IN THE SPOTLIGHT:

AN ASSESSMENT OF BEACHFRONT LIGHTING AT FOUR HOTELS AND RECOMMENDATIONS FOR MITIGATION NECESSARY TO SAFEGUARD SEA TURTLES NESTING IN BARBADOS, WEST INDIES

by
John English Knowles
Dr. Karen L. Eckert, Advisor
December 2007

Masters project submitted in partial fulfillment of the requirements for the Master of Environmental Management degree in the Nicholas School of the Environment and Earth Sciences of Duke University
2007
ABSTRACT

Artificial beachfront lighting is an increasing problem for sea turtle hatchlings and adult females. Barbados, the easternmost Caribbean island, exhibits particularly acute light pollution on the south and west coasts, which overlap one of the largest hawksbill sea turtle, *Eretmochelys imbricata*, rookeries in the region. A predominant source of artificial beachfront lighting is from hotels. To address the industry’s impact, and following the recommendations of a 2000 national workshop titled, “Sea Turtles and Beachfront Lighting: An Interactive Workshop for Industry Professionals and Policy-Makers in Barbados,” four leading hotels participated in a six-month voluntary lighting assessment. The lighting assessments followed standard guidelines and a ranking system was developed to objectively evaluate each light fixture based on intensity. The ranking system highlights fixtures most detrimental to sea turtle orientation, and encourages hoteliers to evaluate progress made toward sea turtle friendly lighting regimes over time. The results of the assessment were presented to the four hotels in user friendly assessment reports, which included mitigation recommendations for each fixture type. The assessment reports establish a lighting baseline for future assessments and act as a clearinghouse of recommendations for problematic lighting schemes. The hotel industry bears responsibility for the effects of their properties on sea turtle nesting grounds; therefore, encouraging them to rectify beachfront light pollution is crucial to the management of sea turtle populations in the Caribbean and throughout the world. The study, and the willingness of major beachfront hotels to participate, provides a replicable model for other countries to follow.
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Introduction

Artificial beachfront lighting contributes to the degradation of sea turtle nesting grounds because natural light guiding gravid females and their young to the sea is diminished by light pollution from beachfront properties. The resulting disorientation (loss of bearings) and misorientation (incorrect orientation) is especially acute in the hatchling stage (U.S. Fish and Wildlife Service 1999), and the consequences are often fatal (Mrosovsky and Carr 1967; Mrosovsky and Shettleworth 1968; Philibosian 1976; Dickerson and Nelson 1989; Witherington and Bjorndal 1991; Witherington and Martin 2003). Working towards a solution to this problem, this document explores light pollution mitigation processes and techniques at four hotel properties in Barbados, West Indies.

Over the course of the last century, human activity along the coastline has reduced the reproductive success of marine turtles in the Caribbean Sea and elsewhere (Kemf et al. 2000; Lutz and Musick 1996; MTSG 1995). As a result of coastal land use patterns, and centuries of largely unmanaged exploitation, incidental capture and international trade, sea turtles are recognized as endangered species by international law (Frazier 2002) and are fully protected by more than half of all Wider Caribbean governments (Fleming 2001; Bräutigam and Eckert 2006), including Barbados (Horrocks 1992). All six Caribbean-occurring species are classified as Endangered or Critically Endangered by the ICUN Red List of Threatened Species either because of reduced range of habitat, recent decline in population sizes, or both (Pritchard 1996; WWF 2004; IUCN 2007).
The hawksbill turtle (*Eretmochelys imbricata*) has also been affected by widespread over-exploitation for traditional crafting industries associated with its keratinized carapace scutes, known as tortoiseshell or bekko (King 1982; Meylan and Donnelly 1999; Kemf et al. 2000; Bräutigam and Eckert 2006; Reuter and Crawford 2006). Notwithstanding, signs of population increases are evident at remnant nesting colonies where long-term protection has been the norm, including Barbados (Krueger et al. 2003; Beggs et al. 2007).

In furtherance of national conservation policies in Barbados, where, as in many other nations, threats persist even after implementation of protective legislation and ratification of international trade treaties (see Bräutigam and Eckert 2006 for a summary of legislation and treaty obligations in Barbados), my objective was to assess and quantify the nation’s dominant sea turtle survival threat (beachfront lighting) and to offer specific recommendations for mitigation, thereby demonstrating to the hotel industry that there are feasible and practical solutions to light pollution.

Artificial beachfront lighting has increased tremendously (Frazer 1992) resulting in the inadvertent mortality of thousands of hatchlings (Eckert and Horrocks 2002; Witherington and Martin 2003). Artificial light is often associated with built development adjoining the beach, including hotels, private homes, villas, condos, streets, and parking lots. Depending on the location, certain property types dominant the landscape – but of all the various beachfront properties in Barbados and elsewhere, large hotels tend to have the most significant effect on the beaches they abut.
Tackling light pollution in large hotels might seem daunting due to the scale of some complexes, the number of fixtures, and the amount of light emitted towards the beach. However, hotel premises can work to the advantage of mitigating beachfront lighting. First, large hotel properties can be elongated along significant portions of beach, which can be managed as a whole. Correcting light pollution at a single hotel can have a considerable impact to the nocturnal environment for an entire bay. It can be mentioned that the financial capacity of the hotel sector (PKF 2006) can enable change to take place in the management regimes of adjoining beaches at a much faster pace than is likely to occur with similar regimes for beachside roads and parks managed by Government (McConney et al. 2003). However the strength of this argument is diminished since light pollution mitigation is not expensive and is often cost effective once implemented. Third, hotels are usually organized under an industry representative that can provide direction for a larger portfolio of hotel properties. Finally, hotels are critiqued by third party evaluation/certification organizations and the guests they cater to. Both of these groups, when led correctly, can provide the recognition warranted from increased responsibility among individual hotels.

Barbados in the Spotlight

In Barbados, the southwest coast has many beachfront hotels. The low wave energy beaches of the Caribbean Sea attract tourists as well hawksbill sea turtles. The overlap has resulted in the degradation of turtle nesting grounds due to artificial beachfront lighting that affects both hatchlings and nesting females. Problems associated with artificial lighting have only worsened since being identified (Potter 1996; Meylan and Donnelly 1999).
It is no coincidence that in 2000, the Wider Caribbean Sea Turtle Conservation Network (WIDECAST), the Barbados Sea Turtle Project, and the Tourism Development Corporation sponsored an event titled “Sea Turtles and Beachfront Lighting: An Interactive Workshop for Industry Professionals and Policy-Makers in Barbados” (Eckert and Horrocks 2002). The workshop culminated in several recommendations and pledges by the hotel industry in Barbados that demonstrated their commitment to the survival of sea turtles (Appendix I).

Among the pledges made by the hotel industry in Barbados was the pledge to “undertake a lighting assessment and investigate [their] capacities to participate in ‘turtle friendly’ lighting schemes [and to] implement, as soon as practicable, ‘turtle friendly’ lighting on all beaches” (Eckert and Horrocks 2002). A formal lighting assessment provides the most effective foundation by which specific lighting issues, recurring along the coast, can be addressed. It also provides the information required for hotels to prioritize, implement, and evaluate the lighting improvements so desperately needed on the island.

The lighting assessment tool has been used successfully both in the United States and in parts of the Caribbean. This technique focuses on identifying the most serious light pollution problems and making recommendations as to the most efficient way(s) to reduce the amount of light that reaches the beach, encapsulated by the three Golden Rules of correcting lighting problems: keep it low, keep it shielded, keep it long [wavelength] (http://www.myfwc.com/seaturtle/lighting/lighting_course.htm). The three Golden Rules are not substitutes for lights that can safely be turned off at night during the nesting and hatching seasons.
Mitigating light pollution is sensible and straightforward, but often overlooked as a provision for a healthy beach environment. As a result, many beach communities come to recognize the negative impacts of artificial lighting only after much of the nesting habitat has already been degraded. Once this point has been reached, legislative intervention is helpful because unilateral action by one or two properties can be ineffective in a densely developed landscape. Some governments have responded by taking protection of their sea turtles to the next level: by passing lighting ordinances and other appropriate laws. The leader in this field is clearly the State of Florida, USA, where many municipalities and other communities have passed lighting ordinances in compliance with state mandates (see Witherington and Martin 2003).

Like most countries in the Caribbean, Barbados does not have specific regulations concerning beachfront lighting and the resulting loss of many thousands of endangered hawksbill hatchlings who are fatally disoriented every year is a serious threat to conservation (Eckert and Horrocks 2002). There are also numerous cases of nesting females finding their way into backyard swimming pools and drains (Barry H. Krueger, Barbados Sea Turtle Project, personal communication, 2006). As the number of these incidences grow, it is clear that the issue must be addressed through a stakeholder (hotels, hospitality industry representative, government and community) led process that will effectively mitigate this threat on a national basis.

Participating Hotels

With a view to evaluating the extent to which hotels had implemented the pledges made at the 2000 hotelier workshop (Eckert and Horrocks 2002), the Barbados Sea Turtle Project
initiated a partnership with WIDECAST to conduct formal lighting assessments at four prominent beachfront hotels in Barbados – Fairmont Royal Pavilion, Sandy Lane, Turtle Beach Resort, and Southern Palms Beach Club (Assessments Reports). The four hotels were chosen because of their leadership in environmental consciousness, location on critical nesting beach habitat, unresolved beachfront lighting and/or past interests/efforts in mitigating artificial beachfront lighting. The hotels differ in ownership, clientele, architecture, and degree of light pollution. Each was asked, and agreed, to participate in a voluntary lighting assessment during the summer of 2006 (Appendix II).

The selected hotels are not to blame for the lighting problems in Barbados, even if they do hold some responsibility. Also, they do not represent the worst case scenarios, for there are many other beaches with high levels of artificial lighting. Finally, correcting the beachfront lighting at these four hotels will not solve the national problem; however, their assessments act as a baseline to ameliorating the conflict between beachfront lighting and sea turtle nesting grounds.

Aware that Barbados lacks a national lighting ordinance, leaving any emphasis on ‘turtle friendly’ lighting to the discretion of the hotelier, we hope that this study and attendant recommendations will not only spur participating hotels to make significant progress towards turtle friendly, energy efficient and safe alternatives, but will provide models of success that can be replicated at other properties in Barbados and beyond.
Fairmont Royal Pavilion

The Fairmont Royal Pavilion hosts 72 deluxe ocean-front rooms, running along 1000 feet of beach. The cost of the most expensive room is approximately $550 USD/night. The hotel is couple-oriented and will not book families with children under the age of 13 during the busy season (November to April). It is managed under Fairmont Hotels and Resorts, “the largest luxury hotel company in North America”, ensuring consistency to its clientele by applying strict company standards regarding amenities for all its properties (www.fairmont.com/royalpavilion).

Sandy Lane

Preferred Hotels and Resorts certifies Sandy Lane through their Standards of Excellence program since they offer only the highest quality of service. Of the 112 luxury rooms and suites, totaling approximately 116,000 square feet, 79 view the ocean. The cost of the rooms range from $450 USD/night to $900 USD/night, with the price of one of the villas reaching $24,000 USD/night during the busy season. The clientele is varied, consisting of family, honeymoon couples and small niche corporate and incentive groups. The property stretches along 1000 feet of beachfront (www.sandylane.com/introduction/index.html).

Turtle Beach Resort

Turtle Beach Resort was the only all-inclusive hotel assessed, which is why the cost per night is upwards of $1,000 USD. It has 166 spacious suites, many with panoramic ocean views. It is a four star hotel, managed under Elegant Hotels Group Barbados and caters to families
offering a variety of activities for all ages. The hotel extends along 1,500 feet of beach (www.turtlebeachresortbarbados.com).

Southern Palms Beach Club

Of the four hotels, the Southern Palms Beach Club had the least expensive rooms with the most costly ones reaching $350 USD/night. According to the website, the hotel “welcomes the young who want to do it all, the couple that just wants to enjoy each other’s company in the tranquil beauty of the island, or the family with children.” Southern Palms Beach Club has 92 rooms of which 53 view the ocean. The property is situated along 1000 feet of beachfront (www.southernpalms.net).

Methodology

The overall procedure to conducting a lighting survey is simple; walk the beach and identify sources of light observed. In Florida, properties identified as having problem lights are warned and then an assessment is conducted. The assessment usually involves the completion of a lighting evaluation form (Appendix III), which is handed to the property owners (R. Erik Martin, Ecological Associates, personal communication). A modified version of the lighting evaluation form (Appendix IV) from Ecological Associates, Inc was still used, but the data was ultimately conveyed in the user friendly assessment reports.

Each assessment report is broken down into several sections, beginning with an introduction, where readers are reminded of the effects of beachfront lighting on endangered sea
turtles and why hotels play such a critical role in mitigating light pollution. A survey method section details the systematic nature of this procedure and why it took place during the hours it did. The following section, making up the bulk of the report, defines the ranking scale used to evaluate fixtures based on intensity and details the recommendations given.

It is first explained that each fixture receives a rank of 1, 2, or 3 and the meaning that each rank holds. It is the inability to quantify the impact of light on marine turtles that led to the development of a ranking scale in the first place. The ranking (1, 2 or 3) was modified from the scale used by Ecological Associate, Inc. As explained in each assessment report, a rank of “1” describes indirect light visible by an observer on the beach, but not likely to present a strong attraction to nesting or hatching turtles. A rank of “2” describes direct light or a visible globe, glowing element, lamp, or reflector likely to disorient turtles. Both “1” and “2” ranking lights are not strong enough to cast a discernible shadow on the beach during a dark night. A rank of “3” describes a light source strong enough to cast a shadow on the beach regardless of the illumination being direct or indirect. Ideally, a beach should not have any source of illumination to rank, revealing a score of zero and hence no need for an assessment. However, in context of reality a rank of “1” is preferred over a rank of “2”, which is preferred over a rank of “3.”

Three important aspects of the ranking scale are its simplicity, objectivity, and reproducibility. It can be understood by maintenance personnel who will most likely be implementing the recommendations. It can also be easily understood by upper management who will be making the lighting scheme decisions during renovations or new additions. This will
allow current fixtures to be corrected properly and quickly, and allow the introduction of turtle friendly alternatives in future lighting designs.

The ranking scale is also objective because each fixture assessment will result in the same ranking, regardless of the assessor. This consistency will aid in reproducibility, providing a baseline for hotels to track their progress from nesting season to nesting season.

The assessment reports then list of all the recommendations given in the assessments, which correspond to small, user-friendly illustrations. Each assessment report has a different list because each property is unique, but many recommendations are shared. Please note that this list is not exhaustive.

Next in the assessment report are the evaluations of the fixture types, which is succinctly displayed on one easy to view page. The display includes a labeled photograph, the assigned rank, location, number of fixtures of that kind, comments (if necessary), and the illustrated recommendations. Most fixtures have more than one recommendation, some more involved than others, which is the main reason why recommendation illustrations were used. They are much easier to absorb than repetitive text. If certain fixtures required a more in depth explanation than the illustration could offer or if distinct issues arose, then the comment section was utilized.

The fixture type evaluations themselves are ordered based on the degree of rank (1, 2 or 3) as a primary tier. Since a rank of “3” indicates the most problematic light they are all listed first, then the “2” ranking lights and finally the “1” ranking lights. Within the primary tier, the
order is based on the number of fixtures of that kind, color, the creativity involved in resolving
the lighting problem, the attention it will require, or the cost to implementing the
recommendation. The order within the primary tier (1, 2 or 3) is more subjective because precise
quantification on the impacts to marine turtles is still not possible.

The user friendly format is intended to direct a hotel’s focus on the most problematic
lights, provide easy to understand recommendation illustrations and present a simple ranking
scheme. It is hoped that the ease of quick referencing the assessment will foster a more
favorable response by busy hotel staff and managers.

The assessment reports conclude by commending the hotels on their past and present
efforts in beachfront light reduction, but reaffirm the importance in executing the
recommendations. An internet resources section directs readers to any of the websites where
certain bulbs or fixtures mentioned in the assessment can be bought or viewed.
Management Issues

Hatchling Arena Assays

The potential effectiveness of the recommendations given in the assessment reports was simulated by the results from hatchling arena assays. Historically, such experiments were performed when the effect on hatchlings of certain lighting schemes or designs were uncertain.

![Diagram of Hatchling Arena Assays]

- Hotel A
  - Site 1
    - P < 0.0005
  - Site 2
    - 0.0025 < P < 0.005
- Hotel B
  - Site 1
    - P < 0.0005
  - Site 2
    - P > 0.25
  - Site 3
    - P < 0.0005
  - Site 4
    - 0.005 < P < 0.01
(Ecological Associates 2002). Unfortunately for Barbados, uncertainty is not the reason for performing such experiments since hatchling disorientation is so severe (JEK, personal observation; Eckert and Horrocks 2002). The experiments demonstrate the effect hotels can have by reducing beachfront light.

The experiment was performed in front of two hotels (Hotels A and B). The assay acts as a staged hatching event inside a designated circular arena. The arena had a one meter radius divided into 36 sections. A trench was dug for the arena’s perimeter and each of the 36 sections, representing 10 degrees of a circle, were divided off using cardboard slots each separated by a 17.5 cm arc length. The arena was modified from Salmon and Witherington (1995). Two property arenas were positioned directly in front of Hotel A (Site 1 and 2) and Hotel B (Site 1 and 2). Hotel B had two additional peripheral arenas, one 25 meters north of the property (Site 3) and one 25 meters south of the property (Site 4).

The hatchlings used were collected from hotels where they had emerged and been previously disoriented that night. Twelve (12) neonates were placed center circle, facing the sea and released one at a time (modified from Salmon and Witherington 1995). This was carried out in two rounds for each arena. The first round was performed with lights on as they would be during normal early evening operation. The second round was carried out with all “3” ranking lights turned off. The data recorded for each hatchling included its final position at the perimeter, the length of its track, and the time needed to reach the arena boundary.
In Salmon and Witherington (1995), “Rayleigh tests were used to determine whether the orientation of a group of turtles in any one experiment differed significantly from random” (p. 933). This experiment used a Watson-Wilson test for two samples, which incorporates the Rayleigh test to determine if there is a difference in the means between the two rounds (Zar 1984). Orientation for each experiment did differ significantly from random and all (lights on – lights off) pairs were significantly different except for one. The exception was Site 2 at Hotel B (P>0.25) where one floodlight (with a rank of “3”) was unable to be turned off.

The results of this analysis reinforce the importance of hotel cooperation in mitigation beachfront lighting. The results obtained from the peripheral arenas at Hotel B help demonstrate lights can affect more than the area of beach they directly illuminate. The broadcast of some fixtures can affect an entire bay by actually drawing hatchlings from darker section of beach out of the water (JEK, personal observation).

Commonalities among Properties

Most hotels provide the same service and similar functions. For example, they provide restaurants, balcony rooms, large windows for unobstructed viewing, and security for protection. Usually little thought is put into the side effects of providing these services, which usually go unnoticed, unless you are a beachfront hotel. The side effects of common services are much more serious for hotels that abut endangered sea turtle nesting grounds.

One common problem observed at all four hotels was the issue of beachfront restaurants. In most cases, there was no intentional illumination of the beach associated with the restaurants.
Ceiling and wall mounted light fixtures were the main source of broadcast out of the restaurant. Recommendations included concealing wall mounted fixtures and shielding ceiling fixtures. The light from these fixture types usually provide two purposes. One is to illuminate the space where people walk and the other is to illuminate the food and faces at the table. Ultimately, all light sources used to illuminate spaces of beach front buildings should be lowered behind opaque objects. Louvered foot lights installed into the wall of the restaurants are excellent examples. Landscaping is another excellent means to screening light and was recommended quite often. As for illuminating the table area, table lamps with shades and LED candles were recommended in the assessments. Shaded table lamps and LED candles are both efficient light sources because they provide the illumination needed at a dinner table without broadcasting light beyond the restaurant.

Decorative lighting should be one of the easier categories of lighting to mitigate because they serve only to enhance ambiance and the best recommendation is to eliminate. However, this might be much harder in practice because of their popularity on hotel beachfronts. Although such fixtures are festive, it was highly encouraged that decorative lighting be reserved for areas not visible from the beach because it is “much more harmful to sea turtles than it is useful to people” (Witherington and Martin 2003, p.21).

Recommendations for lights that serve multiple purposes are more difficult. Two commonly paired categories of lighting were security and area lighting, most of which are spotlights. Security lighting includes lights that illuminate a perimeter or an area for the soul purpose of preventing crime. An area light is defined as a source of illumination for spaces such
as walkways, patios, or steps. When it comes to mitigating artificial beachfront lighting, separating light sources into their separate functions creates greater ease in resolving the lighting problem. Thus, lights and fixtures which primarily provide for security are best handled by recommending the installation of motion detectors. For area lighting, it was recommended that fixtures be replaced with a turtle friendly alternative, such as a louvered bollard or path light, which can be easily concealed behind opaque objects. Area lighting that intentionally included portions of beach was highly discouraged.

Along with multi-purpose lighting fixtures, the assessment of hotels can be quite difficult because of the depth, height and length of the hotel complex, which only increase the number and types of fixtures to be evaluated and corrected. Both the Southern Palms Beach Club and the Fairmont Royal Pavilion, a hotel with only beachfront rooms, exemplify the length factor. Each hotel is stretched along 1,000 feet of beach front with buildings and fixtures occupying most every foot.

The properties of Sandy Lane and Turtle Beach Resort stretch back from the beach servicing the depth factor. Evaluation and mitigation difficulties arise when forward lights are corrected but its improvement is only counteracted by lights from behind. This is why it is important to work with the hotels during an assessment so that brighter forward lights can be turned off to obtain the true effect of the lights from behind.
Height was not an issue for the hotels assessed in Barbados since most did not exceed four stories. One advantage in not exceeding four stories is the ability to exploit vegetation as a buffer between lights and the beach. This becomes less applicable with high rise hotels.

All three issue of height, depth and length are compounded by the proximity to the beach. Lights become more disruptive to sea turtles the closer the hotel is to the ocean. The Fairmont Royal Pavilion and the Southern Palms Club are closest to the beach. This is the main reason why most lights at these hotels ranked as high as they did. Pushing these same hotels with the same lights back from the water would lessen the effect on sea turtles. It was not recommended in the assessments that hotels move their building back from the water, since property setbacks is the responsibility government managing the coastal zones.

Distinct Issues

Just as the lighting problems shared among the four hotels are likely to be observed throughout the Caribbean, so too are the unique lighting problems observed between the hotels. In this report, uniqueness is defined either by the reason why a particular lighting problem is present or by the mitigation technique used to correct the problem.

As mentioned previously, beachfront restaurants are quite common and the effect on the beach from lighting these areas is compounded by their length and close proximity to the beach. Not mentioned was the overlap between hatchling emergence from the nest and restaurant’s operational hours. Witherington et al. (1990) demonstrated that peak emergence of loggerhead turtles on Florida beaches is around midnight, with 31% emerging before that time. Although no
formal study has been completed in Barbados, emergence patterns for hawksbills appear to be similar, with a significant portion of nests emerging before midnight (Asanchia Harewood, Barbados Sea Turtle Project, personal communication). This is also the time in which many beachfront restaurants are open for business (thus fully lit).

The Palm Terrace Restaurant at the Fairmont Royal Pavilion is no exception with hours of operation from 19:00 to 21:45. Of the four hotels, the Palm Terrace Restaurant is the most extreme for beach proximity, even the hotels website exclaims that the “sea [is] so close that it almost reaches the table” (www.fairmont.com/royalpavilion). Moreover, the dining space is separated from the outside by large wide arches, giving space for ample light to exit onto the beach. The recommendations related to this restaurant are what make this example unique.

The problem fixtures at the Palm Terrace Restaurant were the spot lights located at the wall and ceiling junctions. Some fixtures created wall wash, while others were directed into the dining space, but their bulbs were still visible from the beach. As with other restaurants, fixture replacements and repositioning were recommended. The fixtures pointed directly towards the beach were recommended for removal. However, it was indicated that these fixtures could not be removed. Working on this assumption, it was recommended that the fixtures be lowered, shielded and concealed. In any other case, planting a vegetation buffer in the space between the restaurant and the beach would be advisable, but because such space doesn’t exist in this case, the recommended action would need to originate from within the restaurant. It was suggested that potted coconut palms within the dining area be positioned to block the high mounted spotlights. However, even with repositioning of some spotlights and the urging of substituting
still others with lower level lights, it is most likely indirect light would still present a problem. As a final barrier to the beach it was recommended that the arches be landscaped in such a way to reduce the space from which light could leave the dining area, but still allowing guests to view the ocean.

Ironically, a unique lighting problem was observed at Sandy Lane, which has very low ranking lights, a likely situation for premier luxury and award winning hotels. However, one fixture type was somehow overlooked. The hotel’s beachfront was illuminated from dusk until 2:00 by very large, blue tinted, tree mounted floodlights. These four fixtures embody everything that a light should not be with regards to being sea turtle friendly, not to mention their high maintenance. Because they are mounted to trees they are highly visible and their broadcast is directed out across the bay and onto peripheral beaches. They emit short wavelength light, the color most attractive to sea turtles and they shine at such very high intensity that it is likely even a red version of these lights would cause problems. These lights are purely aesthetic and the best recommendation is their elimination. However, it was indicated that these lights are prized by Dermot Desmond, Sandy Lane’s owner. If the fixtures must remain, then it was urged their use be restricted to outside the turtle nesting season for Barbados (May – November).

The final unique lighting problem to be discussed is the one observed at the Southern Palms Beach Club. This property’s waterfront is lined with yellow spotlights. This particular situation has improved after the 2000 “Sea Turtle and Beachfront Lighting Workshop,” where wattage was reduced and white spotlights were replaced with yellow spotlights. But the fact remains; artificial light continues to reach the beach mis-orientating almost all emergences (JEK,
personal observation). Management indicated that the lights remain for guest safety and for security cameras. The question to use beachside, nighttime running security cameras as the best means for added security was raised in the assessment. It was unique that Southern Palms Beach Club was the only hotel on the island with operational beachside, nighttime running security cameras. Ironically, the light provided by these fixtures and others was actually not bright enough to provide a clear image for the cameras. Therefore, other security measures were recommended as a substitute.

Guests walking the beach at night do not actually need artificial light to see because human eyes are capable of sight in low light when allowed to adjust (Hecht 2001). This is possible if walkways and steps to the beach are outlined with red LEDs. This would provide safety, while at the same time allowing the human eye to adjust naturally. The preference of tourists to have a lit beach is probably indifferent, but when educated about the effects had by artificial lights on marine turtles, their preference is likely to favor darker beaches.

Lighting and Crime Misconceptions

As stated in the proceedings of “Sea Turtle and Beachfront Lighting: An Interactive Workshop for Industry Professionals and Policy-Makers in Barbados,” “the issue of safety and security of guests continue to concern the hotel sector.” Eckert and Horrocks (2002) state in the Epilogue: “perceived issues of guests hotels have been a major impediment to light reduction on Barbados’ beaches”.

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The issue of safety and sea turtle lighting is common enough to be including in the frequently asked question section of the Technical Report by Witherington and Martin (2003):

How can the sacrifice of human safety and security to save a few sea turtles be justified?

Thankfully, no such choice is necessary. The safety and security of humans can be preserved without jeopardizing sea turtles. The goal of any program to reduce sea turtle harassment and mortality caused by lighting is to manage light so that it performs the necessary function without reaching the nesting beach. Still, some may contend that any inconvenience at all is too much and that the concerns of humans should always outweigh those for turtles. People insistent on this generalization should not ignore the large and resolute constituency that values sea turtles. Sea turtles are valuable to people both ecologically and for pure enjoyment. In many ways, the protection of sea turtles is in our own best interests (p. 69).

The question above asks about the justification for the compromise between security and saving a few turtles. If nothing else, then it must be noted that implementing sea turtle friendly lighting will save a lot more than a few turtles in Barbados. Thousands of hatchlings are affected every year by lighting on Barbados, which hosts one of the largest hawksbill rookeries in the Caribbean (Beggs 2007). The degradation of this population due to artificial lighting does not bode well for the Caribbean’s overall population. There are many islands and nations that also hosts important rookeries for other species of turtles, which are also valuable to people and tourism economies. Fortunately, as mentioned in the quoted answer, there is no compromise between security and dark beaches. Both can exist in harmony.
Security and dark beaches can exist in harmony for two main reasons. First, security does not have to come in the form of continuous beachfront lighting. There are different means of providing added security, without constant illumination of the beach. Motion detector lights are an excellent example. The light comes on when needed alerting hotel personnel that someone as entered the detector’s field of view and also can scare away suspicious persons (www.darksky.org). Good security guards with flashlights also provide excellent protection from crime as this is a very common safety measure already observed by hotels in Barbados (JEK, personal observation).

Second and more importantly than substituting continuous beachfront illumination, is the correlation between security lighting and crime prevention. It should be noted that many sources state that crime most often occurs during the day. But for the percentage of crimes that do occur at night, the presence of light is often of little concern. The website for the International Dark Skies Association (IDA) asks if security lights prevent crimes and they answer with uncertainty (www.darksky.org). A study by the United Kingdom’s Home Office Crime Prevention Unit on street lighting and crime discovered that improvements in street lighting do little to prevent crime and criminals are less often deterred by light (Ramsay and Newton 1991). Another study by the group concluded that increasing intensity of street lighting also does not improve criminal activity (Atkins et al. 1991). Although the crime prevention studies do not look at beach lighting and examine areas with crime rates much higher that what is observed in Barbados or other Caribbean islands, the results are telling (Nuttall 2000).
Witherington and Martin (2003) respond to the comment that “[c]rime will increase if the beach is not lighted” by stating:

Generally, beaches are not areas where there is a great need for crime prevention. Very little valuable property is stored on beaches and there is seldom much nighttime human activity to require security. Fortunately, areas adjacent to nesting beaches where people reside, work, recreate, and store valuables can be lighted for protection without affecting turtles on the nesting beach. Where this type of light management was legislated in Florida coastal communities, the Florida State Attorney’s Office has found no subsequent increase in crime (p. 68).

Volusia County, Florida, USA is a good example of the harmony existing between darker beaches and security. The county has one of the strictest coastal lighting ordinances in the state. When their lighting ordinance was passed in 1989, businesses feared losses and worries about crime spikes were also raised. As it turns out, no such things materialized (Lelis 2003; William “Bill” Sorrentino Sr., Zoning Compliance Division, Daytona Beach, FL, personal communication).

**Next Steps and Broader Recommendations**

Other than the recommended implementations at the specific properties, there are several next steps that need to be considered by the hotel industry, its representatives (e.g. Barbados Hotel and Tourism Association, Tourism Development Corporation of Barbados), and
Properties with the most significant lighting issues should receive priority attention in terms of training, assessment, mitigation, and evaluation. Hotels that have not formally assessed their beachfront lighting should be encouraged to do so. Training is available through WIDECAST (contact Prof. Julia Horrocks, WIDECAST Country Coordinator, at the University of the West Indies). Once the initial lighting assessment is complete using the ranking scale provided in this document and after recommendations have been implemented, routine follow-up assessments should ensue. The ranking scale allows hotels to track the progress of their lighting after each formal lighting assessment. In most cases, the initial lighting assessment should suffice in resolving all lighting problems. But because of potential changes associated with renovation, revised landscaping, storm damage, etc. lighting will need to be constantly re-evaluated. Although formal lighting assessment might not need to occur but every five years, hotels need to be reminded before every turtle season to re-evaluate the lighting conditions present and remedy off-season lighting schemes that are not turtle friendly.

The Barbados Sea Turtle Project (BSTP) operates a national Sea Turtle Hotline, a method for turtle activity to be reported. Hatchling disorientation calls were logged for the 2006 season, which approximately ranks properties in terms of sea turtle activity. The BSTP also documents hatchling disorientation not reported by the Hotline. Between the two methods of reporting sea turtle disorientation events, the Hotline calls are easiest to prioritize because they represent only a subset of total disorientation events. In addition, Barbados hotels are ardent about calling the
hotline, even if only one hatchling is found. Therefore, hotline calls are a close proxy to actual disorientation events for hotel properties because of the high probability of the events being reported due to guests, security guards, and length of beach lined by hotels.

Collecting disorientated hatchlings can be both fun and educational for guests, but this somber reality can take away from more critical monitoring of adult females. If such systems are in place, then hotels should be encouraged to participate because the number of disorientation events for a property reported is an opportunity for positive improvement. It should not be seen as embarrassing or wrong. Hotel participation greatly extends the management ability for monitoring organizations and quick identification and correction of light pollution at active properties will help both parties involved. If hatchlings are provided an environment where they may enter the water as nature intended, then the strain on monitoring organizations and hotels is removed. Monitoring organizations could spend more time monitoring beaches and provide more appropriate outlets for hotel guest education. Security guards would also be relieved from having to constantly save endangered species and focus on their assigned job.

Internally, hotels can help themselves become better stewards of the environment in which they rely on by adopting sea turtle policy statements within their environmental management systems (EMS). For example, “X Hotel recognizes its responsibility to the coastal environment on which it operates. We are committed to reducing our footprint on this ecosystem by the following: 1) Preventing light pollution, 2) Removing chairs at night and using umbrellas with a flat base instead of staking the post directly in the sand and 3) Collaborating with stakeholders to ensure sustainable operations for coastal areas including other beachfront
properties owners, biologists, guests, surrounding community, government and industry representatives.”

Efforts to reduce light pollution are not exclusive from improvements in energy efficiency, architectural design and local markets. One, lighting is the second most significant daily expenditure for hotels in the Caribbean region (Tourism Global Inc. 2006). Two, energy efficient lighting will support the efforts announced by the Caribbean Tourism Association to neutralize carbon emissions from the tourism industry (The Caribbean 2007).

An energy audit was not performed at the four participating hotels to demonstrate the cost savings of energy efficient lighting. However, reducing wattage, keeping lights off, and installing LEDs, compact fluorescents and/or fixtures that direct light more efficiently could possibly help save money in a region where energy costs are some of the highest in the world (www.climate.org/programs/washington_summit4.shtml). It has also been suggested that energy efficient lighting translates into elegance (www.lrc.rpi.edu), thus increased revenue since sophisticated lighting attracts today’s sophisticated traveler (Anonymous 2004; Ruffino 2007). Providing this type of lighting will become increasingly easy as new technologies are developed and LED and CFL fixture types are diversified (Dean Gallagher, Florida Fish and Wildlife Conservation Commission, personal communication).

It was recommended that the Fairmont Royal Pavilion purchase turtle friendly fixtures manufactured locally by Earthworks Pottery. This particular recommendation, when implemented, would create a link with local industry and delight guests with authentic
presentation (MacCannell 1973; Poon 2003; Tourism Global Inc. 2006). It is hoped that the purchase of locally manufactured fixtures or locally supplied bulbs would improve economic development (Witter 2002; Duval 2004; Pattullo 2005; Tourism Global Inc. 2006; Travelwatch 2006). The implementation of such recommendations would almost certainly differ between hotel types. Large multinational cooperate hotels, such as ones owned by Fairmont Hotels and Resorts, might have some difficulty in providing the authentically local experience, while still adhering to their strict company wide standards that apply to architecture as well. Locally owned and smaller hotels might find such recommendations easier and welcoming. In any case, an economic analysis on the role of beachfront lighting reduction with regards to local material would be interesting.

Hotels can also be helped by third party organizations already in place, such as Green Globe. The benchmarks set by this organization, and others like it, assist the tourism industry meet the triple bottom line by becoming more sustainable. For countries that do not have specific lighting regulation, these programs have the potential to positively impact the beachfront. Criteria for turtle friendly lighting could be included in the existing standards. This might fit particular well under the ecosystem management and conservation impact area of the Green Globe program.

For beaches that do not have serious lighting issues, a more efficient focus might be an entire bay. This might be more appropriate if each property had only a few lighting problems to be assessed. Cooperation between property owners would be much more important in this case because different property types would most likely be assessed.
Ultimately, lighting legislation needs to be passed for long-term commitment to protect beaches from light pollution. Lighting legislation is also necessary because unilateral voluntary action usually falls short since some properties will inevitably refuse to mitigate their lighting. Unfortunately, beachfront artificial lighting, in most cases, is a symptom to a greater problem of coastal management and the effort to correct how society makes use of the coast will take much longer than correcting light pollution.

A good lighting ordinance should have a clearly stated purpose, set standards for existing and new developments for both public and private properties, and be mandatory. The effectiveness of a lighting ordinance could be increased by allowing existing properties to phase in appropriate lighting designs and require new construction to take immediate action. It should also be embedded in a larger conservation strategy as well as a sustainable coastal zone management plan.

In summary, four hotels in Barbados with support from their industry representative have committed to the lighting assessment pledge stemming from a first of its kind lighting workshop in the region. The resulting user friendly assessment reports provide a simple and objective ranking scheme based on light fixture intensity, which can be used to ratchet down the effect of a light. The reports also set a lighting baseline for the four hotels so that improvements in beachfront lighting may be tracked. In addition, the reports act as a clearinghouse of recommendations for problematic lighting schemes observed at most hotels.
Hotels are an excellent focus point for reducing artificial beachfront lighting, especially in Barbados, since they encompass a significant portion of beachfront and are influenced by other parties. But ultimately, if stakeholders in Barbados want to lead by example and take a long term stance to light pollution impacts on sea turtles, legislation should be introduced. Mitigating beachfront light pollution will safeguard the reproductive stage for sea turtles, increase beach quality and safety for tourists, dovetail hotel management priorities in energy conservation and sustainable operations and be a step forward towards better management of coastal zones and natural resources.
Literature Cited


Appendix I - Resolutions, pledges, and recommendations emerging the meeting title: Sea Turtles and Beachfront Lighting: An Interactive Workshop for Industry Professionals and Policy-Makers in Barbados held in 2000

Sea Turtles and Beachfront Lighting:  
An Interactive Workshop for Industry Professionals and Policy-Makers in Barbados

An Interactive Workshop hosted by the Barbados Sea Turtle Project and Wider Caribbean Sea Turtle Conservation Network (WIDECAST)

Sponsored by the Tourism Development Corporation of Barbados  
Glitter Bay Fairmont Hotel  
- 13 October 2000 -

RESOLUTION OF THE MEETING

RECOGNISING that Caribbean sea turtles species are classified either as Endangered or Critically Endangered by international authorities, and are fully protected in Barbados under the Fisheries (Management) Regulations, 1997;

CONCERNED that sea turtle populations in Barbados have declined dramatically over the course of the 20th century, due to threats both domestic and foreign;

AWARE that natural sandy beach habitat is essential to the survival of the tourism industry in Barbados, as well as to the survival of our sea turtles;

ALARMED that the majority of sea turtle hatchlings emerging from the beaches of Barbados are confused and disoriented by artificial lighting and that, as a result, thousands of them die every year;

SENSITIVE to the impact the modern tourism industry, including coastal construction and artificial beachfront lighting, has on the plight of sea turtles;

ENLIGHTENED, based on the results of this workshop, about how the coast-based tourism industry can participate in sea turtle conservation and protection; and

COMMITTED to taking effective action, both as individuals and as an industry, to ensure the survival of sea turtles in Barbados -

WE PLEDGE TO:
ADOPT a Policy Statement regarding the protection of sea turtles on hotel grounds;

REVISE Standard Operating Procedures (SOPs) to implement the Sea Turtle Policy Statement and further encourage reporting and protecting nesting turtles and hatchlings by hotels and other beachfront properties;

SEEK to ensure that funding is available to support annual training (by the Barbados Sea Turtle Project) of support staff in those departments that are responsible for actualisation of the Sea Turtle Policy Statement;

UNDERTAKE a lighting assessment (following the guidance of Witherington and Martin, 2000) and investigate our individual hotel and villa capacities to participate in “turtle friendly” lighting schemes; and

IMPLEMENT, as soon as practicable, “turtle friendly” lighting on all beaches (e.g., replace HPS lights with LPS alternatives, install motion-sensitive security lights, turn off purely aesthetic lights at 9:00 PM during peak nesting and hatching seasons).

RECOMMENDATIONS OF THE MEETING

TO PROMOTE full implementation of the RESOLUTION, we recommend that the Tourism Development Corporation, in consultation with the Barbados Sea Turtle Project and the Wider Caribbean Sea Turtle Conservation Network (WIDECAST) and in collaboration with other local (BHTA) and regional (CAST) industry coalitions:

PROVIDE the hoteliers, villa rental agencies, Ministries and other relevant agencies in Barbados with a draft to be adopted and implemented by the hotel and villa rental community nation-wide, with each establishment ensuring that its SOPs are revised as necessary;

PROVIDE the hoteliers and villa rental agencies in Barbados with standard guidelines and criteria for implementing the Sea Turtle Policy Statement; and

PROVIDE coastal hoteliers and landowners with emergency numbers for reporting sea turtle sightings and violations, and a calendar noting the nesting and hatching months of local sea turtle species.

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Appendix II - Hotel invitation letter to participate in lighting assessment

Dear Mr. Michael Pownall,

On October 13, 2000, Kelly Robinson, then Executive Director of the Caribbean Alliance for Sustainable Tourism (CAST), opened the Caribbean’s first industry meeting on “Sea Turtles and Beachfront Lighting: An interactive Workshop for Industry Professionals and Policy Makers in Barbados” at Fairmont Glitter Bay Hotel in Barbados. The Workshop, hosted by the Barbados Sea Turtle Project (BSTP, UWI) and the Wider Caribbean Sea Turtle Conservation Network (WIDECAST), and funded by the Tourism Development Corporation, was the first of its kind in the region. Ms. Robinson, herself a hotel industry professional with first-hand experience of the negative impacts of beachfront lighting on nesting sea turtles and their hatchlings in the Dominican Republic and elsewhere, was pleased to offer the commitment of CAST in tackling and resolving the conflicts between beachfront development and the survival of the region’s depleted and endangered sea turtles.

The Workshop showed that there are indeed solutions to the challenges of lighting a property while protecting sea turtles nesting on adjacent beaches, and that many of these solutions simultaneously offer economic rewards in terms of improving energy efficiency. The Proceedings of the Workshop (Eckert and Horrocks, 2002) were subsequently circulated to all hotels in Barbados. In a Resolution adopted unanimously, Workshop participants pledged to undertake lighting assessments of their properties and to implement as soon as practicable “turtle friendly” solutions to problem lights. Over the intervening years, several hotels have contacted the BSTP to request assistance in addressing lighting issues, and indeed some have already implemented solutions.

This year, again with funding from the Tourism Development Corporation, we are undertaking an evaluation of the extent to which the recommendations emerging from the 2000 Workshop held in Barbados have been implemented, and an assessment of whether the situation for sea turtle survival on Barbados’ beaches has improved in the last five years. To accomplish this, we have requested assistance from the BSTP in identifying four prestigious hotels on the west and south coasts of Barbados, situated adjacent to important nesting beaches, that have expressed interest in addressing the conflicts that they recognise between their lighting and sea turtle survival, and whose leadership in addressing the lighting problem is likely to be emulated by other hotels. In
response to our request, the BSTP has recommended your hotel, Sandy Lane, be invited to participate in this important study as one of these four case studies.

If our invitation is accepted, we propose to conduct a formal lighting assessment of each property, including the beaches adjoining your property at Sandy Lane.

This will require standardized daytime and nighttime lighting inspections and surveys to be conducted (cf. Witherington and Martin, 2000). Each hotel will be asked, in advance, to identify a contact (e.g. Chief Engineer, maintenance or security personnel) who can assist in the assessment by identifying the purpose of each light source and the circumstances under which it is used. The inspections will be undertaken by Mr. John English Knowles from Duke University in North Carolina, USA. He has been fully trained to undertake this type of work by Erik Martin of Ecological Associates, Inc., an inspector for lighting compliance in Florida and co-author of the definitive text, “Understanding, Assessing, & Resolving Light Pollution Problems on Sea Turtle Nesting Beaches” (http://www.nests-certified.org/pdf/LightingTechReport.pdf).

Daytime surveys will identify and document all potential sources of light reaching the beach. Nighttime inspections will determine the extent to which each light identified during the day, is having a negative effect on nesting habitat. Each inspection will result in a ranking and scoring of light pollution sources, and specific recommendations will be made in a report for each hotel. Hotels will be requested to study and internalize the report, and to implement some recommendations (those that require no or minimal expense to implement) immediately, and others as practicable. Simultaneous to the inspections, documentation of sea turtle disorientation will be undertaken with the assistance of the BSTP, allowing an assessment of problem lights before and after mitigation measures are taken.

A Final Project Report will summarize the findings and provide a suite of tools that we hope will be useful to any hotel seeking to enhance the survival of sea turtles nesting on their property. Following up on the 2000 Workshop Resolution, the Report will feature a draft Sea Turtle Policy Statement suitable for integration into hotel environmental management systems (EMS), a list of locally available lighting technologies, a protocol for conducting a lighting assessment, sample data sheets, helpful illustrations and photographs, potential energy saving calculations, and a list of contacts to assist hoteliers and others in implementing “turtle friendly” lighting schemes that will launch both your hotel and Barbados as leaders in this field.

The Final Project Report will also act as a baseline for future assessments – enabling stakeholders in Barbados to track progress in light reduction one year, five years, or ten years into the future – and will provide a model for other Caribbean countries, facing similar coastal management issues, to follow in their efforts to initiate a national dialogue with the tourism industry on this important topic.

Last, but certainly not least, the project will aid significantly in the survival and sustainability of Barbados’ marine turtles. A sustainable future is clearly a possibility, as evidenced by the attention already given to this issue in Barbados. WIDECAST – with the support and endorsement of the UN Environment Programme (UNEP-CEP) and the
Caribbean Alliance for Sustainable Tourism (CAST) - is proud to be conducting this assessment in collaboration with its affiliate, the BSTP, in Barbados and, fully recognising the leadership role that your property has already shown in seeking solutions that will promote harmony between nesting turtles, hatchlings, and coastal development, we are confident that together we can set an example for other properties to follow.

We sincerely hope that you will take up our invitation to participate, and we respectfully request that you send a response to Prof. Julia Horrocks, Director of the Barbados Sea Turtle Project (Tel: 417-4320; Fax 417 4325) as soon as possible. I assure you that the evaluation and assessment will be conducted with science-based protocols that do not intrude on your busy staff, and that the underlying motive is to assist your management team with solutions that will enhance your property in ways that promote the survival of our endangered sea turtles without compromising aesthetics, security, or economic viability.

We look forward to working with you!

Yours very sincerely,

Karen Eckert, Ph.D.
Executive Director


Appendix III - Original lighting evaluation form
Lighting Evaluation Form

Facility Name/Address: ____________________________________________

Light Location: ___________________________________________________

Type of Observation (Circle One): Initial Daytime  Initial Nighttime  Follow-up Nighttime

Date/Time of Observation: _________________________________________

Observer(s): _____________________________________________________

General Comments: _____________________________________________

_________________________________________________________________

_________________________________________________________________

_________________________________________________________________

_________________________________________________________________

Light Visible From Beach: YES  NO

Fixture Type: ___________________________ Photo #: _____________

Current Problem Code: 1  2  3  4  5  OFF  NOB

Comments:

_________________________________________________________________

Recommended Modifications: _______________________________________

_________________________________________________________________

_________________________________________________________________

_________________________________________________________________

Observed Modifications: __________________________________________

_________________________________________________________________

Additional Modifications Required: YES  NO
Appendix IV - Modified lighting evaluation form

Lighting Evaluation Form

Facility Name/Address: ________________________________

Light Location: ________________________________

Type of Observation (Circle): Daytime  Early Nighttime  Late Nighttime  Follow-up Nighttime

Date/Time of Observation: ________________________________

Observer(s): ________________________________

General Comments: ________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

Light Visible From Beach:  YES  NO

Fixture Type: ________________________________  Photo #: __________

Rank:  1  2  3  OFF  NOB

Comments: ________________________________

______________________________________________________________________________

Recommended Modifications: ________________________________

______________________________________________________________________________

Observed Modifications: ________________________________

______________________________________________________________________________

Additional Modifications Required:  YES  NO
Appendix V – Fairmont Royal Pavilion property map
Appendix VI – Fairmont Royal Pavilion assessment report
National Assessment of Beachfront Lighting and its Effect on the Survival of Endangered Marine Turtles in Barbados, West Indies

Property Assessment:
The Fairmont Royal Pavilion

Respectfully submitted
John English Knowles

WIDERCAST
Wider Caribbean Sea Turtle Conservation Network

Tourism Development Corporation
INTRODUCTION

In partnership with the Barbados Sea Turtle Project (BSTP), local affiliate of the Wider Caribbean Sea Turtle Conservation Network (WIDECAST), and the Tourism Development Corporation in Barbados, a formal lighting assessment was conducted at the Fairmont Royal Pavilion as part of a follow-up initiative to implement recommendations made at a national “Sea Turtles and Beachfront Lighting” workshop held in 2000 (Eckert and Horrocks, 2002).

The evaluation of lighting associated with the Fairmont Royal Pavilion property attests to the efforts and dedication of the hotel industry and the BSTP in improving the conditions of artificial beach lighting, which is well known to be detrimental to both hatchlings and nesting sea turtles (Eckert and Horrocks, 2002).

The Fairmont Royal Pavilion has identified itself as a leader in addressing the lighting problem by voluntarily participating in this assessment. The property – along with four (4) other beachfront hotels – was chosen because it plays a crucial role in the quality of sea turtle nesting habitat. The intent of the lighting assessment was to evaluate current conditions, and to propose solutions and recommendations for each light identified as contributing to the nocturnal illumination of the nesting beach.

The attention of such work is critical in the survival of the hawksbill sea turtle, *Eretmochelys imbricata*, a critically endangered species worldwide (cf. IUCN RedList). Barbados plays a very important role in the survival of this species, its southwest coast having been identified as one of the most important nesting grounds remaining in the Wider Caribbean Region.

Artificial beachfront lighting, characterized as “light pollution” by Witherington and Martin (2003, p. V), is the most serious contemporary threat to the survival of sea turtles in Barbados (Eckert and Horrocks, 2002). Marine turtles are most sensitive to shorter wavelengths (emitted by blue, green and white light), which they use as a sea-finding cue. When such lights are visible from the beach the effect on sea turtles is tremendous.

Witherington and Martin (2003) suggest the following approach to mitigate “light pollution” by either eliminating the fixture or by adjusting wavelength or intensity:

We have no reliable formula that can be used to calculate how much each light source will affect sea turtles. We do know, however, that if spectral emissions are equivalent, reducing intensity will reduce effects, and if intensities are similar, substituting less attractive sources (like yellow bug or red lights) will also reduce effects. A sound strategy, therefore, would be to reduce effects on sea turtles by manipulation both intensity and color. As few lights as practicable should be used, and for lighting deemed essential, long wavelength light sources should replace more disruptive light sources and intensity should be reduced by using lamps of minimal wattage that are housed within well-directed fixtures aimed down and away from the beach (p. 23).

In point, direct light on the beach can be highly disruptive to both adult turtles and hatchlings and, eliminating sources of direct light reaching the beach is preferred over all other conservation alternatives (Witherington and Martin, 2003). In circumstances where eliminating light sources – either by turning them off or by removing the fixtures all together – is not practical, several alternatives are available which direct light more efficiently and/or shield the source from the beach.

Similarly, indirect lighting is also highly disruptive. Witherington and Martin reiterate that, “luminaires should not be directed onto...any object visible from the beach,” this includes walls, ceilings, and vegetation (p. 21). A form of intentional indirect lighting can be decorative, such as glowing beachfront vegetation.
Although enchanting for some, such a practice should be reserved for areas out of sight from the beach. If indirect light is unintentional, then modern fixtures are highly recommended that will prevent “wall wash” (the illumination of the side or façade of a building).

So far, the discussion above has been on exterior fixtures; however interior lighting is also a source of “light pollution.”

The criteria for identifying problems caused by indoor lighting are the same as those for identifying problems caused by outdoor lighting... [As with an outdoor light, an] indoor light is a problem if it is visible from the beach.

Indoor lighting from buildings that are close to the beach, are very tall, or have large sea-side windows causes the greatest problem for sea turtles. Because indoor lighting is usually not meant to light the outdoors, the unwanted effects of indoor lighting can easily be eliminated without compromising the intended function of the light (Witherington and Martin, 2003, p. 22).

In truth, the Fairmont Royal Pavilion does not have direct control over which room lights are utilized by guests. However, indoor lights be can minimized from reaching the beach by simply informing and reminding guests to close opaque curtains during evening hours when room lights are on.

The hotel does have direct control over almost all other fixtures, which cast light onto or visible from the beach. It is these fixtures that make up the bulk of this assessment.

In the sections that follow I provide specific recommendations for mitigation of these fixtures, and detail my methods and results. If constraints hinder the implementation of particular recommendations, one option is that effective action be taken in high priority cases (Rank “3” lights, see METHODS) and that lower priority actions be budgeted over time. In general, and in keeping with the decisions of the 2000 “Sea Turtles and Beachfront Lighting” workshop, recommendations are based on best practices and current science as articulated by Witherington and Martin (2003).

**METHODS**

**Daytime Lighting Survey**

A baseline daytime lighting survey was conducted on foot on 3 June 2006 by observing lighting fixtures and bulbs directly visible from the beach. The entire property was accessed to clarify, identify, and/or count particular fixture(s). All exterior lights within line-of-sight of the observer [John English Knowles] were described with respect to fixture type and location. The function of lights was deduced by the observer; however, subsequent meetings with hotel management staff insured that the correct functionality was documented in each case. Light fixtures with lamps (light bulbs) visible from the beach and those that were designed or positioned so that they would likely illuminate the beach were considered to be potentially problematic.

**Nighttime Lighting Survey**

In coordination with hotel management, a nighttime lighting survey was conducted on foot on 23 July 2006. During the nighttime survey, each light identified in the daytime survey was located and evaluated with respect to its potential effect on sea turtles. Lights unseen during the day, but visible when emitting light, were also evaluated. Each light was rated and ranked on a scale of 1 to 3.
The Lights

Following are the surveyed lights listed from the most disruptive (Rank 3) to the least disruptive (Rank 1) for marine turtles. A rank of “1” describes indirect light visible by an observer on the beach, but not likely to present a strong attraction to nesting or hatching turtles. A rank of “2” describes a visible globe, glowing element, lamp, or reflector likely to disorient turtles, but not strong enough to cast a shadow on the beach. And a rank of “3” describes a light source strong enough to cast a shadow on the beach regardless of whether the illumination is direct or indirect.

Even the smallest lights can rank as a “3” if they cast a shadow on the beach; their close proximity to the beach and their low vertical placement near the horizon can be just as disorientating as a more powerful light further away. The “3” ranking lights have been placed first in the assessment because of their potentially more serious effects on marine turtles. The focus of corrective actions should begin with these lights, as their mitigation will have the most significant impact on the beach environment.

Within each rank – 1, 2, 3 – fixtures listed first are expected to require the greatest attention either in number, expense, or creativity. The list continues through fixtures that are progressively simpler and/or cheaper to mitigate. For each light the number of fixtures visible from the beach, the fixture type, location, rank, comments (if any), function, picture and recommendations are documented. Each recommendation is specific to an individual light, and may include one or many explanatory remarks. Some recommendations will pertain to mitigating the current fixture; others will suggest the replacement of a fixture with an alternative.

Recommendations are illustrated by the following:

Permanently eliminate fixture. Some cases are specific to the number or location of the fixtures.

Reposition fixture to the landward side of the tree or object.

Aim fixture away from the beach.

Replace existing fixture with a more directed and functional path light, and re-position it to eliminate any direct (or indirect) illumination of the beach.

Install low wattage (40 watts or less) yellow bug light bulb.

Install compact fluorescent Turtle Safe Lighting lamps (light bulbs). See INTERNET RESOURCES.
Replace existing fixture with a more directed, more functional downlight.

Replace existing fixture with a more directed, more functional step light positioned to eliminate any direct (or indirect) illumination of the beach.

Reduce intensity of light or lower wattage.

Plant, landscape, or improve native vegetation buffer to eliminate or screen any direct (or indirect) illumination of the beach.

Install hood, aim away from beach, and connect fixture to a motion detector.

Keep lights off when not in use, especially lights closest to the beach. Inform guests via table tents, door hangers, or other educational materials about fixtures under their control.

Install shield or mask of sufficient size that covers an arch of 180° on the ocean side.

Shade arches.
Install a Hubbell Skycap or similar shield.

For security, install a motion detector so it only comes on when somebody is on the beach (motion detectors can be designed to be engaged or disengaged).

Eliminate fixtures and use low table lamps (such as Aurelle LED Candle Series or Maxxima MLC-01 LED Flameless Candle) or candles. This would serve the purpose of illuminating the tables without unintended broadcast beyond the restaurant.
Rank: 3  
Light Location: Coconut palm at Water Sports Centre at southern end of property  
Number of fixtures: 2  
Comments: Currently, the light is directed toward the boat ramp and steps. A better alternative in illuminating the steps would be to install small red foot/step lights. These lights should be connected to a motion detector so they only come on when needed. If lights are needed for security, then low-profile, louvered bollards with beach-side shields could be used. To minimize the effects of these lights on sea turtles, they should be connected to a motion detector and either low-pressure sodium vapor lamps or yellow bug light bulbs should be used.  
Recommendations:
Rank: 3
Light Location: Roof Water Sports Centre
Number of fixtures: 2
Recommendations:
Rank: 3
Light Location: North beach by vendor stalls
Number of fixtures: 1
Recommendations:
Rank: 3
Light Location: Palm Terrace Restaurant
Number of fixtures: 21 smaller spotlights, 4 larger spotlights for stage of which 2 are orange and 2 are white
Comments: The restaurant presents a unique challenge because it is directly on the beach. Using wall-mounted downlights, step lights, and/or other directional fixtures in combination with low-level small table lights can minimize the amount of light leaving the restaurant. The downlights should be mounted low enough so that they do not illuminate the beach. Vegetation can also be planted inside the arches in such a way as to limit the amount of light passing through them, but not obstructing the view of seated guests. In addition, some fixtures do contribute to “wall wash.” It should be noted that “wall wash” from a yellow or red light is much less disruptive than “wall wash” from a white light. Therefore, to further minimize the detrimental effects to sea turtles, yellow bug light bulbs or Turtle Friendly Lighting lamps may be used. By following these recommendations neither the dining experience of Royal Pavilion guests nor the behavior of sea turtle hatchlings should be compromised.

Recommendations on existing fixtures:

Ultimate recommendation:
Suggested landscaping of arches:
Rank: 3  
Light Location: Café Taboras  
Number of fixtures: 6  
Comments: Café Taboras presents a unique case that can be easily mitigated. The current lights are a source of direct light on the beach and their replacement with a modern alternative is highly recommended. A fixture that shields the light bulb from the beach as well as customers is preferred over the existing bare bulb lights. The current fixture could be made turtle friendly by replacing the glass chimneys with an opaque one, concealing the bulb. Earthworks could possibly design such a fixture thereby increasing the quality of the beach, the restaurant, and supporting the local economy.  
Recommendations on existing fixtures:  

Ultimate recommendation:
Rank: 3 – period light, 3 - shell sconce light

Light Location: First, Second, and Third Floor Balconies of North and South buildings

Number of fixtures: 138

Comments: Until the installation of turtle friendly fixtures, the detrimental effects of the light can be reduced by shielding or tinting of glass on the current fixtures. However, this probably will not completely eliminate direct illumination of the beach. Because the shell sconce shields the bare bulb from the beach, it is preferred to the period light. However, considerable light from the sconce is reflected off the balcony wall towards the beach. It is recommended that the current bulb be replaced with a low-wattage yellow bug light bulb or Turtle Safe Lighting lamp. Small portable book lights can be placed in every room for guests that prefer to read on the balconies at night.

Recommendations on the existing fixtures, especially the period light:
Rank: 3
Light Location: Cafe Taboras
Number of fixtures: 13
Recommendations:
Rank: 3  
Light Location: North beach  
Number of fixtures: 10  

Comments: The best option is to eliminate the light, either by turning them all off or removing the fixtures. If the purpose of the light is to illuminate dining or entertainment events, then having them on for short durations on random nights is better than having them on all the time. If the lights are not needed for an event, then it is recommended that they are turned off. If all lights cannot be removed or turned off, then it is recommended that the number of lights (currently 10) and wattage of each lamp be reduced. The installation of yellow bug light bulbs is also recommended and a Turtle friendly CF PAR-38 snap-on filter is available (See INTERNET RESOURCES).

Recommendations on the number of fixtures:

Recommendations on existing or remaining fixtures:

Snap-on red filter to be used with CF PAR-38 (picture from http://www.turtlesafelighting.com/TurtleSafe%201.0/mainframe.html)

Yellow PAR-38 Bug Lamp (picture from http://www.doityourself.com/invt/1063239)
Rank: 3  
Light Location: North beach  
Number of fixtures: 1  
Comments: The best recommendation and preferred option is to eliminate the light. If the purpose of the light is to illuminate dining or entertainment, then it should be shielded and turned off when not needed. If the purpose of the light is to illuminate the beach so that security can view potential trespassers, then a more effective and economical means might be to install a motion detector so that security is alerted when someone approaches the hotel. Security personnel can always use flashlights to illuminate any section of beach when they prefer.

Recommendations on existing fixture:

Ultimate recommendation:
Rank: 3
Light Location: Two spotlights at base of coconut palm aimed up, one spotlight mounted in coconut palm aimed down at beach within “garden area” in front of Palm Terrace Restaurant
Number of fixtures: 3
Comments: The down positioned coconut palm mounted light is casting a great deal of direct light on the beach and of the three spotlights would be the most disruptive to the sea finding behavior of hatchlings. The best recommendation is its elimination. The other two spotlights at the base of the coconut palm should also be eliminated.
Recommendations:
Rank: 3
Light Location: Mounted on one coconut palm, the other is mounted on the mahogany between Café Taboras and south building
Number of fixtures: 2
Comments: A common recommendation to correct lighting problems is lower light below a point that is not visible from the beach. In this situation, the purpose of the lights is to illuminate the terrace/patio of Café Taboras. This can be done without high mounted tree fixtures, which increase stray light reaching the beach. A more preferred alternative is to lower lights and place them behind an opaque object. This can be accomplished here by placing lights on the landward side of wall. Landscaped vegetation can also be advantageous in ensuring that little light as possible reaches the beach. Lowering lights behind opaque objects and vegetation increases the quality of the environment for both the hatchlings on the beach and dinning guests on the terrace. This way the purpose of the lights has not been compromised.
Recommendations:
Rank: **Off at the time of assessment** – Fixture closest to beach, 2 - Fixture set further back

**Light Location:** Coconut palms just south of north building

**Number:** 2

**Comments:** Of the two lights, the one that would be most disruptive to the sea finding behavior of hatchlings is the one closest to the beach. Eliminating the light closest to the sea or keeping it off is the best recommendation. The other light should be redirected and repositioned away from the beach.

**Recommendations:**

![Switch off the closest fixture to the beach](image)
The effort of the Fairmont Royal Pavilion does not go unnoticed in their never ending quest for improvements. The hotel constantly strives for a more suitable beach environment, which only increases its quality as a luxury resort. The Fairmont Royal Pavilion is praised for supporting umbrellas with a flat base instead of spiking the post directly into the sand. This and the continued effort to stack beach chairs will ensure that nests are not damaged and mother turtles are not obstructed from crawling along the beach. Another obvious consideration in seaside ambience is the hooding of beachfront spotlights. Such a fixture will reduce glare and improve the night sky for guests.

However, the impact of almost all evaluated lights, including the spotlights, is compounded for two reasons. First, the Fairmont Royal Pavilion beach side property is elongated. Second, this elongated edge of the property is directly on top of the coastline with little or no set back. In this particular situation even a small bulb is problematic and is why nearly all fixtures are categorized as most disruptive to marine turtles (Rank 3).

Even with a hood, a spotlight directly on the beach can cause an egg-bearing female to turn away from suitable nesting habitat. This might result in the turtle laying her clutch in a sub optimal area somewhere else down the beach.

In addition, a beach centered spotlight can cause extreme disorientation to hatchlings, preventing them from ever reaching the sea. In many cases, misdirected hatchlings are eaten by crabs or die from heat exposure the following morning.

The cumulative effect of multiple balcony lights has an even greater impact on marine turtles. It is highly recommended that a modern alternative is installed on beach front balconies. But even with turtle-friendly fixtures, balcony lights should be kept off when not in use.

The two restaurants also pose a challenge in reducing light pollution, since they too sit directly on the beach. The solution must meet the needs of dining guests and marine turtles, since the restaurant’s operation overlaps with the emergence of most hatchlings.

The circumstances present at the restaurant will require creativity and a clear understanding of light pollution mitigation that this assessment hopes to cultivate. One recommendation is to incorporate landscaping or vegetation into a turtle friendly lighting scheme. In this case, it would be important to ensure that the vegetation is not illuminated in such a way that is visible from the beach.

The recommendations, once implemented, will not only improve beach conditions for marine turtles, but will contribute to the existing sophisticated theme in lighting ambiance of this resort while reducing operational expenses through an expectation of lower energy use. To encourage lighting improvements and assist in implementation, the Tourism Development Corporation is available to purchase items (fixtures, CF bug lights) in bulk, which will further reduce the cost of retrofitting and innovation.

The Fairmont Royal Pavilion plays an essential role in the survival of the endangered turtles that use its beaches, and is well positioned to serve as a model for sea turtle friendly environmental management systems elsewhere in Barbados and beyond.

INTERNET RESOURCES

Turtle safe lighting products

www.turtlesafelighting.com

http://www.turtlesafelighting.com/TurtleSafe%201.0/product%20sheets/SnapOnFilter.pdf
Turtle friendly fixture


CF PAR 38

http://www.prismaecat.lighting.philips.com/LightSite/Whirlwind.asp?eca=LNPPLA&cpf=USNPUS&stg=ACT&lan=US&ecu=LMP%7cPLC%7cNP&cnt_key=CI_PAR38%7cPLC&t=1&tree=0&ser_md=1111&nav_key=1885&nav=Null&loc=us_en&leftnav=1_1_4_1_4

http://genet.gelighting.com/LightProducts/Dispatcher?REQUEST=CONSUMERSPECPAGE&PRODUCTCODE=21739


PAR 38 bug light

http://genet.gelighting.com/LightProducts/Dispatcher?REQUEST=CONSUMERSPECPAGE&PRODUCTCODE=20945

LITERATURE CITED


ACKNOWLEDGMENTS

I am deeply indebted to the staff and management of the Fairmont Royal Pavilion, including Nicholas Emery, General Manager and Andre Berube, Chief Engineer for their collaboration in this assessment. They were extraordinarily kind in accommodating my requests, which often involved their working off-hours, including late at night. Equally important, the assessment would not have been possible without the foresight and financial support of the Tourism Development Corporation of Barbados. I would also like to recognize the tireless efforts of the Barbados Sea Turtle Project, especially Dr. Julia Horrocks, Barry Krueger and their 2006 seasonal staff. The professional work of the BSTP has set a high standard for research and conservation in Barbados and throughout the Caribbean region. Without their collaboration, including providing me with housing, training, access to data and other technical information, and the opportunity to contribute to their important field work, which has been professionally and personally enriching for me, this lighting assessment could not have been accomplished. Finally, I am grateful to Dr. Karen Eckert, Executive Director of WIDECAST and my academic advisor at Duke University’s Nicholas School of the Environment, for her encouragement of my efforts and her leadership in Caribbean sea turtle conservation issues in general, and to Erik Martin of Ecological Associates, Inc. for his kindness and
patience in training me in the protocols of professional beachfront lighting assessments, a field in which he is well-recognized.
Appendix VII – Sandy Lane property map
Appendix VIII – Sandy Lane assessment report
National Assessment of Beachfront Lighting and its Effect on the Survival of Endangered Marine Turtles in Barbados, West Indies

Property Assessment:
SANDY LANE

Respectfully submitted
John English Knowles
INTRODUCTION

In partnership with the Barbados Sea Turtle Project (BSTP), local affiliate of the Wider Caribbean Sea Turtle Conservation Network (WIDECAST), and the Tourism Development Corporation in Barbados, a formal lighting assessment was conducted at Sandy Lane as part of a follow-up initiative to implement recommendations made at a national “Sea Turtles and Beachfront Lighting” workshop held in 2000 (Eckert and Horrocks, 2002).

The evaluation of lighting associated with the Sandy Lane property attests to the efforts and dedication of the hotel industry and the BSTP in improving the conditions of artificial beach lighting, which is well known to be detrimental to both hatchlings and nesting sea turtles (Eckert and Horrocks, 2002).

Sandy Lane has identified itself as a leader in addressing the lighting problem by voluntarily participating in this assessment. The property – along with four (4) other beachfront hotels – was chosen because it plays a crucial role in the quality of sea turtle nesting habitat. The intent of the lighting assessment was to evaluate current conditions, and to propose solutions and recommendations for each light identified as contributing to the nocturnal illumination of the nesting beach.

The attention of such work is critical in the survival of the hawksbill sea turtle, *Eretmochelys imbricata*, a critically endangered species worldwide (cf. IUCN RedList). Barbados plays a very important role in the survival of this species, its southwest coast having been identified as one of the most important nesting grounds remaining in the Wider Caribbean Region.

Artificial beachfront lighting, characterized as “light pollution” by Witherington and Martin (2003, p. V), is the most serious contemporary threat to the survival of sea turtles in Barbados (Eckert and Horrocks, 2002). Marine turtles are most sensitive to shorter wavelengths (blues and greens), which they use as a sea-finding cue. Shorter wavelengths are also emitted by white light.

When such lights are visible from the beach, the effect is tremendous.

Witherington and Martin (2003) suggest the following approach to mitigate “light pollution” by either eliminating the fixture or by adjusting wavelength or intensity:

We have no reliable formula that can be used to calculate how much each light source will affect sea turtles. We do know, however, that if spectral emissions are equivalent, reducing intensity will reduce effects, and if intensities are similar, substituting less attractive sources (like yellow bug or red lights) will also reduce effects. A sound strategy, therefore, would be to reduce effects on sea turtles by manipulation both intensity and color. As few lights as practicable should be used, and for lighting deemed essential, long wavelength light sources should replace more disruptive light sources and intensity should be reduced by using lamps of minimal wattage that are housed within well-directed fixtures aimed down and away from the beach (p. 23).

In point, direct light on the beach can be highly disruptive to both adult turtles and hatchlings, and eliminating sources of direct light reaching the beach is preferred over all other conservation alternatives (Witherington and Martin, 2003). In circumstances where eliminating light sources – either by turning them off or by removing the fixtures all together – is not practical, several alternatives are available which direct light more efficiently and/or shield the source from the beach. Many of these modern fixtures also prevent “wall wash” (the illumination of the side or façade of a building) and are highly recommended over fixtures that expose a bare bulb to the beachfront.

In the case of decorative lighting, which “has limited use for any purpose other than aesthetic enhancement [and when] near
nesteing beaches may be much more harmful to sea turtles than it is useful to people” (Witherington and Martin, 2003, p. 20-21), mitigation is limited. For example, even if the four high-intensity blue flood lights currently positioned along the beach-face of the hotel could be altered to emit the wavelengths least disruptive to sea turtles (red), there would still most likely be detrimental effects. This goes without mentioning the impracticality of such bright oceanfront lights that effect beach zones beyond the Sandy Lane property. (Witherington and Martin, 2003; J.E.K., personal observation)

In the sections that follow I will detail my methods and results, and provide specific recommendations for mitigation. If constraints hinder the implementation of particular recommendations, one option is that effective action be taken in high priority cases (Rank “3” lights, see METHODS) and that lower priority actions be budgeted over time. In general, and in keeping with the decisions of the 2000 “Sea Turtles and Beachfront Lighting” workshop, recommendations are based on best practices and current science as articulated by Witherington and Martin (2003).

**METHODS**

**Daytime Lighting Survey**

A baseline daytime lighting survey was conducted on foot on 23 July 2006 by observing lighting fixtures and bulbs directly visible from the beach. The entire property was accessed to clarify, identify, and/or count particular fixture(s). All exterior lights within line-of-sight of the observer [John English Knowles] were described with respect to fixture type and location. The function of lights was deduced by the observer; however, subsequent meetings with hotel management staff insured that the correct functionality was documented in each case. Light fixtures with lamps (light bulbs) visible from the beach and those that were designed or positioned so that they would likely illuminate the beach were considered to be potentially problematic.

**Nighttime Lighting Survey**

In coordination with hotel management, a nighttime lighting survey was conducted on foot on 23 July 2006. During the nighttime survey, each light identified in the daytime survey was located and evaluated with respect to its potential effect on sea turtles. Lights unseen during the day, but visible when emitting light, were also evaluated. Each light was rated and ranked on a scale of 1 to 3.

The nighttime survey involved two inspections, one before midnight and one after midnight, allowing for an accurate ranking of each individual light source in the context of changing background illumination of different lighting conditions and intensities throughout the night. Because particularly bright lights lessen the degree or the actual brightness of the lights behind them, and because some lights are extinguished late at night under normal operating procedure, the observer was able to use the sequential inspections to more accurately characterize those lights that remained.

**The Lights**

Following are the surveyed lights listed from the most disruptive (Rank 3) to the least disruptive (Rank 1) for marine turtles. A rank of “1” describes indirect light visible by an observer on the beach, but not likely to present a strong attraction to nesting or hatching turtles. A rank of “2” describes a visible globe, glowing element, lamp, or reflector likely to disorient turtles, but not strong enough to cast a shadow on the beach. And a rank of “3” describes a light source strong enough to cast a shadow on the beach regardless of whether the illumination is direct or indirect.
Even the smallest lights can rank as a “3” if they cast a shadow on the beach; their close proximity to the beach and their low vertical placement near the horizon can be just as disorientating as a more powerful light further away. The “3” ranking lights have been placed first in the assessment because of their potentially more serious effects on marine turtles. The focus of corrective actions should begin with these lights, as their mitigation will have the most significant impact on the beach environment.

Within each rank – 1, 2, 3 – fixtures listed first are expected to require the greatest attention either in number, expense, or creativity. The list continues through fixtures that are progressively simpler and/or cheaper to mitigate. For each light the number of fixtures visible from the beach, the fixture type, location, rank, comments (if any), function, picture and recommendations are documented. Each recommendation is specific to an individual light, and may include one or many explanatory remarks. Some recommendations will pertain to mitigating the current fixture; others will suggest the replacement of a fixture with an alternative.

Recommendations are illustrated by the following:

- **Permanently eliminate fixture.** Some cases are specific to the number or location of the fixtures.

- **Reposition fixture to the landward side of the tree or object.**

- **Aim fixture away from the beach.**

- **Install low wattage (50 watts or less) yellow bug light bulb.**

- **Install hood of sufficient depth and width.**

- **Reduce intensity of light or lower wattage.**

- **Shield seaward side of fixtures that are visible from the beach.**
Keep lights off when not in use, especially lights closest to the beach. Inform guests via table tents, door hangers, or other educational materials about fixtures under their control.

Install shield or mask of sufficient size that covers an arch of 180° on the ocean side.

Position lip over rope lighting to conceal bare bulbs.

Replace existing fixture with a more directed, more functional step light positioned to eliminate any direct (or indirect) illumination of the beach.

Remove when not in use.

Extinguish when not in use.

Replace existing fixture with a more directed, more functional downlight.
Replace existing fixture with a more directed and functional path light, and re-position it to eliminate any direct (or indirect) illumination of the beach.

Install compact fluorescent *Turtle Safe Lighting* lamps (light bulbs). See [INTERNET RESOURCES](#).

Install red LED bulb.

**RED**

**L.E.D.**

Use dimmer to lessen the effect of indirect light leaving the dining area.

Eliminate fixtures and use low table lamps (such as Aurelle LED Candle Series or Maxxima MLC-01 LED Flameless Candle) or candles. This would serve the purpose of illuminating the table without unintended broadcast beyond the restaurant.

Place small lamp shade over bare bulbs to prevent their visibility from the beach.

Cap or cover top of fixture to prevent up-lighting and “wall wash.”

Install red filter.
Rank: 3
Number of fixtures: 4
Light Location: Trees (some manchineel) along beach front
Comments: These high intensity, blue floodlights are extremely disruptive to the sea finding behavior of marine turtles, so much so that they can attract hatchlings from the ocean, which entered the water from darker stretches of the beach (personal observation, JEK). Keep off during the nesting/hatching season (May – November).

Recommendations: 

Very large tree mounted floodlight
**Rank:** 3

**Number of fixtures:** 14

**Light Location:** Beachside trees along property

**Comments:** For purposes of illuminating walking paths, low profile lights, such as path lights, are recommended over higher mounted spotlights.

**Recommendations on the number of fixtures:**

- **All Fixtures**
- **Some Fixtures**

**Recommendations on existing or remaining fixtures:**

- Seaward
- Landward
- ≤50W
- **On**
- **Off**

**Ultimate recommendation:**

---

Tree mounted hooded spotlight
Rank: 3
Length of rope lighting: 233 meters
Light Location: Along beachside wall
Comments: Although less intense than some floodlights, tiny white lights that are low to the horizon present a real obstacle to hatchlings, especially on dark nights. Even a short strip can emit enough light on the landward side to lead hatchlings astray.
Recommendation on location of rope lighting:

Recommendation for existing fixtures:

Replacement Recommendation
Rank: 3
Number of fixture: 7
Light Location: Tree on north end of property (in picture), tree near the north gazebo, Bajan Blue Restaurant tree
Comments: These lights are used on special occasions. Installing a hood over the bulbs will increase the aesthetics for guests as well as direct light in a more efficient manner.
Recommendations:
Large torch with open flame

Rank: 3
Number of fixtures: 2
Light Location: On beach, center property
Recommendations:

Tree mounted hooded spotlight

Rank: 2
Number of fixtures: 2
Light Location: Trees in lower terrace
Recommendations:
Wall mounted candle holding fixture

**Rank:** 2  
**Number of fixtures:** 176  
**Light Location:** Balconies of north and south wings  
**Recommendations for existing fixtures:**

- ≤50W

**Ultimate recommendation:**
Rank: 2
Number of fixtures: 20
Light Location: Bajan Blue Restaurant
Comments: Even though these rank as moderate for potentially disrupting the sea finding behavior of marine turtles, these lights cause significant broadcast of indirect light. Bouncing light off the umbrella does illuminate the dining area, but also bounces light in many other directions, including the beach. Highly directed low profile lights should be used in the illumination of a beach front dining area.
Recommendations for existing fixtures:

Ultimate recommendation:
Rank: 2
Number of fixtures: 14
Light Location: Bajan Blue Restaurant
Comments: Bajan Blue Restaurant presents a unique case that can be easily mitigated. The current lights are a source of direct light and their replacement with a modern alternative is highly recommended. A fixture that shields the light bulb from the beach as well as restaurant guests is preferred over the existing bare bulb lights for both marine turtles and the restaurant environment.
Recommendations:
Rank: 2
Number of fixtures: 16
Light Location: Grass area in front of first floor rooms for both the north and south wings
Comments: “Luminaires should not be directed onto…any object visible from the beach” (Witherington). Glowing beachfront vegetation is highly disruptive to the sea finding behavior of hatchlings especially on moonless nights. It is recommended that such “aesthetics” are not employed directly beach front.
Recommendations on the number of fixtures:

Recommendations on existing or remaining fixtures:

Ultimate recommendation:
Wall mounted candle light

Rank: 2
Number of fixtures: 2
Light Location: Upper terrace just outside lobby
Recommendations:

Wall mounted wick

Rank: 2
Number of fixtures: 28
Light Location: L’acajou
Recommendations:

Examples of acceptable fixtures:
Recessed step lights

**Rank:** 2  
**Number of fixtures:** 52  
**Light Location:** Terrace stairway  
**Comments:** Use red light  
**Recommendations:**

---

One chandelier fixture, but three bulbs

**Rank:** 2  
**Number of fixtures:** 1 chandelier fixture, but 3 bulbs  
**Light Location:** Lobby  
**Comments:** It is important to conceal sources of direct light.  
**Recommendations:**
Ceiling mounted spotlight over front desk

**Rank:** 2  
**Number of fixtures:** 2  
**Light Location:** Lobby  
**Recommendations:**

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Small ceiling mounted spotlight in restaurant

**Rank:** 2  
**Number of fixtures:** 11  
**Light Location:** Bajan Blue Restaurant  
**Recommendations:**
Rank: 2
Number of fixtures: 13
Light Location: On beach, in front of Bajan Blue Restaurant, Lower terrace.
Recommendations:
Rank: 1
Number of fixtures: 344
Light Location: Balconies
Comments: The balcony rooms at Sandy Lane have three different types of fixtures present on each balcony. The candle type fixtures have the greatest potential to disrupt the sea finding behavior of marine turtles. If these fixtures are replaced with a modern turtle friendly alternative, then they become least problematic. The second categories of lights are the lamps, which are minimally disruptive. Finally, the up lights are moderately disruptive because of "wall washing", even though the bulb is concealed. This is why down lights are always recommended over up lights. To mitigate the effects on marine turtles, the current fixtures could be installed with bug lights or turtle friendly lamps. The wattage could also be lowered. However, with adequate lighting already present, the elimination of the up lights on beach front balconies is an option.

Recommendations on the existing fixtures:

Ultimate recommendation when adequate lighting is already provided:
Rank: 1
Number of fixtures: 18
Light Location: Upper and lower terrace
Recommendations:
≤50W

Wall mounted clay covered fixture

Bottom view
Rank: 1
Number of fixtures: 13
Light Location: Lower terrace (below trees in natural area)
Recommendations on the number of fixtures:

Recommendations on existing or remaining fixtures:

Ultimate recommendation:
Ground recessed spotlight

**Rank:** 1  
**Number of fixtures:** 10  
**Light Location:** Beachside grassy areas  
**Comments:** “Luminares should not be directed onto…any object visible from the beach” (Witherington). Glowing beachfront vegetation is highly disruptive to the sea finding behavior of hatchlings especially on moonless nights. It is recommended that such “aesthetics” are not employed directly beach front.

**Recommendations on the number of fixtures:**

**Recommendations on existing or remaining fixtures:**

**Ultimate recommendation:**
Rank: 1
Number of fixtures: 75
Light Location: Present on the balconies of the north and south wings
Recommendations:

≤50W
Rank: 1
Number of fixtures: 4
Light Location: Upper and lower terrace
Comments: Fixture does contribute to “wall wash”. A down light is preferred over an up light. The elimination of the fixture is always an option with adequate lighting already present.
Recommendations on the existing fixtures:

Ultimate recommendation when adequate lighting is already provided:

Rank: 1
Number of fixtures: 6
Light Location: Lower Terrace
Comments: Fixture does contribute to “wall wash”. A down light is preferred over an up light. The elimination of the fixture is always an option with adequate lighting already present.
Recommendations on the existing fixtures:

Ultimate recommendation when adequate lighting is already provided:
Recessed ceiling light in restaurant

Rank: 1
Number of fixtures: 70
Light Location: Bajan Blue Restaurant
Comments: Not all fixtures are visible from beach.
Recommendations:

Small circular recessed ceiling light

Rank: 1
Number of fixtures: 59
Light Location: Ceiling of stairwell in north wing and third floor of both north and south wings
Comments: Not all fixtures are visible from beach.
Recommendations:
**Recessed ceiling spotlight in square fixture**

*Rank:* 1  
*Number of fixtures:* 55  
*Light Location:* Ceiling of L’acajou Restaurant  
*Comments:* Not all fixtures are visible from the beach.  
*Recommendations:*  

**Larger circular recessed light**

*Rank:* 1  
*Number of fixtures:* 21  
*Light Location:* Ceiling of owner’s penthouse  
*Comments:* Not all fixtures are visible from beach.  
*Recommendations:*
Largest recessed ceiling light in lobby

Rank: 1
Number of fixtures: 6
Light Location: Lobby
Comments: Not all fixtures are visible from beach. The number given is of fixtures that are visible from the beach
Recommendations:

Recessed ceiling spotlights

Rank: 1
Number of fixtures: 24
Light Location: Ceiling of both gazebos
Comments: Gazebo employees claim lights are too hot!
Recommendations:
Floodlight

Rank: 1
Number of fixtures: 2
Light Location: Above rafters of both gazebos

Recommendations:

Chandelier

Rank: 1
Number of fixtures: 5
Light Location: Lower terrace
Comments: Not all fixtures are visible from the beach.
Recommendations:
Rank: 1
Number of fixtures: 2
Light Location: North wing fountain
Recommendations:

Under water recessed spotlight at the base of the fountain
SUMMARY

As a premier luxury establishment, it is not coincidental that most of the lights at Sandy Lane rank comparatively low in terms of their potential to disrupt and disorient endangered marine turtles. The majority of fixtures conceal the actual luminaire or bulb. A bare bulb can be jarring and garish for humans and sea turtles alike, but the majority of the conditions at Sandy Lane are nothing less than very pleasing. The atmosphere of low light levels and tasteful fixtures only enhances the tourism experience one receives at Sandy Lane, and the resort is commended for such architectural design and consideration. Sandy Lane also contributes directly to the survival of marine turtles in other ways, including stacking beach chairs at night, in an effort to prevent the entanglement of egg-bearing female turtles crawling on the beach.

That said, the relatively few lights that rank as most disruptive to marine turtles (Rank 3) do so at very high and disturbing intensities. It is hoped that by acting on these fixtures – mostly tree-mounted spotlights and string lighting along the beachfront – as a priority, this evaluation will improve the conditions of the beach environment for both the guests at Sandy Lane and the marine turtles that rely on the beach for the successful incubation of their young. The improvements will only increase Sandy Lane’s quality, providing it yet another competitive edge against other privately owned, luxury hotels in the Caribbean and around the world.

The recommendations, once implemented, will not only improve beach conditions for marine turtles, but will contribute to the existing sophisticated theme in lighting ambiance of this resort while reducing operational expenses through an expectation of lower energy use. To encourage lighting improvements and assist in implementation, the Tourism Development Corporation is available to purchase items (fixtures, CF bug lights) in bulk, which will further reduce the cost of retrofitting and innovation.

Along with an improved beachfront in terms of lighting comes a parallel responsibility for conservation-minded beachfront management in general, including, for example, supporting umbrellas with a flat base instead of staking the post directly into the sand and clearing leaves with a hand rake rather than a tractor. Sandy Lane plays an essential role in the survival of the endangered turtles that use its beaches, and is well positioned to serve as a model for sea turtle friendly environmental management systems elsewhere in Barbados and beyond.

INTERNET RESOURCES

www.turtlesafelighting.com

LITERATURE CITED


ACKNOWLEDGMENTS

I am deeply indebted to the staff and management of Sandy Lane, including Michael Pownall, Chief Executive Officer, Paula Yarde, Chief Engineer, Lawrence Cumberbatch, Director of Engineering, and Leo Blackman and the rest of the engineering department for their collaboration in this assessment. They were extraordinarily kind in accommodating my requests, which often involved their working off-hours, including late at night. Equally important, the assessment would not have been possible without the foresight and financial support of the Tourism Development Corporation of Barbados. I would also like to recognize the tireless efforts of the Barbados Sea Turtle Project, especially Dr. Julia Horrocks, Barry Krueger and their 2006 seasonal staff. The professional work of the BSTP has set a high standard for research and conservation in Barbados and throughout the Caribbean region. Without their collaboration, including providing me with housing, training, access to data and other technical information, and the opportunity to contribute to their important field work, which has been professionally and personally enriching for me, this lighting assessment could not have been accomplished. Finally, I am grateful to Dr. Karen Eckert, Executive Director of WIDECAST and my academic advisor at Duke University’s Nicholas School of the Environment, for her encouragement of my efforts and her leadership in Caribbean sea turtle conservation issues in general, and to Erik Martin of Ecological Associates, Inc. for his kindness and patience in training me in the protocols of professional beachfront lighting assessments, a field in which he is well-recognized.
Appendix IX – Turtle Beach Resort property map
Appendix X – Turtle Beach Resort assessment report
National Assessment of Beachfront Lighting and its Effect on the Survival of Endangered Marine Turtles in Barbados, West Indies

Property Assessment:

Turtle Beach Resort

Respectfully submitted
John English Knowles
INTRODUCTION

In partnership with the Barbados Sea Turtle Project (BSTP), local affiliate of the Wider Caribbean Sea Turtle Conservation Network (WIDECAST), and the Tourism Development Corporation in Barbados, a formal lighting assessment was conducted at the Turtle Beach Resort as part of a follow-up initiative to implement recommendations made at a national “Sea Turtles and Beachfront Lighting” workshop held in 2000 (Eckert and Horrocks, 2002).

The evaluation of lighting associated with the Turtle Beach Resort property attests to the efforts and dedication of the hotel industry and the BSTP in improving the conditions of artificial beach lighting, which is well known to be detrimental to both hatchlings and nesting sea turtles (Eckert and Horrocks, 2002).

Turtle Beach Resort has identified itself as a leader in addressing the lighting problem by voluntarily participating in this assessment. The property – along with four (4) other beachfront hotels – was chosen because it plays a crucial role in the quality of sea turtle nesting habitat. The intent of the lighting assessment was to evaluate current conditions, and to propose solutions and recommendations for each light identified as contributing to the nocturnal illumination of the nesting beach.

The attention of such work is critical in the survival of the hawksbill sea turtle, *Eretmochelys imbricata*, a critically endangered species worldwide (cf. IUCN RedList). Barbados plays a very important role in the survival of this species, its southwest coast having been identified as one of the most important nesting grounds remaining in the Wider Caribbean Region.

Artificial beachfront lighting, characterized as “light pollution” by Witherington and Martin (2003, p. V), is the most serious contemporary threat to the survival of sea turtles in Barbados (Eckert and Horrocks, 2002). Marine turtles are most sensitive to shorter wavelengths (blues and greens), which they use as a sea-finding cue. Shorter wavelengths are also emitted by white light.

When such lights are visible from the beach, the effect is tremendous.

Witherington and Martin (2003) suggest the following approach to mitigate “light pollution” by either eliminating the fixture or by adjusting wavelength or intensity:

We have no reliable formula that can be used to calculate how much each light source will affect sea turtles. We do know, however, that if spectral emissions are equivalent, reducing intensity will reduce effects, and if intensities are similar, substituting less attractive sources (like yellow bug or red lights) will also reduce effects. A sound strategy, therefore, would be to reduce effects on sea turtles by manipulation both intensity and color. As few lights as practicable should be used, and for lighting deemed essential, long wavelength light sources should replace more disruptive light sources and intensity should be reduced by using lamps of minimal wattage that are housed within well-directed fixtures aimed down and away from the beach (p. 23).

In point, direct light on the beach can be highly disruptive to both adult turtles and hatchlings and, eliminating sources of direct light reaching the beach is preferred over all other conservation alternatives (Witherington and Martin, 2003). In circumstances where eliminating light sources – either by turning them off or by removing the fixtures all together – is not practical, several alternatives are available which direct light more efficiently and/or shield the source from the beach.

Similarly, indirect lighting is also highly disruptive. Witherington and Martin reiterate that, “luminaires should not be directed onto…any object visible from the beach,” this includes walls, ceilings, and vegetation (p. 21). A form of intentional indirect lighting can be decorative, which “has limited use for any purpose
other than aesthetic enhancement [and when] near nesting beaches may be much more harmful to sea turtles than it is useful to people” (p. 20-21). Mitigation techniques for decorative lighting are limited and such a practice should be reserved for areas out of sight from the beach. If indirect light is unintentional, then modern fixtures are highly recommended that will prevent “wall wash” (the illumination of the side or façade of a building).

So far, the discussion above has been centered on exterior fixtures; however interior lighting is also a source of “light pollution.”

The criteria for identifying problems caused by indoor lighting are the same as those for identifying problems caused by outdoor lighting... [As with an outdoor light, an] indoor light is a problem if it is visible from the beach.

Indoor lighting from buildings that are close to the beach, are very tall, or have large sea-side windows causes the greatest problem for sea turtles. Because indoor lighting is usually not meant to light the outdoors, the unwanted effects of indoor lighting can easily be eliminated without compromising the intended function of the light (Witherington and Martin, 2003, p. 22).

In truth, the Turtle Beach Resort does not have direct control over which room lights are utilized by guests. However, indoor lights be can minimized from reaching the beach by simply informing and reminding guests to close opaque curtains during evening hours when room lights are on.

The hotel does have direct control over almost all other fixtures that cast light visible from the beach. It is these fixtures that make up the bulk of this assessment.

In the sections that follow I will detail my methods and results, and provide specific recommendations for mitigation. If constraints hinder the implementation of particular recommendations, one option is that effective action be taken in high priority cases (Rank “3” lights, see METHODS) and that lower priority actions be budgeted over time. In general, and in keeping with the decisions of the 2000 “Sea Turtles and Beachfront Lighting” workshop, recommendations are based on best practices and current science as articulated by Witherington and Martin (2003).

METHODS

Daytime Lighting Survey

A baseline daytime lighting survey was conducted on foot on 26 July 2006 by observing lighting fixtures and bulbs directly visible from the beach. The entire property was accessed to clarify, identify, and/or count particular fixture(s). All exterior lights within line-of-sight of the observer [John English Knowles] were described with respect to fixture type and location. The function of lights was deduced by the observer; however, subsequent meetings with hotel management staff insured that the correct functionality was documented in each case. Light fixtures with lamps (light bulbs) visible from the beach and those that were designed or positioned so that they would likely illuminate the beach were considered to be potentially problematic.

Nighttime Lighting Survey

In coordination with hotel management, a nighttime lighting survey was conducted on foot on 26 July 2006. During the nighttime survey, each light identified in the daytime survey was located and evaluated with respect to its potential effect on sea turtles. Lights unseen during the day, but visible when emitting light, were also evaluated. Each light was rated and ranked on a scale of 1 to 3.
The nighttime survey involved two inspections, one before midnight and one after midnight, allowing for an accurate ranking of each individual light source in the context of changing background illumination of different lighting conditions and intensities throughout the night. Because particularly bright lights lessen the degree or the actual brightness of the lights behind them, and because some lights are extinguished late at night under normal operating procedures, the observer was able to use the sequential inspections to more accurately characterize those lights that remained.

The Lights

Following are the surveyed lights listed from the most disruptive (Rank 3) to the least disruptive (Rank 1) for marine turtles. A rank of “1” describes indirect light visible by an observer on the beach, but not likely to present a strong attraction to nesting or hatching turtles. A rank of “2” describes a visible globe, glowing element, lamp, or reflector likely to disorient turtles, but not strong enough to cast a shadow on the beach. And a rank of “3” describes a light source strong enough to cast a shadow on the beach regardless of whether the illumination is direct or indirect.

Even the smallest lights can rank as a “3” if they cast a shadow on the beach; their close proximity to the beach and their low vertical placement near the horizon can be just as disorientating as a more powerful light further away. The “3” ranking lights have been placed first in the assessment because of their potentially more serious effects on marine turtles. The focus of corrective actions should begin with these lights, as their mitigation will have the most significant impact on the beach environment.

Within each rank – 1, 2, 3 – fixtures listed first are expected to require the greatest attention either in number, expense, or creativity. The list continues through fixtures that are progressively simpler and/or cheaper to mitigate. For each light the number of fixtures visible from the beach, the fixture type, location, rank, comments (if any), function, picture and recommendations are documented. Each recommendation is specific to an individual light, and may include one or many explanatory remarks. Some recommendations will pertain to mitigating the current fixture; others will suggest the replacement of a fixture with an alternative.

Recommendations are illustrated by the following:

Permanently eliminate fixture. Some cases are specific to the number of fixtures.

Reposition fixture to landward side of tree or object.

Aim fixture away from the beach.

Replace existing fixture with a more directed and functional bollard with external louvers.
Replace existing fixture with a more directed and functional path light that is positioned as to not directly or indirectly illuminate the beach.

Install low wattage (50 watts or less) yellow bug light bulb.

Install compact fluorescent Turtle Safe Lighting lamps (light bulbs). See INTERNET RESOURCES.

Replace existing fixture with a more directed and functional downlight.

Install hood of sufficient depth and width.

Reduce intensity of light or lower wattage.

Plant, landscape, or improve native vegetation buffer so that light is screened and not directly visible from the beach.

Keep lights off when not in use, especially for lights that are closest to the beach. Inform guests via table tents, door hangers, or other educational materials (e.g. the information booklets in each room) about fixtures under their control.
Eliminate fixtures and use low table lamps (such as Aurelle LED Candle Series or Maxxima MLC-01 LED Flameless Candle) or candles. This would serve the purpose of illuminating the tables without unintended broadcast out of the restaurant.

Use dimmer to lessen the effect of indirect light leaving the dining area.

Install red filter

Extinguish when not in use.
Rank: 3
Number of fixtures: 21
Light Location: Mounted on coconut palms/casuarinas beginning at B block and continuing east to the end of the property
Comments: The best option is to eliminate the light, either by turning them all off or removing the fixtures. If all lights cannot be removed or turned off, then it is recommended that the number of lights (currently 21) and wattage of each lamp be reduced. Some lights could also be lowered. The installation of yellow bug lights is also recommended. Lights that point directly towards the beach should be repositioned. For the purpose of illuminating the hotel grounds in this area, low profile lights are preferred.

Recommendations on the number of fixtures:

Recommendations on existing or remaining fixtures:

Ultimate recommendation:
Rank: 3  
Number of fixtures: 16  
Light Location: Waterfront Restaurant  
Comments: During the few nights a week of operation, the Waterfront Restaurant presents a unique case that can be easily mitigated. The current lights are a source of direct light on the beach and their replacement with a modern alternative is encouraged. Earthworks could possibly design such a fixture thereby increasing the quality of the beach, the restaurant, and supporting the local economy. In addition, strategic landscaping can be employed to conceal the current fixtures from the beach, a task seemingly well employed by the Turtle Beach Resort with its lush hotel grounds.  
Recommendations on existing fixtures:  
Ultimate recommendations:
Orange flood/stage light

Rank: 3
Number of fixtures: 1
Light Location: Overhand of restaurant
Comments: When the light is on (during a performance) it does reach the beach. Strategic landscaping could conceal light (e.g. native vegetation that surrounds the Jacuzzi area).
Recommendations:

Ceiling mounted colored spotlight

Rank: 3
Number of fixtures: 4
Light Location: Ceiling of Waterfront Restaurant
Comments: A red filtered light is preferred over other colors. Lights don’t seem to be of concern since they are rarely used.
Recommendations:
Wall mounted downlight

Rank: 2  
Number of fixtures: 62  
Light Location: Balconies of C block  
Comments: The fixture offsets the bulb from the wall reducing the amount of “wall washing” that can occur with fixtures flush to the wall. Installing a yellow bug light bulb will greatly minimize the chances of disrupting the sea finding behavior of marine turtles. The yellow light is also not visible to most insects. However, guests need to be reminded to turn lights off when not in use.

Recommendations:

Fluorescent and incandescent bulbs covered by perforated wood box

Rank: 2  
Number of fixtures: 16  
Light Location: Waterfront Restaurant, Bathrooms at Waterfront Restaurant  
Comments: The only fixture visible from the beach is the one located at the women’s bathroom. The number given is the number of fixtures on the hotel grounds. These fixtures are encouraged because the bare bulb is concealed and light is directed down. However, a yellow bug light in the women’s bathroom fixture is preferred over the current white incandescent bulb

Recommendations:
Small bare spotlight

*Rank:* 2  
*Number of fixtures:* 3  
*Light Location:* Hanging above Restaurant  
*Recommendations:*  

[Images of light fixtures]
Room lights

Rank: 1
Number of balconies visible from the beach: 172
Light Location: Ocean view rooms
Recommendations from Witherington and Martin 2003 on “Minimizing beach lighting from indoor sources”:
1. Turning off lighting in rooms that are not in use. Reminder notices placed on switches in oceanfront rooms can help in this effort.
2. Relocating moveable lamps away from windows that are visible from the beach.
3. Tinting or applying window treatments to windows visible from the beach so that light passing from inside to outside is substantially reduced. A good tinted glass or window-tinting treatment will reduce visible light from the inside to 45% or less (transmittance ≤ 45%). Window glass may be either tinted during its manufacture or tinted later with an applied film. Window treatments (shading materials) are less permanent and can reduce light transmittance more than tints and films can. A complete blocking of light is ideal.
4. Closing opaque curtains or blinds after dark to completely cover windows visible from the beach. This is an inexpensive solution because most home windows have curtains or blinds to provide privacy to the occupants (p. 22).
Rank: 1
Number of fixtures: 128
Light Location: Balconies of A, B, D and E block
Recommendations: ≤50W
Small recessed ceiling spotlight

**Rank:** 1  
**Number of fixtures:** 40  
**Light Location:** Above doors in E block  
**Comments:** These lights are causing significant amounts of “wall wash” in the corridor between D and E block as well as along the back of D block. Cumulatively they are potentially disruptive. The number given is the number of fixtures that are causing visible “wall wash” from the beach. One option might be to install a R30 amber bug light or something similar. See [INTERNET RESOURCES](#).  
**Recommendations:**

Green pathway light

**Rank:** 1  
**Number of fixtures:** 6  
**Light Location:** Sidewalk to E block  
**Recommendations:**

≤50W  

[Tree 🌳]
Pathway light

**Rank:** 1  
**Number of fixtures:** 6  
**Light Location:** Around pool area in front of C block/ path from kid pool to D and E block  
**Comments:** Not all fixtures are visible from beach.  
**Recommendations:**

![leaves](image1.png)  
![leaves](image2.png)

Hooded spotlight

**Rank:** 1  
**Number of fixtures:** 2  
**Light Location:** Grass area in front of E block  
**Comments:** This light does contribute to “wall wash.” The light is not directed up, which is highly encouraged. In the effort to illuminate the lawn in front of E block other light fixtures can be employed that do not unintentionally reflect light off the walls of buildings.  
**Recommendations:**

![leaves](image3.png)  
![leaves](image4.png)

or
Up directed hooded spotlight

Rank: 1
Number of fixtures: 3
Light Location: Ground of the Jacuzzi area
Recommendation on existing fixtures:

Ultimate recommendations:

or

Green floodlight

Rank: 1
Number of fixtures: 2
Light Location: Jacuzzi area
Comments: Strategic landscaping could conceal illuminated vegetation.
Recommendation on existing fixtures:

Ultimate recommendation:
**Downlight**

*Rank:* 1  
*Number of fixtures:* 1  
*Light Location:* Rafters of Restaurant  
*Comments:* 
*Recommendations:*  

**Tiki torch with open flame**

*Rank:* Lights off  
*Number of fixtures:* 10  
*Light Location:* Around Waterfront Restaurant at edge of vegetation and along main entrance of beach  
*Comments:* The number given was the number of tiki torches that were out and visible during the time of the assessment.  
*Recommendations:*
SUMMARY

The Turtle Beach Resort is commended in retaining some of the best lighting conditions observed at any beachfront hotel on the island. First, turtle friendly fixtures are installed on all balconies. These fixtures are ideal because the bare bulb is recessed and concealed, preventing direct light reaching the beach. In addition, the fixtures are offset from the wall reducing the amount “wall wash.” Second, native vegetation is used as a screen, reducing the amount of light reaching the beach. Third, the watersports stand does not have any exterior lighting. Many such beachfront stands often have exterior lighting and lead to extreme disorientation of marine turtles. Lastly, it is observed that some of the tree mounted spotlights are disconnected to intentionally reduce disorientation of hatchlings.

Nevertheless, there is still room for improvements. For instance, strategic landscaping should be continued as this is one of the easiest ways to reduce beachfront lighting. Also, bug lights should be installed in all balcony fixtures. Bug lights emit a wavelength that is less attractive to hatchlings, as well as mosquitoes. It is also recommended that the number of tree mounted spotlight be reduced or lowered. The illumination of the hotel grounds can easily be accomplished by low profile path lights. It is important to remember that beach front lights should be turned off when not in use. This includes soda machines, televisions, and decorative lighting (e.g. string lights on the band stand). As far as decorative lighting is concerned, red light is always preferred over green or white (e.g. rope lighting along the pool bridges).

The few recommendations, once implemented, will not only improve beach conditions for marine turtles, but will contribute to the existing sophisticated theme in lighting ambiance of this resort while reducing operational expenses through an expectation of lower energy use. To encourage lighting improvements and assist in implementation, the Tourism Development Corporation is available to purchase items (fixtures, CF bug lights) in bulk, which will further reduce the cost of retrofitting and innovation.

Along with an improved beachfront in terms of lighting comes a parallel responsibility for conservation-minded beachfront management in general, including, for example, stacking beach chairs to ensure that mother turtles are not obstructed during their crawl to and from the water. Turtle Beach Resort plays an essential role in the survival of the endangered turtles that use its beaches, and is well positioned to serve as a model for sea turtle friendly environmental management systems elsewhere in Barbados and beyond.

INTERNET RESOURCES

Turtle safe lighting products

www.turtlesafelighting.com

http://www.turtlesafelighting.com/TurtleSafe%201.0/product%20sheets/SnapOnFilter.pdf

CF PAR 38

http://www.prismaeclighting.philips.com/LightSite/Whirlwind.aspx?eca=LNPPPLA&epf=USNPUS&stg=ACT&lan=US+&ecu=LMP%7cPLC%7cNP&cnt_key=CI_PAR38%7cPLC&t=1&tree=0&scr_md=1111&nav_key=1885&nav=Null&loc=us_en&leftnav=1_1_4_1_4

http://genet.gelighting.com/LightProducts/Dispatcher?REQUEST=CONSUMPERSPECPAGE&PRODUCTCODE=21739

R30 Amber Bug Light

https://store.lsgc.com/R30-AMBER-BUG-LIGHT-LONG-CONE-P38C0.aspx?UserID=535513&SessionID=rNFp6CRYNJPrxJVbsKr

LITERATURE CITED


ACKNOWLEDGMENTS

I am deeply indebted to the staff and management of the Turtle Beach Resort, including Adrian Grant, General Manager, Steven John, Assistant Maintenance Supervisor, and Woodrow Trotman, Maintenance Supervisor for their collaboration in this assessment. They were extraordinarily kind in accommodating my requests, which often involved their working off-hours, including late at night. Equally important, the assessment would not have been possible without the foresight and financial support of the Tourism Development Corporation of Barbados. I would also like to recognize the tireless efforts of the Barbados Sea Turtle Project, especially Dr. Julia Horrocks, Barry Krueger and their 2006 seasonal staff. The professional work of the BSTP has set a high standard for research and conservation in Barbados and throughout the Caribbean region. Without their collaboration, including providing me with housing, training, access to data and other technical information, and the opportunity to contribute to their important field work, which has been professionally and personally enriching for me, this lighting assessment could not have been accomplished. Finally, I am grateful to Dr. Karen Eckert, Executive Director of WIDECAST and my academic advisor at Duke University’s Nicholas School of the Environment, for her encouragement of my efforts and her leadership in Caribbean sea turtle conservation issues in general, and to Erik Martin of Ecological Associates, Inc. for his kindness and patience in training me in the protocols of professional beachfront lighting assessments, a field in which he is well-recognized.
Appendix XI – Southern Palms Beach Club property map
Appendix XII – Southern Palms Beach Club assessment report
Respectfully submitted

Southern Palms Beach Club

Property Assessment

In Barbados, West Indies

Effect on the Survival of Endangered Marine Turtles

National Assessment of Beachfront Lighting and its
INTRODUCTION

In partnership with the Barbados Sea Turtle Project (BSTP), local affiliate of the Wider Caribbean Sea Turtle Conservation Network (WIDECAST), and the Tourism Development Corporation in Barbados, a formal lighting assessment was conducted at the Southern Palms Beach Club as part of a follow-up initiative to implement recommendations made at a national “Sea Turtles and Beachfront Lighting” workshop held in 2000 (Eckert and Horrocks, 2002).

The evaluation of lighting associated with the Southern Palms Beach Club property attests to the efforts and dedication of the hotel industry and the BSTP in improving the conditions of artificial beach lighting, which is well known to be detrimental to both hatchlings and nesting sea turtles (Eckert and Horrocks, 2002).

The Southern Palms Beach Club has identified itself as a leader in addressing the lighting problem by voluntarily participating in this assessment. The property – along with four (4) other beachfront hotels – was chosen because it plays a crucial role in the quality of sea turtle nesting habitat. The intent of the lighting assessment was to evaluate current conditions, and to propose solutions and recommendations for each light identified as contributing to the nocturnal illumination of the nesting beach.

The attention of such work is critical in the survival of the hawksbill sea turtle, Eretmochelys imbricata, a critically endangered species worldwide (cf. IUCN RedList). Barbados plays a very important role in the survival of this species, its southwest coast having been identified as one of the most important nesting grounds remaining in the Wider Caribbean Region.

Artificial beachfront lighting, characterized as “light pollution” by Witherington and Martin (2003, p. V), is the most serious contemporary threat to the survival of sea turtles in Barbados (Eckert and Horrocks, 2002). Marine turtles are most sensitive to shorter wavelengths (blues and greens), which they use as a sea-finding cue. Shorter wavelengths are also emitted by white light. When such lights are visible from the beach, the effect is tremendous.

Witherington and Martin (2003) suggest the following approach to mitigate “light pollution” by either eliminating the fixture or by adjusting wavelength or intensity:

We have no reliable formula that can be used to calculate how much each light source will affect sea turtles. We do know, however, that if spectral emissions are equivalent, reducing intensity will reduce effects, and if intensities are similar, substituting less attractive sources (like yellow bug or red lights) will also reduce effects. A sound strategy, therefore, would be to reduce effects on sea turtles by manipulation both intensity and color. As few lights as practicable should be used, and for lighting deemed essential, long wavelength light sources should replace more disruptive light sources and intensity should be reduced by using lamps of minimal wattage that are housed within well-directed fixtures aimed down and away from the beach (p. 23).

In point, direct light on the beach can be highly disruptive to both adult turtles and hatchlings, and eliminating sources of direct light reaching the beach is preferred over all other conservation alternatives (Witherington and Martin, 2003). In circumstances where eliminating light sources – either by turning them off or by removing the fixtures all together – is not practical, several alternatives are available which direct light more efficiently and/or shield the source from the beach. Many of these modern fixtures also prevent “wall wash” (the illumination of the side or façade of a building) and are highly recommended over fixtures that expose a bare bulb to the beachfront.
So far, most of the discussion above has been on exterior fixtures; however interior lighting is also a source of “light pollution.”

The criteria for identifying problems caused by indoor lighting are the same as those for identifying problems caused by outdoor lighting… [As with an outdoor light, an] indoor light is a problem if it is visible from the beach.

Indoor lighting from buildings that are close to the beach, are very tall, or have large sea-side windows causes the greatest problem for sea turtles. Because indoor lighting is usually not meant to light the outdoors, the unwanted effects of indoor lighting can easily be eliminated without compromising the intended function of the light (Witherington and Martin, 2003, p. 22).

In truth, the Southern Palms Beach Club does not have direct control over which room lights are utilized by guests. However, indoor lights can be minimized from reaching the beach by simply informing and reminding guests to close opaque curtains during evening hours when room lights are on.

The hotel does have direct control over almost all other fixtures, which cast light onto or visible from the beach. It is these fixtures that make up the bulk of this assessment.

In the sections that follow I provide specific recommendations for mitigation of these fixtures, and detail my methods and results. If constraints hinder the implementation of particular recommendations, one option is that effective action be taken in high priority cases (Rank “3” lights, see METHODS) and that lower priority actions be budgeted over time. In general, and in keeping with the decisions of the 2000 “Sea Turtles and Beachfront Lighting” workshop, recommendations are based on best practices and current science as articulated by Witherington and Martin (2003).

METHODS

Daytime Lighting Survey

A baseline daytime lighting survey was conducted on foot on 25 July 2006 by observing lighting fixtures and bulbs directly visible from the beach. The entire property was accessed to clarify, identify, and/or count particular fixture(s). All exterior lights within line-of-sight of the observer [John English Knowles] were described with respect to fixture type and location. The function of lights was deduced by the observer; however, subsequent meetings with hotel management staff insured that the correct functionality was documented in each case. Light fixtures with lamps (light bulbs) visible from the beach and those that were designed or positioned so that they would likely illuminate the beach were considered to be potentially problematic.

Nighttime Lighting Survey

In coordination with hotel management, a nighttime lighting survey was conducted on foot on 25 July 2006. During the nighttime survey, each light identified in the daytime survey was located and evaluated with respect to its potential effect on sea turtles. Lights unseen during the day, but visible when emitting light, were also evaluated. Each light was rated and ranked on a scale of 1 to 3.

The nighttime survey involved two inspections, one before midnight and one after midnight, allowing for an accurate ranking of each individual light source in the context of changing background illumination of different lighting conditions and intensities throughout the night. Because particularly bright lights lessen the
degree or the actual brightness of the lights behind them, and because some lights are extinguished late at night under normal operating procedure, the observer was able to use the sequential inspections to more accurately characterize those lights that remained.

The Lights

Following are the surveyed lights listed from the most disruptive (Rank 3) to the least disruptive (Rank 1) for marine turtles. A rank of “1” describes indirect light visible by an observer on the beach, but not likely to present a strong attraction to nesting or hatching turtles. A rank of “2” describes a visible globe, glowing element, lamp, or reflector likely to disorient turtles, but not strong enough to cast a shadow on the beach. And a rank of “3” describes a light source strong enough to cast a shadow on the beach regardless of whether the illumination is direct or indirect.

Even the smallest lights can rank as a “3” if they cast a shadow on the beach; their close proximity to the beach and their low vertical placement near the horizon can be just as disorientating as a more powerful light further away. The “3” ranking lights have been placed first in the assessment because of their potentially more serious effects on marine turtles. The focus of corrective actions should begin with these lights, as their mitigation will have the most significant impact on the beach environment.

Within each rank – 1, 2, 3 – fixtures listed first are expected to require the greatest attention either in number, expense, or creativity. The list continues through fixtures that are progressively simpler and/or cheaper to mitigate. For each light the number of fixtures visible from the beach, the fixture type, location, rank, comments (if any), function, picture and recommendations are documented. Each recommendation is specific to an individual light, and may include one or many explanatory remarks. Some recommendations will pertain to mitigating the current fixture; others will suggest the replacement of a fixture with an alternative.

Recommendations are illustrated by the following:

- Permanently eliminate fixture. Some cases are specific to the number or location of the fixtures.
- Reposition fixture to the landward side of the tree or object.
- Install hood, lower wattage, and aim fixture away from the beach.
- Aim fixture away from the beach.
- Install shield or mask of sufficient size that covers an arch of 180° on the ocean side.
Replace existing fixture with a more directed and functional bollard with external louvers.

Replace existing fixture with a more directed and functional path light, and re-position it to eliminate any direct (or indirect) illumination of the beach.

Install low wattage (50 watts or less) yellow bug light bulb.

Install compact fluorescent *Turtle Safe Lighting* lamps (light bulbs). See **INTERNET RESOURCES**.

Replace existing fixture with a more directed, more functional downlight.

Replace existing fixture with a more directed, more functional step light positioned to eliminate any direct (or indirect) illumination of the beach.

Install covers or filters across beach facing sides of fixture to eliminate any direct (or indirect) illumination of the beach.

Install hood of sufficient depth and width.
Reduce intensity of light or lower wattage.

Shield seaward side of fixtures that are visible from the beach.

Plant, landscape, or improve native vegetation buffer to eliminate any direct (or indirect) illumination of the beach.

Install hood, aim fixture away from the beach, and connect to a motion detector.

Keep lights off when not in use, especially for lights closest to the beach. Inform guests via table tents, door hangers, or other educational materials about fixtures under their control.
White un-hooded spotlight

Rank: 3
Number of fixtures: 17
Light Location: Coconut palms from just east of Capri to eastern end of property/Lady Smith/roof of the Khus Khus Bar, Garden Terrace and Off the Bar/main pool area
Comments: Lights serve to illuminate the beach for security cameras and perceived guest safety.
Recommendations on the number of fixtures:

Recommendations on existing or remaining fixtures:

Yellow un-hooded spotlight

Rank: 3
Number of fixtures: 16
Light Location: Seaward side of trees that are located from the western end to center property
Recommendations on the number of fixtures:

Recommendations on existing or remaining fixtures:
Rank: 3  
Number of fixtures: 15  
Light Location: Landward side of beach wall. They are present on the beach side of the Carlisle rooms, the Palm court and around the main pool area in front of the lobby. One is visible between Lady Smith and the Banyan Court Building  
Comments: These fixtures attempt to provide enough light for the security cameras located on the property during the evening hours (See SUMMARY). The recommendation given is one that only considers the secondary purpose of the lights, which is to illuminate the courtyard during the evening for crossing on foot. Such illumination can use low levels of light. In addition, the sea wall at Southern Palms Beach Club provides an excellent opaque object that can conceal low profile lights.  
Recommendations:
Wall mounted clay covered light

Rank: 3
Number of fixtures: 70
Light Location: Present on most balconies
Comments: The clay fixtures shield the bare bulb from the beach, which is preferred over all other balcony light and wall mounted lights on the property. Of the 70 fixtures, the ones with rain shields are the most turtle friendly because the light is prevented from washing the wall in an up direction.

Recommendations:

- LE: 50W
- Bug friendly
- Turtle friendly
Rank: 3
Number of fixtures: 4
Light Location: Second floor balcony rooms on eastern portion of the Carlisle Rooms Building
Recommendations for existing fixtures:

Ultimate recommendation:
Wall mounted uplight

Rank: 3
Number of fixtures: 4
Light Location: First floor rooms on eastern end of the Carlisle Rooms Building
Recommendations for existing fixtures:

Ultimate recommendation:
Orange un-hooded spotlight

Rank: 3  
Number of fixtures: 3  
Light Location: Coconut palms in main pool area/east face of Banyan Court Building  
Comments: An orange wavelength is less disruptive than a pure white light, which emit all wavelengths including the most disruptive (green and blue). 
Recommendations:

Single globe

Rank: 3  
Number of fixtures: 1  
Light Location: Hedge on the beach side of the Palm Court Building  
Recommendations:
Arch mounted incandescent light

Rank: 3
Number of fixtures: 1
Light Location: Arched gap of concrete divider between Lady Smith and Banyan Court Building
Recommendations:

Column mounted clay fixture with an incandescent bulb

Rank: 3
Number of fixtures: 2
Light Location: Circle Terrace
Comments: Recessed bulbs are preferred over bare bulbs for beach front lighting.
Recommendations for existing fixtures:

Ultimate recommendation:
White un-hooded incandescent bulbs in spotlight fixtures

**Rank:** 3  
**Number of fixtures:** 7  
**Light Location:** Jasmine Court Building/On tree just west of Banyan Court Building/Sundecks of Crescent Beach Building/Lady Smith/Hairdressing Salon Building  
**Recommendations:**

---

**Rank:** 3  
**Number of fixtures:** 9  
**Light Location:** Balconies on west face of Palm Court Building  
**Comments:** The current position of the fixtures induces “wall wash. The light can be directed more efficiently if fixture was a downlight  
**Recommendations:**
Small recessed ceiling spotlight

Rank: 3
Number of fixtures: 100
Light Location: Ceiling of lobby, Khus Khus Bar, Rondelle Restaurant, Garden Terrace Restaurant, Off the Bar area
Comments: Not all fixtures are visible from beach, the ones that are visible are so at sharp angles from high up on the beach.
Recommendations:

Small recessed ceiling incandescent light bulb fixture

Rank: 3
Number of fixtures: 17
Light Location: Terrace and Khus Khus Bar
Comments: Not all are visible from beach. The ones at Khus Khus Bar are visible only at sharp angles from high up on the beach. The roof’s low overhang provides good cover.
Recommendations:
Rank: 3
Number of fixtures: 3
Light Location: West end of Khus Khus Bar
Comments: Lights are only on three nights a week during performances
Recommendations:
Rank: Lights were off, but probably rank as a “3” when on
Number of fixtures: 3
Light Location: Second floor beach front balcony of Carlisle Rooms Building/Jasmine Court Building third floor
Comments: The use of 25 or 40 watt bulbs is encouraged, with emphasis placed on 25 watt yellow bug light bulbs.
Recommendations for existing fixtures:

Ultimate recommendation:
Rank: 2, but most likely a rank of “3” for rooms closest to the beach
Number of rooms visible from the beach: 53
Light Location: Beachfront of hotel

Recommendations from Witherington and Martin 2003 on “Minimizing beach lighting from indoor sources”:
1. Turning off lighting in rooms that are not in use. Reminder notices placed on switches in oceanfront rooms can help in this effort.
2. Relocating moveable lamps away from windows that are visible from the beach.
3. Tinting or applying window treatments to windows visible from the beach so that light passing from inside to outside is substantially reduced. A good tinted glass or window-tinting treatment will reduce visible light from the inside to 45% or less (transmittance ≤ 45%). Window glass may be either tinted during its manufacture or tinted later with an applied film. Window treatments (shading materials) are less permanent and can reduce light transmittance more than tints and films can. A complete blocking of light is ideal.
4. Closing opaque curtains or blinds after dark to completely cover windows visible from the beach. This is an inexpensive solution because most home windows have curtains or blinds to provide privacy to the occupants (p. 22).
Rank: 2  
Number of fixtures: 2  
Light Location: Main pool area  
Comments: The purpose of illuminating the walking path by these lights is diffused because of other lights surrounding the main pool area. However, these types of path lights are highly recommended. They are low to the ground and efficiently direct light where it is needed, reducing unintended broadcast. If desired, there are other styles of path lighting available with turtle friendly designs (See INTERNET RESOURCES). Another choice of turtle friendly lighting is the bollard. (Pictured, also see INTERNET RESOURCES). In any case, both path lights and bollards should have recessed bulbs, hidden reflectors, and bug lights. Bollards should have external louvers.

Recommendations on existing fixture and under existing light conditions:

Recommendations under darker lighting conditions:
Ceiling mounted light

Rank: 2
Number of fixtures: 4
Light Location: Walkway between kitchen building and Crescent Beach Building
Comments: Only two are visible from the beach.
Recommendations:

Small black path light

Rank: 1
Number of fixtures: 9
Light Location: Courtyard of Palm Court and Lady Smith Building. They are also present in the main pool area. In addition, two are located in front of north face of Palm Court Building.
Recommendations:
**Rank**: Light off  
**Number of fixtures**: 3  
**Light Location**: Placed around base of statue in the courtyard of Palm Court, Jasmine Court and Capri Buildings  
**Comments**: Fixtures are not in use and only one bulb is present.  
**Recommendations**:  

![White un-hooded wall mounted spotlight](image)

**Rank**: Light off  
**Number of fixtures**: 1  
**Light Location**: Very north end of wall on hairdressing salon  
**Recommendations**:  

![Seaward Landward Motion detector](image)
SUMMARY

The efforts of the Southern Palms Beach Club do not go unnoticed in their never ending quest for improvements. They are commended on the installation of yellow spotlights and their clay covered balcony lights. It is obvious the hotel constantly strives to provide a more suitable beach environment, increasing quality for its guests and turtles.

However, the impact of almost all evaluated lights is compounded for two reasons. First, the Southern Palms Beach Club property is elongated along the ocean (approximately 1000 feet). Second, this elongated edge of the property is directly on top of the beach with little or no set back. This places limitations on strategic landscaping and increases the effects of even the smallest lights. However, solutions are available to meet the needs of both guests and marine turtles. They will have to involve creativity and a clear understanding of light-pollution prevention.

The ranking system can be used as a guide in understanding why lights are more disruptive to turtles than others. Ideally, a score of zero is preferred, where there are no lights visible or detected from the beach. Moving from ideal to reality, a rank of “1” is preferred over a rank of “2”, which is preferred over a rank of “3”. However, even if a property contains only the least disruptive lights (Rank 1), there will still be moonless nights where even the smallest and dimmest lights can have an effect. The ranking system can also allow one to ratchet down the effect of a light. For example, if a light ranks as a “3”, then it is important to consider what actions might decrease it to a rank of “2.”

The number of lights is also important. Fewer lights are preferred over many lights. For instance, if there are fifty red and yellow lights on the beach, then the fact remains that there are still fifty lights on the beach. Even if the lights are filtered, fewer lights are always recommended.

As for filters, it is important that proper ones are installed. There are many yellowed colored lights available on the market that are not monochromatic and although they might appear yellow to the human eye, hatchlings might perceive different wavelengths (especially shorter wavelengths of which they are attracted to). It has been shown that the least disruptive lights to hatchlings are yellow bug lights or lights of a pure yellow wavelength.

It is possible to have both a turtle friendly beach in terms of lighting and a secure property. According to Witherington, “light illuminance levels necessary for safety and security are rather low (0.2-1.0 footcandles or 2-11 lux, recommended for fence [or perimeter] security and parking areas)” (p. 21). The decision to use beach front cameras at night, which requires a significant amount of lighting for resolution purposes as an added security measure must be evaluated closely. When considering extra security measures for a property several questions might arise. Why is Southern Palms Beach Club one of the few hotels operating beachfront cameras at night? Is it possible for beach cameras to be used during the day only? Can nighttime use of cameras be reserved for sections of the property that will not indirectly disorientate marine turtle? Can strategic placement of motion detecting lights be used to alert security personnel when a particular area is crossed by an object of a certain height, which will avoid detection of animals, such as cats? Can infrared sensors be positioned along a building’s perimeter to alert security personnel when beams are broken (See INTERNET RESOURCES)? The alternatives to extra security measures might work just as well, if not better than cameras. In any case, providing greater security for guests, more than the standard security personnel, is always applauded and encouraged.

If the decision to eliminate nighttime use of beach front cameras (along with the lights) is implemented, then it does not mean the areas of concern have to go in darkness. The courtyards can be lit by low profile landscape lights, path lights, or bollards.
The seawall provides the ideal opaque object from which low profile lights can be concealed.

The recommendations, once implemented, will not only improve beach conditions for marine turtles, but will contribute to the existing sophisticated theme in lighting ambiance of this resort while reducing operational expenses through an expectation of lower energy use. To encourage lighting improvements and assist in implementation, the Tourism Development Corporation is available to purchase items (fixtures, CF bug lights) in bulk, which will further reduce the cost of retrofitting and innovation.

The Southern Palms Beach Club plays an essential role in the survival of the endangered turtles that use its beaches, and is well positioned to serve as a model for sea turtle friendly environmental management systems elsewhere in Barbados and beyond.

INTERNET RESOURCES

Manufacturers and Distributors of Path and Landscape Lighting


www.fxlighting.com

Architectural Bollards

http://www.greenleelighting.com/PDFs/greenlee/datasheets/ABR_A BS_Series.pdf


Manufacturer of Infrared Detection

www.optexeurope.com

Turtle safe lighting products

www.turtlesafelighting.com

LITERATURE CITED


ACKNOWLEDGMENTS

I am deeply indebted to the staff and management of the Southern Palms Beach Club, including Britta Pollard, General Manager, Jenni Wilson, Activities Director and Roger Yarde, Electrician for their collaboration in this assessment. They were extraordinarily kind in accommodating my requests, which often involved their working off-hours, including late at night. Equally important, the assessment would not have been possible without the
I would also like to recognize the tireless efforts of the Barbados Sea Turtle Project, especially Dr. Julia Horrocks, Barry Krueger and their 2006 seasonal staff. The professional work of the BSTP has set a high standard for research and conservation in Caribbean sea turtle conservation issues in general, and leadership in Caribbean sea turtle conservation issues in particular, for her encouragement of my efforts and her role in providing me with housing, training, access to data and other technical information, and the opportunity to contribute to their important field work, which has been professionally and personally enriching for me. Finally, I am grateful to Dr. Karen Eckert, Executive Director of WIDECAST, and to Erik Martin of Ecological Associates, Inc. for their kindness and patience in training me in the protocols of professional beachfront lighting assessments, a field in which he is well-recognized.