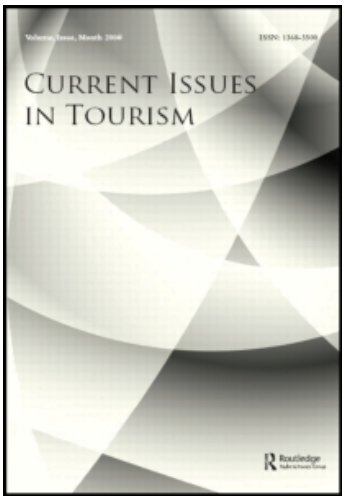

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Welcome to the Wet Tropics: the importance of weather in reef tourism resilience

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Welcome to the Wet Tropics: the importance of weather in reef tourism resilience[1]

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As one of Australia's iconic tourism attractions and one of the seven natural wonders of the world, the Great Barrier Reef (GBR) is an important economic, social and natural resource for Queensland's Tropical North. However, the long-term prognosis for the health of the reef and by implication, the industries dependent on it, is not positive. So far much attention has focussed on the health and resilience of the reef ecosystem, as a foundation for a resilient tourism industry. In this study we explore how weather conditions have affected the reef experiences of 1000 tourists to the Cairns/Port Douglas region, suggesting that this may also be an important indicator of change on the reef. The results suggest that poor weather has a more pronounced effect on experiences than good weather and reinforce the likelihood that seasickness, cold and wet conditions, reduced water visibility, and difficult snorkelling/diving conditions will reduce overall levels of satisfaction. Poor weather was found to have a direct effect on satisfaction scores, the likelihood that reef and tour expectations were not realised, and lowered perceived value for money. These are important considerations for the reef centred tourism industry that is currently facing strong environment pressures from climate change.

Keywords: weather; great barrier reef; climate change

Introduction

Australia's Great Barrier Reef (GBR) contains about 40% of the world's coral reefs, extends for a distance of nearly 2000 kilometres along the north east seaboard of the continent and is one of the nation's major iconic tourism attractions. Its status as an international icon was confirmed in 2007 when it was voted the world's best tourism destination by the World Travel and Tourism Council. Currently, the GBR attracts 1.9 million visitors per annum, is responsible for an estimated 50,000 jobs and has an estimated economic worth of AU$ 5 billion (GBRMPA, 2007). The importance of the reef to tourism in Tropical North Queensland has been reinforced by numerous studies which suggest that seeing the Great Barrier is one of the most important motivations for visiting the region (c.f. Prideaux, Falco-Mammone, & Thompson, 2006). The appeal of the GBR as a tourism attraction is based upon its natural beauty, its status as World Heritage Area for its ecological and cultural significance as well as biodiversity, and its setting within the appealing nature-based destination of Tropical North Queensland.

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Given its significance as a tourism draw card, increasing attention has been given to aspects of the tourism experience provided by the reef, particularly the natural resources upon which it is dependent. This article explores weather as one of these natural resources and examines weather-related issues as they affect satisfaction of reef visitors. In the sense used here weather includes both the average daily variations of hours of sunshine, wind speed and precipitation and the longer-term impacts expected to occur on weather patterns as a result of climate change. As a premise to this study, we suggest that the reef tourism experience is based on resources that extend over and above the health of coral and coral reef biodiversity, which is currently the focus of much work in industry resilience, as the future health of coral reefs is demonstrably linked to climate change, as sea temperature rises causing coral bleaching and the ocean acidifies, diminishing calcium carbonate deposits in skeletons (IPCC, 2007; Marshall & Schuttenberg, 2006). The biological health of reefs is rapidly becoming a significant issue as demonstrated by press reports that have commented on research findings that indicate that climate-induced coral bleaching will reduce the quality of the coral and discourage visitation in coming decades (e.g., Southgate, 2007). Recent media releases based on these findings have placed the GBR among the top 10 tourism attractions to be seen before they disappear due to climate change (Salt, 2006/2007).

However, another natural resource which appears to play an important role in reef tourism is good weather (Gomez Martin, 2005). As a factor in reef tourism, weather has received relatively little attention. This is somewhat surprising as good weather is extensively used as a selling point for the reef and on a wider scale, for many destinations. Marketing campaigns funded by destination marketing organisations as well as the private sector usually include at least some reference to the weather, and in the case of the reef and associated onshore destinations, the weather is always shown in a positive sense despite the high levels of rainfall that occur over much of Tropical North Queensland, also known as the Wet Tropics (the name given to the region's world heritage area, and commonly used by local residents). This region extends from Cape Tribulation in the north to Tully in the south (Figure 1), and is characterised by temperatures that range from 34 to 20 degrees centigrade with pronounced wet and dry seasons.

Given the importance of weather as a pull or selling factor in tourism, it is surprising that the relationship between weather, climate and tourism is currently poorly understood. A review of 142 destination image papers, published in the period 1973–1999, highlighted only one study that specifically dealt with weather. That study (Lohmann & Kaim, 1999) found that there was a lack of empirical evidence on the importance of weather/climate on destination choice decision-making. In a local context, visitor surveys within the region (Moscardo, Pearce, Green, & O'Leary, 2001; Prideaux et al., 2006) confirm the role of weather as an important motivation for visiting the destination and in its first edition of its newsletter *Rethinking the Sunshine State*, Tourism Queensland reports that "Queensland tourism operators will need to rethink marketing plans and maybe reinvent themselves in preparation for a future of wild weather patterns" (Tourism Queensland, 2008).

In a paper that supports Lohmann and Kaim's findings, Scott, Wall, and McBoyle (2005) suggest that climate/tourism research undertaken pre-2000 falls into three phases, formative (1960–1979), stagnant (1980s) and emergence of climate change (1990s), with a maturation stage currently underway. Within this maturation phase, there are increasing numbers of studies that do trace the relationship between climate, weather and destination choice in tourism. For instance, Maddison (2001) built statistical models of the behaviour of certain groups of tourists as a function of weather and climate. Matzarakis (2002) attempted to define indicators of the attractiveness to tourists of certain weather conditions. Hamilton

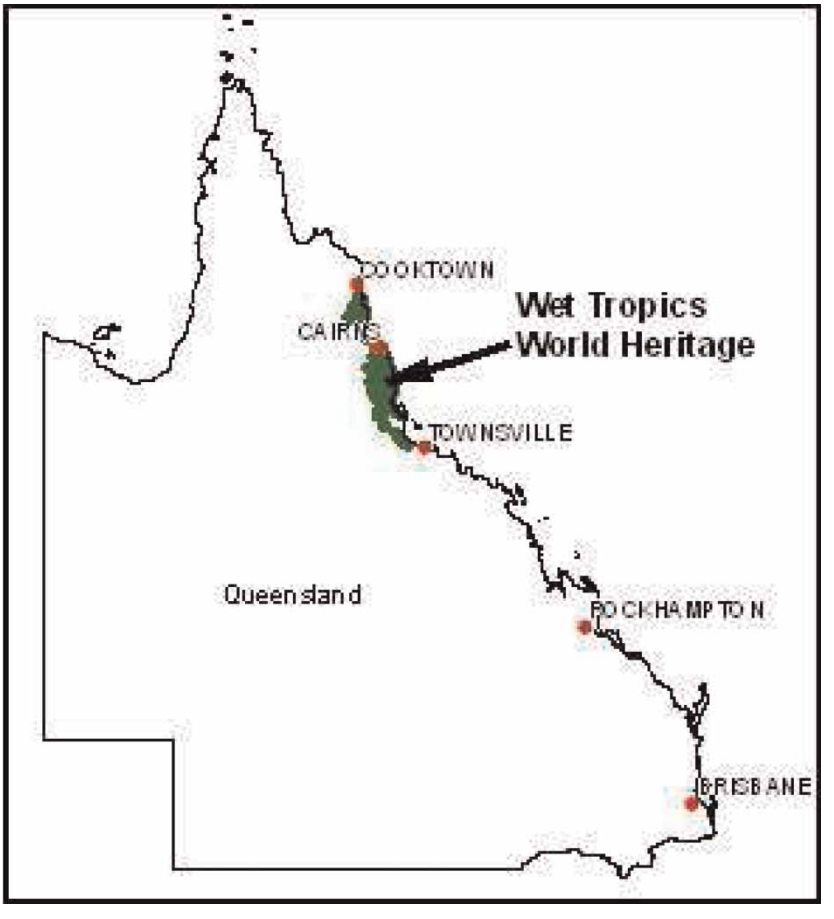

Figure 1. Map of Tropical North Queensland and the Wet Tropics, including data collection site (Source: Wet Tropics Management Authority, http://www.wettropics.gov.au/map/Maps_images/GeneralMaps/LocalityQueensland.jpg).

and Lau (2004) surveyed 400 departing German tourists and found that climate was the most important attribute in destination choice, particularly maximum temperature, water temperature, duration of sunshine, and number of rainy days. Furthermore, 60% had been tracking the weather at their departure destination during the week before departure.

In their edited book on tourism, recreation and climate change, Hall and Higham (2005) provide several chapters on weather as a tourism resource or attraction; in particular, Dewar (2005) lists ways in which different market segments may respond to poor on-site weather conditions and how destinations may respond to unpredictable weather, and De Freitas (2005) examines the characteristics of weather, thermal, physical and aesthetic that make up the resource, based on earlier work on tourism climate indices. In a more recent paper, Kozak, Uysal, and Birkan (2008) undertook a study into the impact of weather in Turkey and found that climate was an important factor in tourism demand. They also observed that in general, weather has been largely ignored in previous research into destination demand variables.

Attempting to link weather as a tourism resource, its effects on the tourists' experiences and overall satisfaction and the future implications of climate change is one area of research

that is emerging for many nature-based holiday destinations. It is likely that holiday-makers visiting a destination that offers outdoor adventure-style activities (such as marine tourism or alpine tourism) or rest and relaxation that depends on good weather are particularly susceptible to changes in seasonal weather patterns. Lounsbury and Houpes (1985) believed the tourist's initial choice of destination will be based upon his or her motivations and needs and the destination's perceived ability to fulfil those needs. It is generally accepted therefore that tourist satisfaction levels will increase as the fit increases between an individual's needs and the location's ability to fulfil these needs. Based on this, the most commonly used model of tourist satisfaction is the expectancy confirmation/disconfirmation paradigm. Here, consumer satisfaction is viewed as a linear function of pre-experience expectations, actual experience and perceived performance, and the degree to which expectations are positively or negatively disconfirmed during the experience (Oliver, 1977). By using post-hoc measures such as satisfaction scores, best and worst experiences (critical incidents) and other measures such as recommending the tour to other visitors, and perceived value for money, we can determine the importance of various destination features in the tourist experience.

Given the significance of the GBR to the region's tourism industry, and the lack of information on the effects of weather on the reef tourism, we look at current weather patterns and the predictions of climate-change-induced changes to the weather in Tropical North Queensland. During the period that the data were collected, the study region recorded higher than average wind speeds (Figure 2) as well as an increase in the average number of days with rain over 1 mm (Figure 3) and cloud cover (Figure 4). As a consequence of this unusual weather pattern the survey results may be slightly skewed and caution will be needed if these results are used as a baseline for future comparisons. It is however apparent that in the future climate-change-induced changes in weather patterns are likely to increase the annual number of days of adverse weather.

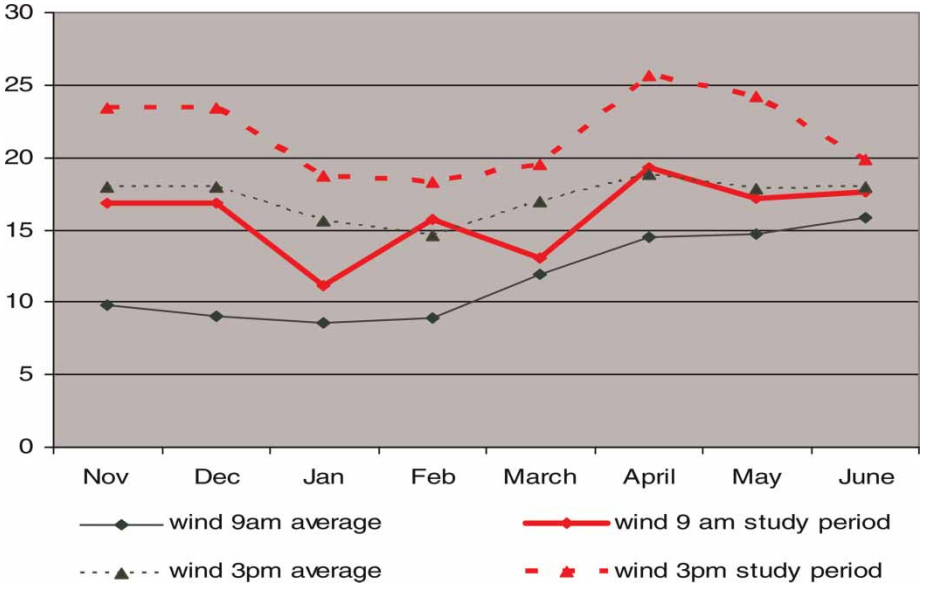

Figure 2. Comparison of average wind speed (in knots) at 9 am and 3 pm between 1945 to present and the study period.
Source: Australian Bureau of Meteorology.

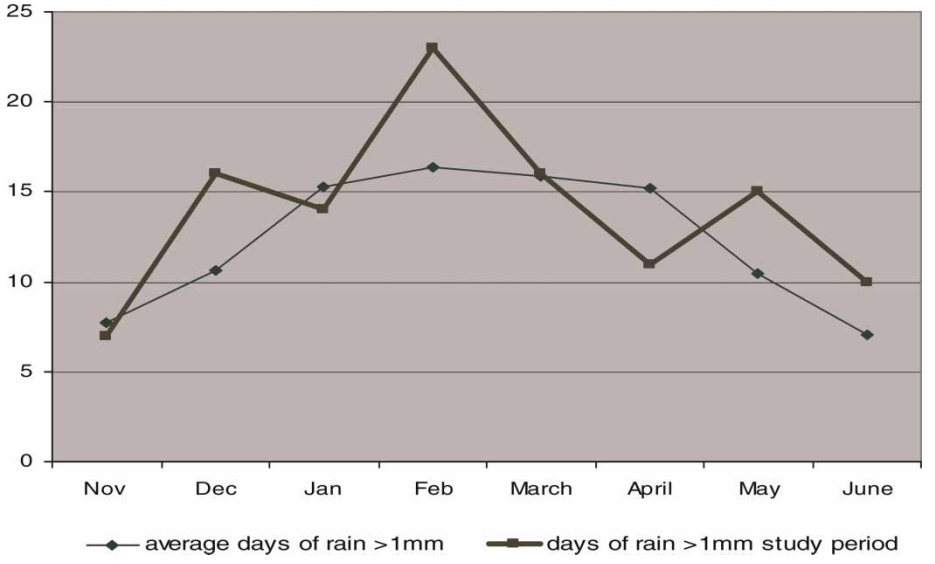

Figure 3. Comparison of number of days with rain exceeding 1 mm from 1945 to present and the study period.
Source: Australian Bureau of Meteorology.

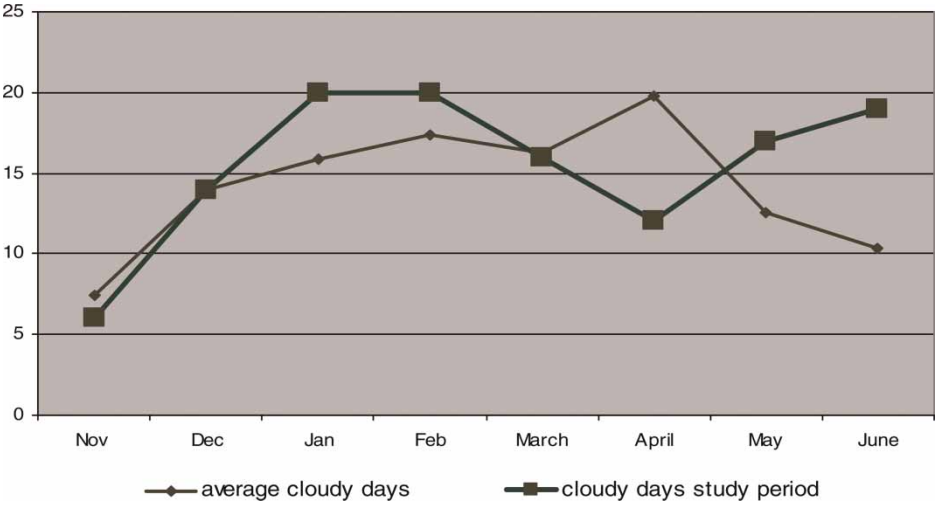

Figure 4. Comparison of the average number of cloudy days from 1945 to the present with the study period.
Source: Australian Bureau of Meteorology.

Recent research into the impact of climate change (Crimp, Balston, & Ash, 2004; IPCC, 2007) indicates that future daily and seasonal weather factors will change include wind speeds, rainfall and temperature. On a regional scale the extent of these changes is not clear, with CSIRO predicting increased temperatures, changes in rainfall from −6% to +5% by 2030 (Suppiah, Macadam, & Whetton, 2007) but is likely to cause more severe

weather patterns which will have a direct impact on visitor satisfaction. Changes in these weather variables will also have secondary impacts such as increased sediment run-off that will reduce water visibility. These changes will be gradual but their cumulative long-term effect is likely to increase visitor discomfort with the probability that this will be reflected in reduced trip satisfaction.

Given these predictions of deteriorating weather, alongside other major climate change-related impacts, this article examines the role of weather on visitor satisfaction from both short- and long-term perspectives.

The aims of the research reported in this article are:

1. to identify the characteristics of respondents who were affected by the weather, both in a positive and negative sense,
2. to identify the characteristics of weather that affect the tourist experience, and
3. to investigate the effect of weather on satisfaction, expectations, recommendations and perceptions of value for money.

Aims one to three were investigated using a visitor's survey. The data collected from the visitors' survey can then be discussed in a broader context to identify climate change associated weather factors that may impact on visitor satisfaction in the future.

Methodology

The results presented in this article are based on data collected as part of a four-year study of Great Barrier Reef tourism funded by the Marine and Tropical Sciences Research Facility (MTSRF) and the results of parallel science based research into climate change also funded by MTSRF and its predecessor organisations (CRC Reef and CRC Rainforest). Visitor data using visitor surveys were collected in Cairns and Port Douglas between November 2006 and August 2007. A total of 1126 useable surveys were collected in these locations with 31% from Port Douglas and 69% from Cairns. Overall, a minimum of 119 surveys were collected each month during the study period.

The survey was distributed by crew members from six reef tour boat operators in the two regions. The diversity of operators and locations ensured that nearly all the activities that are offered on the reef are represented. Specific activities covered included pontoon trips, helicopter tours, all scuba diving activities (introductory, resort, certified and training), helmet dives, snorkel tours, viewing chambers, semi-submersible tours, glass bottom boat tours, sailing and visiting the islands. This coverage of operators enabled the researchers to be reasonably confident that most types of reef experience are represented, and replication of this study with similar types of operations within and between different regions will provide a baseline for future comparative analyses.

Information collected in the surveys include reef visitors' socio-demographic characteristics, travel patterns, motivations, activities, alternative destinations considered, previous reef tourism experience and satisfaction, including measures of expectations, best and worst experiences, recommendations to others, and value for money. The data used in this research includes satisfaction measures using a 1–10 score, critical incidents (best and worst experiences), value for money and reef and trip expectations. Much of the satisfaction data collected were qualitative in nature, asking open-ended questions that were later coded and analysed using content analysis. This approach allows themes that affect tourist experiences to emerge with limited researcher bias (although some subjectivity in coding is always a risk with qualitative data).

Table 1. The socio-demographic characteristics of respondents.

Gender	49% male and 51% female
Origin	27% Australian, 26% from the UK and Ireland, 22% North American and 20% European
Age	35% 20–29 years old, 16.5% 30–39 years old, 15% 40–49 years old, 14% 50–59 years old, and 11.5% 60 and over
Occupation	24% professional, 18.5% students, 11% retired/semi-retired, 9% management, 8.5% self-employed

Several limitations to this study should be noted. Firstly, survey distribution and collection is entirely dependent on the cooperation of boat crews, a situation which creates the potential for surveys to be misplaced or forgotten amongst other crew duties. This distribution system may lead to concerns over the randomisation of sampling, both in terms of respondents and conditions under which distribution occurs (rough/calm seas, no or lots sunshine, poor/good water clarity). The issue of randomisation has been addressed through staff training and large sample sizes, built up over time. Additionally, although asked, crew members rarely reported the weather conditions on the days that the surveys were distributed. As a consequence, some limitations were placed on the scope of comparative work possible with this data and on the scope of interpretation.

Another concern is that some specific markets might not have been captured. For example, many operators market their product specifically to Asian visitors. Further, some operators have expressed concern that as the survey is only (currently) available in English there is a strong bias towards Anglophone respondents. Again, this is a limitation of the methodology in terms of time, financial and human resources for translation of open-ended questions. These limitations are acknowledged within the context of the research, and it is noted that whilst general trends may be recognisable and extrapolated, data represents only the respondents that completed the survey, as is the case in much research.

The socio-demographic characteristics of these respondents are outlined in Table 1.

Results

A total of 1126 surveys were analysed using the computerised Statistical Package for Social Sciences (SPSS) version 14.0. Open-ended questions were analysed through a content analysis. Statistical techniques used in data analysis included comparison of means analyses such as *t*-tests and ANOVAs (the former allowing a comparison of means between two groups and the latter between more than two groups).

Of the 1126 respondents in this survey, one in five felt that the weather had affected their satisfaction ratings. It is worth noting, however, that a significantly greater percentage of negative comments arose from surveys collected during the months of February and June compared to other months (Figure 6, $F = 9.88$, $p = 0.00$). Figures 2–4 show that February and June, as well as May, were particularly wet, windy and cloudy months. This initial result confirms the importance of weather, in particular bad weather, on visitor satisfaction. The following results show which respondents felt that weather played a particularly large role in their experience and how it did so.

Using a comparison of means test (ANOVA) of the socio-demographic characteristics of the respondents, it appears that there are significant differences in weather effects between different age groups (Figure 5, $F = 3.872$, $p = 0.004$) and respondents who

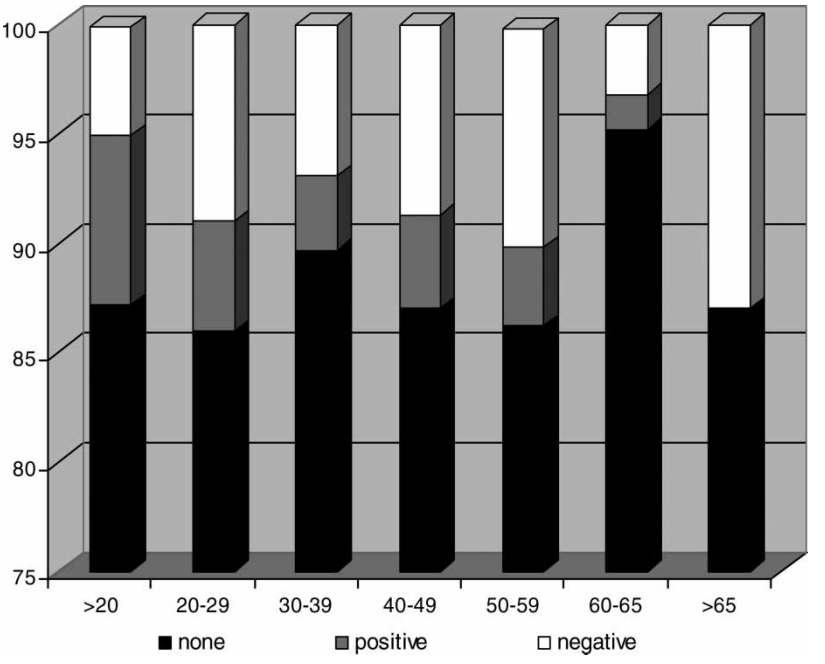

Figure 5. Relationship between respondent age and effects of weather on satisfaction.

rated the GBR as important or not important in their decision to come to the region (Figure 6, $F = 2.818, p = 0.01$). These results could potentially be explained by noting that visitors who reported the Great Barrier Reef as an important motivation may have placed a stronger emphasis on seeing the marine life than on concerns over weather conditions compared to tourists whose primary motivation for visiting the region was for reasons other than visiting the GBR (Figure 6).

Factors that did not influence the relationship between satisfaction and weather included the origin of the respondents, their previous reef tourism experiences, the importance of climate in their decision to visit Tropical North Queensland, their gender, or even the operator that they chose to take them to the reef. There is also no clear relationship between the reasons for choosing an operator and the effects of the weather, e.g., respondents who specifically chose an operator for reasons relating to weather and sea state condition (e.g., "big boats handle the rough seas better", "mainly because of weather" or "larger vessel more stable with yesterdays forecast predictions") did not mention the weather as a component of their satisfaction score or as a best or worst experience.

Respondents were also asked in a series of three open-ended questions what aspects of their day affected their satisfaction with the trip. The first question specifically asked what factors affected their satisfaction scores, whilst the next questions asked respondents to report their best and worst experiences. These open-ended questions were content analysed to identify the importance of weather and its specific characteristics upon the reef experience. In this section, we report on some examples of responses to all three questions, looking at positive and negative aspects of the weather. The classification criteria, using thermal, physical and aesthetic characteristics of the weather, developed by De Freitas (2005) can usefully be applied here. By way of illustration of positive responses and their categorisation we include the following examples as they were noted by respondents:

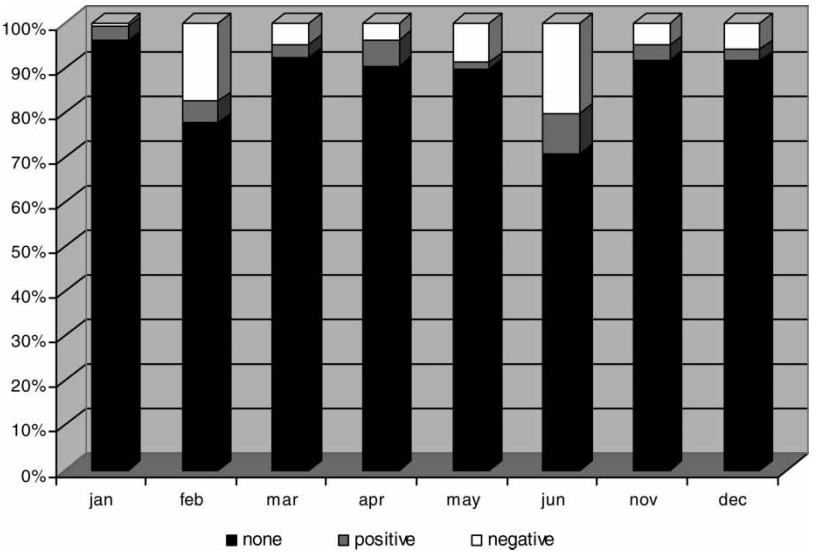

Figure 6. Relationship between month of survey collection and effects of weather on satisfaction.

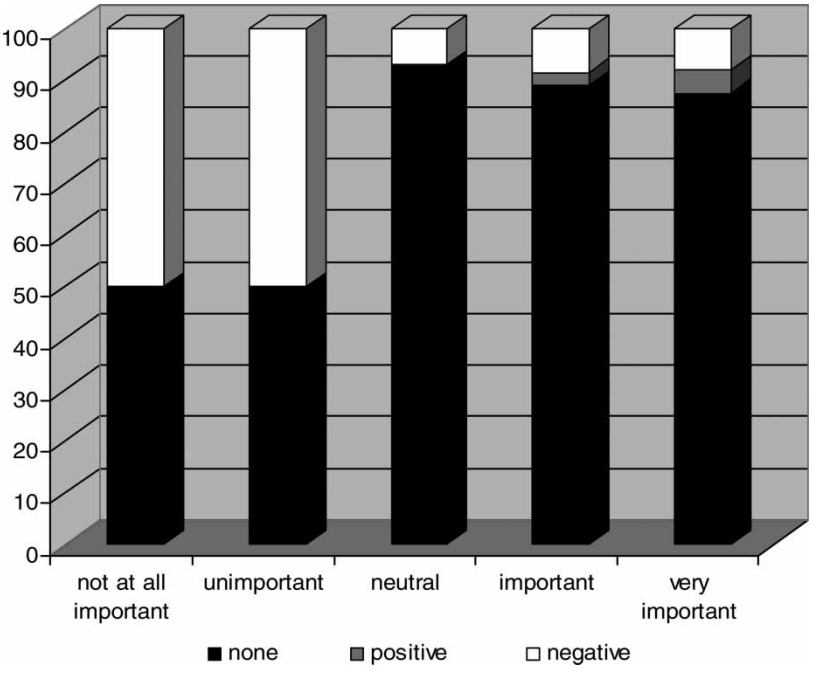

Figure 7. Relationship between visiting the Great Barrier Reef as travel motivation and effects of weather on satisfaction.

- "Friendly crew, good diving conditions, warm weather and minimal seasickness" (thermal, physical and aesthetic).

- "I like to swim and see fish and coral so it was good that the weather was clear and sunny." (aesthetic and physical).
- "Sunny weather, relaxed atmosphere, beautiful reef" (aesthetic).
- "Friendly crew, good diving conditions, warm and clear water" (thermal, physical and aesthetic).

It appears that positive responses about the weather correspond to 11 responses concerning aesthetics, three responses concerning thermal properties and one response concerning physical properties (sea state/seasickness). The aesthetic responses include sunshine (six responses), clear water/good visibility (five responses), the thermal characteristics are warm air temperatures (two responses) and warm water temperature (one response). In addition, there are 28 mentions of "great", "good" and "beautiful" weather, and 104 unspecified responses, stating simply that the weather affected their trip, but not the manner in which it did so.

The negative weather-related comments were quite different, e.g.,

- "The wet and cloudy weather affected our enjoyment – no colour in coral, not able to stay outside".
- "This trip should not have happened with the bad weather; 80% of people were sea sick".
- "Rained all day, return by chopper cancelled due to weather".
- "Nice staff. Good food bad weather for snorkelling".
- "Too windy and low tide".
- "Weather – poor boat to and from marina – boring need on board entertainment".
- "Weather, very rough sea, unable to see coral".

In this case, "bad" and "poor" were the most common descriptors, whilst it would appear that the physical characteristics of poor weather dominate negative experiences, e.g., rough seas was the next most common issue (13 responses), followed by poor visibility (12), seasickness (10), rain (9), windy (6), and finally the cancellation of activities (3) such as helicopter tours and glass bottom boats. Aesthetic characteristics accounted for 12 responses, overcast/cloudy (8) and dull colours (4), whilst thermal qualities were limited to being cold and were noted by five respondents.

A similar analysis of the respondent's reported best and worst experiences found that whilst only 1.75% of respondents mentioned the weather as part of their best experience, 43% of respondents ($N = 318$) who provided a description of their worst experience (230 respondents said that they had had no bad experience) mentioned the weather. Again, a content analysis of the responses show that the positive experiences were mostly related to the sunshine (3), the warm water temperature (2) and the water clarity (2), whilst the negative experiences were mostly concerned with physical attributes such as being seasick (82 responses), rough water/waves (62), rain (21), windy (16), as well as activities or locations cancelled (4), poor snorkelling/diving conditions (4), bad sailing conditions (3). These were followed by thermal attributes such as cold (20), cold water (3) and finally aesthetic attributes such as cloudy/no sun (17), poor water visibility (14), and lack of colour on the reef (2). The similarities and differences between responses to the satisfaction and best/worst experiences questions are shown in Table 1.

From Table 2, it would appear that aesthetics play an important role in creating positive experiences, whilst the physical effects of weather dominate the negative impacts of poor weather.

Effects of the weather on expectations, satisfaction, value for money and future recommendations

Given the results presented above, it is not surprising that weather significantly affected satisfaction scores, views on the meeting of expectations and if the trip represented good value for money. In the case of satisfaction, respondents with more negative weather experiences are significantly more likely to have lower scores (mean score = 7.16), whilst respondents who did not mention the weather or who had a positive experience scored their satisfaction higher (8.93) ($F = 50.104$, $p = 0.00$) (Figure 8).

In a similar manner, respondents who had had a bad weather experience were more likely to say that the reef had "somewhat" met their expectations ($F = 11.498$, $p = 0.00$) that the trip had not really or only somewhat met their expectation after a day of poor weather ($F = 28.712$, $p = 0.00$), or that they were unsure if they received value for money ($F = 5.609$, $p = 0.004$). However, there was no relationship between the likelihood of respondents recommending a trip to the Great Barrier Reef based on their experiences of the weather, suggesting that the respondents (7.5%) who would not necessarily recommend the trip to others were doing so for other reasons.

Discussion

The research reported in this article was designed to examine the impact of weather from a short-term and a long-term perspective. The former perspective relates to specific localised weather variables including daily temperature, rainfall, cloud cover and wind. The latter perspective relates to the more general and long-term changes that will occur to global weather patterns and how these will impact on the reef. This has a longer timeframe and more global context and will become increasingly important to visitor satisfaction particularly when climate-induced damage to the reef becomes apparent in the future. We argue here that both perspectives are important and will occur at different timeframes, with changes in weather patterns become more apparent first, followed by damage to the reef itself.

The results of the visitor survey highlighted seasickness and the sea state/weather as key factors that determine satisfaction of the reef. When describing their worst experience of the day responses such as the following "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" highlight the role of weather-induced seasickness in determining individual satisfaction. For the Great Barrier Reef, it is apparent that weather conditions have a direct effect on visitor's emotional and physical states, particularly through seasickness. The visitor's feeling of wellness is an important consideration in the satisfaction of marine tourists and, alongside boat design, is one of the key factors influencing satisfaction (Orams, 2000).

Other aspects of weather including extensive cloud cover and low light conditions reduce water visibility and the brightness of underwater fauna, resulting in a degradation of visitor enjoyment. Wind, particularly changes away from the predominant wind direction, can stir up sediments trapped against the coral, again reducing the visibility. High rainfall will also increase the sediment load in the water, again reducing visibility. Adverse weather can also affect activities undertaken on site. For example, diving and snorkeling in poor visibility and surge or strong currents, especially at high tide, may become problematic for less experienced tourists and generally less enjoyable for all participants. Glass bottom boats and semi-submersibles may also be affected as crew struggle to get close

Table 2. Characteristic of weather that affect satisfaction scores and reef experiences.

	Aesthetic		Thermal		Physical	
	Enhancing satisfaction	Best experience	Enhancing satisfaction	Best experience	Enhancing satisfaction	Best experience
Sun	6	3				
Clear water	5	2				
Warm air temp			2			
Not seasick					1	
Warm sea temp			1	2		
Total	11	5	3	2	1	0
	Diminishing satisfaction	Worst experience	Diminishing satisfaction	Worst experience	Diminishing satisfaction	Worst experience
Rough sea					13	62
Poor visibility					12	14
Seasick					10	82
Rain					9	21
Overcast	8	17				
Windy					6	16
Cold			5	20		
Dull colours	4	2				
Cancelled activities/locations					3	4
Poor sailing and diving conditions					0	7
Total	12	19	5	20	53	206

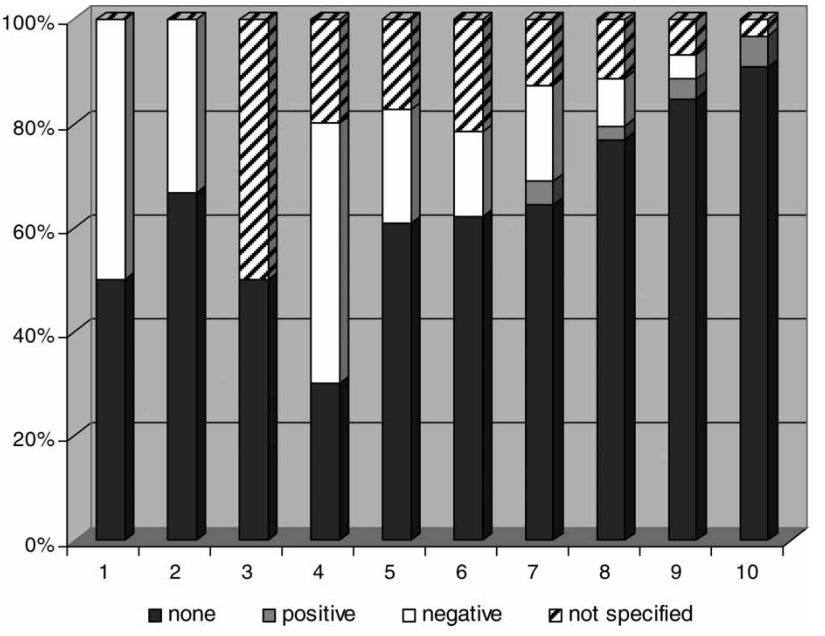

Figure 8. Impact of weather on satisfaction scores. The *X* axis shows satisfaction ratings on a scale of 1 (low) to 10 (high), whilst the *Y* axis indicates the importance of weather as positive (grey), negative (white), irrelevant (black) or unspecified (hatched) for respondents with a given satisfaction score.

to shallow coral in adverse surface conditions which reduce visibility. In some cases adverse weather may lead to cancellation of helicopter joy rides.

With its more immediate and significant impacts on tourist experience and satisfaction, it would appear that weather should be considered as a major variable when considering the resilience of the reef tourism industry. Current models of the tourism–climate interface that incorporate marine elements have focussed on elevated sea temperatures, changed ocean currents, high wave incidents, elevated sea levels, rainfall variability and increased intensity of cyclones (Becken & Hay, 2007). These models provide an overview of the impacts of each of these climate change consequences in the tourism system, placing less emphasis on the tourist experience. However, in tracking the impact of anomalous weather, we may find that weather patterns have a more immediate and pronounced effect on tourism experience and satisfaction. Tracking changes in weather patterns and their impacts on the reef tourism experience should also be considered by researchers investigating reef tourism resilience and built into models of social resilience of the tourism industry to climate change.

These findings support previous research (Saltzer, 2002) which found that for respondents (both repeat and first time visitors) who did not plan to return to the reef, their most frequently cited improvement to the trip is to enhance "weather and weather warnings". Satisfaction levels may also be influenced by the structure of the day where up to four hours of a nine-hour day may be spent in transit between the mainland and the reef. The time budget of a GBR trip is arguably considerably different to reef tourism experiences in other countries where the time spent in transit may be much shorter.

Considering the importance of the reef to the health of the region's tourism industry, and the probability that it will die within the next 20 to 30 years (IPCC, 2007), climate change

research is an important issue for the tourism industry as well as tourism-reliant communities. Current research has focused on the health of the reef, and its resilience to climate change from a scientific aspect (see Hughes, Bellwood, Folke, Stenek, & Wilson, 2005) with less emphasis on community implications. A small number of papers (e.g., Fenton, Young, & Johnson, 1998; Roman, Dearden, & Rollins, 2007) have examined tourists' experiences at reef sites and have concluded that satisfaction is correlated with the health of the reef and in particular, live coral cover. It is apparent therefore that there is now a pressing need to expand the focus of attention to include investigations into how changes in the health of the ecosystem will affect future tourism demand and the region's economy.

New work is emerging on the social resilience of industries and communities that are dependent on vulnerable natural resources, and currently it is believed that social resilience is related to the resilience of the ecological system on which the social system depends. Adger (2000, p. 350) states that this is "most clearly exhibited within social systems that are dependent on a single ecosystem or single resource". One approach that may be worth pursuing is to examine how biological change to the GBR through climate change will affect the region's tourism industry. Another approach is to extrapolate the findings of this research to ascertain how changes to the long-term daily weather pattern will affect visitor satisfaction and chart the subsequent flow on effect on destination image.

A final consideration is that as both weather patterns change and the health of the reef deteriorates, we may find that a third variable, crew hospitality become an increasingly important determinant of visitor satisfaction. Shafer and Inglis (2000), Fitszimmons (2007) and Coghlan and Prideaux (2007) have found that staff play a very important role in the satisfaction of reef tourists. In the near term and while the quality of the reef remains sufficient to continue attracting visitors, this research indicates that crew members may help offset the adverse effects of bad weather by positive interactions with passengers. Yet, the evidence suggests that there is a skills shortage within the tourism industry as a whole and particularly within the marine tourism industry where additional factors increase barriers to recruitment, training and retention of high quality staff. Some of these barriers have been raised in a report by Tourism Whitsundays (the Regional Tourism Organisation for the area incorporating the Whitsunday Regional Council including Bowen, Airlie Beach and the 74 Islands of the Whitsunday group), which include the need for multi-skilled staff (marine, hospitality, customer service skills and a level of safety consciousness are requirements to perform duties); with low pay and few incentives for operator-led staff-training and long-term commitment; a high burn-out rate for crew; and lack of support outside work for younger staff and crew, leading employment in the marine industry to be regarded as short term rather than an opportunity for a career pathway and a choice for only transient and unskilled labour (Tourism Whitsundays, date unknown). Addressing some of these concerns to provide better service quality by crew members during a reef tour may help to compensate some of the pressures, such as climate change, on the natural resource-base of reef tourism industry in the Great Barrier Reef region.

Conclusion

The findings presented in this article highlight the significance of weather in the level of enjoyment experienced by reef tourists. In the past, concerns about the weather were largely confined to considerations of daily temperature, cloud cover, rainfall, etc. In the future, the definition of weather will need to be expanded to include climate-change-induced changes in weather patterns. Given the current state of knowledge, and the considerable uncertainty that exists over the rates at which global temperature will rise, the

form of future weather patterns is unknown but what is known that change will occur and that much of the region's coral cover is headed for destruction. In addition, whilst neither climate change-related coral degradation or deteriorating weather patterns can (effectively) be managed by local stakeholders, there are other elements of the reef tourism experience that are not climate dependent and can be managed by reef tourism stakeholders.

From a broader perspective, there is clear evidence that weather does have an impact on destination selection and visitor satisfaction once at the destination. The seasonal nature of many destinations is substantially based on weather. Beaches are popular sites in the summer months but in colder climates are deserted. Taking a more long-term perspective as suggested in this article it is apparent that localised weather patterns will shortly undergo some form of change because of climate change. The impacts may not be as dramatic as the reduction in snow cover already being felt in some ski fields but will nevertheless need to be factored into destination planning and product development. Given the importance of weather in the destination selection process it is imperative that to develop a greater understanding of the impact of weather on destination selection and satisfaction.

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