BISCAYNE NATIONAL PARK

GEOLOGIC RESOURCE MANAGEMENT ISSUES

SCOPING SUMMARY

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Microkarst on Elliot Key's eastern shore, in Biscayne National Park. Photograph by Trista L. Thornberry- Ehrlich (Colorado State University).

Table of Contents

Executive Summary 4
Introduction 5
Physiography 6
Geologic History of South Florida 7
Stratigraphy 9
Significant Geologic Resource Management Issues in Everglades National Park ... 10
Scoping Meeting Participants 18
References 19
Map of Biscayne National Park 21

Executive Summary

Following a field trip on January 25, 2005, a Geologic Resources Evaluation scoping meeting took place at the park headquarters on January 26, 2005. The scoping meeting participants identified the following list of geologic resource management issues. These topics are discussed in detail on pages 11 - 18.

1. Hydrogeologic system of Biscayne Bay

2. Benthic habitats at Biscayne National Park

3. Inundation history and paleoconditions

4. Sediment transport and erosion

5. Karst activity

6. Sea level rise

7. Disturbed lands

8. Active reefs and coral mapping

9. Recreation demands and resource restoration

10. Sediment thickness

11. Urban development concerns

12. Soil characterization

13. Paleontologic inventory

Introduction

The National Park Service held a Geologic Resource Evaluation scoping meeting for Biscayne National Park at the park headquarters near Homestead, Florida on Wednesday, January 26, 2005. This meeting followed a field trip on January 25, 2005. The purpose of the meeting was to discuss the status of geologic mapping in the park, the associated bibliography, and the geologic issues in the park. The products to be derived from the scoping meeting are: (1) Digitized geologic maps covering the park; (2) An updated and verified bibliography; (3) Scoping summary (this report); and (4) A Geologic Resource Evaluation Report which brings together all of these products.

Biscayne National Monument was established during Lyndon B. Johnson's administration on October 18, 1968. The boundaries were expanded in 1974 to include Swan and Gold Keys. On June 28, 1980, Biscayne was redesignated as a national park. Biscayne covers 172,924 acres along the southeastern Florida coast, 95% of which is underwater (72,000 acres of coral reefs). Biscayne National Park is the largest marine park in North America. The environments protected at the park vary from mangrove forest to the shallow waters of Biscayne Bay, from the northern most islands of the Florida Keys chain to the beginning of the third- largest coral reef tract in the world. The area covers a large portion of the Intercoastal Waterway, a large boating channel running along the Florida coast. The park contains some of the most pristine and unique marine habitat in the continental United States.

Biscayne National Park identified 19 quadrangles of interest. The Florida State Geologic Survey (FGS) has digitized a geologic map covering the state from individual county maps at a small scale (~ 1:750,000). This map only displays 3 separate geologic units (Holocene sediments, Key Largo Limestone, Miami Limestone) for inside the boundaries of the park.

Other geologic maps covering portions of the quadrangles of interest include the USGS I- 2505 (1:24,000, 1997), the benthic habitat map published by NOAA CSC (1:48,000, 1999), Geological Society of America (GSA) Memoir 147 (1:79,000, 1977), the FGS OFMS 83/01- 07 (1:100,000, 1995), 83/08- 12 (1:100,000, 1996), USGS OF- 97- 526 (1:120,000, 1997),), FGS OFMS 83/08- 12 (1:100,000, 1995), 67 (1:126,720, Dade County), 66/01 and 66/02 (1:126,720, Monroe County), USGS OF 97- 526 (1:120,000, 1997) and 86- 4126 (1:136,000, 1986). Additional mapping at a smaller scale will be more helpful for park management. For Biscayne National Park, where most of the park is underwater, mapping needs extend beyond the shoreline.

Physiography

South Florida in the area of the Biscayne is divided into 5 physiographic provinces. These are called the Atlantic Coastal Ridge, Coastal Marshes and Mangrove Swamp, Everglades, Big Cypress Swamp, and Sandy Flatlands provinces. The Everglades province forms the central south dipping, spoon-shaped low- lying area between the Atlantic Coastal Ridge to the east, the Big Cypress Swamp to the west, the Coastal Marshes and Mangrove Swamp to the south, and the Sandy Flatlands area to the north.

Part of Biscayne National Park lies within the Atlantic Coastal Ridge province. It is comprised of Pleistocene marine limestones covered by thin quartz sand sheets. The province ranges in elevation from 1.5 to 6 m (5 to 20 ft) in the southernmost portions. The width of the ridge ranges from 16 km (10 miles) in southern Miami- Dade County and narrows to 5 to 8 km (3 – 5 miles) further north. Periodically breaching the southern portions of the ridge are sloughs (transverse glades) oriented perpendicular to the trend of the ridge.

The rest of Biscayne National Park is composed of islands and marine/bay environments. The reefs of Biscayne National Park are part of a 241 km (150 miles) long chain of coral reefs extending roughly southwestward down through the lower Florida Keys and into the Caribbean. The Florida Keys are divided into three distinct sections: the upper. middle, and lower Keys. These divisions correspond to their orientation, morphology, water depth, and composition. The upper Keys (including Biscayne) are oriented almost north- south and buttress against the east- southeast winds. The middle Keys are oriented northeast- southwest and face directly into the east- southeast winds. The lower Keys are oriented nearly parallel to the winds and trend nearly east- west (Shinn et al., 1997).

Elliot Key in Biscayne National Park is the parks largest island and is considered the northernmost true coral rock Florida Key. There are 42 islands in Biscayne National Park, which form a protective barrier for Biscayne Bay and south Florida. These islands display the transition from coral rock keys from the south to the sand barrier islands in the north. The islands north of Elliott Key, from Sands Key to Soldier Key, are examples of transitional islands. A transitional island contains features of both hard rock coral keys and sand barrier islands.

Geologic History of South Florida

Sediment cores indicate that South Florida has been predominantly an area of carbonate accumulation since the Mesozoic.

Late Paleozoic Era – During the Mississippian, the landmass that would underlie the grand carbonate platform of Florida today was not attached to the North American Craton. It is speculated that it was attached to the northwest portion of the African continent (Condie and Sloan, 1998). However, marine carbonates were being deposited over large portions of the area atop a Paleozoic age crystalline basement high, the Peninsular Arch (Pollastro *et al.*, 2000). In the Pennsylvanian, a collision event, known as the Ouachita orogeny sutured the Florida landmass to the continent as Gondwanaland and North America collided eventually forming the supercontinent Pangaea. The land was still submerged and south Florida was located at the junction of the North American, South American, and African plates. Through the Permian, Pangaea remained intact (Condie and Sloan, 1998).

Early Mesozoic Era – No sooner had Pangaea formed than it began to break up. During the late Triassic, South and Central America and Africa began to rift away from North America. This established the long- standing passive margin of the eastern seaboard that persists today. The Florida and Cuba blocks detached from northwest Africa and the Gulf of Mexico opened (Condie and Sloan, 1998).

Accompanying the rifting of Pangaea was the widespread extrusion of volcanic rocks consistent with mantle plume upwelling due to crustal tension (Heatherington and Mueller, 1991). This continental rifting also opened the Atlantic Ocean basin.

Middle Mesozoic Era - Underlying the south Florida basin are igneous rhyolitic - basaltic rocks (Thomas et al., 1989). These rocks were subaerially exposed and eroded during the late Triassic to middle Jurassic. This caused the formation of redbeds locally. As the Atlantic Ocean continued to develop, deltaic and shallow marine sediments were deposited in the late Jurassic. Restriction of marine circulation at this time resulted in periodic accumulations of evaporites and marine carbonates (Cunningham, 2005). Deposition of Jurassic and Cretaceous sediments was controlled by the south- southeast plunging axis of the Peninsular Arch. Basal sediments onlap and pinch out against the arch (Pollastro *et al.*, 2000).

Late Mesozoic Era – As marine transgression proceeded during the early Cretaceous, the Florida Platform was the site of more widespread deposition of marine limestones and reefs. Further transgression and global warming during

the Late Cretaceous established an open marine accumulation of carbonates over the entire Florida Peninsula.

Cenozoic Era – Cenozoic development of the Florida Platform included additional deposition of marine carbonates and deposition of siliciclastics (grains of silicate minerals such as quartz in lieu of carbonates) from northwestern highlands sources and long shore oceanic currents. Tertiary faulting occurred south of Florida as the Cuban block collided with the Antilles arc and carbonate accumulation continued in Florida (Condie and Sloan, 1998). In southern Florida, the open marine setting continued during the Paleocene as more restricted flow to the north resulted in deposits of mixed carbonates and evaporites. Eocene and Oligocene deposition is marked by shallow water carbonates. Intermittent with this deposition were subaerial exposures associated with local oceanic regressions.

Deposition in south Florida during the Miocene changed with the introduction of more widespread siliciclastics from a fluvio- deltaic system prograding down the peninsula. Phosphates and the carbonate ramp of the Arcadia Formation were deposited during the Miocene in south Florida. A Pliocene lowstand caused many of the previous deposits to be reworked and/or eroded. The Florida Keys area was active as a thick pile of sand that was being transported south to eventually form the Long Key Formation (Guertin et al., 1999; Cunningham, 2005). Continued carbonate accumulation in the Florida Keys during the Pliocene built the Stock Island Formation (Cunningham et al., 1998).

The Pleistocene era resulted in the conversion from siliciclastic deposition mixed with carbonate accumulation to more widespread carbonate sedimentation (Cunningham, 2005). Global sea- level changes during the intermittent ice ages of the Pleistocene controlled the rate and distribution of carbonate units. At 120 Ka, the last major sea level fall occurred as the reefs and the oolite facies were accumulating to become the Miami and Key Largo Limestones. The Pleistocene Key Largo Limestone (130 Ka) underlies the Florida Keys to its northernmost extent at Soldier Key (Shinn *et al.*, 1997). The Miami Limestone (Upper Pleistocene oolite and bryozoan facies) underlies the southeastern portion of the Florida mainland including Biscayne Bay.

At 15- 16 Ka sea levels began to rise rapidly and flood southern Florida around 7 or 6 Ka (Shinn *et al.*, 1997). Sea level has continued to rise. Holocene geologic activity at Biscayne area consists of the accumulation of coral reefs, sand deposits and carbonate muds. These deposits directly overlie the Pleistocene Key Largo and Miami Limestones. Reef distribution at Biscayne is controlled by geologic and climatic factors such as the timing and rate of sea level rise, sediment facies, and underlying bedrock. At present, anthropogenic activity is probably the most prevalent source of reef change in south Florida.

Stratigraphy

Cores such as the deep, continuous core near the Everglades National Park Research Center (W- 17232), those of the South Florida Drilling Project (Florida Geological Survey, University of Miami, Florida Department of Transportation), and the USGS help constrain the stratigraphy at depth underlying the park.

The lowest unit penetrated by the core in the Everglades is the Arcadia Formation (top surface at 147 m, 482 ft). This formation consists of ramp setting carbonates with scant quartz contents increasing northward (~20% quartz grains at W- 17232) (Cunningham, 2005). A major disconformity marks the boundary between the Arcadia Formation and the overlying Peace River Formation. The Peace River Formation is absent south of the Everglades and pinches out west of Biscayne National Park.

Beneath Biscayne National Park, the Long Key Formation overlies the Arcadia Formation. This new unit, proposed by Cunningham *et al.* (1998) is composed of subsurface siliciclastics underlying the southernmost reaches Florida (from core W- 17156 on Long Key). This unit is coeval with the Stock Island Formation of the lower Florida Keys (Guertin *et al.,* 1999). The top of the Long Key Formation beneath the park is ~145 m (475 ft) below the surface. The siliciclastics of the unit were deposited in at least 3 pulses (late Miocene, early Pliocene, and latest Pliocene/earliest Pleistocene). They are present in a channelized morphology of coarse- grained sands (>1mm) (Warzeski *et al.,* 1996).

The Miami Limestone is ~125 – 130 Ka and represented deposition during an interglacial period. Two facies, the oolitic facies and the bryozoan facies are more or less combined in most of the outcrops at east of Biscayne National Park (Hoffmeister *et al.,* 1974; Cunningham, 2005). Further east, towards Biscayne Bay and the upper Keys, the coralline Key Largo Limestone is exposed as far north as Soldier Key (Shinn *et al.,* 1997). The deposition of the Miami and Key Largo Limestones was contemporaneous.

Overlying the Miami and Key Largo Limestones bedrock are surficial units of sands and carbonate muds, coral rubble and reef, as well as local peat and organic material on the islands.

Significant Geologic Resource Management Issues in Biscayne National Park

1. Hydrogeologic system of Biscayne Bay

The resource managers need to understand how water is moving through the hydrogeologic system into, under, and from the park. Two aquifers, the Biscayne (upper) and Florida (lower) aquifers, plus an intermediate aquifer underlie the park. Knowledge is limited about the amount of flow and partitioning between them. Their depths are associated with the five unconformities (Q1 – Q5) in the Fort Thompson – Miami Limestone transition. Porosity is estimated at 40%, but little modeling exists for the system. The USGS has monitoring wells in the park including four seepage wells. These would be useful to perform a tracer study to see how quickly and in what direction water is moving through the system.

Management also needs to understand how the water table might change over time. The Biscayne aquifer is surficial in the Everglades and deepens towards the east. This aquifer provides water for the urban development stretching along the eastern Florida coast. Eight million gallons/day of waste are pumped into deep injection wells from Miami. This waste goes down gradient to the Florida Straights and washes up in the park. Because of Biscayne's location (jutting into the Florida Straights), an understanding of how the water currents and geology interact is vital to understanding contaminant flow through the park.

The interaction between groundwater flow and the overall fresh water and marine ecological quality must be quantitatively determined at Biscayne. Visitor uses and surrounding development are increasing the levels of certain substances in the water at the park. Nutrients from waste are causing algal blooms.

Research and monitoring questions and suggestions include: How many wells are necessary to model the hydrogeologic system at the park? Examine the salt wedge characteristics versus the surface water. How would an increase in hydraulic head affect the local spring activity? Characterize the groundwater interface between the salt and fresh water boundaries. Determine the fresh water discharge into Biscayne Bay. How does a change in hydraulic head affect fresh water discharge into the bay? To what extent does the substrate buffer contaminants in the water flowing into Biscayne Bay? Obtain more cores beneath the park to quantify the characteristics of the Biscayne aquifers location, permeability, porosity, etc. Relate tidal pumping to water movement in the park. Locate the drill log for a 457 m (1,500 ft) well in the center of Elliot Key and use for resource management (possibly located in Denver Service Center?). Access the Harold Hudson Collection of cores at the USGS in St. Petersburg, FL.

Measure stable Sr isotopes in ground water as well as ephemeral salinity changes in the Bay to better understand water movement through the hydrogeologic system. Perform mass balance calculations and stable isotope measurements to determine the freshwater inputs and their proportions from rainfall, canal discharge, and groundwater. Map depressions to find freshwater discharge points. Is there a blue hole just outside the park associated with cave openings? Are upwellings in the bay tidal or hydraulic head driven?

2. Benthic habitats at Biscayne National Park

The features in the bay are strongly related to minute changes in elevation. Environments can change within centimeters of topographic relief. Given the coverage of mapping at the park, normal surficial maps are not sufficient for complex management decisions at Biscayne. An interdisciplinary approach to mapping is critical to producing a useful product for resource management. Anthropogenic, supratidal, intertidal, subtidal, and coastal features would all be helpful. This holistic ecosystem approach integrates biological, physical, cultural, and oceanographic variables.

LIDAR surveys in addition to satellite imagery, multibeam mapping, bathymetry data, water quality and circulation, shoreline change data, pre/post storm comparisons, oceanographic data (waves, tides, currents, turbidity, temperature salinity, sediment transport patterns, coral larvae and other species distributions), etc. are essential for resource management at Biscayne National Park. Research and monitoring questions and suggestions include: What is the minimum mapping unit relevant to resource management? What are the flow dynamics in the bay?

3. Inundation history and paleoconditions

Knowledge of the location and characteristics of paleoshorelines at Biscayne will deepen the understanding of the evolution of the landscape as well as increase predictability of future responses to changing sea level. Any paleoshoreline exposed in the park needs to be dated and mapped. In addition to understanding the paleoshorelines at the park, knowledge of the areas paleodrainages will connect with the archaeology of the area. Approximately 5,000- 8,000 years ago, indigenous people were concentrated along shorelines, creeks and other drainages. Any anthropological sites should be protected, preserved, and/or excavated. These will add to the cultural value of the park. Knowledge of how the drainage and shoreline have changed through time should help with this process.

Research and monitoring questions and suggestions include: Use LIDAR (penetrates unconsolidated Holocene sediments) and DEMs to determine the

paleotopography, locations of drowned reefs and paleochannels flooded off Elliot Key that lie atop Pleistocene bedrock.

4. Sediment transport and erosion

Biscayne National Park straddles the transition between barrier islands to the north and hard rock islands (keys) to the south. Longshore drift processes end at Key Biscayne and Soldier Key. The "Safety Valve" is a large sand bar that allows water in and out, lessening the effects of storm surges. This dynamic feature has been stable for 100 years.

Shifting muds and sands, and carbonate dissolution continually alter the shape and profile of the shoreline. Sand and mud erode from one beach and deposit elsewhere in the course of a single storm event. Focus also needs to be on understanding the sediment transport dynamics at the park. The hydrogeologic system in the area around the park was altered with the construction of canals, roads, and levees.

Research and monitoring questions and suggestions include: How much beach renourishment/degradation is occurring in the park? By what processes are beaches changing? What effect will rising seas have on the Safety Valve? Does longshore drift stabilize or destabilize the Safety Valve?

5. Karst activity

Karst features are not obvious on the landscape at Biscayne. Microkarst appears on the eastern shores of Elliot and other Keys and numerous holes and caves are located beneath the waters of Biscayne Bay. Their distribution, characteristics, depths, and interconnectedness need to be systematically mapped and described.

Research and monitoring questions and suggestions include: How are karst features affecting water quality at Biscayne? How do karst features affect the hydrogeologic regime including retention time, hydraulic head, and water storage? How much of the surface is karst- related collapsed features? What steps should be taken to model water flow in the park regarding karst features? Could aerial photography be used to map sinkholes? Map historic and active sinkholes and other karst features in the bay, especially where it might pose a geohazard to visitors. Relate karst topography with sea grass distribution.

6. Sea level rise

Sea level rise is affecting all of South Florida. Local levels of sea level rise are estimated at 23 cm/year (9 inches/year). Given the low relief of the 42 islands at Biscayne National Park, rising seas will quickly submerge the lower islands and

shoals. While slowing the rate of sea level rise is beyond the resources of the park, monitoring sea level change and evaluating/predicting impacts on the park's landscape is a valid management issue. Increases in turbidity with rising seas are causing large seagrass dieoffs and increased carbonate material suspension. Baseline data and conditions are needed first, and then monitoring can proceed.

Research and monitoring questions and suggestions include: Is there any way to save the subaerial habitat from rising seas? What is the exact local rate of sea level rise? Looking at the affects of storm surges, how will the buttonwood/mangrove zones respond to the rising water? Monitor and measure the relationship between water level flux and elevations to determine an exposure/submergence index (i.e. 100% of the time exposed versus 0% of the time exposed). Quantitatively define the terms subtidal, supratidal, and intertidal units to use for future predictions and relate these to the local elevations and annual regime of water fluctuations. How fast will the park be submerged? How should facilities be sited in light of sea level rise? Determine the vulnerability index of the shorelines at Biscayne to sea level rise. Are coral growth rates keeping up with sea level rise?

7. Disturbed lands

Several oil and gas exploration wells are located within the quadrangles of interest for the park. These are all dry wells. In addition to these wells, canals (such as L31 canal), levees, and quarries (18 m, 60 ft deep canal along Road 107) are disturbed lands in the Biscayne area. Five canals open to the bay within park boundaries.

Research and monitoring questions and suggestions include: Obtain GPS locations of quarry sites. How do quarries and canals affect groundwater flow?

8. Active reefs and coral mapping

Coral reefs are an essential resource to preserve and protect at Biscayne National Park. They are also one of the most fragile features of the park. At least forty-two different benthic types are present in the park. These are associated with small- scale topographic peaks and valleys. There are approximately six types of reefs in the park separated based on their morphology and relief. The reef character changes further north to become smaller and rounder. Older corals are concentrated on the northwest corner of the reef for unknown reasons.

The USGS is using spectral color imaging and LIDAR to produce high- resolution maps of coral reefs in the Biscayne area. This in addition to hand measurements and specific transects with acoustic arrays (measures roughness and hardness of

substrate) greatly increases the understanding of the production and calcification of corals, and of the overall health of the benthic ecosystem.

The NOAA Coral Ecosystem Mapping Team is starting an initiative to form a coral reef task force of federal and state agencies to coordinate data rich programs. The desired products are high- resolution benthic maps that will be used to develop a hierarchical benthic habitat/structure classification scheme. Some of the information required for this project includes high- resolution imagery, LIDAR, GPS measurements, seafloor habitat characterization, and an agreed upon minimum mapping unit based on the technology and accuracy requirements. The National Park Service hopes to cooperate with this program to increase the understanding of the coral reefs at Biscayne National Park.

Research and monitoring questions and suggestions: Which reefs are part of an actual Pleistocene complex and which have been moved as chunks during storm events? Accurately map and characterize the reefs and the reef edge. Use LIDAR and DEMs to determine the locations of lagoonal patch reefs, storm blowouts, drowned reefs, and patch reef cores for resource management. What is the geologic connection with coral distribution? How many reefs are there at Biscayne? What are the controls on reef shape? Research alternatives to concrete for reef restoration (concrete does not dissolve enough). Why have reefs changed in the past (look at fossil record in the Key Largo Limestone)? Characterize reef structure. Determine which coral species is the reef builder (branching or stony corals). How quickly does reef form pavement? Should damaged areas of the reef be filled? If so, how long will it take to stabilize? What are the causes and nature of the barrier island - key transition?

9. Recreation demands and resource restoration

In 2003, Biscayne National Park hosted 490,178 recreation visits. This number does not include the thousands of boats that pass through Biscayne Bay every week. Primary visitor activities in the park include recreational (and commercial) fishing, diving, snorkeling, camping, picnicking, and hiking. Visitors are placing increasing demands on the limited resources and fragile ecosystem of the park. The Sands Cut area (a shallow sand flat) attracts particular attention from boaters who pull up onto the flats to recreate.

Commercial fishing, spear fishing, lobster trapping, etc. all have profound effects on the resources at Biscayne. Vessel groundings can destroy a reef that took thousands of years to build. Shrimp trawlers crush baby corals. Storms toss traps around the sea floor, causing more damage to the bottom. More than 200 vessel groundings are reported per year at Biscayne National Park. Many more are assumed to occur by park management. Ninety percent of these groundings are

in the shallow seagrass beds (~2 m, 6.5 ft deep), 9- 10% are on coral reefs, and occasionally mangrove groundings occur.

Sea grasses grow in shoals and channels in the park. There are three levels of severity for groundings based on the depth of impact. Deeper cuts often fill with drift algae. Restoration options for the seagrass beds include resedimentation, sediment stabilization, transplanting, and bird stakes (fertilization and seed distribution from droppings). Groundings on reefs are also categorized by the severity of the damage. Results include a fractured substrate, altered topography, and rubble production. Restoration of the reefs can include natural recovery, seal/fill fractures, recolonizing the population, reattaching substrate, removing rubble, capping fractures, promoting natural deposition, and abating erosion.

Research and monitoring questions and suggestions: Are visitors affecting sediment transport and the hydrologic system at the park? Should visit limitations be instigated by the park to reduce anthropogenic erosion and sea grass dieoff? Are seagrasses successional species? How are visitors at Sand Cut affecting sediment thickness there? Develop an interpretive exhibit specific to the geology of the park for visitor information.

10. Sediment thickness

The sedimentary cover over the Pleistocene bedrock is only a thin veneer approximately 1.2 to 4.6 m (4 – 15 ft) thick. This veneer is easily disturbed by devegetation and vessel groundings. Understanding the distribution of sediment thickness is vital to determining viable habitat for sea grass. Storm events and hurricanes have a pronounced and often catastrophic effect on the landscape of south Florida. Baseline conditions must be determined and studied for the resource management to predict the environmental response.

Research and monitoring questions and suggestions include: Develop a response protocol in cooperation with other local agencies to determine the geochemical effects of storm surges. Establish baselines for comparison and prediction of future events. Map sedimentary thickness to see differences across the bay as well as solution haloes that form around islands because of organic acids produced by mangrove peats. Monitor changes in sediment distribution because of vessel groundings. How does the clay layer at depth under the sand waves affect sand ripples? How should this clay layer be managed?

11. Urban development concerns

Dominating the western skyline at Biscayne National Park are the Turkey Point nuclear power plant and the Dade County landfill (the highest point in south Florida). The U.S. Air Force Base at Homestead is growing and increasing the

local population west of the park (18,000 new home permits in Homestead). Five canals enter the park and inevitably have an effect on overall water quality. Local agriculture increases the phosphorous and nitrate concentrations by more than 100 times the baseline levels.

The power plant has 217 km (135 miles) of cooling canals which prevent thoroughgoing groundwater movement. The fuel delivery channel to the power plant receives barges approximately 300 days/year (55,000 barrels/day). These barges commonly ground in the shallow water near Biscayne National Park. The potential for a toxic spill is high.

Surrounding canals, including the five that directly enter the park, affect sediment transport, increase turbidity, change water chemistry, and form sediment plumes. The Black Point sewage treatment plant, leachate from the Dade County landfill, as well as contaminated water injected into the Florida aquifer are threatening the water quality of the park. Plans are in place to deepen Miami harbor by 9 m (30 ft) which would cause huge amounts of toxic materials now trapped in sediments to be released. The Intercoastal Waterway that runs through the long axis of the park is on the verge of being dredged.

As local population increases, so does the number of vessel groundings at the park. Florida requires no special license to operate a boat, thus inexperienced boaters are often stranded on shoals, reefs, and sand bars. Buoys and low speed zones are an attempt to reduce the severity of the situation, but monitoring and patrolling boat activity (cooperation with the U.S. Coast Guard) is difficult in the large park. Markers also affect the viewshed of the park. Recovering costs of restoration from responsible parties is very difficult. Park staff needs to join forces with NOAA, FKNMS, DEP, and other state agencies to research the cumulative effects of this boating activity and help restore some of the damage caused by vessel groundings.

Research and monitoring questions and suggestions include: What contaminants are attached to sediments emanating from canals? How can the park cooperate with federal, state, and local agencies to remediate threats to water quality at Biscayne? Discuss alternatives to the fuel barge with the authorities of the Turkey Point nuclear power plant.

12. Soil characterization

Soils need to be mapped and characterized on the 42 islands at Biscayne. Locations of the fresh and saltwater peats in Biscayne Bay are of particular importance to determine the inundation history.

13. Paleontologic inventory

Biscayne National Park contains the fossil remnants of a great Pleistocene reef that forms the foundation for the Florida Keys. These fossilized remains have much to correlate with the modern system, but have to be inventoried, mapped, and described.

Research and monitoring questions and suggestions include: Inventory the Pleistocene fossil corals at Biscayne National Park. Attempt to locate and catalogue specimens previously removed from the park for public/private collections. Create an interpretive exhibit for the fossil resources on Winley Key.

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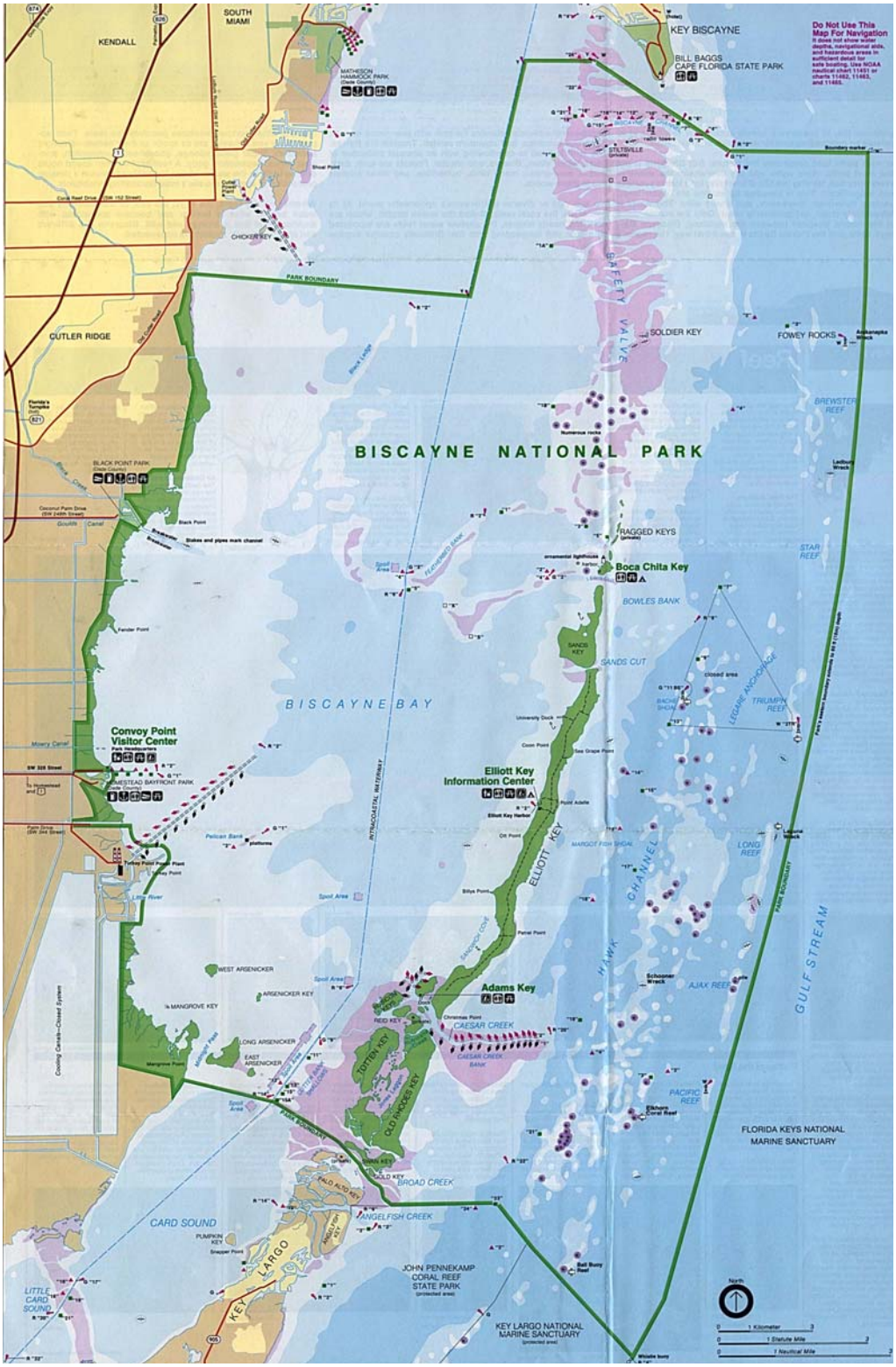
Map of Biscayne National Park