Manual of Best Practices for Safeguarding Sea Turtle Nesting Beaches

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Manual of Best Practices for Safeguarding Sea Turtle Nesting Beaches

Ga-Young Choi

Karen L. Eckert

2009

WIDECAST
Wider Caribbean Sea Turtle Conservation Network

CAST
Caribbean Alliance for Sustainable Tourism

PREFACE AND INTENT

For nearly three decades the Wider Caribbean Sea Turtle Conservation Network (WIDECAST), with Country Coordinators in more than 40 Caribbean States and territories, has linked scientists, conservationists, natural resource users and managers, policy-makers, industry groups, educators and other stakeholders together in a collective effort to develop a unified management framework, and to promote a region-wide capacity to design and implement science-based sea turtle conservation programs.

As a Partner Organization of the UNEP Caribbean Environment Programme and its Regional Programme for Specially Protected Areas and Wildlife (SPAW), WIDECAST is designed to address research and management priorities at national and international levels, both for sea turtles and for the habitats upon which they depend. We focus on bringing the best available science to bear on contemporary management and conservation issues, empowering stakeholders to make effective use of that science in the policy-making process, and providing an operational mechanism and a framework for cooperation at all levels, both within and among nations.

Network participants are committed to working collaboratively to develop their individual and collective capacities to manage shared sea turtle populations. By bringing people together and encouraging inclusive management planning, WIDECAST is helping to ensure that utilization practices, whether consumptive or non-consumptive, do not undermine sea turtle survival over the long term. Among these capacity building initiatives is a regional program, implemented in partnership with the Caribbean Alliance for Sustainable Tourism (CAST), to provide the hospitality sector with information on how property owners and managers can help protect sea turtle nesting beaches on or near their properties.

This Manual responds to recommendations made by industry representatives attending a workshop sponsored by the Tourism Development Corporation in Barbados, and co-hosted by WIDECAST and the Barbados Sea Turtle Project. By unanimous Resolution[1], workshop participants requested guidance in constructing a *Sea Turtle Policy Statement* to be adopted by the hotel and villa rental community, and help in designing "standard guidelines and criteria for implementing the *Sea Turtle Policy Statement*".

The intent is to assist beachfront property owners and managers in identifying actions that can be taken to protect sea turtles and their nesting beaches. We provide a model *Sea Turtle Policy Statement* and a "check list" for its implementation, followed by a primer on sea turtle biology. The body of the Manual is devoted to recommendations for the pre-construction phase, building setbacks, coastal lighting, beach cleaning and restoration, erosion control, vegetation and landscaping, and the operation of marine vessels near nesting beaches, explaining in each case the linkages between actions taken from a facilities management standpoint and the benefits of those actions to endangered sea turtles. Finally, we discuss Guest Education and Participation and offer insight into the implications of investing in conservation programs as they relate to Green Globe and other industry certifications.

Please visit http://www.widecast.org for more information, including updates on conservation technology, descriptions of successful programs, and inspiration on how to become more involved!

Dr. Karen L. Eckert
Executive Director, WIDECAST
October 2008

[1] Eckert, K.L. and J.A. Horrocks (Editors). 2002. Sea Turtles and Beachfront Lighting: An Interactive Workshop for Industry Professionals and Policy-Makers in Barbados. Wider Caribbean Sea Turtle Conservation Network. WIDECAST Technical Report No. 1. Bridgetown, Barbados. 44 pp.

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I. WHY IS THIS MANUAL NEEDED?

For more than a decade, dozens of progressive hotels and beachfront property owners throughout the Caribbean region have been working closely with the Wider Caribbean Sea Turtle Conservation Network (WIDECAST) to invest in conservation technologies (such as energy-efficient "turtle friendly" lighting), train staff, educate guests, design innovative landscaping, and support local sea turtle research and conservation programs … all to enhance the survival prospects of endangered sea turtles nesting on or near their properties, engaging their guests in unique experiences (such as Turtle Watching), and generally committing themselves to a more sustainable future.

These partnerships generally start with a request for help:

> *"What can we do to ensure the survival of sea turtles and their young on our beach? The poaching of nesting females is still a challenge for local authorities, and we know that dogs dig up several of the turtle nests each year. As for hatchlings that survive the incubation period, many of them end up trapped in our gardens or dead on the road. We've heard that the only solution to the disorientation of these hatchlings is to turn off all of our security lights at night! Is this really necessary? How do we take the sea turtles into account while protecting our guests, grounds, and staff? Any information that you can provide would be greatly appreciated."*

Other enquires focus on developments still in the planning stages; for example:

> *"We are very concerned about a development proposed for [Beach X] which, as you know, is an important nesting ground for marine turtles. An EIA is currently being prepared for the development and [Regulatory Agency Y] has asked our organization to review the document to ensure that the development will not compromise the sea turtles. We will be meeting with the developer and the architect next week to bring to their attention the requirements under [Regulation Z] for developments on this beach, and also our national commitments to various international agreements aimed at safeguarding depleted sea turtle populations throughout the region. Could you please provide us with advice and any relevant material you may have on best practices for coastal developments? The developer proposes to use the fact that it is a turtle nesting beach as a marketing tool, so we may be able to turn this into an opportunity for sustained collaboration. Thank you in advance!"*

Perhaps you've asked (or thought about asking) just such a question to a local biologist, fisheries officer, or sea turtle conservationist. Perhaps you've done a little reading on your own and already invested in some conservation alternatives, but you're not really sure that you did the right thing. Perhaps you've scheduled some renovation with the aim of saving money (e.g., landscaping with native or salt tolerant plants, eliminating redundant lighting) and figure that this is the time to take a fresh look at the larger issues of beach management. For these reasons and many more, this Manual was designed for you!

This Manual emphasizes the positive role that the hospitality and tourism sector can play in biodiversity conservation by demonstrating ways in which the industry can help protect endangered sea turtles and their nesting habitats. Some recommendations, such as construction setbacks, require considerable foresight; others, such as moving sunbeds and other potential obstacles to nesting, directing lights away from the beach, or rescuing disoriented hatchlings, can be adopted at any time. **Our hope is that the Manual will inspire you to adopt and implement a *Sea Turtle Policy Statement*, collaborate with local experts, communicate relevant information to guests, staff and contractors, and start taking steps, however small, to promote the survival of Caribbean sea turtles.**

Executive Summary: Best Management Practices for Sea Turtle Nesting Areas

Sea turtles are ancient creatures, living mostly unseen in the world's oceans. At certain times of the year, egg-bearing females must come ashore to lay eggs deep in the warm sand of tropical beaches. The nesting process can be threatened by various aspects (e.g., deforestation, lights, sand mining, roads and construction, noise, activity, recreation) associated with beachfront development. Fortunately, an informed property manager can help ensure the survival of endangered sea turtles and their young by implementing the following check list. Following a brief overview (see "Sea Turtle Primer"), recommendations associated with each of these activities are explained in greater detail in the chapters that follow.

Activity	Sea Turtle Protection BMPs	Chapter
Pre-Construction Phase	➢ Know whether (and when) sea turtles nest on beaches near your property ➢ Be aware of laws and policies protecting sea turtles and their eggs ➢ Support the development and implementation of an independent Environment Impact Assessment ➢ Evaluate – and commit to minimizing – impacts to the nesting beach from access roads, vegetation removal/burning, excavation, erosion, lights and activity associated with work crews, etc. ➢ Schedule construction during non-nesting periods ➢ Identify and collaborate with local sea turtle experts to monitor the effects of construction ➢ Support formation of a local Advisory Board for transparency, information-exchange, oversight ➢ Adopt a *Sea Turtle Policy Statement*	**Chapter IV.** Management Issues: Pre-Construction Phase
Construction Setbacks	➢ Do not construct permanent buildings, snack bars, pools, etc. on the sandy beach platform ➢ To protect both the nesting beach and coastal infrastructure, establish reasonable setbacks between the ocean and any permanent buildings ➢ Inform contractors and partners of the importance of these setbacks, and of preserving native vegetation within a buffer zone	**Chapter IV.** Management Issues: Construction Setbacks
Exterior Lighting	➢ Commit to reducing "light pollution" that can be fatal to nesting females and their young ➢ Conduct lighting inspections, at least annually, and respond promptly to recommended corrective measures ➢ All exterior fixtures – anywhere on the property – that produce light visible from the nesting beach should be shielded, directed only where light is needed, generally placed as low as practicable, and use long wavelength lamps (e.g., red/amber LEDs, low pressure sodium) and black baffles ➢ Avoid bright white light, such as metal halide, halogen, fluorescent, mercury vapor, and incandescent lamps – and never use where such light could be visible from the beach	**Chapter IV.** Management Issues: Beachfront Lighting

Activity	Sea Turtle Protection BMPs	Chapter
	➢ Turn off balcony lights when not in use ➢ Use ornamental vegetation to block and reduce light leakage to the nesting beach ➢ Emphasize timers and motion sensitive lights to reduce beachfront lighting and operational costs ➢ Prohibit bonfires or fire pits on the beach or in line-of-sight of the beach during nesting season	
Glass Windows and Doors Visible from the Beach	➢ Commit to reducing the amount of light that reaches the nesting beach from hotel rooms, restaurants, and other interior spaces ➢ When possible, use blackout curtains or shade-screens – if glass tinting is an option, apply film with a visible light transmittance value of 45% or less to all windows and doors within line-of-sight of the beach ➢ Turn off lights when not in use!	**Chapter IV.** Management Issues: Beachfront Lighting
Beach Sand Mining	➢ Know the law with regard to sourcing construction aggregate ➢ Avoid using sand mined from coastal beaches ➢ Report violations of sand mining laws	**Chapter IV.** Management Issues: Beach Sand Mining
Obstacles on the Nesting Beach	➢ Remove furniture and recreational equipment (kayaks, small sailboats) from the beach nightly ➢ Stack and arrange furniture off-beach ➢ Use a permanent umbrella holder or sleeve – never thrust an umbrella (or other penetrating object) into a nesting beach ➢ Consider signage (if egg poaching is not a problem) alerting visitors to nest locations and asking that they stay 2m (6ft) from the nest site	**Chapter IV.** Management Issues: Obstacles to Nesting
Litter and Debris	➢ Implement policies to keep grounds and adjoining beach areas clean ➢ Hand-rake beach debris (vs. using a tractor) to avoid harming eggs incubating below the surface ➢ Partner with local youth or conservation groups to conduct Beach Clean-Ups, especially just prior to the nesting season	**Chapter IV.** Management Issues: Litter and Debris
Beach Stabilization and Restoration	➢ Seek alternatives to coastal armoring/seawalls ➢ Protect beachfront property through enforced construction setbacks, mixed-species (preferably native) vegetation buffers, and dune protection ➢ If beach restoration/rebuilding is unavoidable, replacement sand should be similar (grain size, organic content) to the original beach sand, thereby maintaining the suitability of the beach for egg incubation ➢ Beach restoration should never take place during the nesting/hatching season	**Chapter IV.** Management Issues: Beach Stabilization Beach Restoration WIDECAST Wider Caribbean Sea Turtle Conservation Network © 2009

Activity	Sea Turtle Protection BMPs	Chapter
Vehicles on the Beach	➢ With the exception of authorized patrol or emergency vehicles (which should drive below the high tide line), motorized vehicles should be prohibited from driving on sandy beaches ➢ Smooth-out tire tracks – ruts trap emerging hatchlings, prevent them from reaching the sea	**Chapter IV.** Management Issues: Vehicle Use
Protecting Beach Vegetation	➢ Know the law regarding removal and restoration of coastal vegetation and maritime forest ➢ Incorporate established vegetation into architectural plans – minimize removal of beachfront vegetation, restore what has been lost ➢ Emphasize the use of native plant/tree species ➢ Construct raised walkways over sensitive areas ➢ Consider planting "beach gardens" to help restore nesting habitat for hawksbill sea turtles	**Chapter IV.** Management Issues: Protecting Coastal Habitats
Protecting Seagrass and Coral	➢ Prohibit actions that damage seagrass or coral ➢ Require all marine vessels be moored or docked ➢ Restrict anchoring to non-sensitive marine areas ➢ Demarcate a no-wake Swim Zone offshore the nesting beach ➢ Eliminate sedimentation and pollution – e.g., manage wastewater effluent, recycle graywater, maintain high standards for sewage treatment, emphasize low doses of landscape chemicals ➢ Educate divers and snorkelers about appropriate behavior underwater	**Chapter IV.** Management Issues: Protecting Coastal Habitats
Boats, Personal Watercraft	➢ Commit to reducing the impact of recreational boating on sensitive marine ecosystems ➢ Enforce a slow speed or no-wake zone offshore the nesting beach ➢ Encourage the use of propeller guards to reduce injury to marine life, including sea turtles ➢ Ensure that staff and guests know and understand all relevant rules and restrictions	**Chapter IV.** Management Issues: Boats and Personal Watercraft
Educating Staff and Guests	➢ Regularly train/evaluate staff in environmental management systems and sea turtle protocols ➢ Involve guests in sea turtle protocols; e.g., close curtains at night when interior lights are lit ➢ Make conservation fun! Host a Sea Turtle Summer Camp or Story Hour, sponsor a Beach Clean-Up, invite a local expert to give a Sea Turtle Talk, organize Nature Tours, recognize staff efforts ➢ Partner with a local conservation group to offer professionally guided Turtle Watches, <u>if</u> sea turtle species and habitats are conducive to viewing ➢ Use signage/in-room materials to inform guests of sea turtle (and other conservation) issues ➢ Always report nesting and hatching events	**Chapter V.** Guest Education and Participation

II. SEA TURTLE POLICY STATEMENT

Sustainable development requires commitment to a broad range of social and environmental issues. The intent of this Manual is to promote sustainable development within the hospitality sector, and specifically to assist beachfront property owners and managers in identifying actions that can be taken to protect sea turtles and their nesting beaches. We recommend that a *Sea Turtle Policy Statement* (STPS) be adopted to guide conservation efforts, that it support existing environmental management systems, and that it conform to industry standards (http://www.iso.org/iso/iso_14000_essentials). To this end we begin with a model STPS and a "check list" for its implementation, followed by a primer on sea turtle biology. The body of the Manual is devoted to recommendations, explaining in each case the linkages between actions taken from a facilities management standpoint and the benefits of those actions to endangered sea turtles. Finally, we discuss Guest Education and Participation and offer insight into the implications of investing in conservation programs as they relate to Green Globe and other industry certifications.

Getting Started

As stewards of some the most valuable and most vulnerable of Caribbean landscapes – coastal sandy beaches and nearshore marine environments – the tourism sector has the capacity to play a vital role in preventing the extinction of Caribbean sea turtles. Beachfront hotels in sea turtle nesting areas should have a *Sea Turtle Policy Statement* supported by environmental management systems (Eckert and Horrocks 2002). Guests, staff and contractors should be encouraged to take measures that protect nesting sea turtles, their eggs and their young. Staff in departments responsible for the actualization of the Policy should be trained annually. These departments may include Sports and Activities, Security, Grounds, and Maintenance.

Hotels should maintain important information, including emergency numbers (such as for local sea turtle experts, veterinarians, fisheries and wildlife officers, and police) and a calendar of nesting and hatching months. Relevant information should also be communicated with guests, including how (and to whom) to report a sea turtle sighting and how to behave if a sea turtle is encountered (e.g., see Appendix V, VI). Guests should be alerted to the fact that it is illegal to carry sea turtle parts and products, including jewelry, through Customs. Hotels should take all necessary steps to ensure that no items made from sea turtle shell are sold in gift shops on site, and that guests are aware of national laws protecting turtles.

In addition, consider making information about local sea turtle conservation projects available to guests. Guests and clients can be an important source of support for conservation projects, providing volunteer labor, donated skills and services, equipment, networking, and funding. Informed and active guests are more likely to pay attention to hotel rules concerning sea turtle conservation, and more likely to leave their vacation experience with treasured memories of their stay.

Making your property inviting to charismatic wildlife species and investing in their conservation can pay important dividends in public awareness and sustainable development, while providing an enchanting experience for guests and clients.

In the sections that follow, you will find useful information concerning a variety of considerations that, if properly addressed, can help to ensure ***harmonious co-existence with endangered sea turtles***. We hope that by learning more about sea turtles and the issues that affect them, you will be inspired to implement the Manual's recommendations – and to encourage others to do so. Sea turtles return to their birthplace to lay their eggs, meaning that your area supports a unique assemblage of reproductively active adults. If the population is extinguished, it cannot be replaced in any relevant time frame and, with its demise, will go the special value of your coastal property. We invite you to invest in your economic and ecological future by participating in sea turtle conservation – ***we can show you how***!

Sea Turtle Policy Statement

The International Organization for Standardization (ISO) develops standards for business, government and society, including requirements and guidelines for environmental management systems (EMS). An EMS meeting the requirements of ISO 14001:2004 is a management tool enabling an organization to identify and control the environmental impact of its activities, products or services; improve its environmental performance continually; and implement a systematic approach to setting (and achieving) environmental objectives and targets. The intention is to provide a framework for a holistic, strategic approach to environmental policy, plans and actions (see http://www.iso.org/iso/iso_14000_essentials).

WIDECAST's objective in developing this *Manual of Best Practices for Safeguarding Sea Turtle Nesting Beaches* is to provide the hospitality sector with a greater awareness of what can be done, within an EMS context, to "control the environmental impact of its activities" as far as sea turtles and their nesting beaches are concerned, and to provide "a framework for a holistic, strategic approach" to sea turtle conservation. As a first step, we recommend adoption of a *Sea Turtle Policy Statement* (see also Appendix I), not only for the benefit of sea turtles but also in support of the larger goals of sustainable development and good corporate citizenship. It should be the management's responsibility to ensure that the Policy Statement is available and accessible to all employees and published externally for the public.

Sea Turtle Policy Statement

Recognizing that sea turtles contribute in significant ways to the ecology, culture, and economy of the Wider Caribbean Region; that sea turtles are severely depleted from their historical abundance; and that while the large majority of Caribbean nations protect sea turtles, population recovery will not be possible without greater attention to the conservation of essential nesting and feeding habitats, **We Pledge To:**

- Encourage a commitment to environmental responsibility among employees and guests;
- View sea turtle protection as an opportunity for civic engagement in biodiversity issues;
- Be vigilant and aware of any risks to the environment which may occur within or outside our development area as a result of our activities;
- Assess environmental impacts of all activities, planned and ongoing, as they relate to the conservation of sea turtles and their habitats;
- Provide employees and contractors with information and instruction to enhance their awareness of relevant environmental issues, and to ensure effective management of environmental impacts, including impacts on sea turtles and their habitats;
- Identify and collaborate with local experts in designing, implementing and evaluating our sea turtle program to ensure that it fits within national sea turtle conservation priorities and ongoing initiatives;
- Make continual improvements in operations and management oversight to increase the effectiveness and reliability of our sea turtle conservation program;
- Comply with environmental legislation and local best practice policies related to turtles and their habitats (sandy beaches, seagrass, coral reefs) and encourage others to do so;
- Promote setbacks, maintain vegetated buffer zones between buildings and sandy beaches;
- Implement measures to minimize waste, including applying monitoring procedures to ensure that the nesting beach and nearshore waters remain free of debris and pollution;
- Conduct regular (at least annual) lighting assessments to identify sources of light pollution, and strive to eliminate artificial light visible from the beach during nesting season;
- Implement a system that removes potential obstacles to sea turtle nesting, including sunbeds and recreational equipment, from the beach each night during the nesting season;
- Discourage vehicles on the nesting beach and require hand-raking of debris and seaweed;
- Support sea turtle research, including offering financial or in-kind support, as practicable;
- Report all incidents of sea turtle harassment or harm to the proper authorities.

Check List for Implementing Your Sea Turtle Policy Statement

☐ **Identify sea turtle nesting habitat** on or near my property, know when nesting occurs.

☐ **Request assistance** from (and compensate) local experts for staff training and evaluation.

☐ **Preserve native maritime forest; restore vegetative cover** near nesting areas to help stabilize the sand, as well as further inland to reduce sediment run-off to reefs and seagrass.

☐ **Stop the mining of sand, gravel and stones from beaches** and adjacent areas; utilize alternative and more sustainable sources of construction material, and advocate for others to do the same.

☐ **Conduct beachfront lighting assessments** at least annually; remove, extinguish, redirect and/or lower light sources to **guarantee a dark nesting beach** and advocate for others to do the same.

☐ **Share the beach!** During nesting season remove obstacles (e.g., sunbeds) from the beach each night, hand-rake beach debris, and restrict or prohibit vehicle use, pets and bonfires in nesting areas.

☐ **Provide for ongoing beach cleaning** through government and private initiatives, public awareness efforts; provide garbage collection, proper sewage disposal, and effluent control.

☐ **Control the number of visitors** to sensitive areas; implement policies and enforce restrictions.

☐ **Think outside the beach**: implement policies to protect inter-nesting habitat and feeding grounds, including no-wake zones and mooring requirements, and enforce restrictions.

☐ **Provide for dedicated public access lanes to all beaches** and, where appropriate, provide facilities for beach users (e.g., parking, safety measures, sanitary facilities, garbage disposal).

☐ **Plan for existing and future coastline change** by positioning all new development, large and small, a "safe" distance landward of the line of permanent vegetation. Consult the Department of Physical Planning and/or relevant studies for information on **appropriate setback distances**.

☐ **Review and carefully consider all options** (planning, ecological, engineering) when considering ways to slow the rate of coastline change; **monitor changes** and share findings with stakeholders.

☐ **When considering new construction:** conduct, review and commit to implementation of an **Environmental Impact Assessment** (EIA). Identify and **collaborate with sea turtle experts** at all stages of planning, construction and operational phases, including for monitoring of impacts.

☐ **Involve all stakeholders** (Government, coastal residents and communities, NGOs, beach users, SCUBA dive operators) in the review and permitting process for coastal developments – and always take the needs of sea turtles into account! Planning processes should be **equitable, transparent**.

☐ **Involve our guests, clients, staff and contractors** in conservation measures through visible personal and corporate commitment to conservation issues, education, and invitations to participate.

III. SEA TURTLE PRIMER

There are seven species of sea turtle in the world, and six of these species are found in the Wider Caribbean Region (see Appendix II and Appendix III). These are, from largest to smallest, the leatherback (*Dermochelys coriacea*), green turtle (*Chelonia mydas*), loggerhead (*Caretta caretta*), hawksbill (*Eretmochelys imbricata*), olive ridley (*Lepidochelys olivacea*), and Kemp's ridley (*Lepidochelys kempii*), ranging in size from nearly 1,000 kg in the case of an adult male Leatherback to about 40 kg for an adult ridley. Most sea turtles inhabit tropical and subtropical waters. The leatherback has the broadest distribution of any living reptile, including swimming into subarctic waters.

Sandy Caribbean beaches are uniquely valuable in providing nesting habitat for endangered sea turtles, such as these loggerhead turtles shown during egg-laying (left) and, in hatchling form, scurrying for the sea (right). Photos: Scott A. Eckert (WIDECAST).

Basic Biology of Sea Turtles

Sea turtles are gentle, ancient reptiles adapted to life in the ocean. Like all reptiles, sea turtles have lungs and must come to the surface regularly to breathe air. With few exceptions, the only time a sea turtle leaves the ocean is to lay eggs. During breeding years, adult sea turtles leave their feeding grounds and migrate hundreds, sometimes thousands, of kilometers to mating grounds and nesting beaches.

No one knows for sure how long sea turtles live, but research shows clearly that sea turtles are slow growing, late maturing, and long-lived. Remarkably, sea turtles are 12 to 40 years old, depending on the species, before they breed for the first time. Once mature, a female may nest for two decades or more. Nesting behavior is stereotypic (meaning that basic behaviors do not differ appreciably among species) and generally occurs at night. Having located a suitable site above the tide line, a nest cavity is dug with the rear flippers and 80-200 or more eggs are laid and covered with sand. Females typically nest 2-6 times per year at 9-15 day intervals, depending on the species, and this cycle is repeated at 2-5 year intervals (only the smallest of sea turtles, the ridleys, tend to nest every year).

A sea turtle may produce thousands of eggs in her lifetime, but not all of them will hatch. Some will be infertile, some will be lost to erosion or eaten by predators, and others will be collected for human consumption, often illegally. Hatchlings are eaten in large numbers by predators; juveniles, too, face many dangers. Scientists estimate that only 1 in every 1,000 eggs will result in an adult sea turtle.

Once free from the egg, hatchlings work cooperatively to reach the beach surface. Generally they wait just beneath the surface of the sand for the temperature to cool, and most commonly become visible to beachgoers during the late afternoon or early evening hours. There is no parental care, and hatchings must find the sea using subtle light cues (orienting to the lowest, brightest horizon). When they reach the water they take advantage of an instinctive "wave compass", which compels them to swim directly into incoming waves. The tiny turtles then engage in a "swim frenzy", well known to science, that ultimately leads them into oceanic convergence zones that offer food and shelter during their early years.

With the exception of the leatherback (for which almost nothing is known about the juvenile life stage), young sea turtles return to coastal waters when they are about the size of a small dinner plate after having spent several years on the high seas. Once they return to the coastal zone they assume their adult diets and spend the next one to several decades traveling throughout the Caribbean Sea, slowly growing to maturity. At maturity, adult females return to the area where they were born, sometimes undertaking trans-oceanic journeys, to engage in egg-laying. Because adults tend to migrate long distances to preferred nesting beaches, nesting populations are often unrelated (genetically) to resident juvenile and adult foraging populations encountered year-around in coastal waters.

Sea Turtle Biology: Internet Resources

WIDECAST, *Caribbean Sea Turtles* (including taxonomic keys, terminology, and links for further reading): http://www.widecast.org/Biology/BasicBiology.html

FFWCC *Florida Marine Turtle Program* (including biology, research, and conservation issues): http://myfwc.com/seaturtle/

WWF, *Marine Turtle Programme for Latin American and the Caribbean*: http://www.panda.org/what_we_do/endangered_species/marine_turtles/lac_marine_turtle_programme/

WIDECAST, *Caribbean National Sea Turtle Recovery Plans*: http://www.widecast.org/Resources/STRAPs.html

NOAA Fisheries - Office of Protected Resources, *US National Sea Turtle Recovery Plans*: http://www.nmfs.noaa.gov/pr/recovery/plans.htm#turtles

NOAA Fisheries - Office of Protected Resources, *Marine Turtles*: http://www.nmfs.noaa.gov/pr/species/turtles/

US Fish and Wildlife Service - North Florida Field Office, *Sea Turtle Information*: http://www.fws.gov/northflorida/SeaTurtles/seaturtle-info.htm

Orientation and Navigation of Sea Turtles (University of North Carolina at Chapel Hill) http://www.unc.edu/depts/oceanweb/turtles/

During non-breeding seasons, leatherback turtles travel extensively on the high seas in search of jellyfish and related prey. Other species are more likely to be coastal in their habits. Loggerhead and ridley turtles are omnivores, consuming mollusks, crabs, jellyfish and other invertebrates; fishes and plants are also eaten. The green turtle is an herbivore, preferring to graze in calm, shallow seagrass meadows. Hawksbills specialize on coral reef sponges. Because most sea turtles will eat jellyfish, plastic bags pose a serious threat and can be fatal if ingested.

Sea turtles play important keystone roles in the marine environment, such as helping to maintain species diversity in coral reefs. Sea turtles are more easily studied on the nesting beach than at sea, however, so comparatively little is known of their non-nesting distribution, abundance, and behavior. Research conducted in the Caribbean Sea – including capture-recapture studies, tissue sampling, tagging, and telemetry – has taught us important new facts about patterns of residency, local and international movements, diet and growth, habitat use, genetic origin, and population status and trend. For more detail, please explore http://www.widecast.org.

Threats to Sea Turtle Survival

In general, and notwithstanding laudable conservation successes, sea turtle populations in the Caribbean Sea and throughout the world are severely reduced from historical levels. According to the World Conservation Union (IUCN) *Red List of Threatened Species* (http://www.iucnredlist.org/), persistent overexploitation, especially of adult females on nesting beaches, and the widespread collection of eggs are largely responsible for the Endangered or Critically Endangered status of all six Caribbean species. Some of the largest sea turtle populations the world has ever known once flourished in the Caribbean Sea (for example, the green turtles of the Cayman Islands), and these have all but vanished.

Sea turtles face a variety of dangers, both natural and man-made, that threaten their existence and result in localized extinctions. Threats accumulate over long periods of time and can occur anywhere in a population's range. Because sea turtles are highly migratory, declines often result from a combination of factors, both domestic and foreign.

In addition to a largely unmanaged harvest that has spanned centuries, turtles are accidentally ***captured in active or abandoned fishing gear***, resulting in death to tens, if not hundreds, of thousands of turtles each year. Coral reef and seagrass degradation, chemical pollution and marine debris, high density coastal development, and an increase in ocean-based tourism are among the many factors that have damaged or eliminated important nesting beaches and feeding areas throughout the Caribbean Sea. International trade in turtle products has also contributed to the demise of some species.

Sea turtles must return to the land to lay their eggs, and many contemporary threats are associated with physical development on or near nesting beaches. Perhaps the most pervasive problem is ***artificial lighting***. Sea turtles orient themselves for the return trip to the ocean by heading toward the lowest, brightest horizon which, under natural circumstances, is the open horizon over the ocean. Artificial lights and their glow confuse both adult females and hatchlings, disorienting them and luring them away from sea, making them more vulnerable to predators, dehydration, exhaustion, and an untimely death.

In addition to lighting, development often creates unnatural cycles of ***erosion***, reducing potential nesting habitat. Many mechanisms influence beach erosion, including the ***armouring of the shoreline***, placement of permanent structures on the beach, and the removal of native vegetation. Beach restoration and nourishment are sometimes executed to combat erosion. In bringing foreign sediments to the shore, however, ***beach nourishment*** can compact the surface of the sand, disturb or bury incubating eggs, and alter sand composition and temperature, potentially skewing the sex ratio of the hatchlings. Hatchling gender is largely determined by the temperature at which eggs incubate: warmer temperatures favour females, while cooler temperatures favour males.

The chronic removal of beach sand scars the terrain, accelerates erosion, and degrades or destroys stabilizing beach vegetation by extraction or saltwater inundation. ***Sand mining*** may also cause the formation of saline ponds in unsightly pits, the loss of trees to the sea, and the elimination of entire beach habitats. The loss of sandy beaches not only reduces the reproductive success of sea turtles, but endangers beachfront property and has serious economic implications for locally vital industries such as fishing and coast-based tourism. The Caribbean is replete with examples of sand mining operations that have reduced previously sandy beaches to rocky shorelines or foul-smelling saline pits, and eliminated once active nesting assemblages of sea turtles.

Beach erosion exposes sea turtle eggs in Trinidad (photo: Scott A. Eckert, WIDECAST), beach sand is mined in Montserrat (photo: Corinne Martin, Marine Turtle Research Group), and a local group protests beach sand removal in Bonaire (photo: STCB).

Obstructions, such as physical objects left on the beach at night (e.g., beach chairs, umbrellas, sail boats) can prevent sea turtles from finding suitable nesting habitat and, later, fatally hinder hatchlings from finding their way to the sea. ***Beach driving*** and the mechanical cleaning of beaches can crush incubating eggs and tire ruts trap hatchlings as they crawl across the beach to the sea.

Improper disposal of waste products also pose a threat. ***Litter*** can entangle or trap emerging hatchlings, preventing them from reaching the sea. The smell of garbage draws ***non-native predators*** such as dogs, raccoons, rats, and mongoose that eat eggs and hatchlings. ***Natural predators***, including ants, vultures, crabs, and so on, also take a toll. Once at sea, predatory birds and fish prey on hatchlings and larger predatory fish and mammals (such as orca or 'killer' whales) prey on juveniles and adults.

Native (vulture) and introduced (dog) predators consume eggs and hatchlings on the nesting beach (photos: Scott A. Eckert, WIDECAST), and a wide variety of carnivorous fishes (catfish) prey on hatchlings at sea (photo: Jacques Fretey).

In addition to predatory birds, fishes and sea mammals, turtles also face man-induced threats far from shore. Large quantities of ***marine debris*** are found in the ocean: plastic can block the stomach and hinder buoyancy and respiration, and sea turtles can die from eating plastic bags mistaken for jellyfish. Active or abandoned monofilament fishing lines entangle or hook sea turtles, often injuring or slowly killing them, and commercial fishing practices drown a tragically high number of sea turtles every year.

Potentially fatal encounters with fishing line (loggerhead turtle), an abandoned net (olive ridley turtle), and a buoy rope (leatherback turtle). Photos: T. Dellinger, R. L. Pitman, and J. DeSalvo, respectively.

Dredging, indiscriminate anchoring, blasting and chemical fishing also contribute to sea turtle mortality. Other consequences of general coastal development, such as industrial, residential and agricultural operations, include the runoff of ***pollutants*** (e.g., materials used in agricultural and industrial processes) and the dumping of untreated or under-treated ***sewage*** directly into the sea. The addition of organic pollution, nutrients, and sediments encourages algal growth while negatively affecting seagrass beds and coral reefs, both critical habitats for endangered sea turtles.

An ***oil contaminated environment*** can be lethal to sea turtles and their eggs. Behavioral experiments indicate that sea turtles possess limited ability to avoid oil slicks. Crude oil significantly affects the skin, some aspects of blood chemistry and composition, respiration, and salt gland function in juvenile sea turtles, as evidenced by physiological experiments. ***Oil and tar fouling*** can be both internal and external; cleaning is not difficult but does require expertise.

A young hawksbill turtle, drenched in tar, is cleaned and later released from The Turtle Hospital in Marathon, Florida (photo: The Turtle Hospital); a giant leatherback turtle, fatally injured, is not so fortunate (photo: P. Miller); a green turtle is heavily afflicted with fibropapillomatosis tumors (photo: MarineLife Center of Juno Beach, Florida).

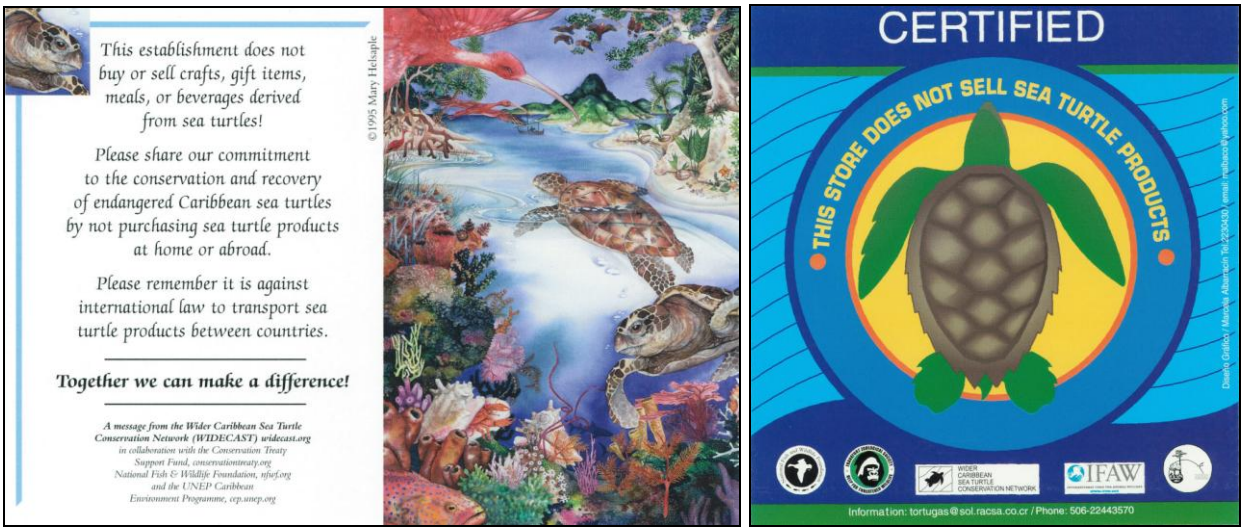
Various ***diseases and parasites*** affect the health of sea turtles. Fibropapillomatosis, certain species of encrusting barnacles, blood flukes and roundworms can all cause harm to sea turtles. ***Fungi and bacteria*** sometimes invade nests, lowering the probability that the eggs will hatch. Invading plant roots, especially from creeping beach vines, can also engulf and destroy incubating nests.

While the focus of this Manual is on habitat management, with a special emphasis on encouraging beachfront properties to adopt and implement a *Sea Turtle Policy Statement* to minimize development-related factors that threaten the survival of sea turtles, it is noteworthy that the ***direct take of turtles and eggs*** remains a significant source of mortality in many areas. Partnerships between coastal developers, local communities, conservation groups, and natural resource management agencies can lessen or eliminate this threat – for example, nightly beach patrols and/or guided Turtle Watches can help protect sea turtles, eggs and hatchlings, while at the same time collecting valuable management data, offering

seasonal employment to community partners, and providing an opportunity for guests to interact with local biologists, historians, and other experts while potentially witnessing the nesting process.

In addition to the consumption of meat and eggs, other products – including oil, skin (leather) and shell – may have cultural significance, medicinal value, or other utility. Hawksbill shell, in particular, has traditionally been crafted into jewelry and other ornamentation. ***International trade*** in hawksbill shell, illegal under the terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), is widely implicated in this species' decline. Such commerce is significantly reduced today, but turtle shell items can still be found for sale in some countries. Vendors should be vigilant about ensuring that turtle shell is not offered for sale to tourists, as departing the country with endangered species products in possession directly violates international law.

A clock face affixed to a green turtle carapace (left, photo: courtesy of the CITES Scientific Authority in Aruba) and accessories made from hawksbill shell in Mexico (middle) and Costa Rica (right) (photos courtesy of WIDECAST).



Vendor placards, available from WIDECAST, assure customers that products derived from endangered sea turtles are not sold.

In the chapter that follows, priority sea turtle management issues are presented in greater detail. Recommendations are given to assist and encourage the hospitality sector, and managers of beachfront property in particular, in their efforts to reduce mortal threats posed to sea turtles by construction and vehicles, beachfront lighting, beach stabilization and restoration, the removal of native vegetation, and other common consequences of shoreline development. Discussion is also aimed at pre-construction phases. In each case, ***recommendations are followed by suggestions for further reading*** and links to online reference materials.

IV. SEA TURTLE MANAGEMENT ISSUES

In support of an internally adopted *Sea Turtle Policy Statement* (see Section II), beachfront property owners and managers can take practical steps to enhance the survival prospects of endangered sea turtles nesting on or adjacent to their properties. In addition to the positive effect on sea turtles, benefits range from cost savings, including greater energy efficiency and/or lower water use, to stronger partnerships with local communities (including native plant vendors, artisans, historians, suppliers, tour guides, youth and conservation groups, law enforcement), greater staff involvement in conservation and community issues, unique guest experiences, and progress toward certain industry certifications.

We hope that the recommendations presented herein will inspire additional steps, large and small, that can be accomplished within an EMS context and with an aim to meaningfully and measurably improve sea turtle survival for the benefit of generations present and future.

Pre-Construction Phase

The pre-construction phase is the most important phase for environmental planning and for establishing a clear commitment to best practices; this is the phase where the placement of roads and buildings and patterns of access are established by design. In addition, it is in the pre-construction phase that workers typically bulldoze access roads, cut bush, fell native trees, dig trenches, burn debris and may in general be subject to less supervision than the more skilled workers that follow them.

Strict guidelines – and the will and the capacity to enforce them – are needed during the pre-construction phase, both on the part of Government and, equally important, at the highest levels of property ownership and management.

We recommend that developers and other stakeholders identify and approach local sea turtle experts (visit http://www.widecast.org/Who/Contact.html for contact information) early in the planning stages to discuss relevant issues, and to facilitate awareness and knowledge of practical solutions to potential threats to sea turtles resulting from the development scheme. From a beach protection standpoint, adequate setbacks are the most important aspect of any development, followed by proper attention to access roads and drainage, minimizing vegetation losses, and emphasizing the importance of keeping sandy beaches and associated dunes unlit and in their natural state.

Without a serious evaluation of the environment and terrain of access roads leading to key parts of the resort (including sandy beaches), gullies, dams and barriers may be inadvertently created or deviated and, as an unwanted consequence, the beach may be badly damaged by heavy rains. Resulting sediment plumes can affect nesting sites and adjoining marine habitats, including seagrass and coral reefs, and these can be severely degraded by new drainage patterns that carve through the beach, wash away vegetation, erode enormous volumes of sand, and undermine the root systems of even the largest trees. These issues should be addressed in an independent Environmental Impact Assessment, transparently reviewed and adhered to. There is no single source for information on best practices for Caribbean coastal construction, and relevant laws and policies differ from one country to another. But one thing is always true: it is cheaper to do it right the first time. Early planning to meet conservation goals pays its own dividends in eliminating the need to revise, retrofit, and re-engineer.

Pre-construction measures that should be accomplished to facilitate achieving environmental goals and prevent excess impacts include planning (project design can reduce impacts), scheduling (determining most appropriate/inappropriate times for project activities; e.g., avoiding sea turtle nesting and hatching seasons), operational details (considering the manner in which project activities are carried out; e.g., with minimal land clearing, hand-clearing vs. bulldozing, etc.), and technological considerations (e.g., using

control devices to prevent or restrict the release of deleterious substances; for example, use of filters and scrubbers, etc.). Security personnel during this phase should be trained to view the destruction of sea turtles and their habitats as an undesirable and unacceptable outcome, if not a criminal act.

Safeguarding environmental assets, including an uncontaminated water-table, clean sandy beaches, and erosion control, sediment filtration and shade provided by native vegetation, may not be intuitive (or even a high priority) for a developer. Moreover, national expertise may not be available to properly evaluate the scheme proposed. Therefore, establishing partnerships with experts and advocates is important. Ask colleagues for recommendations. Expertise can also be sourced from the UNEP Caribbean Environment Programme (http://www.cep.unep.org/issues/czm.html), OECS Environment and Sustainable Development Unit (http://www.oecs.org/esdu/index.html), Caribbean Alliance for Sustainable Tourism (http://www.cha-cast.com/), Caribbean Development Bank (http://www.caribank.org) and its Register of Consultants, UNDP in Latin America/Caribbean (http://www.undp.org/regions/latinamerica/), Caribbean Environmental Health Institute (http://www.cehi.org.lc/), eLAW: Environmental Law Alliance Worldwide (http://www.elaw.org/), experienced faculty of the region's many universities, and so on.

Experience has shown that it can be very useful to bring stakeholders and experts together through the formation of a local Advisory Group able to contribute in a positive way to ensuring a desired degree of procedural transparency, identifying solutions to a broader range of environmental challenges than can be addressed in this Manual, and then serving as or overseeing an independent monitoring body. The Advisory Group should be able to invite additional expertise, facilitate greater public awareness of key issues, and communicate effectively within and among affected sectors.

We hope that in reading through the sections that follow, developers and their advisors and contractors will be moved to take early action to forge partnerships with conservation experts, consider carefully the environmental consequences of access roads, drainage designs and deforestation, take into account the various recommendations of this Manual, and take pride in their role as sea turtle stewards.

Getting Started: Internet Resources

NOAA Ocean and Costal Resource Management, *Planning, Policy and Regulatory Approaches to Shoreline Management*:
http://coastalmanagement.noaa.gov/initiatives/shoreline_ppr_overview.html

UNEP Caribbean Environment Programme, *Coastal Zone Management*:
http://www.cep.unep.org/issues/czm.html

Island Resources Foundation, *Environmental Planning, Sustainable Development and Impact Assessment in the insular Caribbean*: http://www.irf.org/mission/planning/pubs.php

A Note about Internet Resources: Each topic is followed by links to more detailed information available on the Internet. As an example, see "Getting Started: Internet Resources" above. The name of the host organization, as well as the title of the page or article, is presented. Specific Internet addresses may become inactive over time, but the information you seek is most likely still available. Access the host organization (e.g., WIDECAST, UNESCO-CSI, NOAA, Surfrider Foundation), then search for the subject of interest. To minimize the probability that Internet information will disappear, we have confined our links to well-established programs; for example, UNESCO's "Environment and Development in Coastal Regions and in Small Islands" program, NOAA's "Ocean and Coastal Resource Management" program, etc. The Manual is concise by design and intent, but the issues are complex. Stakeholders should always identify local experts, create partnerships, and actively seek information on current (and sometimes evolving) best practices.

Construction Setbacks

Hawksbill sea turtles (left: Jumby Bay, Antigua) often seek the shelter of vegetation, while green sea turtles (right: Mona Island, Puerto Rico) tend to prefer the open beach platform. Photos: Scott A. Eckert (WIDECAST).

Many sea turtle species preferentially select wide, obstacle-free beaches for nesting. Losses to erosion and salt water inundation are less likely to occur in nests located on the higher areas of the beach. Coastal development, especially beachfront development, can reduce the quantity and quality of available nesting habitat. Physical development, including construction, equipment storage and landscaping, appropriately set back from the sandy beach, is the best way to promote continued nesting by sea turtles.

Most shorelines continuously change due to the nature of wave action, making setbacks desirable to protect both beachfront property and sea turtle nesting habitat, as well as to protect pristine vistas that enhance the tourist experience. Specific characteristics of the beach and backshore environments must be considered in determining an appropriate setback. Setback limits should reflect any potential damage that a major storm can cause to the beach and its surrounding areas. Areas of vegetation – sand dunes and lawns located between buildings and the beach – also need to be considered in establishing the setback.

According to Cambers (1998a,b), coastal setback provisions ensure that development is prohibited in a protected zone adjacent to the water's edge. Setbacks are often defined as a prescribed distance to a coastal feature (such as the line of permanent vegetation, see Wason and Nurse 1994), within which all or certain types of development are prohibited. Coastal development setback guidelines differ depending on shoreline characteristics and typically range from 15 m to 100 m from the line of permanent vegetation. The shortest setback distances are typically associated with cliffed coasts or low rocky shores, while longer distances are typically associated with less predictable sandy shores.

Setbacks serve several widely recognized functions:

- Setbacks provide buffer zones between the ocean and coastal infrastructure, within which the beach zone may expand or contract naturally without the need for seawalls and other structures that may imperil an entire beach system
- Setbacks reduce damage to beachfront property during high wave events, such as hurricanes
- Setbacks provide improved vistas and access along the beach

- Setbacks provide privacy for the occupiers of coastal property and also for persons enjoying the beach for recreation

The grassy lawn landward of the maritime forest serves as a "buffer zone" on Disney's Vero Beach Resort in Florida (left, photo: Ga-Young Choi), as opposed to the more traditional style of Caribbean beachfront development sited directly on the beach (middle, photo: Barbados Sea Turtle Project). Private homes in Antigua effectively utilize native shrubbery to shield the nesting beach from light and activity (right, photo: Jumby Bay Island Company).

Ideally, native vegetation and especially woody vegetation (which stabilizes the beach zone) should remain in place, as opposed to being cleared for "beautification" purposes or to make room for shoreside development. Some sea turtles prefer to nest in the vegetation, and others tend to nest in front of the vegetation – the farther the vegetation is cleared from the water, the further an egg-bearing female has to crawl to reach a favorable nesting site.

The setback area can be thought of as a "buffer zone", an area that can be utilized for activities that have minimal effects on sea turtles. Within this zone, salt-tolerant native species and ornamental landscaping can help minimize the potentially negative effects (e.g., lighting) of the primary development.

A lawn-style buffer zone is an option better suited for large properties, but with the caveat that dense ornamental grasses can prevent sea turtles from successfully digging a nest and therefore such plantings should not extend to the beach boundary. Non-native grasses often require excessive water and fertilizer, as well. Landscaping with native shrubby can block or reduce light pollution while at the same time demarcating a property boundary without further reducing nesting habitat. As a bonus, native shrubbery can actually provide important nesting habitat, as in the case of hawksbill sea turtles which tend to select sites within beach vegetation to deposit their eggs (Witzelll 1983, Meylan and Redlow 2006).

Cambers (1998a,b) suggests that one possible development option for the buffer zone might be a "small individual building made of wood and with no concrete foundations, to be used exclusively as a restaurant and/or bar", on the grounds that their economic viability depends on their proximity to the beach, with a setback for these structures established at 8 m landward of the vegetation line. The challenges in this case would be to limit artificial lighting on the beach (see "Beachfront Lighting") and to ensure that the structure did not hinder access to suitable nesting habitat.

Remember, the more dynamic the beach is, the more area of setback is necessary! In the absence of a setback, sea turtle conservation goals are more difficult to achieve.

Benefits of Implementation

In addition to protecting sea turtle nesting habitat, construction setbacks have been shown to significantly reduce the risk of property damage due to shoreline erosion (e.g., Cambers 1997, Clark 1996, 1998, McKenna et al. 2000, Cambers et al. 2008).

In the absence of construction setbacks, beachfront property is highly vulnerable to damage from natural erosion and storm cycles, as illustrated by this Four Seasons Hotel in Nevis, pictured before and after Hurricane Luis. Photos: Gillian Cambers (UNDP).

Coastal Setbacks: Internet Resources

Coastal Ecology of The Bahamas, *Best Management Practices for Site Design and Construction*: http://henge.bio.miami.edu/coastalecology/sustainable%20development/Best%20Practices.htm

UNESCO-CSI, *Coastal Setback Provisions*: http://www.unesco.org/csi/pub/info/info49.htm

Government of Barbados (Coastal Zone Management Unit), *Coastal Setbacks*: http://www.coastal.gov.bb/info.cfm?category=2&catinfo=9

NOAA Ocean and Coastal Resource Management, *Construction Setbacks*: http://coastalmanagement.noaa.gov/initiatives/shoreline_ppr_setbacks.html

Beachfront Lighting

A pervasive challenge throughout the Caribbean region is "light pollution", which can be defined as the introduction of artificially produced light into areas where it is neither needed nor desired. At nesting beaches, light pollution is known to modify sea turtle behavior. For example, artificial lighting onshore can discourage egg-bearing females from coming ashore to nest (Witherington 1992).

Beachfront lighting strongly affects sea turtle hatchlings, misdirecting them inland and away from the sea. Therefore, by depositing her eggs in lighted areas, the female may also endanger the lives of her hatchlings (for example, see studies by Witherington and Bjorndal 1991a,b). Hatchlings immediately orient themselves towards the ocean under natural (unlit) conditions, because the brightest direction is the open horizon of the sea. When artificial light becomes the brightest horizon, hatchlings can become either misdirected (move in the wrong direction) or disorientated (unable to orient in one constant direction), causing the hatchlings to suffer high levels of mortality due to predation and dehydration.

Bonfires are also a concern, as hatchlings can be attracted to and burned by the flames (Mortimer 1979).

Beachfront hotel lighting can confuse and disorient nesting sea turtles and their young, and is a common threat to sea turtle survival in the Caribbean region (photos: John Knowles, The Nature Conservancy).

Fortunately, reducing light pollution is among the most manageable of conservation practices. ***Artificial light does not need to be eliminated if proper light management techniques are adopted. Artificial light only becomes a problem if the light or glow from the source can be seen from the beach during nesting and hatching seasons.***

"Problem" light sources directly or indirectly produce a glow on the beach that can negatively influence sea turtle behavior. Direct lighting is a source that is visible from the beach, while indirect lighting illuminates buildings and landscaping which can be seen on the beach. The cumulative effect of lights from an area creates a sky-glow that can also affect sea turtles. Sky-glow can emanate from lights located inside and outside of buildings, as well as from street lights and recreational facilities (e.g., tennis courts, baseball fields) several miles away.

Hotel and resort projects in their initial stages of development should be encouraged to incorporate good lighting techniques into their building plans. The best practice is to prohibit lights near the nesting beach area. While it may not be practical in many cases to eliminate all lights near the beach, developers are often receptive to new ideas when informed about beach lighting and its potential consequences. With this in mind, hoteliers and developers, along with their architects, should discuss their lighting plans with local and regional experts. Developers should also be aware that Caribbean governments are increasingly requiring "sea turtle friendly" lighting for all new beachfront development.

The following discussion of "Inspections" and "Corrective Measures" is taken from the authoritative source on this subject: Witherington and Martin (2000).

Inspections

Existing hotels and resorts can take several steps to manage light pollution. Conducting an inspection is the first of these steps. First, demarcate the area to be inspected (e.g., the boundary lines of the hotel property) so that a census of the types, locations, and numbers of light sources observable from the beach can be conducted. The surveyor should conduct a preliminary daytime inspection to determine the exact locations of light sources that may be harder to verify in the dark. Along with placement, the surveyor should include detailed descriptions so that each light source can be located during follow-up inspections in the future. This process entails sketches, descriptions of the light sources (type of light, mounting), and photographs. The surveyor may also remark about how specific problems can be corrected (e.g., that the light can be turned off, shielded, or redirected).

Because the effects of some light sources, particularly indirect sources, are difficult to evaluate during the day, a night-time inspection (preferably on a moonless night) follows the daytime inspection, using notes taken during the day as a guide. Night-time inspections involve searching for visible light while walking the length of the nesting beach. Each source of light is categorized as either "direct" or "indirect", depending on how it appears on the beach. If the observer notices a bulb or glow from a light source, then this source qualifies as a direct source. If an illuminated building or landscaping is visible from the beach, the illumination is described as an indirect source.

The surveyor should also note the location of the light source, mounting (porch, pole), style of fixture, lamp type and color, and the number of lights. Photographing these sources at night is very useful. For indirect sources, the surveyor should take note of lit buildings and the angle of illumination. In a follow-up daytime inspection, a potential source for the indirect illumination should be determined, and property owners alerted to options to rectify the problem.

A comprehensive lighting inspection should occur at least annually, just prior to the nesting season. A follow-up night-time inspection should always occur two weeks after the initial inspection in order to identify lights that may have been missed previously. Two supplementary inspections during peak nesting and hatching periods will alert managers in a timely way to new and/or unexpected lighting problems on their own or adjoining properties. Potentially problematic lights should be remedied quickly, before they affect sea turtle behavior.

The Bucuti Beach Resort (Aruba) has incorporated many ecologically-sound management schemes, in addition to providing support to local sea turtle conservation organizations. The resort is continually looking to better its property, including assessing the costs and benefits of replacing existing outdoor lights with more 'sea turtle friendly' low pressure sodium lights. Photo: Ga-Young Choi.

Corrective Measures

All artificial lights can affect sea turtle behavior, but through certain management techniques, hotels and resorts can effectively reduce or eliminate potential harm. The following are recommendations for outdoor or external lights on hotel property. After the property makes alterations to the lighting scheme, a night-time inspection – and regular follow-up inspections (see above) – should take place to verify the effectiveness of the new lighting.

Priority Recommendations

Invest in Alterative Light Sources – Sea turtles are less sensitive to certain types (and colors) of lights. All metal hyalites can have adverse effects on sea turtles and should be replaced as a priority. High pressure sodium vapor lights also strongly affect sea turtles, and should only be used in areas not visible on the beach. Incandescent lights have moderate effects on sea turtle behavior, except for "bug lights" which are tinted yellow. Low pressure sodium vapor lights (LPS) are the least detrimental to sea turtles. Monochromatic yellow in color, LPS lights have the longest wavelengths, which sea turtles do not detect as readily. The best choice, if light is necessary, is often LPS lighting.

Lower Lights – The most visible lights (from a beach standpoint) are lights mounted high on buildings or poles. In many cases, simply lowering the height of the light may solve the problem. Lowering and directing light to precisely where it is needed can also be more aesthetically pleasing, more functional, and more cost-efficient from an energy usage standpoint.

Use Directional Fixtures – Some lights, such as carriage lights or globe lights, disperse light in every direction. Be thoughtful about your lighting! Do you really need to illuminate (and pay for!) the entire night sky? Directional fixtures applied to broadcast lights can focus the light downwards and away from areas visible from the beach.

Shield Lights – Shielding an open light source may reduce the amount of light directed onto the beach. Simple screens (such as the use of aluminum flashing) or planting vegetation (such as an ornamental hedge) can effectively shield lights. Be creative! Soften lights with locally-made basket shades, make greater use of wall sconces, and/or recess lighting in architectural elements. If shielding is impractical, then these lights may need to be substituted with lower, directional lighting.

Install Motion Sensitive Lights – When night-time lighting is indispensable, particularly from a security standpoint, installing lights with motion detectors reduces their detrimental effect on sea turtles because of the relatively brief duration of their illumination. Moreover, motion sensitive lighting carries the element of surprise, conveying a distinct advantage to posted guards who remain in the shadows. Motion-lighting provides light only when necessary, and is ideal for low-traffic areas.

Remove Unnecessary Lights – Lighting inspections may determine that some lights are unnecessary or redundant and can be removed or turned off, saving money and benefiting both ambiance and sea turtles. Try to avoid the use of purely decorative lighting, such as lights that highlight vegetation, in places that can be seen from the beach.

General Options and Recommendations

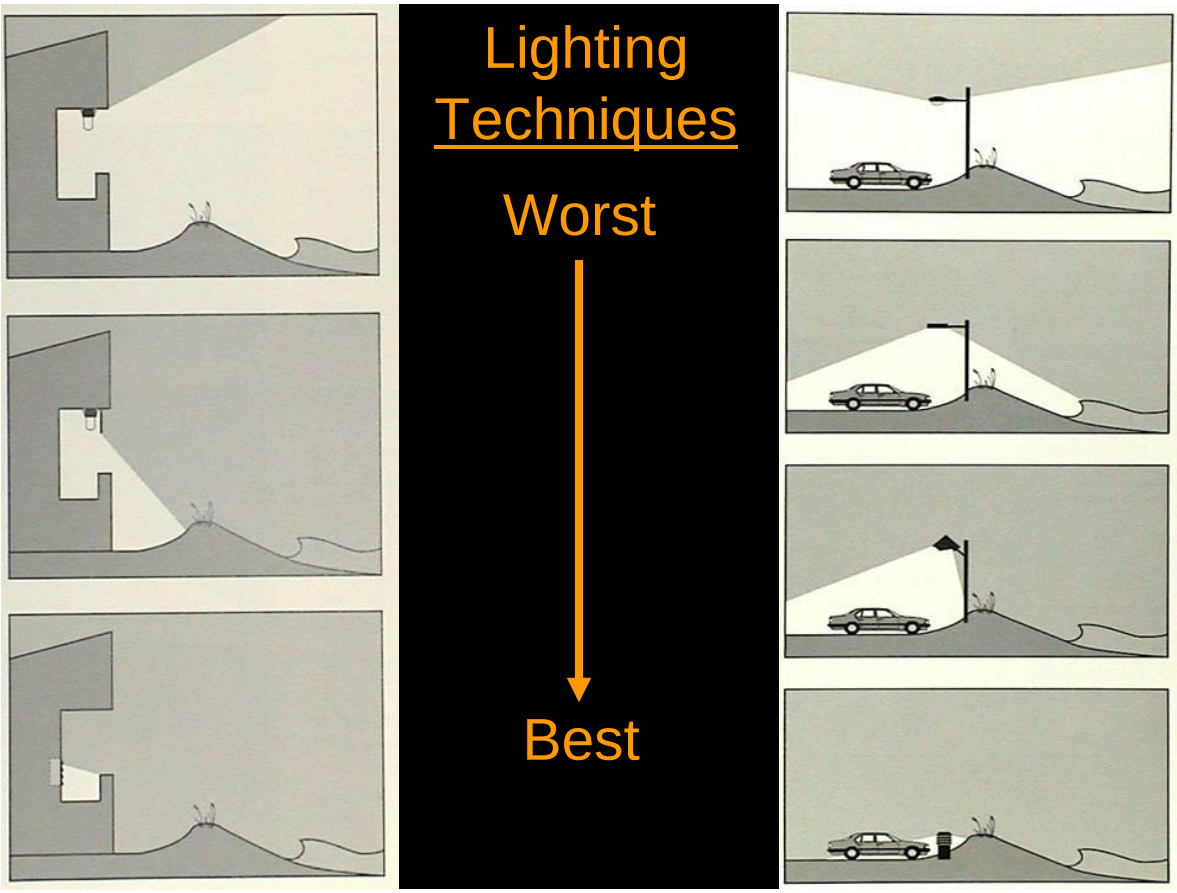
Time Restrictions – Restrict usage or extinguish lights during peak sea turtle nesting and hatching seasons, and especially during peak hatching hours (typically 7-11 PM) when hatchlings are most likely to emerge from their nests.

Area Restrictions – Limit beach lighting to areas of the beach that are not used by sea turtles, keeping in mind that even distant light sources can influence hatchling orientation.

Window Treatments – Interior lights, especially from high-rise buildings, can strongly affect hatchling behavior. Hoteliers can remedy this problem in various ways, including the use of black-out draperies (or heavy, opaque curtains), shade-screens, and/or tinting or using shading film on windows. Guests need to be reminded to close the drapes during sensitive hours. If window-

tinting is an option, tint the windows to meet the 45% light transmittance from inside to outside standards – this will reduce light leakage, as well as decrease energy loss and cooling costs.

Vegetation - Plant a decorative vegetation buffer between the beach and any buildings, with the specific aim of blocking light emanating from built structures. Use native plant species whenever possible (see also "Construction Setbacks").



Always consider where light is actually needed, and install lighting to meet that need (source: Witherington and Martin, 2000)

Benefits of Implementation

Reduce electrical demand by eliminating unnecessary lights, utilizing motion-sensitive lights, replacing incandescent lights with low pressure sodium (LPS) lights, etc. Initial costs may be high, but the investment is repaid by reducing the frequency with which light bulbs need to be replaced and reducing energy costs. If supplies for alternative lighting schemes are locally unavailable, consider networking with other hotels and developing a bulk supply order. Negotiate with the hotel association, tourism development agency, or other industry group to import the supplies at discounted rates.

Responding to Disoriented Turtles

During sea turtle nesting and hatching seasons the grounds should be inspected daily, both during the night and in the early morning, to rescue any adults or hatchlings that may have crawled inland. This task can be delegated to security officers, grounds staff, or any person routinely on hotel premises early

in the morning. Contribute to the national database by reporting sightings, as well as incidents of disorientation, to the appropriate management agency or conservation organization.

Adult Turtles

The following are helpful in ensuring the safety of a disoriented turtle: Turn off the offending lights to help the animal regain her bearings; quietly position yourself landward of the turtle to block her path away from the sea; clear any obstacles in her path; direct her movements with a dim flashlight (take care not to shine it directly in her face); allow her to crawl unassisted; and monitor her progress until she re-enters the sea.

Hatchling Turtles

Hatchlings rescued during the night or early morning hours should be allowed to crawl unassisted to the sea. Hatchlings rescued later in the day (when the sun and sand are hot) should be placed in a shaded bucket or cooler with slightly damp beach sand; at nightfall, they can be released at the site of hatching (with the offending lights turned off) or at a nearby locale with natural dark ambiance. In either case, hatchlings should be allowed to crawl unassisted across the beach to the sea. The beach crawl helps them to get their bearings. During the release, follow the same recommendations as above for adult turtles. Turn off lights, flashlights, and flash cameras. Do not place hatchlings directly in the surf.

Under no circumstances should hatchlings be retained as pets, for display or for profiteering. Hatchlings benefit from residual yolk that is internalized at hatching and is sufficient, under natural conditions, to nourish them during their offshore swim (see "Basic Biology of Sea Turtles"). If held captive during their earliest days, hatchlings may fall short of their swimming goal and meet an untimely death.

More questions? Model studies, including lighting inspection methodology for Caribbean properties and easy-to-follow, fixture-specific recommendations for problematic lights, are provided in Knowles (2007) and Lake and Eckert (2009), both of which are downloadable at http://www.widecast.org.

Disney's Vero Beach Resort (Florida) has implemented low pressure sodium (LPS) vapor lights, low and close to the ground to illuminate all walkways (left, photo: Ga-Young Choi). The US Fish and Wildlife Service, in partnership with Sea Grant and WIDECAST, has created switchplate stickers to remind hotel guests to turn their lights off during peak nesting and hatching periods.

Beachfront Lighting: Internet Resources

Witherington and Martin (2000), *Understanding, Assessing and Resolving Light-Pollution Problems on Sea Turtle Nesting Beaches*:
http://research.myfwc.com/publications/publication_info.asp?id=39080

Florida Fish and Wildlife Conservation Commission, *Florida Marine Turtle Program (including "Marine Turtles & Lights")*: http://myfwc.com/seaturtle/

FFWCC/USFWS, *Wildlife Lighting Certification Program*:
http://www.myfwc.com/conservation/Conservation_LivingWith_WildlifeLighting_index.htm

WIDECAST, *Conservation Threats and Solutions*:
http://www.widecast.org/Conservation/Threats.html

International Dark-Sky Association (including approved fixtures): http://www.darksky.org/

Starry Night Lights (including approved fixtures): http://www.starrynightlights.com/

Beach Sand Mining

We recommend that beach sand mining be prohibited by law. Because mining removes sand from the coastal system as a whole and may ultimately affect beach properties distant from the mining, lobbying for holistic regulations and enforcement is important. Specific sites, preferably inland deposits, should be designated for sand mining – extraction fees should be implemented and permit conditions enforced.

Natural beach sand deposits are important for recreation by residents and tourists and serve as a barrier against storm waves, thus protecting coastal residences and commercial investment. Sand is important as a raw material for cement, but chronic removal of sand for construction and other purposes can accelerate beach erosion and degrade or destroy coastal vegetation by uprooting it or flooding the ground with seawater. In severe cases, saline ponds are formed in unsightly pits left by mining operations, shoreline trees and other stabilizing vegetation are lost to the sea, and entire beach habitats are eliminated.

Beach sand mining degrades sea turtle nesting habitat in Nevis (photo: Alicia Marin) and Sint Eustatius (photo: STENAPA).

Beach sand removal has reached crisis proportions in many area of the Caribbean (e.g., Cambers 1997). Islands, in particular, are replete with examples of sand mining operations that have reduced previously sandy beaches to rocky shorelines or foul-smelling saline pits and eliminated once active nesting assemblages of sea turtles. Loss of sandy beaches not only reduces the reproductive success of sea turtles and endangers beachfront property, but it has serious economic implications for vital sectors such as fishing and coast-based tourism.

Benefits of Implementation

The use of beach sand in construction provides inferior results, including corrosion of steel support elements and electrical components. By using high quality, legal aggregate developers achieve better construction with less impact on fragile coastal resources – and help to protect sea turtle nesting habitat.

Beach Sand Mining: Internet Resources

UNESCO-CSI, *Coping with Erosion* (Case 6: Where Sand has been Mined from the Beach): http://www.unesco.org/csi/pub/source/ero1.htm

UNESCO-CSI, *Managing Beach Resources in the Smaller Caribbean Islands*: http://www.unesco.org/csi/pub/papers/papers13.htm

Beach Maintenance

Sea turtles return predictably to sandy beaches to lay their eggs. At the same time, restaurants, hotels, resorts, and other service-providing businesses take advantage of and rely on these same beaches to appeal to beachgoers and tourists.

With a little effort and to the benefit of both, businesses and sea turtles can share the beach. Emphasizing best practices with regard to beach maintenance not only enhances the beauty of these areas and safeguards their utility for sea turtle reproduction, but can also improve the health and safety of beaches for residents and tourists alike.

A leatherback turtle crawls ashore to nest: if she encounters a major obstacle, such as a storage building, a fence or stone wall, a sailboat or swimming pool, she may be unable to locate a suitable nest site. Similarly, small hatchlings can become trapped and disoriented by obstacles. Photos: Benoit deThoisy, French Guiana (left) and Jenny Freestone, Antigua (right).

The following are recommendations for safeguarding nesting habitat, including beach cleaning, evaluating the need for beach restoration and stabilization structures, managing traffic patterns, and more. In each case, suggestions on overcoming the most common challenges are provided.

Obstacles to Nesting

Hotels and resorts often provide guests with beach chairs and umbrellas. If these remain on the beach at night, they may block egg-laden females from suitable nesting sites or confuse hatchlings attempting to find the sea. Beach furniture, recreational equipment (e.g., sailboats) and other large objects should be removed from the beach before nightfall. To the extent practicable, furniture and equipment should be removed manually because vehicles can compact surface sand and crush incubating eggs.

If beach furniture cannot be removed from the beach entirely, consider stacking it. Furniture left on the beach can deter females from reaching nesting areas above the high water line (Figure 1), whereas stacked furniture (Figure 2) is less likely to have the same effect. Furniture should be arranged so that the shortest side faces the water.

Figure 1

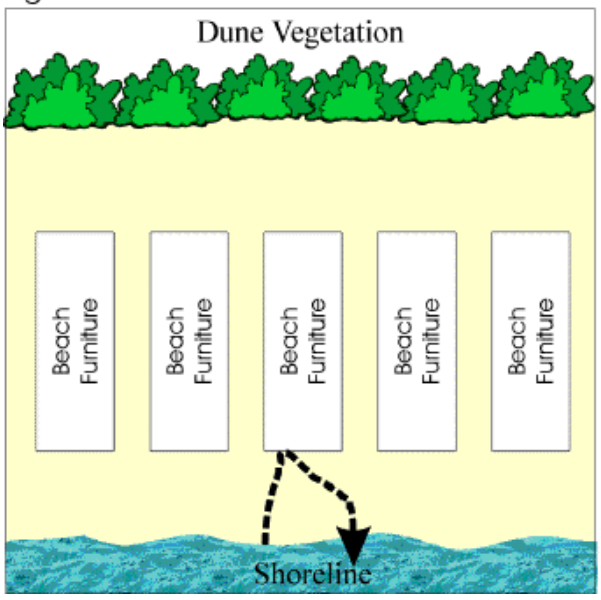
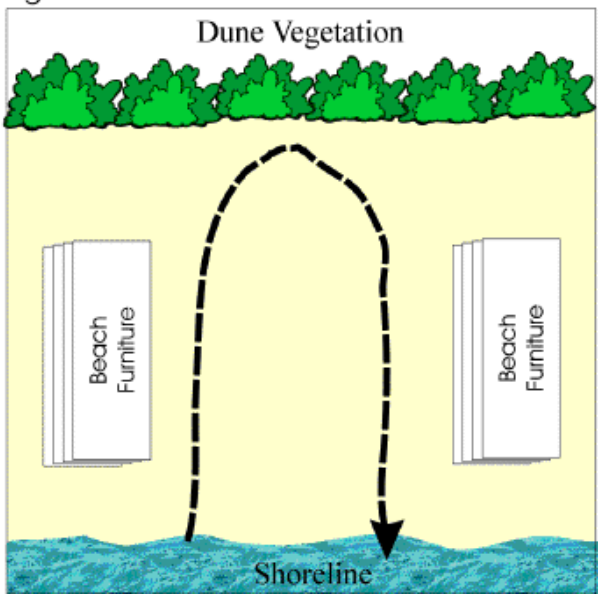


Figure 2



Florida Fish and Wildlife Conservation Commission: http://myfwc.com/seaturtle/beach%20activities/beach_furniture.htm

Umbrella sleeves or permanent holders can offer additional protection against nest damage by ensuring that umbrellas will not be thrust into a nest area. Umbrellas that fasten onto other furniture present another practical alternative. Ideally, a sea turtle expert should be recruited (or trained in-house) to monitor the beach, make note of the position of new nests, obscure (rub out) the nesting crawl if poaching is a threat, and clearly block-off these nests every morning before guests or staff begin to re-establish the beach furniture.

With the help of local conservation groups, beachfront hotels and resorts can promote nest protection using any one of several techniques that prevent beachgoers from accidentally damaging the incubating eggs. These techniques can include markings and signs that caution beachgoers to sensitive habitat, and can be informative in terms of letting the public know that sea turtle eggs are incubating. Signage can also inform tourists that chairs and umbrellas should be established at least 2 m (6 feet) from marked sea turtle nests in order to prevent the accidental puncture of eggs or compaction (crushing) of the nest.

Cautionary notes: if egg poaching is a threat, nest locations should not be marked. Eggs should never be handled (such as with the intent of relocating them to hatchery enclosures) without appropriate permits from Government and without explicit training and oversight by local sea turtle experts. Internationally accepted protocols should be adopted (e.g., Eckert et al. 1999, Wood 2004, Stapleton and Eckert 2008).

The hotels on Eagle Beach (Aruba) support the efforts of local conservation groups to protect turtle nests from beach traffic. The barricades (left) prevent people from accidentally trampling on the nest. Signs affixed to each barricade (middle) describe appropriate behavior around nesting turtles and hatchlings. The barricaded nests generate curiosity amongst tourists, who eagerly await the emergence of hatchlings (right). Photos: Ga-Young Choi.

In the absence of any mitigative action, experience shows that sea turtles can be mortally harmed on beaches strewn with recreational equipment and other potential obstacles to nesting.

Beach chairs, umbrellas, boats and kayaks act as obstacles to nesting and hatching sea turtles (left, photo: Ga-Young Choi) and Can be fatal as in this case (right) where an egg-laden female was impaled in a beach chair while attempting to nest in Florida (photo: Zoé Bass, Coastal Wildlife Club, Inc.).

Litter and Debris

The ubiquitous presence of marine debris, coupled with its physical, ecological and socio-economic complexities, poses a severe threat to the sustainability of the world's natural resources. Marine debris – man-made objects that enter the marine environment through careless handling or disposal, intentional or unintentional release, or as a result of natural disasters and storms – is one of the ocean's most pervasive, yet potentially solvable, pollution problems (e.g., Coe and Rogers 1997, Sheavly 2007).

Litter and debris along the coast, including on sea turtle nesting beaches, soon makes its way to the sea where turtles and other marine creatures may consume it and be injured or killed as a result. Since both sea turtles and the tourism industry – not to mention the broader ocean – benefit from clean sandy beaches, it is important to remove (and dispose of) litter and debris in an environmentally sound way.

Beach cleaning should be accomplished by non-mechanized raking and litter removal. EMS protocols should emphasize the importance of beach cleaners reporting any evidence of sea turtle crawling, nesting, egg poaching, or hatching before the evidence is disturbed by raking.

Cleaning equipment should only be used outside of the sea turtle nesting season: tractors compact sand and can crush incubating eggs, making it more difficult for females to nest and for hatchlings to emerge successfully (photo: Frankston City Council, Australia). Hand-raking is an environmentally friendly alternative (photo: Turtugaruba Foundation, Aruba).

Heavy machinery can compact sand, destroy nests, and leave deep grooves that trap hatchlings as they crawl to the sea. If the use of mechanical equipment cannot be avoided during the nesting season:

- Cleaning should only take place at or below the high tide line, and only during the day
- Cleaning equipment should not penetrate more than 2 inches into the sand
- Collected debris and trash should be disposed of properly, away from the beach
- Cleaning equipment should be kept at least 3 m (10 feet) from salt-tolerant beach plants

Hoteliers can take preventative measures to reduce the amount of garbage discarded on or near nesting beaches by the convenient placement of waste receptacles. Receptacles must be emptied often so as not to become unsightly and/or attract unwanted predators (including dogs, mongoose, rats, foxes, vultures and seagulls) of sea turtle eggs and hatchlings.

Equally important are efforts to reduce waste generation, in accordance with EMS, in all aspects of facility operations. For example, reducing the amount of plastic used by the hotel will reduce potential plastic waste on the beach. To the end, Disney's Vero Beach Resort (located on an important nesting beach in Florida) has eliminated the use of plastic lids and straws, offering reusable cups and glasses instead (Denise Leeming, Disney's Vero Beach Resort, personal communication).

Organizing a beach clean-up offers a way for staff, members of the local community, conservation partners, and even guests and clients to become involved in keeping the nesting beach safe for sea turtles and sanitary for beachgoers. In-house options may require that a different department take turns, perhaps on a monthly basis during the nesting season, organizing an employee-sponsored beach clean-up. Inviting guests to participate might involve offering, on a lottery basis, a complementary meal or night's stay when they book a future vacation.

It is a common occurrence throughout the Caribbean that local conservation groups, in partnership with youth, organize community-sponsored beach clean-ups, enticing volunteers with incentives such as free prizes and food. Members of the hospitality sector often become involved in these campaigns by paying for garbage bags, sponsoring bus transportation or water for volunteers, or donating prizes. Joining the International Coastal Cleanup (see "Internet Resources") links your efforts to global databases.

Youth participating in community-organized clean-ups of sea turtle nesting beaches on Union Island, Saint Vincent (photo: Environmental Attackers), Nevis (photo: Nevis Turtle Group) and Rosalie Beach, Dominica (photo: Scott A. Eckert, WIDECAST).

Beach Cleaning: Internet Resources

Florida Fish and Wildlife Conservation Commission, *Share the Beach – Guidelines for Beach Cleaning during Sea Turtle Nesting Season*: http://www.myfwc.com/WILDLIFEHABITATS/Seaturtle_BeachCleaning.htm

Surfrider Foundation, *Beach Grooming*: http://www.surfrider.org/a-z/beach_grooming.php

Surfrider Foundation, *Marine Debris*: http://www.surfrider.org/a-z/marine_debris.php

NOAA, *Marine Debris* (including definitions, types and components, sources, movement, and impacts): http://marinedebris.noaa.gov/marinedebris101/mdinfo.html

The Ocean Conservancy, *International Coastal Cleanup* (register and get involved!): http://www.oceanconservancy.org/site/PageServer?pagename=icc_home

Katelios Group (Greece), *Education – A Decalogue for Tourists*: http://www.kateliosgroup.org/decalogue.htm

Beach Stabilization

Most Caribbean beaches are naturally dynamic. To protect commercial investments, such as beachfront hotels, from cycles of erosion and accretion, beach stabilization typically involves the use of breakwaters, jetties, impermeable groynes and/or seawalls. However, these structures are expensive and can be less effective in the long term than certain alternatives, such as the use of construction setbacks (see "Construction Setbacks"). Moreover, because they interfere with the natural longshore transport of sediment, the armoring of one beach segment often results in the "starvation" and eventual loss of other beaches down-current (e.g., Greene 2002). In addition, the armoring of beaches can limit or eliminate access to sea turtles seeking a suitable incubation environment for their eggs.

According to Cambers (1998b), "One of the dominant characteristics of beaches is their constant changes in form, shape and sometimes the very material of which they are composed. The best way to conserve beaches is to allow them the space to move – in a seaward direction when sand is building up (accretion) and in a landward direction during erosion phases. The prudent use of coastal development setbacks or establishing a safe distance between buildings and the active beach zone can ensure that space is provided for a beach to move naturally, both during normal events and infrequent hurricanes, thereby ensuring the beach is conserved for all to enjoy and that coastal infrastructure remains intact."

Beach armoring, such as this seawall (left), can worsen localized erosion and reduce sea turtle nesting habitat, while jetties (right) disrupt longshore sand transport and starve down-current beach segments, also reducing sea turtle nesting habitat (photos: Florida Fish and Wildlife Research Institute, http://research.myfwc.com/gallery/).

Coastal armoring structures impede sea turtle reproduction by limiting access to suitable nest sites; e.g., egg-laden females cannot reach favorable habitat above the high-tide mark due to barricades and sea walls. On some beaches, stabilizing structures have inhibited all sea turtle nesting activity (Steinitz et al. 1998). The disruption of the sand distribution cycle also impacts other sea-life; for example, armoring alters coastal currents, influencing algae density and distribution (e.g., Fletcher et al. 1997).

The better solution to beach maintenance is an enforced construction setback adequate to reduce or eliminate the risk of losing coastal buildings to routine erosion or violent storms. **We recommend**, from a policy standpoint, that national planning legislation adopt a strong stance regarding setbacks for beach-front development and require mixed-species vegetated buffer zones between built facilities and sandy beach platforms. Setbacks not only help to protect coastal properties from storm damage, but lessen the likelihood that local residents will be excluded from the beach and enhance the probability that artificial lighting will not shine directly on the beach (see "Beachfront Lighting").

Beach Stabilization: Internet Resources

UNESCO-CSI, *Coastal Erosion* (including publications on coastal development and setback guidelines for Caribbean nations, as well as strategies and "wise practices" for coping with beach erosion): http://www.unesco.org/csi/theme/them2.htm

UNESCO-CSI, *Coping with Beach Erosion* (determine your "Vulnerability Index", see Chapter 2 and Appendix I): http://www.unesco.org/csi/pub/source/ero1.htm

NOAA, *Shoreline Management (Alternatives to Hardening the Shore)*: http://coastalmanagement.noaa.gov/shoreline.html

Western Carolina University, *Program for the Study of Developed Shorelines* (including reports and documents on coastal hazards, beach nourishment, beach preservation, and beach stabilization): http://psds.wcu.edu

Surfrider Foundation, *Shoreline Structures* (including an overview of the issue, environmental impacts and policy responses): http://www.surfrider.org/structures/index.asp

Beach Restoration[2]

The linkages between development and the persistence of sandy beaches are complex, and should be considered with care before construction near sandy beaches is permitted or undertaken. If dunes are leveled, vegetation removed, and/or solid jetties or seawalls constructed, the likelihood of committing the owners to repetitive and increasingly expensive beach renourishment is heightened. Rebuilding a natural beach is costly, and often ineffective. The forces precipitating the erosion generally cannot be allayed by the act of restoration, and in many cases the cycle inexorably begins anew.

According to Cambers (1999), beach restoration (or renourishment) is a technique little used on Caribbean islands, in part because the cost of dredged sand ranges from US$5 to $16 per cubic meter; in addition, mobilization costs for the dredge may range from $100,000 to $300,000, depending on the location of a suitable dredge. She describes beach restoration as the addition of large volumes of sand (obtained from an inland or offshore source) to the beach and notes that, since land sources of sand are limited in the Caribbean, the sand is usually obtained from the offshore zone, mixed with water, and pumped via a floating pipeline onto the shore.

In a recent assessment in southeast Florida, Wanless and Maier (2007) attributed widespread failure of renourishment projects to, among other things, a lack of appropriate and affordable material nearby. Replacement sediments generally displayed unsuitable grain size, durability, and hydrodynamic behavior for a beach setting. Specifically, sands derived from dredging on the adjacent shelf contained excessive amounts of fine sand and silt too small to remain on the beach; as a result, coral and hardbottom habitat on the adjacent narrow shelf were stressed by increased sediment turbidity, siltation, and smothering.

Beach renourishment project in Ocean City (photo: Rutgers University, Institute of Marine and Coastal Sciences, http://marine.rutgers.edu/geomorph/oceancityfill.jpg).

Renourished beach sand also tends to become compacted, reducing the quality of the nesting habitat. Compaction alters sand temperature and moisture levels, preventing adult females from successfully constructing their nests and/or affecting the development process of the incubating eggs. If restoration is

[2] *Beach restoration* involves the placement of sand on an eroded beach for the purposes of restoring it as a recreational beach and providing storm protection for upland properties. *Beach nourishment* (or renourishment) generally refers to the maintenance of a restored beach by the replacement of sand. Restoration is generally accomplished by bringing sand to the beach from inland sites or adjoining beach segments, or by hydraulically pumping sand onshore from an offshore site.

unavoidable, replacement sand should be similar (grain size, organic content) to that which was eroded, thereby maintaining the suitability of the beach for the incubation of sea turtle eggs. Restoration should never occur during nesting and hatching seasons when heavy equipment and activity can deter nesting, crush eggs, and/or prevent hatchlings from successfully digging out of the nest.

Experts continue to debate whether beach renourishment affects sea turtle nesting behavior (Davis et al. 1999). Steinitz et al. (1998), Rumbold et al. (2001) and others have published data demonstrating that the number of nests decreases and the number of false crawls (unsuccessful nesting attempts) increases immediately following the renourishment of a beach. Crain et al. (1995) concluded that while beach restoration projects may enhance some nesting areas, in general the effects (for sea turtles) are negative.

It is worth noting that there is an imbalance in the system somewhere when sand is lost from an otherwise predictable beach habitat and is not replaced by natural accretion processes. The underlying cause can be as direct as an up-current solid jetty or pier that is literally "starving" the down-current beaches by interrupting the longshore transport of sand and sediments (see "Beach Stabilization Structures"). Or the impetus may be more subtle, as occurs with the removal of beach vegetation or when nearshore pollution retards the productivity of calcareous (coralline) algae and other sand sources.

The best – and least expensive in the long term – way to reduce the need for beach restoration is to define and enforce construction setbacks adequate to ensure that the development itself does not exacerbate natural cycles of erosion and accretion. Setbacks can also help to ensure that natural beaches will replenish themselves over time, following a serious erosion episode (see "Construction Setbacks").

Protecting coastal vegetation is also important. Damage assessments following the December 2004 Indian Ocean Tsunami clearly showed that coastal vegetation (e.g., mangroves, beach forests) helped to provide protection and reduce effects on adjacent communities. When this vegetation is cleared, the shoreline is more vulnerable to storm damage; conversely, establishing or strengthening greenbelts of mangroves and other coastal forests "may play a key role in reducing the effect of future extreme events" (Danielsen et al. 2005), reduce the need for beach restoration, and reduce economic losses.

Beach Restoration and Nourishment: Internet Resources

UNESCO-CSI, *Coastal Erosion*: http://www.unesco.org/csi/theme/them2.htm

UNESCO-CSI, *Coping with shoreline erosion in the Caribbean*: http://www.unesco.org/csi/act/cosalc/shore-ero.htm

UNESCO-CSI, *Wise Practices for Coping with Beach Erosion*: http://www.unesco.org/csi/wise2b.htm

National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center, *Beach Nourishment Guide for Local Government Officials*: http://www.csc.noaa.gov/beachnourishment/

National Oceanic and Atmospheric Administration (NOAA), *Overview of State, Territory, and Commonwealth Beach Nourishment Programs*: http://coastalmanagement.noaa.gov/resources/docs/finalbeach.pdf

Western Carolina University, *Program for the Study of Developed Shorelines* (including reports and documents on coastal hazards, beach nourishment, beach preservation, and beach stabilization): http://psds.wcu.edu

Vehicle Use

In many areas, beach driving has become a popular activity. However, driving on beaches can seriously degrade the coastal environment by damaging beach vegetation, compacting sand, crushing incubating eggs, creating deep ruts and tire tracks that can trap hatchlings trying to reach the sea (Hosier et al. 1981), and accelerating erosion (potentially resulting in the loss of nests to the sea). Vehicles can also strike and kill hatchlings crawling to the sea, or frighten females away from nesting. Hatchlings huddled just below the surface of the sand (waiting to emerge later in the evening, when the sun sets and the beach surface cools) are particularly vulnerable to being crushed by passing vehicles.

Driving on nesting beaches can be detrimental to sea turtles by compacting the sand (which can crush buried eggs), killing hatchlings, and promoting erosion. Photos: Turtugaruba Foundation, Aruba.

We recommend that, with the exception of authorized patrol or emergency vehicles (which should be required to drive below the high tide line), motorized vehicles not be allowed to drive on sandy beaches except at authorized boat haul-out sites.

A bumper sticker encourages awareness of beach driving. Here we see eggs and hatchlings, buried unseen below the sand at Sandy Point National Wildlife Refuge in St. Croix, crushed by a passing vehicle (left, photo: Scott A. Eckert, WIDECAST).

Beach Driving: Internet Resources

Surfrider Foundation, *Beach Driving*: http://www.surfrider.org/a-z/beach_driving.php

Protecting Coastal Habitats

Beach Vegetation

The hawksbill sea turtle often selects a nest site within the shelter of woody vegetation. The loss of vegetation can mean that a female must crawl further onshore in search of suitably vegetated areas. Other species prefer to nest on the open beach platform in front of vegetated areas, using the dark vegetation backdrop as an important ambient cue. After egg-laying is complete, vegetation can be important in safeguarding sea turtle nests by helping to maintain the natural beach structure, reducing compaction of sand grains, moderating diurnal temperature changes, and reducing erosion.

Vegetation can also provide an aesthetically pleasing tool to reduce or block beachfront lighting that would otherwise discourage sea turtles from nesting or misdirect hatchlings away from the sea (see "Beachfront Lighting"). One study has shown that this is especially true on urban beaches where problems with artificial lights exist; female sea turtles preferentially nested in front of vegetated areas or dunes in these areas (Salmon et al. 1995).

Coastal tourism development has placed extreme pressures on once pristine sandy beaches. Among other stresses, property owners often remove native vegetation and natural debris (e.g., St. Omer and Barclay 2002) and replace (or displace) native species with non-native ornamentals. Non-native species can disrupt vegetative communities, pollination cycles, water use, nutrient transfer, and patterns of erosion. For example, Australian pines often crowd-out native trees and palm trees can exacerbate wind erosion. These human-induced actions and reactions cause an overall reduction in available nesting habitat for sea turtles, and can significantly diminish the quality of the nesting habitat that remains.

What Can Be Done?

Hoteliers and resorts can adopt, within the context of EMS, certain standards and practices in regards to vegetation. ***Strive to protect beachfront forest, and to restore native vegetation*** and natural habitat which has been lost. Become familiar with and utilize native trees and shrubs – including sea grape (*Coccoloba uvifera*), almond (*Terminalia catappa*) and portia (*Thespesia populnea*) trees, coco plum (*Chysobalanus icaco*), and so on – for landscaping purposes.

In general, native plants require less maintenance and save energy – planted properly, they require little or no extra water, fertilizer, or pesticides (which ultimately pollute local waterways). In addition, they display resistance to insects and disease and often attract desirable wildlife including birds, butterflies, and pollinators. Identify source-books on locally occurring species (e.g., Honeychurch 1986, Bannochie et al. 1993, Roegiers and McCuen 2007), explore online resources such as the Cayman Wildlife Connection's inventory of Native Trees and Seaside Plants (http://www.caymanwildlife.org/plants.html), and establish partnerships with experts, including botanical gardens and nurseries.

Non-native plants, especially ***coconut palms (Cocos nucifera), should not be planted*** on or near beaches where sea turtles are likely to nest. Our experience confirms that palms provide insufficient cover for nesting, and their roots act as a hardened structure which solidifies habitat and may accelerate erosion (especially wind erosion) of the beach. Other non-native plants may create too much shade on the sand, which can alter nest temperature and affect the development (and sex ratio) of sea turtle embryos, or they may out-compete or displace important native species.

Remember to ***share your conservation efforts!*** Post signs that communicate to guests, clients and visitors the importance of coastal plantings and habitats, and describe any restrictions or conditionalities. Raised walkways can be very effective in guiding beachgoers to the shore while protecting fragile coastal areas. Visitors are likely to enjoy learning about historical uses (e.g., cultural, nutritional, medicinal) of native species – create a "nature walk" simply by posting botanical notes!

Natural vegetation acts as a buffer between the beach and buildings, and raised walkways protect fragile habitat at Disney's Vero Beach Resort, Florida (left, photo: Ga-Young Choi). A "Welcome" sign, posted at Juno Beach, Florida, encourages Sustainable beach visitation practices (right, photo: Chris Johnson, MarineLife Center).

Beach Gardens

An idea that may be favorable to both developers and sea turtles is the creation of a "***beach garden***." On Pasture Bay Beach (Jumby Bay) in Antigua, homeowners have initiated an innovative approach to develop their beach in a way that supports nesting hawksbill sea turtles while maintaining an aesthetically beautiful landscape for the island owners and their resort guests. Native coastal plant species – including ink berry (*Scaevola plumeria*), sea-grape (*Coccoloba uvifera*), bay cedar (*Suriana maritime*), beach morning glory (*Ipomoea pes-caprae*), and sea bean (*Canavalia maritime*) – were planted in groupings on a nesting beach that had seen its beach forest diminished by development. After five years with no disturbance from hurricanes, there was positive evidence that the beach gardens were providing additional nesting habitat suitable for endangered hawksbill turtles (Muenz and Andrews 2005).

While the results suggest that beach gardens are working, the highest density of nesting still occurs in areas of the beach with remnants of intact native maritime forest. Therefore, while restoration with beach gardens can be viewed as a support technique where habitat loss has already occurred, architects and property managers should make every effort to preserve native maritime forest.

Restoring nesting habitat with beach gardens demands a thorough investigation to compare habitat quality to native maritime forest. With that in mind, the "gardens" appear to provide a useful management tool to help in reconciling the needs of sea turtles with those of beach development.

Natural vegetation (maritime forest) buffer zones have been integrated into the Jumby Bay development (Antigua), in addition to the innovative use of planted "beach gardens" seen here in the lower right corner. Photo courtesy of Jumby Bay Island Company.

Seagrass and Coral Reefs

Native marine vegetation such as seagrass, *Thalassia testudium* (left, photo: S. I. Apteker), is just as important to the vitality of a coastal ecosystem as a maritime forest species, such as seagrape, *Coccoloba uvifera* (right, photo: Ga-Young Choi).

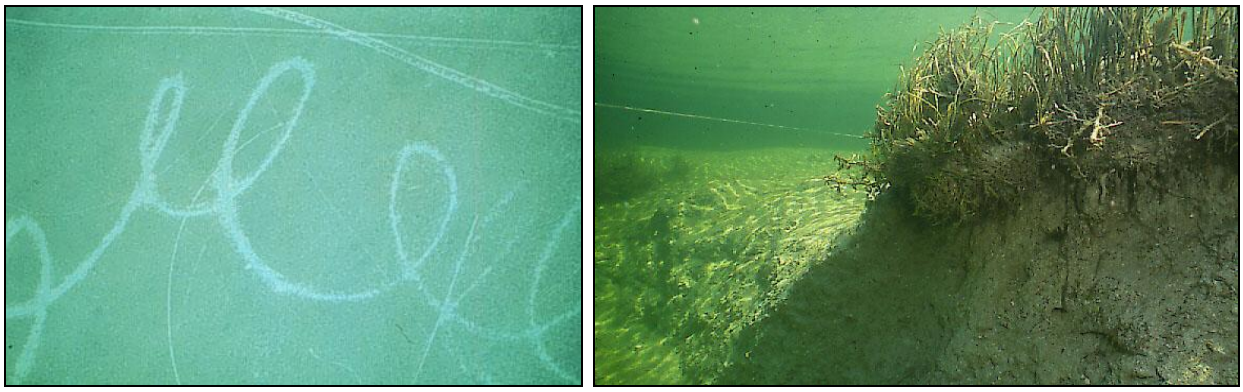
Much has been made, and appropriately so, of the importance of ***coral reefs*** in dissipating wave energy, stabilizing the shore, and safeguarding life and property in the face of storm events (e.g., Mimura et al. 2007, Burke et al. 2008). ***Marine vegetation*** also reduces erosion pressure. Plants create drag in the water current, which slows the current and deposits suspended particles in the seagrass bed – the result of this process is that seagrass promotes sediment-building that acts to protect the shoreline.

Like rainforests and wetlands, coral reefs have a high "recycling" rate for nutrients. This allows biodiversity to thrive, even though the surrounding ecosystem is relatively low in nutrients. Producers (plants that photosynthesize, including algae and seaweed) form the base for any food web and are found in abundance in coral reefs. The producers provide food for small fish and marine life, which in turn provide food for larger animals. Coral reefs are important indicators of ocean health, and their decline has serious economic as well as environmental consequences, especially in fisheries and tourism sectors.

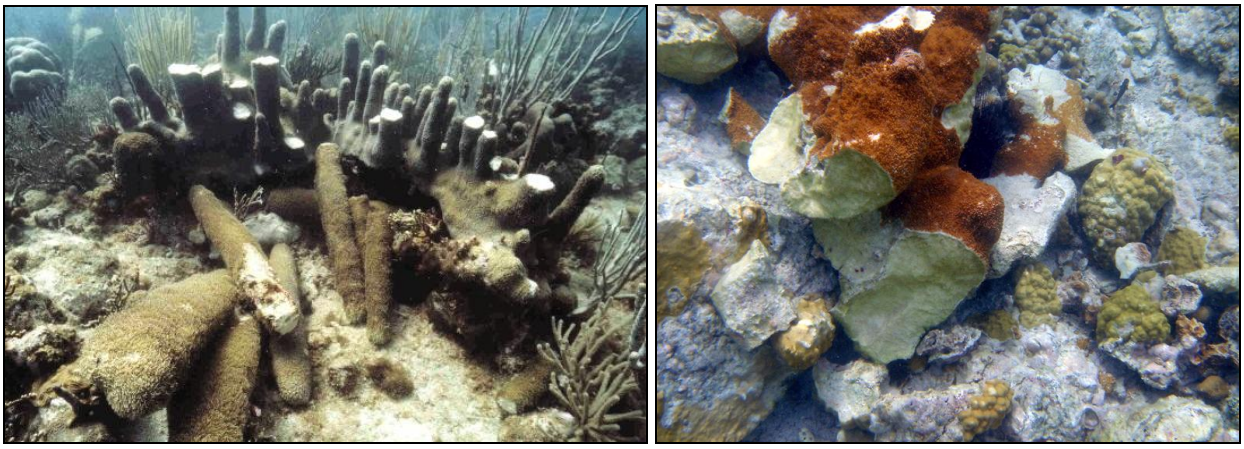
Seagrass is also important, both ecologically and economically. Seagrass thrives in protected shallow waters (depths less than 2 m), where it flourishes in the presence of sunlight. Many species (including many commercially valuable fishery species) depend on seagrass, which provides nursery and foraging habitat for a large variety of juvenile fish and crustaceans (Zieman and Zieman 1989). In the Caribbean, the degradation or loss of mangrove and seagrass habitats has been shown to have a significant negative impact on commercial reef fisheries (e.g., Nagelkerken et al. 2002)

Marine vegetation is critical to the survival of sea turtles. Green sea turtles feed primarily on seagrass in the Caribbean Sea, and studies indicate that the turtles have a major effect on nutrient cycling and community structure in their foraging habitats (Thayer et al. 1984, Bjorndal 1997). Moreover, seagrass communities are intricately tied to coral reef systems. Sea turtles often feed on organisms that live within, or depend upon, both seagrass and coral reefs. Sea turtles also use the reef for sleep and shelter.

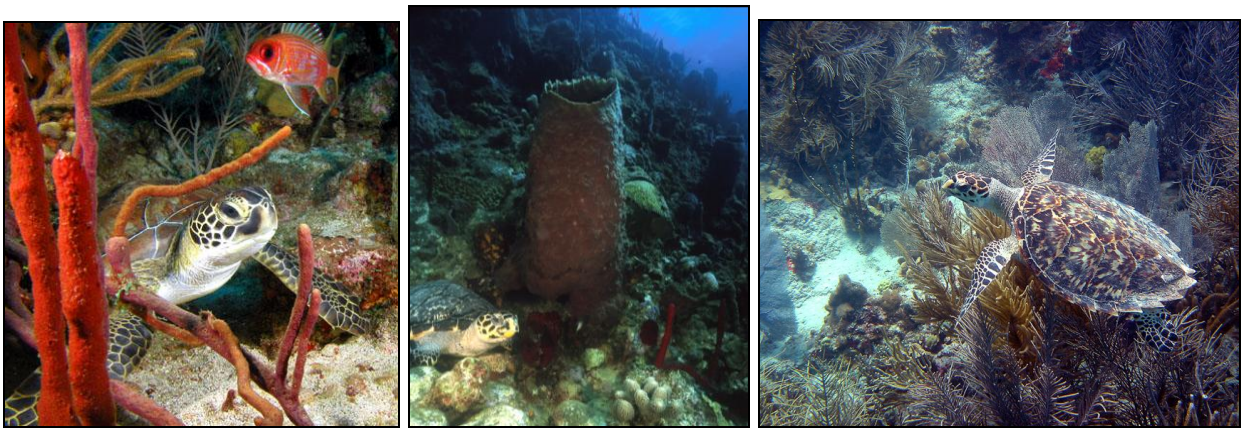
Shallow marine ecosystems, including both coral reefs and seagrass meadows, can be greatly affected by coastal development and ocean-based recreation. Dredging, chains, anchors, propellers, even swimmers can cause damage by uprooting seagrass, scarring the seabed, reducing water quality and destabilizing sediments which, in turn, inhibits seagrass growth, reduces fish and wildlife habitat, and can threaten entire coastlines. Orth et al. (2006) characterize the decline of seagrass as a "global crisis", while Texas Parks and Wildlife (1999) describe the declining quantity and quality of seagrass as the most serious threat to wildlife, recreation, and economy along the Gulf Coast of the U.S.



Both of these photographs show boat damage to seagrass beds, which can take more than a decade to overcome. On the left, propeller scarring is evident; on the right, boats cut into the seabed when they try to "power off" (photos: http://www.dep.state.fl.us/coastal/images/habitats/seagrasses/Blowunder.jpg). Scars that channel water currents can erode deeper and wider with time, and may never recover.



Physical damage to coral reefs due to anchoring (left, photo: E. Kintzing) and collision (right, photo: Caroline Rogers, USGS).



Green and hawksbill sea turtles in healthy hardbottom and coral reef habitat (left, photo: STENAPA Sint Eustatius; middle, photo: Arun Madisetti; right, photo: Caroline Rogers, USGS).

Fast Fact – A seagrass meadow one hectare in size can produce about 20 tonnes of organic matter per year! These remarkably important and productive habitats are damaged by a wide range of human actions, including dredging and anchoring, coastal development, pollution, sedimentation and eutrophication, hypersalinization (resulting from reduction in freshwater inflows), habitat conversion, and climate change (e.g., Lapointe et al. 2004, McField et al. 2007). Major losses of seagrass habitat have been reported in the Mediterranean, Florida Bay, and Australia, and current losses are expected to accelerate, especially in Southeast Asia and the Caribbean (Millennium Ecosystem Assessment 2005a).

Fast Fact – Despite covering only 0.2% of the sea-floor, coral reefs contain 25% of global marine species. These highly productive ecosystems also provide inland protection from storm surges and are integral to both coastal fisheries and tourism, supporting the livelihoods of about 100 million people around the world. Yet, according to the recent Millennium Ecosystem Assessment (2005b), 20% of coral reefs have been destroyed in the last few decades and an additional 20% or more are severely degraded, particularly in the Caribbean Sea and parts of Southeast Asia, and revenue from tourism associated with coral reefs has been estimated to be US$30 *billion* annually.

What Can Be Done?

Do not scar or remove seagrass meadows or coral reefs in nearshore waters. Manage wastewater to reduce effluent to the sea; for example, recycling graywater (wastewater that emanates for sinks and showers) and using it to water hotel grounds and other landscaping helps defray freshwater use and can lower operating costs (http://www.graywater.net/). Maintain high standards for sewage treatment, and emphasize low doses of landscape chemicals. Promote limits or bans on watercraft that may damage the seagrass beds (see "Boats and Personal Watercraft").

Boaters can minimize seagrass destruction by lifting their motors and drifting, poling, or trolling through shallow areas. When possible, avoid running a boat through shallow areas, consider wind speed and direction, check tide charts and forecasts and create a float plan accordingly, use deeper water or existing marked channels as preferred access, and know the boat's limitations for running and takeoff depths.

Divers and snorkelers (http://www.coral.org/resources/guides_best_practices/for_tourists) should be aware of appropriate behavior. Demarcating a no-wake ***Swim Zone*** offshore the nesting beach can be a win-win, offering both swimmers and sensitive ecosystems a reprieve from water-sports and anchoring. All vessels should be ***moored***. Anchoring, as needed, should be strictly relegated to non-sensitive areas.

Seagrass and Coral Reefs: Internet Resources

REEF CHECK: http://www.reefcheck.org/

World Resources Institute, *Economic Valuation of Coral Reefs in the Caribbean*:
http://www.wri.org/project/valuation-caribbean-reefs

Texas Parks and Wildlife, *Seagrasses*:
http://www.tpwd.state.tx.us/landwater/water/habitats/seagrass/index.phtml

Millennium Assessment Reports: http://www.millenniumassessment.org/en/index.aspx

NOAA, *25 Things You Can Do To Save Coral Reefs:*
http://www.publicaffairs.noaa.gov/25list.html

Boats and Personal Water Craft (PWC)

Marine vessels operating in coastal waters can kill or seriously injure sea turtles. Turtles can be struck by the hull and/or suffer propeller wounds, as evidenced by body lacerations and shell damage. These injuries can affect vision, movement and buoyancy, and may increase the chance that the turtle, now debilitated, will be struck again or attacked by a predator. The recreational use of personal watercraft (PWC), popularly known as "jetskis", may also pose a threat, though data are scarce.

Some of the best documentation of propeller injury is from southeast Florida (Martin County through Miami-Dade County) where, from 1980 through 2007, about 35% of sea turtle strandings had distinct propeller wounds, with the highest annual percentage occurrence of propeller wounds being 46% in 2004 (Allen Foley, Florida Fish and Wildlife Conservation Commission, in litt. 17 February 2009). The exact number of sea turtles killed or injured by boats and PWCs is unknown; many, if not most, injured animals are never encountered or tallied by management agencies.

Propellers slice into sea turtles surfacing to breathe; the interaction can be fatal (photos: Johan Chevalier, DIREN, Guadeloupe).

With the rising popularity of coastal tourism, the number of boats and PWCs has escalated. PWCs can travel at high speeds in shallow areas, including areas close to shore, where wildlife, including sea turtles, are found. Numerous studies present evidence that PWCs disturb waterfowl and nesting coastal birds (e.g., Burger and Leonard 2000, Rodgers and Schwikert 2002, Burger 2003).

PWCs can travel at high speeds in nearshore areas (photo: http://www.pahrumpvalleytimes.com/2004/07/28/photos/2jetski.jpg). Leatherback sea turtle killed by the lacerations of a boat propeller (right, photo: Scott A. Eckert, WIDECAST).

Boats and PWCs can compromise the general health of the coastal environment by lowering air and water quality. The engines that power boats and PWCs run on gasoline, contributing to noise and air pollution

(hydrocarbons and nitrogen emissions). Two-stroke engines dump 25% - 30% of their fuel unburned into the water, creating the familiar "rainbow sheen" on the surface of the water in marinas and other high use areas, and scientific studies confirm that petrochemical effluents negatively affect estuarine flora and fauna (e.g., Wake 2005, McLusky and Martins 1998).

Seagrass beds provide food and shelter to numerous marine species, including green sea turtles (left, photo: Caroline Rogers, USGS), and can be negatively affected by boat traffic, including propellers and wakes (right, photo: http://www.moccasinlanding.homestead.com/files/Vpoint/FWCWake.jpg). Without proper caution, sea creatures can be disturbed, displaced, or killed.

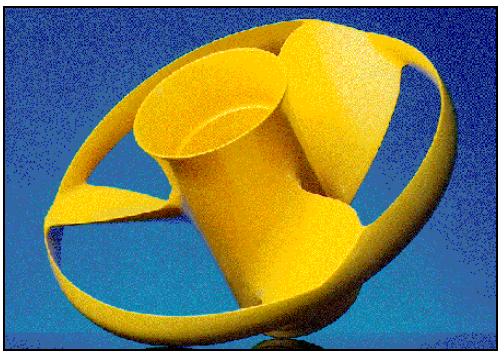
What Can Be Done?

Various restrictions can be implemented to ***reduce the harmful effects*** of pleasure craft on wildlife, on sensitive marine ecosystems (seagrass, coral reefs, mangroves), and on the shoreline. Safety is also an issue: according to US Coast Guard statistics, jetskis represent roughly 10% of all boats, yet are involved in approximately 30% of all boating accidents (http://www.bluewaternetwork.org/).

One way that some areas have protected their natural resources is by employing ***slow speed or 'no wake' zones*** (Apsund 2000, Hazel et al. 2007). Florida, for example, has incorporated two types of slow speed zones – idle speed and slow speed. In idle speed areas, all watercraft must move at the slowest speed possible to keep steerage of the boat or PWC and generate no wake. Slow speed areas require all vessels to produce only minimal wakes and keep the hull fully in the water. The state of Florida uses these restrictions to help protect manatees, which are struck frequently by boats (Florida Fish and Wildlife Conservation Commission, *2003 Florida Statutes*).

Enforced slow speed zones can reduce the number of PWCs that use an area (Blair Witherington, Florida Fish and Wildlife Conservation Commission, personal communication). Jet skiers enjoy riding PWCs for the thrill of moving at high speeds; if speed is heavily restricted in an ecologically sensitive area, the result is that the use of these watercraft is reduced (as drivers move to unregulated zones).

Boats and PWCs can also be ***restricted or banned from certain areas***. Many national parks in the US, such as Biscayne National Park and Olympic National park, have banned PWCs for several reasons, which include the safety of other people recreating in highly visited areas; reducing noise, air, and water pollution; and protecting wildlife and beach vegetation. Area bans could be appropriate for shallow waters bordering hotels and resorts, with such a ban serving to reduce noise pollution and prevent dangerous accidents (between jet skiers and swimmers, kayakers, etc.), as well as safeguarding sea turtle habitat and the important ecological functions of nearshore marine habitats.



Together, slow speed zones (left, Biscayne National Park, Florida: http://www.nps.gov/bisc/visit/speed.htm) and propeller guards can reduce the number human and wildlife injuries due to propeller strikes (middle: https://www.adventuremarine.net/, right: http://www.floridaconservation.org/psm/images/prop/stealth.gif).

Another tactic that can be applied is to ***limit the number*** of PWCs in one area at any given time. Studies of sea turtle/propeller interaction data in Florida suggest that limiting the number of boats/PWCs in a given area might allow sea turtles to dodge these vessels (April Norem, University of Florida, unpubl. data). This type of restriction may be the most effective when sea turtles are the most active near the surface of the water, such as during peak feeding times.

The use of ***propeller guards*** on boats may help reduce propeller strikes on wildlife. Many styles are available (http://www.uscgboating.org/articles/pdf/April08_08_prop.pdf). However, blunt trauma from a hull strike occurs just as frequently and potentially causes more harm (Nancy Mettee DVM, MarineLife Center of Juno Beach, personal communication). Thus, an integrated approach is necessary: propeller guards are unlikely to achieve conservation results without restrictions that enforce no-wake zones off nesting beaches and in sensitive nearshore habitats such as seagrass meadows. The slower the rate of travel, the more likely a sea turtle, manatee or human swimmer will move out of harm's way.

In summary, hoteliers can do their part in reducing the boat-strike injury and mortality of sea turtles by promoting the restricted usage of personal watercraft near nesting beaches, in inter-nesting habitats, and on foraging grounds. ***Public awareness and consistent enforcement*** of restrictions are necessary for success. Local sea turtle experts are good partners in any education campaign. To identify a sea turtle program in your area, visit http://www.widecast.org/Who/Contact.html.

Finally, ***advocate*** for similar policies throughout the hospitality sector. Sea turtles are very mobile, and while taking unilateral action is an essential first step, encouraging unified policies among coastal operations in general is the best way to meaningfully promote the survival of endangered sea turtles in your area. Encourage discussion of these issues within industry organizations (e.g., hotel and tourism representatives) and participate in alliances with solution-oriented conservation partners in order to advocate for changes sector-wide.

Boats and Personal Watercraft (PWC): Internet Resources

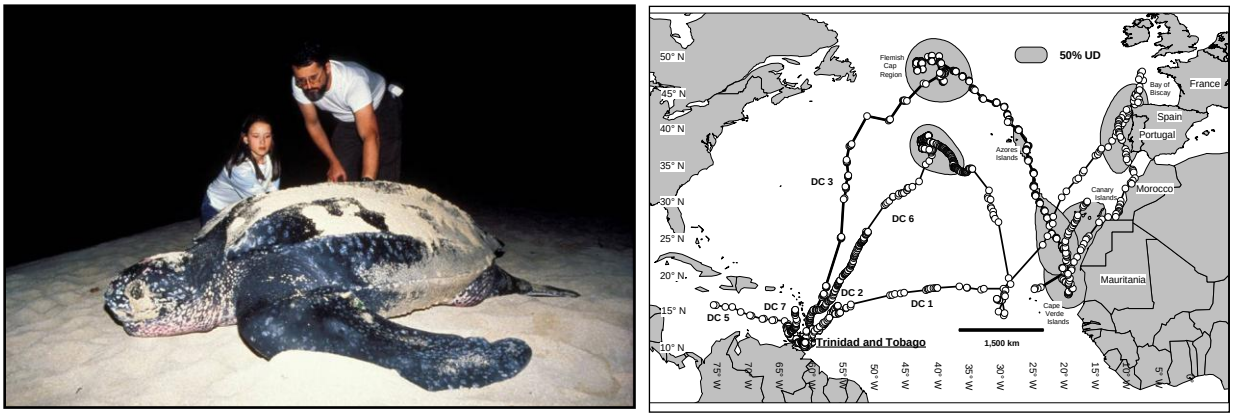
Surfrider Foundation, *Personal Water Craft*: http://www.surfrider.org/a-z/pwc.php

Bluewater Network, *Personal Watercraft: Creating Havoc in their Wake:* http://www.bluewaternetwork.org/campaign_pl_pwc.shtml

U.S. Environmental Protection Agency, *Gasoline Boats and Personal Watercraft*: http://www.epa.gov/otaq/marinesi.htm

Final Considerations: Think Global, Think Climate Change

Sea turtles are highly migratory during all life stages, so conservation actions taken in any one place can have profound and positive implications for their survival throughout the Caribbean Sea – and beyond.



Sea turtles have international ranges, and they rely on conservation actions taken in dozens of countries to ensure their survival. For example, leatherbacks protected at their nesting grounds in Trinidad return to highseas foraging grounds in the northern and eastern Atlantic. Photos: (left) Scott A. Eckert, WIDECAST; (right) post-nesting dispersal of adult females (from Eckert 2006).

Ecologically conscious management of coastal areas accrues benefits far beyond sea turtles. Coral reefs, for example, provide a wide range of commercial and non-commercial benefits to human society, including ecosystem goods and services of high value to local and national economies. In addition to reducing the impact of waves on the shore (slowing erosion and beach loss, and lessening storm damage), Caribbean coral reefs are critical for nutrition and food security and draw millions of visitors to the region each year – and tourism is the single largest economic sector for the region, accounting for more than 15% of total employment and 13% of GDP (CARSEA Assessment 2007 *in* Burke et al. 2008). Despite their importance and the many benefits they provide, most Caribbean coral reefs are threatened: an estimated 70% are threatened by human activities including overfishing, coastal development, and runoff from land (Burke and Maidens 2004).

Protection of coral reefs and maritime forest, and adherence to setbacks, becomes even more important in the face of future sea level rise driven by climate change. Over the next century, sea level is expected to rise 18-59 cm above present (IPCC 2007), greatly increasing the likelihood and frequency of coastal flooding events, severity of hurricane impacts, and beach erosion, all contributing to a net loss of coastal land. Sea turtle nesting beaches may be lost if buildings, roads, or other infrastructure hinder their shifting inland, as sea level rises. Local topography and conditions will influence the extent of vulnerability to these threats but a logical relationship between beach slope, sea level rise, and setback regulations is clear: the greater the slope of the beach and the greater the setback from the shoreline, the more likely the beach is to prevail and a beachfront property to survive under sea level rise scenarios. Fish et al. (2005, 2008) estimated beach loss due to sea level rise for Bonaire and Barbados and found that setbacks of at least 90 m would be required to safeguard coastal investments from climate change impacts.

Another reason for concern from climate change is the rise in temperature, which in the US is causing loggerhead sea turtles to nest earlier in the year (Weishampel et al. 2004, Pike et al. 2006, Hawkes et al. 2007) and also affects incubation conditions for sea turtle eggs in the sand. As temperature increases, the sex ratio of developing sea turtles shifts, sometimes producing only females and in extreme cases killing all embryos from over-heating (Ackerman 1997, Davenport 1997, Glen and Mrosovsky 2004). Native coastal vegetation provides shade in some areas of the beach, hence mitigating partly the effects of increasing temperatures. In areas where the native vegetation is removed, hotels on beachfront

property may contribute to sea turtle conservation by restoring the original vegetation fringe above the high tide line. Turtles and other wildlife benefits from such intervention, which in turn provides tourists with shady spots for the enjoyment of beaches in tropical latitudes.

Consider the many benefits that your business enjoys from a clean and ecologically intact coastline, then weigh those benefits seriously in decisions regarding everything from water and pesticide use to beach-front lighting and mooring policies. Sea turtles are widely acknowledged as useful "ambassadors" for sustainable coastal zone management (e.g., Frazier 2005), use them to communicate to your guests and clients the importance of decisions and policies that may otherwise seem burdensome or unimportant.

Meaningful progress is measured one step at a time – educate yourself, set an example, advocate for ecologically sound policies, and stay involved at local, national and even international levels. Your success (or failure) is and will continue to be integrally linked to the success of others. We hope that this Manual will inspire your management team to progress beyond old habits, and become an advocate for globally relevant environmental policies worthy of the hospitality and tourism sector in the 21st century.

V. GUEST EDUCATION AND PARTICIPATION

An informed public can be a powerful force in promoting the protection of sea turtles, and in endorsing and seeking to support sustainable choices made by the hospitality sector in general.

Public involvement ranges from influencing legislation and policy to volunteering (monitor and protect nests, report sightings or infractions, etc.) and donating to conservation causes. Raising public awareness of the plight of sea turtles is crucial to sea turtle survival. Perhaps the most important aspect of guest/client education and outreach is that informed guests/clients are likely to be more responsive to and accepting of the various conservation actions taken by the resort, including modified lighting regimes, enforcing "no-wake" zones, moving sunbeds off the beach at night, restricting bonfires and vehicle traffic in nesting zones, etc.

Hotels and resorts can (and many do) offer a variety of informative programs on sea turtles and the local environment for the enjoyment and intellectual stimulation of guests. Resorts can tailor these programs to meet the needs and desires of their guests, including family- and child-friendly activities. Guests can even experience direct encounters with sea turtles on "Turtle Walks". Turtle Walks should not be ad hoc, they should always be offered in partnership with trained local experts (conservation groups, government wildlife officers) or trained and certified hotel staff. Turtle Walks can focus on nesting adults or emerging hatchlings. In the case of hatchlings, guests may be asked to participate directly in hatching survival by forming a line that shields the tiny turtles from shoreline lighting – remember to enforce a "no touch" rule! See "Sea Turtle Encounters and Turtle Watches".

Remember that local sea turtle conservation groups operate on very small budgets, so offering compensation for their services is appropriate. Such compensation might include contributing to transportation and fuel costs, providing housing during the low tourism season (which typically corresponds to peak nesting season) for beach patrollers and other sea turtle conservation volunteers, offering fair pay for services like Sea Turtle Summer Camp (Marin, *in press*) and evening slide shows, and exhibiting information explaining the importance of the group's conservation efforts (e.g. through in-room materials and/or features on hotel television stations, industry magazines, and other corporate outreach venues).

Remember that interactions with endangered and protected species (including Turtle Watching and "rescuing" hatchlings) require proper training and often require a Government permit.

Environmental Programs

Environmental programs can focus on biodiversity (e.g., bird walks, botanical displays, coral reef diving), cultural or historical aspects, or "green" community partnerships such as touring an organic farm or fair-trade agricultural area that supplies food to the hotel. Hands-on experiences are the most memorable and might include such things as guided scenic tours, Sea Turtle Summer Camp for young guests, special evening presentations or films, Story Hour with local authors or cultural historians, star-gazing with an entertaining story-teller, and interactive expos or craft fairs.

Invite local conservation organizations and other experts to develop and deliver scheduled presentations. Visit http://www.widecast.org/Educators/Resources.html for education and outreach materials focused on sea turtles, including multi-lingual narrated slide shows, Summer Camp activities and crafts for children, puppet shows, and lesson plans for both indoor and outdoor enrichment activities. These materials are designed to "bring sea turtle biology to life", and all accommodate efforts by the educator to insert added information on locally occurring species, conservation efforts, program successes, and specific ways in which tourists can become involved in conservation issues.

Local conservation groups may be willing to assist with other guest programs, including unexpectedly popular activities, … like beach clean-ups! To identify a sea turtle conservation partner in your country, visit http://www.widecast.org/Who/Contact.html. For information on how to organize a beach clean-up, visit http://www.oceanconservancy.org/site/PageServer?pagename=icc_home.

Photographs showing the wide range of sea turtle conservation activities taking place in the Caribbean Sea can capture the attention of guests and provide a context for on-site conservation measures. Here a leatherback nests at dawn in Querepare, Venezuela (left, photo: Mariana Malaver, CICTMAR) and fishermen tag and release a young Hawksbill in Bonaire, Dutch West Indies (right, photo: Robert van Dam, STCB).

Whether on- or off-site, environment-focused programs can raise awareness about endangered species, including sea turtles; sustainable choices, such as organic farming and fair-trade practices; and sensitive ecosystems like coral reefs, wetlands and rainforests.

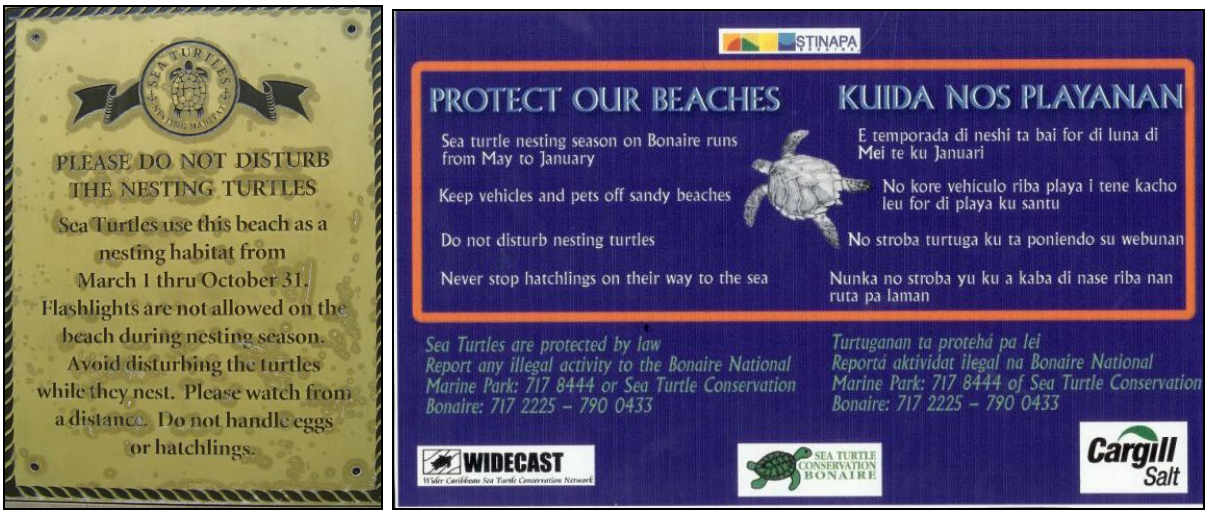
Unique and memorable programming not only enriches the experience of guests (a reality that may, more often than not, increase the chance of a return visit!), but can increase support for hotel-sponsored conservation activities, such as nest monitoring, hatchling rescue and release, landscaping with native species, efforts to reduce beachfront lighting, restrictions on anchoring, efforts to conserve electricity and water, and slow-speed zones offshore.

Getting the Message Across

Signage can help in directing foot traffic away from sensitive areas and alert tourists to regulations protecting sea turtles and their nesting grounds. Signage alone, however, is not sufficient. Care should be taken to reinforce this information on the hotel's in-house TV channel, in guest orientation/welcome packages, materials placed in hotel rooms (see Appendix IV), and during regularly scheduled outreach activities (see "Environmental Programs"). Equally important is conservation signage and outreach at ports of entry, including airports and cruiseports.

Tourists are generally unaware of local environmental issues; consequently, they inadvertently engage in activities that can have negative effects on both wildlife and sensitive habitats, potentially – as in the case of driving on the beach, littering, contributing to light pollution, or ignoring conservation policies while diving or boating – reducing the aesthetic values of surrounding landscapes, compromising the quality of the environment for themselves and others, and lowering the survival prospects of endangered species.

Hotels can employ several tactics to inform guests of the importance of respecting the local environment. Signs strategically placed on hotel property can enlighten guests concerning endangered species, such as sea turtles. Information should be simple, concise and clear, such as alerting guests to the seasonal presence of nesting sea turtles and emphasizing appropriate behaviors.



These signs alert Caribbean visitors to rules that have been established to protect nesting sea turtles.

In addition to emphasizing appropriate behavior, such as restrictions on beach fires, pets, or the use of flashlights, signs near nesting beaches can provide updates on the number of nests incubating on the beach, ask visitors to maintain a safe distance, and explain how to report infractions. Signs and billboards should be updated periodically and maintained in an attractive condition. As appropriate, the message should be multi-lingual.

If your business distributes a regular newsletter or guest/client information package, include tips on how to assist in local conservation efforts. For example, reminding guests to close their curtains at night to prevent light leakage (see "Beachfront Lighting") and explaining what to do if a sea turtle is encountered (see Appendix V, VI), will help to ensure that the industry's impact on nesting activity is progressively reduced. Remember to lead by example! If the maid turns down the sheets at night, then (during sea turtle nesting season) closing beach-facing curtains should also be part of her routine.

Beach sign on Klein Bonaire, a protected nesting beach in the Netherlands Antilles, provides nesting updates and asks beachgoers to keep a safe distance from the nests. Photo: Robert van Dam, Sea Turtle Conservation Bonaire.

Interested guests may request more information regarding environmental issues and conservation opportunities. Local sea turtle groups, as well as regional entities – WIDECAST (http://www.widecast.org), the Caribbean Alliance for Sustainable Tourism (http://www.cha-cast.com), and the UNEP Caribbean Environment Programme (http://www.cep.unep.org/) – will have updated information to share and can direct you to natural resource experts.

The hospitality industry can help spread the conservation message by sponsoring off-site signage, as in roadside billboards (French Guiana; photo: B. deThoisy), murals (Venezuela; photo: CICTMAR), airport light-boxes (Costa Rica; photo: B. Pinto) and signs associated with bus and taxi stops (Dominica; photo: WIDECAST).

Finally, encourage the purchase of souvenirs that support sea turtle conservation. Commercial items such as books, DVDs, and plush animals can reinforce a conservation message or remind visitors of a special experience. Seek partnerships with local crafters or guilds able to provide an inventory of unique products that provide income to local communities and support conservation causes. These might include hand-bags woven from plastic bags, wood carvings (from sustainable sources!), pottery, photography, soaps, spices, candles, and/or crafts from locally abundant materials such as grasses, seeds, coconut, calabash, and recycled glass … but not seashells, coral, or products derived from rare or protected species.

Sea Turtle Encounters and Turtle Watches

Nesting is both the most accessible and the most vulnerable stage of sea turtle life history. If there is a possibility of encountering egg-bearing females or newborn hatchlings on the beach, then certain rules of behavior must apply. If these rules are not enforced, the encounter(s) may result in sea turtle harassment, changing patterns of nest site selection, lowered reproductive success, and environmental degradation (e.g., shoreline erosion, litter, beach fires, trampling of vegetation).

Without a trained guide or other expert in attendance, onlookers can easily frighten the turtle or alter her natural behavior, collect or restrain hatchlings, or damage the nest cavity. Property managers should notify guests of the seasonal presence of sea turtles and their young, request that guests keep a respectful distance, and ask that they inform the front desk if they observe any evidence of nesting (see Appendix III). To encourage an appropriately respectful viewing experience, a guide to appropriate behavior (e.g., see Appendix V), should be posted prominently and included in guest welcome packages. Be aware of any special regulations, guidelines or restrictions in your area – *and remember that not all sea turtle species lend themselves well to Turtle Watches.* Similarly, some beaches are too narrow, steep, or debris-strewn to accommodate visitors safely at night.

Turtle Watches can be exploitative and abusive (left, photo: Ancom Marketing Services) or respectful and positive (right, photo: Turtugaruba Foundation). To ensure best practices, guests should be accompanied by a trained guide and follow strict guidelines. In the photo on the right, an alert onlooker called the national Sea Turtle Hotline, a public service line maintained in Aruba by the Turtugaruba Foundation, to report a rare daylight nesting. A member of the Foundation arrived to provide guests and visitors with guidelines on watching the animal, including keeping a respectful distance.

A guided Turtle Watch allows residents and visitors alike to enjoy an unforgettable experience. For countries that still have ample and predictable nesting, turtle watching can also offer financial incentives for communities to protect, rather than to harvest, sea turtles (e.g., Fournillier 1994, Wilson and Tisdell 2001, Campbell 2003, Troëng and Drews 2004, UNEP-CMS 2006, Sammy et al. 2008).

We strongly recommend that any formalized Turtle Watch offerings be developed in close partnership with a local sea turtle conservation group. Another option is to collaborate with a community-based group

already active in general tour guiding whose members can be trained to conduct Turtle Watches. Such a partnership benefits hotel guests, strengthens community ties with the hospitality industry, contributes to local employment, and helps to protect sea turtles. If you cannot identify a suitable partner, visit http://www.widecast.org/Who/Contact.html and ask your WIDECAST Country Coordinator for advice or for information on training.

A Turtle Watch typically consists of an information session presented by a trained guide, followed by the opportunity to witness a nesting event first-hand. During the information session, the guide or local sea turtle specialist talks about the various species of sea turtles, their life stages, what foods they eat, threats affecting their survival, and other relevant information. The guide or specialist also explains that certain behaviors are appropriate and certain behaviors are inappropriate, providing a clear explanation of the rules for the Turtle Watch experience (Baptiste and Sammy 2007, Sammy and Baptiste 2008).

Caution: Consider the risks carefully. Sea turtles can be negatively affected by noise, activity, flashlights and other distractions, and experience has shown that a poorly-run Turtle Watch can do more harm than good both to the sea turtle and with regard to visitor satisfaction. **Remember** that interactions with endangered and protected species (including Turtle Watching) may require a Government permit.

Hatchlings are often viewed as especially "touchable", and the following guidelines should prevail:

- Hatchlings must be allowed to crawl to the sea without being disturbed.
- Curious onlookers should stand behind the nest and away from the hatchlings' path. The public must be managed and organized so that the chance of a person inadvertently trampling on and/ or killing a hatchling is removed.
- If lighting is misdirecting the hatchlings landward, the hotel should turn off the lights or, if this is not possible, onlookers should position themselves so as to shield the small turtles from the light, giving them a chance to locate the sea. Remember that hatchlings orient to the subtle brightness of the open ocean horizon. It is important that this orientation be allowed to take place as naturally as possible because it is the first in a series of orientation exercises that the hatchlings will need to accomplish in order to reach the distant highseas where they spend the first several years of their lives.
- If hatchlings, misdirected and confused by lights, are found on hotel property during the day, they should be kept in a dark, cool place (in a covered cooler or bucket) for release (with the lights off!) that evening. Hatchlings are less mobile during the heat of the day; moreover, a daylight release may attract predators.
- Nests may only be dug after the hatchlings have *completed* their emergence (the emergence may occur over the course of several nights). Nest excavation is generally done for the purpose of evaluating hatch success and releasing any residual hatchlings that may have been left behind. Excavation should **only** be undertaken by someone trained and permitted to do so, standardized data should be collected, and nest contents disposed of properly so as not to attract predators.

Sea turtles may also be encountered at sea while diving or snorkeling. Care should be taken not to chase or harass the turtles. Natural rhythms of feeding and resting can be disrupted by divers intent on getting too close, by pursuing the animal, or by preventing it from coming to the surface to breathe. Standards of appropriate behavior are not well developed for at-sea encounters, but general guidelines are included in Appendix V and Appendix VI, the latter courtesy of the Barbados Sea Turtle Project. Meadows (2004) recommends safe-approach distances (for snorkellers) "on the order of 2 to 5 m".

Encourage guests to report evidence of nesting and hatching. Compile the information, and share it with conservation partners and Government (request and use standardized data reporting forms). Staff should know whom to contact in the event that a sick or wounded sea turtle is reported. Guidelines are available (Phelan and Eckert 2006). The assistance of a veterinarian or animal care professional might be needed, especially if recuperative care is called for (Bluvias 2009).

Sea Turtle Watching: Internet Resources

WIDECAST, *Sea Turtle Ecotourism*: http://www.widecast.org/TurtleWatch/Why.html

Ocean Revolution, *SEE TURTLES*: http://www.seeturtles.org/41/about-see-turtles.html

Florida Marine Turtle Program, *Where to View Sea Turtles*: http://www.myfwc.com/WILDLIFEHABITATS/Seaturtle_Facilities_Walks.htm

Turtle Safe Products, *Turtle Safe Flashlight Filters*: http://www.turtlesafeproducts.com

An experienced tour guide from Nature Seekers explains the nesting process while keeping his guests positioned behind a leatherback sea turtle at Matura Beach. With the exception of headlamps worn by the guide and a trained data recorder, no lighting is used (Trinidad; photo: Scott A. Eckert, WIDECAST).

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APPENDIX I

SEA TURTLE POLICY STATEMENT

SEA TURTLE POLICY STATEMENT

Aware that sea turtles contribute in significant ways to the ecology, culture, and economy of the Wider Caribbean Region;

Concerned that sea turtles are severely depleted from their historical abundance; and

Acknowledging that while the large majority of Caribbean nations protect sea turtles, population recovery will not be possible without greater attention to the conservation of essential nesting and feeding habitats,

We Pledge To:

- Encourage a commitment to environmental responsibility among employees and guests;
- View sea turtle protection as an opportunity for civic engagement in biodiversity issues;
- Be vigilant and aware of any risks to the environment which may occur within or outside our development area as a result of our activities;
- Assess environmental impacts of all activities, planned and ongoing, as they relate to the conservation of sea turtles and their habitats;
- Provide employees and contractors with information and instruction to enhance their awareness of relevant environmental issues, and to ensure effective management of environmental impacts, including impacts on sea turtles and their habitats;
- Identify and collaborate with local experts in designing, implementing and evaluating our sea turtle program to ensure that it fits within national sea turtle conservation priorities, policies, and ongoing initiatives;
- Make continual improvements in operations and management oversight to increase the effectiveness and reliability of our sea turtle conservation program;
- Comply with environmental legislation and local best practice policies related to turtles and their habitats (sandy beaches, seagrass, coral reefs) and encourage others to do so;
- Promote setbacks, and maintain vegetated buffer zones between sandy beaches and all buildings, patios, and other built structures;
- Implement measures to minimize waste, including applying monitoring procedures to ensure that the nesting beach and nearshore waters remain free of debris and pollution;
- Conduct regular (at least annual) lighting assessments to identify sources of light pollution, and strive to eliminate artificial light visible from the beach during nesting season;
- Implement a system that removes potential obstacles to sea turtle nesting, including sun beds and recreational equipment, from the beach each night during nesting season;
- Discourage vehicles on the nesting beach, require hand-raking of debris and seaweed;
- Support local sea turtle conservation and research, including offering financial or in-kind support, as practicable; and
- Report all incidents of sea turtle harassment or harm to the proper authorities.

WIDECAST
Wider Caribbean Sea Turtle Conservation Network

CAST
Caribbean Alliance for Sustainable Tourism

APPENDIX II

SEA TURTLE SPECIES IDENTIFICATION LEAFLET *

* Other language versions are available at
http://www.widecast.org/Biology/Pictorial/PictorialKey.html

Wider Caribbean Sea Turtles

Leatherback turtle *(Dermochelys coriacea)*

Loggerhead turtle *(Caretta caretta)*

Hawksbill turtle *(Eretmochelys imbricata)*

Green turtle *(Chelonia mydas)*

Kemp's Ridley turtle *(Lepidochelys kempii)*

Olive Ridley turtle *(Lepidochelys olivacea)*

WIDECAST
Wider Caribbean Sea Turtle
Conservation Network

Caribbean Environment Programme
United Nations Environment Programme

Wider Caribbean Sea Turtles

IDENTIFICATION KEY

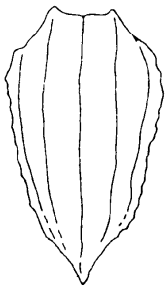
Flexible carapace with
- 5 distinct ridges
- no scutes

Bony carapace (shell) with
- no continuous ridges
- large scutes (shell plates)

4 pair lateral scutes (shown shaded)

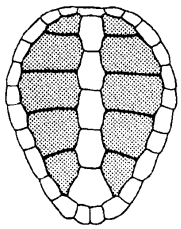
5 (rarely 6) pair lateral scutes

6 or more pair lateral scutes (sometimes asymmetrical)



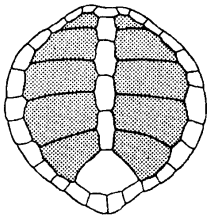
Carapace strongly tapered
Carapace leathery, flexible
Color dark gray or black with white or pale spots
Jaw deeply notched
To 500 kg ♀, "shell" to 180 cm

Leatherback turtle, Trunk turtle
(Dermochelys coriacea)



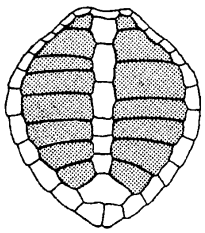
Carapace longer than wide
3 bridge scutes
No pores in bridge scutes
Head broad (to 25 cm)
Color red-brown to brown
To 200 kg, shell to 120 cm

Loggerhead turtle
(Caretta caretta)



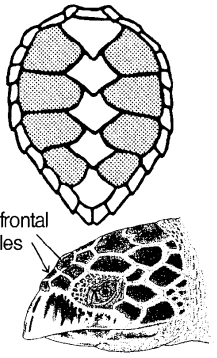
Carapace very round
4 bridge scutes with pores
Very rarely south of 16° N
Juvenile color charcoal gray
Adult color dark gray-green
To 45 kg, shell to 70 cm

Kemp's Ridley turtle
(Lepidochelys kempii)



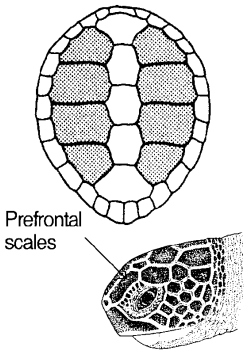
Carapace nearly circular
4 bridge scutes with pores
Very rarely north of 13° N
Juvenile color charcoal gray
Adult color dark gray-green
To 45 kg, shell to 70 cm

Olive Ridley turtle
(Lepidochelys olivacea)



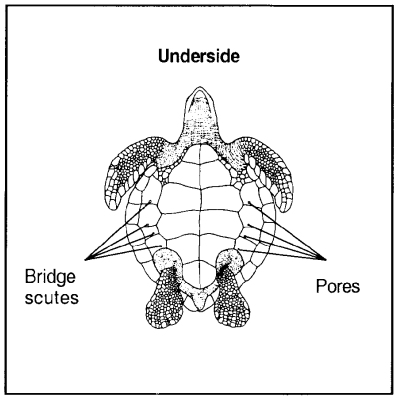
2 pair prefrontal scales
Over-lapping shell scutes
Pointed face, distinct over-bite
Juvenile color and pattern variable
Adult color orange, brown, yellow
To 85 kg, shell to 95 cm

Hawksbill turtle
(Eretmochelys imbricata)



1 pair prefrontal scales
No over-lapping shell scutes
Round face, serrated jaw
Juvenile color and pattern variable
Adult color dark gray green
To 230 kg, shell to 125 cm

Green turtle
(Chelonia mydas)



Photos: Scott A. Eckert (loggerhead, olive ridley) and others by Peter C. H. Pritchard.

APPENDIX III

HOW TO IDENTIFY SIGNS OF SEA TURTLE NESTING

SEA TURTLE NESTING AND CRAWL SIGNS

During the nesting season – a period of several months each year – sea turtles leave the ocean at regular intervals (typically every 9-14 days, depending on the species) to lay their eggs in cavities they excavate in the sand. Although they mostly emerge at night, they leave tracks, mounds and pits on the beach as evidence of the visit. On accessible beaches throughout the tropical world, sea turtle experts and conservation groups collect nesting information on a daily basis. This information is used to evaluate population status, identify threats, and decipher local nesting trends.

This section is designed to help you identify the nesting tracks found on your beach and to use this information to determine the sea turtle species that made them. The ability to "read" field signs, including the width and symmetry of the nesting crawl (track) is important to population monitoring activities. By carefully examining these clues, you can often determine the sea turtle species that came ashore, if nesting (egg-laying) took place, and the approximate location of the nest. If the turtle did not nest, but "false crawled" instead, experts can often decipher why she was unsuccessful in her attempt; for example, were there obstacles that may have prevented her from excavating a nest cavity?

Remember, a sea turtle nesting crawl will *lead from* and *return to* the ocean. A one-way track may indicate that the turtle was killed before she had a chance to return to the sea. Approach one-way crawls carefully (the turtle may still be present!) and notify authorities if there is evidence of poaching.

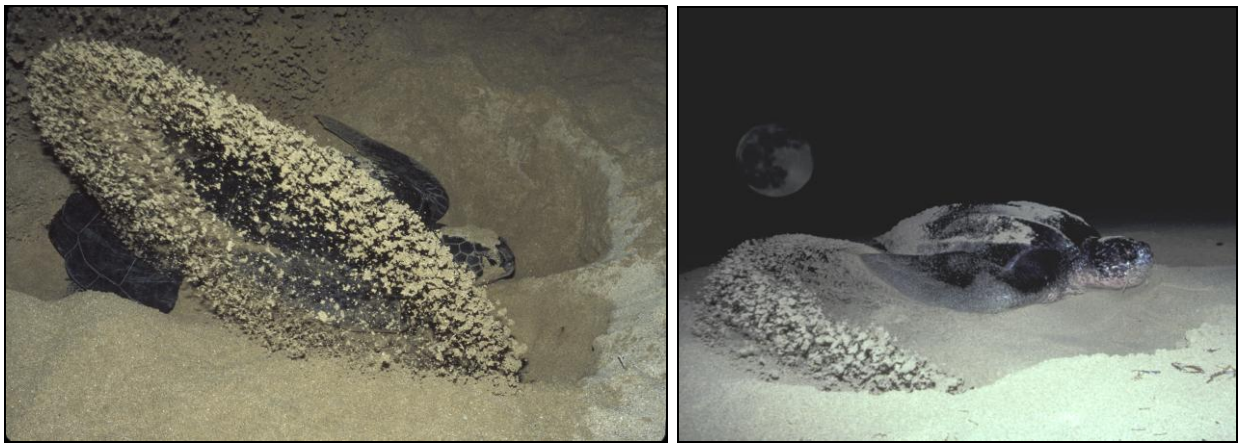
Sea turtles crawl onto Caribbean beaches to lay their eggs. The nesting crawl includes an approach and departure track, and often features evidence of body-pitting, nest excavation, and covering/camouflage (left, photo: Turtugaruba Foundation). The field signs left by a nesting leatherback turtle can include a beach disturbance 5-10 m across (right, photo: Scott A. Eckert, WIDECAST).

Nesting occurs on sandy beaches throughout the Wider Caribbean region. Some species nest virtually year around, but most have a defined peak season. Many lines of evidence suggest that the female will return to lay her eggs on or near the beach where she was born. Scientists believe that the homing mechanism may rely on a combination of cues, including the earth's magnetism, the position of the sun and stars, prevailing ocean temperatures or currents, and geologic features, among others. (For the most accessible assemblage of information on migration and orientation, visit the research laboratory of Dr. Kenneth Lohmann and associates at http://www.unc.edu/depts/geomag/.) Each nesting ground supports a unique assemblage of sea turtles.

Females most often nest at night. Males do not come ashore. Most species nest individually; however, Kemp's and olive ridleys display another kind of nesting strategy, called an *arribada*, which is characterized by females emerging from the sea in large numbers to nest simultaneously. *Arribada* nesting can be

observed in the Pacific and Indian oceans, but this unique phenomenon no longer occurs in the Caribbean Sea where ridley sea turtles are highly endangered.

Occasionally a female will emerge from the sea and "false crawl" (meaning that she was unsuccessful in the laying of her eggs) for a variety of reasons including physical obstructions, bright lights, vehicle traffic or aggressive dogs, the presence of people, etc. If the female does find a suitable nesting site she will begin the construction of a nest by making a "body pit".



Caribbean green (left) and leatherback (right) turtles are shown "bodypitting", a process by which the dry surface sand is swept away to reveal the slightly damp underlayer into which the nest chamber will be carved. Photos: Scott A. Eckert (WIDECAST).

Carefully using her rear flippers, the egg-laden female digs a nest chamber by scooping deeply with one flipper and then the other. When this is completed, she positions her body at an angle over the nest chamber and deposits her eggs. Different species of sea turtles lay varying numbers of eggs in one nest. Eighty to 200 or more eggs are deposited in the nest chamber, but typically the average number of eggs (referred to as the "clutch size") is closer to 100.

A green sea turtle carefully covers her clutch of eggs (left, photo: Rowan Byrne) and returns to the sea, leaving a distinctive symmetrical track (right, photo: Scott A. Eckert, WIDECAST).

After egg-laying, the female sweeps sand over the eggs and compacts the nest with her rear flippers. She will repeat this process several times throughout the nesting season. Typically anywhere from 2 to 6 clutches of eggs are laid per year (see "Basic Biology of Sea Turtles"), but leatherbacks have been

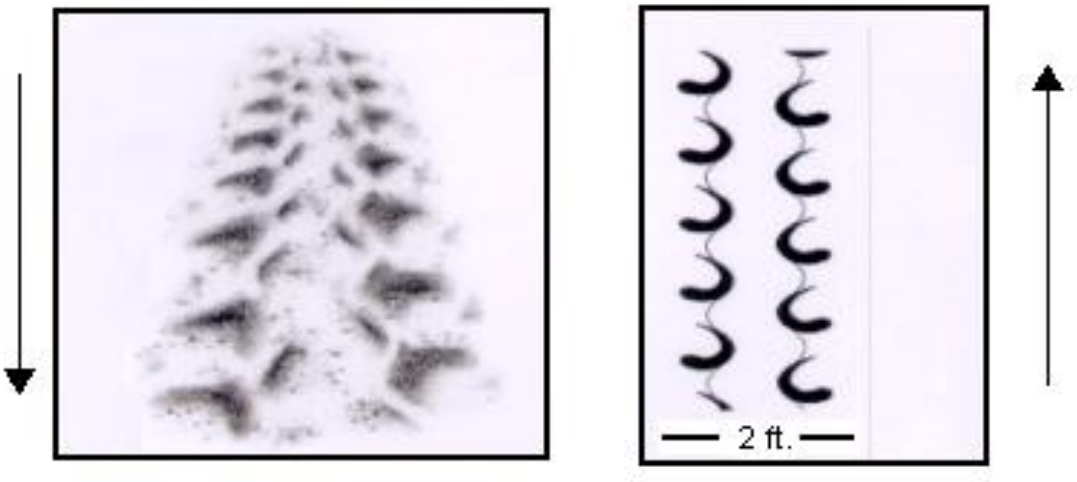
observed to deposit as many as 13 clutches of eggs per year (Reina et al. 2002). When all stages of the nesting sequence have been completed, the turtle returns to the ocean, leaving the eggs behind to incubate unattended in the warm sand.

Asymmetrical tracks

Four species of sea turtle leave asymmetrical tracks, sometimes referred to as "zipper crawls". These turtles – the loggerhead (see illustration below), hawksbill, Kemp's ridley, and olive ridley – alternate the movement of their front flippers so that the front and rear flippers on opposite sides move together. A faint tail drag running through the middle of the tracks may or may not be present. If the track is fresh and the sand crisp, an exact measurement of maximum track width can provide yet another clue as to species:

Species	**Track Width (widest point)**
Loggerhead	80-90+ cm
Hawksbill	70-85 cm
Kemp's Ridley	70-80 cm
Olive Ridley	70-80 cm

Loggerhead Turtle Track



Source: *Sea Turtle Conservation Guidelines* (FFWCC 2007).

For all practical purposes, a ridley track is physically indistinguishable from that of a hawksbill. However, because the nesting range of the ridleys is relatively narrow (Kemp's ridley: Gulf of Mexico; olive ridley: extreme southern Caribbean and South America), the track is more likely to have been made by a female hawksbill than by either of the ridleys at most Caribbean sites.

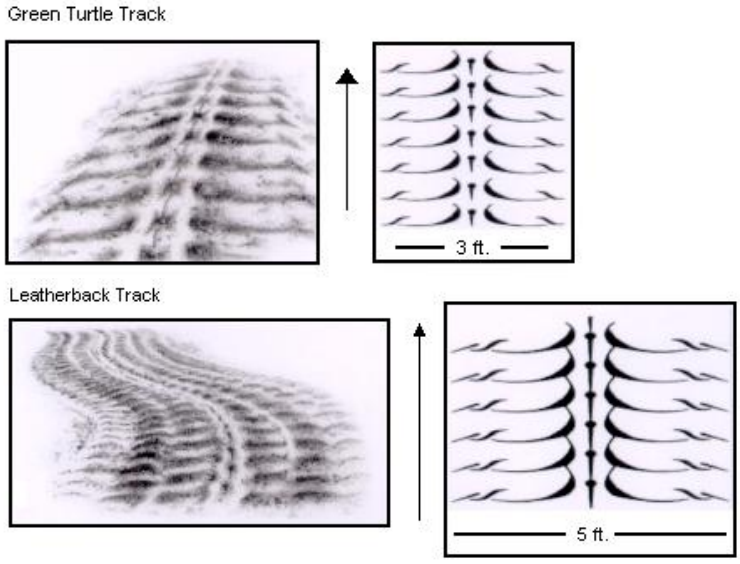
Kemp's and olive ridley tracks are also indistinguishable from each other, but their nesting ranges are non-overlapping. In the Western Atlantic region, Kemps ridleys are generally confined to latitudes north of 15ºN, while olive ridleys are generally confined to latitudes south of 15ºN. The ridleys are the smallest of the sea turtles and despite the fact that they once nested in our region by the tens of thousands of turtles *per day* (e.g., in Mexico: Ross et al. 1989, Márquez 1994), they are now the rarest of all Caribbean and Atlantic sea turtles.

Examples of asymmetrical nesting tracks: a loggerhead nesting in Florida (left, photo: Kate Mansfield) and a hawksbill nesting in Antigua (right, photo: Johan Chevalier, DIREN). Note the alternating flipper pattern and intermittent tail drag.

Symmetrical tracks

The tracks of the remaining two species are symmetrical in design, meaning that green and leatherback sea turtles move their front flippers unison, literally dragging themselves above the high-tide line. Hind flippers create matching parallel mounds in the middle of the track. Both species tend to drag their tails, leaving behind either solid or broken lines with accentuated points. The track sizes of these turtles differ noticeably, potentially confused only in the case of a very large green turtle or a very small leatherback:

Species	**Track Width (widest point)**
Leatherback	150-230+ cm
Green	70-130 cm



Source: *Sea Turtle Conservation Guidelines* (FFWCC 2007).

Example of a symmetrical nesting track: a leatherback returns to the sea in Aruba (left, photo: Turtugaruba Foundation), and a leatherback hatchling makes a similar journey in Sint Eustatius (right, photo: STENAPA).

Because both leatherbacks and green turtles leave a symmetrical track in the sand, other field signs can be useful in distinguishing between them. For example, the beach disturbance left by a leatherback is broad and disorganized. An expanse of hummocks and thrown sand may extend 5-10 meters across the beach platform, with a track some 2 meters wide leading to and from the sea. In contrast, a green sea turtle leaves a characteristic pit, approximately 1 meter deep and 1.5 meters across, associated with each attempt to dig a nest chamber. The green turtle's nesting pit, unique among sea turtles, is deep and broad enough to nearly completely conceal the nesting female during her egg-laying.

Green turtles typically leave a crater on the high beach platform (left, photo: Aruba, Turtugaruba Foundation), whereas a hawksbill nests discretely in maritime forest and the site can be difficult to locate (right, photo: Antigua, C.G. Stapleton and S. Stapleton).
See page 64 for a photo of a typical leatherback nesting site.

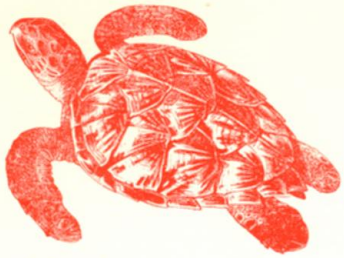
Want to know more? An excellent resource is Wood (2004), "A Field Guide for Sea Turtle Nesting Surveys, Southeast U.S. Region". Photos and field signs are well presented in this guide, which is available online at http://www.dnr.sc.gov/marine/turtles/volres/Wood%20Nesting%20Field%20Guide.pdf.

APPENDIX IV

SAMPLE MATERIALS FOR PLACEMENT IN HOTEL ROOMS *

* Used with permission

Helping Our Sea Turtle Friends



Disney's Vero Beach Resort is committed to the preservation of the environment and wildlife around us. We are especially concerned about the preservation of endangered animals such as sea turtles.

Sea turtles live nearly all of their lives in the sea, but females come onto land in order to nest. The East Coast of Florida is one of the most important nesting sites in the U.S., especially the area just to the north of our Resort. Because hatchlings are so vital to the preservation of the species, it is vital to ensure that nests are never disturbed. Sea turtles almost always hatch at night. Once they are free from their nests, they head for the sea, attracted by the light reflected off the water. Artificial lights on the beachfront disrupts the hatchlings' journey into the sea. For this reason, one should never use flashlights or other artificial lighting on the beach from May 1 through October 31. We ask that you close the drapes in your room after 10:30 p.m. during this period as well.

Following these simple measures, and remembering to keep all litter off the beach will help the sea turtles' chances for survival.

Thank you for your cooperation.

Help Preserve Our Beautiful Beaches

Disney's Vero Beach Resort is surrounded by a lush and bountiful coastal environment that provides us with a beautiful natural setting. We are committed to maintaining this wondrous environment and preserving the breathtaking array of natural wildlife that makes this area a special habitat for all.

The sand dunes along the beach are an integral part of this environment. They form a natural barrier against the sea. Dunes are held together by resilient little plants called Sea Oats. Damage to the sea oats exposes the dunes to the slow but powerful effects of the sea and wind. For this reason, walking on the dunes or picking sea oats is prohibited. Thank you for your cooperation in preserving our beautiful beaches.

We hope you enjoy our beautiful beaches during your stay. In addition to being a great place to enjoy the sun and surf, our beaches are important nesting areas for sea turtles and our dunes are home to many plants and animals. During your stay, we hope you will help us protect our coastal wildlife & habitats.

Funded by a grant awarded from the Sea Turtle Grants Program. Learn more at www.helpingseaturtles.org

Please Help Protect Florida's Sea Turtles & Coastal Habitats

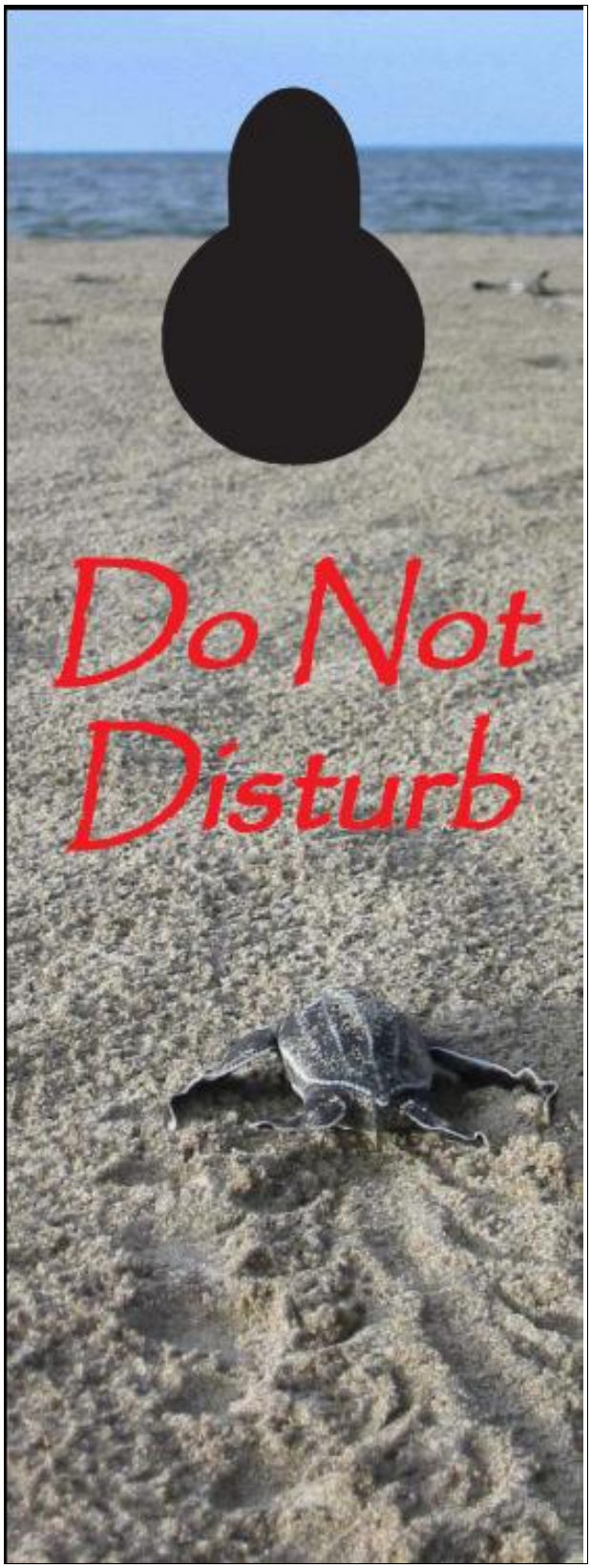
Photo courtesy of Turtle Time, Inc.

Sea turtle season is March 1 to October 31 (Atlantic coast) or May 1 to October 31 (Gulf coast), please remember a few simple things to help protect sea turtles & their habitats:

- It is against the law to touch or disturb nesting sea turtles, hatchlings, or their nests. Sea turtles are protected by Federal and State Laws.
- Avoid using flashlights, lanterns or flash photography while on the beach at night.
- Turn off or shield lights, close drapes/blinds to prevent lights from shining onto the beach. Lights disturb nesting turtles and hatchlings.
- Avoid disturbing marked nests and please take your trash when you leave the beach.
- Please make sure to remove all items, such as beach chairs, from the beach at night.

CARIBBEAN CONSERVATION

Produced by the Caribbean Conservation Corporation. www.cccturtle.org



We hope you enjoy our beautiful beaches and waters during your stay. In addition to being a great place to enjoy the sun and surf, our beaches are important nesting areas for sea turtles and our dunes are home to many unique plants and animals. During your stay, we hope you will help us protect our coastal habitats and wildlife. Sea turtle season is from March through October, so please remember a few simple things to help protect these magnificent creatures and their habitat:

- It is against the law to touch or disturb nesting sea turtles, hatchlings, or their nests. Sea turtles are protected by the Federal Endangered Species Act and the Florida Marine Turtle Protection Act.
- Avoid using flashlights or flash photography while on the beach at night.
- Turn off outside patio lights or shield indoor lights from shining directly onto the beach at night. Lights disturb nesting turtles and hatchlings.
- While enjoying the beautiful beaches during the day, avoid disturbing marked sea turtle nests.
- When crossing a dune, please use designated cross overs and walk ways. Do not climb over the dunes or disturb the dune vegetation.

For More Information Contact:

St. Lucie County Environmental Resources Department
772-462-2526 | www.stlucieco.gov/erd/turtles.htm
Caribbean Conservation, 800-678-7853 | www.cccturtle.org

Funding for this printing provided by a grant from the National Fish & Wildlife Foundation

Photo by Daniel Evans/CCC

Do Not Disturb

You can help protect nesting sea turtles by following these simple precautions at night.

Tips to Help Nesting Sea Turtles

Sea turtles like it dark. Please no flashlights or flash photography.

It's a long, arduous journey to get to the water. Please don't disturb sea turtles.

Don't tread on me. Sea turtles lay eggs near the foot of the beach dunes. Please stay clear of the dunes and walk along the water's edge.

Remove beach furniture, toys and litter that may trap or disorient sea turtles.

Columbus ZOO and Aquarium

FRIENDS OF THE CARR REFUGE FLORIDA

SEA TURTLE PRESERVATION SOCIETY Sea Turtle PRESERVATION SOCIETY BREVARD COUNTY, FLORIDA

Funding provided by the Columbus, Ohio Zoo
Door hanger design by Cape Canaveral Scientific, Inc.
Photograph by Jim Angy

A Message for Our Guests...

Lights Out for Sea Turtles

during sea turtle nesting season (May ~October)

These beaches are North America's most important nesting site for sea turtles.

Female sea turtles lumber ashore at night to lay 40- 180 leathery, ping pong ball- sized eggs near the dune line.

Artificial lights confuse nesting female sea turtles.

After 55 days of incubation in the sand, artificial light near the beach can disorient hatchlings who use the light of the horizon to direct them to the sea.

Once disoriented, these hatchlings may die from dehydration.

Three species of sea turtles can be seen around Barbados. The Hawksbill, and more rarely the Leatherback, nest on our beaches. Green turtles feed in our waters, but nest elsewhere.

DID YOU KNOW?

Sea turtles return to their natal beach to nest.
It is suggested that the beach a turtle chooses to nest on is the same one which she herself was hatched on many years previously.

The sex of a turtle is largely determined by the temperature at which the eggs develop in the beach.
Warmer temperatures result in females, cooler temperatures result in males.

Sea turtles can take 20 -30 years to become sexually mature.
It is estimated that only about one out of one thousand eggs survives to reproduce.

Elegant Hotels Group is promoting the conservation of endangered sea turtles through its support of the Barbados Sea Turtle Project. Our participation in the conservation of this critically endangered species is our first step towards promoting environmental awareness in conjunction with the Barbados Sea Turtle Project.

ELEGANT HOTELS
GROUP

For further information contact:
Barbados Sea Turtle Project
Bellairs Research Institute
St. James, Barbados
Tel: 422-2034, 230-0142
Fax: 422-0692

ADOPT YOUR BEACH. . . & SEA TURTLES!

You use your beach for recreational activities - sea turtles use it for serious business! What you do on your beach can have a significant impact on the success of turtle nesting. Here are a few tips on how you can share your beach with these endangered species and help preserve Barbados' natural heritage.

Barbados Sea Turtle Project
Bellairs Research Institute

HOW YOU CAN HELP MAKE YOUR BEACH TURTLE FRIENDLY

Leave native beach vegetation in place.

Don't remove vegetation when cleaning up your beach. Vegetation helps to prevent beach erosion. Also, hawksbill turtles prefer to nest on vegetated beaches. Get guidance from the Coastal Zone Management Unit before attempting any revegetation efforts.

Discourage driving on your beach

Vehicles compact the sand and make it difficult for turtles to dig into or out of the sand. They also destroy beach vegetation. Mechanised beach cleaners do the same thing (plus they often miss plastic straws and cigarette butts!)

Minimise beachfront lighting

Beachfront lighting is a major problem for turtles in Barbados. Every year thousands of hatchlings are attracted inland by lights, instead of swimming out to sea. Shade lights, hide them behind vegetation or use low pressure sodium bulbs.

Don't burn or bury garbage and leaves on the beach

Take garbage away. Garbage contaminates beach sand, increasing bacterial and fungal infections in turtle eggs. It also obstructs the emergence of hatchlings from their nests.

Minimise the amount of beach space used up at night.

High tides can wash away turtle nests or drown developing embryos. Sea turtles need to nest in the dry sand above the high water mark. Beach chairs can be stacked in tall piles to free up more beach space for nesting turtles.

Discourage the use of pointed drink stands.

When stuck into the sand, these stands can pierce turtle eggs. (The same applies to sun umbrellas and shades!)

In-Room Reference Guide

Managing Light

Protecting Sea Turtles, Saving Energy

ARTIFICIAL LIGHT that shines on the beach disrupts critical nighttime behavior of adult and hatchling sea turtles. Fortunately, light from homes, condominiums, businesses, signs, street lights and other structures near the beach can be managed effectively so that it does not cause harm to sea turtles. This can be accomplished without a great deal of effort, expense or compromise to personal safety, security and convenience. In many instances, good light management not only improves the aesthetic appearance of the property but it also reduces energy costs.

Keep Light Off the Beach

The most important aspect of light management is to confine light to your property and not let it stray out onto the beach.

- Position fixtures so they cannot be seen from the beach
- Aim lights down and away from the beach
- Apply shields to light fixtures
- Replace fixtures that allow light to shine in many directions with fixtures that direct light only onto the area where it is needed
- Recess porch lights into roof soffits
- Lower the mounting height of pole lights
- Position walkway fixtures close to the ground
- Plant native vegetation to block lights from shining on the beach

Minimize Your Property's Illumination

THE GREATER THE AMOUNT of light near the beach, the greater the potential for harm to sea turtles. Determine what is the lowest acceptable level of illumination on your property for personal safety and security.

- Turn off non-essential lights during the sea turtle nesting season
- Eliminate accent lights and decorative fixtures
- Reduce the total number of fixtures used to illuminate the grounds
- Reduce the wattage of bulbs used in exterior fixtures
- Place lights on timers so they are on when needed
- Place security lights on motion detectors so they come on only when someone is on the property
- Install 45% transmittance window tint (saves energy costs, too!)
- Position interior lights away from windows, if possible

Failure to protect sea turtles from harmful lighting can result in hearings before the Citizen Code Enforcement Board. This Board has the power to fine violators up to $250 per day for an initial violation and up to $500 per day for a repeat violation. The Board also may choose to invoke a one-time $5,000 fine for irreparable, irreversible damage.

If you should see an injured or dead stranded turtle or hatchlings on the beach during daylight hours or a daytime nesting turtle, please report this information immediately to the nearest Lifeguard or Beach Patrol officer. If beach personnel are not present, please call the Beach Patrol at 424-2345 (New Smyrna Beach) or 239-6484 (Daytona Beach). To report disoriented hatchlings at night, please call the Volusia County Sheriff's office at 423-3888 (New Smyrna Beach) or 248-1777 (Daytona Beach), then press O after the recorded prompt.

Use Light Sources That Are Minimally Disruptive to Sea Turtles

SEA TURTLES are affected by most types of light when it shines directly onto the beach. However, some types of light are less disruptive than others.

- Use low wattage yellow bug lights instead of white lights
- Replace high pressure sodium vapor parking lot and security lights with shielded low pressure sodium vapor lights

Be a Considerate Beachfront Resident/Visitor

- *Please* Draw your curtains and window shades at night so interior lighting does not shine on the beach
- *Please* Don't use flashlights and lanterns on the beach at night during the turtle nesting season. Also during nesting season, bonfires are prohibited.

This information guide is printed as a special edition of **EnviroNet**, a monthly newsletter published by the Volusia County Environmental Management Department. Requests for additional information and questions may be directed to:
Daytona Beach: 254-4612
DeLand 736-5927
New Smyrna Beach: 423-3303
FAX: 822-5727
www.volusia.org/environet

APPENDIX V

"WHAT SHOULD I DO IF I SEE A SEA TURTLE ON THE BEACH?" *

* Staff should always report sightings to management, who, in turn, should provide this information to local conservation partners and the appropriate authorities. The following brief guidelines will help in establishing basic rules of behavior when sea turtles are encountered.

TURTLE WATCHING

Sea turtles have lived in the world's oceans for more than 150 million years. Sadly these ancient reptiles are now globally threatened with extinction. Many populations are declining as a result of persistent hunting, increasing coastal development, incidental capture in fisheries, the degradation and destruction of nesting beaches, and marine pollution. You can help to protect them by following these simple guidelines.

Developed in collaboration with the Wider Caribbean Sea Turtle Conservation Network (WIDECAST), these guidelines are intended to give general advice only – be sure to find out about local rules and regulations.

TURTLE FACTS

- All species of sea turtle are endangered and need our protection
- Turtles breathe air just like us, which means they can drown if they are prevented from reaching the surface of the sea
- Litter is dangerous, especially plastic bags which can be mistaken for jellyfish – a favourite turtle food
- Turtles remain in the same area for years and, as adults, return to the same nesting area year after year – if a nesting colony is destroyed, the turtles may never return

WHAT YOU CAN DO

- Support local sea turtle conservation initiatives – consider volunteering!
- Participate in local sighting networks and complete all sighting forms
- Do not buy or sell sea turtle products – turtles are strictly protected under CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) and most national laws

ON THE WATER

- Keep a good look out for sea turtles while boating – boat strikes can kill
- When in the water, keep your distance and avoid startling turtles; avoid disturbing resting, sleeping or actively feeding turtles
- To ensure that encounters are as unthreatening as possible, approach turtles slowly and calmly and move away if the turtle shows signs of distress
- Never try to spear, harass, catch or ride turtles
- Experts advise not to touch or feed wild turtles
- Take all litter home with you: trash can kill, especially when it is mistaken for food

Participating in turtle watching programmes actually helps to protect turtles by raising awareness about them

Be sure to find out about local laws and regulations, as they may differ from these general guidelines

TURTLE WATCHING

ON THE BEACH

During breeding seasons, some special considerations apply to turtle nesting beaches.

- Avoid damage to incubating nests – for example, avoid driving on a turtle nesting beach or using these beaches for camp fires or barbecues
- Do not leave large items (such as chairs, umbrellas or recreational vehicles) on nesting beaches at night – these can obstruct a turtle's path and prevent egg-laying
- Keep pets, especially dogs, away as they can endanger eggs and hatchlings
- Keep beach lighting to a minimum – artificial lighting disorients turtles
- Shield or switch off lighting which is visible from the beach

Watching nesting turtles

Seeing an adult turtle come on shore to lay her eggs is an unforgettable experience. However, on land turtles are very vulnerable and if startled, a female turtle may return to the sea before her eggs can be successfully laid. Please follow these simple rules when watching nesting turtles.

- Keep disturbance to a minimum – stay quiet and move around slowly
- Do not approach turtles as they arrive from the sea: they are easily frightened off
- Turtles that have not yet laid their eggs must be left alone
- Make minimal use of flashlights; never shine lights directly into a turtle's face
- Try not to "trap" turtles – approach from behind and keep low to the ground
- Move away if the turtle shows signs of distress
- Turtle eggs and hatchlings should be left undisturbed
- Consider limiting viewing to 30 minutes at a time

Photography

Flash photography of nesting turtles is a controversial topic. In some places this constitutes harassment and is illegal. If using a camera flash, do so sparingly and:

- Never take photographs before a turtle has laid her eggs
- Only take photographs from behind the turtle – the flash will temporarily "blind" her and complicate her return to the sea

Hatchling turtles

- Try to shield hatchlings if they appear disoriented by beachfront lighting – place yourself between the hatchlings and the light source, and ask that the lights be turned off long enough for the hatchlings to reach the sea
- Do not interfere with their crawl to the sea as this could jeopardize their survival
- Never photograph hatchlings – they are very sensitive to light

The Coral Reef Alliance (CORAL) is a member-supported, non-profit international organization dedicated to keeping coral reefs alive around the world. Visit our website http://www.coral.org

Visit the Wider Caribbean Sea Turtle Conservation Network (WIDECAST) website at http://www.widecast.org for more information on marine turtles and turtle conservation

CORAL RP-102:2002

APPENDIX VI

"WHAT SHOULD I DO IF I SEE A TURTLE WHILE DIVING OR SNORKELING?"

Swimming with Sea Turtles

While swimming, you will see mainly green turtles, and occasionally hawksbill turtles. Barbados is a foraging area for juvenile green turtles born in Costa Rica, Surinam, Aves Island, Florida and Ascension Island. Adults are rarely seen here. Most are tagged with uniquely numbered metal clips on the inside edge of the front flippers. This is to allow the animals to be monitored and their movements tracked.

THREATS

Propeller & Boat Strike Injuries

Fishing Hooks

Entanglement in Fishing Nets

Ingestion of Garbage

Remember that sea turtles are wild animals that are also endangered. They should be treated with respect. Please follow the guidelines below.

Do Not Chase

Do Not Ride or Hold on

Do Not Overfeed or Feed Inappropriately

No Fishing

No Fins

No Littering

For additional information on sea turtles and how to make a donation for sea turtle conservation in Barbados, see www.barbadosseaturtles.org or call the Sea Turtle Hotline 230- 0142.

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APPENIDX VII

"WHAT'S IN IT FOR ME?"

GREEN GLOBE AND BLUE FLAG CERTIFICATION PROGRAMS

INDUSTRY CERTIFICATION PROGRAMS

Green Globe

Green Globe (http://www.greenglobeint.com/) is a global benchmarking and certification program that promotes sustainable tourism throughout the world by providing a framework for environmental and social performance improvement. Based on Agenda 21 and the principles endorsed at the United Nations Rio de Janeiro Earth Summit in 1992, Green Globe Standards are performance-oriented, providing participants with a framework to measure their environmental impact and then develop and implement strategies to reduce those impacts.

Participants of the Green Globe benefit in a variety of ways, including demonstrating the high level of standards that they hold for themselves in their operation to their customers and shareholders, as well as the government and local community. They also gain market share and credibility among consumers seeking companies within the tourism industry that have adopted high environmental standards and sustainable management practices. As importantly, by implementing a more systematic and integrated approach in its operations, a company can significantly reduce energy costs while decreasing water use and waste production.

The Green Globe journey involves three steps: Benchmarked Bronze, Certified Silver, and Certified Gold. In order to qualify as a Green Globe operation and display the trademarked Green Globe logo, businesses and communities must be certified by one or more Green Globe licensee. Green Globe Standards, which underpin the Benchmarking and Certification program for the travel and tourism industry, are available in five categories: Company (Enterprise), Community/Destination, Design and Construct, Precinct, and EcoTourism.

There are several Focus Areas in achieving the Community Standard, including inter alia a sustainability policy, environmental investment, and a commitment to biodiversity conservation. Adopting and implementing a *Sea Turtle Policy Statement* contributes meaningfully to each of these areas. "Enhanced local socio-economic benefits" must also be demonstrated, a criterion which can be met through the kinds of partnerships with local communities and conservation organizations discussed in this Manual.

The Caribbean has the largest number of Green Globe certified properties: according to the Caribbean Alliance for Sustainable Tourism (CAST) (http://www.cha-cast.com/), an allied partner of Green Globe, there are 57 Certified Properties in the region and the "Top 10 Benefits" of Certification are:

- Reduced water consumption
- Reduced energy consumption
- Lower operational costs
- Improved staff morale and productivity
- Increased staff creativity
- Increased customer satisfaction
- Reduced employee conflict
- Increased employee retention
- Improved community relationships and benefits
- Improved business and shareholder value

To those who incorporate the recommendations embodied in this Manual, we can add a further benefit: that of sea turtle conservation and the satisfaction of assisting a unique group of animals that once flourished in the Caribbean Sea and, according to archeological evidence, have contributed substantially to the nutrition and economy of humankind in the region for more than 1,000 years. This is your opportunity to give something back – and to reap corporate benefits at the same time.

Case Study: Bucuti Beach Resort

Bucuti Beach Resort (www.bucuti.com) is located on Eagle Beach on the western coast of Aruba. Firmly committed to conserving the environment, the resort's management team has implemented conservation programs ranging from waste recycling to preserving wildlife to "green" construction. The progressive nature of the operation and its positive results have been recognized numerous times, for example:

- 2007: ISLANDS Magazine BLUE LIST Global Tourism Sustainable Awards
- 2007: Green Globe 21, ISO 14001 and ISO 9001 Certified
- 2006: Green Globe 21 Re-Certified
- 2004: International Hotel & Restaurant Association "Green Hotel Award", Independent Hotel category
- 2003: "Green Hotel of the Year" by the Caribbean Hotel Association
- 2003: ISO 14001 Environmental Certification (the first hotel in the Americas and the Caribbean to achieve this certification)
- 2002: Green Globe 21 Certified

Sea turtle conservation is a strong component of the resort's environmental and social commitment. At the start of each nesting season, the local WIDECAST affiliate (Turtugaruba Foundation) trains Bucuti Associates to recognize nesting signs on the beach and to respond appropriately. Training always includes an interactive slide presentation, providing an opportunity for management, staff and guests to learn about sea turtle biology and the resort's role in safeguarding some of the most important nesting habitat in Aruba. Informed and empowered, staff routinely participate in resort-sponsored beach clean-ups, report sea turtle nesting and hatching events, and support and interact with Turtugaruba volunteers (e.g., http://bucuti.com/en/about_us/news.php?release=20060531).

Bucuti Beach Resort fulfills their Certification Performance Criteria in a number of ways, including:

Environmental and Social Policy – the resort has focused on reducing energy and water use, limiting solid and liquid waste, promoting guest participation in environmental efforts of the resort, and raising environmental awareness in the community

Energy – The resort has limited energy use by installing energy-efficient light bulbs, solar panels, and motion sensors for lights and air conditioning; air condition energy consumption has declined by 30%

Water – Numerous water-saving techniques have been implemented on the property including flow reducers on shower heads and water faucets, reduced capacity toilet tanks, drip and timed irrigation systems, a gray water reuse system, and a linen and towel reuse program

Solid and liquid waste – The resort uses a variety of management schemes to minimize solid and liquid waste, including eliminating the use of disposable dishes and cups and placing bulk soap and shampoo dispensers in all the rooms

Resource conservation – The resort has reduced the use of paper in their offices, communicating mostly through the internet and placing brochures and sales kits on CDs; they also promote wildlife conservation by placing informative signs throughout their property, and support and collaborate with local conservation organizations to protect wildlife found on their property, including sea turtles

Each of these commitments – from social policy to solid waste – benefits the natural environment and contributes in important ways to biodiversity conservation. In return, the resort's relationship with the local sea turtle population is embraced by resort guests and contributes to a positive vacation experience. Combined with the fact that sea turtles are protected in Aruba (Bräutigam and Eckert 2006), it is not surprising that sea turtle nesting is increasing on Eagle Beach.

Blue Flag

The Blue Flag Campaign (http://www.blueflag.org/) is an international voluntary certification scheme for beaches and marinas. The Blue Flag is an exclusive eco-label that was awarded to 3,200 beaches and marinas in 35 countries across Europe, South Africa, New Zealand, Canada and the Caribbean in 2005.

The Blue Flag label requires beaches and marinas to meet high standards in environmental management, education and information, water quality, safety, and other services. The standards of environmental management include the proper disposal and recycling of waste, beach cleanliness, and the maintenance of buildings and equipment, among other things.

Blue Flag beaches also must meet the criteria of environmental education and information, which highlights the need for informing the public by providing necessary information regarding water quality and environmental resources; additionally, educational activities need to be provided. Water quality requirements address compliance with treaties, discharge of pollutants and runoff, as well as monitoring the health of nearby coral reefs. The Blue Flag program also checks to see if proper measures are taken to ensure visitor safety by providing lifeguards, preventing conflicts or accidents, and other public services.

While Blue Flag does not specifically require the conservation of wildlife, innovative partnerships, such as with REEF CHECK, are focusing attention on the importance of protecting coastal and marine biodiversity. Similarly, WIDECAST is exploring the possibility of a Blue Flag partnership that recognizes sea turtle conservation measures implemented by beachfront properties. Such measures might include providing quality nesting habitat by adopting and implementing a *Sea Turtle Policy Statement* to include setbacks, proper lighting, unobstructed nesting areas, partnerships with local experts to monitor nesting activity, promoting awareness among beach users of the presence of incubating eggs on the beach, etc.

By adopting and implementing a *Sea Turtle Policy Statement*, many of Blue Flag mandates are met, including: compliance with all coastal zone planning regulations and environmental legislation, the beach must be clean (e.g., no industrial or sewage related discharges may affect the beach; waste disposal bins /receptacles must be available on the beach in adequate numbers, regularly maintained and emptied; requirements for sewage treatment and effluent quality must be met), no unauthorizd camping or driving on the beach and no dumping, regulations concerning dogs and other domestic animals on the beach must be strictly enforced, etc.

In the Caribbean Sea, protecting sea turtles is good business! For more information concerning the Caribbean Blue Flag program, contact the Caribbean Alliance for Sustainable Tourism (CAST) at cast@cha-cast.com.

NOTES

WIDECAST

Wider Caribbean Sea Turtle Conservation Network

"Working together to build a future where all inhabitants of the Wider Caribbean Region, human and sea turtle alike, can live together in balance."

The Wider Caribbean Sea Turtle Conservation Network (WIDECAST) is a regional coalition of experts and a Partner Organization to the U.N. Environment Programme's Caribbean Environment Programme. WIDECAST was founded in 1981 in response to a recommendation by the IUCN/CCA *Meeting of Non-Governmental Caribbean Organizations on Living Resources Conservation for Sustainable Development in the Wider Caribbean* (Santo Domingo, 26-29 August 1981) that a "Wider Caribbean Sea Turtle Recovery Action Plan should be prepared ... consistent with the Action Plan for the Caribbean Environment Programme."

WIDECAST's vision for achieving a regional recovery action plan has focused on bringing the best available science to bear on sea turtle management and conservation, empowering people to make effective use of that science in the policy-making process, and providing a mechanism and a framework for cooperation within and among nations. By involving stakeholders at all levels and encouraging policy-oriented research, WIDECAST puts science to practical use in conserving biodiversity and advocates for grassroots involvement in decision-making and project leadership.

Emphasizing initiatives that strengthen capacity within participating countries and institutions, the network develops and replicates pilot projects, provides technical assistance, enables coordination in the collection, sharing and use of information and data, and promotes strong linkages between science, policy, and public participation in the design and implementation of conservation actions. Working closely with local communities and resource managers, the network has also developed standard management guidelines and criteria that emphasize best practices and sustainability, ensuring that current utilization practices, whether consumptive or non-consumptive, do not undermine sea turtle survival over the long term.

With Country Coordinators in more than 40 Caribbean nations and territories, WIDECAST is uniquely able to facilitate complementary conservation action across range States, including strengthening legislation, encouraging community involvement, and raising public awareness of the endangered status of the region's six species of migratory sea turtles. As a result, most Caribbean nations have adopted a national sea turtle management plan, poaching and illegal product sales have been dramatically reduced or eliminated at key sites, many of the region's largest breeding colonies are monitored on an annual basis, alternative livelihood models are increasingly available for rural areas, and citizens are mobilized in support of conservation action. You can join us! Visit www.widecast.org for more information.

WWW.WIDECAST.ORG