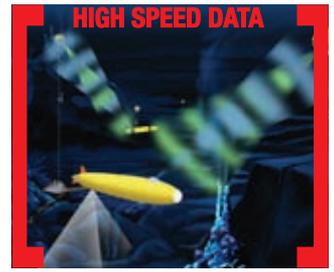


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PRESERVING the CRYSTAL CAVES

The Bahamian Island of Abaco is home to an extraordinary cave system that's a wellspring of scientific revelations but the mighty dollar is a formidable force. Will this irreplaceable resource be of ongoing benefit or will it be bulldozed for bucks?

Text and Photography by Jill Heinerth

With impressive stealth the giant carnivore advances under cover of poisonwood and palmetto scrub. For a heart beat it pauses, then leaps into the clearing and bounds across the open pine forest. Curly tail lizards scramble for cover as it accelerates over the open ground. Covering more than 15 feet (5m) a second the fearsome crocodile is now almost upon its prey, a land tortoise sunning on the edge of a limestone pit. As it snares the creature in its powerful jaws, the big croc teeters, its momentum carrying them both over the unseen precipice.

In freefall, the disoriented animals separate as they plummet past a cliff-side bird roost. They land hard on the rocky talus cone, rolling and crashing across the chasm floor. In time it will become their tomb. Its shell pierced by the croc's dagger-like incisors, the wounded tortoise manages to escape as the croc slinks into the darkness of the cave where it will fail to find an escape route.

Millennia ago these animals had fallen into the depths of Sawmill Sink on the Bahamian island of Abaco. Today, it's a blue hole, a remarkable window into the past filled with cerulean water that's become a hotspot for paleontologists and cave divers.

On Assignment

Working on a National Geographic expedition, I had the opportunity to help document the recovery of the ancient bones of these animals. We had plunged through clear water to an eerie transition of hydrogen sulfide where wispy clouds of pink and white swallowed up my diving partner Brian Kakuk, and assaulted us with its odor of rotten eggs. We descended to a bottom that seemed to undulate as we passed. Cinematographer Wes Skiles followed closely hoping to get one sequence before the visibility was shot for days. The croc's remains were together in the silty nest of a tiny alcove. I got only my hand into the niche to light the area for Brian who carefully extracted the beast from its muddy grave. I missed this action as a mushroom cloud of silt obliterated my view. We were all on a guideline but Wes, who'd pressed himself sideways into a tiny slot trying to get a view of the bones. We had to grope around for him in the explosion of silt and then pull him back to the opening of the nook and continue our blind retreat along the guideline and to clear water.

At the time of the crocodile's demise, it was dogs, wolves, fox, moose and antelope that roamed across continental North America. In contrast, the Bahama Islands were home to a fundamentally different ecosystem. Before people set foot on Abaco's shores, crocodiles were calling the shots. Evolution, on this isolated island, took a completely different path, and the evidence lies preserved in the oxygen-depleted waters of Bahamian blue holes. According to University of Florida



■ Although much of Dan's Cave is intimate side mount passage, other regions are large spaces such as this room.

biologist, Dr. David Steadman, these blue holes, “Give us a fascinating look at history and just how vulnerable an ecosystem can be... we have very real evidence of the impact of mankind on an ecosystem.”

The fossil remains within these sinks tell a story of a predacious land, until the greatest hunter of all consumed them out of existence. Although humanity still poses an enormous threat to Bahamian ecology, it is from a very different type of consumption. Steadman says, “If we don’t protect places like this, then the bulldozers will arrive without warning. The damage they will do in a day cannot be reversed in a millennia.”

Measuring Value

At Wilkinson Quarry in Bermuda, we have already seen the results played out when greed eclipses a desire to protect natural resources. In 2002, blasting revealed a large cave at a privately owned quarry in Castle Harbour. Limited scientific exploration yielded six species of aquatic, cave-adapted stygobitic crustaceans – all listed as critically endangered – and two completely new species of copepod. Within the Pleistocene/Pliocene strata, are remarkable formations rivaling the most elaborately decorated underground galleries on the island, yet the cave remains locked in a fierce difference of opinion, between its protectors and the land owners who feel the cave has no intrinsic value beyond mining the rock into road aggregate.

In Abaco, organizations such as Friends of the Environment, the Bahamas National Trust, Bahama Caves Research Foundation and the National Museum of the Bahamas Antiquities, Monuments and Museums Corporation, have joined forces, cooperating to ensure the protection of their national treasures – the blue holes. The proposed South Abaco Blue Holes Conservation Area would protect over 10 miles (16km) of the world’s most visually stunning, unique underwater cave passages, as well as the landscape surrounding these remarkable underground chambers.

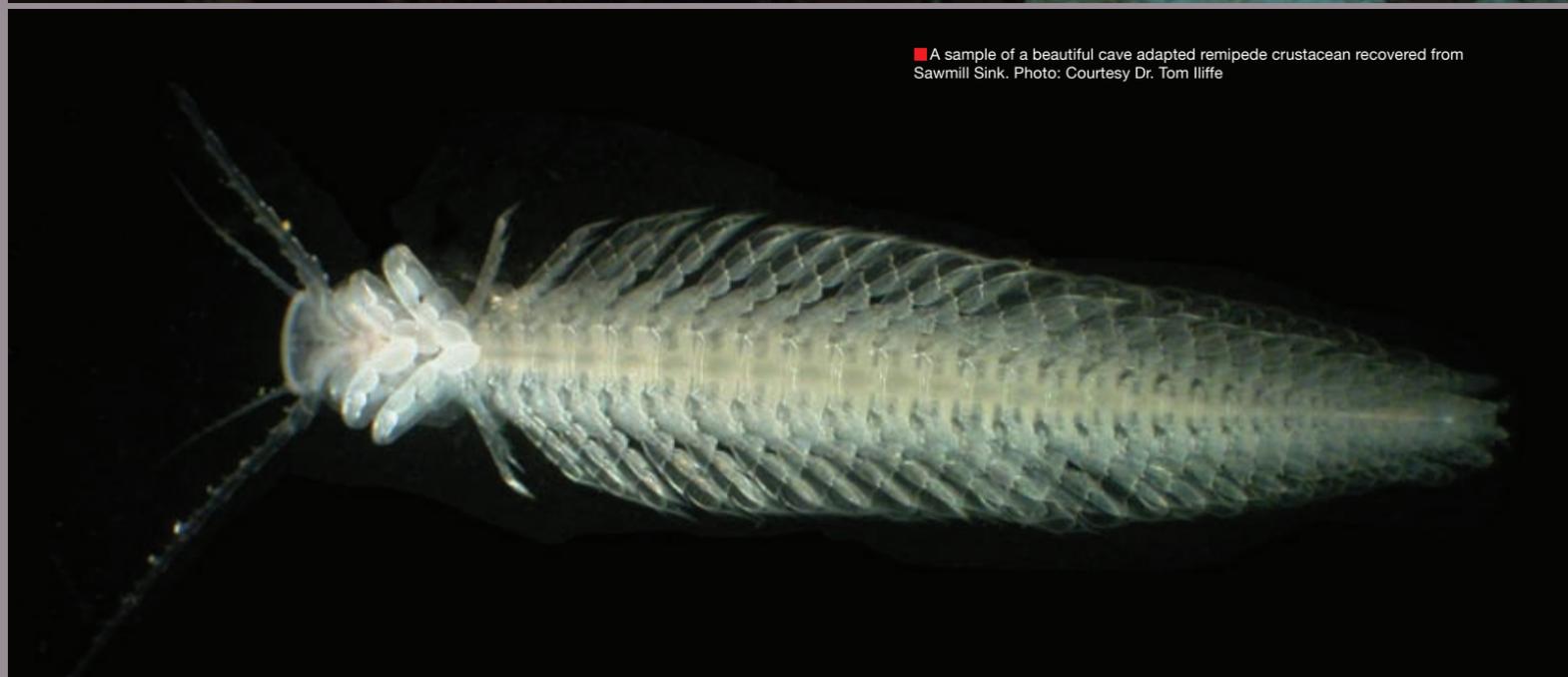
According to Brian Kakuk, of the Bahama Caves Research Foundation, “There are many large scale developments which are currently being bulldozed into place on the eastern side of Abaco’s highway, directly adjacent to the proposed protected area. If these developments expand to the West, with their utility facilities, fuel depots, generator buildings and repair shops, the ground and the water below it will be destroyed by the trash and chemicals that always accompany such human influence.” Ironically, a mere two years ago, the region was slated for quarry development. Fortunately, that particular project was not viable, but other industries and developers have their sights set on this area of pineland, irreplaceable hardwood coppice and scrub.

Cobalt Cave Portals

Blue holes are the doorways to underwater cave systems. They get their name from the cobalt blue water of their depths and the ring of shallow, lighter blue water around them. Like a well of time, the blue holes are virtual time capsules. Within the oxygen-depleted zone, the bones of the crocodile and tortoise are perfectly preserved at Sawmill Sink. These zones have also preserved the oldest dated human remains in the Bahamas, showing that these sites were used by humans long before Columbus ever “discovered” the new world. Evidence of the



■ Speleothems in Dan’s Cave were formed during several different dry epochs in the Bahamas, making the cave itself a virtual time capsule of earth’s history.



■ A sample of a beautiful cave adapted remipede crustacean recovered from Sawmill Sink. Photo: Courtesy Dr. Tom Iliffe



■ Illustration: Courtesy Jill Heinerth.

island's ancient vegetation also sits protected within the peat-layered entrances of blue holes.

These portals were formed during previous ice ages. During drier times, much of the earth's water was locked up in glacial ice. The sea stand was hundreds of feet lower, exposing towering cliffs on the edge of a large Bahamas Bank. When rain eventually fell on the expansive plateau, acidic water soaked into the ground and slowly eroded passages within the rock. At the interface between fresh and salt water, the dissolution was aggressive, forming long horizontal warrens through the substrate. During arid times, when more ice was formed, the caves were drained again. Over eons, water dripping through cracks in the ceiling created colossal forests of formations, which now decorate the caves. These stalagmites and stalactites were tinted with sediments that they piggybacked through the sponge-like earth. Repeatedly, the sea reclaimed the caves as warmer, wetter weather slowly graced the earth.

Today, at inland blue holes, a lens of lighter fresh water floats on top of a layer of almost anoxic salt water. The fresh water is critical for nourishing the inhabitants of the Bahamas, while the oxygen depleted layer below preserves almost everything that falls in.

Alive, Not Fossils!

Cave diving biologist, Dr. Tom Iliffe, of Texas A&M University, has been studying the caves of Abaco and the Bahamas for most of his career. He believes that this region is the virtual Garden of Eden for cave animals. "The caves of the Bahamas are the center of biodiversity and very possibly the center of origin for marine cave animals worldwide," he said. Distribution of cave-adapted crustaceans suggest that they had their origin, perhaps as many as several hundred millions of years ago, when the continents on Earth were a single landmass. As the supercontinent fractured and the present day landmasses began to drift, cave animals moved along with them. Amazingly, these animals, which swam through caves at the time of the dinosaurs, are still found, thriving in Abaco's caves.

Brian Kakuk works closely with Dr. Iliffe, ushering him back to the far corners of Dan's Cave to capture live species that have only been noted in ancient fossil records. Meandering through hallways of crystalline columns painted red with dust from the far Sahara, Iliffe and Kakuk use closed circuit rebreathers to give them the time they need to capture their prey. They drop through the basement of the cave at 150 feet (46m), swimming over cracked mud floors and chalky white boulders. Ascending again, they pierce a shimmering halocline to reach chandelier-encrusted rooms at 70 feet (21m). It is here their animals live, in a narrow band of chemical activity. As Dr. Iliffe darts from one side of the room to the other, Brian's light beam focuses on a small white speck that's propelling itself through the water with dozens of rows of filamentous arms. On closer examination, the head of this tiny, caterpillar-like creature is sporting large fangs. If this remipede was the size of a cat, it could drop Kakuk with its venomous pincers and declare itself as one of the deadliest creatures on the planet. Instead Iliffe steers the white, eyeless dancer into a small vial and tucks it carefully in his chest-mounted pouch. His day has just begun. He hopes to fill several more vials before withdrawing back through to the entrance of Dan's Cave.



■ Brian Kakuk views Sahara-red dust-tinted formations in Dan's cave, seen foreground at top.



■ National Geographic Director James Barrat, Cameraman Gordy Waterman and Audio Recordist Dave Strayer speak with Brian Kakuk for the PBS NOVA program Extreme Cave Diving.



■ Dr. Kenny Broad carefully prepares his Megalodon rebreather prior to a deep dive to recover speleothems for scientists at the University of Miami.

Chambers of Time

They swim among vast galleries of toppled pillars, covered with columns, decorated with multi-stripped calcite strips, resembling bacon, and wind-forged helictite flowers. Radical pools of purple tinted dogtooth spar covered with cauliflower heads are piled on sheets of lacy calcite. These vaulted chambers speak of time. Through fluctuating sea levels, Mother Nature has stacked breathtaking decorations on top of treasure troves on top of Tiffany glass and rare caches of jewels.

Searching for answers regarding the mysterious history of Abaco's caves, Kakuk teamed up with geologist Dr. Peter Swart from the University of Miami. Swart uses electron microscopy to determine the age of stalagmites in caves. Like counting the growth rings of a tree, Swart can determine climate history by looking at the variety of layers within the rock. His research has revealed that the formations in Dan's Cave may be as old as 350,000 years. He has discovered significant evidence that global climate and sea level change has been rapid and catastrophic. By looking at thin red layers within the rock, he can pinpoint times when the Bahamas were covered in dust carried across oceans, from the Sahara Desert. In mere decades, these windy times ended, and sea levels rose. Now, Dr. Swart's work is scrutinized by worldwide climatologists, who fear that we may be experiencing a similar period in time.

World Time Forgotten

The ongoing exploration of blue holes offers an even deeper look into Earth's past and perhaps a glimpse at life in other parts of the universe. Penn State University astrobiologist, Jenn Macalady, believes that blue holes represent a precious natural laboratory for understanding both the modern biogeochemistry of the Bahamas, and bio-geochemical cycling of early earth. "The Bahamas blue holes are important examples of ecosystems that have an ancient biogeochemistry," she said, "meaning that nutrients are cycling in a way much more similar to ancient oceans than modern oceans." Macalady adds that, "Some of the blue holes like Sawmill Sink have microbiology and chemistry very much like that of the oxygen minimum zones developing in the modern ocean as a result of increased nutrient pollution and global warming." She says Sawmill Sink may represent the future of large regions of the modern ocean if global climate change goes unchecked.

What this translates to in the field is endless sampling of the water column and collection of large algal mats that coat the walls and floors in the sinks. Macalady cultivates "goo" and cultures it in the lab. From those materials, she has identified several new species of photosynthetic microbes of the type that dominated the earth up to 2.5 billion years ago. Additionally, she has accessed hundreds of unique DNA sequences that represent species, previously unknown to science. Just a few samples, collected from Sawmill Sink, may generate decades of chemical and biological discovery. Combining her work with that of others, Macalady gives us a view of a world time forgot; an aperture into the past, offering up forgotten species waiting to be discovered and a record of ancient climate that may predict earth's future.



■ Brian Kakuk eases up for his last decompression stops in the entrance to Dan's Cave, Abaco.



■ Brian Kakuk carefully lifts a Lucayan skull from the mung at 240 feet (73m) in Stargate Cave, Andros. This skull was brought topside for a paleontologist representing the Bahamas National Museum.



■ The vermillion red Sahara dust lays in thick layers and inside of calcite formations within the caves of Abaco.



■ A diver approaches the camera in the 'Badlands' of Dan's Cave.

Swimming through the museum-like beauty of Abaco's caves, it can be hard to grasp their scientific significance. Drifting over garrulous bands of fine orange silt, it's difficult to imagine the rapid change and mass extinctions that would have occurred here. Pan global dust storms lasting perhaps 200 years, tell of a super drought, which drained this cave and sent remipedes back further into the matrix of rock. Toppled columns and delicate crystals attempt to mask the evidence that the resilient earth recovers and recycles, and ecosystems periodically begin anew.

Project Coordinator for the Bahamas Caves Research Foundation, Nancy Albury, perhaps, says it best. "Blue holes are windows into our past, but they are also windows into our daily activities. Many blue holes are seriously and permanently fouled with human generated debris." Unfortunately, it is really difficult to get people excited about something they cannot see. The challenge lies in helping the Bahamian government and citizens understand the global significance of such a place and find sustainable activities that will support tourism and science into the future. "If we are successful in protecting this region, it will suggest that government and local people value their environment and their history. It's a step towards preserving more than the almighty dollar, and one that creates a pristine place for future generations to behold."

Just as we are beginning to appreciate the history of Bahamian blue holes, a bulldozer clumsily carves another slice out of the limestone on the east side of the highway. As the clock ticks for blue holes, one wonders whether these precious, timeless vessels will survive man's need to expand his dominion over this fragile land. 🍀

For more information about the South Abaco Blue Holes Conservation Area:
www.bahamascaves.com/blueholesconservation/sabhca.html

■ Dr. Kenny Broad and Brian Kakuk chop their way through the dense bush to reach the remote Owl Hole.



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