

08  
REGIONAL INITIATIVE



# Earthwatch.

2008 EXPEDITION BRIEFING

## Sustainable Southern Belize

Edwin Martinez  
Earthwatch Institute





## EXPEDITION UPDATE: TEAMS 6, 7 AND 10

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Hello *Sustainable Southern Belize* Volunteers,

We hope you are all doing well and are looking forward to your upcoming expedition to Belize!

Please note that Teams 6, 7 and 10 will conduct research in the Port Honduras Marine Reserve (PHMR), and will not be based at the Living Reef Center, where all other *Sustainable Southern Belize* teams will stay. Instead, **Teams 6, 7 and 10 will stay at the Beya Suites throughout the expedition.** Please see Section 2 '*Accommodations*' for information on the Beya Suites.

Please don't hesitate to contact Earthwatch with any questions.

Thank you, and enjoy your expedition!

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Welcome to Earthwatch Institute!

You are just one step away from a life-changing experience! You may travel to a land you've never seen, live with a culture you know little about, learn skills you've only imagined – all in the name of field research that leads to further understanding of our natural and cultural resources.

Your team will take part in one of Earthwatch Institute's regional initiatives. Through this initiative, we believe we can accelerate the conservation process by using the Earthwatch participatory model to produce data that will be used by our local and international partners in conservation. With our partners, we identify areas in need of urgent action and then deploy multiple Earthwatch teams to support research projects at a single location, all working toward an overall conservation aim. In this way, every fragment of datum you collect can be used by the scientists and our conservation partners to further protect a critically endangered region. This research will be conducted as part of our *Sustainable Southern Belize* regional initiative.

The Expedition Briefing in your hands is your initiation to these projects. You will learn about the inspiration that led the scientists to launch the research, the objectives, goals and even some of the achievements of the project. You will get a very real sense of how your participation contributes to solving global research questions.

Your assignment is to apply your own skills and talents to the research question. Your support helps to make *Sustainable Southern Belize* possible. Thank you for contributing your time and money to supporting scientific research and experiential learning, and for inspiring environmental responsibility and global citizenship.

Now, find a comfortable chair and prepare for a fascinating journey.

*~Earthwatch Institute Staff*

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-- An international nonprofit organization founded in Boston, Massachusetts in 1971 --

# Sustainable Southern Belize

## EXPEDITION BRIEFING

Team	Project	Activity	Location
Team 1	Queen Conch	Snorkel	SCMR
Team 2	Coral Bleaching	Snorkel	SCMR
Team 3	Queen Conch	Snorkel	SCMR
Team 4	Coral Bleaching	Snorkel	SCMR
Team 5	Coral Bleaching	Snorkel	SCMR
Team 6	Seagrass	Dive	PHMR
Team 7	Mangrove	Survey	PHMR
Team 8 ( <i>Teen Team</i> )	Queen Conch	Snorkel	SCMR
Team 9	Coral Bleaching	Snorkel	SCMR
Team 10	Conch	Dive	PHMR

**Please note:**

- Teams 1-5 and 8-9 will be based in the Sapodilla Cayes Marine Reserve (SCMR) and will participate in research tasks that involve snorkeling. Teams 6-7 and 10 will be based in the Port Honduras Marine Reserve (PHMR). Teams 6 and 10 will conduct research tasks that involve scuba diving. Team 7 will conduct research from a boat. More information will be provided for teams based in PHMR as it becomes available.
- Team 8 is an Earthwatch Teen Team and is reserved for participants 16 – 17 years of age. Volunteers on this team will receive a separate Expedition Briefing. To learn more about Earthwatch Institute’s Teen Teams, visit [www.earthwatch.org](http://www.earthwatch.org).
- You must be 18 years of age or older to participate on standard *Sustainable Southern Belize* teams (Teams 1-7 and 9-10). It may also be possible for 16- and 17-year-olds to participate if accompanied by a parent or guardian. Contact Earthwatch for more information and see Section 4 ‘*Before You Leave*’ for traveling advice for minors.

Dear Earthwatch Volunteers,

The mission of the *Sustainable Southern Belize* regional initiative is to engage communities, partners, stakeholders, scientists and the Government of Belize in actions necessary for the sustainable management of Belize's natural resources. This will support a better quality of life and future within southern Belize for Belizeans and our visiting friends. If you love nature and the outdoors, want to contribute to the conservation of the Maya Mountain to Barrier Reef ecosystem in southern Belize, and desire to have direct interaction with the indigenous Maya and Garifuna cultures, then the *Sustainable Southern Belize* regional initiative is where you want to be.

At various marine sites in the Port Honduras Marine Reserve (PHMR) and the Sapodilla Cayes Marine Reserve (SCMR), volunteers will become directly engaged in research on mangroves, coral reefs, conch, water quality and a host of other monitoring efforts. Some of the activities require scuba diving experience but if you are not a scuba diver there are also snorkeling and boating projects. The waters of the SCMR are crystal clear with various species of corals ranging from branching and pillar corals to leaf, plate and sheet corals. The PHMR is closer to shore and is dotted with many islands, sea grass beds, mangrove forests and patch coral reefs.

As an Earthwatch volunteer, you will have the opportunity to converse with students, teachers and other members of the surrounding local communities. Many of them have not experienced a visit to these Marine Protected Areas (MPAs) so your input engaging locals will be very important. You will get the opportunity to partner with local people on various research tasks.

Southern Belize needs you. Your contribution to the conservation of this ecosystem is very important. You will be directly involved in surveys, data collecting and monitoring, habitat assessment, handling of specimens, stakeholder engagement, and many other interesting research and educational opportunities.

While on the mainland, Earthwatch teams will stay at a local inn with private baths and air-conditioned rooms. Offshore, teams will stay in the newly constructed Living Reef Center on Hunting Caye. This facility includes dorms and laboratories and will be ready for occupation at the start of the 2008 season. During your recreational time you may have the opportunity to visit Mayan ruins, Mayan communities, caves and waterfalls, and to kayak rivers and coastal waters. You may also be able to arrange jungle hikes and bird-watching trips, and enjoy some of the local Maya, Garifuna, Creole and East Indian cuisine.

We extend to you an invitation to join us in protecting one of the most pristine regions of Belize. For decades this ecosystem has been the source of cultural and socio-economic support for nearby communities. The heavy reliance on the local ecosystem for human survival has posed threats to its ecological health and biological diversity. Our goal is to develop a sustainable environment where the communities and the ecosystem can live in harmony.

Kind Regards,

Edwin Martinez  
*Sustainable Southern Belize* Field Director

# Sustainable Southern Belize

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## SUSTAINABLE SOUTHERN BELIZE REGIONAL INITIATIVE

### *What is an Earthwatch Regional Initiative?*

Earthwatch Institute's regional initiatives are comprehensive research and education programs that develop conservation action plans in regions of exceptional natural and cultural value around the world. Located at key sites in Australia, Belize, Costa Rica, and Kenya, they are strategically placed to make the most impact in terms of conservation. These initiatives serve as a base for a multidisciplinary team of scientists whose integrated research can best address issues raised by local communities. Cultural perspectives and economic and social concerns are integrated with ecosystem-level research for lasting, locally supported conservation outcomes.

### **Landscape, Wildlife and People**

The *Sustainable Southern Belize* research area runs east from the ridge tops of the Maya Mountains through rainforests, coastal plains and mangrove forests to the world's second largest barrier reef, a UNESCO World Heritage Site. This unique slice of tropical habitat is home to whale sharks, manatees, jaguars, crocodiles and over 540 species of birds. Southern Belize is populated by a great diversity of people and cultures, including Garifuna, Maya, East Indian and Creole, and is steeped in the rich history of the Mayan civilization.

In its third year of operation, *Sustainable Southern Belize* will continue to bring together researchers to concentrate on marine and coastal issues in two locations in Toledo District: Port Honduras Marine Reserve and Sapodilla Cayes Marine Reserve.

### **Port Honduras Marine Reserve (PHMR)**

PHMR was declared a marine reserve in January 2000. With an area of 160 square miles/414.4 square kilometers, it links the freshwater coastal mangrove forests, which serve as critical fish nurseries and home to manatees, birds and crocodiles, to coral beds teeming with beautiful tropical fish and dolphins, and to saline mangrove islands and important Mayan archeological sites.

### **Sapodilla Cayes Marine Reserve (SCMR)**

SCMR is located within the Mesoamerican Barrier Reef System (MBRS). Stretching over 625 miles/1,000 kilometers of coastline, the MBRS is the largest continuous reef in the Western Hemisphere and has been identified as a UNESCO World Heritage site, a unique and globally important ecosystem. Belizean, Guatemalan and Honduran communities living along the MBRS rely heavily on it for their livelihood and sustenance. The reef provides habitat for fish and shellfish, a prime target of local fisheries, providing a valuable source of protein and livelihood for many coastal communities. Coral reefs are also economically important as an attraction for tourists, supporting the lucrative dive tourism industry and coastal tourism in general.

## **Threats to the Environment**

Despite having one of the lowest population densities in the world, Belize is not totally protected from environmental concerns. As one of the most biologically diverse habitats on Earth, the MBRS has been treated in the past as a limitless resource and evidence indicates that the reef system is threatened by severe natural and human-induced impacts. Rising population density, associated coastal development, increased fishing and agricultural and industrial activities result in increased pressure on the reef and associated ecosystems. The recent discovery, extraction and exportation of crude oil from Belize, though a tremendous and welcomed economic opportunity, also poses a new challenge to the management of the country's natural resources. Noteworthy is that route for the oil tankers passes through the Victoria Channel, which is adjacent to both the PHMR and SCMR, posing a high risk for contamination from potential oil spills.

These threats become evident in the population levels of indicator species such as coral and conch, both economically and culturally important in southern Belize. The decline of coral reefs has been most pronounced in the Caribbean region, where coral cover has dropped 80% in the last three decades due to climate change, coastal run-off and coral diseases. The futures of species such as queen conch are in question with the high demand fishing places on them.

## **Working with Communities towards a Sustainable Environment**

### ***Capacity Building***

Capacity building is the process of helping people identify issues and develop insights, knowledge and experience needed to implement change and solve problems. Earthwatch Institute's regional initiatives serve as focal points for local capacity building and community education, moving conservation to the forefront of local issues and putting constructive solutions within reach. Fellowships to teachers, conservation professionals and researchers from the region represent 30-50% of our volunteer work force at regional initiative locations every year. At each location, Earthwatch is developing a global network of concerned citizens and conservation professionals who understand the issues and can take positive action in their own community - whether locally or thousands of miles away. Earthwatch volunteers from around the world are a vital part of that network.

Earthwatch has been working closely with local partners in southern Belize to identify research needs in the area that Earthwatch projects can address. Local partners include the Toledo Association for Sustainable Tourism and Empowerment (TASTE), the Government of Belize (GOB) Fisheries and Forestry Department, the Toledo Institute for Development and the Environment (TIDE), the University of Belize (UB), Ya'axché Conservation Trust (YCT), Toledo Development Corporation (TDC) and the Sarstoon Temash Institute for Indigenous Management (SATIIM).

In 2005, two workshops were held with these partners, community members and other stakeholders to prioritize research needs for sustainability of the local environment and culture. Based on these results, local and international scientists have created an initial multi-species, comprehensive field research program to begin to determine the state of the fisheries, associated ecosystems, and the factors that influence them. Projects focus on coral health, queen conch populations and ecosystem monitoring.

Through *Sustainable Southern Belize*, Belizean fishers, policy makers, educators, students, conservation professionals, and the public will work side-by-side with researchers as fellowship recipients. This hands-on experience will be brought back to their communities to stimulate change. The Living Reef Center will also serve as a location for workshops, community education, and as part of a network of local stakeholders.

### **How You Can Help**

An Earthwatch regional initiative offers you the unique opportunity to be a part of a locally driven conservation research program that will make a difference in people's lives. Like any other Earthwatch experience, you will be a vital part of a field research team, bringing science to life every day through a variety of tasks.

As a *Sustainable Southern Belize* participant, you will join a multinational initiative to monitor and protect the health of the Mesoamerican Barrier Reef System and the communities that depend on it. Depending on your team, you may work with staff from local conservation organizations to monitor water quality, coral reefs, seagrass beds, mangrove forests, sea turtles, jaguars, or birds. Other teams will work with Earthwatch-supported scientists to monitor conch populations, investigate the impact of storms on coral reefs, or conduct experiments on coral resilience to environmental impacts. Each and every task is an integral part of the larger effort to conserve community resources. All teams will work with *Sustainable Southern Belize* staff for a motivating perspective on the community-level action they are supporting.

The *Sustainable Southern Belize* research team awaits your arrival and extends a warm welcome for you to take part in this extraordinary scientific effort, and to take in the Belizean landscape and culture! If possible, include extra time in your travels for excellent local fishing, caving, snorkeling, wildlife tours and archaeological sites!

# DAILY LIFE IN THE FIELD

**Note:** For an itinerary, daily schedule and additional information for each research project, see the individual project sections following Section 10 '*Helpful Resources.*'

## 1. RESEARCH AREA

The research takes place within the Toledo District of southern Belize, in the Port Honduras Marine Reserve (PHMR) located between Punta Gorda and Monkey River, and in the Sapodilla Cayes Marine Reserve (SCMR) located 40 miles/64.4 kilometers due east of Punta Gorda. All teams will stay in Punta Gorda on the night of arrival and the night before departure. During the rest of the expedition, teams will stay at the new Living Reef Center on Hunting Caye.

### **The Toledo District**

The Toledo District is first and foremost Mayan country; over half the population and most of the villages are Mayan. Traveling south along the Southern Highway, clusters of thatched huts appear with increasing regularity. Along the interior roads of the district, you'll encounter Mayan women leading their children while balancing wash-loads or firewood on their heads. You'll see Mayan men heading to or returning from their milpas, machete and produce in hand.

Several communities of mixed ethnic groups are scattered along the coastline of Toledo. These communities are fairly undeveloped. The people live a simple lifestyle and are dependent on the sea for their livelihood. Tourism is increasingly becoming an important part of their lives. The majority of tour guides in Toledo operate out of Monkey River Town and Punta Gorda Town, both of which have nearby access to the rivers and cayes for excellent fishing, snorkeling, scuba diving and wildlife tours.

Toledans are proud of the harmony that exists between the many varied cultures of southern Belize. At least five distinct cultures have settled in the Toledo District and contribute to its rich cultural heritage. These groups include the Mopan and Kekchi Maya, Garifuna, Creole, East Indians and Chinese.

### **Punta Gorda Town**

Known locally as P.G. or Peini, this is the southernmost town in Belize and the capital of the Toledo District. The population is close to 6,000 people, with a mixture of Mopan and Kekchi Maya, Garifuna, Creoles, Lebanese, East Indian and Chinese peoples. Almost 210 miles/338 kilometers by road from Belize City, it is the last sizeable settlement in southern Belize. The road into town follows the shoreline; five main streets run parallel inland. Various fruit trees, especially mango trees, line the streets. Most small homes are made of wood on stilts. The town has one hospital, a police station, two banks, a post office, a gas station, a civic center, a number of churches and schools, and various grocery stores, hotels, restaurants and bars. Punta Gorda is a gateway to the Guatemalan port of Puerto Barrios, with an Immigration and Customs office near the town dock.

With its cool sea breezes and friendly people, Punta Gorda is a pleasant and interesting town. The pace of life is slow and easy-going. Traffic is minimal on the streets with no traffic lights. People hang out on street corners chatting, while children play chase in the schoolyards. The

town springs to life on holidays and market days – Friday, Saturday and Wednesday mornings – when the villagers pour in to town to buy and sell homegrown produce and simple household goods around the clock tower.

The waterfront is great for long strolls, with constant light breezes blowing in from the Bay of Honduras. Nightlife is quiet, but there are a couple of bars with pool tables and on certain nights Garifuna drummers perform for tourists (though on any given night, you can hear drumming as P.G. is considered a major center for the Garinagu people). You may run into P.G.'s own local band known as the "Coolie Rebels," who play their own renditions of popular songs.

### **Port Honduras Marine Reserve**

PHMR is a 160-square-mile/414.4-square-kilometer coastal reserve with input from five major rivers: Rio Grande, Deep River, Middle River, Golden Stream and Monkey River. The reserve lies 2 miles/3.2 kilometers from the town of Punta Gorda and includes 30 miles/48.3 kilometers of coastline up to the Monkey River. Water depth averages 40 feet/12 meters in the inner portion of the reserve and goes to a maximum of 120 feet/36.6 meters around the outside cayes. Red mangroves form the perimeter of the coastal areas and the outer cayes and the coastal areas are primarily wetlands and habitat for manatees. PHMR is managed by the Toledo Institute for Development and the Environment (TIDE) through a co-management agreement with the Fisheries Department of the Government of Belize.

There is a ranger station at the Rio Grande river mouth and one at Abalone Cay in the middle of the reserve. Here a tower provides a good 360-degree view of the waters within the reserve and it is the base for rangers monitoring the outer Snake Cayes (a no-take zone) where foreign fishermen generally poach lobster and conch. The Snake Cayes are also a nesting area for sooty terns. Ground nests are found along exposed coral areas as well as under the mangrove canopy.

### **Sapodilla Cayes Marine Reserve**

The southern 3.7 miles/6 kilometers of the Mesoamerican Barrier Reef System (MBRS) consists of a series of large shoal patches intersected by deep channels. Standing on these patches are six carbonate islands known as the Sapodilla Cayes: Northeast Sapodilla, Frank's, Nicholas, Hunting, Lime and Ragged Cayes. Instead of an abrupt end, the reef trends westward for 2.3 miles/3.7 kilometers and makes a sharp U-turn toward the north to form an additional 5.6 miles/9 kilometers of reefs and several small cayes and reef patches.

The Sapodilla Cayes are located in an area that is recognized as a tri-national border among Belize, Guatemala and Honduras. Designated as a Marine Reserve and a UNESCO World Heritage Site in 1996 because of its extraordinary natural value and socio-economic significance, SCMR is currently co-managed by the Belize Department of Fisheries and the Toledo Association for Sustainable Tourism and Empowerment (TASTE).

SCMR covers an area of approximately 48.3 square miles/125 square kilometers and includes 14 sand and mangrove cayes along the southernmost tip of the Belize Barrier Reef. The outer portion of the reserve is characterized by shallow water reefs that occur as a fringe around the cayes. The depth of water over these fringing reefs is often less than 15 feet/4.6 meters, and some of them are exposed at low tide. The drop-off east of the islands is gently sloping, in contrast to the near vertical walls further north and surrounding the outer coral atolls.

The outer reefs support a wide variety of fish. Often, large schools of jacks or spadefish will feed just off the outer slope. Nearer the bottom, angelfish, parrotfish and snappers begin to dominate. The waters are often spectacularly clear as water from the Caribbean washes over and through the reef cuts. The lagoon area is characterized by silt, sand and shallow seagrass beds. Pristine

reefs of lettuce coral carpet the ridges that jut into the lagoon from the barrier reef. As the depth increases, the lettuce coral gives way to more coral diversity, and more sponge and algae species.

Because of the type of marine circulation around the Sapodilla Cayes, this area is particularly vulnerable to freshwater discharges into the Gulf of Honduras, which contain large amounts of marine debris, high levels of pesticides, sediments and nutrients from agricultural practices and settlements, and suffer from inadequate sewage treatment.

### **Cultural History of Belize**

The earliest known inhabitants of southern Belize were the ancient Maya. Great Mayan cities and ceremonial centers grew and flourished throughout the region. Uxbenka (“The Old Place”) is one of the oldest settlements known, perched on a hill outside of Santa Cruz village. Nim Li Punit (“Big Hat”) wasn’t discovered until the 1970s and is known for its variety and number of stele (modest-sized monoliths). Lubaantun (“Place of the Fallen Stones”) is thought to have been the regional capital, acting as the religious, administrative, political and commercial center of the region.

Eventually, these great cities disappeared beneath the dense jungle canopy. The reason for the collapse of the Mayan Civilization is hidden in the mists of time. But we do know that the architects of the Mayan cities of southern Belize were a group of people called the “Manche Chol Maya.” Throughout the 16<sup>th</sup> and 17<sup>th</sup> centuries the Chol remained unconquered, successfully resisting attempts by the Spanish to rule and tax them, though many were converted to Catholicism. Eventually, diseases such as smallpox decimated the Mayan population, and during the 18<sup>th</sup> and 19<sup>th</sup> centuries the entire Chol population was transported to the highlands of Guatemala by the British.

After this forced movement of people out of southern Belize, Toledo was mostly unpopulated until the mid 1800s when the Garifuna settlements of Punta Gorda, Punta Negra and Barranco were founded. The Garifuna are the result of a cultural and racial fusion of Carib Indians and African Blacks that occurred on the Lesser Antillean island of St. Vincent in the 16<sup>th</sup> century. The Garifuna have remained along the coastal communities of southern Belize.

Meanwhile, in 1868, Confederate soldiers seeking asylum at the end of the American Civil War settled in a spot called “Cattle Landing” just north of present day Punta Gorda. Sugar quickly became the dominant crop and by 1870, no less than 12 distinct sugar mills were in full operation in the region. Within a few years, sugar prices fell and combined with a labor shortage, the sugar industry collapsed by the turn of the century.

In the late 19<sup>th</sup> and early 20<sup>th</sup> centuries, two distinct groups of Maya Indians, Mopan and Kekchi, began migrating into southern Belize from Guatemala, fleeing from heavy taxation. The Mopan Maya settled the uplands of Toledo around the present day village of San Antonio. The Kekchi Maya spread out into the isolated lowlands and along the many rivers of Toledo.

Today, the Maya comprise the largest percentage of the population in Toledo and have remained the most traditional and culturally distinct. The Mopan and Kekchi Maya have together formed over 30 communities throughout Toledo. The other ethnic groups – Garifuna, Creole, East Indians and Chinese – live together in Punta Gorda and a few other small communities along the coastline.

**Note:** Earthwatch Institute and the *Sustainable Southern Belize* projects do not discriminate against volunteers of any race, religion or sexual preference. However, homosexual acts are illegal in Belize and for your own protection, discretion is required of homosexual volunteers.

### **\*\* Important Note to Divers and Snorkelers \*\***

Earthwatch diving and snorkeling teams will work around coral reefs, across sandy flats in between reefs, and in seagrass beds. Some areas may have high coral, fish and invertebrate diversity. Belize hosts over 65 species of corals and 300 species of marine fish. However, some areas will appear degraded, highly impacted by anthropogenic effects. While your every dive may not be crystal-clear and on a pristine reef, you will see many interesting species, such as queen conch, anemones, sea cucumbers and sea urchins, plus lots of different species of reef fish. Regardless of the appearance of the reef, the data collected are extremely valuable.

Much of this research is conducted underwater, and conditions can and do change related to weather. Visibility is sometimes near perfect. But sometimes wind and rain combine to create limited visibility conditions. In-water work will continue as long as the visibility makes it possible. If one site is too murky, the team will try to find one where work can be done. The nature of these surveys is very explorative. Some of these reefs may not have been surveyed before, so the baseline data are critical to understanding the changes happening over the coming years.

Please keep in mind that you are diving to conduct research, and to contribute to a database that will help scientists and local communities as they try to understand the condition of local reefs and seagrass beds and how Marine Protected Areas (MPAs) can better manage this precious resource. This is not a dive vacation, but a field science project where your diving and snorkeling skills and desire to contribute to coral reef conservation can really have a positive impact.

## **2. ACCOMMODATIONS**

### **Punta Gorda Town**

You will be met at the Punta Gorda airstrip by a staff member who will drive you to your accommodations either by truck or minivan. It is only a short 10-minute ride from the airstrip to the town of Punta Gorda and the accommodations.

The first and last nights for all teams will be spent either at the Beya Suites Hotel or the Sea Front Inn located along the waterfront in Punta Gorda, where guests can go for a relaxing swim. Both hotels have spectacular views of the Caribbean Sea and portions of PHMR. They are within walking distance to downtown Punta Gorda, the TIDE boat dock, the TIDE and Earthwatch offices, and other local amenities. There are dining facilities at both hotels where breakfast will be served. Electrical outlets are available in the rooms with a voltage of 110. You may bring your own cameras and digital equipment but be aware that power outages, salt air, sand and water can be rough on sensitive equipment. There is no phone or internet access in the rooms.

The following services can be arranged for an additional cost at both hotels: laundry, internet, telephone and postal. Tours to inner Toledo and the cayes can be booked upon request. Credit cards and US and Belizean dollars are accepted at the hotel where local souvenirs can also be purchased.

### **Beya Suites Hotel**

This hotel is a two-storey structure made of a mixture of stone and wood. Each room is unique and has a private balcony, cable television, air conditioning and an en suite bathroom with hot/cold water. There is a spacious verandah on the upper floor set aside for recreation that offers great views and is great for sunbathing and relaxation. Volunteers will sleep two to a room

and genders will be separated. A double or queen bed will be available for each person. Couples can be accommodated in their own room if arranged in advance of the expedition. Please notify Earthwatch Institute of your wishes when you sign up for your team. Linens and towels are provided, but please bring your own beach towel.

### **Sea Front Inn**

The Sea Front Inn is a four-storey structure with rooms named after animals and plants indigenous to this part of Belize. The decor of each guestroom coordinates with the name. Every room offers cable television, air-conditioning and en suite bathrooms with hot/cold water. Volunteers will sleep two to a room and genders will be separated. A single or double bed will be available for each person. Singles or couples can be accommodated in their own room (at possible extra cost) if arranged in advance. Please notify Earthwatch Institute when you sign up for your team. Linens and towels are provided, but please bring your own beach towel.

### **Living Reef Center on Hunting Caye (Teams 1-5 and 8-9)**

During the rest of the expedition, the SCMR teams (Teams 1-5 and 8-9) will be housed at Living Reef Center (LRC) on Hunting Caye. This is a newly constructed two-storey concrete building with nine dormitory-style rooms, a wet lab, a dry lab, a kitchen and dining room, a co-ed bathroom and a small storeroom. The LRC is approximately 100 feet from the eastern seashore, providing a breathtaking view of the ocean and pristine waters dotted with coral reefs. The center provides an unimpeded view of the majestic sunrises and magnificent sunsets.

Eight of the dorm rooms have two twin-size bunk beds to accommodate a maximum of four volunteers per room. The ninth dorm room will be furnished with two queen-size beds to accommodate families. Requests for single/private rooms will be accommodated based on availability, and will incur an extra cost. Each room will be furnished with floor fans. Strategically located windows allow for adequate ventilation and 110-volt electrical outlets allow for charging of batteries and use of small electrical appliances. Bed linens and pillows will be provided but volunteers should bring their own towels, personal hygiene supplies and toiletries. The building is equipped with one co-ed bathroom with hot and cold running water. It has three low-flush composting toilets, three showers and two sinks.

A small cove on the eastern shore, approximately 100 feet from the LRC, serves as a natural salt-water pool that is perfect for relaxation after a long day at sea. The fresh water supply for the building is rainwater captured in huge plastic storage tanks. However, this water supply will be limited, therefore volunteers will be strongly encouraged to conserve on the usage of fresh water for showering and personal hygiene. An ample supply of safe drinking water will be available on the island through purification of captured rainwater using a reverse osmosis system.

### 3. FOOD

Volunteers will eat in the dining room of the LRC and meals will be prepared by a local Belizean cook. Below are examples of the foods you might expect during your expedition. Please bear in mind that variety depends on availability. This list is intended to provide a general idea of food types, but it is very important that volunteers be flexible.

- Breakfast:** Bacon, eggs, rice, beans, oatmeal, cereal, toast, assorted tropical fruit
- Lunch:** Packed lunches for the field with sandwiches or rice, beans and meat or fish, assorted tropical fruit, coleslaw
- Dinner:** Rice and beans (mixed or served separately), curried chicken, fish, shrimp, stew chicken, kriol bread, assorted tropical fruit, white rice, coleslaw, plantains
- Snacks:** Fruit, crackers, granola bars (volunteers can purchase other snacks such as chips and cookies in Punta Gorda Town, but these are expensive)
- Beverages:** Orange and lime juice, coffee (local beer and soda are available for purchase in Punta Gorda Town at your own expense)
- Water:** Bottled water is preferable to local water and will always be available

#### Special Dietary Requirements

Please alert your Earthwatch Expedition Coordinator to any special dietary requirements as soon as possible (e.g. diabetic, lactose intolerant, etc.). Accommodating special diets is not guaranteed and can be very difficult due to availability, location and local conditions.

**Special note to vegans and strict vegetarians:** Please be aware that it is often difficult to accommodate strict vegetarians and vegans. It may be possible to have meatless meals (by eating lots of rice and beans) but vegans and strict vegetarians may have a problem avoiding animal products altogether. If this poses a problem, then participation on this Earthwatch expedition should be seriously reconsidered.

# TRAVEL PLANNING

## 4. BEFORE YOU LEAVE

**Note:** Earthwatch Institute's international travel insurance company, International SOS, has a wealth of useful information available at their website, including visa, passport, currency, medical, etc. information for the country in which this project takes place. See [www.internationalsos.com](http://www.internationalsos.com) and enter Earthwatch's member identification number: 14ACPA000075. Under "Select Resource" choose "English Country Guide," and then select Belize from the list. For a listing of other useful websites for passport and visa requirements, see Section 10 'Helpful Resources.'

### **Passport Information**

With the exception of cruise ship passengers, all visitors to Belize must present a valid passport before entering the country. Please note that driver's licenses and birth certificates are not approved travel documents and cannot be used to enter the country. Passports must be valid up until time of return to country of origin. Any traveler whose passport is full or damaged (but still readable) must obtain a Visitor's Permit at the cost of US\$100.

### **Visa Information**

Citizens of the following countries currently do not require a visa to enter Belize for up to 30 days: Australia, Canada, Hong Kong, Mexico, New Zealand, Norway, United States, Venezuela, CARICOM member states, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and the United Kingdom. Citizens of other countries will require a Tourist Visa to enter Belize. A full listing of visa requirements is located at <http://www.travelbelize.org/immigration.html>.

You must also have documents for return/onward travel. Citizens of other countries should check with their travel agent or a visa agency for specific visa and entry requirements. A useful website for visa requirements is <http://www.embassyworld.com>. If you do need a visa, the chart below should be helpful.

**Reminder:** When filling out your visa application, remember to list the purpose of your visit as "vacation," "holiday" or "travel." Foreign immigration officials do not always understand the concept of a "working vacation" or even "volunteering." Words such as "working", "volunteering," "research" or a "scientific expedition" can raise questions concerning the country's foreign labor laws and/or prompt questions about official scientific research permits and credentials, etc., to which volunteers on their own will not be equipped to respond. All required research permits for the project are in place and have been approved by the proper authorities.

## Essential Information for Volunteers Requiring Visas

<b>Type of Visa</b>	You must get a <b>TOURIST VISA</b> .
<b>Where to Get a Visa</b>	Contact the nearest Belizean <b>embassy or consulate</b> to find out how to apply for your visa. Please note that this process can take weeks or more. If you have less than six weeks or wish to save yourself trouble, we strongly recommend using a <b>visa agency</b> , which can both expedite and simplify the process.
<b>Required Information</b>	You will need to send your <b>passport</b> (valid for at least six months beyond your stay), a <b>Visa Application and Immigration Form</b> , <b>2-4 passport-size photos plus payment</b> to the embassy or visa agency (if applicable). Please be sure that your passport is valid for at least six months beyond your stay.
<b>Cost of a Visa</b>	Generally between US\$40-100, but varies from country to country and can potentially cost <b>up to US\$180</b> . A visa agency will charge an additional fee (depending on the amount of time it takes to process the application), which you can inquire about directly.

## Volunteers Under 18 Years of Age

### Entry to Foreign Countries

In an effort to prevent international child abduction many governments have initiated procedures at entry/exit points. It may be possible for 16- and 17-year-olds to participate in the project if accompanied by a parent or guardian. In this case, if the minor will be traveling with only one guardian or if for any reason they will be traveling alone, it may be necessary to have a notarized letter from all legal guardians stipulating that they may travel unaccompanied or in the presence of a single guardian. This letter must give an explanation for why only one parent or someone other than a parent is signing the letter. For example, if one parent is deceased, only one parent has legal guardianship, or someone other than the parents are legal guardians, the letter should state that.

In addition, airlines may also have documentation requirements for unaccompanied minors. Parents of minors are responsible for checking with each airline that their child will be flying to ensure that sufficient documentation is provided. This could include a copy of a birth certificate or a notarized letter stating that the minor has his or her parent's permission to travel alone or with only one parent.

**Note:** Requirements by specific countries and airlines vary and change frequently. You **MUST** keep informed of the requirements on your own to avoid problems at immigration. If a letter is not available, the volunteer under 18 can be refused entry into the country. There is nothing Earthwatch Institute can do to help in this circumstance.

### Travel Medical Insurance

Travel medical and evacuation insurance is mandatory for Earthwatch volunteers while on an Earthwatch expedition anywhere in the world. The cost of this insurance is included in your volunteer contribution. It covers volunteer travel medical risk, including medical expenses and medical evacuation, while traveling with Earthwatch overseas or on an expedition within your home country. Without insurance, the costs of such measures can range from US\$20,000 to \$50,000.

The emergency medical and evacuation assistance provider for Earthwatch is On Call International. On Call is a 24-hour international operation which provides medical assistance and evacuation, a 24-hour nurse help line and other travel assistance services such as lost baggage and lost document assistance.

Basic coverage is valid in the country of your Earthwatch expedition and during international travel to and from your expedition. If the expedition takes place in your home country, coverage begins when your group forms for the expedition and ends when the group disbands, and is incremental to your existing health insurance. Options are available for volunteers who would like to extend the period of coverage, increase insurance amounts or purchase additional cancellation or baggage insurance. Application forms for additional coverage are included in your volunteer packet.

A detailed description of the Volunteer Medical and Evacuation Insurance Program policy, including the optional coverage increases, will be sent with this briefing. **Please note that policies are specific to each Earthwatch office.**

To contact On Call International in the event of an emergency, dial:

- 1-866-509-7715 from within the US
- +1-603-898-9159 from outside the US

State that you are on an Earthwatch expedition. The Earthwatch policy number is #US008020.

### **Cancellation Insurance**

Trip cancellation insurance is highly recommended for Earthwatch volunteers. Depending on the level of coverage you purchase, cancellation insurance will help cover your airfare and Earthwatch contribution if you need to cancel your expedition due to medical or other covered reasons. Earthwatch Institute does not reimburse airfare or costs associated with cancelled flights or expeditions. Levels of reimbursement for cancelled airline tickets or ticket change fees will vary depending on what type of trip cancellation policy you purchase. You are strongly advised to buy flexible or refundable plane tickets. Note that volunteers with preexisting medical conditions are encouraged to explore their coverage options.

### **For US and Canadian Volunteers**

Earthwatch is offering comprehensive optional travel insurance through CSA Travel Protection as a service to our US and Canadian volunteers. While our inclusive insurance covers your emergency medical needs while in the field, this optional policy covers trip cancellation insurance due to medical emergencies, lost luggage, travel delays, etc. For more information on the insurance policy, call Earthwatch at 1-800-776-0188 or visit [www.csatravelprotection.com](http://www.csatravelprotection.com). Please note that some coverage is dependent on purchasing insurance within 24 hours of paying in full for your expedition. Should you decide to take out our optional insurance, please use the following producer code to indicate your affiliation with Earthwatch: 83534816.

### **For Volunteers Signing Up through Earthwatch Europe**

Earthwatch Europe volunteers can purchase travel insurance from Earthwatch that is underwritten by Endsleigh and includes Additional Cancellation Cover. Additional Cancellation Cover insurance includes cover for non-refundable travel expenses should your expedition be cancelled. Alternatively, if Earthwatch Europe volunteers hold their own travel insurance they may be able to purchase Additional Cancellation Cover through their existing insurer.

### **DAN Dive Insurance**

All volunteers who wish to scuba dive on any project must hold adequate dive insurance that includes coverage for treatment of diving-related injuries, such as DAN (Divers Alert Network) Membership and Insurance. Diving will not be permitted for any volunteer who is not covered by this insurance. All volunteers must present documentation of such insurance as part of their

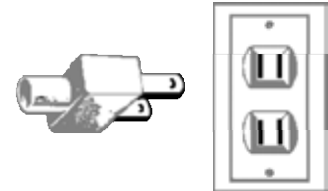
applications. **Note that scuba diving may NOT be a part of the research activities for your team and may not be permitted during the expedition.**

### Travel Agencies

Contact your local travel agent or use the web to find the lowest rates to make your travel arrangements. A list of suggested travel agents can be found in Section 10 'Helpful Resources.' Be sure to give your rendezvous details to your travel agent as soon as possible so they can plan your trip accordingly.

### Other Advice / Information

- *Language:* The country's official language is English, but most people speak Kriol (Belizean Creole) in informal situations.
- *Electricity:* 110 volts AC, 60 Hz, flat two-pin plugs (Type A - see image)
- *Time zone:* GMT/UTC - 6
- *Telephone dialing codes:* To call home from Belize dial 00 plus the country code and then the area code. If calling within Belize dial 501 (0) and then the number.
- *Personal funds:* The official currency is Belizean dollars; however US dollars are accepted and welcomed everywhere at a more or less fixed rate of BZ\$2 = US\$1, which is a better exchange than you get at the bank. There is NO NEED to change US dollars into Belizean dollars. Past volunteers typically spent limited funds during Belize-based projects, but up to US\$200 for activities and snacks during their recreational day. However, please note that tipping is customary in Belize (see below). Small bills are useful (US\$1, US\$5, US\$10) as change will be given in Belizean dollars. Traveler's checks and credit cards are somewhat difficult to use, but are becoming more acceptable each year. Traveler's checks can be cashed in banks and Visa and MasterCard credit cards can be used to get cash advances from most banks. Don't expect your debit card to work in the ATMs in Belize. There are ATMs, but they appear to be tied to Visa credit cards only. Larger stores, restaurants and hotels take Visa and MasterCard, but few take American Express. Smaller shops and street vendors only take cash.
- *Tipping:* As a visitor, it is customary to tip for services in Belize. The researchers understand that cultural differences, financial situations, and value systems may affect your willingness or ability to tip.
- *Personal conduct:* The project is able to remain in Belize due to the courtesy of the people and the Government of Belize. As such, you will be expected to conduct yourself in a manner that is respectful of local sensitivities, customs, and laws. Any violations of Belizean law will be prosecuted in Belize with no recourse to foreign laws and attorneys. Any conduct that reflects negatively on the project will be grounds for immediate deportation at the expense of the individual(s) involved.



## 5. PROJECT CONDITIONS

Please show this section to your physician when he/she is completing your health statement. Be sure to discuss inoculation requirements with your physician well in advance of your departure date. See Section 6 'Health Information' for inoculation information.

### To the examining physician:

Your patient has volunteered to join a field research team that has specific physical demands of which you and your patient should be aware. **We need your accurate evaluation of your patient's ability to meet the conditions detailed below in order to safeguard his/her health and safety and ensure that he/she can participate fully and effectively.**

### General Conditions of the Research Area

<b>Humidity</b>	Yearly average		83%	
	March-May		Low	
	June-August		Very high	
<b>Temperature Range</b>	March-May	50°F/10°C	to	95°F/35°C
	June-August	65°F/18°C	to	100°F/38°C
<b>Annual Rainfall</b>	200 cm/78 in			

The overall climate of Belize can be described as sub-tropical. The coastal areas are exposed to southeast trade winds averaging 10-13 knots. These winds are more consistent during the month of July. On many days the humidity is masked by cooling sea breezes. Temperatures in Belize range from 50°F/10°C to 95°F/35°C with an annual mean of 79°F/26°C. May through August are the warmest months at about an 81°F/27°C average. Location is a big factor for temperature as inland areas to the west can be several degrees colder than along the coast.

The area around Punta Gorda is characterized by sub-tropical rainforest inland and coastal wetlands dominated by mangroves. The terrain is mostly flat around Punta Gorda and the offshore cayes are small, sandy coralline islands either covered by mangrove patches or by mixed low vegetation and dotted with palm trees.

### **Water Conditions for Snorkeling in SCMR (Teams 1-5 and 8-9)**

Typical water temperature at working depths	25°C/78°F	to	32°C/89°F
Typical water visibility	0.9 ft/0.3 m	to	66 ft/20 m
Typical maximum water bottom depth in area	1 ft/0.3 m	to	12 ft/3.7 m
Anticipated number of snorkels per day	1	to	4
Snorkel session initiated from	Shore and boats		
Timing of snorkel sessions	Day		
Site snorkeling type	Open ocean and bay/cove		
Egress into water	Over edge and from shore		
Bottom substrate type	Sand, seagrass, and coral reef		

### Water Conditions for Diving in PHMR (Teams 6 and 10)

**Note:** Only certified scuba divers will be permitted to dive. Note that not all projects or teams include diving-based tasks.

Typical water temperature at working depths	28°C/82°F	to	32°C/89°F
Typical water visibility	5 ft/1.5 m	to	66 ft/20 m
Typical maximum bottom depth in area	4 ft/1.2 m	to	50 ft/15.2 m
Anticipated depth of dives	15 ft/4.6 m	to	65 ft/20 m
Diving bottom-limit	20 ft/6.1 m	to	65 ft/20 m
Anticipated number of dives per day	1	to	3
Dives initiated from	Shore and boats		
Timing of dives	Day		
Site diving type	Estuary and bay/cove		
Egress into water	Over edge and from shore		
Bottom substrate type	Soft sediment, seagrass and patch coral reef		

### General Demands of the Project

Volunteers are expected to be in average to good physical condition, competent swimmers and capable of climbing stairs and maneuvering in and out of small boats. Physical demands include long-term exposure (up to eight hours per day) to sun, wind, high humidity, salt water and occasional rain. Long hours will be spent on a small boat that may or may not have a Bimini shade top. Volunteers may also spend 60-90 minutes at a time collecting samples in the water.

Depending on your team, project activities will include snorkeling and/or scuba diving. Not all volunteers will be permitted to scuba dive (see below). **All volunteers who join the project should be able to swim 200 meters unaided by flotation devices or fins.**

The sea can sometimes be choppy; some rolling may occur and affect those who become seasick easily. In such a case it is advised that volunteers enter the water as soon as the boat anchors or consider taking motion sickness medication (bring it with you). Be sure to check with your doctor before taking any medication while snorkeling/scuba diving.

Below are the expected physical demands of the project, but please keep in mind that conditions may change once in the field and the project could potentially be more or less strenuous.

Activity	Workload/Intensity	Hours Per Day
Boat work	Long periods of sitting, searching for animals and recording data	Up to 8
Hiking	Minimal	2 (one day only)
Walking	Every day to/from housing/transportation/lab	1
Carrying	Buckets and research and diving equipment	Up to 1
Lifting	Up to 5-gallon/19-liter buckets of water for all projects; 10-20 pounds of snorkel gear daily for snorkel projects only; 30-50 pounds of dive gear daily for dive projects only	Daily
Swimming	Up to 100 meters	4-6

Psychological demands may include working from a boat, sharing a room with up to three other people and being on a very small island for up to eight days.

The researchers recommend that volunteers prepare for the project by increasing daily exercise with an emphasis on swimming and holding their breath for short dives to 5-10 feet/1.5-3 meters, carefully reading all recommended literature before the project, and making a detailed checklist of essential items to bring.

### **Potential Hazards and Other Advice/Information**

Below is additional information on the project conditions, including hazards associated with the tasks, area, etc., and advice on how to prevent or manage them. Note that anyone with heart trouble, a cold, sinus congestion, an ear infection, epilepsy, asthma or a severe medical problem, or who is taking any medication, should not dive or snorkel without a physician's explicit approval.

#### **Scuba Diving (Teams 6 and 10 ONLY)**

Scuba diving is a physically demanding activity with inherent risks. Safety procedures are established to minimize the risk associated with diving and should be adhered to closely. If you intend to dive, you must be in good physical condition and must have undergone a recent physical examination by a physician familiar with diving.

To participate as a diver on this project, a volunteer must:

- Provide proof of diving certification and DAN (or equivalent) insurance.
- Meet the minimum dive certification level of the project. The minimum certification for any diver on an Earthwatch project is NAUI Scuba Diver or PADI or SSI Open Water Diver or equivalent.
- Have logged at least 10 dives post certification.
- Have completed at least five dives within one year prior to the project, or have completed a refresher course or skills check-out from a certifying agency or instructor. Divers with 100 or more logged dives may have a skills check-out; divers with under 100 dives must take a refresher course.
- Have good buoyancy control and be completely comfortable underwater.
- Send Earthwatch the most recent five dives from their dive log (NOT the entire log), and bring the log to the field for the project Dive Master to check.
- Undergo a medical exam and have the Earthwatch scuba medical form signed by a diving doctor prior to the project.
- Undergo a check-out dive by the Dive Master of the project who will have the right to modify their activities if needed.
- Bring their own mask, snorkel, fins BC, weight belt (not weights), wetsuit/skin, regulator, computer, booties, light, etc.
- Have their regulator serviced within a year prior to the expedition start date, and dive with that equipment immediately prior to arriving on the project in order to test its use.

Volunteers who are scuba certified and wish to dive during the project should be able to fulfill the requirements for diving, including being able to stand with the weight of scuba gear.

A certified Dive Master or Instructor will be present on all Earthwatch projects that involve scuba. The Dive Master/Instructor is responsible for all aspects of safe diving. He/She will also inform divers about safety procedures, environmental rules and regulations and safe diving limits. The Dive Master/Instructor has the right to exclude anyone from participating in scuba activities if they fail their check-out dive, dive unsafely or place themselves or others in a situation of undue risk. The Dive Master/Instructor may limit or modify the planned diving activities if he/she determines that a volunteer does not have suitable abilities to participate safely. If the Dive Master/Instructor determines that the conditions are not suitable for diving, he/she may halt scuba or other in-water activities at any time.

**Note:** See Section 4 '*Before You Leave*' for information on diving insurance, which is **mandatory** for all those who plan to scuba dive during their expedition.

## **Snorkeling and Swimming**

Volunteers should expect to spend 60-150 minutes in the water at any one time (up to four times a day) doing a variety of activities. The kind and level of activities, and swimming abilities needed, include: transcribing data from dive slates to data sheets, transferring buckets, rinsing samples, transporting samples, buckets and other gear from the boat to the research site and short dives to shallow depths (5-10 feet/1.5-3 meters) to count and collect organisms and samples, and transcribing data onto data sheets. Not all volunteers are expected to do all of these activities. Individual tasks will be determined based on ability and comfort level.

There are inherent risks to snorkeling, including the effects of environmental conditions, nitrogen (for those who've recently been scuba diving), barotrauma, boat traffic, marine life and other risks specific to your own physical/medical history. When snorkeling, it is important to learn to properly control your breathing to reduce the risk of hyperventilation and blackout. You need to bring and maintain your own mask, snorkel, fins, booties and exposure protection. Snorkel vests can be provided for those that either prefer them or are required to use them. It is critical that you ensure that all gear is in good working order and you are fully trained in appropriate response if a failure occurs while in the water.

A three-millimeter wetsuit is highly recommended, especially during the winter/spring. A one- or two-millimeter (or three-millimeter if you chill easily) wetsuit or dive skin is a good alternative during summer for preventing pica-pica ("itchy-itchy," a skin irritation caused by marine organisms), sunburn, and other stings. It is strongly recommended that you wear some type of exposure suit while snorkeling.

## **Working on a Boat**

Working aboard a small boat poses risks. Bouncing or jostling can be quite uncomfortable for volunteers with chronic back problems or a history of seasickness. Boat surfaces are wet and can be slippery, putting one at risk of falling and injury. You must be able to keep your balance on a rocking boat. Unplanned immersion in the water from falling overboard can also put one at risk of injury and/or cold related illnesses. The boats are equipped with appropriate safety equipment including life jackets for each person. Staff will brief volunteers on risks and precautions. The trips to/from the Sapodillas Cayes and the mainland cross 40 miles/64.4 kilometers of ocean and can be very rough, bumpy, jarring and wet.

## **Climate/Weather**

The Caribbean sun is very intense. You are encouraged to bring plenty of good-quality waterproof sunscreen at several SPF levels. You'll also want to bring after-sun lotion to soothe your skin after a long day in the sun. Some volunteers have found it helpful to bring long-sleeved lightweight cotton shirts and long pants to wear whenever not in the water (including on the boat between dives). A hat with a wide brim is critical, as are polarized sunglasses and a cord to secure them around your neck. With the sun comes heat and risks of overheating and dehydration. Both events can lead to illness. Drinking water freely and minimizing exposure to the sun will help make your experience more enjoyable.

Brief periods of intense rain are not uncommon during the field season. More extreme tropical storms and hurricanes traditionally occur from June through November with late August, September and October as the most active periods. A hurricane plan exists and will be followed in the case of an extreme weather event.

## **Insects**

Sand flies (also known as “sand fleas” or “no-see-ums”) and mosquitoes are nuisances throughout the year. Sand flies are believed to be a vector for leishmaniasis in some regions. Some volunteers find them to be only irritating. Occasionally volunteers find they have very bad reactions to the bites. For this reason, it is best if you come prepared with an oral anti-histamine that you are certain you can tolerate, as well as topical anti-itch creams. Those traveling from outside the Americas may have a more severe reaction to bites than others. Sand flies are only deterred by oil. You should bring oil or oil-based repellent (e.g. baby oil, AVON Skin-so-Soft Original Bath Oil, citronella oil repellent, Bit Blocker, etc.) for sand flies. A good way to avoid sand flies is to wear lightweight long pants and socks during the evening. Sand flies generally bite from the knee down.

Mosquitoes may transmit a number of diseases, including malaria, which is present in Belize. Although avoiding mosquito bites by covering up at night and using repellent are effective measures, volunteers should consult a doctor for updated conditions and consider taking an anti-malarial medication. Volunteers who will be scuba diving and plan to take an anti-malarial should inform their doctor of their planned diving activities. Some anti-malarial medications are contraindicated for scuba diving. Mosquitoes are effectively deterred by repellents containing DEET. If you are very allergic, plan your clothing accordingly – lightweight long pants, shirts and socks for the evening.

## **Marine Animals**

Potentially dangerous animals include sharks, stingrays, sea urchins, jellyfish, and others. You will be trained to identify dangerous species and to avoid touching any organisms. Those with a severe allergy to bee or wasp stings may have a similarly dangerous reaction to corals and jellyfish and must carry an epi-pen with them at all times. The best prevention is to avoid touching unfamiliar animals. Anti-histamines, such as Benadryl, are generally effective against mild allergic reactions.

## **Land Transportation**

There is higher risk of traffic accidents in Belize than in the US and most European countries. Seatbelts are not always available, though every effort will be made to arrange transport that has them. If there are seatbelts, volunteers will wear them. Traffic rules will be followed and volunteers will not drive.

## **Diseases**

Diseases found in tropical regions include malaria, dengue fever, filariasis, leishmaniasis, onchocerciasis, trypanosomiasis, schistosomiasis, hepatitis and typhoid. Please see Section 6 ‘*Health Information*’ for inoculation recommendations and other advice.

## **Personal Security**

Volunteers should exercise caution and good judgment regarding their personal security. You are advised to not travel alone at night and to safeguard your valuables. For those traveling to other regions in Belize before or after the expedition, be aware that Belize City is a high crime area and that crime is rising in well-traveled tourist destinations in Belize. Please consult <http://travel.state.gov/travel> for the latest travel information.

## **Walking/Hiking**

Recreational activities could include strenuous hiking, but this is always optional. If you intend to do extensive walking/hiking, please bring appropriate footwear. Sandals or sneakers will suffice around the project sites.

### Medical Conditions of Special Concern

Note that you MUST be prepared to spend long hours working in hot, humid and wet conditions. Any condition that limits stamina in the water, balance, swimming or breathing should be carefully considered. The conditions below would make participation uncomfortable or impossible. Please speak with your physician about whether participation is advisable.

<b>Condition</b>	<b>Concerns and Precautions</b>
Mobility restrictions or neck, back or spinal problems	Boat work may pose particular challenges to volunteers with conditions that affect balance, agility or ability to tolerate the bouncing that occurs in a small boat. Boarding and disembarking and/or sitting onboard in choppy seas may result in pain or discomfort for those with a history of neck, spinal, or back problems. Volunteers with limited mobility who are not wheelchair-bound should consult a physician and/or Earthwatch before signing up to participate.
Poor bladder control	Since there are no toilet facilities onboard, volunteers who have difficulty waiting up to five hours to urinate should reconsider participation. Those who are comfortable doing so may go off the side of the boat.
Strong sensitivity to heat and sun	Work conditions will be hot and in the sun. Volunteers should take necessary precautions and maintain proper hydration. However, if you are extremely sensitive to sunlight, this expedition may not be for you.
Proneness to extreme seasickness	Volunteers who are habitually seasick in small boats may find this project quite uncomfortable. Bring along medication as suggested by your physician and be sure to discuss the side-effects and any contraindications for diving with your physician. If you are unwilling to take medication or if it is unable to alleviate your seasickness, you may want to choose another expedition.
Hydrophobia	This project is marine-based, and volunteers will spend a great deal of time on and in the water. Any volunteer who exhibits signs of hydrophobia will not be permitted on the boats or in the water, for the safety of both the afflicted person and other team members and staff.
Inability to swim	Volunteers on this project must be extremely comfortable in the water and able to swim up to 200 meters at a time. Life jackets are available on the boat. Volunteers must wear them any time the boat is underway.
Allergies	If you are severely allergic to bee or wasp stings, you may react similarly to jellyfish stings. You must bring and carry your own epi-kit.
Pregnancy	Diving presents potential risks to the developing fetus, and volunteers who are pregnant may not scuba dive on this expedition.
Ear infection	Any ear or sinus infection should be fully healed prior to your participation.
Poor hearing or vision	Good vision and hearing are important for participation in the project. Corrected vision (eyeglasses or contact lenses) is fine.
Conditions affecting ability to dive	Uncontrolled inner ear infections, limited ability to equalize pressure in one's ears, blood clotting issues and/or any condition that interferes or limits swimming or breathing should be considered carefully. Anyone with heart trouble, current cold or congestion, ear infection, epilepsy, asthma, or a severe medical problem should not dive without a physician's explicit approval. You should never dive/swim under the influence of alcohol or drugs.
Conditions requiring immediate attention	For at least part of every expedition, volunteers will be working in remote locations in tropical conditions, many hours from medical care. Any chronic medical condition (e.g. heart or kidney problems, epilepsy, seizure conditions, etc.) subject to hospitalization or need of medical supervision should be discussed with your physician prior to joining the team.

## 6. HEALTH INFORMATION

See [www.internationalsos.com](http://www.internationalsos.com) for information on the current health conditions in Belize. At the homepage, enter Earthwatch's member identification number: 14ACPA000075. Under "Select Resource" choose "English Country Guide," and then select Belize from the list.

### Routine Immunizations

All volunteers should make sure to have the following up-to-date immunizations: DPT (diphtheria, pertussis, tetanus), polio, MMR (measles, mumps, rubella) and varicella (if you have not already had chicken pox). Please be sure your tetanus shot is current.

### Project Inoculations

The following are recommendations only. Medical decisions are the responsibility of each volunteer. Note that health conditions around the world are constantly changing, so keep informed and consult your physician, a local travel health clinic, the US Center for Disease Control ([www.cdc.gov](http://www.cdc.gov)), the World Health Organization ([www.who.int](http://www.who.int)), International SOS (see above), and/or the resources in Section 10 'Helpful Resources' for the latest health information for travelers. Please consult your physician for guidance on inoculations if you intend to travel to other parts of the country.

<b>Typhoid</b>	These inoculations are recommended for health reasons.
<b>Hepatitis A</b>	
<b>Hepatitis B</b>	
<b>Yellow Fever</b>	A Certificate of Vaccination is required if traveling from an endemic area.

### Other Advice / Information

- *Malaria*: Malaria is present in southern Belize. The CDC reports that there is risk of malaria in all parts of Belize except Belize City. They recommend the use of a prescription anti-malarial drug and protection against mosquito bites using clothing and repellent. Volunteers should consult a doctor and consider taking a prophylactic. Be sure to inform your doctor if you will be scuba diving, as some malarial prophylactics are contraindicated for scuba diving.
- *Dengue fever*: Dengue fever is endemic to Latin America and the Caribbean and can occur throughout the year. In 2007 there was a marked increase in the number of reported cases. Dengue is a flu-like virus spread primarily by day-biting mosquitoes. It is characterized by fever, headache, rash, vomiting and severe muscle pains. There is no vaccine and mosquito bites should be avoided whenever possible. Repellent and long sleeves and pants are highly recommended. There is no treatment for standard dengue other than acetaminophen (avoid aspirin), fluids and rest. It is usually resolved after about two weeks. However, hemorrhagic dengue, characterized by bleeding and shock, occasionally occurs and requires medical care.
- *Bot flies*: Bot flies occur rarely in coastal Belize. Humans become infected when the eggs of the bot fly are transmitted by mosquitoes. The larvae grow under the skin and cause swelling, pain and redness, though in most cases it is not dangerous. Infestations can be avoided by wearing appropriate clothing and repellent to ward off mosquitoes, their intermediate host.
- *Rabies*: Rabies is not common, but it is present in Belize. It is transmitted through the saliva of an infected animal (generally stray dogs) through bites and scratches. The best way to avoid infection is to never approach, feed or touch any stray or wild animals, even if they look friendly. If you will be traveling in the region for an extended period of time and will not have access to medical facilities, please consult your doctor about rabies vaccination.

## 7. PACKING CONSIDERATIONS

**PLEASE SEE THE PACKING CHECKLIST AT THE BACK OF THIS BRIEFING AND REMEMBER TO TAKE YOUR BRIEFING WITH YOU ON YOUR EXPEDITION.**

### General Considerations

**Luggage should be soft duffle-type bags or backpacks, not hard or rectangular suitcases.** Do not bring more luggage than you can carry and handle on your own. You are encouraged to pack a carry-on bag with an extra set of field clothing and personal essentials in the event that your luggage is lost and/or takes several days to catch up with you. Please limit your baggage to a total weight of no more than 50 pounds and check with your airline regarding more stringent luggage weight limits and updates on acceptable items for checked and carry-on baggage.

Pack as light as possible, but do not forget insect repellent for mosquitoes, oil for sand flies, sunscreen, hat, sunglasses with cord, a long-sleeved cover-up, swimsuit, beach towel, raincoat, and field clothes. Some folks require more creature comforts; others can do without some items. It might not rain during the expedition, but it's more likely that it will; there may be no bugs or there may be bugs every day. You should read the entire Expedition Briefing and Packing Checklist closely. Those with lots of travel experience should use this information to pack according to their experience, while less experienced travelers should bring everything recommended.

Please note that if you are certified to dive and are joining a diving team, you must provide your own dive gear as outlined in the Expedition Packing Checklist. Renting equipment locally is not permitted as it may be unreliable.

### Cultural Considerations

Belize is a predominately Christian culture. Shorts and t-shirts are fine for both men and women. Swimwear is appropriate for beaches, but not for Belize City, where shirts and shoes are recommended at all times.

### Weather Considerations

Please take weather conditions into consideration when packing for your expedition. Climate information and packing advice can be found in Section 5 '*Project Conditions.*'

### Essential Items

**Make sure to bring your Earthwatch Expedition Briefing with you!** It includes essential information to which you may need to refer during your expedition, as well as during your journey to and from the project site. Also, **don't forget to bring photocopies of your passport, flight itinerary and credit cards, packed separately from the original documents.**

**Please see the Expedition Packing Checklist for a complete list of what you will need to take with you.** You are encouraged to go through the list and mark off each required item right before you leave for your expedition.

## 8. RECOMMENDED READING

Please read the specific project section for the project in which your team will participate (e.g. Queen Conch or Coral Bleaching). Below are recommended materials for those interested in further preparing for the expedition. Many can be purchased online through popular vendors. See Section 10 'Helpful Resources' for suggested vendor websites.

### Guides to Belize

- Chicki Mallan and Joshua Berman. 2004. *Moon Handbooks: Belize 6th Edition*. Avalon Travel Publishing. ISBN 1566915759 (~US\$17; **highly recommended**).
- Ian Peedle. 1999. *Belize in Focus: A Guide to the People, Politics, and Culture*. Interlink Publishing Group. ISBN 1566562848 (~US\$11).
- Les Beletsky. 2004. *Belize: And Northern Guatemala (Travellers' Wildlife Guides)*. Interlink Books. ISBN 0120848112 (~US\$23).
- Eric Hoffman. 1994. *Adventuring in Belize: The Sierra Club Travel Guide to the Islands, Waters, and Inland Parks of Central America's Tropical Paradise*. Sierra Club Books. ISBN 0871565927 (~US\$13).

### Coral Reef Information

- J.M. Pandolfi *et al.* March 18, 2005. Are US Coral Reefs on the Slippery Slope to Slime? *Science*. Volume 307. Pages 1725-1727.
- T.A. Gardner *et al.* August 15, 2003. Long-Term Region-Wide Declines in Caribbean Corals. *Science*. Pages 958-961.
- B.E. Brown and J. Ogden. January 1993. Coral Bleaching. *Scientific American* (offers an overview of bleaching and its effects).
- P.A. Marshall and H.Z. Schuttenberg. 2006. *A Reef Manager's Guide to Coral Bleaching*. Great Barrier Reef Marine Park Authority, Australia (available at [http://www.coris.noaa.gov/activities/reef\\_managers\\_guide](http://www.coris.noaa.gov/activities/reef_managers_guide)).
- Paul Humann. 1994. *The Reef Set*. New World Publications, Inc., Jacksonville, FL (note that this guide is expensive, and a copy will be available to all teams; while you do not need to purchase it, it is a fantastic book with great photos that will help you come to better recognize the fish and corals of this region).

### Conch Information

- Dee Carstarphen. 2000. *The Conch Book: All You Ever Wanted to Know about the Queen Conch, from Gestation to Gastronomy*. Second edition. Pen & Ink Press. ISBN 0960754458 (~US\$12).
- Katherine S. Orr and Carl J. Berg Jr. 1987. *Queen Conch*. Windward Pub Co. ISBN 0893170380 (~US\$4).

### Monitoring Work with the Toledo Institute for Development and the Environment (TIDE)

- *Manual of Methods for the MBRS Synoptic Monitoring Program (volunteers working with TIDE are strongly encouraged to review this manual)*, available for download at: <http://www.opwall.com/Library/Honduras/Honduras%20Marine/Management/Meso-American%20Barrier%20Reef%20monitoring%20manual.pdf>.

## 9. EMERGENCIES IN THE FIELD

Minor injuries will be treated onsite. A boat will be available to transport anyone with major injuries to the Punta Gorda Town Hospital. Standard safe diving procedures will be used. A Dive Master will be present and a DAN oxygen kit will be available on all diving teams (Teams 6 and 10). Anyone with a life threatening condition/injury will be evacuated by the British Army Training Support Unit Belize (BATSUB) via helicopter from Hunting Caye. If a recompression chamber is needed the person will be evacuated to Ambergris Caye. If other medical care is needed they will be transported to Belize Medical Associates in Belize City.

**Note:** Divers need to have DAN membership. There is a hyperbaric chamber in San Pedro.

Volunteers may leave the expedition early ONLY in cases of emergency. From the cayes, volunteers would be transported by vessel to the mainland and driven to the airstrip by *Sustainable Southern Belize* staff.

### **Proximity to Medical Care**

<b>Safety Certifications</b>	Edwin Martinez is certified in CPR and Oxygen Administration and First Aid. A certified Dive Master will be present on all dive teams (Teams 6 and 10).
<b>Nearest Hospital</b>	Punta Gorda Town Hospital Main Street, Punta Gorda Town Tel: +501 (0) 722-2026 Travel time: 10 minutes-4 hours, depending on where teams are located
<b>Nearest Hyperbaric Chamber</b>	SubAquatic Safety Services of Belize Dr. Otto Rodriguez Lions Clinic, San Pedro Ambergris Caye Tel: +501 (0) 226-2851 or 2852 Lions Clinic tel: +-501 (0) 26-2073 Chamber tel: + 501 (0) 226-3195 Email: <a href="mailto:belize@sssnetwork.com">belize@sssnetwork.com</a> Web: <a href="http://www.sssnetwork.com">www.sssnetwork.com</a> Travel time: 45 minutes from Airport Camp Belize City to Hunting Caye, then about an hour by helicopter from Hunting Caye to San Pedro

## 10. HELPFUL RESOURCES

### Project and Research Area Information

- Toledo Institute for Development and the Environment: <http://www.tidebelize.org>
- Sapodilla Cayes Marine Reserve: <http://www.southernbelize.com/sapodilla.html>
- Punta Gorda Town website: <http://www.puntagordabelize.com/organizations.htm>
- Belize News - provides links to major Belizean news sources: <http://belizenews.com>
- Belize by Naturalight - commercial website about Belize: <http://www.belizenet.com>
- Official government website - provides contact info for ministers, press releases, library, national symbols, etc.: <http://www.belize.gov.bz>

### Passport and Visa Information

- Embassies around the world: <http://www.embassyworld.com>
- For Japanese citizens: [http://www.rainbowt.jp/travel/visa\\_top.html](http://www.rainbowt.jp/travel/visa_top.html)
- For Australian citizens: <https://www.passports.gov.au> and <http://www.dfat.gov.au/visas/index.html>
- Passport Visa Express (for US citizens): [www.passportvisasexpress.com](http://www.passportvisasexpress.com)
- The Visaservice: <http://www.visaservice.co.uk>
- Thames Consular Services Ltd: <http://www.visapassport.com>

### Travel Guidebooks and Booksellers

- Lonely Planet: <http://www.lonelyplanet.com>
- Rough Guide: <http://travel.roughguides.com>
- Amazon: <http://www.amazon.com>
- Barnes and Noble: <http://www.bn.com>

### Travel Agencies and Advice

- Exito Travel (familiar with Earthwatch and specializes in Latin America):  
<http://www.exitotravel.com>  
108 Rutgers St.  
Ft. Collins, CO 80525  
Tel: 800 655 4053, ext. 8507 (toll free US and Canada, ask for Isaac Hilpman)  
Email: [isaac@exitotravel.com](mailto:isaac@exitotravel.com)  
Fax: +1 510 868-8306 (worldwide)  
Code: EARTH
- STA Travel (contact Angie Kurtz or Chris Chappell and mention that you will be going on an Earthwatch Expedition): <http://www.statravel.com>  
36 Geary Street  
San Francisco, CA 94108  
Tel: +1 415 391-8407  
Email: [sfo@statravel.com](mailto:sfo@statravel.com)
- STA Travel (UK): <http://www.statravel.co.uk>  
Tel: +44 (0) 1865 792800  
Fax: +44 (0) 1865 792911  
Email: [manager.oxford@statravel.co.uk](mailto:manager.oxford@statravel.co.uk)  
Quote code: EWE01/02
- Wexas International (Europe): <http://www.wexas.com>  
Tel: +44 (0) 20 7581 8761  
Fax: +44 (0) 20 7581 7679

Email: [southern@wexas.com](mailto:southern@wexas.com)

Quote code: EWE01/02

- World Travel Guide: <http://www.worldtravelguide.com>
- UK Foreign Office travel advice: <http://www.fco.gov.uk/travel>

### **Airline/Airport Resources**

- Flight comparison tools: <http://www.bookingbuddy.com> and <http://www.1800-fly.com>
- Airport codes worldwide: <http://www.logisticsworld.com/airports.asp>

### **Country Information**

- Country information from around the world: <http://www.countryreports.org>
- National Geographic Map Machine: <http://plasma.nationalgeographic.com/mapmachine>
- US State Department: <http://www.state.gov>
- Time worldwide with GMT/UTC: <http://www.worldtimeserver.com>
- Currency converter: <http://www.xe.com>
- Electrical current converter: <http://kropla.com/electric2.htm>
- Telephone dialing codes: <http://kropla.com/dialcode.htm>
- Online unit conversions: <http://www.onlineconversion.com>
- Worldwide weather: <http://www.wunderground.com> or <http://www.tutiempo.net/en>
- ATM locator: <http://visa.via.infonow.net/locator/global/jsp/SearchPage.jsp> or <http://www.mastercard.com/atmlocator/index.jsp>

### **Health Information**

- Travel health website: <http://www.mdtravelhealth.com>
- Center for Disease Control: <http://www.cdc.gov>  
Tel: +1 800 311-3435 or +1 888 232-3228
- World Health Organization: <http://www.who.int>
- The Travel Doctor: <http://www.tmvc.com.au>
- Disease outbreaks: <http://www.who.int/csr/don/en>
- Hospital for Tropical Diseases: <http://www.thehtd.org>
- Travellers Healthline Advisory Service  
Tel: 020 7950 7799
- MASTA Travelers' Healthline (UK)  
Tel: 0906 8 224100 (within UK)

### **Marine Information**

- Divers Alert Network: <http://www.diversalertnetwork.org>
- Dive Master Insurance Consultants Ltd.: <http://www.dive-master.net>

# QUEEN CONCH

PRINCIPAL INVESTIGATOR:       **John A. Cigliano, Ph.D.**  
POSITION/TITLE:               Associate Professor of Biology  
AFFILIATION:                 Cedar Crest College

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## THE PROJECT

### Introduction

Fisheries around the world are severely threatened by overfishing, and traditional management methods, which include limits on catch size, amount and fishing effort, and seasonal closures, have not been effective in protecting these stocks. An alternative to traditional fishery management techniques that has become popular is the designation of Marine Protected Areas (MPAs). MPAs are discrete geographic areas that are “permanently protected from at least one preventable [anthropogenic] threat” (Crowder and Norse 2005). A specific type of MPA is the Marine No-take Reserve, or just Marine Reserve (MR), where all extractive or consumptive activities, including harvesting, are prohibited and other forms of disturbances are minimized. The assumptions that underlie how MPAs, and specifically MRs, can protect marine fisheries include increasing biomass and density of protected species inside the reserve, due to lower mortality from the prohibition on harvesting, and an increase or maintenance of populations outside the reserve by supplying the non-protected areas outside with recruits through the emigration of post-settlement individuals (“spillover effect”) and through the dispersal of pelagic larvae (“dispersal effect”).

While there is ample evidence that reserves maintain species diversity and lead to an increase in density and biomass of the protected fisheries (e.g. Roberts 1995, Jennings *et al.* 1996, Halpern and Warner 2002), there is less evidence for the spillover effect (e.g. Roberts *et al.* 2003). The “dispersal” assumptions of MPAs have rarely been tested directly and this holds especially true for invertebrates (National Research Council 2001, Palumbi 2001, Sobel and Dahlgren 2004).

The two largest fisheries in Belize are the lobster (spiny and spotted) and the queen conch, both of which appear to be severely over-harvested. Traditional regulations for queen conch require that conch be at least seven inches/18 centimeters in length with a minimum weight of 86 grams for cleaned meat. There is also a closed season (July 1- September 30) and the use of scuba is prohibited. A network of 13 MPAs has been established to protect these as well as other fisheries. One of these is the Sapodilla Cayes Marine Reserve (SCMR), which is where this study will take place. The reserve has been divided up into zones of varying levels of protection: a General Use Zone (GUZ), where commercial extractive activities are allowed but managed, two Conservation Zones (CZ), where no extractive activities are allowed but other activities such as scuba and snorkeling are allowed, and a Preservation Zone (PZ), where entry is prohibited except with a special permit for research. However, this management plan is not currently being enforced.

### **Queen Conch Ecology, Natural History and Conservation**

The queen conch is a large marine gastropod that is found from Venezuela to southern Florida, Bermuda and throughout the Caribbean (Randall 1964). Females produce demersal eggs that are deposited in long, crescent-shaped, sand-covered masses (Robertson 1959). Females produce egg masses containing 313,000-485,000 eggs each and spawn approximately nine egg masses per reproductive season (Randall 1964, Davis *et al.* 1984). The larvae (veligers) are pelagic and, based on time to metamorphic competence (i.e. larvae is ready to settle out of plankton), spend two weeks to as long as two months in the plankton (Davis 1993, Noyes 1996). The actual dispersal rates for queen conch veligers are unknown, but the prevailing view is that queen conch larvae disperse over long distances, even though recent models of larval dispersal in the Caribbean suggest otherwise (Cowen *et al.* 2003). Furthermore, ecological and genetic evidence suggest that self-recruitment of larvae might be significant in queen conch populations.

Once veligers settle out of the plankton, they bury themselves in sand for at least one year, after which they emerge and migrate in early spring to shallow nursery habitats that are typically seagrass beds in areas of good water movement (Randall 1964, Weil and Laughlin 1984). At 2-3 years of age, juveniles move from the shallow nursery grounds to deeper seagrass meadows and the characteristic broad shell lip begins to form (Randall 1964, Weil and Laughlin 1984). Conch move to deeper water as they grow older, with adults found as deep as 30 meters (Stoner and Sandt 1991; pers. obs.). These deep-water adult aggregations might act as important refugia in heavily exploited populations (Thiel 2001). There appears to be at least two deep-water aggregations in SCMR (P. Wood *pers. comm.*). Gonadal maturity is reached when shell lip thickness is four millimeter, at approximately 3-4 years of age (Appeldoorn 1988). However, mating and spawning might not occur until the shell lip is over 11 millimeters thick (Gascoigne and Lipcius 2004).

Reproduction generally occurs from March through September, but in Belize spawning may occur year-round (Thiele 2001). Sexually mature adults generally migrate from deep-water to shallow-water sand plains for mating and spawning (Stoner *et al.* 1992). However, deep-water (approximately 30 meters) mating might be occurring in the Sapodilla Cayes (P. Wood *pers. comm.*). Fertilization is internal and spawning may follow copulation by several weeks (D'Asaro 1965). During the winter, queen conch migrate to deeper waters (Weil and Laughlin 1984, Stoner *et al.* 1992). Only a few studies have attempted to measure migration rates and distances of juvenile and adult queen conch, and these were limited in duration and area (Hesse 1979, Stoner *et al.* 1988, Stoner 1989, Stoner and Sandt 1992, Stoner and Ray 1993).

### **Significance of the Project**

The broad significance of this research project is that it will test the fundamental and critical assumptions of MRs. If MRs do not replenish harvested queen conch populations with recruits, the effectiveness of MRs in conserving and managing fisheries will be severely limited. However, if these assumptions are supported, the use of MRs to manage fisheries will be validated. On a more local level, this project will provide valuable information that is needed for the local conservation and management of queen conch and lobster. And it will help build the capacity of the local community for long-term, successful management of the reserve.

## RESEARCH OBJECTIVES AND METHODS

The broad, long-term goals of this project are to:

- Determine the effectiveness of SCMR in protecting and replenishing queen conch populations
- Provide information for adaptive management of the marine reserve
- Build capacity in all stakeholders to ensure the long-term effectiveness of the reserve

To achieve these goals, it is necessary to:

- Map queen conch aggregations and habitat within the reserve and surrounding areas
- Conduct surveys as part of a long-term monitoring effort of queen conch populations and as part of a Before-After-Control-Impact (BACI) study to determine the effectiveness of the reserve in protecting queen conch populations
- Determine the extent of demographic connectivity of the reserve with surrounding areas through post-settlement migration (spillover effect) and larval dispersal (dispersal effect) and the overall level of self-recruitment of queen conch populations within the Sapodilla Cayes and Port Honduras region
- Develop a strong collaborative relationship with local stakeholders and the Fisheries Department to help build capacity in the community, and conduct educational outreach activities with local stakeholders

The specific objectives and methods that will be used to achieve the long-term goals of this project are detailed below.

### **Mapping Queen Conch Aggregations and Habitat**

During the first field season (2006) the project located shallow-water queen conch nurseries at the reef cuts between Franks Caye and Nicholas Caye, and Franks Caye and Northeast Caye, and in shallow water behind the cayes of Tom Owens, Hunting, Ragged, Franks and Seal. During the 2007 season, an additional site (South Seal Caye) was added and two sites (off Lime Caye) were located for future mapping. Deep-water spawning sites were located by ReefCI in the cut between Nicholas Cay and Hunting Cay (Nichols Cut), in an area called the "Stadium," and off of Lawrence Rock. Mapping queen conch aggregations is necessary in order to determine whether all queen conch life-history stages and the associated habitats are present in the reserve.

### **Methods**

Volunteers will assist in mapping queen conch aggregations inside and outside the various reserve zones of SCMR. Conch aggregations in all zones of the reserve were located and marked during the 2006 and 2007 field seasons using a Global Positioning System (GPS). In the upcoming season these aggregations will be located again by navigating to the GPS coordinate (waypoint) for each aggregation.

Habitat type will be determined by randomly placing 10 quadrats of 0.25 square meters each along each randomly chosen 50-meter transect in each aggregation. The percent cover of each substrate type (e.g. coral rubble, sand, seagrass, etc.) in each quadrat will be recorded. Benthic plants, algae and invertebrates will be identified to lowest taxonomic rank possible and density of invertebrates, algae and seagrass will be determined.

### **Determining the Effectiveness of SCMR**

The second objective is to conduct BACI surveys to determine the effectiveness of the reserve in protecting and replenishing queen conch populations. It is expected that the enforcement of No-take Zones will positively affect population growth of queen conch within these zones by eliminating non-natural mortality. Thus, this project predicts that the density of conch will increase after enforcement of the No-take Zones and also in relation to the control sites. It is also expected that the enforcement of the No-take Zones will increase the biomass of queen conch within these zones because larger individuals are no longer being harvested.

Recent surveys have found that queen conch populations (and now harvests) are dominated by juveniles (i.e. there is a reduction or loss in non-juvenile age classes) due to the over-harvesting of adults (Theile 2001). Therefore, protected populations are expected to show an increase in the number of adult individuals (i.e. harvestable) in the population compared to harvested populations.

#### **Methods**

Population data will be collected from all conch aggregations from each impacted site and from aggregations in the General Use Zone (controls) before and after enforcement of the no-take regulations (see below). Aggregations from treatment and control will be matched for type (e.g. spawning).

In conducting a BACI study, surveys are conducted in an area before and after an anthropogenic impact (Kaly and Jones 1997), which in this case is the enforcement of no-take regulations in the reserve. Control areas are also surveyed before and after the impact. It is predicted that protected populations will increase in density and biomass after enforcement. Kaly and Jones (1997) suggest a minimum of three control sites and a minimum of two surveys before and two surveys after impact to account for natural temporal variation in population characteristics. Rarely is more than one site impacted, thus, SCMR offers a unique opportunity in that there will be three impacted sites – the two Conservation Zones and the Preservation Zone. This will provide the opportunity to determine whether the level of protection will have a significant effect. Kaly and Jones (1997) also suggest that surveys should be conducted at irregular intervals. However, conch density within a site changes seasonally (e.g. spawning season versus winter) and within seasons. Therefore, aggregations (winter, spawning, adult-feeding, nursery) will be surveyed during the same time interval each year. This will also allow construction of a statistical time series, as recommended by Acosta (2002). Additionally, the mean proportion of individuals in each age category will be used to determine if population age structure is affected by enforcement.

### **Long-term Monitoring of Queen Conch Populations**

It will be necessary to survey queen conch populations well after enforcement of the reserve and after the second objective (see above) is fulfilled, to be sure that the reserve maintains its effectiveness and to provide constant information on the workings of the reserve to TASTE, SCMR and the Fisheries Department so that the reserve can be adaptively managed.

#### **Methods**

To monitor conch populations, a 100-meter baseline transect will be placed along the lagoonward edge of each conch aggregation. 50-meter transects will then be placed perpendicular to the baseline transect every 10 meters. A team of three snorkelers will swim slowly along the transect to locate conch. A two-meter PVC pole, centered over the transect, will be used to define the sample area. All queen conch found within the two-meter sampling area will be counted, measured and aged by measuring lip width and thickness at the point of greatest thickness (Appeldoorn 1988, Acosta 2002). Queen conch are considered adults if shell lip thickness is four

or more millimeters (Appeldoorn 1988, Tewfik and Béné 2000). Adults will be categorized as young adult or old adult (Tewfik and Béné 2000); juveniles will be categorized as small, medium, large or subadult. Aggregations will be designated as nursery, adult feeding or spawning as determined by size, age and behavior.

### **Reproductively in Queen Conch Populations**

The project's fourth objective is to determine if the populations of queen conch are reproductive. There is evidence that queen conch exhibit both an Allee effect (a minimum density is required for reproduction) and delayed functional maturity (gonadal development and reproductive behavior are not linked; gonads are mature when shell lip thickness is approximately five millimeters but mating might not occur until shell lip thickness is over 11 millimeters (Gascoigne and Lipcius 2004). Both can have major implications for management.

Stoner and Ray-Culp (2000) found evidence that the Allee threshold for queen conch appears to be 56 adult conch per hectare for mating to occur and 48 adult conch per hectare for spawning to occur. Unfortunately, many populations throughout the Caribbean are near or below these densities (Thiele 2001), which suggests that recovery even after protection may be slow or impossible if larval recruitment into these populations is mainly from exogenous sources. Currently, the density of adult queen conch in SCMR is unknown; therefore, it is critical to determine the average density of adult conch in SCMR and whether this population exhibits an Allee effect.

Many countries impose a minimum shell lip thickness for the harvest of queen conch (and many do not). However, no country imposes a minimum greater than 11 millimeters. If Gascoigne and Lipcius (2004) are correct, reproductive stocks in Belize, and elsewhere, are not being protected. If delayed functional maturity does occur in this population, the average lip thickness of reproducing conch is expected to be significantly greater than five millimeters.

### **Methods**

To determine if queen conch populations in SCMR are reproductive, all mating and spawning events observed during population censuses (see above) will be recorded.

### **Spillover and Dispersal of Queen Conch from the Reserve to the Surrounding Areas**

The project aims to determine the extent of demographic connectivity of the reserve with surrounding areas through post-settlement migration (spillover effect) and larval dispersal (dispersal effect).

One of the most important functions of a marine reserve is to replenish the surrounding areas with recruits. The reasoning for this is that as the density of post-settlement individuals increases inside a reserve (due to decreased fishing mortality), there will be an increase in density-dependent emigration due to reduced per capita availability of limiting resources (e.g. food) (Sobel and Dahlgren 2004). Thus, if spillover of queen conch occurs in SCMR, this project predicts that there will be a statistically significant increase over time in the number of recaptures in non-protected areas of conch tagged while inside the No-take Zones. This increase will parallel the increase in density of conch inside the reserve. It is also expected that conch will migrate between the shallow water habitats behind the cayes and the deep-water populations outside the reef through reef cuts.

It is also assumed that marine reserves will supply fished areas with pre-settlement (i.e. pelagic larvae) recruits. This suggests that self-recruitment of larvae is more significant than recruitment from exogenous sources. If this is occurring, it is expected that the distribution of queen conch

veligers exhibit an offshore (seaward side of barrier reef above deep-water spawning sites) to nearshore (nurseries in SCMR) density gradient through the reef cuts with all veliger stages found in SCMR. If veligers come from exogenous sources (i.e. from outside SCMR), the project would expect to find a shallow or non-existent gradient of veliger density; only late stage (near-competent and competent) veligers will be found in shallow water habitats (Leis *et al.* 1998, Swearer *et al.* 2002).

## **Methods**

Post-settlement migration (spillover effect) will be determined by tagging all individuals from all zones around the spire (during 2006, 975 conch were tagged in both deep and shallow water; approximately 900 were tagged in 2007). The date, location and habitat for each individual and for each re-sighting will be recorded. Sightings will be mapped to determine the migration pattern of conch.

To measure the dispersal effect, larvae will be sampled following the procedure of Stoner *et al.* (1996). Conical plankton nets will be towed for 15 minutes during the day. Tow volume will be determined by suspending a flow meter from the mouth of the net. Sampling will be conducted over nursery habitats and 25 randomly selected shallow water non-nursery sites. Sites will be selected by placing a 100 x 100 meter grid over a topographic map of SCMR and randomly choosing grids that do not contain nursery sites. Similarly, the project will randomly sample from areas in the reef cuts and over deep-water (i.e. outside the barrier reef) spawning aggregations and 25 randomly selected sites over deep water that are not over spawning aggregations.

Plankton samples will be rinsed and sorted using a dissecting microscope. Queen conch veligers will be measured and assigned to one of three size classes: early-stage, mid-stage, and late-stage (Stoner *et al.* 1997). Early stage veligers are about 1-5 days old, while late stage veligers are near-competent or competent (Davis 1993, Stoner *et al.* 1997).

## **Building Relationships and Increasing Awareness**

The final objective of this project is to develop a strong collaborative relationship with local stakeholders and the Fisheries Department to help build capacity in the community, and conduct educational outreach activities with local stakeholders. The most exciting, and arguably most important, characteristic of an Earthwatch regional initiative is that it is a partnership-based program that engages local stakeholders to build capacity within the community. Earthwatch has partnered with TASTE, TIDE, and the University of Belize in the development and implementation of the *Sustainable Southern Belize* regional initiative. With the help of Earthwatch volunteers, the Queen Conch project will build on this relationship whenever, and however, it can.

## TEAM ITINERARY

**Note:** Teams 1 and 8 will join an eight-day expedition while Team 3 will join for nine days. Team 8 is an Earthwatch Teen Team. The itinerary for all three teams will be essentially the same; however, Team 3 will have one extra field/lab work day.

- Day 1:** Rendezvous in Punta Gorda, travel to accommodations, introduction to staff and overview of *Sustainable Southern Belize* and the project, relax and unwind
- Day 2:** Early morning travel to the Living Reef Center in SCMR (approximately two hours by boat), settle in, project overview and field training
- Days 3-6:** Variable schedule including fieldwork and lab work and some down time
- Day 7:** Teams 1 and 8 will return to Punta Gorda; Team 3 will continue with schedule for Days 3-6
- Day 8:** **End of expedition for Teams 1 and 8** – these teams will depart from Punta Gorda airstrip at 7:00 am local time (the flight is scheduled to arrive at Goldson International Airport, Belize City, at 8:10 am); Team 3 will return to Punta Gorda
- Day 9:** **End of expedition for Team 3** – this team will depart from Punta Gorda airstrip at 7:00 am local time (the flight is scheduled to arrive at Goldson International Airport, Belize City, at 8:10 am)

## DAILY SCHEDULE AND TASKS

The following is an example of a research day for volunteers participating in this project:

- 6:30-7:30 am** Wake up, breakfast
- 7:30-8:00 am** Transportation to field site
- 8:00-12:00 pm** Surveys, fieldwork
- 12:00-1:30 pm** Lunch, rest and return to fieldwork
- 1:30-6:00 pm** Surveys, fieldwork, lab work
- 6:00-8:00 pm** Return from field, leisure time, dinner
- 8:00-9:00 pm** Informal talks, reports of field observations, data entry, leisure time
- 9:00 pm** Suggested bed-time

## VOLUNTEER TRAINING AND ASSIGNMENTS

### Training

Earthwatch expeditions provide both a scientific research experience and an educational experience. Educating volunteers about coral reef ecosystems, queen conch, marine conservation issues and Belize are as important as conducting scientific research. Throughout the expedition there will be lectures, discussions and nature walks.

The team will be on shore for the first day of the expedition. Over dinner and coffee, volunteers and staff will get to know each other and will also go over the general daily structure of the expedition. Day 2 of the expedition will consist of a morning boat ride to the Living Reef Center. Once at the center there will be an orientation to the site and a talk about safety. After settling in and eating lunch, staff will discuss the project's background and data recording techniques. The team will then practice the field techniques on land and in the shallow water off the boat dock until all volunteers are comfortable with the techniques. That evening there will be a discussion of the day's activities and any confusion about the techniques will be clarified. The rest of the expedition will be devoted to data collection and entry. Each night after dinner, the team will review the day, record data, process samples and discuss the next day's schedule.

Throughout the expedition the project staff will lead lectures on marine conservation, focusing on marine reserves, tropical marine conservation and the need to build capacity in local stakeholders. When possible, colleagues from the University of Belize, TASTE, TIDE and the Fisheries Department will be invited to discuss local culture and conservation-related issues. Project staff will also take volunteers on island walks and lead snorkeling trips to the adjacent barrier reef. In addition to scheduled discussions, staff will encourage discussions during breaks, meals and all other periods of “down time.” You are encouraged to be curious and ask questions.

### Assignments

Volunteers are needed because of the labor-intensive nature of this project and will assist in all aspects of the study. In the field, you will assist in queen conch surveys, veliger surveys, mapping of conch aggregations, habitat assessment and tagging and recapture of conch. In the lab, you will be responsible for veliger identification, data recording and reduction. Please see *Research Objectives and Methods* above for more information.

## PROJECT STAFF

### Principal Investigator

**Dr. John A. Cigliano** is an Associate Professor of Biology at Cedar Crest College. His research specialties include marine conservation ecology, queen conch ecology, octopus behavioral ecology and natural history. His field responsibilities include oversight of the entire project, leading field teams, education of field teams on queen conch ecology and marine reserve theory, research design and data analysis. Dr. Cigliano has conducted research on queen conch conservation ecology in the Bahamas (Andros) and in the Turks and Caicos Islands (South Caicos).

**Dr. Richard Kliman** is an Associate Professor of Biology at Cedar Crest College. He is a population geneticist with research interests in conservation genetics, natural history of closely related species and molecular evolution. Dr. Kliman collaborates with Dr. Cigliano on the queen conch research program, which combines fieldwork on population demographics with laboratory work on DNA sequence variation within and among conch populations. His field responsibilities include supervision of teams and education on the use of genetics to study population history and migration.

### Research Staff

**Bryan Bugler** holds a B.S. in Marine Biology and has been field assistant to Dr. Cigliano for the last six years, including during the *Octopuses of Costa Rica* project funded by Earthwatch. Bugler will assist with fieldwork, logistics, education and team building this season.

**April Ridlon** holds a B.S. in Conservation Biology and is interested in community-based management. She will be responsible for working with stakeholders on capacity building and education outreach, and for team building and assisting in the field and lab.

## RESULTS AND OPPORTUNITIES

### **Significance and Benefits of the Project**

The broad significance of this project is that it will test the fundamental and critical assumptions of MRs. MR managers, conservation biologists and marine biologists will benefit from this study. On a more local level, this project will provide valuable information that is needed for the local conservation and management of queen conch and lobster. Queen conch is a major export of Belize. This study will contribute significantly to the management, and thus the protection, of this important species. All data will be shared with TASTE and the Fisheries Department, as well as other stakeholders. The expectation is that this data will be incorporated into policy related to the management of SCMR. It is also hoped that these findings will be disseminated to managers of other MRs in Belize and might influence public policy related to these reserves. Queen conch and lobster are also important exports in other Caribbean countries. The findings of this project will be applicable to management policies in these other countries as well. It is anticipated that this project will lead to several publications in peer-reviewed journals. It is also likely that this project, along with the other *Sustainable Southern Belize* projects, will be attractive to popular publications.

### **Initial Research Results**

The following is based on a preliminary analysis of the data collected in 2006 and 2007:

- Aggregation density varied from 0.00 conch per square meter to 0.88 conch per square meter, which are among the highest reported for shallow-water nursery aggregations (see Wicklund *et al.* 1991; Tewfik and Guzman 2003).
- Age structure of aggregations were skewed towards juveniles and differed among sites, seasons and years. It is not known if this is an indication of changing population structure or due to sampling biases. Continued sampling should determine the cause.
- All aggregations were in shallow water (less than two meters) and associated with reef cuts.
- Nursery habitat was sparse to medium-heavy seagrass.
- Two deep-water (14 meters and 30 meters) spawning aggregations have been located in the park. Both are associated with reef cuts and nursery aggregations.
- Approximately 2,500 conch were sampled with approximately 1,800 tagged.
- Approximately 250 tagged conch have been resighted or harvested (fishermen receive a reward for reporting location harvested).
- Preliminary results suggest that deep-water conch do not migrate while shallow-water conch use two reef cuts as a primary migration route (deep water in winter, shallow water in spring/summer).
- However, shallow-water conch appear to have strong site fidelity (return to same aggregation in spring).
- It is not known what percentage of juvenile conch migrate.
- It appears that conch grow approximately five centimeters per year in total length.
- It appears that currently SCMR has several “healthy” juvenile conch aggregations. It also appears that at least two deep-water spawning aggregations exist. There are likely others. Studies have begun to locate other spawning aggregations and to determine the level of self-recruitment in SCMR.

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# CORAL BLEACHING

PRINCIPAL INVESTIGATOR:	1) <b>Christina Garcia</b> 2) <b>Jocelyn Rae Finch</b>
POSITION/TITLE:	1) Technical Coordinator 2) Science Coordinator
AFFILIATION:	Toledo Association for Sustainable Tourism and Empowerment (TASTE)

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## THE PROJECT

Coral reefs are one of the most diverse ecosystems on the planet, but the oceans' underwater gardens are under increasing threat from global climate change. Over the past 20 years there has been a substantial increase in both the severity and number of coral bleaching events around the world. The small colonial coral polyps which build up coral reefs are home to symbiotic algae called zooxanthellae. When corals experience stress, such as that associated with an increase in sea temperature, they expel these algae. This loss of zooxanthellae causes them to "bleach" or turn white due to a reduction in the pigmentation contributed by the algae. Although corals can regain their zooxanthellae, prolonged or intense stress can lead to the death of the coral. While corals can bleach under any number of stressful conditions, recently it has become clear that the major cause of increased bleaching is likely related to the increase in sea temperatures due to global warming.

With support from Earthwatch Institute, the Toledo Association for Sustainable Tourism and Empowerment (TASTE) has developed a comprehensive monitoring program to evaluate the extent of bleaching in the shallow back reef at the Sapodilla Cayes Marine Reserve (SCMR). This season's work will build upon data collected by Earthwatch teams in the 2007 field season and will provide key support and valuable information for managers. Greater understanding of the extent and potential influences of bleaching in SCMR will provide managers with the tools necessary for effective conservation and protection of crucial coral reef ecosystems within the reserve. Monitoring and documenting coral bleaching events has also been identified as a key research priority for all of southern Belize.

On this expedition volunteers will participate in an important conservation effort and will witness the beauty and diversity of the marine habitats contained in SCMR. For some of you, it will be your first experience snorkeling in the Caribbean, however you will quickly learn to identify and assess the health of key coral species. This expedition may also offer the opportunity to observe the endangered hawksbill sea turtle, indulge in traditional local foods, and of course enjoy a few moments of relaxation under a coconut tree. You will also learn about the area's economic and environmental challenges, and the problems that threaten the region and its stunning biodiversity. You will help collect vital baseline data that will be used to make informed management decisions and to launch research projects into new and exciting directions.

## RESEARCH OBJECTIVES AND METHODS

The goals of this research project are to monitor and document the effects of bleaching on key coral species, to monitor key influences on coral bleaching events such as water quality, light intensity and temperature, and to develop a greater understanding of the impact and extent of coral bleaching within the Sapodilla Cayes. In addition to providing valuable information on any potential bleaching events, the data collected by volunteers will help to develop a better understanding about the overall health of the coral reefs in the shallow back reefs of SCMR. In order to achieve these goals, Earthwatch volunteers will assist with coral monitoring as well as the collection of basic water quality data. One of the goals of the partnership between TASTE and Earthwatch is to support ongoing research and monitoring programs in SCMR. This project directly addresses management and research needs for monitoring.

Specifically, the project aims to:

- Establish a multi-year data series on the extent of bleaching at selected sites within SCMR
- Monitor coral health along permanent transects and among tagged colonies at selected sites
- Record key physical and biological factors that may influence coral bleaching
- Develop a strategy to monitor, provide early warning and possibly mitigate future bleaching events

Some of the methods that may be employed to achieve these objectives include:

- *Line transects*: Permanent transects will be established at each of the back reef sites. These transects will be assessed monthly for coral health. By establishing permanent transects at each of the sites, managers will be able to collect directly comparable data about the sites' composition and health over an extended time period.
- *Tagged colonies*: It is likely that in addition to establishing permanent transects some colonies may be tagged and photographed in order to monitor coral growth and health.
- *Weighted bar drop*: This method has been used by researchers throughout the region and offers an assessment of coral health at each site. The method uses divers who randomly measure the health of individual coral colonies at each site. This allows researchers to cover larger areas in a short period of time.
- *Photography*: The use of digital photography will assist researchers in developing a greater understanding of the progression of bleaching events at each site. It will also provide a permanent record of work carried out.
- *In-situ data loggers*: These will be used to record temperature and light intensity at each of the selected sites. This should allow for comparison between observed coral health and factors known to effect bleaching.
- *Water quality*: Using basic equipment, information will be collected about the water quality at each site on the day of sampling. This information will allow researchers to track any changes in water quality between sites or over time.

For the 2008 Earthwatch season, seven monitoring sites are expected to be established within the reserve at shallow back reef locations. It is also possible that up to three sites will be established at deeper locations within the reserve for comparison. Each Earthwatch team will be responsible for monitoring and documenting benthic cover, coral health, the extent of coral bleaching and possible influences on coral health at each site. This monitoring will occur through snorkeling surveys, photo documentation and basic water quality monitoring. On all tasks volunteers will work closely with the Principal Investigators to collect data. Although some tasks may vary, the goal of this project is to develop a monthly monitoring system to give managers a better picture of the impact of bleaching within SCMR.

## TEAM ITINERARY

- Day 1:** Rendezvous in Punta Gorda and travel to accommodations, introduction to staff and overview of *Sustainable Southern Belize*, TASTE, and the project, time to relax
- Day 2:** Early morning travel to the Sapodilla Cayes (approximately two hours by boat), settle in, project overview and field training
- Day 3:** Project training
- Days 4-7:** Variable schedule including data collection and entry, lab work and down time
- Day 8:** Return to Punta Gorda
- Day 9:** Depart from Punta Gorda airstrip at 7:00 am local time (the flight is expected to arrive Goldson International Airport, Belize City, at 8:10 am)

Most of the volunteers' time will be spent out in SCMR, located 40 miles from the coastal town of Punta Gorda. SCMR offers beautiful sand beaches and clear waters with a diverse sampling of marine life. Volunteers will spend a significant amount of time with their heads in the water but an effort is always made to allow volunteers to enjoy the tranquility and beauty of the reserve. Because of the reserve's isolation, interested volunteers are encouraged to schedule time at the beginning or end of their trip to sample some of the cultural and environmental offerings of the Toledo District. Arrangements can be made with a variety of local tour guides and agencies to explore the waterfalls and Mayan ruins around Punta Gorda Town.

## DAILY SCHEDULE AND TASKS

Volunteers should be aware that a variety of factors, including weather, can affect the daily schedule. Project staff rely on good communication and volunteer flexibility to ensure an effective expedition. The daily schedule will depend to some degree on the location of monitoring sites and the type of work that needs to be accomplished. The following is an example of a research day for volunteers participating in this project:

- 7:00 am:** Wake up, breakfast
- 8:00 am:** Assemble equipment, transportation to field site
- 8:00-11:00 am:** Surveys, fieldwork
- 11:00-2:00 pm:** Lunch, rest and return to fieldwork
- 2:00-5:00 pm:** Surveys, fieldwork, lab work
- 5:00-7:00 pm:** Return from field, leisure time, dinner
- 7:00-9:00 pm:** Informal talks, reports on field observations, data entry, leisure time

## VOLUNTEER TRAINING AND ASSIGNMENTS

The main volunteer tasks will be snorkel-based coral surveys. During some expeditions, there may also be an opportunity to assist with sea turtle monitoring and other reserve monitoring activities. These opportunities will be determined within the general course of the research program throughout the season, and volunteers will be briefed about these activities when they are to be undertaken.

### Training

On the first evening of the expedition, an introductory talk by staff from TASTE and representatives from *Sustainable Southern Belize* will orient volunteers to the area, the local culture, daily schedule, and safety and emergency procedures. On the following days, training sessions will be scheduled either in the form of informal presentations or hands-on training depending on the tasks to be completed. TASTE staff will always be present to assist in the daily tasks and to interpret the area and the significance of the data being collected.

The first few days of the expedition will consist of an intense training period. Volunteers will be trained to identify 8-10 species of coral as well as signs of coral disease and bleaching. They will then be trained to evaluate coral health. Although at first coral identification can be difficult, TASTE has developed a methodology which enables even those with no experience the opportunity to quickly master the basics of coral identification. However, volunteers should be prepared for an intense first few days. In order to facilitate training of volunteers a coral "cheat sheet" will be developed and distributed prior to the volunteers' arrival.

### **Assignments**

By the beginning of the third day out at the cayes, volunteers should be ready to start surveying. Surveys will involve snorkeling at shallow back-reef sites. The team will be divided into smaller groups who will be assigned specific tasks. A good snorkeling ability and the capacity to surface dive are a great advantage, but there are plenty of tasks and a variety of ability levels can normally be accommodated. Those with the ability to write legibly while snorkeling are always appreciated! Normally volunteers can expect to spend between 45 minutes to an hour in the water at a time. While snorkeling, volunteers will record the species and health of corals, either using a random sample or along permanent transects. This close monitoring of the health of specific coral species should give managers a relative picture of the status of the reef. In addition to random sampling, photographs will be taken to document the extent of bleaching and/or disease. At each study site volunteers will assist TASTE staff with the collection of basic water quality parameters such as dissolved oxygen, salinity and pH, which may then be correlated to any observed bleaching and/or disease. Temperature and light intensity loggers will also be installed at each site to allow closer monitoring of these factors, which are thought to heavily influence the occurrence of bleaching events. Volunteers will also be responsible for data entry.

In addition to in-water assignments, volunteers may be engaged in a number of other tasks. Additional lectures and activities may be planned for down time. It is important to project staff to draw on the strengths of each volunteer team and individuals with specific skills maybe recruited for special tasks.

## **PROJECT STAFF**

In addition to the two Principal Investigators, TASTE and other staff members will occasionally join teams and assist with boat driving and other tasks. Personnel will change depending on schedule and availability.

### **Principal Investigators**

**Christina Garcia**, TASTE's Technical Coordinator, has an Associate degree in Natural Resource Management. She has worked for TASTE for the past three years and has a great knowledge of SCMR and TASTE's educational efforts. She is involved with TASTE and SCMR in a wide range of capacities, including helping with the management plan update, assisting with grant proposals, administration and research out at the reserve. She is co-author of a lesson guide called "Let's protect our reef" that was used in her Environmental Education Program. Garcia has served a key role in developing and implementing SCMR's new monitoring plan. Her mission is to see SCMR be converted into one of the most productive and best monitoring efforts in all of Belize. She is committed to ensuring the protection and management of all the diverse organisms found within SCMR, especially the amazing hawksbill turtle. She is also a scuba diver and is working towards getting her Dive Master certification.

**Jocelyn Rae Finch**, TASTE's Science Coordinator, was a former Peace Corps Volunteer with TASTE in 2003-2005. She has returned to TASTE after completing her Master's degree in Forestry/International Resource Management at the University of Montana. She has worked closely with Garcia to develop a comprehensive monitoring plan for the Sapodilla Cayes and has been involved with the management of the reserve for the past three years. Her goal is to improve the link between science and management decision making to ensure many generations of Belizeans can continue to understand and enjoy SCMR. She is a PADI Rescue Diver and like Garcia is working towards her Dive Master certification.

## RESULTS AND OPPORTUNITIES

TASTE began this coral bleaching and health project in 2007 and each Earthwatch team has greatly improved knowledge about the current status of a variety of ecosystems and species throughout SCMR. This research has been valuable and is helping TASTE and SCMR to develop a more significant baseline on the status of the shallow reefs in the reserve. Locally it gives managers a better idea as to the current status of the reefs in SCMR and will allow them to better track changes in reef health. On a national and international level it is helping to improve knowledge about the impacts of global climate change and other influences on coral reef health. Within Belize, SCMR has always been regarded as a site of high coral diversity but also has a high risk of degradation. This data will allow for improved monitoring and expand the knowledge about this critical ecosystem. At TASTE it is hoped that the data collected this season and as a part of this project will be able to be directly used for improved management at a site and national level. In order to ensure management is directly addressing issues of sustainability and ecosystem health it is necessary to have a complex understanding of the current status, and if possible, past history of the coral reefs. The 2008 season's research will contribute to a growing knowledge about the health and status of coral reefs within SCMR.

All data collected will be shared with partners such as the Belize Fisheries Department, Earthwatch and other stakeholders. Volunteers may help with the creation of a bleaching newsletter to be distributed to local people to raise awareness about the impacts of global warming on the world's second largest barrier reef. Findings from this study and others within *Sustainable Southern Belize* will be disseminated to local non-governmental organizations and to the Fisheries Department. The expectation is that these findings will be incorporated into policy related to the management of SCMR. It is also hoped that these findings will be disseminated to managers of other marine reserves in Belize and, thus, might influence public policy related to these reserves.

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# MONITORING IN THE PORT HONDURAS MARINE RESERVE

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POSITION AND AFFILIATION: Senior Marine Biologist, Toledo Institute for Development and the Environment (TIDE)

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## THE PROJECT

As an integral part of the *Sustainable Southern Belize* regional initiative, Earthwatch teams working with researchers from the Toledo Institute for Development and the Environment (TIDE) will help monitor a number of species within the Port Honduras Marine Reserve (PHMR). Topics and species to be studied include water quality, seagrass, mangroves, and queen conch. As a participant on one of these exciting teams, you'll have the opportunity to take a look at the big picture of monitoring the health of species in PHMR, human impacts on this ecosystem and its inhabitants, and the conservation and tourism value of the area.

You will participate in an important conservation effort, experience a new culture, and witness the beauty and the diversity of marine habitats managed by PHMR. For some of you, it will be your first experience working in mangroves or seagrass beds, or performing biodiversity and population surveys such as counting queen conch. You will also learn about the area's economic and environmental challenges, and the problems that threaten the region and its stunning biodiversity. You will be helping to collect vital baseline data that will be used to make informed management decisions and to launch research projects into new and exciting directions.

The individual studies described below, developed by TIDE along with Earthwatch Institute, will work towards addressing identified areas of concern in the Port Honduras Marine Reserve.

## RESEARCH OBJECTIVES AND METHODS

The objectives of this project are to:

- Collect all the scientific information currently available for PHMR and make it available to the Government of Belize, scientists and local stakeholders
- Implement a long-term monitoring program of various ecosystems and species within PHMR
- Create a centralized database system
- Determine, through the monitoring program, consultations, and workshops with local stakeholders, the relevant environmental and economic issues facing the Toledo District, and formulate, based on these needs, appropriate scientific questions to be investigated with ad-hoc research projects
- Identify researchers qualified to carry out action-based projects based on these questions
- Formulate both short and long-term management plans based on the outcome of the research
- Involve the local community through educational outreach, consultation, direct involvement in the research projects, arts and crafts, beach clean-ups, and other events

Earthwatch teams will address some of these objectives by helping to collect baseline data on the oceanography and ecology of the area, and will help assess how some of the ecosystems within PHMR are used. These baseline data will be fed into a comprehensive database for the area and shared with government officials and managers.

## **Team 6: Seagrass**

### **Seagrass Monitoring**

Seagrass communities are ecologically important habitats in marine environments. Seagrass and their associated algae are very productive. As a result, this habitat is attractive to larger marine organisms, especially fish, in search of good feeding areas. In PHMR, seagrass meadows serve as important nursery grounds for the juvenile stages of commercially important conch, lobsters, and fish, and as important feeding sites for adult fish and birds. Seagrass communities are also indicators of water quality in tropical marine ecosystems, as the growth of benthic algae, increased phytoplankton and increased nutrient concentrations have been used to gauge the onset of eutrophication. Studies in the Florida Keys have shown how nutrient enrichment affects algal growth on seagrass blades, and the productivity and structure of the shallow water turtle grass community.

Team 6 will help to measure the diversity of species that make up the seagrass community, the percentage of seagrass cover (affects juvenile fish and other species), and the community's biomass (gives an indication of the area's productivity). To measure such parameters, scuba diving is necessary. The three monitoring sites within PHMR are located about 30 to 45 minutes from town at various locations within the reserve, all easily reachable by boat. The monitoring that is executed by the TIDE/Earthwatch team follows CARICOMP/MBRS protocol, and studies the health of the seagrass meadows in PHMR. Team 6 will have the opportunity to know a healthy seagrass meadow and to learn what defines the health state of seagrass ecosystems.

### **Water Quality Monitoring**

Water quality is key to determining ecosystem health, as nutrient levels can greatly affect the species composition of an ecosystem. Tropical marine hard bottom and seagrass communities have evolved and thrived in relatively low nutrient conditions, while nearshore nutrients are generally higher due to river input. Species found within low nutrient communities efficiently take up nutrients and out-compete other less adapted species in the area. However, they cannot successfully compete with organisms that have evolved to take advantage of elevated nutrient loads, often caused by increased human development. When nutrients are added to low nutrient systems, they are very quickly taken up by opportunistic species, out-competing native ones and disrupting the marine ecosystem. Currently, agricultural byproducts are seeping into coastal waters through rivers and streams coming from the major watersheds, aquaculture farms, and coastal and riparian developments. In addition, a variety of chemicals are transported to the offshore cays of the Gulf of Honduras by the currents typical of this area. These chemicals and byproducts of agriculture and household discharge arrive mainly from the countries of Honduras and Guatemala.

To monitor water quality, a variety of factors must be taken into consideration. Parameters to be measured include nitrates, phosphates and pH (indicators of pollution), dissolved oxygen (essential to the health of fish and other aquatic organisms), clarity of water (nutrient increases can increase turbidity and affect plant health), temperature (key variable controlling water quality), and salinity (influenced by river inflow, wind and currents).

## **Team 7: Mangroves**

### **Mangrove Monitoring**

Mangroves perform a vital ecological role by providing habitat for a wide variety of species. They are the dominant vegetation type within the Gulf of Honduras coastal strip and outer cays. The most abundant species is the red mangrove. The importance of mangrove communities to the ecological functioning of the local ecosystems cannot be stressed enough, especially in terms of

habitat for commercially valuable species (e.g. lobster, snapper, Goliath grouper, etc.). Many species, though not permanent mangrove inhabitants, make use of mangrove areas for juvenile habitat, foraging, breeding, and other activities. Additionally, mangrove roots are particularly suitable for juvenile fish. A study in the Florida Everglades showed that comparatively more fishes were found in mangrove areas than in adjacent seagrass beds. When fish densities in each habitat were examined, density in mangroves was 35 times higher than in adjacent seagrass beds! In terms of productivity, mangrove litter contributes greatly to local fisheries in terms of nutrition. The rate and amount of removal of leaf litter is an indication of how much material is being recycled back into the marine system in the form of nutrients, and the amount of organic material available to other components of the ecosystem.

Mangroves are the biological filters of the sea. For example, the red mangrove is found along the coastline and uses its roots to trap all the sediments that come into the sea through rivers and estuaries. Coral reefs and seagrass meadows need clear water to survive, since they both depend on photosynthesis. If the water is not clear the light cannot get to these organisms and they cannot carry out photosynthesis. Without the mangroves on the shore, the inland sediments would reach the marine waters making them more turbid. It is thanks to mangroves that seagrass meadows and coral reefs don't starve to death. In return, the coral reefs protect the mangroves from strong waves and agitated waters, allowing them to proliferate and become a strong ecosystem capable of surviving through a hurricane.

Mangrove productivity is affected by both direct impacts, such as clearing of mangrove patches, and indirect impacts, such as pollution and hydrological interference. Changes in pH, dissolved oxygen and salinity lead to inhibition of photosynthesis and respiration in mangroves, causing dieback and less productivity. Current threats to mangroves in the area include upstream development, encroachments (i.e. fishing camps, housing, squatting on the coast and cayes), and possibly boat exhaust fumes, especially in fly-fishing areas. Through the maintenance of an appropriate level of mangrove productivity, it will be possible to maintain the ecological integrity of the mangrove ecosystem.

Team 7 may help to visually examine human threats to the mangroves (e.g. deforestation for timber, charcoal, firewood, boating, fish traps, and coastal fish or shrimp farming), determine the type and number of organisms present within the mangroves, and measure leaf litter fall.

### **Water Quality Monitoring**

Team 7 will also assist with water quality monitoring. See Water Quality Monitoring under Seagrass above.

### **Team 10: Queen Conch Monitoring**

The queen conch is the second most valuable marine resource in the area. Queen conchs grow relatively slowly, and do not reach sexual maturity until 3.5 years of age. Conchs are generally thought to have localized recruitment and self-sustaining populations, which is an important factor in selecting target conservation areas. In a recent resource value assessment, queen conchs brought in an estimated BZ\$51,420 in revenue to the local Toledo fishermen. Team 10 will help TIDE researchers measure the abundance, density and size structure of conchs throughout key sites in PHMR. To measure such parameters, both snorkeling and scuba diving are necessary. It is important to keep a record of these ecological parameters in order to ensure sustainable fishing of conch. Populations can easily be overexploited by fishermen, due to the ease of catching these organisms. It is a key aspect of management to keep a scientific record of their state in order to be able to implement sound management actions.

## TEAM ITINERARY

Below is a tentative itinerary for Teams 6, 7 and 10.

- Day 1:** Rendezvous in Punta Gorda, orientation at the *Sustainable Southern Belize* Field Center, discussion of research project, preparation of field equipment
- Day 2:** Training for all teams; for diving teams (Teams 6 and 10), there will be an orientation dive for gear and skills checkout and buoyancy tuning
- Days 3-8:** Monitoring in Port Honduras; diving teams will boat to diving sites
- Day 9:** Drop off at Punta Gorda airport for departure

## DAILY SCHEDULE AND TASKS

The following is an example of a research day for Teams 6, 7 and 10:

- 6:30-7:30 am:** Wake up, breakfast
- 7:30-8:00 am:** Preparation
- 8:00-9:00 am:** Transportation to field site
- 9:00-11:30 am:** Surveys, fieldwork
- 11:30-1:30 pm:** Lunch, rest and return to fieldwork
- 1:30-4:30 pm:** Surveys, fieldwork, lab work
- 4:30-5:30 pm:** Return from field
- 6:00-8:00 pm:** Leisure time, dinner
- 8:00-9:00 pm:** Informal talks, reports on field observations, data entry, leisure time
- 9:00 pm:** Suggested bedtime

## VOLUNTEER TRAINING AND ASSIGNMENTS

### Training

Upon arrival in Punta Gorda on Day 1, each team will be greeted by a representative from TIDE. Teams will also be greeted by the *Sustainable Southern Belize* Field Director and oriented to Earthwatch's regional initiative in Belize and to the study areas. Volunteers and field staff will have the opportunity to interact and get acquainted. An introductory talk will orient the volunteers to the area, the local culture, daily schedule, and safety and emergency procedures. On the following days, training sessions will be scheduled either in the form of informal presentations or hands-on training depending on the tasks to be completed. TIDE staff will always be present to assist in the daily tasks and to interpret the area and the significance of the data being collected.

### Team 6: Seagrass \* SCUBA DIVING REQUIRED \*

#### **Seagrass Tasks**

To monitor seagrass beds, some training in the identification of the main species to be encountered will be necessary and field staff will provide a picture guide of the coral and seagrass species of importance. To measure community composition, the percent cover for preset biological categories of organisms (e.g. macroalgae, turf algae, soft coral, hard coral, sand, mud, rubble, etc.) will be recorded on datasheets and any species of hard coral will be recorded at each occurrence. Finally, to measure biomass, core samples of seagrass will be taken using a corer made from PVC pipe. The corer will be pushed and rotated back and forth into the sediment to at least 45 centimeters to obtain 90% of the seagrass roots. Once at the surface, the samples will be placed into separate buckets.

At the lab, teams will further clean, rinse and sort the samples. Samples also need to be dried, and this procedure may take several days. After the drying procedure, samples will be weighed and subsequently stored in plastic bags.

### **Water Quality Tasks**

This study monitors water quality at 14 stations located along transects in the inner and outer waters of PHMR. Water monitoring is completed on a monthly basis. Teams will depart by boat and reach specific GPS (Global Positioning System) locations along predetermined transects. To measure dissolved oxygen, temperature, turbidity, pH, and salinity, a probe is lowered to a given water depth and parameter values are recorded on datasheets. Water samples to measure nitrates and phosphates are collected using plastic bottles, labeled, stored on ice, and taken back to the shore lab where analysis is completed using a spectrophotometer (an instrument specifically designed to measure these parameters).

### **Team 7: Mangroves**

#### **Mangrove Tasks**

One site has been established for mangrove monitoring in the cayes. Visual examination of mangrove cover takes place once a year during aerial surveys to determine if any alteration of the landscape has occurred within the reserve. Community composition is generally measured once a year, while productivity is measured twice a year, once during low productivity periods (March-May) and once during high productivity periods (June-August). Damage assessment to mangrove patches will be carried out by visual inspection. Generally, damage will be obvious (e.g. areas cleared for development, damage by storms). Sites identified as damaged in previous surveys may be revisited to determine whether the mangrove is recovering or being damaged further. Community composition will be determined within three plots at each monitoring site marked with flagging tape. Selected trees within the plot will be measured and the main species occurring within the plot will be identified. Floor litter samples will be carefully washed to remove sediments and then dried, sorted and weighted. Ten litter fall traps will be deployed and material collected from these traps will be sorted according to type.

### **Water Quality Tasks**

See *Water Quality Tasks* under *Seagrass* above.

### **Team 10: Queen Conch \* SCUBA DIVING REQUIRED \***

Prior to data gathering, brief identification training will take place. Smaller conch shells tend to bury during the day and a practice run should be conducted to train the eye in finding them. There are 11 conch monitoring sites that have been identified in PHMR. A transect line will be placed at each of these sites. Divers will swim along the transect line and record all queen conchs on both sides. Conchs will be identified as adult or juvenile, and the length and lip thickness of the shells will be measured using a caliper.

## **PROJECT STAFF**

### **Principal Investigator**

**Renata Ferrari Legorreta**, PHMR Senior Marine Biologist, has conducted monitoring and research across the Wider Caribbean and has over three years of experience in Belizean waters. She is interested in coral reef ecological dynamics and is a PADI Certified Dive Master. She has a biology background and has specialized in tropical marine resource management and sustainable use since she graduated from a dual program between McGill University in Canada and Universidad de las Americas, Puebla, in Mexico in 2004. Renata will lead the TIDE/Earthwatch

team training and monitoring in the PHMR area. She enjoys working with volunteers and believes that in the end, we can only protect what we love, can love only what we understand, and we can understand only what we are taught (Senegalese poet Baba Djoun, 1968).

### **Research Staff**

**Mario Muschamp**, PHMR Manager, is active in monitoring, research and baseline studies for PHMR. He has been a PADI Certified Open Water Diver since 2003. Mario has experience in coral and fish monitoring and identification and participates in the spawning aggregation studies for the southern portion of the Belize Barrier Reef.

**Marlon Williams**, PHMR Head Ranger, is a high school graduate with experience in boat handling and marine knowledge. He has four years of experience working as a ranger at PHMR. He is a certified open water scuba diver and has been active in research and monitoring in PHMR for the past three years. Marlon knows the waters of PHMR like the back of his hand, and will help carry out the research and training activities.

Other staff and PHMR Rangers working for TIDE will occasionally join teams and assist with boat driving and other tasks. Personnel will change depending on schedule and availability.

## **RESULTS AND OPPORTUNITIES**

TIDE is entering its fifth year of research and monitoring in PHMR. Last season, more queen conchs were found within the reserve's Conservation Zones than in previous years. Lobster counts were more than 50% greater in the Conservation Zones than in the General Use Zone. Corals were much healthier and fish diversity was much greater at the Snake Cayes. However, in order to determine major changes in resource population and community composition, continuous monitoring is necessary. The work conducted this year will contribute to a dataset that will help biologists track trends and inform a revision of the PHMR management plan in 2008. The results of the research will also help TIDE measure the effects of inland agriculture and shrimp farming on the reserve and to gauge management effectiveness in sustaining the reef's commercial fish, lobster and conch populations. Further, by monitoring the health of these ecosystems and key species, TIDE will have a better insight into the ecological effects of PHMR's different use zones on the area, improving its management.

All data will be fed into the Mesoamerican Barrier Reef Systems (MBRS) project's regional database and will be shared with colleagues across the region. The results will also be disseminated among the various stakeholders of PHMR, including buffering communities, and at the national level through reports and presentations.

## **LITERATURE CITED**

- N. Cushion and L. Kukich. 2004. *Port Honduras Marine Reserve: Manual for Biological Monitoring Management effectiveness indicators and GIS applications*. TIDE.
- P.C. Almada-Villela, P.F. Sale and G. Gold-Bouchot. 2003. *Manual of Methods for the MBRS Synoptic Monitoring Program*. Mesoamerican Barrier Reef Systems (MBRS).

# EXPEDITION PACKING CHECKLIST

## Essential Items

- This Expedition Briefing**
- Photocopies of your passport, flight itinerary and credit cards in case the originals are lost or stolen; the copies should be packed separately from the original documents**
- Passport and/or visa (if necessary)**
- Certification of inoculation (if necessary)**

## Required Items

### *Clothing/Footwear*

- Reef shoes, booties or sandals (coral can be sharp and cut your feet)
- Casual shoes/flip flops
- Bathing suits (2)
- Easy drying, lightweight shorts (2-3)
- Loose fitting, quick-drying, comfortable pants (1-2) – pants with zip-off legs work well and can double as shorts
- Easy drying, lightweight shirts (2-4)
- Lightweight, long-sleeved shirts to prevent sunburn (1-2)
- Rain jacket (for teams in June, July and August, rubberized rain gear is recommended, as the lighter-weight nylon jackets will get soaked straight through)
- Hat with wide brim (a chin strap or toggle is recommended for the boat)
- Thin socks for mosquito protection
- Warm sweatshirt/sweater/jacket (e.g. fleece) for overcast days on the water
- Set of clothing to keep clean for end of expedition and recreational time

### *Field Supplies*

- Small daypack/rucksack
- Drybag to protect all luggage from water on trip to the cayes
- Plastic sealable bags (e.g. Ziploc brand) for protecting equipment such as camera and other personal items from dust, humidity and water
- Insect repellent spray with DEET for mosquitoes
- Oil or oil-based repellent (e.g. baby oil, olive oil, AVON Skin-so-Soft Original Bath Oil, citronella oil repellent, Bit Blocker, etc.) for sand flies (baby oil works fine and is readily available in Punta Gorda)
- Sunscreen (waterproof with SPF 30+)
- Water bottle(s) able to hold at least 1 liter
- Polarized sunglasses with a strap to hold them around your neck
- Hard case for sunglasses or prescription glasses for protection on the boat

- Small notebook and pencil(s) to bring in the field
- Alarm clock/watch
- Mask, snorkel and fins, plus extra mask and fin straps (not needed for Team 7)
- Thin (1-3 mm) wetsuit if you are prone to getting cold in the water (not needed for Team 7)
- Headlamp or flashlight/torch with extra batteries and extra bulb

### ***Personal Supplies***

**Note:** Bedding and bath towels will be provided.

- Beach towels (1-2)
- Pack-towel or sarong
- Personal toiletries (biodegradable soaps and shampoos are recommended)
- Antibacterial wipes or lotion (good for “washing” hands while in the field)
- Personal First Aid kit (e.g. anti-diarrhea pills, antibiotics, antiseptic, itch-relief, pain reliever, oral anti-histamine, bandages, blister covers, etc.) and personal medications
- Seasick medications if there is ANY chance you may get sick (Dramamine, Bonine, etc.)
- Spending money (approximately US\$300 cash recommended)

### ***Scuba Gear (Certified Divers on Teams 6 and 10 Only)***

**Note:** The following information applies ONLY to scuba-certified volunteers on teams that will involve scuba diving-based research activities.

- Certification card and dive log showing at least last 10 dives after certification (copies of this information must also be turned in with your volunteer forms)
- DAN (or equivalent) dive insurance card (copy of card or proof of insurance must be turned in with your volunteer forms)
- Mask, snorkel and fins
- Buoyancy compensator (BC)
- Regulator with octopus
- Webbing style weight belt with buckle and clips (weights provided at site)
- Emergency whistle
- Thin (1-3 mm) wetsuit, if you are prone to getting cold in the water, or dive-skin for protection from sun and stinging critters
- Dive tables or dive wheel
- Depth and pressure gauge (minimum required, though a dive computer is optional)
- Spare batteries for dive computer/other equipment
- Repair kit with extra parts for all scuba gear (O rings, fin and mask straps, BC patch kit)
- Inflatable “safety sausage” that can be clipped to your BC
- Bottom timer (don’t bring anything too expensive – a water resistant wrist watch is fine)
- Mesh bag to keep all of your gear together

## Optional Items

- Camera, film/digital memory storage, extra camera battery
- Video camera
- Earplugs
- Binoculars
- Extra sunglasses and hat (you don't want to be without these)
- Books, games, etc. for use during recreational time
- Dive knife (for scuba-certified volunteers participating on diving-based teams)
- Dive computer (for scuba-certified volunteers participating on diving-based teams)
- Dive light (for scuba-certified volunteers participating on diving-based teams)