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RESPONDING TO STAKEHOLDER RESEARCH NEEDS USING A VISITOR MONITORING SURVEY: THE CASE OF THE GREAT BARRIER REEF TOURISM INDUSTRY

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Marketed internationally as an iconic tourism experience, Australia's Great Barrier Reef (GBR) faces a range of issues similar to those faced by coral reefs in other parts of the world. According to the Great Barrier Reef Marine Park Authority (GRBMPA), the management body responsible for the reef, 1.9 million tourists visit the reef annually, using marine tour operators that offer a wide range of tour products. Management of the tourism industry is based on a zoning system that requires natural and social science input. Data on visitor experiences and satisfaction have been collected in the past by CRC Reef Research, and more recently by a new long-term reporting system of reef tourist visitation supported by the Marine and Tropical Sciences Research Facility (MTSRF) funded by the Australian Federal Government. The sustainability of this industry is influenced by a range of natural (climate change, crown-of-thorns, etc.) and social (rising cost of fuel, changing travel patterns, emerging markets) issues. These issues are reviewed followed by analysis of the reef tourism experience within this natural and social context. Data used in this analysis were drawn from a visitor monitoring survey that is discussed in this article. The monitoring program was designed to collect data that can be compared on a monthly and annual basis to enable comparison over time with the aim of identifying emerging social and environmental issues and threats to determine their effect on the sustainability of reef tourism. Finally, the article identifies a number of solutions and strategies that may be available to tourism operators.

Key words: Reef tourism; Great Barrier Reef; Great Barrier Reef Marine Park Authority; Climate change

Introduction

The Great Barrier Reef (GBR) is one of world's iconic tourism destinations. Listed as a World Heritage Area in 1981 and included as one of the seven natural wonders of the world, its status as a must-see destination has recently been confirmed by the World Travel and Tourism

Council (WTTC) when the reef was voted "best destination" as part of the Tourism for Tomorrow awards in May 2007 (WTTC, 2007). According to the Great Barrier Reef Marine Park Authority (GRBMPA, 2007), the management agency responsible for one of Australia's most important natural assets, the tourism industry that has developed around the marine park welcomes 1.9 million

tourists each year, generates approximately AUD\$5 billion in income per annum, and supports up to 50,000 jobs along the Queensland coast. These figures place the GBR in the same league as the reefs of Southern Florida, and as more lucrative than the other US reefs for which data are available (Craig, 2007). The importance of the reef to tourism in Tropical North Queensland has been reinforced by numerous studies, which suggest that seeing the GBR is one of the most important motivations for visiting the region (Prideaux, Falco-Mammone, & Thompson, 2006). However, while the reef is visually appealing to tourists, reefs are also fragile ecosystems that can suffer as a result of changing environmental conditions (Marshall & Schuttenberg, 2006). To ensure the suitability and sustainability of reef tourism in a future that will be increasingly influenced by the impact of climate change, a medium-term monitoring program has been established to identify key drivers and trends in reef tourism on the GBR. The aim of this article is to describe this monitoring program, its uses, and the research results that are particularly relevant to management, industry, and to tourists.

The Structure and Operation of Reef Tourism

Tourism on the GBR is managed by the GBRMPA through a zoning and permit system that allows for a range of activities in specifically zoned areas (Peut & McGinnity, 2007). As a condition of their permit, commercial operators are required to collect an Environmental Management Charge from all commercial visitors to the GBR Marine Park. Currently the charge is AUD\$5.00 per passenger and the revenue raised is used to fund Marine Park management, including education, ranger patrols, policy development, and to support research into tourism on the reef. As a by-product of the charge, information is available on the number of visitors carried by the operator each day and the locations visited, providing a detailed picture of commercial visitation rates to the GBR (GRBMPA, 2007).

Current commercial tourism activities on the GBR include (i) day trips to pontoons anchored on the reef, (ii) a range of day trips to reef sites on a variety of boats types, (iii) day trips to reef is-

lands, (iv) island resort accommodation, (v) island camping, (vi) 1-day dive trips, (vii) live-aboard dive trips, (viii) longer cruises, and (ix) live-aboard sailing (Moscardo, Saltzer, Galletly, Burke, & Hildebrandt, 2003). Activities offered to tourists once they reach the reef include swimming, glass-bottom boat tours, semisubmersible boat tours, scuba diving (as certified divers, trainee divers, or introductory divers), reef viewing through viewing platforms and underwater observatories that are located on a number of pontoons and islands, visiting a range of coral islands, participating in guided/adventure snorkels, independent snorkeling, helmet diving, and, in a limited number of areas, fishing. In addition, scenic flights using helicopters and fixed wing aircraft are available in a number of areas and sea kayak ventures appear to be growing in popularity (personal observation).

Literature Review

Given the role that reef tourism has in the North Queensland tourism industry, it is apparent that ongoing research into a range of issues is required. This includes understanding current forms of reef tourism, the popularity of the activities that are available, and the impacts of these experiences. The GBR, in parallel with other reefs worldwide, continues to face increasing anthropogenic and natural pressures. Most research into the reef has had a specific scientific focus with a smaller social science focus emerging in the last two decades. Scientific research suggests that the Reef will undergo significant ecosystems change in the future as a result of climate change and decreased water quality. Problems with water quality are the result of activities that include farming and urban coastal development. Together these factors are very likely to lower the reef's biodiversity through loss of coral and associated changes in reef ecology. Rising sea temperatures through climate change have been blamed for coral bleaching events, when corals become increasingly vulnerable to damage by light or increases in water temperature and eventually die. Based upon predictions of global warming rates, bleaching events will increase in frequency and intensity (Hoegh-Guldberg et al., 2007; Intergovernmental Panel on Cli-

mate Change [IPCC], 2007). Bleaching events as severe as the 1998 event are very likely to become commonplace within 20 years and bleaching events are predicted to occur annually in most tropical oceans after that period (Wilkinson, 2002). Also associated with climate change is increasing acidification of the oceans, which will ultimately impact on the strength of calcium in the shells and bones of sea organisms (Hoegh-Guldberg et al., 2007).

In addition to coral bleaching, the GBR has experienced several population explosions of crown-of-thorns starfish, *Acanthaster planci* (GRRMPA, 1995). This large starfish feeds on corals by extruding its stomach onto the coral to digest the living tissue layer. Areas of coral that have been attacked by crown-of-thorns starfish are easily recognizable as dead, white coral in the middle of otherwise healthy coral. Outbreaks of the starfish have become more common on the GBR in recent decades and may be linked to increased coastal development and eutrophication (CRC Reef, 2003). Another significant threat to coral reefs is the growth of human populations in adjacent coastal areas. In particular, the increasing levels of freshwater run-off, high sediment, and pollution loads from cleared land and farm run-off are major problems. The sediment loads and nutrients in the water (causing eutrophication of the water) and a decrease in the amounts of sunlight reaching corals may contribute to bleaching and speed up the growth rate of competing organisms, including sponges and algae. There is also a growing risk that climate change will generate more intense tropical cyclones in the Tropical North Queensland (TNQ) region (Watson et al., 2001).

Compared to the natural sciences, social science has only recently begun to attract substantial government research funding. The Cooperative Research Centre for the Great Barrier Reef World Heritage Area (CRC Reef) established in 1994 to provide research to support reef management has provided funding for social science research with a strong tourism emphasis. A review by Moscardo et al. (2003) identified a range of tourism research on the GBR, including studies into the economic contribution and other direct uses of the reef to the regional economy (Driml & Common, 1996); the environmental impacts of tourism (Dinsdale &

Harriot, 2004; Harriott, 2002; Roberts & Harriott, 1994; Roupheal & Inglis, 1997); investigations of reef experiences at certain sites (Ormsby & Shafer, 1999); perceptions of ideal and actual coral reefs (Fenton, Young, & Johnson, 1997); evaluation of reef pontoons (Moscardo, 2001); and patterns of reef tourism (Moscardo, 1999; Moscardo et al., 2003; Moscardo & Woods, 1998).

Other research has addressed issues that include: marketing and promotion of marine tourism (Burns & Murphy, 1998; Greenwood, 2000); an examination of the limits of acceptable change and crowding impacts for snorkelers and divers (Inglis, Johnson, & Ponte, 1999; Roman, Dearden, & Rollins, 2007); the role of interpretation and information in reef tourism (Fenton et al., 1997; Green, 1997; Moscardo, 1998, 1999, 2002; Moscardo, Green, & Greenwood, 2001; Moscardo, Woods, & Pearce, 1997; Plathong, Inglis, & Huber, 2000); and research directed towards understanding the needs of different markets (Greenwood, 2000; Greenwood & Moscardo, 1999; Kim & Lee, 1998, 2000; Moscardo, Pearce, Green, & O'Leary, 2001). Fitzsimmons (2007) provides a useful overview of studies that examine diver satisfaction and experiences, as well as her own results from a study of eco-tourists in Fiji that highlighted the importance of social and personal factors as influences on satisfaction.

Most of the social science research outlined above has been based on short-term studies that were not followed up over time to enable identification of emerging trends and drivers. Moreover, data have not been centralized and in many cases are not easily accessible for follow-up research. Little of the work identified above has been directed towards the possible impacts of the future dangers that have been identified by research in the natural sciences. Based on social science research in other regions, a decline in reef health can be expected to translate into a decline in visitor numbers, which will in turn have serious impacts on regional economies. It is now apparent that there is an urgent need to develop a more rigorous methodology for undertaking social science research that incorporates the findings of natural science and is directed towards identifying possible impacts of these events on visitor patterns and experiences.

To develop a capacity for undertaking long-term monitoring of visitor patterns and to identify trends, drivers, and threats, it is apparent that a data baseline needs to be established. Using this methodology it then becomes possible to build a research framework that can inform on a range of issues including lifecycle patterns of reef tourism, visitor motivations, segmentation, seasonality, changing markets, competing destinations, sustainable experiences (perceived damage, interpretation), and service quality analyses.

In response to these issues and the need for specific tourism-focused research, the CRC Reef funded a range of research projects in the period 1994 to 2006. Following the cessation of the CRC Reef in 2006 the Australian Federal Government, through the Department of Environment, Water, Heritage and Arts (formally the Department of Environment and Heritage), established the Marine and Tropical Sciences Research Facility (MTSRF) to develop a comprehensive scientific and social science research program that included tourism research. The tourism program was funded for a 4-year period to examine a range of issues, including sustainable uses and management of marine resources (Program 4.8), and within this program an analysis of recreational and tourism use and their impact on the GBR (Program 4.8.6).

The project was developed in consultation with stakeholders to identify trends in annual visitor use patterns of the GBR, as well as the drivers of these patterns. Within the catalogue of trends, the research identifies *demand* and *supply* patterns: that is, who is coming to the reef, what they are doing and where are they going, and what products and services the tourism industry provides. Within the research on the drivers of tourism, issues examined include *external* factors such as destination image (pull factors), competition from other destinations, economic climate, health of the reef, etc., and *internal* factors that include motivations (push factors), time and financial constraints, experience, expectations, and satisfaction. The data collected include sociodemographic variables, travel patterns, motivations, activities on the reef, previous reef tourism experience, satisfaction and expectations, best and worst experiences. This information enables analyses of the types of tourists who visit the reef (nature based, mass, eco-

tourist, etc.), the correlates of satisfaction, the factors that affect experience, and a descriptive analysis of GBR tourism experiences.

Objectives and Methodology

This article describes the MTSRF-funded reef tourism monitoring program and its uses. Specifically, the article describes the methodology used to collect data on visitor trends and drivers on the GBR; reviews the research results that are particularly relevant to reef tourism stakeholders; and highlights some of the issues that will determine the structure of future tourism patterns on the GBR. These results are then used to discuss some of the adaptive strategies that can be applied by industry and management to light on the issues facing tourism use of the GBR.

To identify drivers and trends of reef tourism, a thorough literature review was first undertaken, discussions were held with key researchers and research providers, and finally meetings were held with key stakeholders [GBRMPA, the Environmental Protection Agency, the Australian Marine Tourism Operators Association (AMPTO), and regional tourism organizations]. Follow-up meetings were held with AMPTO and the GBRMPA to discuss potential survey distribution methodologies and the design of a pilot survey based on existing research and stakeholder needs. Due to funding constraints, surveys are distributed by boat crews, not paid survey staff. In exchange for this contribution, boat operators are given a confidential report on the findings of the surveys distributed on their boat.

The pilot survey was reviewed by an external researcher and comments taken into consideration. In preparation for the launch of the survey program, several fieldtrips were undertaken to observe the distribution of the survey to identify any potential distribution issues and to obtain feedback from both crew and passengers. At the same time, participant observation techniques were used to identify and illustrate some of the key elements of reef tourism that contribute towards quality reef tours. The pilot survey was tested over a 2-week period in October 2006 and involved five operators in the Cairns region. After refinements were made to the survey distribution commenced in the first week of November 2006.

The survey is currently distributed by 11 reef operators across four regions (Port Douglas, Cairns, Townsville, and Airlie Beach). The diversity of operators and locations ensures that nearly all activities that are offered on the reef are represented, including pontoon trips, helicopter tours, all scuba diving activities (introductory and resort, certified and training), helmet dives, snorkel tours, viewing chambers, semisubmersible tours, glass-bottom boat tours, sailing, and visiting the islands. The activities that are not represented include fishing, overnight guests at islands resorts, and the dedicated diving live-aboard operations such as those offered by members of the Cod Hole and Ribbon Reefs Association (CHARROA). The large number of activities included has enabled the researchers to be reasonably confident that most types of reef experience are represented and that replication of similar types of operations within and between different regions allows comparative analyses to be undertaken.

However, there are several limitations to this approach. The first is that survey distribution and collection is entirely dependent on boat crews. This method creates the potential for surveys to be misplaced or forgotten among other crew duties, and may lead to concerns over the randomization of sampling, both in terms of respondents and conditions under which distribution occurs (rough/calm seas, no or lots of sunshine, poor/good water clarity). While boat crews have been asked to maximize sampling randomization (e.g., asking the crews to approach every fourth table on the larger boats, or every third seated person on the smaller boats, on set days of the month), it cannot always be guaranteed that staff, particularly new or casual crew, are following these instructions. The issue of randomization is being addressed through large sample sizes, built up over time.

In addition to the limitations outlined above, some specific markets might not have been captured. Some operators market their product specifically to Asian visitors. The next phase of the research will include distribution of Japanese language surveys. Further, some operators have expressed concern that because the survey is only available in English, there is a strong bias towards Anglophone respondents. Again, this is a limitation of the methodology as boat crew cannot be

expected to carry and distribute surveys in a range of languages, as well as issues of time, financial, and human resources in terms of back-translation of open-ended questions. These limitations are acknowledged within the context of the research, and it is noted that while general trends may be recognizable and extrapolated, data represent only the respondents who completed the survey (as is the case in much research).

Stakeholder-Relevant Research Results

As the research progresses, and the total sample size increases, trends have started to emerge. The data upon which this article is based represent the first 5 months of data collection ($N = 1,000$ surveys). Not all the results of the research will be presented here, as they are available free of charge on the website maintained by the Reef and Rainforest Research Centre (RRRC), the organization that administers the overall MTSRF research program (www.rrrc.org.au). Results reported upon in this article include some of the more pertinent issues that directly affect reef tourism management and development.

One of the first points that can be made is that there has been relatively little change in the socio-demographics of visitors to the GBR over the last few years. Table 1 summarizes some of the similarities between Moscardo et al.'s (2003) results and the results of this research. There has been little change in visitor origin (including the proportion of domestic visitors), ages, travel parties, and proportion of repeat visitors, representing a relatively stable market for the GBR. In addition, this research has highlighted the large proportion of locals who use commercial operators to visit the reef, often in the company of visiting friends and relatives.

Perhaps as a result of this family and couples market segment, it appears that the social aspects of the trip to the reef are as important as natural aspects, such as the health of the coral. This is reflected in the responses to satisfaction influences (28.5% of responses to satisfaction influences concerned the social environment, while 17% of responses concerned the natural environment). When asked what activities they had engaged in during their reef trip, just over a quarter (28%) of respon-

Table 1
Comparison of Current Respondents' Profiles to Moscardo's Results in 2003

Characteristic	Moscardo 2003	Prideaux and Coghlan 2006/7
Origin	39% domestic; internationals mainly from UK/Ireland & North America	30% were domestic tourists, and 65% of internationals were from UK/Ireland & North America
Age	30% 21–30 years old	34.5% 20–29 years old
Repeat visitation	69% first visit	75% first visit
Travel party	34% couple, 25% family	36.5% couple, 14.2% family
Information sources	39% friends & family	39% friends and relatives
Satisfaction scores	8.6: 81% scored 8 or over	8.35: 79.5% scored 8 or over
Recommendation rates	73% recommend it	91% recommend it

dents mentioned viewing marine wildlife as one of their activities. The marine wildlife that stood out the most were starfish and sea cucumbers, possibly because these animals are often presented to novice divers and snorkelers to handle as part of their reef experience. Other animals that are sometimes mentioned in these cases are turtles and dolphins, while corals, fish, sharks, and general marine life are mentioned by 26% of respondents as a best experience.

Another interesting finding was that the level of staff knowledge of the marine environment and the interpretation offered on board is not frequently mentioned by respondents (4.5% of respondents), despite operators investing heavily in interpretation programs, a number of which offer very sophisticated interpretive experiences. This result is reinforced by participant observation of visitors during the "marine biologist's talk" or GBR video, often only attended by 25% or less of the total number of passengers on board, and conversations with visitors who often have to be heavily prompted to discuss their evaluations of the interpretation available or what they have learnt that day. Moreover, only 50% of respondents had noticed whether their operator was eco-certified, and only one respondent mentioned eco-certification as the reason that they chose that to travel with a particular operator.

Another issue that was highlighted by the results is that visitor price sensitivity is not high. Only 16% of respondents gave price as a reason for choosing their operator. According to the industry, however, price sensitivity might be based on recommendations made by agents, who will of-

ten only recommend a tour that they can sell based its price—a more expensive operator for visitors requiring a premium experience or a budget price for visitors traveling on a low budget. There is a general feeling that price sensitivity is higher than represented in the results, although 85% of respondents do feel that they did receive value for money on their reef trip. Moreover, since Moscardo et al.'s (2003) last study, there appears to have been an increase in the number of respondents who would recommend the trip to others, while there has also been a small decrease in the overall satisfaction score from 8.6/10 to 8.35/10.

In terms of destination image, the results suggest that the GBR may actually be more important as a snorkeling destination than as a diving destination (given the limitations of the size of the sample reported upon in this study). While 40% of respondents indicated that they had planned to dive during their trip to the reef, only 29% actually dived that day. This may be accounted for by a variety of different reasons (e.g., medical constraints or the additional cost of diving), but is also reinforced by the proportion of certified divers and uncertified divers with no previous experience (43% and 28%, respectively), the relative inexperience of certified divers (median number of certified dives was two), and a content analysis of diving magazines, which often suggest that the GBR is a good snorkeling or trainee diver destination. When examining the comments of more experienced divers and tourists who had visited other reefs, there appears to be a general consensus that the GBR does not stand out as a particularly better reef than any other reef around the world (al-

though respondents are not asked to qualify the terms “better,” “same,” or “worse”) (39.5% comparisons suggested that the GBR is the same as other reefs, 26.5% suggest that GBR is better, and 22% suggest that GBR is worse).

One last point that needs to be mentioned in the results is the role of seasickness and sea states. This research has highlighted that seasickness and sea state/weather should be included in any discussion of the factors that determine satisfaction on the reef. In the survey visitors were asked to respond to an open-ended question that asked them to describe their worst experience of the day. Comments such as the following were common: “my wife was sea sick and no relief was available onboard the boat i.e. sea sick pills” or “people getting sick all over the place. Looked like a hospital when at dock.” Results such as these indicate another aspect of the issues that must be taken into account when considering the GBR reef tourism and the issues that it faces.

One of the aims of this research is to investigate the impact of a range of drivers of visitor satisfaction and expectations. These include water quality, global warming, the state of the coral, interpretation, the crew, and perceptions of value for money. To explore these issues, the survey examined the impact of a range of issues that over time will facilitate a longitudinal research that will have the capability of allowing researchers to drill down into issues that appear to be significant. Another aspect of the survey is its ability to examine a range of issues on a monthly or annual basis through inclusion of specific questions. The first stage of this aspect of the research was an examination of issues related to visitor perceptions of water quality. The article now highlights some of these issues to be investigated in more detail over the next 3 years, in the light of the results presented above.

Some of the Issues Facing Reef Tourism on the GBR

The GBR’s management agency, GBRMPA, is recognized internationally as a leading reef management agency, particularly in the area of its reef tourism initiatives. It, along with the Australian Government, have also made significant advances

in regulating fishing (both commercial and recreational) through the rezoning of the GRB Marine Park. However, it may be argued that as a nature-based tourism industry in a tropical, cyclone-prone marine environment, situated off-shore in a location that is relatively geographically isolated from major international tourism markets, reef tourism on the GBR will have to adapt to some emerging issues over the coming years.

As mentioned in the introduction, the GBR is facing a number of threats that will influence the future of the reef tourism industry. These are discussed in this section, before moving onto some strategies that might be applied by operators and managers to mitigate the effect of these threats. The threats themselves have been grouped into those that occur within the region and lend themselves to local management strategies, and those that fall outside the region and are more dependent on adaptive strategies by local industry.

One of the first major threats associated with the reefs in general is loss of biodiversity. As discussed in the introduction, reefs have already been subjected to two major bleaching events, the first in 1998 and the second in 2002. These events reduced large amounts of live coral cover at various reef sites around the world (Marshall & Schuttenberg, 2006). Placed within a context of reef tourism, this is important for several reasons. Firstly, previous research suggests that live coral cover is a direct correlate with snorkeler satisfaction (Roman et al., 2007). It may be that loss of coral cover will lead to lower visitor satisfaction. In the results shown here, it would appear that the quality of the marine life, though still important, was the not the only major influence on satisfaction, and instead was one of a suite of influences that also included the professionalism of the staff, the comfort of the boat, the quality and timing of the food offered on the boat, and sharing the experience with other visitors. While these results may be an artifact of different measurement techniques (in this case, respondents were not directly asked to comment upon the health of the reef and its effect upon satisfaction), it could also be argued that the time budget of a GBR trip is considerably different to most other reef tourism products where reefs have an inshore location. To access the GBR, most boats have total travel times of up

to 6 hours, leaving only 2–3 hours available for reef-specific activities.

A second very important consequence of biodiversity loss is public perception of coral reefs, highlighted with the International Year of the Reef in 2008. Media coverage of this topic suggests that tourists will soon be faced with an aesthetically less pleasing reef and recommendations that tourists visit the Reef before it dies. As the result of the IPCC (2007) report on climate change, coral reef health has become a hot topic in the media with a series of articles on the limited life expectancy of coral reefs. An example is *Cosmos*' (Salt, 2006) article with its "couldn't find Nemo" catch phrase that places the GBR among the top 10 attractions to visit before it is severely degraded by climate change. Other magazines such as *Qantas' Australian Way* also ran articles on what is being done to protect the reef before it is too late (Southgate, 2007). Wide newspaper coverage of research findings such as those recently published in *Science* (Hoegh-Guldberg et al., 2007) also add to the general perception that the reef is suffering. While empirical evidence has yet to be collected, there is a concern within the industry and management (personal communication) that media coverage of this nature is beginning to influence visitation patterns on the reef (e.g., increasing rates of visitation in the short term and a potential decrease in the long term).

Another result of climate change is the expectation of increased severity of wind storms (cyclones, typhoons, and hurricanes) in tropical areas such as North Queensland. The impacts of these are manifold. For instance, more severe storms can cause large corals to break apart and scatter fragments about the reefs. After the storm, these slow growing corals might easily be overgrown by quicker growing algae. In addition, storms generally bring heavy rain, which increases runoff and sedimentation, possibly smothering the reefs (CSIRO, 2007), and again lowering biodiversity with similar results to those described previously. Moreover, it was noted in the results that seasickness plays a very important role in visitor satisfaction. An increase in storms and rough seas can be expected to have a detrimental effect on visitor experiences, and may in extreme cases shorten the

season that is suitable for long-distance travel to reefs in exposed seas.

Alongside the direct environmental and ecological effects of climate change, other impacts might be felt by the tourism industry. For instance, it was noted that many respondents are from Europe and North America (Table 1). There has been a considerable push among certain sectors of society in these nations to reduce carbon footprints by minimizing long-haul flights ("It's Carbon," 2007). Some of these source markets, which according to Moscardo et al. (2003) are also repeat reef visitors, may choose to visit reefs closer to home (the Caribbean and the Red Sea), which were found to compare favorably with the GBR (50% of respondents who had visited the Caribbean rated the Caribbean as the same or better and 73% of respondents who had visited the Red Sea said it was the same or better than the GBR) or, alternatively, may choose to visit the GBR only once "before it is too late." One implication of this is the changing structure of visitor markets to the GBR and TNQ. Tourism Tropical North Queensland (TTNQ), the region's marketing body, has suggested the China and India have the potential to become major markets in the near future. These markets will have different travel patterns (usually package tours), different demands, and certainly have different attitudes towards the natural environment and environmental interpretation compared to TNQ's traditional markets. In this case, it is not unimaginable to envisage a move away from nature-based tourism to some form of mass tourism, with nature as a backdrop. Paralleling the potential shift in visitor markets to the GBR is the emergence of new reef tourism destinations in Southeast Asian including Cambodia, Papua New Guinea, the South Pacific islands including Vanuatu and Hawaii's Midway Atoll, and even alternative destinations within Australia such as Ningaloo Reef Marine Park in Western Australia.

Another important issue, the importance of which is reinforced by the results of this research, is the increasing cost of fuel that is already having an impact on the cost of visiting the reef through operator-imposed fuel levies on visitors. While the price sensitivity of respondents was moderately low, increasing tour prices may act as a deterrent

to some visitor groups. This will be monitored over the coming years. Finally, respondents also mentioned the comfort of the boats they traveled on was an important factor. While this is an important factor to the respondents, some operators suggest that the industry is witnessing an ageing of existing infrastructure, including boats and pontoons, with decreasing profit margins available for reinvested into infrastructure that includes refurbishment of boats, upgrading engines, adding stabilizers, and so forth (industry, personal communication).

Discussion and Conclusions

The aim of this article was to outline the aims and initial findings of the MTSRF-funded medium-term monitoring program of reef tourism on the GBR, and illustrate how some of the issues emerging out of the natural sciences (and other issues such as rising cost of fuel) affect the GBR's reef tourism industry and its sustainability. The results presented paint a complex picture that does not always correspond to results emerging out of other reef tourism industries. For instance, the importance of the social elements of the trip as well as comfort, cost, and infrastructure were highlighted and it was suggested that the role of ecotourism, interpretation, and reef health may not be as clear as in other reef tourism industries. Results such as these offer industry and management a wide scope of adaptive strategies that can be used to ensure the long-term viability of this reef tourism industry.

For instance, although reef tourism on the GBR is a form of nature-based tourism, the social component appears to be highly important, with an emphasis on staff (friendliness, helpfulness, and professionalism), comfort, and sharing the experience with others. This can be used to the industry's advantage in situations where the declining health of the reef may otherwise negatively impact on satisfaction. Other solutions include diversifying to include other aspects of the marine environment. Most other reef destinations include whale or dolphin watching in their experience, as well as dugongs, turtles, and sharks (personal observation). In the GBR, some operators are taking ad-

vantage of this by promoting dwarf minke whale or shark tours. Alternative activities are also important in other destinations, such as Hawaii, the Canary Islands, Western Australia, and Malaysia. These activities include kayaking tours, parasailing, small boat sailing, scenic cruises, sunset cruises, and so on. These could be effectively incorporated into a marine tourism industry in Tropical North Queensland.

Other adaptive solutions include boat upgrades. Many of the newer boats are equipped with stabilizers and all boats now offer seasickness tablets for sale on board. Engine upgrades may also be an option for some operators and may become a necessity as controls on carbon emissions become more stringent. Additionally, there have been some initiatives including research undertaken by the Federal Government-funded Commonwealth Scientific and Industrial Research Organisation (CSIRO) to investigate carbon offsetting programs to markets that are more sensitive to their carbon footprints while on holidays.

In addition, there is a growth in specialization where some operators target specific markets that may demand a high level of reef interpretation, while other operators market to mass tourists who are less concerned with the condition of the reef, preferring to meet other demands such as affiliation and fun. Many operators fall in between, with tourists who want to see a healthy reef but have little interest in high levels of interpretation. As reef health decreases, these operators may need to rely more on interpretation of the reef to provide a quality experience.

In addition, a range of technical solutions including shade cloths that limit light penetration and help to minimize the bleaching (Marshall & Schuttenberg, 2006), crown-of-thorns eradication programs, and reef balls to create artificial reefs have been suggested as ways of protecting the health of the reef. These solutions fall within the scope of natural scientists and management. However, a medium-term monitoring program such as the one described in this article will be able to track changes in visitor trends, needs, and satisfaction and allow managers and industry to promote the sustainability of reef tourism on the GBR in the face of a dynamic natural and social environ-

ment that is facing uncertain changes in the coming decades.

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Biographical Notes

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