authority (GBRMPA) 2009. *Great Barrier Reef Outlook Report 2009,* Great Barrier Reef Marine Park Authority, Townsville.

Greene, W. 2008. Functional forms for the negative binomial model for count data. *Economics Letters*, 99: 585-590.

Grijalva, T.C., Berrens, R.P., Bohara, A.K. and Shaw, W.D. 2002. 'Testing the validity of contingent behaviour trip responses', *American Journal of Agricultural Economics,* 84(2): 401-414.

Haab, T.C. and McConnell, K.E. 2002. *Valuing Environmental and Natural Resources The Econometrics of Non-Market Valuation.* Edward Elgar, Cheltenham, UK.

Hanley, N., Bell, D. and Alvarez-Farizo, B. 2003. Valuing the Benefits of Coastal Water Quality Improvements Using Contingent and Real Behaviour, *Environmental and Resource Economics* 24: 273-285

Hanley, N. and Spash, C. L. 1993. *Cost-Benefit Analysis and the Environment*. Edward Elgar, UK.

Huang, J., Haab, T.C. and Whitehead, J.C. (\1997. 'Willingness to pay for quality improvement: Should revealed and stated preference data be combined?', *Journal of Environmental Economics and Management*, 34: 240-255.

Hellerstein, D.M. and Mendelsohn, R. 1993. A Theoretical Foundation for Count Data Models., *American Journal of Agricultural Economics* 75: 604-611.

Hundloe, T. 1990. Measuring the Value of the Great Barrier Reef, *Australian Parks and Recreation*, 26(3): 11-15.

Hundloe, T., Vanclay, F. and Carter, M. 1987. Economic and socio-economic impacts of the crown of thorns starfish on the Great Barrier Reef, Great Barrier Reef Marine Park Authority, Townsville.

Koenker, R. 2005. *Quantile Regression*. Cambridge University Press, New York.

Koenker, R. 2011. *Quantile Regression: An R package*. http://cran.r-project.org/web/packages /quantreg/quantreg.pdf, accessed 23rd April 2011.

Koenker, R. and Hallock, K. 2001. Quantile Regression. *Journal of Economic Perspectives*, 15(4): 143-156.

Kragt, M.E., Roebeling, P.C. and Ruijs, A. 2009. Effects of Great Barrier Reef degradation on recreational reef-trip demand: a contingent behaviour approach, *The Australian Journal of Agricultural and Resource Economics* 53: 213-229

Machado, J. and Santos Silva, J. 1999. *Quantiles for Counts*. Centre for microdata methods and practice working paper CWP22/02, University College London.

Munkin, M. and Trivedi, P. 1999. Simulated maximum likelihood estimation of multivariate mixed-poisson regression models, with application. *Econometrics Journal*, 2: 29-49.

Powell, J. 1984. Least absolute deviations estimation for the censored regression model. *Journal of Econometrics*, 35: 303-325.

Prayaga, P, Rolfe, J. and Sinden, J. 2006. A travel cost analysis of the value of special events: Gemfest in Central Queensland, *Tourism Economics*, 12(3): 403-420.

Randall, A. 1994. A difficulty with the travel cost method, *Land Economics,* 70(1): 88.

Riphahn, R., Wambach, A. and Million, A. 2003. Incentive effects in the demand for health care: A bivariate panel count data estimation. *Journal of Applied Econometrics*, 18(4):387-405.

Rolfe, J.C. and Dyack, B. 2011. “Valuing recreation in the Coorong, Australia, with travel cost and contingent behaviour models”, *Economic Record*, 87(277): 282-293.

Shrestha, R.K., Seidl, A.F. and Moraes, A.S. (2002). Value of recreational fishing in the Brazilian Pantanal: a travel cost analysis using count data models, *Ecological Economics,* 42(1-2): 289-299

Toomet, O. and Henningsen, A. 2010. MaxLik: A package for maximum likelihood estimation in R. http://cran.r-project.org/web/packages/maxLik/maxLik.pdf, accessed 23rd April 2010.

Ward, F.A. and Beal, D.J. 2000. *Valuing Nature with Travel Cost Models A Manual*. Edward Elgar, Cheltenham, UK.

Whitehead, J.C., Haab, T.C. and Huang, J.C. 2000. Measuring recreation benefits of quality improvements with revealed and stated behavior data, *Resource and Energy Economics* 22(4): 339-354.

Windle, J. & Rolfe, J. 2011. Comparing responses from internet and paper-based collection methods in more complex stated preference environmental valuation surveys *Economic Analysis and Policy,* 41(1), 83-97.

Appendices

Appendix 1: Respondent socio-demographic characteristics

	Burnett	Gladstone	Capricorn Coast	Sarina to Whitsunday's	Townsville	Cairns
# Respondents	199	106	149	158	387	101
Age range	18 - 74	18 - 82	18 - 70	18 - 74	18 - 84	18 - 71
Average age	50	45	45	44	43	47
% Females	51.4%	52.4%	51.8%	52.5%	50.6%	42.3%
% with dependent children	26.9%	28.4%	36.8%	35.3%	32.8%	21.2%
Education:						
Post-school qualification	50.9%	44.1%	52.6%	45.2%	54.2%	61.8%
Tertiary education	20.9%	15.4%	29.0%	15.7%	21.8%	36.1%
Household income						
< $25,999	23.9%	8.6%	15.2%	12.7%	15.1%	10.3%
$26,000 - $41,599	28.1%	11.9%	19.4%	12.6%	15.1%	18.5%
$41,600 - $62,399	19.3%	9.8%	20.8%	12.7%	23.3%	23.1%
$62,400 - $103,999	7.4%	26.2%	20.3%	20.8%	24.1%	20.0%
$104,000 or more	5.0%	20.0%	9.4%	14.5%	9.9%	13.9%
No response	16.3%	23.4%	14.9%	26.8%	12.5%	14.2%

Appendix 2: Proportion of respondents living in towns within regions

Burnett Region

Town	No. of respondents	Proportion of respondents
Agnes Water	2	1.2
Alloway	1	.6
Avondale	2	1.0
Baffle Creek	1	.3
Bargara	21	10.6
Bingera	2	.8
Branyan	1	.6
Bucca	2	.8
Bundaberg	118	59.2
Burnett Heads	8	4.3
Captain creek	1	.3
Coral Cove	1	.6
Deepwater	1	.3
Elliott Heads	7	3.7
Innes Park	5	2.7
Miriam Vale	4	2.2
Moore Park Beach	7	3.8
Mt Maria	1	.6
Rosedale	1	.6
South Kolan	4	2.1
Turkey Beach	1	.6
Waterloo	1	.3
Winfield	4	1.9
Yandaran	1	.7

Gladstone Region

Town	No.of respondents	Proportion of respondents
Bajool	1	1.1
Beecher	1	1.2
Boyne Island	9	8.3
Calliope	13	12.0
Clifton Beach	1	.6
Cooloola Cove	1	.6
Darts Creek	1	.6
Gladstone	69	65.7
Mount Larcom	1	1.1
Tannum Sands	8	7.3

Capricorn Coast Region

Town	No.of respondents	Proportion of respondents
Barmaryee	1	.9
Causeway Lake	1	.4
Emu Park	3	2.3
Gladstone	1	.8
Kinka Beach	1	.4
Rockhampton	112	74.9
Taroomball	1	.8
Yeppoon	23	15.7
Zilzie	4	2.6

Sarina to Whitsunday Region

Town	No.of respondents	Proportion of respondents
Airlie Beach	6	3.6
Andergrove	1	.4
Armstrong Beach	2	1.2
Bloomsbury	3	1.8
Bowen	1	.4
Bucasia	2	1.3
Calen	1	.4
Campwin Beach	1	.9
Cannonvale	8	5.0
Carmila	1	.4
Conway Beach	1	.8
Eimeo	1	.8
Grasstree beach	1	.8
Grasstree Beach	1	.4
Hydeaway Bay	1	.8
Jubilee	1	.4
Mackay	95	60.5
Marian	3	1.8
Midge Point	2	1.2
Mount Julian	1	.9
Mount Pleasant	1	.4
North Gregory	2	1.0
Proserpine	13	7.9
Sarina	5	3.3

Strathdickie	1	.4
Walkerston	5	3.1
Woodwark	1	.4

Townsville Region

Town	No.of respondents	Proportion of respondents
Aitkenvale	2	.4
Annandake	1	.2
Ayr	15	3.9
Babinda	1	.2
Bentley park	1	.2
Bentley Park	4	1.1
Bingil Bay	2	.4
Black River	1	.2
Bluewater	1	.3
Bowen	7	1.9
Burdell	1	.2
Bushland Beach	5	1.3
Cairns	49	12.7
Cape Upstart	2	.4
Deeragun	1	.4
East Palmerston	2	.5
Edmonton	10	2.7
El Arish	1	.3
Flying Fish Point	1	.4
Goldsborough	1	.2
Gordonvale	3	.7
Gumlu	1	.2
Home Hill	3	.8
Innisfail	15	3.9
Kelso	6	1.5
Mission Beach	5	1.4
Mourilyan	3	.8
Mt Sheridan	1	.2
New Harbourline	1	.2
Townsville	239	61.8
Woree	4	1.1

Cairns Region

Town	No.of respondents	Proportion of respondents
Almaden	2	1.6
Cairns	30	29.8
Caravonica	1	1.4
Chillagoe	1	.6
Clifton Beach	5	5.2
Cooktown	1	.6
Cooya Beach	1	.6
Deeral	2	2.4
Einasleigh	1	.6
Holloways Beach	5	5.4
Julatten	4	4.2
Kewarra Beach	6	5.6
Kurrimine Beach	3	2.6
Lakeplacid	2	1.6
Mossman	5	4.8
Newell	2	1.6
Palm Cove	5	5.4
Port Douglas	12	11.0
Smithfield	4	4.0
Trinity Beach	7	7.4
Yorkeys Knob	4	3.8

Appendix 3 … continued from Table 4.3 (a to f): Visit rates for less frequently visited islands

Island	Burnett	Gladstone	Capricorn Coast	Sarina to W.sunday's	Towns -ville	Cairns	Grand Total
Bedarra Island					1		1
Blackcurrant Island				1			1
Boyne Island		1					1
Brampton Island		2		5	2		9
Conical Island			1				1
Curtis Island		6					6
Dent Island				2			2
Double Cone Island				2			2
Double Island						3	3
Family Island					1		1
Franklin Island					2	1	3
Fraser Island	2				1		3
Frasier Island	8				1		9
Gloucester Island				3			3
Goldsmith Island				1			1
Gould Island					1		1
Haymen Island				2	6		8
Hazelwood Island				1			1
High Island					1	1	2
Hinchinbrook Island		1			1	1	3
Holbourne Island				2			2
Hope Island						1	1
Humick Hill Island		1					1
Humpy Island			1				1
Keswick Island				4			4
Lady Elliot Island	2						2
L. Musgrave Island	7		2				9
Lindeman Island			1	3	1		5
Lizard Island					1		1
Masthead Island		1					1
Michaelmas Quay					1	4	5
Middle Island			1				1
Morten Island	1						1
Newey Island					1		1
Normanby Island					1		1
North Island				1			1
Nth Keppel Island			6				6
Nth Molle Island				1			1
Nth Repulse Island				1			1
Nthwest Island		1					1
Orphus Island					3		3
Palm Island				1	5		6

Island	Burnett	Gladstone	Capricorn Coast	Sarina to W.sunday's	Towns -ville	Cairns	Grand Total
Paradise Island					1		1
Peel Island	1						1
Plelous Island					1		1
Pumpkin Island			1				1
Quoin Island		3					3
Rattlesnake Island					2		2
Rattray Island				1			1
Shag Island				1			1
Snapper Island						3	3
South End Island		1					1
St Bees Island				3			3
Stephen Island					2		2
Tangalooma	1						1
Thursday Island		1					1
Townsend			1				1
Upolo Cay					1	1	2
Vlashoff Cay					1		1
Wheeler Island						1	1
Yellow Patch Island			1				1
Unknown		1		1	1	1	4

Appendix 4: Number of respondents visiting each of the most visited (more than ten visits) islands (showing respondents' region)

Island	Burnett	Gladstone	Capricorn Coast	Sarina to W.sunday's	Towns-ville	Cairns	Total
Magnetic Island	3	2		5	127	3	140
Daydream Island	1		3	41	15	1	61
Hamilton Island		1	1	32	25	1	60
Green Island			1	1	23	13	38
Great Keppel Island			32		1	1	34
Whitsunday Island	1	1	2	16	6		26
Dunk Island	1		1		16	5	23
Long Island	1		1	12	7		21
Hook Island	1		1	9	5		16
South Molle Island				6	9		15
Fitzroy Island					8	6	14
Low Isles					2	12	14
Facing Island		10	1				11
Heron Island		8	2				10
Other Islands#	7	11	9	19	24	10	80
Total	15	33	54	141	269	52	564

#Remaining islands visited by respondents are in 3b

Appendix 5: Number of times an island was visited by respondents (on five or more occasions) (showing respondents' region)

Island	Burnett	Gladstone	Capricorn Coast	Sarina to W.sunday's	Towns-ville	Cairns	Total
Magnetic Island	4	3		14	381	3	405
Facing Island		129	5				134
Great Keppel Island			124		2	1	127
Daydream Island	1		3	101	18	1	124
Hamilton Island		1	1	67	31	1	101
Hook Island	2		1	66	6		75
Fitzroy Island					10	56	66
Green Island			1	1	27	37	66
Whitsunday Island	2	1	2	48	8		61
Long Island	2		1	41	7		51
Low Isles					3	44	47
Dunk Island	2		1		24	11	38
Gloucester Island				31			31
Michaelmas Quay					6	21	27
Palm Island				3	24		27
Humm. Hill Island		25					25
South Molle Island				11	11		22
Frasier Island	14				2		16
Hayman Island				15	11		16
Double Island						13	13
L. Musgrave Island	11		2				13
Boyne Island		12					12
North Island				12			12
Heron Island		9	2				11
Keswick Island				11			11
Brampton Island		2		6	2		10
Curtis Island		10					10
North Keppel Island			10				10
Rattray Island				10			10
Franklin Island				3	6		9
High Island				3	6		9
Holbourne Island			9				9
St Bees Island			9				9
Upolu Cay				1	8		9
Dbl. Cone Island			8				8
Snapper Island					7		7
Humpy Island		6					6
Hinchinbrook Island	1			2	2	1	5
Lindeman Island		1	3				5
North Molle Island			5				5
Nth Repulse Island			5				5
# of islands visited	13	17	20	28	36	19	76
# of visits to islands	44	207	171	494	616	227	1759

Appendix 6: Survey of recreational activities in the Great Barrier Reef region

This survey is being undertaken by researchers from CQUniversity and is supported with funding from the Australian Government.

In this survey we want to understand how much people use beaches, islands and the ocean in the Great Barrier Reef region for recreation. This information will help government understand the extent to which the area is used for recreation.

The survey should take about 10 to 15 minutes to complete.

Your answers are strictly confidential.

There are four sections in the survey.

Section 1: asks questions about your visits to **beaches on the mainland**

Section 2: asks questions about your visits to **islands**

Section 3: asks questions about your **activities on the water (fishing, boating, sailing)**

Section 4: general information questions

Section 1: Your visits to mainland beaches

We would like to gather information about the mainland **beaches in your region** that you visit most frequently. Do not count beaches on an island as this is dealt with in the next section. We are interested in the **two beaches you visit most frequently** (these may not be your favourite beaches).

Q1. **In the last 2 years**, which beach did you visit most frequently?

_____ Beach

☐ N/A, I did not visit a beach please go to Section 2 Question 12

Q2. **In** the **last 12 months**, which was your second most frequently visited beach?

_____ Beach

☐ N/A, I only visit one beach

Q3. <u>What do you do</u> when you visit these two beaches?
Please score the importance of the following list of activities on a scale from **0 = not at all important (not relevant) to 5 = very important** for your two most visited beaches

	Most visited Beach	Second most visited beach
Example: *Relaxing/enjoying the views*	4	3
Relaxing/enjoying the views		
Walking the dog		
Picnicking		
Spending time with family		
Walking		
Camping		
Observing wildlife/nature		
Swimming		
Surfing/kite surfing/boogie boarding		
Beach sport(cricket, football, volleyball, etc)		
Sailing / boating (inc water skiing)		
Fishing		
Attend organised events (festivals, etc)		
Shopping		
Eating out/ restaurants		
Night life		
Other activity Describe:_____		

Q4. **<u>What features</u> of these two beaches are important to you?**
Please score the importance of the following list on a scale from **0 = not at all important (not relevant) to 5 = very important** for your two most visited beaches.

	Most visited Beach	Second most visited beach
Example: *Lifesaver*	4	3
Lifesaver patrols		
4WD access		
Dogs allowed		
Fishing allowed		
Clean beach		
Good water quality		
The beach is not very crowded		
Public toilets and showers		
BBQ facilities, tables, grassed areas		
Shade		
Jetty or boat ramp		
Camping facilities		
Stinger nets		
Shark nets		
Other _____		

Q5. **In the last 2 years** how often did you go to your most visited beaches?

(Please tick one box in each column)

Frequency of visits	Most visited beach	Second most visited beach
Everyday	☐	☐
Most days of the week	☐	☐
More than once a week	☐	☐
About once a week	☐	☐
About once a fortnight	☐	☐
About once a month	☐	☐
About once a year	☐	☐
A few times a year*(specify)*	☐	☐

Q6. **In the next 2 years** how often do you expect to go to your most visited beaches?
(Please tick one box in each column)

Frequency of visits	Most visited beach	Second most visited beach
Everyday	☐	☐
Most days of the week	☐	☐
More than once a week	☐	☐
About once a week	☐	☐
About once a fortnight	☐	☐
About once a month	☐	☐
About once a year	☐	☐
A few times a year*(specify)*	☐	☐

Q7. Please complete the following details about your beach visits:

	Most visited Beach	Second most visited beach
Distance to beach from home (km)	_____Km	_____km
No. of people you usually go to beach with	_____	_____
Average time spent at beach (hours)	_____hrs	_____hrs

Q8. How do you usually get to the beaches from your home and how long does it take (ONE WAY)?

Please complete details for all travel methods that apply for a normal visit to each beach. For example, you might drive and walk to the beach.

Usual method of travel	Most visited Beach		Second most visited beach	
Walk				
Time taken to get to beach	____ hrs	____ mins	____ hrs	____ mins
Bicycle				
Time taken to get to beach	____ hrs	____ mins	____ hrs	____ mins
Motorcycle				
Time taken to get to beach	____ hrs	____ mins	____ hrs	____ mins
Small car				
Time taken to get to beach	____ hrs	____ mins	____ hrs	____ mins
Large car, ute, small truck				
Time taken to get to beach	____ hrs	____ mins	____ hrs	____ mins
4WD				
Time taken to get to beach	____ hrs	____ mins	____ hrs	____ mins
Bus				
Time taken to get to beach	____ hrs	____ mins	____ hrs	____ mins
Boat			____ hrs	____ mins
Time taken to get to beach	____ hrs	____ mins		
Other, specify _____				
Time taken to get to beach	____ hrs	____ mins	____ hrs	____ mins

Q9. **In the last 2 years**, have any of the following reasons **ever made you leave or stopped you going** to your **most frequently visited beach**. Do you think of any of them might **in the next 2 years?**

Most visited Beach	Last 2 years		Next 2 years		
Stingers	___ yes	___ no	___ yes	___ no	___ maybe
Bad weather (strong winds/murky water)	___ yes	___ no	___ yes	___ no	___ maybe
Dirty water	___ yes	___ no	___ yes	___ no	___ maybe
Rubbish in the water	___ yes	___ no	___ yes	___ no	___ maybe
Smelly water (from algal blooms)	___ yes	___ no	___ yes	___ no	___ maybe
Beach too crowded	___ yes	___ no	___ yes	___ no	___ maybe
Too much rubbish on the beach	___ yes	___ no	___ yes	___ no	___ maybe
Bad behaviour (eg drunkenness)	___ yes	___ no	___ yes	___ no	___ maybe
No parking spaces	___ yes	___ no	___ yes	___ no	___ maybe
Dirty facilities (toilets/BBQ etc)	___ yes	___ no	___ yes	___ no	___ maybe
Other (specify) _____	___ yes	___ no	___ yes	___ no	___ maybe

Q10. If **water quality gets worse** (for any reason that might be important to you) do you think you might make fewer trips to the beach?

In the next 2 years , would you change how often you go to **your most visited beach** if the water quality got worse as follows:

(a) Water quality gets **slightly worse** by about 10%

(b) Water quality gets **considerably worse** by about 20%

REDUCED frequency of visits	Water quality gets slightly worse by about 10%	Water quality gets considerably worse by about
I would **not change** the frequency of my visits	☐	☐
If you think you would change the frequency of your visits, please complete the relevant section/s below		
Stop going completely	☐	☐
About two or three visits a week less often	☐	☐
About one visit a week less often	☐	☐
About once a fortnight less often	☐	☐
About once a month less often	☐	☐
About once a year less often	☐	☐
A few times a year less often *(specify)*	☐	☐
Don't know/ not sure	☐	☐

Q11. What is the main water quality issue that would affect your visits.

_____

Section 2: Visits to Islands

We would now like to know about any visits you made to the islands in the Great Barrier Reef area (from Bundaberg in the south to the eastern tip of Cape York peninsular in the north - not including the Torres Strait Islands.

If your fishing trip or your boating trip includes some time when you step on to the island, the activities on the island are all we are interested in here – not any activity off the island. We will ask about boating trips around islands in the next section.

In this section, please only consider visits to islands where you stepped onto or were physically on the island.

Q12. In the last 2 years, which islands have you visited in the Great Barrier Reef area?

Name of Island	Number of visits
_____	☐
_____	☐
_____	☐
_____	☐
None	☐

Q13. In the next 2 years, which islands are you likely to visit in the Great Barrier Reef area?

Name of Island	Number of visits
_____	☐
_____	☐
_____	☐
_____	☐
None	☐

Q14. How often do you usually visit one of the islands in your region.

Frequency of visits	
I have never visited an island	☐
Everyday	☐
More than once a week	☐
About once a week	☐
About once a fortnight	☐
About once a month	☐
A few times a year*(specify)*	☐
About once a year	☐
About once every 2 years	☐

Go to Section3 Qu 22

Q15. In the last 2 years, what is the name of the island **you last visited**

_____

Q16. When did you last visit this island ? _____month _____ year

Q17. How long did you spend at this island **when you last visited**?

_____ days **or** _____hours

Q18. How many people in your group went to the island (including you)? _____

Q19. Consider how you got to the island on **your last visit.** Please select **all** the types of transport you used to get to the island.

Travel method	Distance	Time taken
Getting to the harbour or water		
Travel by car	_____ km	_____hr _____mins
Travel by bus	_____ km	_____hr _____mins
Travel by taxi	_____ km	_____hr _____mins
Other _____	_____ km	_____hr _____mins
Getting to the island		
Travel by plane	_____ km	_____hr _____mins
Travel by ferry, water taxi	_____ km	_____hr _____mins
Travel by commercial boat	_____ km	_____hr _____mins
Travel by own boat	_____ km	_____hr _____mins
Travel by other boat	_____ km	_____hr _____mins
Travel by jet ski	_____ km	_____hr _____mins
Other: _____	_____ km	_____hr _____mins

Q20. Please indicate how important the following activities were for you and your travel group on **your last island visit**? Please score the following on a scale from **0 = not at all important (not relevant) to 5 = very important**. (**Circle the relevant number)**

	Not al all important					Very important
Viewing fish +coral reefs	0	1	2	3	4	5
Snorkelling/diving	0	1	2	3	4	5
Spending time with family	0	1	2	3	4	5
Walking	0	1	2	3	4	5
Camping	0	1	2	3	4	5
Sailing/boating	0	1	2	3	4	5
Water skiing	0	1	2	3	4	5
Fishing	0	1	2	3	4	5
Picnicking	0	1	2	3	4	5
Swimming	0	1	2	3	4	5
Relaxation	0	1	2	3	4	5
Visiting family/friends	0	1	2	3	4	5
Sightseeing	0	1	2	3	4	5
Activities at a resort	0	1	2	3	4	5
Shopping	0	1	2	3	4	5
Eating out / Restaurants	0	1	2	3	4	5
Business trip	0	1	2	3	4	5
Night life	0	1	2	3	4	5
Other: _____	0	1	2	3	4	5

Q21. Approximately how much did you (and your family if applicable) spend on **your last island** visit? If this was part of a boating or fishing trip, only include the costs or money you spent while **on** the island.

Cost details	your last island visit
Getting to and from the island (from home)	
Transport Car, bus, taxi, plane etc.	$_____
Parking	$_____
Private boat (fuel costs or your contribution if boat shared)	$_____
Commercial boat/ ferry or other boat charges	$_____
On the island	
Food	$_____
Accommodation	$_____
Water sports and other activities	$_____
Entertainment	$_____
Shopping (general)	$_____
Other: _____	$_____

Section 3: Fishing, sailing or boat recreation trips

Q21. **In the last 2 years** did you go fishing, sailing or boating?

Yes ☐ - Fishing, where fishing is the **primary reason** for the trip

Yes ☐ - Sailing, where sailing is the **primary reason** for the trip

Yes ☐ - Boating (includes scuba diving, water skiing, snorkelling)

No ☐ If No, please go to Section 4, Question 32

Q22. **In the last 2 years,** how often did you go fishing, boating and sailing? Fishing means fishing from a boat (not from the beach). Boating covers all other non-fishing boating activities. This includes scuba diving, snorkelling, pulling inflatable devices etc. Please tick the appropriate box in each column.

Frequency of activity	Fishing	Boating	Sailing
More than once a week	☐	☐	☐
About once a week	☐	☐	☐
About once a fortnight	☐	☐	☐
About once a month	☐	☐	☐
Two or three times a year	☐	☐	☐
About once a year	☐	☐	☐
Once only	☐	☐	☐
Not al all	☐	☐	☐

Q23. **In the next 2 years,** how often do you expect to go fishing, boating and sailing?

Frequency of activity	Fishing	Boating	Sailing
About the same as before	☐	☐	☐
If you think you will change your activity, please complete the relevant section/s below			
More than once a week	☐	☐	☐
About once a week	☐	☐	☐
About once a fortnight	☐	☐	☐
About once a month	☐	☐	☐
About two or three times a year	☐	☐	☐
About once a year			☐
Once only	☐	☐	
Never/ Not at all	☐	☐	☐

Q24. Please consider some details about **a typical trip**. If you cannot think of a typical trip please enter details **about your last trip.**

	Fishing	Boating	Sailing
How long is a typical trip?	_____	_____	_____
How far do you travel in the boat on a typical trip?	_____ km	_____ km	_____ km
How many people go on a typical trip?	_____	_____	_____
Not applicable	☐	☐	☐

Q25. Does your household own a boat for fishing, sailing or recreation?

Yes – a sail boat ☐ What is its approximate value (to nearest $5000) $_____

Yes – other boat ☐ What is its approximate value (to nearest $5000) $_____

No ☐

Q27. Approximately how much do you (and your family, if applicable) spend on **a typical trip** (or on **your last trip**)

	Fishing	Boating	Sailing
Getting from home to the boat ramp/ harbour / water and back	$_____	$_____	$_____
Boat fuel (your contribution if shared)	$_____	$_____	$_____
Boat hire (your contribution if shared)	$_____	$_____	$_____
Food and drinks	$_____	$_____	$_____
Bait	$_____	$_____	$_____
Other _____	$_____	$_____	$_____
Not applicable	☐	☐	☐

Q26. For those of you who go fishing:
In the next 2 years would you go fishing **more often** if:

Fish catch rates improve by 10%

Fish catch rates improve by 20%

INCREASED frequency of trip	Fish catch rates improve by about 10%	Fish catch rates improve by about 20%
I would **not change** the frequency of my trips	☐	☐
If you think you would change the frequency of your trips, please complete the relevant section/s below		
About two or three visits a week more often	☐	☐
About one visit a week more often	☐	☐
About once a fortnight more often	☐	☐
About once a month more often	☐	☐
About once a year more often	☐	☐
A few times a year more often *(specify)*	☐	☐
Don't know/ not sure	☐	☐
Don't go fishing	☐	☐

Q27. For those of you who go fishing:
In the next 2 years would you go fishing **less often** if:

Fish catch rates decline by 10%

Fish catch rates decline by 20%

REDUCED frequency of trips	Fish catch rates improve by about 10%	Fish catch rates improve by about 20%
I would **not change** the frequency of my visits	☐	☐
If you think you would change the frequency of your trips, please complete the relevant section/s below		
Stop going completely	☐	☐
About two or three visits a week less often	☐	☐
About one visit a week less often	☐	☐
About once a fortnight less often	☐	☐
About once a month less often	☐	☐
About once a year less often	☐	☐
A few times a year less often *(specify)*	☐	☐
Don't know/ not sure	☐	☐
Don't go fishing	☐	☐

Q28. For those of you who go boating (including scuba diving and other water sports):
In the **next 2 years,** would you go boating **less often** if:

Water visibility declines by 10%

Water visibility declines by 20%

REDUCED frequency of trips	Water visibility declines by 10%	Water visibility declines by 20%
I would **not change** the frequency of my visits	☐	☐
If you think you would change the frequency of your visits, please complete the relevant section/s below		
Stop going completely	☐	☐
About two or three visits a week less often	☐	☐
About one visit a week less often	☐	☐
About once a fortnight less often	☐	☐
About once a month less often	☐	☐
About once a year less often	☐	☐
A few times a year less often *(specify)*	☐	☐
Don't know/ not sure	☐	☐
Don't go boating	☐	☐

Q29. For those of you who go sailing:
In the **next 2 years,** would you go sailing **less often** if:

Water visibility declines by 10%

Water visibility declines by 20%

REDUCED frequency of visits	Water visibility declines by 10%	Water visibility declines by 20%
I would **not change** the frequency of my visits	☐	☐
If you think you would change the frequency of your visits, please complete the relevant section/s below		
Stop going completely	☐	☐
About two or three visits a week less often	☐	☐
About one visit a week less often	☐	☐
About once a fortnight less often	☐	☐
About once a month less often	☐	☐
About once a year less often	☐	☐
A few times a year less often *(specify)*	☐	☐
Don't know/ not sure	☐	☐
Don't go sailing	☐	☐

Section 4: Information about you, your family and where you live

Q30. What is the name of the town where you live : _____

Q31. How long have you lived in this area? _____ years

Q32. Please indicate how important the following reasons are for you to live in this area. Please score the following on a scale from **0 = not at all important (not relevant) to 5 = very important**. (**Circle the relevant number)**

	Not al all important					Very important
Beach access	0	1	2	3	4	5
Fishing access	0	1	2	3	4	5
Lifestyle	0	1	2	3	4	5
Close to family	0	1	2	3	4	5
Close to work	0	1	2	3	4	5
Access to health services	0	1	2	3	4	5
Access to schools and other education	0	1	2	3	4	5
Close to major services and shopping centres	0	1	2	3	4	5
Other: _____	0	1	2	3	4	5

Q33. Do you own the house that you live in? Yes ☐ No ☐ If No, go to Question 37

Q34. How long have you owned your house? _____ years

Q35. How far is it from where you live to the beach? _____km

Q36. Did you choose where to live so it was close to the beach or boating recreation facilities?

Yes ☐ No ☐

Q37. How many people live in your household?

Adults ☐ Children (15 yrs and under) ☐

Q38. Are you Male ☐ Female ☐

Q39. How old are you?_____

Q40. What is the highest level of education you have obtained or are obtaining?

☐ Primary only

☐ Junior/Year 10

☐ Secondary/Year 12

☐ Diploma or trade certificate

☐ Tertiary degree

☐ Post graduate

☐ Other (please specify) _____

Q41. Please indicate the total weekly income (before taxes) that you and your spouse (if applicable) currently earn:

- ☐ less than $499 per week ($25,999 per year)
- ☐ $500 – $799 per week ($26,000 – $41,599 per year)
- ☐ $800 – $1199 per week ($41,600 – $62,399 per year)
- ☐ $1200 – $1999 per week ($62,400 – $103,999 per year)
- ☐ $2000 or more per week ($104,000 or more per year)

Thank you for answering this questionnaire survey.