AUSTRALIAN COMMUNITY MEMBERS' ATTITUDES TOWARD CLIMATE CHANGE IMPACTS AT THE GREAT BARRIER REEF

Carena J. van Riper
Texas A&M University
cvanripe@tamu.edu

Gerard Kyle
Texas A&M University

Jee In Yoon
Texas A&M University

Stephen G. Sutton
James Cook University

Abstract.—This research identified homogenous groups of Australian community members that share similar attitudes toward climate change impacts within the Great Barrier Reef World Heritage Area (GBRWHA). A questionnaire was administered to a random sample of adult residents living near the GBRWHA (n = 1,623) in order to assess public awareness of climate change, concern about associated impacts, and involvement in mitigation strategies. Five distinct segments of the survey population were identified using three attitudinal dimensions drawn from the Theory of Planned Behavior. Study findings illustrated that each group perceived a variety of social, commercial, and environmental threats to the health of the Great Barrier Reef ecosystem and reported different levels of intended and carried-out environmentally responsible behaviors. Recommendations are provided for how to engage the identified groups of survey respondents in environmentally responsible behaviors.

1.0 INTRODUCTION

The Great Barrier Reef World Heritage Area (GBRWHA) is one of the most biologically diverse systems in the world. This area extends approximately 1,500 miles along the northeastern coast of Australia, protecting an expansive network of coral reef ecosystems, continental islands, and sandy cays. Multiple uses are considered in its management with the goal of providing opportunities for the public to value and appreciate the reef (GBRMPA 2009). Shipping, commercial charters, recreational activities such as fishing and diving, and hunting by indigenous peoples are among the many uses accommodated within the GBRWHA.

There are a number of impacts and external pressures that are considered in managing the GBRWHA including climate change, which is recognized as one of the greatest threats facing the GBR ecosystems (IPCC 2007, Johnson and Marshall 2007, Moscardo et al. 2001, Vanclay 1988). In response to the anticipated impacts of climate change, GBRWHA management has made it a priority to reduce human influences on the reef. Managers have also been communicating with and involving the public in climate change mitigation strategies (Lynch et al. 2009). For example, the Australian Government developed the Climate Change Action Plan, a five-year project to better understand and test strategies for helping the reef cope with climate change impacts (GBRMPA, 2007). A thorough understanding of both public engagement and behavioral responses to environmental concerns is integral to this plan and to climate change mitigation strategies in general (Fielding et al. 2008, Lorenzoni et al. 2007).

The present study sought to identify homogenous groups of Australian residents that share similar attitudes toward climate change impacts within the GBRWHA. The findings from this research will help managers efficiently direct agency resources toward segments of the Great Barrier Reef regional community. Recommendations are provided for how to engage the identified groups of survey respondents in environmentally responsible behaviors (ERBs).

2.0 METHODS

2.1 Survey of Community Members

A telephone survey was administered in November 2008 to a random sample of adult residents living near the GBRWHA. The study area was stratified into eight regions, five of which were located within 50 km of the coastline: Cape York, Far Northern, Northern, Central, and Southern Queensland. The three remaining regions included residents in the Metropolitan Statistical Areas of Sydney, Melbourne, and Brisbane.

2.2 Analysis Approach

This research approach drew on the Theory of Planned Behavior (TPB) to determine whether individuals will engage in ERBs (Ajzen 1988, 1991). The TPB model was employed because it has previously demonstrated good explanatory power and has been extensively applied to measure ERBs in a variety of contexts (Fielding et al. 2008, Hinds and Sparks 2008). Confirmatory factor analysis (CFA) was used to test the adequacy of a three-factor solution that aligned with the three TPB dimensions: 1) attitudes, 2) subjective norms, and 3) perceived behavioral control (PBC). All survey items were aligned with the areas conceptualized by the TPB model to predict intentions to engage in ERBs, which in turn were used to predict public engagement in climate change mitigation strategies. More specifically, the first factor measured levels of environmental concern about climate change impacts on the health of the GBRWHA. The second factor assessed the extent to which respondents felt personally obligated to engage in mitigation efforts. The third factor assessed respondents' perceived levels of control over climate change. Mean value scores from the three factors were used to perform a cluster analysis (K-means), segmenting respondents into homogeneous groups. For the final cluster solution, various cluster combinations were evaluated based on the distinction among groups, proportionality of the clusters, and the analysts' informed judgment.

Batteries of questions on the following were used to compare and contrast the identified groups of survey respondents: 1) potential threats to the GBRWHA, 2) behavioral intentions, and 3) reported behavior. This phase of the analysis helped to evaluate the division of attitudinal segments (Jun et al. 2009, Kotler et al. 2002). First, respondents' opinions of potential threats were measured with 10 survey items. (Chi-square tests were later used to examine each item individually across groups of respondents.) The next step assessed intended behaviors by asking respondents what actions they would undertake over the following 12 months to help reduce the impacts of climate change on the Great Barrier Reef ecosystem. The third step assessed reported behaviors by asking if, in the previous 12 months, respondents had engaged in behaviors equivalent to those that were used to measure behavioral intentions. For these two behavioral measures, summative scores were created from a list of 14 survey items and entered into an ANOVA to assess the similarities and differences among groups.

3.0 STUDY FINDINGS

3.1 Response Rates

A total of 10,057 households were contacted by Roy Morgan Research, an Australian-based consulting firm. A phone survey was administered to 1,623 respondents for a response rate of 16 percent. Approximately 90 percent of those who declined to participate did so prior to being informed about the content of the survey. Approximately 200 residents in each of the eight communities completed the survey: Sydney (n = 200), Melbourne (n = 200), Brisbane (n = 200), Cape York (n = 200), Far Northern (n = 206), Northern (n = 202), Central (n = 202), and Southern Queensland (n = 213). Non-response bias for respondents and non-respondents was not assessed, so there is a possibility that the study estimates were mildly skewed. It should also be noted that potential bias does not extend to the cluster analysis, which examined relationships among variables rather than estimating population parameters. However, the size of the groups would be affected and, therefore, the results might not be generalizable to the broader population.

3.2. Socio-demographics

Just over half (54 percent) of the survey respondents were male. The average age was between 40 and

44 years. Approximately one third (32 percent) had achieved less than a U.S. high school diploma (i.e., graduated from primary school or secondary school) and 21 percent had attained what is equivalent to a high school diploma. Few respondents (6 percent) had attended some form of trade school, 18 percent had earned some postsecondary education, and 23 percent were college graduates. Most respondents had high annual household incomes: 4 out of 10 earned greater than $100,000, 3 out of 10 earned between $50,000 and $100,000, just over 1 in10 earned between $30,000 and $49,999, and 1 in10 earned less than $30,000 on an annual basis. Only 4 percent reported being of Aboriginal or Torres Strait Islander descent, 80 percent were born in Australia, and 95 percent spoke English as a first language. Average household size was just over three people.

3.3 Modeling Results

This research employed a three-factor TPB model (Table 1). The associated fit indices revealed an acceptable model fit (χ^2 =197.093, df =51, RMSEA =.042; NNFI =.982; CFI =.986). Using this attitudinal model, five distinct segments of the population were identified in the cluster procedure. No significant differences were found between clusters based on number of days visiting the Great Barrier Reef, household size, income, or ethnicity (Aboriginal or Torres Strait Islander). However, several distinguishing items emerged, including education, gender, birthplace in Australia, English as first language, and average age.

Table 1.—Factor loadings, mean values, and standards deviations for Australian residents' attitudes, subjective norms and perceived behavioral control (n = 1,623)

	Factor Loadings				
	Factor 1	Factor 2	Factor 3	Mean	SD
Attitudes [ac]				3.86	0.75
8a. The overall health of the Great Barrier Reef	.70			3.90	1.00
8b. The natural beauty of the Great Barrier Reef	.76			3.93	0.95
8c. The ability of the Great Barrier Reef to support populations of fish and wildlife	.71			3.82	1.03
8d. The enjoyment people get from visiting the Great Barrier Reef	.70			3.72	1.05
8e. The ability of the Great Barrier Reef to support sustainable fisheries	.63			3.92	1.02
8f. The ability of the Great Barrier Reef to support sustainable tourism	.67			3.73	1.04
8g. The amount of coral on the Great Barrier Reef	.68			3.99	0.95
Subjective norms [bc]				2.47	0.96
6e. I feel personally obligated to help reduce the impact of climate change on the Great Barrier Reef		.75		2.59	1.15
6f. I would feel guilty if climate change had a negative impact on the Great Barrier Reef		.57		2.64	1.27
6g. People like me should do everything they can to reduce the impact of climate change on the health of the Great Barrier Reef		.67		2.19	1.09
Perceived Behavioral Control [bc]				2.25	1.02
6a. If everyone took action, we could reduce the impact of climate change on the Great Barrier Reef			.56	1.95	1.15
6c. I have the ability to help reduce the impact of climate change on the Great Barrier Reef			.69	2.54	1.20

[a] Mean score value is on a scale ranging from 1 (strongly increase) to 5 (strongly decrease).
[b] Mean score value is on a scale ranging from 1 (strongly agree) to 5 (strongly disagree).
[c] Fit indices: χ^2 =197.093 , df =51 ; RMSEA =.042 ; NNFI =.982 ; CFI =.986

The TPB model was used to segment respondents into five groups (see Table 2). Cluster One reported a low average score (mean = 3.18) on attitude items relative to the four other groups of respondents. This group had the highest reported values for items measuring subjective norms (mean = 3.99) and PBC (mean = 4.14). Several distinguishing variables arose in the profile of Cluster One: 75 percent were 45 years of age or above, 73 percent were male, and 86 percent were born in Australia. Cluster Two had the highest average attitude score (mean = 4.21), as well as high levels of subjective norms (mean = 3.39) and PBC (mean = 3.5). Respondents in this cluster were in one of two groups containing the lowest percentage (75 percent) of Australian-born residents and they fell into one of the highest average age groups. Cluster Three did not report strong feelings about the three factors, ranking third in all categories including attitudes (mean = 4.04), subjective norms (mean = 2.8), and PBC (mean = 2.17), though it should be noted that the average attitude score for Cluster Three was high considering its placement on a scale ranging from one to five. Many of the socio-demographics that helped to identify respondents in Cluster Three were consistent with the larger sample; however, this group contained one of the highest proportions (86 percent) of Australian-born residents. Cluster Four was comprised of respondents who reported the lowest attitude scores (mean = 2.63), low levels of subjective norms (mean = 2.20), and low PCB (mean = 1.95). This cluster was distinct from the others in terms of respondents' low levels of education, large proportion of non-native English speakers, low income bracket, and young age. Finally, respondents assigned to Cluster Five reported the highest attitude scores (mean = 4.21) and the lowest level of agreement with items measuring both subjective norms (mean = 1.67) and PCB (mean = 1.51). Similar to Clusters Three and Four, this group was relatively young and contained more females than males.

3.4 Cluster Comparisons

Three batteries of questions were used to profile and compare across the five clusters, the first of which measured respondents' perceived levels of social (e.g., recreation, tourism, development, indigenous uses), commercial (e.g., fishing, shipping), and environmental (e.g., climate change, water quality) threats to the GBRWHA (Table 3). Study findings suggest that there was higher concern about commercial uses and environmental impacts than about recreation, development, or subsistence living in the GBRWHA. Clusters One and Two reported lower degrees of perceived threats than did Clusters Three, Four, and Five. In other words, respondents in the two clusters that reported the highest levels of subjective norms and perceived behavioral control also reported less severe perceived impacts from threats to the GBRWHA than did individuals in the other three clusters.

Table 2.—Average factor scores for five-cluster solution

	Cluster 1 (n = 160)	Cluster 2 (n = 199)	Cluster 3 (n = 423)	Cluster 4 (n =210)	Cluster 5 (n =631)	F
Attitudes (mean, SD)	3.18 (0.51) ^{ac}	4.21 (0.63) ^{ab}	4.04 (0.47) ^{abc}	2.63 (0.54) ^{abc}	4.21 (0.46) ^{ac}	503.24*
Subjective Norms (mean, SD)	3.99 (0.70) ^{a}	3.39 (0.73) ^{a}	2.80 (0.51) ^{a}	2.20 (0.64) ^{a}	1.67 (0.44) ^{a}	809.35*
Perceived Behavioral Control (mean, SD)	4.14 (0.62) ^{a}	3.50 (0.62) ^{a}	2.17 (0.47) ^{a}	1.95 (0.47) ^{a}	1.51 (0.45) ^{a}	1169.53*

Similar superscripts indicate significant differences at $p \leq 0.05$.
*Significant at $p \leq 0$ .001.

Table 3.—Descriptive statistics for measures of potential threats to the Great Barrier Reef reported by Australian community members

Survey Item mean (SD)	Total	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	F
Commercial fishing in the GBRMP	3.35 (0.81)	3.01[a] (1.00)	3.19[b] (0.86)	3.38[ab] (0.79)	3.23[c] (0.85)	3.50[abc] (0.70)	15.40*
Recreational fishing in the GBRMP	2.56 (0.86)	1.99[a] (0.89)	2.35[ab] (0.81)	2.57[abc] (0.80)	2.62[ab] (0.87)	2.75[abc] (0.83)	29.84*
Recreational activities such as snorkeling or diving on the reef	2.20 (0.82)	1.88[a] (0.91)	2.16[a] (0.80)	2.15[ab] (0.79)	2.23[a] (0.88)	2.31[ab] (0.77)	9.69*
Shipping on the GBRMP	3.26 (0.85)	2.58[a] (1.10)	3.20[ab] (0.83)	3.27[ac] (0.79)	3.37[a] (0.83)	3.42[abc] (0.74)	34.45*
Declining quality of the water from land run-off into the GBRMP	3.39 (0.81)	2.62[a] (0.98)	3.23[ab] (0.90)	3.44[abc] (0.76)	3.33[ad] (0.81)	3.63[abcd] (0.61)	58.89*
Coastal development along the GBRMP	3.29 (0.82)	2.62[a] (0.97)	3.23[ab] (0.88)	3.29[ac] (0.79)	3.16[ad] (0.85)	3.51[abcd] (0.66)	43.10*
Tourism in the GBRMP	2.66 (0.83)	2.22[a] (0.94)	2.60[ab] (0.82)	2.64[ac] (0.82)	2.68[a] (0.81)	2.81[abc] (0.76)	17.56*
Climate change or global warming	3.45 (0.84)	2.29[a] (1.06)	3.21[ab] (0.90)	3.53[abc] (0.70)	3.35[ad] (0.88)	3.76[abcd] (0.51)	129.87*
Indigenous hunting in the GBRMP	2.31 (0.94)	2.13[a] (1.07)	2.10[b] (0.92)	2.24[c] (0.88)	2.56[abc] (0.94)	2.37[ab] (0.92)	8.58*
Recreational boating in the GBRMP	2.59 (0.85)	2.10[a] (0.92)	2.43[ab] (0.81)	2.59[a] (0.83)	2.75[ab] (0.89)	2.71[ab] (0.80)	20.82*

Mean score value is on a scale ranging from 1 (no threat at all) to 4 (major threat).
Similar superscripts indicate significant differences at $p \leq 0.05$.
*Significant at $p \leq 0$ .001.

The second and third batteries of questions used to validate the five-cluster solution measured intended and reported behaviors (Table 4). Respondents intended to take actions and reported actually taking actions to reduce climate change impacts in the GBRWHA. A total of 79 percent of respondents in the aggregated sample reported undertaking at least one ERB in the previous 12 months. Across all groups, respondents underestimated their intended behaviors by actually engaging in more behaviors than they reported intending to engage in (see Figure 1). The most frequently cited behavioral intention items were miscellaneous (15 percent), reduced power, energy, and/or electricity usage (12 percent), and recycling (5 percent). The most common behaviors that had occurred in the previous 12 months were turning off lights and appliances (38 percent) and recycling (33 percent).

Table 4.—Average factor scores for five-cluster solution

	Cluster 1 (n = 160)	Cluster 2 (n = 199)	Cluster 3 (n = 423)	Cluster 4 (n =210)	Cluster 5 (n =631)	F
Behavioral Intentions	0.62 (0.88)	0.52 (0.67)	0.60 (0.79)[a]	0.47 (0.68)	0.66 (1.08)[a]	2.67*
Reported Behavior	1.93 (1.47)[a]	1.57 (1.28)[b]	1.65 (1.17)[c]	1.86 (1.46)[d]	1.68 (1.31)[abcd]	7.05*

Similar superscripts indicate significant differences at $p \leq 0.05$.
*Significant at $p \leq 0$ .001.

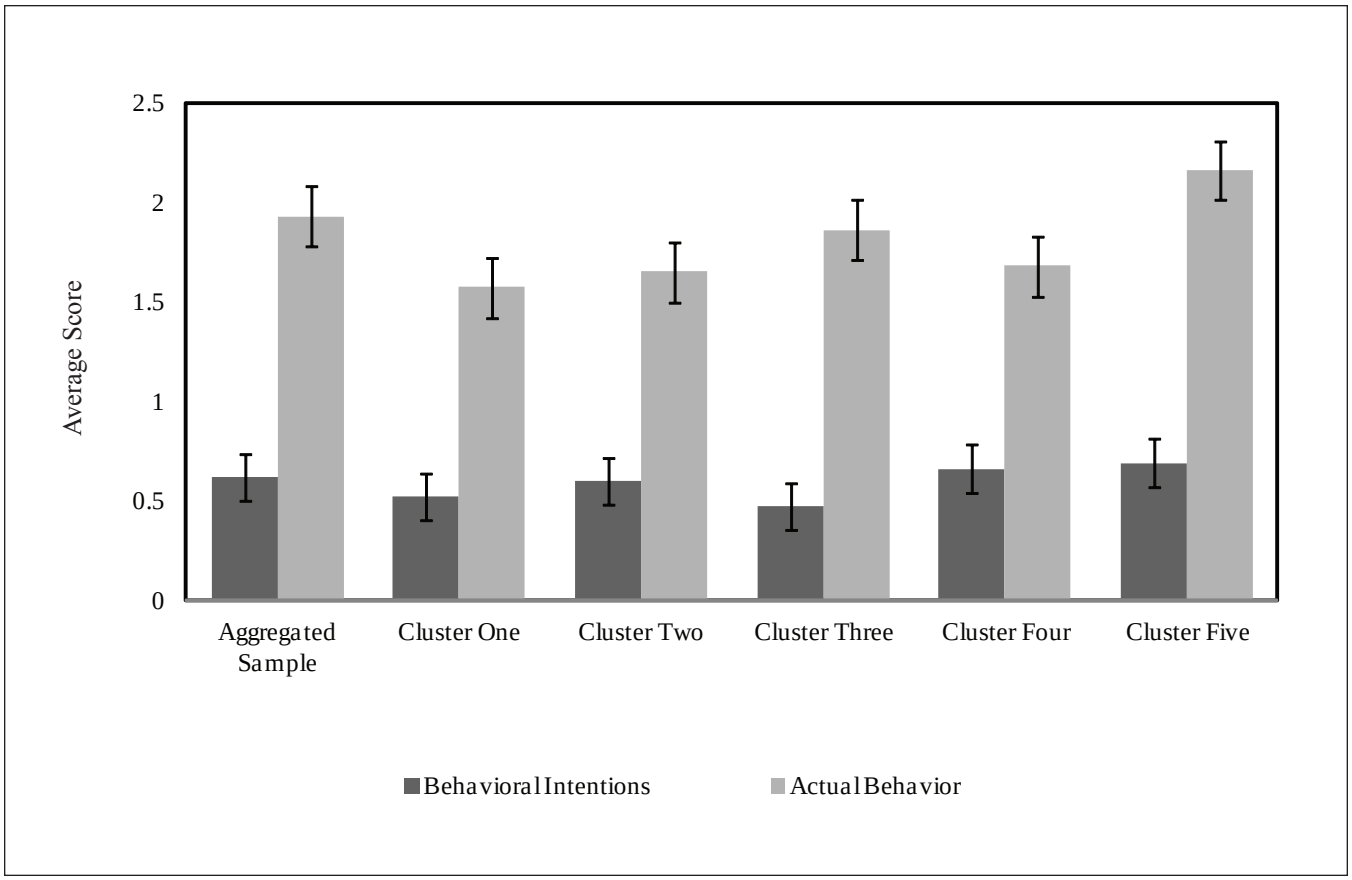

Figure 1.—Comparison between intended and reported environmentally responsible behaviors.

4.0 DISCUSSION

Consistent with past research, the results of this study show that the survey respondents shared widespread awareness and concern over climate change and its perceived impacts on the health of the Great Barrier Reef ecosystem (Johnson & Marshall 2007, Moscardo et al. 2001, Nilsson et al. 2010, Vanclay 1988). This suggests that educational efforts aimed at engaging the public in climate change mitigation strategies would be well received among the survey respondents.

We identified five homogenous groups of Australian community members living in close proximity to the GBRWHA who share distinct attitudes and beliefs about climate change. GBR managers may want to know how to direct resources in ways that are appealing to these different groups. Cluster One is comprised mostly of older males born in Australia who have relatively weak attitudes, are strongly influenced by moral obligations, and feel the highest level of control over ERBs,. These respondents would be especially receptive to climate change-friendly management strategies. Cluster Two, older non-residents, reported strong attitudes and moderate levels of norms and PBC, indicating that respondents in this group value the environment and the GBRWHA in particular. Both Clusters One and Two would be likely to support pro-environmental management actions. Cluster Three, the group with the highest proportion of Australian-born residents, high levels of income, and young average age, reported average attitudinal scores relative to the four other identified groups. Although Cluster Three ranked third in all categories, respondents in this group have strong attitudes but feel a relatively weak degree of social obligation and control over reducing climate change impacts at the GBRWHA. Cluster Four included survey respondents with lower levels of education and income, a large proportion of non-native English speakers, and of a relatively younger age. Respondents in this group reported the lowest overall attitudes. Managers will likely face challenges engaging this group in ERBs.

Finally, Cluster Five contained a greater proportion of young females than any other group, reported strong attitudes, perceived the lowest levels of obligation, and had the strongest disbelief that behavioral measures would influence climate change. To engage this group of survey respondents effectively, managers could convey the message that ERBs can in fact make a difference in reducing climate change impacts.

Three sets of validation variables identified similarities and differences among the five identified groups of respondents, including indicators of perceived threats, intended behaviors, and reported behaviors. First, study findings demonstrate that Clusters Three, Four, and Five are more concerned with social, commercial, and environmental threats facing the health of the GBRWHA, while Clusters One and Two are less concerned about these threats. Perceived threats were thus helpful in determining the distinctiveness of the attitudinal segments. Second, survey respondents intended to engage in ERBs such as reducing energy use, recycling, and using public transportation, suggesting that most respondents are willing to engage in climate change mitigation strategies. Finally, respondents reported engaging in ERBs during the previous year, pointing to behavioral responses to concerns surrounding climate change. In addition to validating the differences among attitudinal segments, assessing intended and reported behaviors revealed that behavioral intentions were underestimated – all groups reported engaging in more ERBs than anticipated. This finding is contrary to past research and may be a function of social judgment theory, in that survey respondents could have felt obliged to provide the most socially acceptable response to the survey questionnaire (Sherif and Hovland 1961).

5.0 CONCLUSIONS

Consistent with past research, the results of this study show that the Great Barrier Reef regional community is aware of the threats that climate change poses to the reef ecosystem. Considering this widespread concern, educational efforts aimed toward the five segments of the survey population should be well received and effective as a mechanism for engaging community members in ERBs.

6.0 LITERATURE CITED

Ajzen, I. 1988. **Attitudes, personality and behavior.** Chicago, IL: Dorsey Press.

Ajzen, I. 1991. **The theory of planned behaviour.** Organizational Behavior and Human Decision Processes. 50: 179-211.

Fielding, K.S.; McDonald, R.; Louis, W.R. 2008. **Theory of planned behaviour, identity and intentions to engage in environmental activism.** Journal of Environmental Activism. 28: 318-326.

Great Barrier Reef Marine Park Authority (GBRMPA). 2007. **Great Barrier Reef climate change action plan 2007 – 2012.** Available at http://www.gbrmpa.gov.au/__data/assets/pdf_file/0012/22620/climate-change-action-plan.pdf. (Accessed March 8, 2009).

Great Barrier Reef Marine Park Authority (GBRMPA). 2009. **Great Barrier Reef outlook report 2009.** Available at http://www.gbrmpa.gov.au/corp_site/about_us/great_barrier_reef_outlook_report.

Hinds, J.; Sparks, P. 2008. **Engaging with the natural environment: the role of affective connection and identity.** Journal of Environmental Psychology. 28(2): 109-120.

IPCC. 2007. **Climate change 2007: the physical science basis: summary for policymakers.** Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva.

Johnson, J.E.; Marshall, P.A. 2007. **Climate change and the Great Barrier Reef: A vulnerability assessment.** Great Barrier Reef Marine Park Authority and Australia Greenhouse Office.

Jun, J.; Kyle, G.T.; Mowen, A.J. 2009. **Market segmentation using perceived constraints.** Journal of Park & Recreation Administration. 26: 35-55.

Kotler, P.; Roberto, E.; Lee, N. 2002. **Social marketing: Improving the quality of life.** Thousand Oaks, CA: Sage Publications.

Lorenzoni, I.; Nicholson-Cole, S.; Whitmarsh, L. 2007. **Barriers perceived to engaging with climate change among the UK public and their policy implications.** Global Environmental Change. 17: 445-459.

Lynch, A.M.; Sutton, S.; Tobin, R. 2009. **A review of community perceptions of climate change: Implications for the Great Barrier Reef.** Report prepared for the Great Barrier Reef Marine Park Authority.

Moscardo, G.; Green, D.; Greenwood, T. 2001. **How great is the Great Barrier Reef! tourists' knowledge and understanding of World Heritage status of the Great Barrier Reef.** Tourism Recreation Research. 26: 19-25.

Nilsson, J.A.; Sutton, S.G.; Tobin, R.C. 2010. **A community survey of climate change and the Great Barrier Reef.** Report prepared for the Great Barrier Reef Marine Park Authority.

Sherif, M.; Hovland, C.I. 1961. **Social judgment: assimilation and contrast effects in reaction to communication and attitude change.** New Haven, CT: Greenwood.

Vanclay, F.M. 1988. **Tourist perceptions of the Great Barrier Reef.** Research Publication No. 38. Great Barrier Reef Marine Park Authority.