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Coral Bleaching and Dive Operators in the Caribbean: Observations, Understanding and Response

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ABSTRACT

The increasing frequency of coral bleaching events is beginning to greatly impact dive tourism destinations, and the Caribbean region is no exception. With this region being highly dependent on tourism, of which dive tourism is a valued part, the Caribbean and its tourism industry have much to lose. This paper examines the impacts of coral bleaching on dive tourism operators across the Caribbean region. This multi-phase study consists of interviews with Tobago dive operators, which took place in January 2011, and a web-based survey, which will be emailed to dive operators Caribbean wide April 2011.

Keywords: dive tourism, coral bleaching, Caribbean tourism

INTRODUCTION

Dive tourism is a growing and important industry which is often reliant on a natural environment high in quality. As dive tourism continues to grow in significance due to its economic and ecological impacts on many tropical destinations, it is important to understand how this special-interest tourism may be affected by environmental change (Gossling et al., 2008). In particular, coral bleaching has become a major environmental concern for dive tourism. It is therefore the purpose of this study to highlight dive operators’ perceptions of these dramatic events.

Mass coral bleaching is a visually spectacular phenomenon with potentially severe implications for the health of coral reef ecosystems, the enjoyment of visitors, and the prosperity of individuals and businesses that depend on the reef. It also stands to greatly affect dive tourism in the Caribbean (Marshall & Schuttenberg, 2006). Mass bleaching events have been documented in the literature since 1982, with the most recent event taking place in 2005 (Wilkinson & Souter, 2008). However, the National Oceanic and Atmospheric Administration’s (NOAA) model for the 2010 bleaching event is predicting higher thermal stress and a wider reaching bleaching event than that of 2005 (Eakin, 2010). This bleaching event makes research on tourism and coral bleaching timely, as operators can comment on past as well as present bleaching.

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As coral bleaching is a form of environmental change caused by a change in climate, environmental change for the purposes of this paper will be defined as issues such “as climate change, modifications of global biogeochemical cycles, land alterations, the loss of non-renewable resources, unsustainable uses of renewable resources, species extinctions and reductions in biodiversity.” (Hall & Lew, 2009, p. 196)

Some destinations rely heavily on tourism, and should climate change affect them, the change could be detrimental to the local community, the economy and ultimately tourism-based livelihood (Scott, McBoyle & Minogue, 2007). Scott et al. (2008) and Dwyer et al., (2009) state that climate
change will have far reaching consequences for tourism businesses and destinations. This holds true for dive operators, since they are dependent upon specific coral reefs and they may not be able to adapt due to the inherent inflexibility of their business (Marshall et al., 2010). It is therefore surprising that there are so few studies examining the impacts of climate change on reef-diving operators in regards to the future and sustainability of tourism (Timothy & Ioannides, 2002).

Operators, if consulted at all, have been asked in conjunction with tourists about coral bleaching (see Gossling, et al., 2008; Dearden, Bennett and Rollins 2006 and Cesar, 2000). It is important to study this topic because dive operators apparently stand to lose much from these recurring mass bleaching episodes because their business is dependent upon healthy reefs. Their experience with the reefs also gives them a unique perspective on climate change and its effect on both corals and their businesses.

In this case, this research will contribute to the growing body of literature on climate change and its effects on tourism, but from the supply side of tourism, the dive-tour operator. However, gaps often occur in the literature and research on tourism and climate change, predominantly in regards to developing nations, in which tourism plays a large part in national economies (Scott and Becken, 2010; Scott et al., 2008). Examining dive operator perspectives on coral bleaching will allow for a unique look at how such businesses are affected by changing climates and environmental conditions. Therefore the larger purpose of this study is to explore the perceptions, opinions and adaptation strategies of dive operators in the Caribbean regarding coral bleaching and its effects on their country, business and dive tourism.

**REVIEW OF THE LITERATURE**

A literature review was compiled in order to develop knowledge surrounding dive tourism and coral bleaching. This section highlights and discusses many concepts and ideas involved with this study, including, but not limited to, Caribbean tourism, dive tourism, and climate change and coral reefs.

**Caribbean Tourism**

The words Caribbean and tourism, frequently synonymous, often conjure up images of pristine beaches, palm trees, and relaxation. Tourism is considered to be one of the few limited options to sustain individual livelihood in the Caribbean (Burke & Maidens, 2004). Presently the Caribbean is seen as one of the most tourism-intensive regions in the world, and is considered a premier destination: it attracted 7% of the world’s tourist arrivals in 2004 and employed 10.8% of the population and accounted for 12.8% of the area’s gross domestic product in 2010 (WTTC, 2010; Bryant, 2007).

As climate change is predicted to affect coastal areas on a greater scale than other land based locations, coastal tourism, which drives much of Caribbean tourism, may experience more hardships than other forms of tourism. This includes two of the fastest growing sectors in the industry and region, scuba diving and snorkeling, as well as those who prefer to sit or swim at the region’s numerous beaches (Spalding, 2004).

**Dive Tourism**

As a growing sport, scuba diving’s popularity is expected to continue (Dimmock, 2007; World Tourism Organization, 2001). This means an economic boon for dive tourism. The World Tourism Organization (WTO) describes dive tourism as “persons travelling to destinations with the main purpose of their trip being to partake in scuba diving.” (p. 85). The attraction of the destination is
almost exclusively related to its dive qualities rather than any other factor, such as the quality of the accommodation or land based attractions (WTO, 2001, p. 85).

Because dive tourism can only occur in certain locations across the globe, it is important to realize that if the sport’s growth and development is to continue, care must be taken to conserve the locations that divers find most appealing. In comparison with tourism in general, dive tourism occurs along the coasts of tropical countries, and these marine areas are limited (Orams, 1999). Although marine areas are within what seems like a vast expanse of ocean, the marine environments that are targeted are relatively small covering a mere 0.3 % of the total ocean surface, making them a finite resource (WTO, 2001; Orams, 1999).

Dive tourism is a high value product, as divers, who often travel to unique locations, typically spend 60-80 % more than other tourists. For example the average diver in the Caribbean will spend US$2,100 per visit, compared to the average tourist who spends US$1,200 (Burke & Maidens, 2004).

Dive Operators
Dive tourism operators provide service to a niche market, catering to those who come to an area to partake in diving activities. Dive operators are defined by Tabata (1992) as those “which have a retail store offering a variety of services, including tours and dive tour operators who principally offer shore or boat dives.” (p. 175)

One major issue to be addressed is that of climate and environmental change in relation to dive operators, as they are the group that stands to lose much from this phenomenon. Scott et al. (2008) have found that generally there are low levels of concern and minimal planning to combat the effects of climate change among tourism operators. One reason for this may be that the alterations associated with climate change may come at a rapid pace, leaving little time for operators to implement gradual and perhaps expensive adaptation strategies (Dwyer et al., 2009). In a study in Mauritius by Gossling et al. (2008) it was found that dive operators did observe changes, but they felt that the changes would not be detrimental to the dive industry, nor did they believe that dive tourists would be disappointed, because they did not know what was previously there, and what they could have seen. In both of these cases the operators were sampled alongside divers.

Coral Reef Valuation
Many coral reefs have become prime tourist destinations and as a result they have become an economic resource (Buddemeier, Kleypas & Aronson, 2004). Cesar et al., (2003) project that on an annual basis coral reefs across the globe provide goods and services worth US$30 billion a year, which is substantial, considering they cover less than 1% of the earth’s surface. Of this US$30 billion, tourism and recreation contributes approximately US$9.6 billion (Cesar et al., 2003).

Climate Change and Coral Reefs
There is now no doubt that climate change will cause further degradation to some coral reef communities (Buddemeier, Kleypas & Aronson, 2004). Tropical coral reefs are the most sensitive marine ecosystems in the world to climate change, and degradation has already begun (Wilkinson & Souter, 2008). The following will discuss those climate change issues that are the most threatening to coral reefs, such as coral bleaching, an increase in sea surface temperatures, coral disease and ocean acidification (Simpson et al, 2009; Wilkinson & Souter, 2008). These climate change issues are each independent threats, yet when they act in unison the damage to coral reefs can be quite severe (Simpson et al, 2009; Buddemeier, Kleypas & Aronson, 2004).
In the Caribbean, reef bleaching is seen as the most predominant and visual threat from climate change (Burke & Maidens, 2004). Coral reef bleaching is often associated with high sea water temperatures, a loss of zooxanthellae (the corals partner microalgae), the impairment of reproductive capacity, and at times the onset of diseases (Burke & Maidens, 2004). Over the last three decades, the intensity and frequency of bleaching episodes has increased, and has been reported from almost every tropical and subtropical region that supports coral reefs, leaving no region safe from bleaching (Baker, Glynn & Bernhard, 2008).

Increasing sea surface temperatures are seen as the primary trigger for coral bleaching episodes (Hoegh-Guldberg et al., 2007; Fitt, 2001). In fact, Baker, Glynn and Bernhard (2008) and Burke and Maidens (2004) show that each bleaching episode that has been observed coincided with increases in sea temperatures and thermal anomalies, which once again reiterates how important it is to reduce the stress on coral reefs. For this research Jokiel’s (2004) understanding of coral bleaching will be used. This states that:

> coral bleaching occurs when environmental conditions disrupt the symbiosis leading to the degeneration and/or expulsion of zooxanthellae from the coral host. As a result of photosynthetic pigment loss, the white skeleton becomes visible through the transparent coral tissue, giving the organism a “bleached” white appearance (p. 401).

Coral disease is another possible impact of climate change. This can be defined as the “impairment of an organism’s vital organ systems and/or body functions.” (Weil, 2004, p. 36) This definition includes non-infectious diseases, under which bleaching is defined as a disease (Weil, 2004). There are also abiotic diseases, which impairs the structure and function of the coral body and leads to environmental stress, such as increased salinity and temperature (Peters, 1997). Disease outbreaks are often associated with an increase in thermal stress. A rise in temperature physiologically stresses the coral, which in turn makes the coral susceptible to disease, which may lead to an increase in coral cover loss (Miller et al., 2009; Hoegh-Guldberg et al., 2007). Miller et al. (2009) found that corals recovering from a bleaching event are likely to be vulnerable to disease for several months, and with the ever increasing water temperatures occurring as a result of climate change enhancing the likelihood of coral bleaching events this may create a large coral population that is more sensitive to coral disease. Furthermore, while coral bleaching and coral disease are each considered individual threats to coral reefs, the combination of the two can have serious consequences on living coral (Miller et al., 2009).

Ocean acidification is another major threat to coral reefs. It occurs as a result of a change in atmospheric chemistry due to the rising level of CO₂ in the atmosphere (Baker, Glynn & Bernhard, 2008; Wilkinson & Souter, 2008). The biggest problem associated with increased acidification is a decrease in coral calcification rates. Calcification forms the base of the entire reef structure, meaning that the very foundation on which reefs rest may be in jeopardy. According to Simpson et al. (2009) corals may react to ocean acidification in many different ways, including growing or extending at a slower rate; extending at the same rate, but having their skeletal density decrease, leaving corals more susceptible to damage from other stressors; and finally they may redirect their energy from tissue growth or reproduction in order to maintain calcification rates. This can have implications for the tourism industry, as businesses depend on healthy reefs in order for dive tourists to come and see healthy reefs with healthy populations (Becken & Hay, 2007).
Caribbean Coral Reefs

In the Caribbean coral reefs cover an estimated 26,000 square kilometers, comprising 7.6% of the world’s coral (Burke & Maidens, 2004; Spalding, 2004). However a problem surrounding Caribbean reefs is the small geographical size of the Caribbean, which puts the coral reefs at particular risk from the threat of expanding human populations and resource exploitations (Wilkinson & Buddemeier, 1994).

Caribbean coral reefs are often seen as the foundation of part of the region’s tourism industry, and any degradation could have negative implications for the area (Burke & Maidens, 2004). The first mass coral bleaching in the Caribbean was in 1980, with others occurring in 1988, 1995, 1998 and 2005 (Wilkinson & Souter, 2008). 1998 and 2005 are often seen as the worst years on record, with 2005 in particular extending across the entire Caribbean region, causing it to be known as the most extreme bleaching and mortality event in recorded history. During that event, on a Caribbean-wide scale, the “percent cover of bleached coral ranged between 2% and 62%, and bleaching related mortality ranged between 0% and 27%.” (Wilkinson & Souter, 2008, p. 46) The bleaching occurred from June to November 2005, with the most intense period being between August and November when sea surface temperatures were at their highest (Simpson et al., 2009; Wilkinson & Souter, 2008).

The bleaching event of 2005 has and will continue to have important ecological and economic implication for the region (Wilkinson & Souter, 2008). However, these implications may not be fully realized as bleaching events continue. The summer mass bleaching episode of 2010 in the Caribbean has to this point been accurately predicted by the NOAA, and after final analysis is expected to surpass that of 2005 in magnitude and severity (Eakin, 2010). Coral bleaching trends of the past century along with projection models show that bleaching events may become more severe and frequent, increasing the number of reefs, species and coral depth ranges involved (Vernon et al., 2009). These models also hold true for future Caribbean bleaching events, as many of the scenarios used to predict frequency and intensity project that bi-annual or even annual bleaching may become a distinct possibility by the 2020s because of seasonal changes in seawater temperatures (Simpson et al., 2008; Wilkinson & Souter, 2008; Baker, Glynn & Bernhard, 2008). As the frequency of these events increase, so too will the damage to the corals, as they have little time to recover, ultimately leading to long term decline (Vernon, et al., 2009).

The future of bleaching events in the Caribbean does not look promising. Corals are already living close to their temperature-related threshold and with increased sea surface temperatures these thresholds are exceeded on a more frequent basis, leading to more severe and frequently occurring bleaching events (Baker, Glynn & Bernhard, 2008; Jokiel, 2004). It is therefore imperative that more studies are undertaken to examine these environmentally dramatic events.

METHODOLOGY

This study will be guided by a sequential, mixed methods design (Creswell & Plano Clark, 2007) and will consist of two phases: phase 1 uses a semi-structured interview, followed by phase 2, a web-based survey. Purposive sampling will be used in both phases of this study.

The interviews for the initial phase were completed to gain perspectives and insights from local dive operators before the web-based survey is sent out. In this way, key elements and questions that may not be apparent in the available literature will be able to be included in a more refined and appropriate survey. Tobago was chosen as the interview site because its dive industry is substantial, with 54 dive sites and 11 listed dive operators (Association of Tobago Dive Operators, 2010). The first phase of the research began in January 2011 and involved interviews with seven dive operators.
A web-based survey has been chosen for a second phase of the study to investigate operator opinions from across the Caribbean. The survey will be administered by emailing approximately 400 operators across the Caribbean. The list of operators was constructed by the primary (or lead) researcher, as there is no directory or one single location where a list of all dive operators can be found. The sample list was compiled from various internet sources including the Professional Association of Diving Instructors (PADI), National Association of Underwater Instructors (NAUI), scubadviser.com, by searching individual countries travel and tourism pages, and also by browsing various online dive magazines such as Scuba Diving, Skin Diver, Sport Diver and Cyber Diver. Each operator on the list will be contacted and given the opportunity to participate in the quantitative study in Phase 2. The participants for the survey will be dive operators who conduct business in any of the 37 countries associated with the Caribbean Tourism Organization (CTO). The reason for selecting a large number of countries is in the hope of obtaining a more representative picture of dive operators’ perspectives in the entire Caribbean region. As well, the above countries may be affected differently by bleaching events, so the responses stand to be diverse.

EXPECTED RESULTS

The results from the phase 1 interviews with Tobago operators are currently under analysis with no results available at this time. However, some themes that may arise include: a lack of support and understanding from government; a need for more action and less talk from various industry stakeholders, including the operators themselves; and greater concern about other threats to coral reefs and dive tourism than coral bleaching.

Expected results for the quantitative phase will depend on the experience that operators have had with mass bleaching episodes, as the extent and awareness levels may vary by location. How close operators are to bleached sites will dictate their perceptions, thoughts and concerns about the future of their business and of Caribbean dive tourism in general. This will depend heavily on the outcome of the quantitative phase of this research, as the varying locations throughout the Caribbean will result in differing perceptions regarding climate change and coral bleaching. This may produce very interesting results regarding concern for the future of individual operations in association with bleaching events. Connected to this, it is expected that the longer an operation has been in business, or the longer an operator has been involved with dive tourism, a greater level of concern about coral bleaching will be evident. Business stability and length of operation may also affect operators’ ability to adapt, as they may encounter monetary, management or forecasting obstacles due to the size of the enterprise and limited availability of resources.

The responses to current and future threats will also vary depending on how developed the country and its tourism and dive tourism industries are. The lesser developed countries may have a greater concern for dive tourism, as this may be a major source of revenue, whereas the more developed countries may have a different ranking of priorities and concerns, since dive tourism may only be one fragment of their larger economy. This understanding of prioritizing threats and opportunities posed by coral bleaching will reveal a great deal about the dive tourism industry throughout the Caribbean.

Understanding financial loss attributed to coral bleaching will also contribute to an understanding of how adaptation strategies are viewed by operators in the industry. There may be tremendous barriers to taking effective action against coral bleaching, such as enough finances to make changes and the general dependence on the reef for business. An understanding of how operators view the effectiveness of response strategies will also be gleaned from this study, as simpler, more
financially accessible strategies may attract more involvement and therefore become more effective than more expensive and individualized options.

Knowledge of coral bleaching is an important foundation for effectively approaching this issue and an important part of this study will be exploring where and how operators find out about this environmental change. It is anticipated that a large number of operators will have learned firsthand about coral bleaching from their own personal experiences while diving, and that this will continue to be the primary avenue for education. However, this experience may be expanded upon through the use of government and NGO reports and other web-based resources.

REFERENCES


