A Proposal for the Expansion of Lucayan National Park

Grand Bahama Island, The Bahamas

Organization of American States

GLOBAL PARKS

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- Daniel Murray, Overseas Marine Group, Boat Operator
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Executive Summary

Lucayan National Park encompasses 40 acres (16.2 ha) that include the entrances to one of the longest known underwater karst cave systems in the world. Mapping of the six mile (9.6 km) long Lucayan cave system indicates that most of the known cave network lies outside the current Park boundary. In addition, the recently discovered Pirates Mew cave system lies further to the west of the mapped Lucayan caves and is also outside the Park's protection area. The Park encompasses a short section of Gold Rock Creek, a tidal creek that passes through mangrove wetlands. This waterway connects to the underwater cave system and provides plankton filled seawater that is needed to support the variety of species found in the cave environment. However, most of this 4 mile (6.4 km) waterway is outside of Park protection.

Found within the current Park boundary are examples of all the vegetation ecosystems in The Bahamas. Lucayan National Park was designated an Important Bird Area because it supports 3 restricted range birds. The Park is the most heavily visited property managed by the Bahamas National Trust. In order to meet its obligations under the Convention on Biological Diversity, the Government of The Bahamas, through its Master Plan for the Bahamas National System of Protected Areas, has identified targets for expanding protected areas for terrestrial and marine ecosystems.

This proposal provides two options for contributing to the protected area targets through the expansion of the Lucayan National Park. Specifically, Option 1 would increase the Park's area from 40 acres (16.2 ha) to approximately 2,700 acres (1,092 ha). Of this, approximately 950 acres (385 ha) would be terrestrial and 1,750 acres (708 ha) would be in marine ecosystems. A significant amount of additional pinelands would be added as well as karst caves, mangrove wetlands, dune area, tidal creeks and various marine components including approximately 2.8 miles (4.5 kms) of fringing reef. The Option 2 proposal would encompass all of the Option 1 components and further expand the Park's area south of the Queen's Highway to a total of approximately 3,550 acres (1,437 ha). Of this, approximately 1,150 acres (465 ha) would be terrestrial and 2,400 acres (971 ha) would be in marine ecosystems. The entire 4 mile (6.4 km) reach of Gold Rock Creek would come under Park protection status. Approximately 1 mile (1.6 km) of shoreline of the South Shore IBA and 4 miles (6.4 km) of fringing reef would be protected along with additional mangrove wetlands, dune, and coppice vegetation. The Proposal points out additional opportunities for adding protective status to an area along the coast from the Grand Lucayan Waterway and Barbary Beach along an unbroken stretch of beach to Burnside Cove. Significant natural and cultural values are found here including The Heritage Trail, the site of Old Freetown, additional area of the South Shore IBA, a potential linkage with the Peterson

Cay National Park expansion, and the Owl Hole/Mermaid's Lair blue hole and karst cave system.

1.0 Introduction

Clearly visible from space, the aqua-marine waters of The Bahamas' near shore banks, encompassed by some of the world's most extensive coral reefs, are an unsurpassed marine treasure of local, regional and international importance (Figure 1). As the largest small island archipelago in the tropical Atlantic with over 700 islands, and 2,200 miles (3,542 kilometers) of coastline, The Bahamas cover an expansive land and marine area of approximately 89,960 mi² (233,000 km²) within the 12 nautical mile territorial sea. Of this area, only 5, 380 mi² (13,940 km²), or about 5%, is land and 28,790 mi² (116,500 km²), or 50%, is relatively shallow bank. The remainder of about 39,600 mi² (102,560 km²), or 44%, is deep water either in the three major marine canyons that separate the banks or in the outside depths adjacent to the islands' flanking reef systems. These islands and adjacent marine waters encompass a unique confluence of landform types, including both saline and freshwater wetlands, mangroves, blue holes, creek systems, shallow water banks, deep ocean trenches and marine estuaries that host a range of terrestrial and marine resources important to the country, the Caribbean region and beyond. For example, it is thought that the west coast of Andros may serve as the greatest marine estuary for the entire Western Atlantic. On a global scale, the coral reefs of the Bahamas comprise about 5% of the world's total coral reef systems, surpassing even that of Australia's Great Barrier Reef.

Figure 1: The Bahamas Archipelago as seen from the International Space Station. The 50 mile (80 km) wide Strait of Florida separates Grand Bahama Island from Florida.

The relative insularity of Bahamian waters and an extensive shelf with productive coral reefs and other habitats, augmented by a large area of coastal wetlands and mangrove forests, contribute to the considerable abundance and diversity of fish. In this regard, The Bahamas has greater biodiversity abundance and diversity than the entire insular Caribbean (UNEP-GEF, 2010).

The islands themselves are generally of low relief, with a maximum elevation above sea level of 206 feet (63 metres). They are composed primarily of limestone derived from the deposition of calcareous sand and marine shells since the Jurassic period (208 - 144 million years ago) and are over 5 kilometers thick (Moses, 2008). During the Pleistocene (1.2 million - 10,000 years ago) the sea level fluctuated considerably, from being as much as 390-460 feet (120-140 metres) lower than today, to being 82 feet (25 metres) higher than today following the last ice age, as evidenced by wave-cut notches found in limestone cliffs in several locations in the islands, including in Lucayan National Park.

While the Bahama Banks were dry land, they were exposed to the atmosphere where the limestones were subjected to chemical weathering that created the karst topography that the islands are famous for today (Wikipedia, 2013). The now largely submerged limestone banks that comprise the archipelago of the Bahamas are riddled with karst features such as sinks, blue holes, fracture caves and solution caves known as among the most extensive in the world, and hold hydrological, archaeological, paleontological and biological treasures found nowhere else on earth.

2.0 Purpose of this Report

In recognition of this abundant biodiversity and the international significance of both terrestrial and marine environments, the Government of the Bahamas is committed to the establishment and effective management of a comprehensive and ecologically representative system of terrestrial and marine protected areas. The Master Plan released by the Bahamas National Trust in 2012 guides the expansion of the National System of Protected Areas to meet its international obligations under the Convention on Biological Diversity (CBD) and the subsequent Programme of Work on Protected Areas (PoWPA) for the Bahamas (Moultrie, 2012).

The Bahamas has shown leadership in the implementation of the PoWPA, both globally and in the Caribbean region, through the Bahamas 2020 Declaration and the promotion of the Caribbean Challenge, launched in 2008. In so doing, the Bahamas has confirmed its intent to meet and even exceed the CBD goals by setting aside at least 20% of its coastal marine waters as marine protected areas (MPAs) and 10% of its terrestrial area in national parks by 2020.

As the statutory body established by the Government of The Bahamas to establish and manage its system of national parks, the Bahamas National Trust (BNT) has entered into an agreement with Global Parks, supported by funding from the Organization of American States (OAS), to undertake the development of specific proposals for national park expansion and establishment on and adjacent to Grand Bahama Island. This project is comprised of two distinct components:

- Develop proposals for the expansion of two existing national parks, Lucayan National Park and Peterson Cay National Park; and
- Develop a proposal for establishing a new terrestrial and marine national park on the north shore of Grand Bahama Island.

The Government of The Bahamas has also committed to other components of the Caribbean Challenge, including the development and implementation of ecosystem-based projects aimed at adapting to climate change and the development of sustainable finance mechanisms to fund protected areas. While not implicitly integral to this project, these factors will also be given consideration in the development of recommendations for park expansion and establishment.

3.0 The Status of Terrestrial and Marine Protected Areas in The Bahamas

The Bahamas National System of Protected Areas is currently comprised of 27 national parks, four Marine Reserves managed by the Department of Marine Resources and a number of Bird Reserves managed by the Ministry of the Environment, all of which contribute to the 20% goal (for a complete listing of these areas see Moultrie, 2012).

According to the Protected Planet Report (PPR) 2012, the most up to date assessment of the global coverage of all types of protected areas, it is apparent that The Bahamas has made considerable progress in protected area establishment during the PPR's review period 2002-2010 (Bertzky et al, 2012). Prior to 2002, The Bahamas recorded a total of 7.36% protected in its terrestrial environments, but only 0.22% protected in the adjacent marine waters. In 2002, an unprecedented event took place when the Government of The Bahamas created 10 new national parks, effectively doubling the area within the national park system (primarily with the creation of The West Side of Andros National Park). Further expansions in 2011 of West Side Andros National Park and of Conception Island National Park, and the establishment of the new Fowl Cays Land and Sea Park in Abaco, marked significant progress in terrestrial protection where the amount of terrestrial protected area jumped to 13.66% (709 mi^2 or 1,836.85 km^2). In continued contrast, however, the amount of marine environment protected increased only modestly to 0.41% (443 mi^2 or 1,149.45 km^2). The combined total in 2010 for both terrestrial and marine environments amounted to 1,153 mi^2 (2, 986.3 km^2) or 1.01% of Bahamian territory out to the 12 nautical mile limit (Bertzky et al, 2012).

In comparison to the rest of the Caribbean, The Bahamas has performed well terrestrially, exceeding the rate of growth in the Caribbean where the total terrestrial area protected across the region grew to 11.2% in 2010 (from 9.9% in 2000). In the marine environment, however, The Bahamas lies considerably behind the Caribbean region where the level of protection is 2.2%, more than five times the level of protection in Bahamian waters. When comparing total levels of protection, combining marine and terrestrial, the total for the Caribbean region is 4.6%,

whereas The Bahamas is a quarter of that at 1.01% (Bertszy et al, 2012). For further comparison, a total of 7.2% of the coastal marine waters of the world have been protected (UN, 2012).

This data clearly indicates that to meet the goals of the CBD, the Caribbean Challenge and the 2020 Declaration, The Bahamas will need to focus primarily on increasing the level of protection in the marine environment. According to the UNEP-GEF project to assist The Bahamas in achieving the Caribbean Challenge goals, an *interim* national target of a network of MPAs comprising 10% of representative marine ecosystems is about 8,500 - 9,600 mi² (22,000 - 25,000 km²), with the 20% target comprising about 17,000 - 19,200 mi² (44,000 - 49,700 km²) (UNEP-GEF, 2010).

This project described in this report provides recommendations as to how this target can be approached on a regional basis on the Little Bahama Bank and Grand Bahama Island.

4.0 Little Bahama Bank and Grand Bahama Island

The Little Bahama Bank is the northern most of three extensive shallow sand banks that make up the Bahamian Archipelago (Figure 2). These banks are separated from each other by deep, steeply-sloped ocean trenches, known to be among the deepest submarine canyons in the world. The Little Bahama Bank encompasses Grand Bahama Island and Abaco Island in an area of approximately 6,560 mi² (17,000 km²) of which about 65% or 4,250 mi² (11,000 km²) is covered by water (Fearnbach et al 2011). Most of the marine bank lies north of Grand Bahama Island in a well-defined basin that is physically isolated from similar coastal habitats by the deep oceanic waters of North West Providence Channel to the south, the Florida Gap to the west and the Atlantic Ocean to the east. The Bank is bounded to the north and east by a chain of cays extending west from Abaco Island as far west as Walker Cay National Park and another series of cays and submerged sand bars to the south. The Bank also includes a narrow fringe about 1.5 miles (2.4 kms) wide along the south shore of Grand Bahama Island which descends steeply into the depths (>500 meters) of North West Providence Channel. As shown on the map in Appendix A, Little Bahama Bank is virtually

Figure 2: A satellite image of Little Bahama Bank with Grand Bamaha Island and Abaco Island.

surrounded by either fringing, patch or barrier reefs. This project is concerned with only the Grand Bahama "portion" of Little Bahama Bank, or approximately half of the marine area of the bank or about 3,280 mi² (5,500 km²).

The waters of the Little Bahama Bank are very shallow, averaging less than 23 feet (7 meters) in depth. Oceanographically, water movement is generally to the north, being influenced by the flow of the Florida Current and the Gulf Stream. Seasonal variability in surface water temperature on Little Bahama Bank is limited, but temperatures are moderately elevated in summer, peaking at 88°F (31°C), compared to winter when temperatures moderate to about 72-75°F (22-24°C) (Fearnbach et al 2011). These waters are well recognized for their rich biodiversity including a wide variety of fishes, most notably several species of sharks, bonefish, grouper and snapper, conch, spiny lobster and a resident population of approximately 1,000 bottle nosed dolphins that have not been observed in the surrounding pelagic waters, appearing to be restricted to this shallow bank ecosystem (Fearnbach et al 2011).

The Bank is also well recognized for its sea bird populations. The chain of cays extending west from Abaco Island forming the northern extent of the Bank is proposed as an Important Bird Area (IBA) for its breeding populations of Bridled Terns, Least Terns and Roseate Terns (Birdlife International, 2013). In addition, Sale Cay and Little Sale Cay in the north-central Bank area is recognized as a high priority for conservation and protection in the BNT's Master Plan for the National Protected Areas System, most likely for its high value for breeding seabirds (Moultrie, 2012). The Bank is also an important staging area for migrating populations of a variety of seabirds, including species of herons, egrets, ibis' and spoonbills.

In contrast to the broad shallow banks to the north of Grand Bahama Island, the south shore of the island is characterized by its relatively narrow coastal shelf with its fringing reef and a steep drop-off into the considerable depths of the North West Providence Channel. This channel is an extension of the Great Bahama Canyon which also includes the Tongue of the Ocean located between Andros and New Providence islands. North West Providence Channel reaches depths approaching 6,500 feet (2000 meters) and is considered important habitat for a number of cetacean species including bottle nosed dolphins, beaked whales and other deep-diving cetaceans, especially sperm whales. Considering that deep waters constitute 44% of the marine area within the 12 nautical mile territorial sea in the Little Bahama Bank area, the BNT or the Department of Marine Resources may wish to consider the establishment of marine protected areas in these deep water environments as well as in the shallow coastal waters. Accordingly, the expansion proposals for both LNP and PCNP suggest extensions into the channel to the 200 fathom (600 meters) depth contour, which is apparently becoming or is the standard for the seaward boundary for The Bahamas' land and sea parks (Lindy Knowles, pers. com, 2013).

5.0 Terrestrial and Marine Protection Targets

The Master Plan for the Bahamas National System of Protected Areas is based on the identification of a number of terrestrial and marine targets, an Ecological Gap Analysis and a MARXAN analysis leading to the identification of high priority sites for conservation and protection to meet those targets (Moultrie, 2012). This project has endeavored to design the protected area expansion and establishment proposals to contribute to those targets as much as possible. Rather than repeat the targets here, they are easily referenced in the Master Plan document (Moultrie, 2012). The detailed table in Section 7.0 below describes the natural values that are the genesis for the expansion proposals for Lucayan National Park and link then directly to the targets they address.

Also worthy of note in this regard is the identification, both through the Master Plan process (Moultrie, 2012) and at least one other ecoregional conservation planning process (Sealey et al, 2002), of specific areas throughout the Bahamian archipelago that warrant protection, three of which relate to the Little Bahama Bank-Grand Bahama Island region. To the authors' knowledge, these areas have not been specifically mapped and may or may not have been captured in the proposals herein:

- Grand Bahama (eastern cays and offshore marine area extending towards Abaco) (Moultrie, 2012, page 38);
- Marine Area surrounding Great Sale Cay, Pigeon, Gully Cays, and Cross Cays to the South (cays off the western tip of Little Abaco) (Moultrie, 2012, pages 40 and 60); and
- Western Little Bahama Bank (Grand Bahama) (Sealey et al, 2002, page iv).

It is recommended that, at some point, the analyses that led to these protection recommendations be reviewed and considered in the final protected area designs emerging from this project or in future proposals that go forward to the Government for approval.

Also, in addition to Important Bird Areas (IBAs) being a specific target in the Master Plan, the BNT Strategic Plan makes specific reference to supporting "…the further protection of existing Important Bird Areas". There are three existing IBAs on Grand Bahama, all in the vicinity of Lucayan National Park and Peterson Cay National Park, only one of which still lies outside a protected area: BS003 Grand Bahama South Shore. The proposals for park expansion herein address the protection of these IBAs.

6.0 Expansion Proposals for Lucayan National Park

6.1 Park Description

Lucayan National Park (LNP), established in 1977, encompasses 40 acres (16.2 ha) that include the entrances (see cover photo) to one of the longest known underwater karst cave systems in the world. Mapping of the six mile (9.6 km) long Lucayan cave system indicates that most of the known cave network lies outside the current Park boundary (Figure 3 and Appendix B). In addition, the recently discovered Pirates Mew cave system lies further to the west of the mapped Lucayan caves and is also outside the Park's protection area. (Kakuk 2006, Zenato and Pers, Zenato 2013**).**

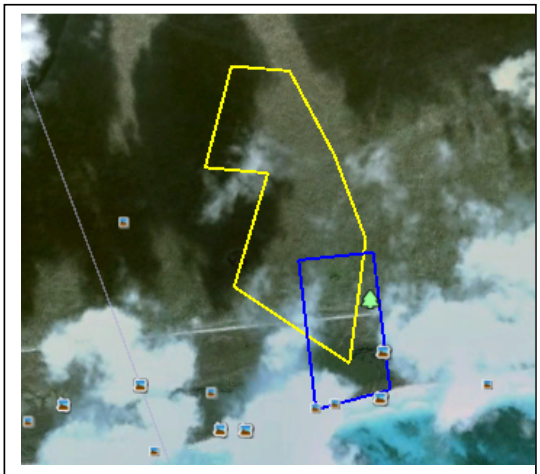

Figure 3: Current boundary of Lucayan National Park (blue) and approximate area of mapped cave system (Zenato and Pers) (yellow).

The Park encompasses a section of Gold Rock Creek, a tidal creek that passes through mangrove wetlands (Figure 4). This waterway connects to the underwater cave system and provides plankton filled seawater that is needed to support the variety of species found in the cave environment including lobsters, crabs, shrimp, sea stars, sea cucumbers, cowries, and species of fish and crustaceans that live both near cave entrances and deep in the cave's totally dark interior. Numerous species that have adapted to a cave environment of darkness (troglobites) are found in the underwater caves within and surrounding the Park. Caves often hold species found nowhere else in the world and species new to science. In fact, in the Lucayan caves, a class of crustacean *Remipedia*, previously thought to be extinct, was

Figure 4: Gold Rock Creek and mangroves in Lucayan National Park.

discovered. Brian Kakuk of the Bahamas Caves Research Foundation concluded that the biodiversity in the Lucayan caves is one of the top 5 in the Bahamas (Bahamas National Trust, 2009).

Pre-Columbian residents of The Bahamas, the Lucayans, used the caves as a source of fresh water and as ceremonial burial places. Due to the low oxygen level found in caves, archeological remains are well preserved and have been found in some cave sites (Kakuk 2006). The freshwater reservoirs found in the caves and blue holes are still highly important for island residents today.

The protection of Gold Rock Creek and its associated mangrove ecosystem is critical to maintaining its ecological health, for sustaining the biota dependent upon it, and for ensuring the health of the cave system that it serves. It also provides recreational opportunities for kayaking, bird watching, photography and scenic viewing (Figure 5). Currently only 1,000 feet (300 metres) of this nearly 4 mile (6.4 kms) creek and associated mangrove ecosystem fall within the Park boundary. The remaining stretches, including the mouth, are unprotected and subject to threats from pollution and other forms of disturbance.

Figure 5: Kayaking in Gold Rock Creek.

Found within the current Park boundary are examples of all the vegetation ecosystems in The Bahamas including pineland, freshwater wetland, transition zone (locally referred to as Rocky Coppice), mangrove, coastal dry broadleaf evergreen formation – shrubland (locally referred to as whiteland coppice), and dune (Freid). These ecosystems within the proposed Park boundaries are all currently underrepresented within the National Protected Area System and are targeted for expanding their area of protection (Moultrie 2012). The mangrove wetland surrounding Gold Rock Creek is the last intact mangrove wetland remaining on the south side of Grand Bahama Island.

More than 300 bird species have been found in the Bahamas. Lucayan National Park was designated by Birdlife International as an Important Bird Area (BS 001) because it supports 3 restricted range birds: Thick-billed Vireo *Vireo crassirostris*, Bahama Swallow *Tachycineta cyaneovifidis* and Olive-capped Warbler *Dendroica piyophila* all of which are found in pinelands and coppice vegetation in the northern section of the Park. Other water birds are found in the

mangrove wetlands and along the shore. IBAs are also target areas for increased protection (Moultrie 2012).

The Grand Bahama South Shore IBA (BS003) was designated because it is a wintering area for the Near Threatened Piping Plover *Charadrius melodus* and a variety of other shore birds. This IBA extends from the south entrance of the Grand Lucayan Waterway along the undeveloped sandy beach, beach flats, and dunes through the site of the former settlement of Old Freetown to the western boundary of Lucayan National Park. None of this IBA is in a protected status. (Moore and Gape).

Figure 6: Visitors on the boardwalk trail.

Lucayan National Park is the most heavily visited property managed by the Bahamas National Trust (BNT). In the five year period (2008 – 2012) an average of xx visitors per year were recorded by BNT. This number underrepresents the actual use since many visitors use the beach area and trails when Park wardens are not present to collect the fees and record the visitation. The beach is the most popular attraction but visitors also enjoy walking the interpretive trails (Figure 6) that wind through the mangroves and lead to view points of the cave entrances. As a significant island attraction the Park represents an important economic component to the area's tourist based economy. Tour companies and taxi services bring island visitors from Freeport resorts and cruise ships to the park (Figure 7). During trips to the Park visitors eat at area restaurants and purchase goods from local merchants and artisans.

Figure 7: Tour bus at Lucayan National Park.

Grand Bahama Nature Tours leases property adjacent to the Park on the east and below the Queen's Highway. This operation provides kayak and interpretive nature tours through the Gold Rock Creek waterway and facilitates activities on the beach. A trail connects this leased area with Lucayan National Park although the tour company

uses their own creek crossing facility rather than the Park's bridge. An opportunity exists for a strong partnership that can benefit both the Park and tour company.

6.2 Potential Threats

- Two invasive species are of particular concern in the Park. Paperbark Tree *(Melaleuca quidqernervia)* is spreading in the freshwater wetlands and Australian Pine *(Causarina equisetifolia)* has spread along the entire length of the dune area. (Freid).
- Raccoons are an exotic species that are numerous in the Park. They cause harm to ground nesting birds and scavenge for food in trash bins.
- Since the mouth and most of the length of Gold Rock Creek are not under any kind of protected status, there exists the potential for pollutants and siltation to enter this waterway and cause serious environmental damage to the mangrove wetlands and the fragile cave ecosystem.
- The potential for resort and residential development adjacent to the Park exists particularly along the nearly pristine shoreline.
- Use by recreationists, if not appropriately managed, can result in unacceptable impacts to Park values, such as dune degradation and trash accumulation.

6.3 Park Expansion Proposals

The following proposals for expanding the boundaries of Lucayan National Park are designed to extend protection status to ecosystems currently underrepresented in the National Protected Area System and that have been identified for increased protection in the Master Plan for The Bahamas National Protected System (Moultrie 2010). Specifically, the proposals will provide protection to include the Lucayan and Pirates Mew cave network, part of the South Shore IBA (Option 2 only), Gold Rock Creek tidal area, offshore fringing reef, mangroves and several other vegetation types.

6.3.1 Park Boundary Expansion Proposal—Option 1

The Lucayan National Park expansion proposal Option 1 would increase the Park's area from 40 acres (16.2 ha) to approximately 2,700 acres (1,092 ha) (Figure 8). Of this, approximately 950 acres (385 ha) would be terrestrial and 1,750 acres (708 ha) would be in marine ecosystems. A significant amount of additional pinelands would be added as well as karst caves, mangrove wetlands, dune area, tidal creeks and various marine components including approximately 2.8 miles (4.5 kms) of fringing reef.

The Option 1 expansion consists of the following elements:

- Expand the Park boundary above the Queen's Highway to the north and west to include the full area of the Lucayan cave system as mapped by Zenato and Pers as well as the Pirates Mew cave network identified by Kakuk.

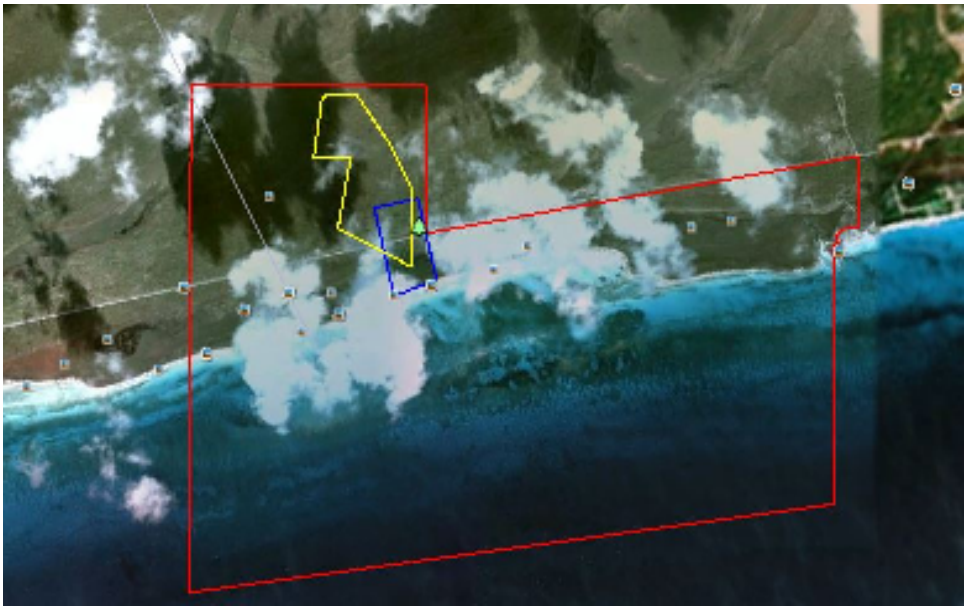

Figure 8 Option 1 boundary (red), current boundary (blue), and approximate area of mapped cave system (Zenato and Pers) (yellow).

- Expand the boundary below the Queens Highway to the east as far as the mouth of Gold Rock Creek and to the west one mile from the current parking area. This will provide protection for approximately 3 miles (4.8 kms) of the Gold Rock Creek waterway and mangrove wetlands. It will help ensure protection for the water dependent ecosystem within the Lucayan cave area.
- Add a marine protected area to Lucayan National Park by extending the southern boundary approximately 1.5 miles (2.4 kms) out from shore to the "drop off" and beyond to wherever the 200 fathom depth contour occurs.
- Rapid Ecological Assessments of the proposed marine protected area and the Gold Rock Creek waterway were conducted in April 2013. Results from these assessments will further inform this proposal.
- Various options exist to accommodate the interests of and create a mutually beneficial partnership with Grand Bahama Nature Tours as part of any Park expansion proposal.

6.3.2 Park Boundary Expansion Proposal—Option 2

The Option 2 proposal would encompass all of the Option 1 components and further expand the Park's area south of the Queen's Highway to a total of approximately 3,550 acres (1,437 ha) (Figure 9). Of this, approximately 1,150 acres (465 ha) would be terrestrial and 2,400 acres (971 ha) would be in marine ecosystems. The entire 4 mile (6.4 km) reach of Gold Rock Creek would come under Park protection status. Approximately 1 mile (1.6 km) of shoreline in IBA BS003 and 4 miles (6.4 km) of fringing reef would be protected along with additional mangrove wetlands, dune, and coppice vegetation.

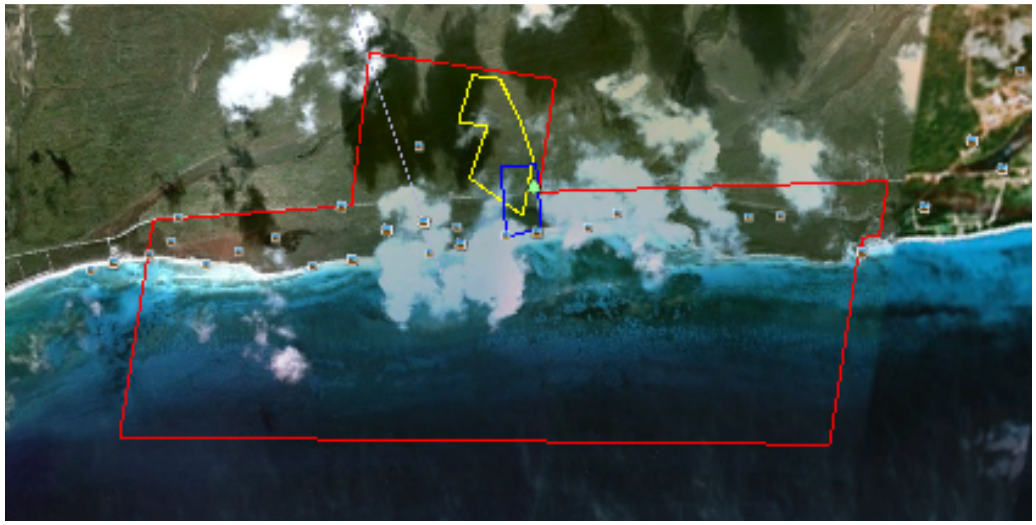

Figure 9: Option 2 boundary (red), current boundary (blue), and approximate area of mapped cave system (Zenato and Pers) (yellow).

The Option 2 expansion consists of the following additions to Option 1:

- Extend the Option 1 western boundary below the Queen's Highway one mile (1.6 kms) west as far as the eastern edge of the developed area that includes the North Riding Point Club at Burnside Cove.
- Expand the marine protected area identified in Option 1 approximately one mile (1.6 kms) to the West to be in line on a north – south bearing with the proposed northwest boundary point mentioned above at Burnside Cove.

7.0 Natural Values Contributing to Options for the Expansion of Lucayan National Park

The following documents in tabular form the natural values that are intended to be protected in the expansion proposals for Lucayan National Park and the contribution their protection would make to the biodiversity targets as defined in the BNT's Master Plan (Moultrie, 2012).

Option 1		
Feature	Description and Contribution to Park Values	Contribution to National Biodiversity Targets*

Protection of Known Karst Cave System	The vast majority of the known underground cave system that is accessible from Ben's Cave and the Burial Mound, recognized as one of the largest submerged cave systems in the world, is outside of the current park boundaries. The Option 1 boundary expands to the north and west to incorporate the known extent of the cave system. The boundary expansion to the west of about 1 mile (1.6 km) is designed to also include another cave system, accessible through Pirates Mew, that may or may not be connected to the Ben's Cave - Burial Mound system. There is another cave system further west inland from Burnside Cove and accessible through the Owl Hole and Mermaid's Lair, but it is unknown whether the two or three cave systems are connected.	• The Ecological Gap Analysis (EGA) target for karst cave systems is 20%;
		  • Only about 1% is currently protected.
		  • The expansion of LNP would make a significant contribution to this target and protect a resource of international significance.

* These targets are the results of an Ecological Gap Analysis as defined in *Master Plan for The Bahamas National Protected Area System* (Moultrie, 2012).

Protection of Gold Rock Creek	This creek system is the only intact tidal creek system remaining on the south shore of Grand Bahama Island. The Option 1 boundary expands to the east to and including the mouth of the creek and the expansive mangrove wetlands to protect the lower reaches. The Rapid Ecological Assessment (REA) undertaken by BNT will confirm species and significance of species in the mangrove and creek ecosystem.	• The EGA target for Tidal Creeks is 30%; only 12% is currently protected.
		  • The EGA target for Mangroves is 30%; only 13% is protected.
		  • The expansion of LNP to include the lower and mid-reaches of Gold Rock Creek would make a significant contribution to these targets.

Ensure Protection of Existing Park Beach and an Additional 3 Miles (4.8 km) of Beach	The current lease for LNP does not include the beach itself and limits the ability of the park to provide for environmental protection and visitor use. Under Option 1, this beach would be totally protected along with an additional 3 miles (4.8 km) of newly protected beach east and west of the existing park, extending east to the mouth of Gold Rock Creek.	• The EGA target for Sandy Beaches is 30%;
		  • Only 6% is currently protected.
		  • The expansion of LNP to add 3 miles (4.8 kms) of protected beach would make a significant contribution to this target.

Protection of Marine Habitats, Offshore Reefs and Slope to Deep Water	Option 1 adds a considerable marine component to LNP extending from the mouth of Gold Rock Creek west to 1 mile (1.6 km) of the current park boundary, for a total length of 2.8 miles (4.5 kms) of reef system. Marine habitats include sand flats, sea grass beds, an extensive reef system and the canyon slope beyond the drop-off to a depth of 200 fathoms (600 meters) in North West Providence Channel. The Rapid Ecological Assessment (REA) undertaken by BNT will confirm species and significance of the offshore reefs. Although unconfirmed, there may be strong ecological relationships between the offshore reefs and the nursery habitats in Gold Rock Creek.	• The EGA identifies a number of marine biodiversity targets to which an expanded LNP could contribute:
		  • Sparse seagrass (20% target; 2% protected)
		  • Medium Seagrass (20% target; 2% protected)
		  • Reef Flat (25% target; 4% protected)
		  • Non-reef Flat (25% target; 4% protected)
		  • Coral walls (30-200m) (20% target; 1% protected)
		  • Coral walls (200-1000m) (20% target; 2% protected)
		  • Sand (20% target; 4% protected)

Partial Protection of Upper Gold Rock Creek	A considerable portion of the Gold Rock Creek watershed lies upstream and west of the park boardwalk and a new western boundary would partially protect these headwaters.	• The EGA target for Tidal Creeks is 30%; only about 12% is currently protected. • The EGA target for Mangroves is 30%; only 13% is protected.

		• The expansion of LNP to include the lower and mid-reaches of Gold Rock Creek would make a significant contribution to these targets.
Improved Representation of all Vegetation Types	LNP currently protects representative examples of all 6 vegetation types found on Grand Bahama Island: a tall dune system, mixed scrub, wet coppice, pine forest, mangrove swamp and beach. However, the small size of the park limits their ecological viability and resilience to disturbance. The expanded boundaries in Option 1 would improve this representation and the viability of these habitats several-fold.	• The EGA identifies a number of targets for terrestrial vegetation to which an expanded LNP could contribute: • Pinelands (25% target; 8% protected) • Dry Broadleaf Evergreen (Coppice) (30% target; 8% protected) • Scrublands (20% target; 6% protected) • Mangrove (30% target; 13% protected) • Sandy Beach (30% target; 6% protected)
Protection of the LNP Important Bird Area (IBA) BS001	The LNP IBA includes the tidal Gold Rock Creek and adjacent beach as well as upland habitats. While the IBA supports a wide diversity of habitats, the key bird species are confined to the coppice and pine forest north of the Queen's Highway. Waterbirds frequent the mangrove swamps, and shorebirds and terns occur along the beach. This IBA is adjoined by the Grand Bahama South Shore IBA (BS003) to the west. A small portion of this latter IBA is also protected through the Option 1 expansion (see below for Option 2).	• The EGA identifies a target for Important Bird Areas (IBAs) of 50%; 33% are currently protected. • The LNP IBA is significant for protecting three (of the 7) Bahamas EBA restricted-range birds, namely Thick-billed Vireo *Vireo crassirostris,* Bahama Swallow *Tachycineta cyaneoviridis* and Olive-capped Warbler *Dendroica pityophila*. The Bahama Swallow is Vulnerable, and is regularly seen in the Lucayan National Park during the breeding season. • The EGA also identifies targets for Seabirds (Low Priority) and Seabirds (High Priority) of 30%, with 11% and 10% protected respectively.

Option 2 (supplemental to Option 1)		
Feature	Description and Contribution to Park Values	Contribution to National Biodiversity Targets*
Protection of Upper Gold Rock Creek	This expansion provides for the protection of the remainder of the upper reaches of the Gold Rock Creek watershed, a distance of approximately 1 mile (1.6 kms) from the westerly boundary of Option 1 and approximately 2 miles (3.2 kms) from the current westerly boundary of LNP. This would protect the entire watershed of Gold Rock Creek, including extensive wetlands and mangroves, and the quality of water both in the creek and mangrove system but also of that occupying the nearby cave systems.	• The EGA target for Tidal Creeks is 30%; only 12% is currently protected. • The EGA target for Mangroves is 30%; only 13% is protected. • The expansion of LNP to include the upper reaches of Gold Rock Creek would make a significant contribution to these targets.
Protection of Additional Beach	Option 2 would extend the protection of the beach an additional approximately 1 mile (1.6 kms) past Mangrove Point to the eastern boundary of the North Riding Point Club.	• The EGA target for Sandy Beaches is 30%; • Only 6% is currently protected. • The expansion of LNP to add 3 miles (4.8 kms) of additional protected beach would make a significant contribution to this target.

Protection of Additional Offshore Reefs and Slope to Deep Water	Option 2 includes another section of the marine environment offshore of the protected wetlands and beach, adding an additional 1.2 miles (1.9 kms) of reef systems for a total of 6 mi^2 (15.5 km^2) out to the canyon slope beyond the drop-off to a depth of 200 fathoms (600 metres) in	• The EGA identifies a number of marine biodiversity targets to which an expanded LNP could contribute:
		  • Sparse seagrass (20% target; 2% protected)
		  • Medium Seagrass (20% target; 2%

Comment [M1]: Fill in

Comment [M2]: Fill in

Comment [M3]: Fill in

* These targets are the results of an Ecological Gap Analysis as defined in *Master Plan for The Bahamas National Protected Area System* (Moultrie, 2012).

	North West Providence Channel.	protected) • Reef Flat (25% target; 4% protected) • Non-reef Flat (25% target; 4% protected) • Coral walls (30-200m) (20% target; 1% protected) • Coral walls (200-1000m) (20% target; 2% protected) • Sand (20% target; 4% protected)
Improves Representation of all Vegetation Types	This Option is intended to primarily protect the wetlands and mangrove area in the upper reaches of Gold Rock Creek. In addition, there is improved representation of hardwood coppice and dune vegetation.	• The EGA identifies a number of targets for terrestrial vegetation to which this option for an expanded LNP could contribute: • Dry Broadleaf Evergreen (Coppice) (30% target; 8% protected) • Mangrove (30% target; 13% protected) • Sandy Beach (30% target; 6% protected)
Improved Protection of a portion the Grand Bahama South Important Bird Area (IBA) BS003	This expansion protects a small additional portion of 1 mile (1.6 km) of The Grand Bahama South Shore IBA for the Near Threatened Piping Plover *Charadrius melodus* which winters on the beach along with a range of other shorebirds, herons and egrets.	• The EGA identifies a target for Important Bird Areas (IBAs) of 50%; 33% are currently protected • The EGA also identifies targets for Seabirds (Low Priority) and Seabirds (High Priority) of 30%, with 11% and 10% protected respectively.

8.0 Application of Selection Criteria to Proposed Expansion of Lucayan National Park

Criteria	High Value	Medium Value	Low Value
Biogeographic importance	X		
Ecological importance	X		
Biodiversity importance	X		
Naturalness/habitat structure	X		
Economic importance		X	
Social importance		X	
Scientific importance	X		
International/national importance	X		
Practicality/feasibility	X		
Biogeographic sub-criteria	**High Value**	**Medium Value**	**Low Value**
Presence of rare biogeographic qualities or representativeness of a biogeographic type	X		
Unique or unusual geographic features	X		
Characteristic of the biogeographic province or region	X		
Ecological sub-criteria	**High Value**	**Medium Value**	**Low Value**
Essential part of ecological process or life-support systems	X		
Area's integrity encompasses a complete ecosystem	X		
Variety of ecosystem	X		
Habitat for rare or endangered species	X		
Nursery or juvenile area	X		
Feeding or courtship breeding rest or migration areas	X		
Rare or unique habitat for species	X		
Genetic diversity		X	
High level of primary and/or secondary production and attendant higher trophic level communities	X		

9.0 Additional Opportunities— Barbary Beach to Burnside Cove

9.1 Area Description

In addition to Options 1 and 2 for the expansion of LNP, there are a number of significant values, both natural and cultural, that coexist in a rich assemblage of resources along the coast from the Grand Lucayan Waterway and Barbary Beach east along an unbroken stretch of beach to Burnside Cove 8 miles (12.9 km) long, passing in front of Peterson Cay National Park. Meeting with the proposed expansion of LNP in Option 2 at the east end of Burnside Cove and extending east to the mouth of Gold Rock Creek, the total stretch of unbroken beach from the Waterway to Gold Rock Creek is 12 miles (19.3 km) long. This is a feature found no where else on Grand Bahama Island and could form the nucleus and binding thread of a magnificent protected area right on Freeport's doorstep. There are many cities in the world that have, and that cherish, their neighboring national parks or other significant protected area, not the least of which are New York; San Francisco; Sydney, Australia; and soon Toronto, Canada. Specifically, the features and values contained in this stretch of coastline include the following:

Feature	Description
The Heritage Trail and the Hermitage	Before 1955, the main transportation artery on Grand Bahama Island was the Old Freetown Road, now better known as The Heritage Trail, a dirt path leading from Old Freetown in the east to Eight Mile Rock and other settlements in the west. After the foundation of Freeport brought in a modern highway, the old road was abandoned. The five mile (eight km) trail is now promoted as one of the island's more popular nature walks and bicycle routes. Also found on the route is "The Hermitage," the oldest intact building on Grand Bahama, dating back to 1901 as the original Baptist church in the now vanished historic settlement of Peterson Cay.

Old Freetown	Old Freetown is one of Grand Bahama Island's oldest settlements, and one of its most significant historic sites as one of the, if not *the*, first site settled by freed slaves after emancipation in 1834. Remains of the settlement include structural ruins and a cemetery. The archaeological reconnaissance of the Freetown settlement in 2007, commissioned by the GBPA, revealed many stone walls, stone concentrations (which may represent building ruins), abundant 19th and early to mid 20th century artifacts and the full extent of the settlement's cemetery. "Ruins, artifacts and subsurface features indicate that this is a substantial site capable of revealing important aspects of early Grand Bahama Island history. Clearly more archaeological and historical research is needed at Freetown if the site or various portions of it is to be properly managed, developed and interpreted to the public." (Elliott, 2007)
Eight Miles of Beach, Potentially Linking Lucayan NP and Peterson Cay NP	The opportunity to protect an eight mile (12.8 kilometers) beach, to link up with an expanded LNP for a possible total of 12 miles (19.3 km), in such close proximity to a major city and that connects so much natural and cultural diversity is rare, and in this case, is unique on Grand Bahama Island. The beach and its adjacent offshore marine environments offer the opportunity to link Peterson Cay and LNP into a single entity, either as one national park, or as two national parks linked through an alternative kind of protected area or conservation management regime.
Offshore Marine Habitats, Reefs and Drop-off Slope to Deep Water	A compatible land management regime along the Barbary Beach-Burnside Cove shoreline accompanies the opportunity to protect the offshore marine environment and reef systems from the beach out to the canyon slope and drop-off to the depths of North West Providence Channel. Including the proposed expansions for both LNP and PCNP, this presents the potential to create a marine protected area 12 miles (19.3 km^2) in length and 1.5 miles across for an area of 18 mi^2 (46.6 km^2).
Blue Holes and Submerged Karst Caves – Owl Hole and Mermaid's Lair	Among the more popular and well-known submerged cave systems in the Bahamas is that marked by the Owl Hole and Mermaid's Lair entrances, classic karst blue holes located just inland from the Old Freetown settlement site. The Owl Hole is named after the Bahamian Barn Owl *(Tyto alba lucayana)*, an uncommon subspecies of barn owl unique to the Bahamas, that roost on the ledges of the cave entrance. Recent mapping of this cave system has revealed an extensive network of caves that extends well north and east of the Owl Hole, possibly linking with the cave system and the Pirates Mew entrance just west of the existing boundaries of LNP (included in both options for LNP

	expansion).
Representation of all Vegetation Types	There is an extensive wetland and mangrove thicket behind the beach dune between Boggy Point and Silver Point that is among the largest remaining natural wetlands on the south shore of Grand Bahama Island. Along the shoreline adjacent to The Heritage Trail is a wet coppice of indigenous hardwoods and 25 species of native plants. Further inland are low density scrub lands with seasonal marshes backed with pinelands. According to the Ecological Gap Analysis, all of these vegetation types are significantly under-represented in the protected area system.
Protection of the Grand Bahama South Important Bird Area (IBA) BS003	In addition to the increased protection for this IBA offered in Option 2 for LNP, this option protects the remaining 8 miles (12.8 km^2) of this IBA for wintering populations of the endangered Piping Plover.

9.2 Values at Risk

All of the above features, with the exception of the offshore marine component, are on lands owned by the Grand Bahama Port Authority (GBPA). The authors have reviewed the GBPA's development plans for the coastal uplands between the Grand Lucayan Waterway and Burnside Cove, and the level of alteration to these features is 100%. In the plans, there is absolutely no acknowledgment or accommodation of the presence of any of these features and the assumption appears to be that they do not exist. Even such obvious features as the Owl Hole or Freetown's cemetery are given no recognition.

With respect to the cemetery, this is especially confusing, as it was the GBPA who retained the LAMAR Institute to undertake the archaeological delineation of the historic cemetery and the community in Old Freetown in 2007. It was reportedly the GBPAs desire to "…rigorously define the cemetery boundaries so that the area can be protected from future ground disturbance" (Elliott, 2007). This is not, however, born out in their development plans.

Further, recent mapping of the submerged cave system accessible through the Owl Hole and Mermaid's Lair entrances has demonstrated that the cave system is very extensive and could extend as much as 2,000 feet out from the Owl Hole entrance in northerly and south-easterly directions. With the water table only about 24 feet or less below the surface, it is conceivable that cave features lie only feet below the surface throughout an extensive area. The combined effects of construction disturbance, the sheer weight of surface buildings and infrastructure, and subsurface water withdrawl for domestic water supplies could significantly destabilize this area and lead to the emergence of cave collapse or new sinkholes as occurred in Florida last year. Furthermore, the risk is considerable of polluting the underground water supplies through inappropriate sewage treatment and the release of a host of pollutants typical of residential subdivisions, negatively affecting the sensitive ecosystems found in these submerged caves, some of which are already known to be unique in the world (see Appendix D).

9.3 Conclusions and Recommendation

Notwithstanding the fact that the GBPA owns the land in question, the authors believe that there is considerable and significant potential for a partnership arrangement between the GBPA and BNT to meet the goals of both organizations. Consider the following:

- Given the current high level of unsold, undeveloped and/or abandoned properties in Freeport and Lucaya for which the road and canal infrastructure is already in place, it may be decades, if ever, that the lands east of the Waterway on Barbary Beach to Burnside Cove are developed.

- There is already clear indication from the GBPA that they would not want to disturb the Freetown cemetery, even though this decision is not reflected in the development plans. This policy, or at least the sentiment, may also extend to the Freetown site, especially given the very close proximity of the Owl Hole/Mermaid's Lair cave system.
- Given the extraordinary assemblage of resource values along this coastline, in such close proximity to the city and tourism destination of Freeport/Lucaya, it makes eminent sense to protect those values to embellish and help promote these communities as places to live and invest in. There is growing interest all over the world in locating protected areas close to urban areas and Freeport/Lucaya could be on the leading edge of this trend.
- For any number of reasons, but primarily for geological instability and the risk of polluting underground water supplies, it can be argued that this land, or much of it, is highly undevelopable. The development plans seem to be highly conceptual and apparently give no consideration to these or any other environmental factors. From a "highest and best use" position, it is readily obvious that the protection of these lands, at least along the coastal fringe and above the cave systems, for conservation and for the recreational use of Grand Bahamians is the best use.
- The stretch of uninterrupted beach (except for the North Riding Point Club) from the Waterway to the mouth of Gold Rock Creek 12miles (19.3 kilometers) long is now unique on the island. While an expanded LNP would go far in protecting some of it, the potential is so much greater. In fact, the only way to protect the South Grand Bahama IBA, the wetlands/ mangroves and the cave system is to protect all or most of this beachfront.

Recommendation:

The BNT enter into an *interim* agreement with the GBPA to lease and manage these lands as (or *as if they were*) a national park until such time as they may be required for development purposes, retaining the right (or privilege) of being involved as a full partner with the GBPA in the design and approval of development plans that would protect as many of these natural and cultural values as possible in perpetuity.

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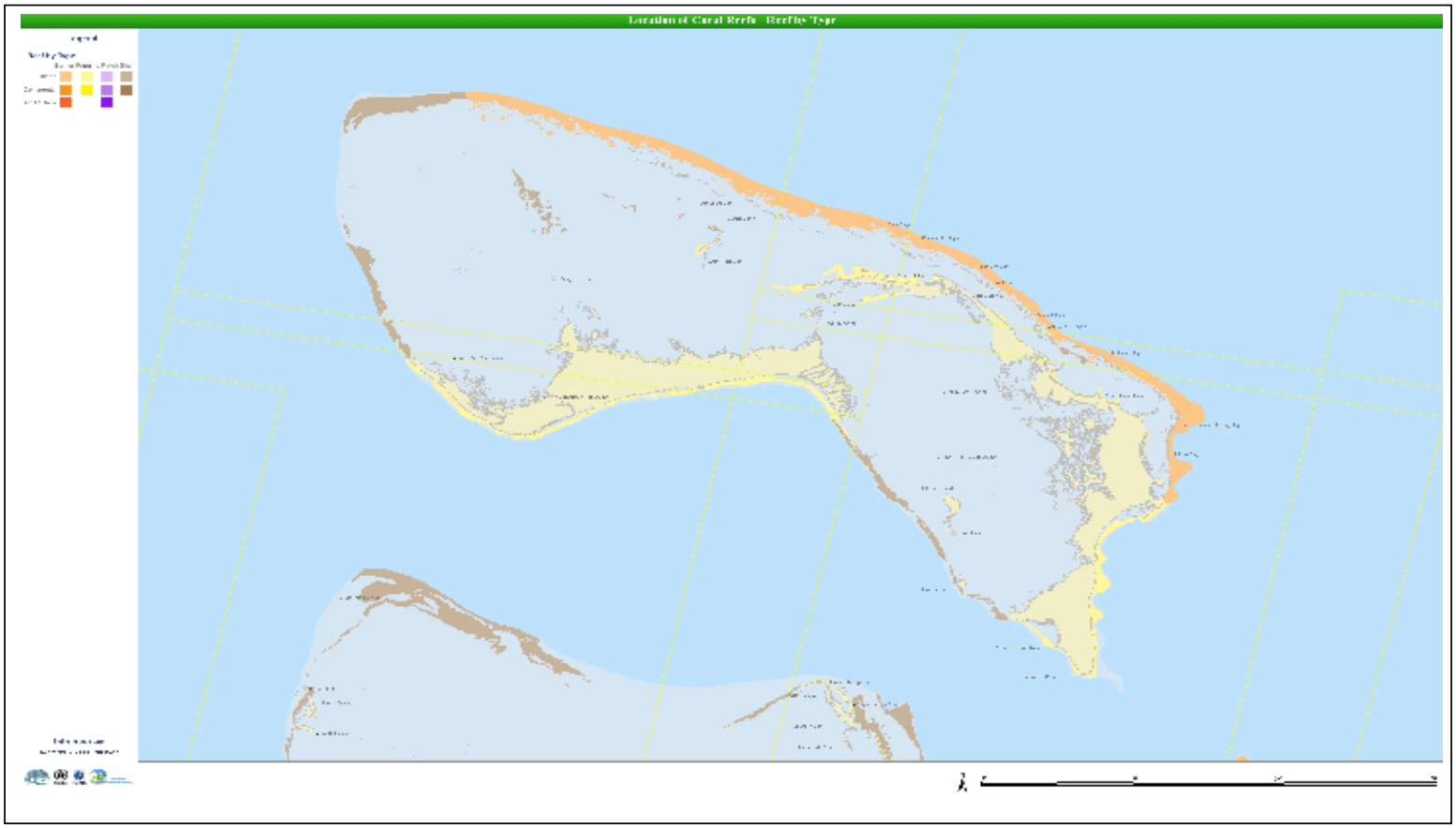
Zenato, Cristina and Pers, Arek. Lucayan Caves (map of cave network)

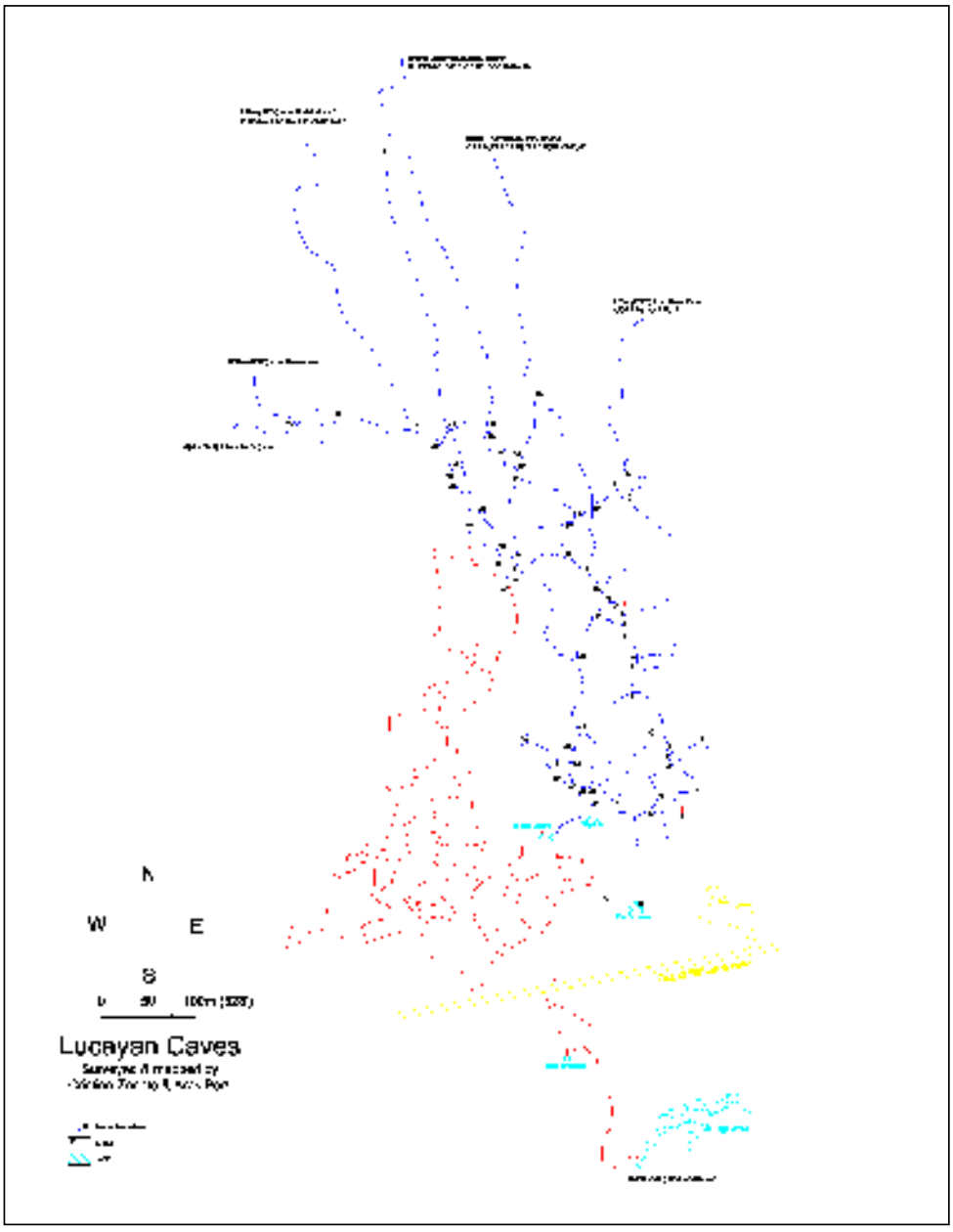
Appendix A

The Reef Systems of Little Bahama Bank, Grand Bahama Island and Abaco Island



Source: http://reefgis.reefbase.org

Appendix B — Map of Lucayan Caves (Zenato and Pers)



Appendix C— Persons and Organizations Consulted

Bahamas National Trust Staff:

- Eric Carey, Executive Director
- Lynn Gape, Deputy Director
- David Knowles, Director of Parks
- Lakeshia Anderson, Parks Planner
- Lindy Knowles, Science Officer
- Krista Sherman, GEF Full Size Project Coordinator
- Ellsworth Weir, Deputy Park Warden (Grand Bahama)
- David Cooper, Warden, Lucayan National Park

Stakeholders:

- Cheri Wood, Volunteer for the Environment/Presto Recycling/Keep Grand Bahama Clean
- Daniel Murray, Overseas Marine Group, Boat Operator
- Lloyd Cheong, Chairman, BNT Grand Bahama Committee
- Robin , Tour Operator and Member, BNT Grand Bahama Committee
- Randy E. Taylor, Assistant Manager, Geographic Information Systems, The Grand Bahama Port Authority
- Nakira Wilchcombe, Environmental Manager, Building and Development, The Grand Bahama Port Authority
- Alithea
- Darius D. Williams, Author/Historian

Cave/Karst Considerations in Grand Bahamas Park Studies

Phil Whitfield, Director, Canadian Cave Conservancy

Karst is defined as a landscape formed by the dissolution of soluble bedrocks such as limestone, dolomite and gypsum. It is characterized by sinkholes, caves and underground drainage systems. On Grand Bahama Island, karst development has occurred as calcareous deposits on the ocean floor built the massive Bahamas Platform and were subsequently eroded when their uppermost levels were exposed to the atmosphere during sea level fluctuations of as much as 145 m. With a maximum elevation of only about 60 m, Grand Bahama has relatively flat karst topography but extensive subsurface development, including cave systems formed both above and below the water table during periods of lower ocean levels, as well as extensions of these systems that are continuing to form, particularly in the aggressive solution zone where fresh water accumulated from rainfall lies atop salt water from the surrounding ocean.

The limestone of the Lucayan National Park area is of the Mid-Pleistocene Owls Hole Formation, the oldest of the three major Bahamas limestone units, with elements extending from 200,000 years in age to at least 500,000 years in age (Mylroie, 2006). The formation is made up completely of *eolianites*, or fossilized carbonate sand dunes and tends to be fragile and brittle. It has a well-developed paleosol, a hard, red to brown crust on its top surface, apparently an accumulation of blown Sahara Desert dust. In Lucayan National Park, the freshwater lens can be seen some 5-6 m below surface level in Ben's Cave and Burial Mound Cave. These “karst windows" into an extensive underwater cave system were formed through a combination of rainfall erosion from the surface and collapse of the ceiling of the cavity from below.

The network of passages in the cave system has developed at two different levels in a zone some 2.4-21m (8-70 ft) below water level. An upper level cave has developed in an entirely fresh water zone between the thin island crust and about 6-9 m (20-30 ft) depth. Occurring mostly on the east side of the system, these passages are a series of big rooms with nothing to sustain the ceiling. The lower layer of the cave system is accessed from the upper layer through restricted cracks on either sides of the upper tunnel. The halocline (active solution zone in which the upper fresh water layer meets the lower salt water layer) is found at a depth of about 19 m (63 feet) and most of the lower system lies in or slightly below this level. This area comprises the majority of the cave system, with vast mazes of tunnels connecting from different directions. The tunnels are low, ranging in height from 1 m (3 ft) to 3 m (10 ft). Three main tunnels heading north, one heading east and one west are phreatic tubes 2.4-3 m in average diameter, originally formed below the water table 125,000 years ago or earlier. Decorations formed in them as the passages drained when ocean levels dropped during glacial periods some 119,000 years ago. Presently flooded and at the halocline, these passages now have a layer of fresh water draining southward at ceiling level above the salt water. As well as

having entrances inland, the Ben's Cave system connects to the ocean and has been mapped by cave divers to a length presently totaling over 9.6 km (6 miles).

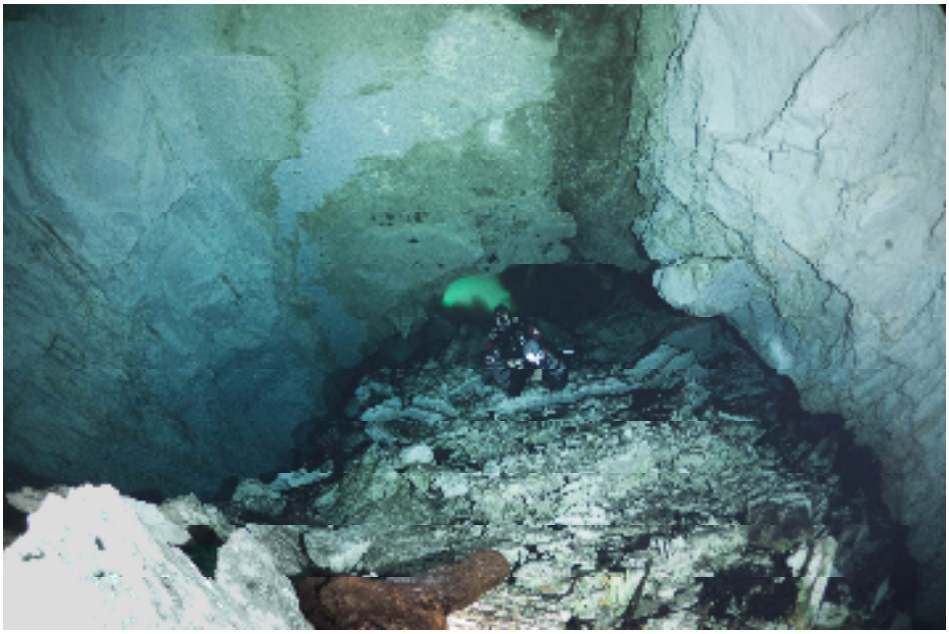
In 2004, members of the Bahamas Caves Research Foundation discovered another underwater cave system some 610 m (2,000 ft) west of the park's western boundary. Explored to a length of some 1,220 m (4,000 ft), the Pirate's Mew system has 8 entrances located on both sides of the Queen's Highway and within the adjacent mangrove swamp. It is considered very likely to have passages connecting with the Lucayan Cavern system (Kukak, 2006; http://www.bahamascaves.com/research/bahamasnationaltrust.html).

A general principle in management of protected areas involving caves is that the boundaries of the protected area should include as much as possible of the surface area above the cave, and ideally also the complete hydrological system of which the cave is a part. If this approach cannot be applied, it may be impossible to maintain the ecological integrity of the cave. Surface activity outside park boundaries can directly affect subsurface water movement, water quality and air quality, with implications for human use of the caves, as well as indirect and possibly devastating effects on cave biota. Protection of the ecosystem of the Lucayan Caverns is internationally important because it is the habitat of *Speleonectes lucayensis,* a previously unknown species and class of centipede-like crustacean which was given the name Rempedia ("oar foot").

Altogether apart from the potential impacts of surface activities upon a protected area cave system are the implications karst elements have for certain kinds of surface activity. Soils are naturally thin in dry karst areas and disturbances such as those involved in timber harvesting and agriculture often increase erosion and loss of soil into the deep fissures and pits of the epikarst or "skin" of the bedrock, as well as into caves below. Besides altering the caves, this loss of soil can ultimately lead to a very barren, rocky surface. Implications for developments such as settlement may be even more severe. Layers of rock between subterranean voids and the surface may be very thin, and in some karst areas, heavy machinery has actually fallen through into such voids. Buildings in Florida not infrequently are undermined or swallowed when sinkholes open beneath them as karst cavities collapse. In locations like the Bahamas that use subsurface aquifers or lenses of fresh water as potable water sources, there is always a high risk of siltation or contamination of such sources by activities in another part of the hydrological system. Disposal of greywater and blackwater in karst areas is of particular concern for this reason, as septic tank effluent and even contaminated runoff from paved areas can easily find its way through bedrock fissures into the water table.

Some 7 km (4.35 miles) west of Lucayan NP is the Mermaid's Lair/Owl's Hole cave system, an alternating series of vast rooms in the fresh water layer and lower passages at depths up to 21 m (70 ft). The rooms are even bigger then those in the Ben's system with one of them measuring 27.5 m by 49 m (90 ft by 160 ft) at its maximum and a ceiling to floor height of 3-15 m (10-50 ft). With an estimated 2,440 m (8,000 feet) of explored passages, shallow depths and a healthy troglobitic ecosystem, this highly decorated lens cave system offers some of the best cave diving in the Bahamas and is one of the primary dive sites for local diver operators specializing in cavern and cave diving. A ladder provides relatively easy access to the water in the Owl's Hole cenote, which is only 50 m

from a road connecting with the Queen's Highway. This entrance is closed during certain times of the year due to the nesting of Giant Barn Owls. At least one other entrance opens into the mangrove swamp drained by Gold Rock Creek, and the overall pattern of the passages forms a rough "L" shape, with its north-south axis passing through Owl's Hole and an east-west axis paralleling the south coast eastward under the mangrove swamp to Mermaid's Lair. Concerns applying to the potential impacts of surface activities on the hydrology and biology of the Lucayan/Pirate's Mew cave systems also apply to this system.



Entrance room of Mermaid Cave System (Photo courtesy of Cristina Zenato).

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