



# A Journey to Cuba's Underwater Eden:



*Ten days of Exploration in the  
Gardens of the Queen*

A Travelogue by EDF Senior Writer Rod Griffin



## INTRODUCTION

With support from the Waitt Foundation, EDF launched an initiative with the University of Havana's Center for Marine Research (CIM) that allowed teams of Cuban, U.S. and Mexican scientists to carry out a series of expeditions to conduct vital new research on Cuba's remarkable—but understudied—marine and coastal ecosystems. EDF provided and will continue to provide scientific expertise by assisting the monitoring of reef fish and shark populations and evaluation of coral reef conditions.

Coral reefs are some of the world's most imperiled marine habitats. Impacts from climate change, pollution, overfishing and resource extraction combine to threaten reefs all over the world. This is especially true in the Caribbean, where rapid development is underway, exacerbating the stressors on coral reefs and their related seagrass and mangrove ecosystems.

However, in one quiet corner of the Caribbean, the Gardens of the Queen archipelago has remained remarkably resilient in the face of these pressures. A stunning marine paradise, the Gardens of the Queen consists of more than 600 cays and islands and is home to the largest contiguous marine reserve in the Caribbean (2,170 square kilometers). It supports a mosaic of mangrove islands, seagrass beds and patch reefs, and is abundant with fish, sharks and other marine life.

To reach the Gardens of the Queen from mainland Cuba, one must cross the Gulf of Ana Maria, a shallow-water ecosystem comprised of mangrove, seagrass and coral reefs. Together, the Gulf of Ana Maria and Gardens of the Queen cover more than 10,000 square kilometers of productive habitat, making the entire archipelago a magnet for ecotourism, including SCUBA diving and recreational fishing. Despite being the centerpiece of a growing tourism industry and offering one of the best examples of a resilient Caribbean reef, much about the Gardens remains a mystery.



## HISTORY RECORDED

In 2012, EDF senior writer Rod Griffin embarked on a scuba expedition to the Jardines de la Reina, or Gardens of the Queen, a spectacular undersea reserve off Cuba's southern coast that has been off-limits to U.S. divers for more than 50 years.

Rod kept a diary of his 10-day-long adventure in the company of some of the world's leading marine experts. Funded by the Waitt Foundation, the trip offers a rare glimpse of this underwater Eden, while underscoring the environmental threats facing even a relatively unspoiled patch of ocean.



## Day 1: Bienvenidos a Cuba!

Arriving at the port of Cienfuegos (pop. 186,000), I'm struck immediately by the lack of tourism. Almost anywhere else in the Caribbean, this city of stunning colonial architecture, originally settled by the French and now a UNESCO World Heritage Site, would be jammed with gleaming condos and pleasure boats. There are perhaps a dozen catamarans, but that's basically it.

From the start, few things go as planned. Our departure for the Gardens is delayed by half a day as three separate waves of Cuban officials board the Waitt Institute's expedition vessel to inspect our papers.

One stern-looking official, dressed in olive-green fatigues, arrives with a search dog to check for contraband. As soul music plays quietly in the background, he pauses to listen. "Ah, Barry White," he says appreciatively. Ah, Cuba.

In 1996, the Cuban government set aside the Gardens as an 850-square mile marine reserve – the biggest in the Caribbean – as part of a planned island-wide network of protected areas. Only 500 catch-and-release fishermen and 1,000 divers are permitted to enter the Gardens each year.

### Underway

We steam past a small flotilla of fishing boats – rowboats mostly.

### Paradise Found

Christopher Columbus called this soft-breezed isle "the most beautiful land human eyes have ever seen." Here, in the Gardens of the Queen, the coral reef ecosystem is a time capsule, a unique place almost entirely free from human influence. Photo by: Ian Shive, courtesy of The Nature Conservancy.

Even today in Cuba, many fishermen still use handlines to catch jack and snapper, much like Santiago did in Hemingway's *The Old Man and the Sea*. A motor and fuel remain luxuries few can afford. But Cubans are renowned for their resourcefulness: One "vessel" is just a surfboard with a chair affixed to it.

Once we hit the open water, we don't see another vessel for hours. Under a cloudless sky, the surface of the deep-blue sea is broken only once by a whale surfacing just 50 meters to starboard.

On the 12-hour voyage to the Gardens, I think about this island nation's amazing biodiversity. It has more than 3,000 miles of coastline

and four primary reef systems (each roughly as long as the Florida Keys).

The sheltered lagoons, dense mangrove swamps and seagrass meadows are a haven for fish and other sea life, including sea turtles, sharks and sponges. The island's varied coastal landscapes also provide habitat for an array of shore birds, as well as migratory species such as black-throated blue warblers and American redstarts.

Amid so much natural wealth, the Jardines de la Reina, named by Christopher Columbus for Queen Isabella, is the crown jewel. The archipelago is a string of hundreds of mangrove-fringed islets and keys stretching over 90 miles along Cuba's southern coast.

Dan Whittle, EDF's Cuba Program Director, organized this voyage with partners from The Nature Conservancy's Caribbean program. In addition to Whittle, my shipmates include EDF senior VP for programs Diane Regas, TNC's John Meyers and Phil Kramer, UC Santa Barbara resource economist Chris Costello and Waitt Institute marine archaeologist Dominique Rissolo.

#### Scientific collaboration

With commercial fishing here restricted to lobster, the Gardens

provide a baseline for gauging the health of sea life and habitat in adjacent areas, which lack such restrictions.

For more than a decade, EDF and TNC have collaborated with Cuban scientists to protect our shared marine resources. "We're here to take a look at one of the most inspiring parks in the region and to think about what can be done in Cuba to strengthen the effectiveness of this and other marine protected areas," says Whittle.

Among the questions we hope to answer: What differentiates this reef from others in the Caribbean? How healthy are the fish populations, including top predators like grouper and shark? What are the biggest threats to this preserve, as tourism expands and the Cuban economy opens up? How can we work together to minimize them?

The existence of this area, one of Fidel Castro's favorite spearfishing sites, was little known outside Cuba until last December, when Anderson Cooper did a 60 Minutes segment on the Gardens. Suddenly 20 million Americans realized that the most unspoiled ecosystem in the Caribbean was literally next door. That exposure has heightened the need to find ways to protect this irreplaceable treasure, while Cuba works hard to meet it

development goals.

"Cuba is really special and has a lot to share with the rest of the world in terms of how we protect marine and coastal ecosystems," says John Myers, deputy director of TNC's Caribbean program.

#### Entering the Gardens

Fifty miles from the mainland, a string of coral keys sparkle like teardrops in the distance. The water turns aquamarine – milky green in the shallows. As we draw closer, you can see patches of mangroves connected by stretches of pure white beaches.

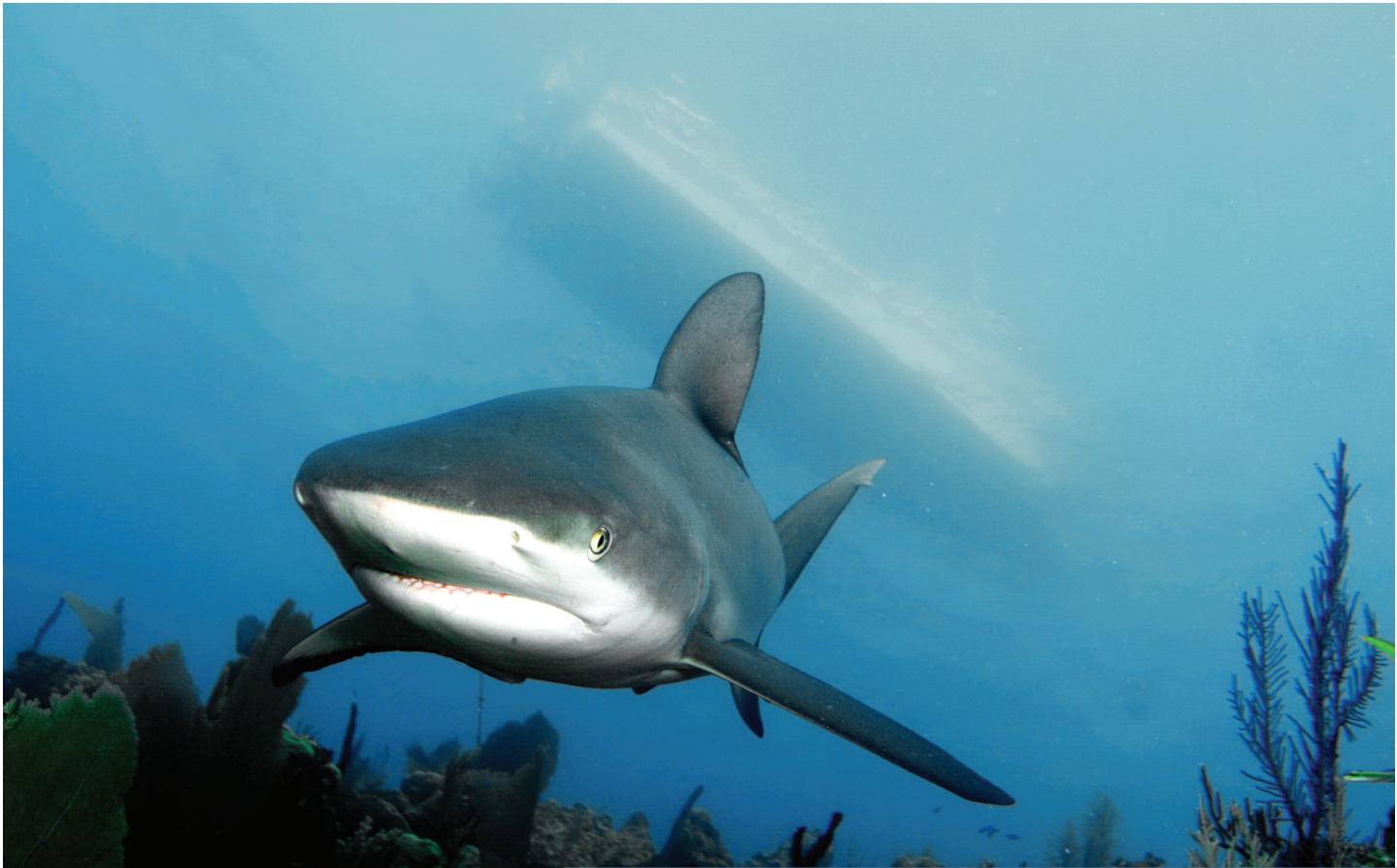
It's 8 pm, and our vessel comes to anchor near Cayo Anclitas, in the heart of the Gardens. As the sun slips beneath the horizon, a frigate bird soars overhead, riding an updraft. Silhouetted against the apricot sky, it's identifiable by its broad wingspan and forked tail. By 11 pm, we're in our bunks. Everyone is eager for tomorrow's dive and a close-up view of the big predators that are the real kings and queens of these Gardens.

**EDF's Cuba Director (below)**  
Dan Whittle has worked on marine conservation in Cuba for over a decade.



**You Have Arrived (below)**  
Near the port of Cienfuegos, a Cuban welcome. Photo by: Rod Griffin.





## Day 2: Close Encounters

The daily routine on the Waitt Institute's expedition vessel is designed to give us as much time on the water as possible. Every night, we organize all the scuba gear so we can make the first dive at 8 am sharp.

Our first dive site is Octopus Cave, a natural tunnel in a reef wall 60-feet down. The surrounding coral gardens and canyons are known for attracting large numbers of sharks and other large predators. Their prevalence is part of what makes the Gardens so special. Elsewhere in the region, some shark populations have declined as much as 90% in recent decades.

Sharks have existed 450 million years, since before the dinosaurs. But their

future hangs in the balance. EDF, working with the Mote Laboratory and other partners, is leading an ambitious tri-national effort to save sharks in the Gulf of Mexico – uniting Cuba, Mexico and the U.S. in an unprecedented conservation partnership.

### Sharks and me

I'll be honest, I am terrified of sharks. I was 19 years old in 1975, the year JAWS came out. I, like many people, left the theater traumatized. I've never been able to entirely shake my fear.

According to U.S. Health Department statistics, I'm more likely to be bitten by a New Yorker than a shark. But there are six to eight times more sharks in the Gardens than anywhere else in

### The Shark's Den

The Gardens of the Queen is known for the abundance of sharks, including Caribbean reef sharks (shown here), lemon sharks, silky sharks and occasionally whale sharks, great hammerhead sharks and tiger sharks. Photo by: Fausto De Nevi Herrera.

the Caribbean. I know that's a sign of a healthy reef, but seriously, what was I thinking?

In preparation for the trip, I read Peter Benchley's 2002 nonfiction book *Shark Trouble*. His advice: "Well, you'd better be an experienced diver" and be prepared "to react counter intuitively."

Did I mention that I only got my scuba certification a month ago?

As the tender motors to the dive site, I'm in a state of "controlled panic." None of the other divers, all of them experienced, seem the least bit anxious. Clearly I'm the weakest diver of the lot. So will I look like baitfish to whatever is lurking below?

Too late to worry about that now as I step into the crystal-clear, aqua blue waters. My shark worries bubble out of me as I struggle with the more immediate challenge: breathing under water. "Find your yogi breath," my wife would say (I never was very good at that.)

#### Octopus cave

Once I regain my composure, I open my eyes to an oasis of color. A school of schoolmaster snappers passes by, followed by a squadron of bluestriped grunts and French grunts, which change direction with instant, perfect synchronization. It seems their maneuvers are choreographed to avoid predators; there's strength in numbers. In the distance, a solitary sting ray cruises the sandy bottom

like a stealth bomber, searching for prey.

We drop down to a shelf at 60 feet and follow a reef wall. In the canyons, we see enormous grouper and cubera snapper and a huge variety of gorgonians and coral. Finally, we come to a 5-foot opening that looks like a black hole.

Others disappear inside and join the octopi and moray eels lurking there, but I'm not quite ready for that.

I'm relieved by my sound judgment when suddenly a 7-foot Caribbean reef shark enters my peripheral vision just a few feet away. It's the moment I've been dreading. But the shark, which obviously sees me as harmless,

inedible or both, just moves on.

In all we see 15 or so reef sharks. Unlike the tropical fish beside them, which travel in compact schools, the sharks are loners. They glide by gracefully -- and nonchalantly -- as if on cruise control.

The sight of so many sharks elicits an odd mix of calm and exhilaration. Maybe I'm just relieved they seem disinterested, but mostly I'm in awe. These primordial creatures appear lordly, beautiful and remote but not menacing.

By day's end, I can't wait for tomorrow's adventure.



#### Undersea Treasures (left)

Divers in the Gardens encounter a mind-boggling array of sea life, from microscopic plankton and surgeonfishes to this spectacular yellow tube sponge. Photo by: Fausto De Nevi Herrera.



#### Diving with Silkies (above)

Mote Laboratory's Kim Richie surfaces after mingling with a group of swirling silky sharks. This graceful species, named after its smooth skin, is generally an open-water shark and rarely found on inshore reefs. Photo by: Ian Shive, courtesy of the Nature Conservancy.



## Day 3: Ecotourism, Cuban-Style

I skip the afternoon dive today and head to La Tortuga, a floating hotel moored amid the labyrinthine mangrove channels of Cayo Anclitas. I want to learn how the people who manage this beautiful preserve plan to protect it.

The Cuban government tightly regulates tourism here. Only 500 fly fishermen and 1,000 divers are permitted to come each year, and the fishermen have to release their catch. It's all operated by Avalon, an Italian company, under contract with Marlin, a government-owned enterprise.

Every week, 20 or so guests come to La Tortuga from all over the world (this week they're mostly Brazilians and Argentines). They pay top dollar for the privilege of exploring this wild place, which is not only a diver's heaven but a world-class bonefishing and tarpon site.

Andres Jimenez, who co-manages the operation, sits with me on the deck of La Tortuga and explains how it all started.

The Gardens sanctuary was the brainchild of Giuseppe "Pepe" Omegna, an Italian outdoorsman who ran a sportfishing operation in the Canary Islands in the 1990s. He and two partners wanted to set up a dive and fishing center in Cuba, and fell in love with the Gardens.

Back in Italy, Pepe faxed two proposals to the Cubans. The first, which he considered a pipe dream, was for a large marine reserve, where fishing for everything but lobster would be prohibited. The second, less fantasy-like, was for a small reserve. The government chose his dream. Why? "We only got one fax," they later told him.

No one is complaining. The private-public partnership provides much-needed revenue and jobs for a lot of former fishermen and their families in nearby communities. In fact, the project has been such a success that the government is now considering Avalon's proposal to double the size of the park. (Pepe is still Avalon's CEO and now lives mostly in Havana.)

"I worry about how to keep areas like this safe as tourism grows," says Jimenez. The day after the 60 Minutes segment on the Gardens aired last December, Avalon got hundreds of hits on its web site. Cuba's Ministry of Tourism, meanwhile, recently announced that record numbers of international tourists visited the island during its most recent "high season."

"We have a strong scientific community here in Cuba, but we face many challenges," he adds. Illegal

fishing remains a serious threat, and realistically there aren't enough resources for enforcement. "When I found out groups like EDF and TNC have the same goals as we do, it gives me hope," says Jimenez.



**A Partner in Conservation**  
Andres Jimenez, co-manager of the dive operation in the Gardens, believes in working together to ensure the health of Cuba's seas. Photo by: Rod Griffin.



## Day 4: Protecting Eden

I'm 70 feet underwater at a dive site called Pipin when a prehistoric-looking fish the size of a VW Beetle swims up to me. It's brazenly curious and fearless, yet nonthreatening. It's a goliath grouper, one of three of these amazing creatures we see on our dive today.

The goliath grouper is critically

endangered in the Caribbean. They were fished to near extinction in Florida, before they were protected in 1990, and are still extremely rare. Protecting large reef fish like these mature goliaths is key for replenishing fish stocks; they can produce as much as ten times more young than smaller fish.

### Up Close and Personal

Dominique Rissolo, a Waitt Institute marine archaeologist approaches a black grouper. Photo by: Ian Shive, courtesy of the Nature Conservancy.

The existence of these giants is one benefit of Cuba's approach to conservation. The government has designated 18% of its ocean shelf as marine protected areas (which EDF helped design), with a goal of increasing that to 25%. Fabian Pina, a scientist with Cuba's Center for Coastal Ecosystems Research, says fish populations in the Gardens have

grown by 30-50% since the area was protected.

Still, MPAs alone are not enough to save many species, particularly wide-ranging fish like tuna, tarpon, bonefish and sharks.

Two years ago tourism operators at Avalon, an Italian company that runs the dive center with the Cuban government, noticed there were fewer sharks in the Gardens. “Where are the sharks?” they wondered. It turns out increased fishing outside the park was taking a toll. In the state-run fishery, fishermen meet their quota by weight – and sharks are heavy.

Even goliath grouper, which are relatively sedentary as adults, move out of the park during spawning season, traveling more than a hundred miles away. As part of a research project, Pina tagged five goliath groupers. Four of them were caught outside the park boundary over the next two years.

The 600-to-800 pounders that Pina frequently saw a decade ago are very rare now.

### What happens outside the park matters

The protected area only partly explains the unusual health of the ecosystems here. Another factor is the underdevelopment of Cuba’s fishing industry.

That’s likely to change as the government takes steps to upgrade its fishing fleet and increase its annual catch. Pressure is already mounting from Cuba’s expanding private market for more fish. And what will happen as the Cuban economy opens up and tourism grows?

In the end, how the government balances ecotourism and the growth in fisheries will be critical.

“Usually governments try to manage fisheries and ignore marine protected areas – or vice versa,” says Prof. Chris Costello, an expedition team member. Costello is a resource economist at the University of California at Santa Barbara and co-author of a groundbreaking study on fisheries management in Science showing how catch shares can help prevent fisheries collapse by giving fishermen a stake in

the health of the resource.

For example, a catch share program for reef fish that EDF helped implement in the Gulf of Mexico has led to rebounds in grouper and snapper populations.

“Putting MPAs and fisheries management together is the key to successful management in the future,” Costello says. “It seems so logical, but it’s just never been done. Cuba could be a model for the world.”

The Cubans get it, which is one reason they are so interested working with EDF and TNC on scientific exchanges. They have a stake in improving fisheries management and expanding the MPA network.

One management option for Cuba, says Rod Fujita, EDF’s director of oceans research and development, is a cooperative system like the one in Chile. “The Chilean example might fit the Cuban situation because profits are shared,” he says. “No one really owns fishing privileges. They’re held collectively, so it doesn’t go against the grain of communism.”

#### EDF’s Rod Fujita (below)

Fujita uses science to conserve the world’s oceans. Photo by: Rod Griffin



#### Safe Haven (above)

The Gardens marine sanctuary provides refuge for an abundant array of sea life, including this school of horse-eye jacks. Photo by: Fausto de Nevi Herrera.



## Day 5: Drifting Through an Undersea Forest

Today, we snorkel through the inlet to Anclitas Lagoon on the incoming tide, drifting effortlessly past patch reefs and over lush seagrass meadows into the mangroves that border the lagoon.

It's like traveling by glider at low altitude – only the terrain beneath you is underwater. (I feel like I'm doing a fly-by of another planet.)

The marine life we see is astounding: Hawksbill turtles, butterfly fish, angel fish, 20-pound cubera snapper, mutton snapper, barracuda, red hind, Nassau grouper. The full array is too numerous to list. There's even a pair of nurse sharks hunkered down under a coral canopy.

Even where stands of elkhorn and staghorn coral have been damaged by warming ocean temperatures – a problem throughout the Caribbean -- there are large mixed schools of snappers and grunts, suggesting a healthy ecosystem. "The fish biomass is off the charts," says TNC's Phil Kramer, who surveyed these reefs with Cuban scientists in 2001.

I'm impressed by everything, but

### Rainforests of the Sea

Snorkeling in the Gardens, divers pass through multiple habitats, from reef crests to mangroves. Only 500 fishermen and 1,000 divers are allowed to visit the sanctuary each year. Photo by: Ian Shive, courtesy of the Nature Conservancy.

the experts are taken mostly by how the habitats are linked. In most places, marine ecosystems are either fragmented or severely degraded. "I don't know if I've ever seen a place with the diversity of habitats so directly connected," says EDF scientist Jake Kritzer, who has dived extensively in the Caribbean as well as in the Pacific. "I thought Turnoff Atoll in Belize was impressive, but this is mind-blowing."

Kritzer's research focuses on ways in which different reef habitats are ecologically connected through the movement of both tiny larvae and full-grown adults.

### Habitat connections

Connectivity, it seems, is the new buzzword in marine science. I never knew scientists were so touchy feely. But as we drift on currents rich with zooplankton, I get it.

Even my untrained eye can see the different species make use of each habitat and how they are linked. As we drift inshore, you can see more invertebrates and crustaceans as well as juvenile fishes that will migrate to the reef when they grow older.

There are other more subtle connections as well; the grunts we saw sheltered amid the coral by day will disperse at night to hunt for food in the seagrasses. When they return to their resting spots, they transfer vital organic matter to the nutrient-poor coral reefs.

Green turtles, squirrel fish and moray eels do the same. Studies show there is higher fish biomass on reefs adjacent to seagrass meadows – yet another explanation for all the robust activity on this reef.

Finally, we reach the mangroves, which act as critical nurseries for virtually all of the bigger fishes on the reef. By trapping sediments and contaminants flowing seaward from inland farms and towns, mangrove roots help maintain coastal water quality and shield fragile offshore coral reefs from damage.

"As an adventurer and outdoorsman, the deep dives are thrilling," says Kritzer, "but as a scientist I have to say this drift snorkel is inspiring."

Everyone agrees.



## Day 6: Exploring Mangroves

Today, Phil Kramer, the director of The Nature Conservancy's Caribbean program, and I paddle a kayak to a small mangrove-fringed island in the Golfo de Ana Maria. Phil is the perfect guide; he knows the area and also happens to be a marine geologist and coral expert.

Straddling land and sea, mangroves occupy a zone of stifling heat, choking mud, and salt levels that would kill an ordinary plant. Yet mangroves swamps are among the most productive and complex ecosystems on Earth. They are the biological engines of the reef – and are important nurseries for a range of species, including grouper, sharks, snapper and lobster.

They are also disappearing. The world has lost about one-fifth of its mangrove forests since 1980. They are sacrificed for salt pans, aquaculture ponds, roads, port facilities and farms.

"These mangroves are extremely

healthy," Kramer notes we approach the island. "You can see that the black mangroves have stabilized the shoreline -- and are building outward." I've read that the world record for traveling 100 meters through a mangrove forest is 22 minutes. I can see why. It's incredibly arduous to make your way among the tangled prop roots.

As we move inland, we find gumbo limbo trees with 3-foot termite mounds alongside, poisonwood and cactuses. It's inhospitable terrain for humans -- silted ponds comprise roughly a third of the real estate – but ideal habitat for crocodiles.

And that's not all. Our arrival causes a night heron, one of the island's myriad inhabitants, to take flight. On one stretch of beach, we see iguanas and "jutias" (endemic tree-living rodents) that have no fear of humans. (Elsewhere in Cuba, they'd likely end up in a stew.) We also watch as a

### Knee-deep in the Sea

Mangroves provide protection for a variety of wildlife and are vital nurseries for juvenile fish. Photo by: Ian Shive, courtesy of The Nature Conservancy.

Wilson's plover feigns injury, fluttering its wings, to distract an interested iguana from its eggs.

### Living on the edge

Cuba has the most extensive mangroves in the Caribbean, covering half of its southern coast. They act as carbon sinks and buffers against coastal pollution. It's no wonder reefs off Cuba's south coast are so pristine.

But even here the mangroves are under threat. According to one of our guides, the Soviets planned to build a golf course on an island in the Gardens back in the 1970s. The project was never completed, but a cracked, overgrown airstrip remains, a monument to the failed dream of some nameless Russian golf lover.

To help avoid that sort of debacle, EDF worked with Cuban experts to write a Spanish-language coastal policy handbook. As the economy opens up and tourism grows, the handbook is

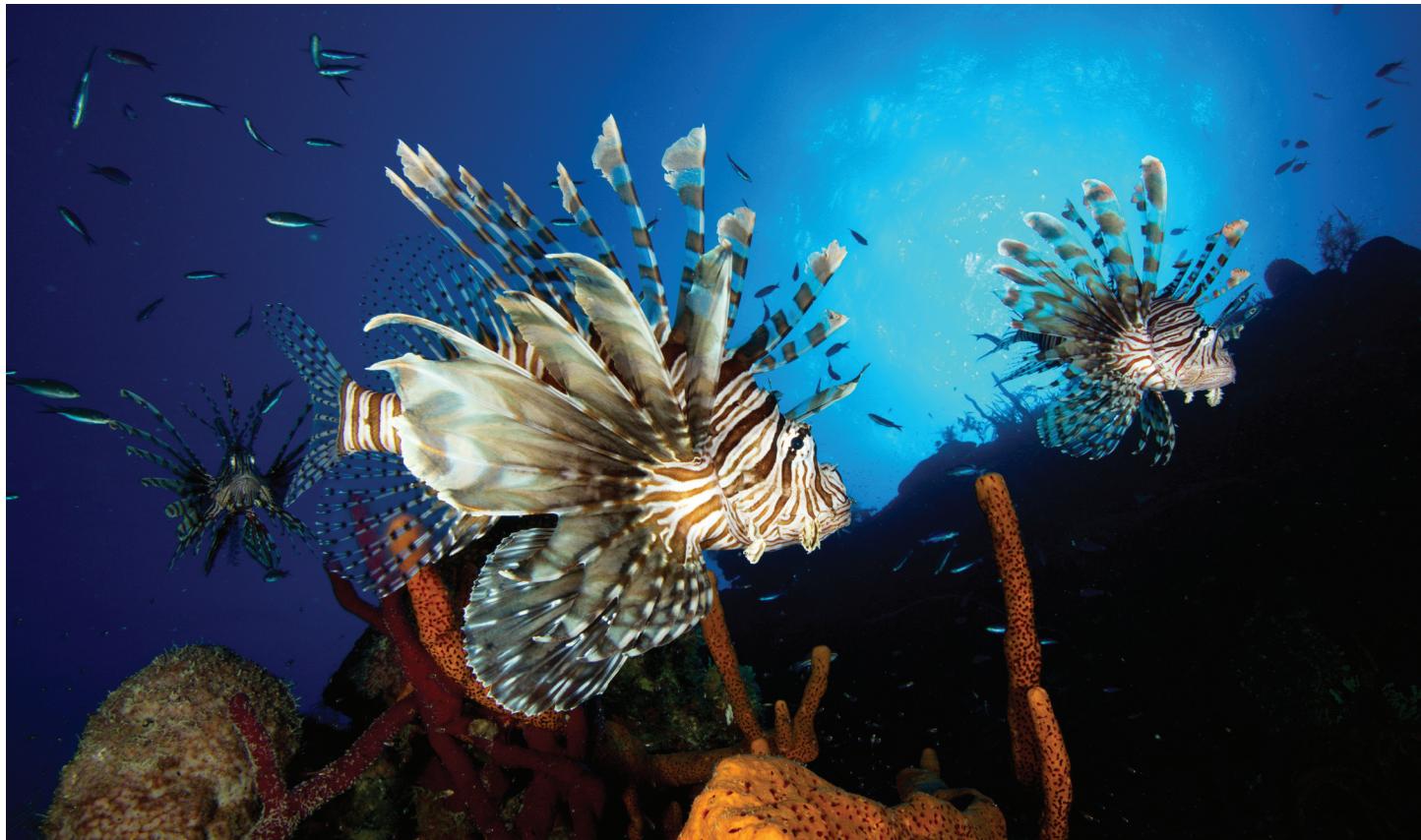
being used to guide Cuban planners and policymakers on how to avoid damaging mangroves, wetlands and other sensitive environments.

By the time we return to the boat, it's 6:30 pm. While we were off exploring, the vessel's crew ventured to Jucaro,

a tiny fishing village on Cuba's south coast. They returned with our supper – mutton snapper procured from a local fisherman in exchange for three Dr. Peppers and a T-shirt. In case you are wondering, Cubans are an enterprising lot.

As evening falls, we marvel at the lack of debris -- the stray fishing nets and plastic trash that invariably wash up on even the most remote shorelines. "It's just remarkable," Kramer says. "That's Cuba for you."

Tomorrow we'll head back underwater.



#### Pest of the Caribbean

The invasive lionfish, native to the Indo-Pacific Ocean and Red Sea, is beautiful but destructive. Photo by: Fausto De Nevi Herrera.

## Day 7: Invasion of the Lionfish

When EDF's Rod Fujita dons scuba gear, he enters a Zen-like zone of tranquility. This seems to be common among practiced divers. Among other things, it helps them conserve air and be less conspicuous in their movements.

Alas, I haven't yet mastered the technique. Fujita, in contrast, takes this mindset to another level. He is remarkably focused and alert on a dive.

Today, descending to 90 feet, he watches closely as a lionfish doggedly pursues a yellow and purple fairy basslet. Some fish are known to puff water to flip over sea urchins, but the lionfish is the only species known to puff water to disorient its prey, making it easier to catch.

The other odd thing about lionfish is that they shouldn't be here. The species is native to the Indo-Pacific Ocean and the Red Sea, but is believed to have been released into the Atlantic by fish

collectors in Miami sometime in the early 1990s. It has since spread up the East Coast past North Carolina and through the Caribbean.

The first sighting in the Gardens was in 2009 – and now they are everywhere. We see twenty or thirty on every dive. "In more than 200 dives in the Bahamas, I haven't seen them this big or in this density," says expedition team member Ken Marks.

"It's scary."

## Exotic but Deadly

How can something so beautiful be so destructive? The problem is that lionfish have voracious appetites and no known natural predators in the Western Atlantic. They can devastate fish populations wherever they feed.

Researchers found 50 species of prey fish inside their bellies, including juveniles of commercially important grouper and snapper. For lionfish, the Gardens, with its density and diversity of fish, is a virtual smorgasbord.

Scientists say one fish can produce 30,000 eggs in a single spawning event, and can spawn as frequently as every four days. You do the math.

## What can Be Done?

One thing is clear to anyone swimming in these waters: Something needs to be done.

Here in the Gardens (at Avalon, the dive center), a specialist was brought in from Europe to demonstrate how to cull the species. He bagged 20 on one dive. When he asked a local guide to try his hand, he brought in 57. The locals know how to do this.

The folks at Avalon are also experimenting with teaching sharks to eat them. They may be one of the few animals with tough enough mouths to handle the lionfish's venomous spines.

In Florida and the Bahamas, some

communities now hold "fishing derbies," one-day team competitions to collect as many lionfish as possible (with \$3,000 in prizes). Sponsored by REEF, a nonprofit organization committed to ocean protection, the derbies have a growing following.

Another potential solution is to promote the fish as food for another voracious predator: humans. Lionfish reportedly tastes good -- like hogfish.

But what is really needed to solve the lionfish problem is a Gulf-wide strategy, one that will engage the governments of Cuba, Mexico and the United States. EDF is working with colleagues to make that happen.



## Day 8: Old Man and the Acropora

With his gray beard, wizened face and intense gaze, David Vaughan, director of the Center for Coral Reef Research at Mote Laboratory, looks like Ernest Hemingway. "Or a homeless person, a pirate or Fidel," jokes Vaughan, a world

renowned coral expert and a very funny man.

After several days of searching for a healthy stand of elkhorn (*Acropora palmata*) and staghorn (*Acropora*

### Mote Lab's David Vaughan

"This is what the Keys were like when I was a kid in the '60s. It's like a flashback to 13 years old. This is the way it's supposed to be." Photo by: Ian Shive, courtesy of The Nature Conservancy.

*cervicornis*) coral, Pablo, our dive guide, finds the site he was looking for. The irrepressible Vaughan is the first one in the water.

"That's what I'm talkin' about!" he

exclaims on first view of the healthy corals. The rest of us jump in after him. What we discover are several acres of fully intact – and alive – coral, with large schools of fish hovering among them.

"This is what the Keys were like when I was a kid in the '60s," Vaughan says later. "It was like a flashback to 13 years old. This is the way it's supposed to be."

Kim Richie, another Mote scientist, is equally jazzed, "I've never seen anything like this."

#### Reefer madness

For the scientists who have spent a good part of their lives studying coral – and watched its heartbreakingly global decline -- it's an emotional moment. "It's like seeing an old friend," says EDF's Rod Fujita, who did postdoctoral research in the Keys in the 1980s.

For a neophyte like me, the elkhorn coral, whose golden branches really do resemble antlers on an elk, are stunning. I imagine it's how John Muir felt when he entered virgin forests of sequoias and redwoods. Some of the coral stands we see are thousands of years old.

Elkhorn and staghorn are important reef-building corals that also provide critical shelter for lobsters, shrimp and reef fish. Yet they are dying off throughout the Caribbean (since 1980 the Florida Keys have lost 90-95% of their elkhorn).

#### Scientific exchanges

For more than a decade, EDF and TNC have been conducting scientific exchanges with Cubans. Working closely with Pedro Alcolado, the guru of Cuban coral science, we helped convene a series of tri-national coral workshops between Cuba, Mexico and the U.S. starting in 2007. Our goal: to learn why and how coral thrives or dies, and find ways to maintain or recreate healthy coral reefs.

Total coral cover in the Gardens is probably less than half what it was in the first half of the 20th century, but still better than most other places in the region. "It's holding its own here," says TNC's Phil Kramer, who conducted a coral survey with Cuban scientists in 2001. "It's reproducing, apparently both by larval settlement and re-sheeting."

One question is on everyone's mind: Why is one field of coral so robust,

while others 100 yards east or west are damaged? There's speculation it could be due to additional nutrients in the mid-channel or because the coral is being shielded from ultraviolet rays by turbid water.

Whatever the cause, there are lessons in this stand of healthy coral for the future.

Recent scientific papers suggest that reefs with more intact trophic structure and higher fish biomass overall – like what we see here – will be healthier in the future, and more resilient to climate change and ocean acidification.

"The news isn't all bad," says Mote Lab's David Vaughan. "We now have the technology where we can replicate reefs. It might take 100 years, but we can do reforestation underwater." His lab in Summerland Key, Florida, has 3000 to 5000 specimens that can be replanted.

"You can re-sheet the surface of damaged coral with live polyps," he says. "The Cubans could do it right here, using the live coral on the same reef next door."



#### Enchanted Forest

There are several tracts of vibrant, healthy elkhorn and staghorn coral in the Gardens, but they are threatened by warming seas and ocean acidification. Photo by: Ian Shive, courtesy of The Nature Conservancy.



#### Common Fairy Basslet (above)

The fairy basslet, a popular aquarium fish and part of the “tank gang” in *Finding Nemo*, can be found throughout the Caribbean. Our quest was to find its cousin, an elusive Cuban variant. Photo by: Paul Humann.

## Day 9: Finding Nemo, the Sequel

Some divers search for sunken Spanish treasure. Ken Marks, a fish identification specialist, is obsessed with the Cuban fairy basslet (*Gramma dejongi*).

Cuban divers first discovered this new tiny species off the coast of Trinidad, the historic city 75 miles northwest of the Gardens. It's closely related to the common fairy basslet (*Gramma loreto*), an adorable yellow-and-purple fish made popular by the character Gurggle, from the movie *Finding Nemo*.

In 2009, several *Gramma dejongi* were caught off Trinidad, and sent to a fish collector in The Netherlands with a batch of *Gramma loreto*, a popular aquarium fish. Because they lacked the distinctive purple color, he contacted scientists. DNA tests revealed that it was a new species, probably endemic to Cuba. But no scientist has ever observed the Cuban native in the wild.

Marks has spent the last nine days trying to become the first. The 1 ½ inch-long yellow fish lives in 65 to 100 feet of water along reef cliffs similar to where we're diving today.

Many of the fishes I see here look familiar. It's a shock to realize that the prettily colored species floating in your dentist's aquarium are actually wild creatures.

In fact, the ornamental fish trade is a serious problem. Up to 30 million tropical fish and 1.5 million live corals are taken from their natural environment each year.

The majority are destined for the United States, but an estimated four out of five die before they complete the trip.

What's even more troubling, there are not adequate laws governing the trade.



#### Taking a Breather

Fish identification expert Ken Marks in a rare moment above the water. Photo by: Kim Ritchie.



## Day 10: Group(er) Sex

Many large groupers – black, Nassau, yellowmouth, yellowfin and tiger, among others – have been fished out, or nearly so, in much of the Caribbean. In the Gardens, however, they are abundant, including the granddaddy of them all, the goliath grouper.

Goliath groupers live large. Not only are they physically imposing, they have personalities to match. The big lugs are insatiably curious, adorable and incurably romantic.

Today, one goliath followed Kim Richie, a coral microbiologist from the Mote Marine Laboratory, for the entire morning dive.

During the spawning season, July to September, 20-80 of these gentle giants will gather at the same reef, often

traveling more than 100 miles to get there. Scientists say the spawning is linked to the lunar cycle.

During the courtship, the males swim in a way that can only be called swaggering. They also change color, becoming darker (and presumably more mysterious). Males jockey for position among the females, 100 to 150 feet undersea, and let out low guttural sounds. These macho goings on, which have been recorded on audio, reach their peak late in the evening.

### Moonstruck

At a precise moment, usually after midnight when the moon is full, the female surges up toward the surface, followed by one or more males. As the female releases her eggs, the males are by her side, ready to fertilize the eggs.

### You Sexy Thing!

When goliath groupers aggregate to spawn, males are said to emit deep booming sounds of roughly 160 decibels – the same volume generated by a jet engine. Photo by: Fausto De Nevi Herrera.

The eggs develop into kite-shaped larvae as they drift in the water column for up to several months before settling into the seabed.

This love fest happens just once a year, so everything has to be just right. Indeed, scientists believe the egg release occurs at night, not because groupers are so romantic, but because darkness limits the number of eggs other fish can find and eat.

As for the goliaths we see in the Gardens, no one knows exactly where they aggregate to spawn. It's almost certainly outside the park. Cuban scientist Fabián Pina, a leading expert, hopes to find out where. The site, should he succeed in finding it, may lead to the creation of a new marine protected area.

EDF nominated Pina for a three-year Pew Fellowship in Marine Conservation to expand his study of goliath grouper populations in Cuba. In February, he was selected to receive the prestigious grant. It marks the first time a Cuban researcher has received the \$150,000 scholarship, akin, in the marine science world, to winning a MacArthur “genius grant.”

#### The perils of love

The groupers’ curiosity, sedentary

nature and spawning behavior make them easy targets for fishermen. Once favored as a trophy fish, goliaths were fished to near extinction in Florida, before they were protected in 1990. They have since recovered somewhat but are still endangered throughout the Caribbean due to their low birth rates, slowness to reach maturity and the loss of mangrove habitat.

Some fishermen in Florida want to resume fishing, blaming grouper

feeding habits for reducing other fish populations. The science, however, doesn’t support their claims. Recent studies show that goliaths mostly eat crabs and other crustaceans.

After diving among these huge, gentle creatures, it would be heartbreakng for them to disappear forever from these waters. But without continued protection, they will.



#### Ocean Steward

Just another day at the office for Cuban marine scientist Fabián Pina Amargós, who has dedicated his life to protecting Cuba’s marine resources for current and future generations. Photo by: Noel Lopez Fernandez.

With continued support, EDF will be able to further this important conservation work that is positively impacting not only the marine environment but also the coastal communities that depend on it to survive. EDF would once again like to thank the Waitt Foundation for making this research expedition possible.

If you’d like to learn more about EDF’s work in Cuba and how to support it, please visit our website: [www.EDF.org/oceans/cuba](http://www.EDF.org/oceans/cuba)

