Assessing recreational benefits as an economic indicator for the Gladstone Harbour Report Card

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Abstract

Industrial harbours are a complex interface between environmental, economic and social systems. Trying to manage the social and economic needs of the community while maintaining the integrity of environmental ecosystems is complicated, as is the identification and evaluation of the various factors that underpin the drivers of economic, community and resource condition. An increasingly popular strategy to deal with the identification and evaluation challenges in complex human-environmental systems is to use a report card system which can be used as a summary assessment tool to monitor the health of aquatic ecosystems. The use of environmental report cards has become increasingly common but reporting has principally focused on environmental indicators. It is only very recently that attempts are being made to include social, cultural and economic indicators. There has been limited consensus in the selection of social and economic indicators applied in different aquatic report cards but as recreation is such an important activity, typically some measure of recreation benefit is included. However, there has been no commonality in the measures applied to assess its performance as an economic indicator.

This paper is focused on the assessment of recreational benefits as an indicator of economic value in the report card for Gladstone Harbour in Queensland, Australia. It is the first aquatic health report card to include an assessment of the nonmarket value of recreation which makes it a more comprehensive indicator of economic value compared to estimates in other report cards based on measures of employment, participation or expenditure. There have now been three consecutive years of reporting (2014-2016) of the Gladstone Harbour report card, and the results indicate that the recreation index appears to be effectively monitoring changes over time.

Keywords: Recreation, non-market valuation, economic indicator, aquatic health report card, Gladstone Harbour

1. Introduction

Recreation and physical activity provide important health (physical and mental) and social benefits which improve community well-being (e.g., Morris and Harman 1997; Ambrey and Fleming 2014; Budruk and Lee 2016; Fenton et al. 2017). A major challenge for resource managers of areas such as coastal zones is to be able summarise and evaluate recreation benefits in these areas so that different competing uses can be managed. Numerous studies have examined the demand for, and determinants of, coastal recreation (Onofri and Nunes 2013). Many studies have assessed coastal recreation, following two main approaches. The first is to assess the direct and indirect economic benefits of the recreation market, which include the direct private benefit to commercial enterprises and the associated flow on effects (Access Economics 2008). The second is to evaluate recreation benefits directly, where non-market valuation techniques are applied because the benefits are not directly revealed in market transactions.

Coastal resource managers not only require information about the economic value of recreation but also about the factors that may impact on that value and the quality of the recreational experience. In beach valuation, this has typically been explored in terms of access and amenities (e.g., Lew and Larson 2005; Oh et al. 2008; Whitehead et al. 2008; Roca et al. 2009; Barry et al. 2011); beach nourishment / erosion (e.g., Shivlani et al. 2003; Huang et al. 2007; Marzetti 2009; Gopalakrishnan et al. 2011) and coastal water quality (e.g., Le Goffe 1995; Hanley et al. 2003; Beharry-Borg and Scarpa 2010; Halkos and Matsiori 2012). The quality of recreational fishing is more often linked to changes in catch rates (e.g., Bergstrom et al. 2004; Rolfe and Prayaga 2007; Melstrom et al. 2015).

The popularity of beach recreation has led to its dominance in the extensive global literature on the non-market value of coastal recreation (e.g., Whitehead et al., 2008; Roca et al., 2009; Barry et al., 2011; Rolfe and Gregg, 2012; Windle and Rolfe 2013). While the trip value of an individual beach visit might be relatively low, the total aggregate value may be more significant if participation rates are high. In comparison, recreational fishing (e.g., Lew and Larson 2005; Prayaga et al. 2010; Raguragavan et al. 2013; Farr et al. 2014; Pascoe et al. 2014a) is usually a higher cost activity and while it attracts a higher economic value for a recreational trip, the aggregate value to the community may be lower than other recreation activities due to lower participation rates.

River estuaries are also popular settings for coastal recreation, as these are often associated with major urban centres that historically developed around shipping and ports. It is these areas where resource management challenges are often most visible, particularly ports and harbours that are complex interfaces between environmental, economic and social systems. Trying to manage the social and economic needs of the community while maintaining the integrity of environmental ecosystems is complicated, as is the identification and evaluation of the various factors that underpin the drivers of economic, community and resource condition (Pascoe et al. 2016).

An increasingly popular strategy to deal with the identification and evaluation challenges in complex human-environmental systems is to use a report card system which can be used as a summary assessment tool to monitor the health of aquatic ecosystems (e.g., Dauvin et al. 2008; Bunn et al. 2010; Halpern et al. 2012; Kelble et al. 2013; Pascoe et al. 2016). A report card is a familiar assessment tool that is easy to understand and interpret, and can translate the complexity of ecosystem management into a readily and widely understood format (Halpern et al. 2012; Connolly et al. 2013; Pascoe et al. 2016). The structured approach of environmental report cards, together with their summary into simple indexes and regularity of performance gives them some powerful advantages for communication with the community compared to complex and more discrete applications of economic analysis (Halpern et al. 2012; Sheldon et al. 2012; Connolly et al. 2013). However, while the use of environmental report cards has increased, reporting has principally focused on bio-physical indicators and it is only more recently that attempts are being made to include social, cultural and economic indicators (Curtin and Prellezo 2010; Connolly et al. 2013; Pascoe et al. 2016).

More broadly there have been many studies that have focused on the selection of social and economic indicators; much of it driven some years ago with the focus on sustainable development and the need to adopt a triple bottom line approach (Strange and Bayley 2008). The development of indicators became an industry of its own (King et al. 2000) that still thrives today. Nonetheless, the challenge of measuring socio-economic indicators in a uniform and simplistic manner has limited their inclusion in aquatic health report cards. In a recent review of 14 aquatic monitoring and report card programs

Connolly et al. (2013) only identified two cases where either economic and/or social indicators were applied. The Great Barrier Reef report card applies social (adoption of best management practices) as well as ecological indicators[1], while the Ocean Health Index (OHI) reports on ten goals and includes ecological, social and economic indicators, with the latter two including 'Artisanal fishing opportunities', 'Coastal livelihoods and economies', 'Sense of place' and, 'Tourism and recreation' [2]. More recently, the inclusion of socio-economic indicators is becoming more commonplace. The preliminary report card for America's Watershed (the Mississippi River) released in 2015, presented the overall status for six broad social, environmental, and economic goals (Transportation, Water supply, Flood control and risk reduction, Economy, Ecosystems, and Recreation) [3]. In 2015, the Healthy Waterways program, (which has been producing report cards for Southeast Queensland (Australia) waterways since 2000), introduced a new waterway benefits rating which measured the level of social and economic benefits to local communities in terms of Community satisfaction, Access, Recreation, Recreational fishing and Drinking water[4]. Other regions in the Great Barrier Reef catchment area (Wet Tropics[5] and Mackay Whitsunday[6]) have recently piloted aquatic health report cards. In both cases, the inclusion of socio-economic indicators has been outlined in the design phase, but they have not been fully included as indicators in the initial report cards[7].

There has been limited consensus in the selection of social and economic indicators applied in different aquatic report cards. Typically some measure of recreation benefit is included but there has been no commonality in the measures applied to assess its performance. For example, recreation is measured by related expenditure in the 2016 Southeast Queensland Healthy Waterways report card[8]; by the proportion of the total labour force engaged in the tourism and recreation sector in the 2015 Ocean Health Index; and by participation in recreational activities in the 2015 America's Watershed report card.

The report card for the Gladstone Harbour in central Queensland, the focus of attention in this paper, provides an assessment of the environmental, economic, social and cultural health of the harbour area (see http://ghhp.org.au/). The economic value of both tourism (market benefits) and recreation (non-market benefits) are included in the economic component of the report card. The value of tourism is included as an indicator (along with shipping activity and commercial fishing) in the category (indicator group) 'Economic performance' while the recreation benefits are assessed as a separate category 'Economic value (recreation)'. Three separate indicators of recreational value are assessed: beach recreation, other land-based recreation and recreational fishing (land and water). This paper is focused only on the assessment of recreational benefits for the report card.

There have now been three consecutive years of reporting (2014-2016) of the Gladstone Harbour report card, and the results provide useful insights into the efficacy of the recreational index applied in the assessment. Two research questions are developed to examine these insights in more detail. The first asks if the recreation value of the three activity types are significantly different from each other. This is important as it establishes the potential transferability of values across different recreational activities as there is little evidence in the literature to provide any such guidance. The

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[1] http://www.reefplan.qld.gov.au/measuring-success/report-cards/ (accessed 31/01/17)
[2] http://www.oceanhealthindex.org/ (accessed 21/12/16)
[3] http://americaswater.wpengine.com/reportcard/ (accessed 21/12/16)
[4] http://healthywaterways.org/report-card (accessed 21/12/16)
[5] http://wettropicswaterways.org.au/report-card/ (Accessed 6/1/17)
[6] http://healthyriverstoreef.org.au/2015-download/ (Accessed 6/1/17).
[7] Other Cultural heritage and Stewardship indicators were included in the first report card (2015) for the Mackay Whitsunday region.
[8] At the time of writing this paper, full methodological details had not been publically released.

second research question asks if the recreation index is sufficiently sensitive to change over time (if appropriate). This is important as it establishes the sensitivity of the measures applied to assess the performance of the three recreation indicators and the efficacy of the recreation index applied in the report card.

This paper is outlined as follows. Background information about the case study is presented in the next section, followed by methodological details. The results are outlined in the fourth section with the discussion and conclusion presented in the final section.

2. Case study background

Gladstone, with a population of over 67,000, is located on the central Queensland coast in Australia and is a key access point to the southern Great Barrier Reef (Figure 1). Historically an agricultural area, it has developed into a major industrial hub and is home to several world scale industries including alumina, aluminium, cement, manufacturing, power and liquefied natural gas (LNG) (Pascoe et al. 2016). The Port of Gladstone has become one of Australia's largest and busiest deep water ports[9]. Coal exports comprised 62% of shipping activity in 2015-16 (GPC 2016). Exports of LNG began in January 2015, and by January 2016 they overtook alumina exports (historically the second largest export in Gladstone). Bauxite remains the major import in Gladstone, accounting for around half of import shipping because of its importance for the aluminium industry[10].

Figure 1. Location of Gladstone Harbour

[9] Gladstone Industry Leadership Group http://gilg.com.au/aboutus (accessed 14/11/16)

[10] Gladstone Ports Corporation, http://www.gpcl.com.au/Pages/Trade-Statistics.aspx (accessed 23/09/16)

The expansion of industrial activity increased the complexity of managing the harbour area as an environmental resource and in 2013, the Gladstone Healthy Harbour Partnership (GHHP) was established into provide support for improved decision making and management of the area. To help identify priorities for future improvements, the GHHP proposed the use of an annual report card to monitor the health of the harbour. The vision and objectives to determine the indicators for the GHHP report card were developed by the local Gladstone community, including Traditional Owners, community members, government, research organisations, conservation groups, recreational and commercial fishers and industry. A series of candidate indicators to assess the socio-economic health of the harbour was suggested by the GHHP Independent Science Panel (McIntosh et al. 2014) and the first report card was piloted in 2014.

3. Methodology

The main aim of a report card is to provide regular snap-shots of current conditions, so that changes (if applicable) over time can be monitored and progress towards specific goals for ecosystem health can be assessed (Bunn et al. 2010; Halpern et al. 2012; Pascoe et al. 2016). Progress is determined through scores and grades for specified performance indicators in the report card. The performance of all indicators in the Gladstone Harbour report card was assessed through a common index with a proportional score from zero to one, which readily converts into an associated A,B,C,D,E grade. The assessment methodology for the social, cultural and economic indicators of the report card was developed and trialled in 2014 by Pascoe et al. (2014b, 2016). Data were collected from both primary and secondary sources and the same methodology was applied for the 2015 (Cannard et al. 2015) and 2016 (Windle et al. 2016) report card assessments.

Two factors were included in the calculation of the recreation index: the economic value of the recreational activity and the quality of the recreational experience. The economic values for the three types of recreational activity were estimated using the Travel Cost Method (TCM) with data collected in a community survey. To provide additional information about the quality of the recreational experience, survey respondents were asked to indicate their level of satisfaction with each activity on a 1-10 scale. This matched the framework applied to measure community opinions and attitudes to assess other social and cultural indicators in the report card with data collected in the same survey. To construct the recreational index for the report card, the satisfaction rating for each activity was effectively weighted by its relative economic value.

In 2014, the first year of reporting, Pascoe et al. (2014b) considered the valuation estimates for a single recreational trip to be reasonably stable over the short-term and recommended they only be re-estimated every five years. Information about trip frequency and trip satisfaction was recommended to be collected on an annual basis.

3.1 Data collection

Each year primary data is collected in a computer assisted telephone interview (CATI) survey of 400 Gladstone residents. In 2014, respondents were asked to provide details about trip frequency for beach recreation, other land-based recreation and recreational fishing. Full travel cost details and satisfaction ratings were collected about the last recreation trip they made for their most frequent activity type. This provided sufficient information to estimate separate TCM models for beach and land-based recreation, but there was too few responses to estimate a separate model for recreational fishing. In 2015, details about trip frequency and satisfaction ratings were collected for each of the three activities and full travel cost details were collected to estimate the value of a recreational fishing trip. In 2016, information was only collected about trip frequency and satisfaction ratings for all three activities.

3.2 Estimating the non-market value of recreational activity

The TCM was selected as the valuation technique. It is the standard approach used to estimate recreational values and has been widely used over the past 50 years (e.g., Rosenberger & Loomis 2000; Bateman & Jones 2003; Johnston et al. 2006). Typically, on-site interviews are conducted with people using the site, but this was not suitable for the Gladstone region, which covers a large area where there are multiple recreational activities to consider at multiple sites. Instead, a population-based approach was adopted following Rolfe and Gregg (2012 and Windle and Rolfe (2013) where a sample of local residents were asked to provide information about their recreational activity in the harbour area. The main advantages of this approach is that it provides a value estimate for the whole Gladstone population including those who do not use the harbour for recreation, and it avoids problems of endogeneity in the sample, where there is a tendency to sample more frequent users in site surveys.

Where sites have relatively high visitation rates, then it is possible to apply individual TCM models, where the dependent variable is the number of recreation visits per person or household over a specified time period. Count data models such as Poisson or negative binomial models can be applied to analyse the data. It is assumed that the dependent variable (number of trips) follows a standard Poisson distribution, where the probability of an individual taking V_i trips can be modelled as:

$$\text{Prob}\ (V = \text{V}_\text{i}) = \text{Exp}(-\lambda_i) * \lambda_i^{V^i}/V_i! \qquad (1)$$

where, λ_i is both the mean and the variance of the random variable V (expected number of trips), takes strictly positive values and is a function of all the explanatory variables.

An important property of the Poisson regression models is equi-dispersion and the assumption that the mean is equal to the variance. However, in most travel cost surveys a large number of visitors make only a few trips to the reference site, while a limited number of visitors may visit the site more regularly. As a result, the variance is expected to be significantly higher than the mean, causing a problem in the Poisson models which is known as over-dispersion. Negative binomial models are a more general form of a count data model than the Poisson model, where the assumption about the equality of the mean and variance is relaxed by incorporating an additional error term to account for systematic differences (Haab and McConnell, 2002). An attractive feature of the model is that by assuming that the coefficient on travel cost is representative of cost tradeoffs, the consumer surplus (value) per trip can be simply estimated as:

$$\text{Consumer Surplus/trip} = -1/\beta_{\text{travel cost}} \qquad (2)$$

Travel costs were estimated as comprised of four components: travel vehicle cost (applied at a standard rate of $0.765/km per vehicle based on the Australian Taxation Office guidelines on work-related car expenses), travel time cost (included for each adult in the travel group at the rate of one third of the Queensland average hourly earnings (i.e. $33.60 per hour in 2012[11]), boat use (fuel) costs and the proportion of trip time spent on the recreational activity. The relationship is shown as:

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[11] Australian Bureau of Statistics 2012. 6306.0 - Employee Earnings and Hours, Australia, May 2012. Australian Bureau of Statistics, Canberra.

$$\text{TC}i = \big((\text{distance} * \text{vc}i) + (\text{time} * \$11.2/\text{adult}) + \text{boat cost}\big) * Rec\%\text{Trip} \quad (3)$$

where TC_i is the travel cost for a travel party (travelling in the same vehicle); *distance* is the two-way distance travelled to the site (km); *time* is the two-way time to travel to the site (hrs); vc_i is the vehicle cost per kilometre for travel method I; and Rec%Trip is the proportion of the trip spent on recreation.

This meant that only a few key details had to be collected in the survey: trip frequency rates, distance and time taken to reach the site, boat fuel costs (if applicable) and the proportion of trip time spent on the recreation activity. Full details are outlined in Pascoe et al. (2014b). Once the travel cost of each trip is established, the total travel cost and other explanatory variables become a function of trip frequency in the travel cost model.

4. Results

In all three years of reporting, the survey results highlight the importance of the harbour area for recreation activity. Over 90% of survey respondents use the harbour each year for beach or land recreation and over a third use it for recreational fishing (Table 1). Trip frequency is much higher for beach and land recreation compared to recreational fishing with 34 and 41 trips per year for beach and land recreation, compared with 19 for fishing in 2016 (Table 1). Satisfaction ratings are generally high with all over 7 out of 10 (Table 1).

Table 1. Participation rates, usage and satisfaction rating by the type of recreational activity

	Beach recreation	Land-based recreation	Rec fishing
2014			
% participation	93%	94%	33%
Avg # trips/yr: Users	26.93	34.53	15.69
Avg # trips/yr: Full sample	25.04	32.54	5.18
Avg satisfaction rating (score 1-10)	7.7	8.2	7.2
2015			
% participation	91%	95%	38%
Avg # trips/yr: Users	29.46	33.08	17.44
Avg # trips/yr: Full sample	26.81	31.34	6.67
Avg satisfaction rating (score 1-10)	7.7	7.9	7.7
2016			
% participation	92%	93%	39%
Avg # trips/yr: Users	34.23	41.33	19.04
Avg # trips/yr: Full sample	31.58	38.55	7.50
Avg satisfaction rating (score 1-10)	8.1	8.2	7.2

The TCM models for the three recreation activities are presented in Table 2 (noting that only one full valuation exercise has been conducted for each activity over the three years). All three models and parameters are significant. The *Alpha* estimate is highly significant in all three models, confirming the presence of over-dispersion and the appropriate use of negative binomial models.

Table 2. Activity specific (zero truncated negative binomial) models and value estimates

Year of valuation	Beach recreation 2014	Land-based recreation 2014	Rec fishing 2015
Constant	4.326***	3.732***	2.777***
Cost per trip	-0.029***	-0.016***	-0.007**
Alpha	1.488***	2.452***	2.451***
Model statistics			
Sample size	53	260	147
Log Likelihood	-234	-1141	-534
AIC/N	8.935	8.800	7.303
McFadden Rsrd	0.815	0.841	0.681
Chi sqrd	2053	12092	2279
Trip value (per household)	**$35.01**	**$61.44**	**$143.16**
(95 % CI)	($26-$52)	($48-$85)	($70-$920)

*** significant at the 1% level; ** significant at the 5% level

The trip value was estimated at $35.01, $61.44 and $143.16 for beach, land and fishing recreation respectively. To extrapolate the values from the survey sample to the population of Gladstone, information was applied from the Queensland Government Statistician's Office and the Australian Bureau of Statistics. It was assumed that the information provided by the respondent represented details of a household trip. While this may have been true for most situations, it would not have been true in all cases. The annual value of each activity is a function of trip value, trip frequency and population size (Table 3.)

Table 3. Economic value of recreational activities 2014-2016

	Beach recreation	Land-based recreation	Rec fishing
2014			
Trip value (per household)	**$35.01**	**$61.44**	
Gladstone population : # households	22,841	22,841	
Full sample: Avg # trips/yr	25.04	32.54	
***Gladstone:* Annual value of recreation trips** (95 % CI)	**$20.02M** ($15-$30M)	**$45.67M** ($36-$64M)	
2015			
Trip value (per household)	**$35.01**	**$61.44**	**$143.16**
Gladstone population : # households	24,480	24,480	24,480
Full sample: Avg # trips/yr	26.81	31.34	6.67
***Gladstone:* Annual value of recreation trips** (95 % CI)	**$22.98M** ($17-$34M)	**$47.14M** ($37-$66M)	**$23.38M** ($11-$150M)
2016			
Trip value (per household)	**$35.01**	**$61.44**	**$143.16**
Gladstone population : # households	24,987	24,987	24,987
Full sample: Avg # trips/yr	31.58	38.55	7.50
***Gladstone:* Annual value of recreation trips** (95 % CI)	**$27.63M** ($20-$41M)	**$59.18M** ($46-$83M)	**$26.83M** ($13-$172M)

The first research question examines the transferability of values across different types of activity. Apart from the influence of population size, there are two key components of recreation value: the value of a single trip and the frequency of trips across the whole sample, and either component may have a dominant influence on total recreation value. For example, the value of a recreational fishing trip ($143) is more than four times greater than that for beach recreation ($35) (Table 3), and yet the total value is similar because fewer people participate in recreational fishing and participation frequency is lower, resulting in lower trip frequency rates for the full sample (Table 1). The total value of land-based recreation is double that for beach recreation, because the trip value is much higher but participation frequency is only slightly higher. Consequently, a comparison of both trip values and trip frequency rates (for the full sample) is required to assess the transferability of values.

The trip value (Consumer Surplus) estimates were calculated using the mean parameter coefficients with 95% confidence intervals estimated using the Krinsky and Robb (1986) procedure. A Poe et al. (2005) procedure (a computational method for measuring the difference of independent empirical distributions estimated by bootstrapping) was applied to determine whether there was a statistically significant difference between different mean Consumer Surplus estimates for a recreation trip. The procedure calculates the proportion of differences greater than zero. The results indicate that there was a significant difference at the 5% level between the trip values for all three activities (Table 4).

Table 4. Comparison of trip value estimates across activities

Mean trip value comparison	**Beach ($35.01)/ Land ($61.44)**	**Beach ($35.01)/ Fish ($143.16)**	**Land ($61.44)/ Fish ($143.16)**
Proportion of differences > 0 (1000 draws)	0.98906	0.98398	0.97398
Significant difference	5% level	5% level	5% level

To test for any significant difference between the full sample trip frequency rates, paired samples T-tests were conducted. Comparisons were made for all three years from 2014-2016; the results indicate that there was a significant difference in the trip frequency rates across all three activities at the 1% level (apart from beach/land in 2015) (Table 5).

Table 5. Comparison (paired sample T-Test) of trip frequency rates across activities

Full sample trip frequency Comparison	**Beach/ Land**	**Beach/ Fish**	**Land/ Fish**
2014			
Frequencies (#trips/yr)	25.04/32.54	25.04/5.18	32.54/5.18
t statistic (significance)	-3.328 (0.001)	8.232 (0.000)	10.062 (0.000)
2015			
Frequencies (#trips/yr)	26.81/31.34	26.81/6.67	31.34/6.67
t statistic (significance)	-1.933 (0.054)	8.507 (0.000)	10.118 (0.000)
2016			
Frequencies (#trips/yr)	31.58/38.55	31.58/7.50	38.55/7.50
t statistic (significance)	-3.023 (0.003)	9.117 (0.000)	11.262 (0.000)

The significant difference between both the primary components of recreational value across all three recreational activities indicates that recreational values are not transferable across different types of activity.

The second research question examines whether the recreation index applied for the report card provides an effective measure for the performance of the three recreation indicators and is sufficiently sensitive to change over time. Two types of data are collected on an annual basis: participation frequency and satisfaction ratings for the three different activities.

Paired sample T-Tests indicated that there was no significant annual variation in participation frequency across reporting periods apart from land-based recreation which had significantly higher participation rates (at the 5% level) between 2015 and 2016 (Table 6). However, there was a significant increase in participation in beach recreation (at the 5% level) and land recreation (at the 10% level) between 2014 and 2016.

There was a significant increase in satisfaction ratings between 2015 and 2016 for both beach and other land-based recreation (at the 5% level), and a significant decrease in the satisfaction rating for fishing recreation (at the 1% level) (Table 6). No comparison was made with the initial year of reporting (2014) because respondents only provided a rating for one particular activity where as in subsequent years they provided a rating for each activity.

Table 6. Temporal comparison (paired sample T-Test) of trip frequency rates and satisfaction ratings

Full sample trip frequency	**Beach**	**Land**	**Fish**
2014 – 2015			
Frequencies (#trips/yr)	25.04/26.81	32.54/31.34	5.18/6.67
t statistic (significance)	-0.560 (0.576)	0.320 (0.749)	-1.155 (0.249)
2015 – 2016			
Frequencies (#trips/yr)	26.81/31.58	31.34/38.55	6.67/7.50
t statistic (significance)	-1.341 (0.181)	-1.986 (0.048)	-0.464 (0.643)
Satisfaction (Mean rating)	7.7/8.1	7.9/8.2	7.7/7.2
t statistic (significance)	2.525 (0.012)	2.239 (0.026)	-3.770 (0.000)
2014 – 2016			
Frequencies (#trips/yr)	25.04/31.58	32.54/38.55	5.18/7.50
t statistic (significance)	-2.016 (0.044)	-1.657 (0.098)	-1.446 (0.149

The results suggest that over the three years of reporting the recreation index has been effective in monitoring change in both participation and satisfaction rates. While annual changes in the quality of recreational experiences have been recorded, behavioural changes appear to take longer to manifest.

5. Discussion and conclusions

The Gladstone Harbour report card is one of the early initiatives to focus on environmental, economic, social and cultural objectives (Pascoe et al. 2016). To the authors' knowledge, it is the first aquatic health report card to include an assessment of the nonmarket value of recreation, which makes it a more comprehensive indicator of economic value compared to estimates in other report cards based only on measures of employment, participation or expenditure. After three consecutive years of reporting the recreation index appears to be effectively monitoring changes over time, and recorded improvements in the performance of the recreation indicators is supported by evidence of improvement in other related social indicators in the report card (Windle et al. 2016).

In this case study, primary data collection was straightforward as a community survey was conducted annually to collect details to measure a range of social indicators for the report card. Little additional effort was required to collect full information for the economic valuation (travel details, participation and satisfaction) with travel details and trip values only updated every five years (Pascoe et al. 2014b). Given the ease of data collection, the results of this study demonstrate how recreation values can be included within a report card system and applied to other marine environment sites.

The study also makes a contribution to knowledge about recreation values. Previously little was known about the economic value of recreational activity in a harbour area as no previous valuation studies have been conducted in Australia. Similarly, there was little information about the variation in values of different recreational activities at a specific location. In this study, recreational values of $35, $61 and $143 per trip were estimated for beach, other land-based and fishing (land and water) recreation respectively in the Gladstone Harbour area. Trip values[12] as well as participation frequency varied significantly across activities; a result that supports the findings of Farr et al. (2014) who identified different determinants associated with participation in fishing and non-fishing recreation in both water and land-based activity in another Great Barrier Reef location (Townsville).

It is also useful to consider value transferability across different locations by comparing the results with other similar studies. The similarity (or lack of) secondary source estimates of recreation value provides insights into the relevance of having conducted a primary valuation study rather than the alternative option of applying benefit transfer (e.g., Brouwer 2000; Johnston and Rosenberger 2010; Johnston et al. 2016). In Queensland, coastal recreation valuations have focused on beach and fishing recreation. Previous studies have estimated recreational (marine) fishing values at $385 per trip (Prayaga et al. 2010) and between $60 to $110 per trip (Pascoe et al. 2014a), which would suggest that values for fishing recreation appear to be relatively location specific. Two other recent studies estimated values for beach recreation by local residents in Queensland. Windle and Rolfe (2013) surveyed Brisbane residents and estimated an average trip value of $40 for Gold Coast beaches and $90 for Sunshine Coast beaches, but average distances travelled may have been longer than for Gladstone residents. A more comparable study is Rolfe and Greg (2012) who estimated the value of beach recreation for local residents along the Queensland coast from Cairns to Bundaberg (including Gladstone) at $35/person/trip. However, this value is still more than double the per person trip value of $16 reported in Pascoe et al. (2014b) for the Gladstone Harbour. These comparisons suggest that it was appropriate to have conducted a primary valuation study as the paucity of similar valuation studies in Queensland limited the potential to apply secondary source estimates. Similar findings from another coastal area in Australia are reported in Rolfe et al. (2015) and internationally in Strand et al. (2017).

The results indicate that while satisfaction ratings are sensitive to annual variation, participation rates are less so. However, over the three years of reporting the recreation index appears to have been effective in monitoring change in both participation and satisfaction rates, with some changes taking longer to manifest than others. It is also necessary to define the benchmark for comparison. For example, in 2016 there were significant changes in the satisfaction ratings for all three activities from the previous year (Table 6), but compared with 2014 (the base year) there had been no change in the ratings for land-based and fishing recreation (Table 1). Similarly, in 2016 there was no significant difference in participation frequency for beach and land recreation between 2015 and 2016, but there was a difference between 2014 and 2016 (Table 6). This highlights the importance of not just

[12] Pascoe et al. (2014b) considered trip values to be reasonably stable in the short term and recommended they be re-estimated every five years. When they are next re-estimated, the results will provide useful insights into the temporal stability of recreation values.

comparing report card results on an annual basis, but to also make a comparison with a baseline year of reporting. Reporting against a baseline also helps identify potential changes that may have time lags and take longer to manifest.

In Gladstone the recreation index is re-estimated annually based on current details about participation rates (to update economic values) and satisfaction ratings. Other studies in the Great Barrier Reef area have identified that both factors can be adversely impacted by ambient conditions, with evidence in relation to increased construction work from land development and reduced water clarity for tourists generally (Jarvis et al. 2016), poor water quality and declining biodiversity for scuba divers and snorkelers (Kragt et al. 2009) and declining water quality for beach recreation (Rolfe and Gregg 2012). In Gladstone Harbour there has been substantial industrial development in recent years but much of the major construction work and development projects have recently been completed. It is possible that conditions for recreational activity may have improved. However, it is not clear what changes may impact on the quality of the recreational experience and what changes are required to induce a behavioural change with impact on participation rates. These are important issues for future studies.

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