Big Cypress

National Park Service
U.S. Department of the Interior

Big Cypress National Preserve
Ochopee, Florida

Application to the International Dark-Sky Association for an International Dark-Sky Preserve Designation of Big Cypress National Preserve, Florida

July, 2016

Photo: Aaron Umpierre

Table of Contents

Summary

Located in Southwest Florida and encompassing over 729,000 acres, Big Cypress National Preserve is a cultural, ecological, and recreational haven. While the preserve was established in 1974, humans have occupied portions of the Big Cypress Swamp for thousands of years. All cultures of the Big Cypress Swamp, past and present, have utilized and revered the night, passing down knowledge of the night sky generation by generation.

Big Cypress National Preserve is home to over 1,000 flowering plants, 300 birds, 40 reptiles, 25 mammals, and 15 amphibians. In all, 15 federally and/or state threatened or endangered species can be found within our boundaries. Significantly, several of these endangered species, including the Florida panther, Florida bonneted bat, and ghost orchid, are dependent on naturally dark night environments during crucial components of their lives.

Big Cypress National Preserve is not only utilized by native flora and fauna. This unit of the National Park Service has become the most highly-visited National Preserve in the country, welcoming over 1.1 million visitors in 2015. Visitors to the preserve can find a wide array of activities and uses, including interpretive ranger-led activities, swamp walks, wildlife viewing, canoeing and kayaking, hunting, off-road vehicle use, camping, scenic driving, and star gazing. Night sky viewing is enhanced by the preserve's open landscapes, warm nights, and cleansing ocean breezes.

Big Cypress National Preserve includes some of the last remaining dark night skies of South Florida. This International Dark Sky Preserve application represents a commitment of Big Cypress National Preserve staff to protect and preserve the night sky, which includes natural, cultural, scenic, scientific, educational, personal health, and economic resources, for all Americans, today and in the future.

All of the criteria addressed under the silver-tier status requirements are met at Big Cypress National Preserve. Based on Big Cypress National Preserve's qualifications in each of the following categories designated by the IDA, we feel that the preserve should be considered for the Silver Tier designation.

1) **Philosophy: Nighttime environments that have minor impacts from light pollution and other artificial light disturbance, yet still display good quality night skies and have exemplary nighttime lightscapes.** Private landowners, Seminole and Miccosukee reservations and small villages, a few small communities, and regulated oil and gas operations exist within, or lie adjacent to the boundary of, Big Cypress National Preserve. Light pollution from these sources is minimal compared to larger, more distant cities.
2) **Artificial Light and Skyglow: Point light sources and glary lights do not dominate nighttime scene. Light domes present around horizon but do not stretch to zenith.** Big Cypress National Preserve is located within an hour's drive of over five million people residing along the east and west coasts of Florida, resulting in light domes from these locations along the horizon.
3) **Observable Sky Phenomena: Brighter sky phenomena can be regularly viewed, with fainter ones sometimes visible. Milky Way is visible in summer and winter.** The summer and winter Milky Way is regularly visible. Fainter night sky objects including M31 (Andromeda Galaxy), M44 (Praesepe), M42 (Orion Nebula), and NGC869 (Double Cluster) are regularly visible to the naked eye on clear, moonless nights, while faint planets such as Uranus can also been observed naked eye during optimal viewing conditions.
4) **Nocturnal Environment: Areas that have minor to moderate ground illumination from artificial skyglow. Lights that may cause disorientation to wildlife are distant. Disruption of ecological processes is minor with no impairment to plants or wildlife.** Several endangered species requiring naturally dark nocturnal environments, including the Florida panther, Florida bonneted bat, and ghost orchid, reside within Big Cypress National Preserve. Due to the isolation of Big Cypress National Preserve from large population centers, Big Cypress preserves a dark sky devoid of significant light pollution.

5) **Visual Limiting Magnitude: 6.0 to 6.7 under clear skies and good conditions.** Under optimal conditions and interior locations, visual limiting magnitude may be equal or greater than 6.8. Visual limiting magnitude between 6.0 to 6.7 is regularly encountered on clear, moonless nights.
6) **Bortle Sky Class: 3-5.** The NPS Night Skies Team has determined a Bortle class of 4 for Big Cypress National Preserve night skies, based on measurements from multiple sites over multiple nights.
7) **Unihedron Sky Quality Meter: 21.74-21.00.** Amateur astronomers have taken Unihedron Sky Quality readings during clear, moonless night skies that regularly measure between 21.00 and 21.74.

Please contact Christine Clark, Management Assistant at Big Cypress National Preserve, with any questions regarding this application. She may be contacted at 239-695-1153 or Christine_Clark@nps.gov.

Nomination Letter, Superintendent Letter, and Additional Letters of Support

INTERNATIONAL DARK-SKY ASSOCIATION
FLORIDA CHAPTER

... defending Florida's natural night sky environment

March 10, 2016

IDA's Dark Sky Places Committee
c/o Scott Feierabend
International Dark-Sky Association (IDA)
3223 N. First Avenue
Tucson, Arizona 85719

SUBJ: Nomination for Big Cypress National Preserve as an International Dark Sky Place

As Chair of the IDA Florida Chapter, it my privilege to nominate Big Cypress National Preserve ("Preserve"), a National Park Service (NPS) unit, for an International Dark Sky Place designation. This designation will be a great reward and a boost to the efforts of many working to protect the remaining natural night skies over South Florida; including the Preserve, our IDA Chapter, and other volunteers/ partners.

I had the distinct honor of approaching the Preserve in early 2013 and meeting the Superintendent at that time (Pedro Ramos) to motivate them to apply for this designation. Since then, the Preserve has made steady progress to earn this designation and is now ready to be rewarded for their efforts. Their exemplary actions include:

- An annual Winter Night Sky program that is one of the most popular interpretative programs of the NPS units in South Florida, often drawing residents from over 100 miles away. A single public night event typically draws 150 to 250 visitors. These events educate the public on a diversity of topics related to the night (e.g. nocturnal ecology, astronomy, folklore, light pollution, etc.). They are supported by several astronomy clubs in the region, as well as other night sky enthusiasts that volunteer their time and observing equipment.
- The Preserve has steadily increased its outreach and popularity as a dark sky destination and as an NPS unit committed to natural night sky conservation.
    - Their website includes pages that promote the night sky programming, educate about light pollution and solutions, and highlight the importance of natural lightscapes.
    - Their outreach utilizes social media outlets, including Facebook, Twitter and others.
    - Staff has communicated their night sky conservation efforts via local newspapers and radio, including the South Dade News Leader and WLRN public radio.
    - Staff conducts interpretive programs featuring night sky themes and issues at local community events.
    - A beautiful art piece was commissioned that promotes Big Cypress National Preserve as a place to enjoy the Milky Way. This work is now available for purchase to visitors as posters and postcards.
- In partnership with NPS Night Sky Team, night sky quality data and images were collected that demonstrate conditions at the Preserve. This dataset has become an educational tool for the Preserve and our IDA chapter.
- The Preserve supports amateur astronomy clubs in the region by allowing them to turn off lighting at certain areas so they can conduct deep night sky imaging.
- And, most importantly, the Preserve has done an admirable job at:
    - developing a policy to manage outdoor lighting,
    - making an adequate inventory of their lighting,
    - working on retrofits to ensure outdoor lighting is ecological responsible where needed,
    - developing a "good neighbor" relationship with private owners within the Preserve to encourage their voluntary participation in night sky protection, and

- gaining the support and commitment for night-sky friendly lighting from the oil/gas operator of a few small wellfields that operate under a lease agreement allowed by the public law that established this NPS Preserve in 1974.

Big Cypress is commonly regarded as the most biologically diverse region of the America's Everglades. Protecting this biodiversity is a day and night time job. Many species in the Preserve need a healthy nocturnal environment to thrive; including the firefly populations we still enjoy, the endangered Florida Panther and the Florida Bonneted Bat.

I could not be prouder of what Big Cypress National Preserve has accomplished over the past 3 years. They have set an example for other NPS units in Florida and the Eastern United States to follow. And, for those of us in the "trenches" of a growing grassroots movement in Florida, we see this designation as a means of elevating night sky conservation issues across the State and motivating many more to protect the night.

With sincere anticipation,

Diana Umpierre, AICP, GISP
International Dark-Sky Association
IDA Florida Chapter, Chair
Pembroke Pines, FL
NightSkyConservancy@gmail.com
https://www.facebook.com/NightSkyConservancy
(954) 829-7632

cc: *Karen Treviño,* Chief, NPS Natural Sounds and Night Skies Division
Tammy Whittington, Superintendent, Big Cypress National Preserve
Pedro Ramos, Superintendent, Everglades & Dry Tortugas National Parks
Luke Gommermann, Park Ranger, Big Cypress National Preserve
Christine Clark, Management Assistant, Big Cypress National Preserve

United States Department of the Interior

NATIONAL PARK SERVICE

Big Cypress National Preserve
33100 Tamiami Trail East
Ochopee, Florida 34141-9710

IN REPLY REFER TO:
N36 (BICY-S)

March 28, 2016

Scott Feierabend
International Dark-Sky Association
Dark Sky Places Committee
3223 North First Avenue
Tuscon, Arizona 85719

Dear Mr. Feierabend:

As the Superintendent of Big Cypress National Preserve, it is both my privilege and pleasure to support this application for International Dark Sky Preserve designation. The night skies over Big Cypress National Preserve contain one of the darkest astronomical displays found across the entire Eastern United States. We are the "dark heart" of South Florida. With nearly 6 million residents living a little more than an hour's drive from the Preserve's boundaries, our opportunity to share the splendor of the night sky – and promote night sky conservation – may be without parallel.

Spanning nearly three-quarters of a million acres, Big Cypress National Preserve was recognized in its enabling legislation to contain great "natural, scenic, hydrologic, floral and faunal, and recreational values." In accordance with the Organic Act of 1916, we are charged to protect and preserve these values for all Americans, today and in the future. Included within these values is the night sky. The night sky is a natural resource that has profoundly shaped our native flora and fauna, from the nocturnal movements of the endangered Florida panther, to the brilliant, white blossom of the endangered ghost orchid and its nocturnal pollinator, the giant sphinx moth. Additionally, lands within Big Cypress National Preserve were, and continue to be, home to numerous cultures dating back thousands of years who have all held the night sky with great significance.

Many features of Big Cypress National Preserve make it ideal for night sky viewing. Our open landscapes provide sweeping vistas of the night sky, warm nights make viewing comfortable, and ocean breezes cleanse the atmosphere of haze and pollution. Visitors can take advantage of these features while they camp under the stars or attend ranger-led interpretive programs focused on the night sky.

Visitor feedback has informed us they are highly interested – even desperate – to protect the night sky over Big Cypress National Preserve. As the light domes originating from metropolises to our east and west can attest, the effect of light pollution in our night sky is easy to see and experience. While our night skies may not be as dark as those of more remote areas, this setting provides a prime location to educate visitors on the implications of light pollution, many of whom reside within the sources of light pollution, and promote stewardship in protecting the night sky. We are committed to incorporate dark sky education and protection through our interpretation division.

The night sky of Big Cypress National Preserve is protected, in part, by the low level of development within our boundaries. We have already made, and will continue to make, improvements to existing lighting across our facilities until we are fully compliant with our lighting management guidelines enclosed in this application. We commit that 90% of lights will be in compliance with night-sky friendly guidelines listed within our application within five years and we will meet 100% compliance within ten years. In addition, we are promoting night sky conservation practices with private property owners within the preserve and local communities beyond our boundaries.

The staff of Big Cypress National Preserve recognizes the value of the night sky and is devoted to its protection. As the Superintendent, it is my personal commitment to ensure that future management documents created by the preserve will be brought into conformance with the outdoor lighting guidelines included in this nomination package.

Due to its natural darkness and landscape features, proximity to dense populations searching for dark skies, ability to provide interpretive programs featuring the night sky, and commitment to outdoor lighting renovations, Big Cypress National Preserve is a prime, and influential, candidate for International Dark-Sky Association's International Dark Sky Places designation.

Please give this nomination your utmost consideration.

Sincerely,

Tammy Whittington

Tammy Whittington
Superintendent

Enclosures

December 29, 2013

Letter of Support for Big Cypress National Preserve as an IDA recognized Dark Sky Park

South Florida Amateur Astronomers Association, Inc. (SFAAA)
16001 W SR 84
Sunrise, FL 33326
Fox Astronomical Observatory
954-384-0442
www.sfaaa.com

IDA Dark Sky Parks Reviewers:

This is a Letter of Support for the National Parks Service Big Cypress National Preserve as an IDA recognized Dark Sky Park from the South Florida Amateur Astronomers Association, Inc. (SFAAA). The SFAAA has been around since the mid-1960s, currently has about 120 members, and has seen the city and suburban skies in South Florida brighten over the years. Our group of amateur astronomers now has only a handful of truly dark sky places where we can observe and image a dark night sky. The National Park Service Big Cypress National Preserve is a great one and deserves your recognition.

Given the Native Americans and the other residents of the Preserve prior to its founding there is a heritage of respect for the lands that make up the Preserve. During the winter months and into the early spring the Preserve hosts monthly night sky education programs which include dark skies education. During these months in South Florida the skies are clearer of rain and clouds and it is the peak of the tourist season. The SFAAA, in cooperation with the IDA South Florida, participates in these programs by being one of the four South Florida astronomy groups invited to provide and point telescopes and large binoculars so the public can view the night sky.

On a clear Moonless night the Preserve is very dark. The Milky Way is clearly visible to the naked eye as are a number of dark sky objects and phenomenon. The nearest city light is Everglades City about 5 miles from the Western edge of the Preserve. The SFAAA has campaigned with local businesses and leaders of this small town to recognize ecotourism and to reduce sky glow.

The best recommendation the SFAAA can provide is that on those good Winter nights our members may travel about 2 hours in order to get to Big Cypress National Preserve for the dark skies,.

Regards,

Monroe Pattillo
President, SFAAA

January 20, 2014

Dear Sirs:

We at the Everglades Astronomical Society are convinced the night sky is an important national and cultural resource. We applaud the efforts of Big Cypress National Preserve to maintain and conserve the dark skies above the everglades for the enjoyment of everyone. We would like to pledge our support for this effort and will help out anyway we can.

Sincerely Yours,

Michael P. Usher
Director, Everglades Astronomical Society

BREITBURN

April 11, 2016

Board of Directors
International Dark-Sky Association
3223 North First Avenue
Tuscon, Arizona 85719

Dear IDA Board Members:

Breitburn Florida LLC is proud of its long-standing and positive relationship with the Big Cypress National Preserve. As the operator of oil and gas production facilities at North Bear Island and Raccoon Point within the Big Cypress National Preserve since 2007, Breitburn and its team have worked closely with the Preserve and its team so that the unique and biologically-sensitive lands of the Preserve are protected. We proactively manage our operations to ensure a safe work environment while maintaining the health of the regional watershed and the protection of local wildlife.

We also recognize the significance and importance of Big Cypress National Preserve's dark night skies. Removed from the larger, brighter cities along South Florida's coastlines, the Preserve helps keep a large portion of this region's land largely free of light at night. We are supportive of the Preserve's role in maintaining dark night skies for the promotion of personal and ecological health as well as for providing public access to, and personal enjoyment of, the night sky.

During our operations, it is necessary that we utilize outdoor lighting to illuminate work areas for the protection and safety of our work crews and to insure proper functioning of production equipment. That having been said, we always strive to minimize outdoor lighting used at our operations. By way of example, we are currently planning to retrofit existing lighting by re-orienting fixtures towards the ground where possible and by installing shielding and motion sensors to further minimize our lighting footprint. These efforts will not only reduce light in the Preserve but they make good business sense as well: we view this as a win-win proposition for all involved

By seeking to become an International Dark Sky Park, we understand that the Big Cypress National Preserve is committing to have 90% of their outdoor lighting comply with night-sky friendly guidelines within five years and 100% of their outdoor lighting in compliance within ten years. We fully support the efforts of Big Cypress National Preserve as they seek designation as an International Dark Sky Park, and we are committed to helping the Preserve meet its goals.

Sincerely

Ed Blake
Area Superintendent

BREITBURN FLORIDA, LLC
Providing management to BreitBurn Energy Partners L.P. and BreitBurn Energy Company L.P.
P.O. Box 3236 Immokalee, Florida 34143 Phone (239) 657-2171 Fax (239) 657-3949

Park Location and General Description

Big Cypress National Preserve (BICY) is located in southwestern Florida and is centrally located between the metropolitan areas of Naples (about 30 miles to the west) and Miami/Fort Lauderdale (about 40 miles to the east). Located within the large, mostly undeveloped portion of the Big Cypress Swamp Watershed, Big Cypress National Preserve spans nearly 3,000 square kilometers (Figure 1) and serves as a sanctuary for flora and fauna, contains water that flows into coastal estuaries and recharges underground aquifers, and preserves a portion of the rich cultural heritage of South Florida.

Big Cypress National Preserve was created through an exercise in compromise. When plans were unveiled in the 1960s calling for the construction of the world's largest jetport in the heart of the Big Cypress Swamp, land owners and users from numerous backgrounds, from sportsmen and off-road vehicle enthusiasts to environmentalists and local native tribes, joined together to save the land from future development. Through their collective efforts, the concept of the national preserve was born, creating a protected area that allowed for specific land use activities that would be prohibited in other national parks. Established in 1974 by President Gerald Ford, Big Cypress National Preserve was created

> …in order to assure the preservation, conservation, and protection of the natural, scenic, hydrologic, floral and faunal, and recreational values of the Big Cypress Watershed in the State of Florida and to provide for the enhancement and public enjoyment thereof… Enabling Legislation, 1974

Figure 1: Map of Big Cypress National Preserve NPS Harpers Ferry Center

The original boundary of the preserve contained over 2,320 square kilometers. Following the addition of the Addition Lands in 1988, Big Cypress National Preserve today encompasses over 2,950 square kilometers of diverse habitats, including hardwood hammocks, slash pinelands, cypress swamps, freshwater marl prairies, and mangrove estuaries. The preserve neighbors Everglades National Park to the south and southwest, the Florida State Miccosukee Indian Reservation and Big Cypress Seminole Indian Reservation to the east and north, respectively, the Florida Panther National Wildlife Refuge to the northwest, and the Fakahatchee Strand Preserve State Park to the west.

In accordance with the enabling legislation, the entire three quarters of one million acres is open to the public without fee. Access to the preserve is available along one of two primary routes. The Tamiami Trail (U.S. Highway 41) traverses the southern half of the preserve for approximately 37 miles and provides access to the Oasis Visitor Center, Big Cypress Swamp Welcome Center, and numerous boardwalks, campgrounds, hiking trails, boat launches, and scenic drives. The Welcome Center and Visitor Center are open regular business hours 364 days a year (only closed on Christmas Day), the rest of the Preserve is open to the public 24 hours a day. Parking areas, trails, and campgrounds are available to all, year round. Alligator Alley (Interstate 75) crosses the northern half of the preserve for approximately 32 miles, providing additional recreational access points to enter the vast backcountry of the Preserve.

First-time visitors to Big Cypress see a flat, wet, primitive land. The area was named Big Cypress because of its extent, not because of the size of its trees, and visitors drive for miles through an expanse of open prairies dotted with cypress trees, distant pinelands, and tree islands broken at intervals by dark, forested swamps. Wildlife is abundant – great blue herons, anhingas, kingfishers, and alligators line the roadside canals and give visitors an exciting visual focus. On the whole, first impressions are likely to be of an inhospitable land, with no firm ground beyond the highway shoulders.

Seasoned visitors and residents, however, see another side of Big Cypress. Sportsmen pursue recreational activities ranging from airboating to bow hunting. Naturalists study the area's rich natural history and its delicate ecological relationships. And some Miccosukee Indians who make their homes in the preserve depend on its resources for food, shelter, and spiritual needs.

For all of these people, however, Big Cypress must be experienced on its own terms. It never becomes too familiar, and getting lost, stuck, or broken down is part of the challenge of this formidable land.

Basic Information of Region

Big Cypress National Preserve is located within the Big Cypress Swamp Watershed in southwest Florida and includes portions of Collier, Miami-Dade, and Monroe counties. The area's climate is influenced by both tropical and temperate weather systems and is characterized by hot, humid summers and mild, dry winters. Precipitation follows a seasonal pattern, with the majority of rainfall occurring during the "wet season," generally May through October. Elevations within Big Cypress National Preserve vary from near sea level along our southwestern boundary to a high elevation of 18 feet. The frequency of fire, initiated via natural lightning strikes and managed prescribed burns, in combination with elevation and hydrology, work synergistically to largely determine the mosaic of habitats found within our boundaries.

Just as the waters of the Atlantic Ocean, Florida Bay, and Gulf of Mexico surround the coastlines of Florida, so too is Big Cypress National Preserve surrounded by another sea – a sea of light (figures 2 and 3). To our east lies the Miami-Ft. Lauderdale-West Palm Beach metropolis, the largest metropolitan area in the southeastern United States home to over 5.5 million people. To our west, the cities of Naples and Marco Island are home to over 320,000, growing over 27 percent between 2000 and 2010. And to our southeast, the city of Everglades City lies only 3 miles from our Preserve's boundary.

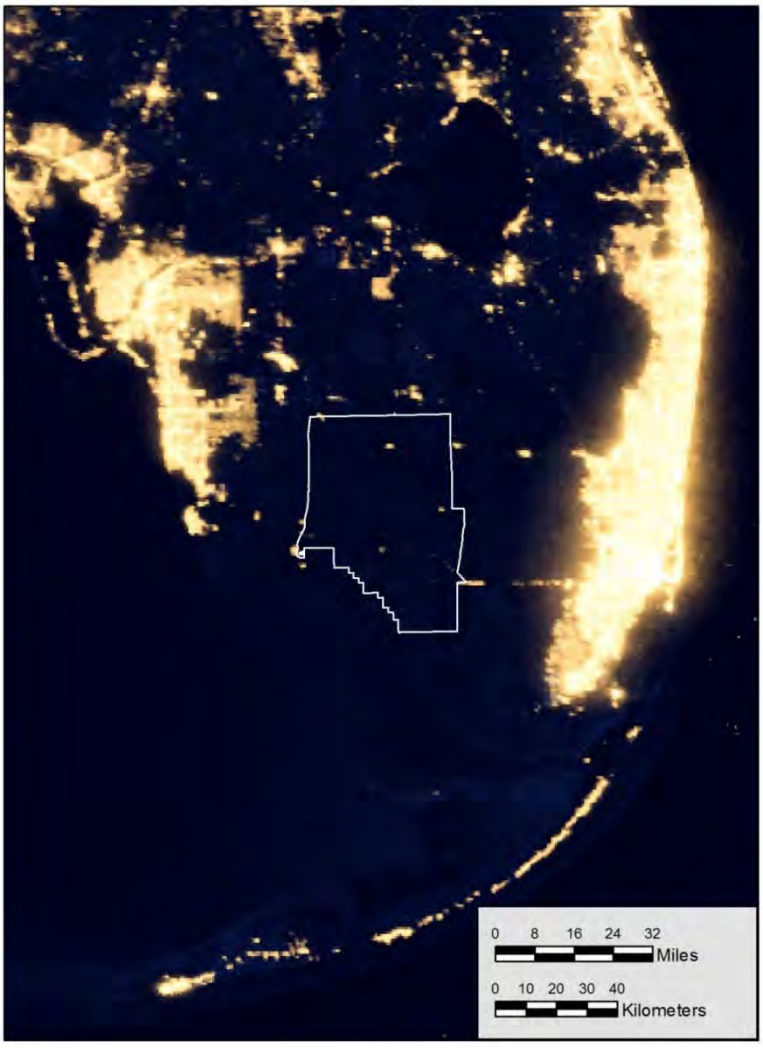


Figure 2: Map of light pollution in South Florida NASA Earth Observatory, 2012

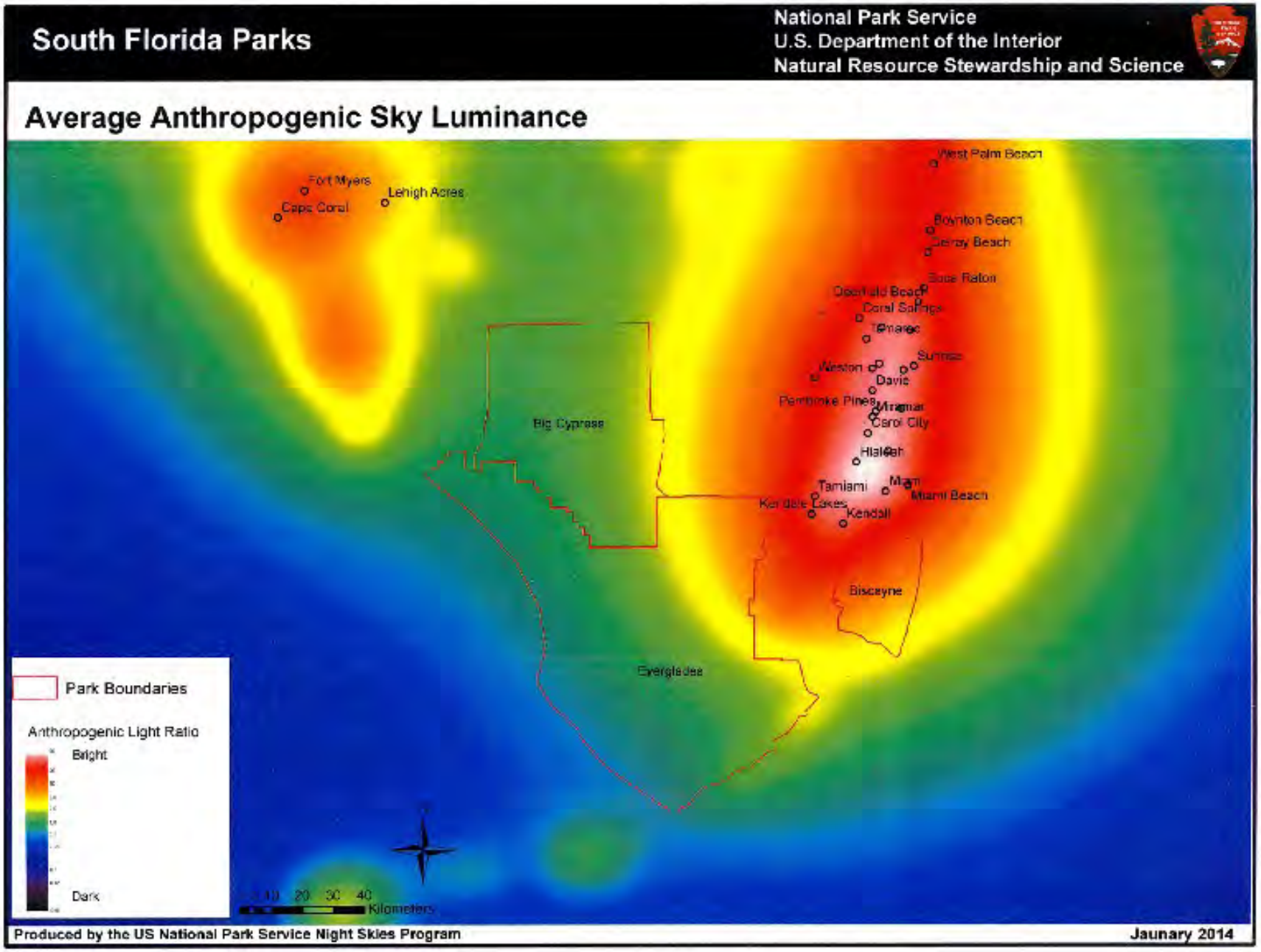


Figure 3: Model of light pollution in South Florida

Preserve Resources and Significance

Natural Resources

Water is a principal natural resource of the entire south Florida region, and about 90% of Big Cypress is flooded during the wet season (May – October). Because of the high annual rainfall (mean annual precipitation is 54 inches, with about 75% falling during the summer) and the flat limestone topography (a seaward slope of about 2 inches per mile), the inundation lasts for several months beyond the actual rainfall period (Duever et al. 1986). Because the preserve is relatively undeveloped, it serves as a large natural reservoir and nutrient filter, permitting natural biological processes to nourish diverse ecological communities that are distinctive to southern Florida. Throughout the wet season most water flows in a southwesterly direction through the estuaries of western Everglades National Park. In remaining locations the water flows in a southeasterly direction towards the water conservation areas. The ecology of the preserve is finely tuned to the seasonal flow of water, and any hydrologic changes can alter this sensitive subtropical habitat.

Extensive prairies and marshes, forested swamps, pinelands, and shallow sloughs characterize the preserve. The hydroperiod, the amount of time each year that soils are saturated, is the major determinant of vegetative communities, and a difference of only a few inches in elevation changes the hydroperiod and leads to the establishment of totally different plant communities. At one time Big Cypress contained pristine cypress strands and old-growth pinelands, but by 1950 virtually all the cypress strands of commercial value and much of the pinelands within the preserve had been logged. The young cypress strands, mixed-hardwood swamps, and pinelands in the preserve today are still recovering. Big Cypress is also noted for its widespread cypress prairies — natural grasslands dotted with stunted cypress trees.

Most wildlife species native to south Florida occur within the Big Cypress watershed. A total of 31 animal species in the Addition receive some level of special protection by the federal government or the state of Florida. Most of these species are limited to South Florida, and they are declining as a result of habitat reduction caused by water management projects, urbanization, and agricultural expansion. One of the United States' most endangered mammals, the Florida panther (*Puma concolor coryi*), is the subject of an intensive recovery effort throughout the region, including the preserve.

Cultural Resources

The Preserve is located within the Glades region (an area defined by hardwood and pinewood hammocks, sawgrass, and dwarf cypress interspersed with shallow freshwater marshes and prairies) of south Florida. The limited vegetation of this region is a result of thin soils underlain by limestone bedrock. This region also includes the Everglades, portions of the Atlantic coast, the Ten Thousand Islands, and the Florida Keys. Human habitation of the Glades region can be traced back to the late Pleistocene or Lithic era.

The prehistoric periods of human culture represented by sites in south Florida include
(1) the Paleo–Indian period (10,000–8,000 BC,
(2) the Archaic period, (which spanned roughly 8,000 BC to 500 BC), and
(3) the Glades Tradition (which extends into the historic period, spanning 500 BC to AD 1760).

The historic periods of human culture begin with the initial Spanish contact in 1513 and continue through the 20th century and the creation of Big Cypress National Preserve.

Evidence of Paleo-Indian human habitation is rare in south Florida, and none has been found within the Addition. In all likelihood, most sites associated with the Paleo Indians of this era are submerged beneath the state's coastal waters.

However, at least one area within the preserve, Deep Lake (a sinkhole), has the potential for association with this prehistoric period.

As of 2001, four hundred and fifty-five archeological sites have been identified in the preserve. These resources are associated with the Archaic and Glades periods in the Addition's cultural chronology. Most of these sites are earth middens, which are refuse piles commonly made up of cultural artifacts and faunal remains.

Based on the archeological evidence, Big Cypress was used year-round by early inhabitants for transitory hunting and gathering. Agriculture was apparently insignificant, perhaps because rich plant, fish, and animal food sources were available. Land animals and seafood were the primary sources of protein. Early cultures in the Big Cypress were not as highly developed as other cultures in the Southeast, possibly because people relied on wild food sources rather than cultivating crops, and the foods, especially shellfish, were not easily preserved and stored for later use. Consequently, only a few large, relatively permanent settlements have been identified.

Today, Seminole and Miccosukee Indians live in the Preserve and also use these lands as a source of natural materials for housing, crafts, and other cultural and religious uses.

Night Sky Preservation Guidance

Protection of the night sky has long been a prerogative of the National Park Service and Big Cypress National Preserve. A summary of guidance documents relating to night sky resource protection is provided below.

National Park Service Organic Act, 1916

This legislation, enacted by the 64th United States Congress and signed into law by Presided Woodrow Wilson in 1916, established the United States National Park Service as the agency that would oversee all national park units. The NPS Organic Act further specifies protection and preservation of the scenery and resources held within national park units:

> "The service thus established shall promote and regulate the use of the Federal areas known as national parks, monuments, and reservations hereinafter specified by such means and measures as conform to the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

The night sky qualifies as both a scenic landscape and natural resource whose protection and preservation is ensured by the NPS Organic Act.

Big Cypress National Preserve General Management Plan/Final Environmental Impact Statement, 1991

This document guides visitor use, natural and cultural resource management, and development within the original boundaries of Big Cypress National Preserve.

"The National Park Service envisions Big Cypress National Preserve as a nationally significant ecological resource – a primitive area where ecological processes are restored and maintained…"

> **Visual Corridors**
>
> "…viewsheds from major roads and facilities are regarded as important elements of the visitor experience, and the maintenance of unimpaired, natural scenes would be essential to the visitor experience…
>
> **Air Quality**
>
> "…if their air quality related values are considered important attributes. These values include visibility, plants and animals dependent on the air environment…"

NPS Management Policies, 2006

This document provides National Park Service staff with required and/or recommended policies to ensure stewardship in the management of the national parks following the directives of the National Park Service Organic Act.

> **1.4.6 What Constitutes Park Resources and Values**
>
> "The 'park resources and values' that are subject to the no-impairment standard include the park's scenery, natural and historic objects, and wildlife, and the processes and conditions that sustain them, including…natural visibility, both in daytime and at night…"
>
> **4.1.4 Partnerships**
>
> "The Service will seek the cooperation of others in minimizing the impacts of influences originating outside parks by controlling noise and artificial lighting…"

4.10 Lightscape Management

"The Service will preserve, to the greatest extent possible, the natural lightscape of parks, which are natural resources and values that exist in the absence of human-caused light…" "The stars, planets, and earth's moon that are visible during clear nights influence humans and many other species of animals, such as birds that navigate by the stars or prey animals that reduce their activities during moonlit nights.

Improper outdoor lighting can impede the view and visitor enjoyment of a natural dark night sky. Recognizing the roles that light and dark periods and darkness play in natural resource process and the evolution of species, the Service will protect natural darkness and other components of the natural lightscape in parks. To prevent the loss of dark conditions and of natural night skies, the Service will minimize light that emanates from park facilities, and also seek the cooperation of park visitors, neighbors, and local government agencies to prevent or minimize the intrusion of artificial light into the night scene of the ecosystem of parks. The Service will not use artificial lighting in areas such as sea turtle nesting locations where the presence of the artificial lighting will disrupt a park's dark-dependent natural resource components.

The Service will

- restrict the use of artificial lighting in parks to those areas where security, basic human safety, and specific cultural resource requirements must be met;
- use minimal-impact lighting techniques;
- shield the use of artificial lighting where necessary to prevent the disruption of the night sky, natural cave processes, physiological processes of living organisms, and similar natural processes.

The decision about whether or not to install artificial lighting in particular circumstances is left to the discretion of the superintendent and is made through the planning process.

9.3.1.4 Amphitheaters

"Artificial lighting must be carefully directed and kept to a minimum, with due regard for natural night sky conditions."

9.3.2.1 Campgrounds

"Lighting will be energy efficient and shielded as much as possible so that visitors have the opportunity to experience the natural darkness and night skies."

Big Cypress National Preserve – Addition: Final General Management Plan/Wilderness Study/Off-Road Vehicle Management Plan/Environmental Impact Statement, 2010

The *Addition* document defined resource conditions and visitor uses within 147,000 acres of land (the "Addition Lands") adjoined to Big Cypress National Preserve in 1988.

Guiding Principles for Management: Natural Resources - Air Quality

"The National Park Service will protect views of the Addition's noteworthy night sky four resource purposes and for visitor enjoyment."

Guiding Principles for Management: Natural Resources – Wilderness

"Efforts will be expanded to ensure that wilderness features, such as natural soundscapes and views of the night skies, are not degraded."

A Call to Action, United States National Park Service, 2011 (revised 2012)

This document serves to outline specific goals and actions intended to advance the mission of the National Park Service as it looks forward to its second century of service.

Goal #27: "Starry, Starry Night"
"Lead the way in protecting natural darkness as a precious resource and create a model for dark sky protection by establishing America's first Dark Sky Cooperative on the Colorado Plateau in collaboration with other federal agencies, partners, and local communities."

Goal #38: "Enjoy the View"
"Protect clean, clear air and spectacular scenery now and for future generations. To do this we will lead collaborative efforts in 10 parks creating viewshed cooperatives with other federal agencies, tribes, and local partners to assess air pollutants and preserve treasured viewsheds and natural and cultural resources."

National Park Service Green Parks Plan, 2012

This document provides "a long-term strategic plan for sustainable management of NPS operations… The plan focuses on the impact of park facilities on the environment and human welfare and encourages NPS employees to adopt sustainability in their daily activities."

"**Preserve Outdoor Values"**

"The NPS will minimize the impact of facility operations on the external environment.

Outdoor experiences can be adversely affected by facility operations. Exterior lighting can reduce dark night sky quality… Reducing the impact of NPS operations on the environment will improve the visitor experience and protect natural and cultural resources through the preservation of night skies, natural sounds, water quality, ecosystems, and viewsheds.

Objectives

1. The NPS will reduce light pollution from park facilities with the goal of dark night sky preservation…
2. The NPS will ensure that all facilities and operations are sustainably integrated into the park landscape to minimize impact on the natural and cultural environment."

NPS Natural Sounds & Night Skies Division Sustainable Outdoor Lighting Principles, October 2015

This document states the importance of night skies to resources protected within NPS boundaries and provides Sustainable Outdoor Lighting Principles to prevent light pollution.

"The National Park Service is charged with protecting night skies along with other park resources. To prevent the loss of dark conditions and of natural night skies, NPS follows science-based principles of sustainable outdoor lighting.

1. Light only if you need it
    - Consider if a light is really necessary (both new and existing)
    - Select other means of enhancing visibility and wayfinding such as reflective surfaces, signage, lighter paint colors, removal of hazards, and flashlights

2. Light only when you need it
    - Control lighting through devices such as timers, motion sensors, remote controls, other smart sensors, and dimmable lamps
    - Turn off lights when leaving an area

3. Light only where you need it
    - Direct the light where it is needed to accomplish a task or activity
    - Shield or retrofit fixtures so they cast no light upward (full cut-off fixture)
    - Avoid fixtures with globes or diffusers that hang below the light fixture
    - Avoid lights that are aimed laterally
4. Use appropriate color spectra for needs and conditions
    - Avoid the use of cool-white or bluish light
    - Select lights with a warmer tone (yellow, amber, red) such as filtered LEDs
5. Use the minimum amount of light necessary
    - Provide adequate visual contrast for a specific task
    - Relatively little light is necessary in typically dark environments
6. Choose energy efficient lamps and fixtures
    - True energy efficiency incorporates multiple factors (not only efficiency of lamp or light bulb)
    - Consider all design constraints and objectives, activity area, spacing of lights, timing of lights, directionality
    - Examine the luminous efficacy, typically stated in lumens per watt, for suitable lamp types"

Big Cypress National Preserve Outdoor Lighting Management Plan

Purposes and Goals

This plan serves as the foundation for preserving naturally dark sky conditions at Big Cypress National Preserve. The guidelines and principles within will be the basis for management decisions about lightscape management, upkeep and possible future lighting projects. This plan will serve to guide any future management documents relating to the night sky resource. In the 2006 NPS Management Policies document, lightscape management is defined as: "the effective use of good design to appropriately light areas and minimize or eliminate light clutter, the spillover of light into areas where light is not wanted, and light pollution, all of which wastes energy and impacts park visitors, neighbors and resources."

The 2010 Big National Preserve *Addition: Final General Management Plan* includes taking steps to preserve and protect natural resources including "views of the Addition's noteworthy night sky" and that "efforts will be expanded to ensure that wilderness features, such as natural soundscapes and views of the night skies, are not degraded."

The proximity of Big Cypress National Preserve to large population centers beyond our boundaries make access to the park relatively easy. Yet, the preserve is far enough away from these population centers to ensure a dark sky with some of the highest quality in South Florida and the Eastern United States. This combination of factors makes the opportunity for excellent outreach and education opportunities today and into the future, if preserve lighting is managed appropriately.

Big Cypress National Preserve has undertaken a series of tangible mitigations to the preserve's exterior lighting. The principles and prescriptions referenced in these guidelines have helped the preserve to begin mitigating ineffective lighting treatments identified in the course of the outdoor lighting inventory. The need to continue mitigation of lighting fixtures underscores the importance of establishing comprehensive lighting guidelines to avoid similar problems in the future.

Currently, 91% of the preserve's exterior light fixtures comply with guidelines outlined in this document. This figure incorporates those lights that have been permanently disabled and are in the process of being removed. All nonconforming lights were addressed individually and were prescribed specific mitigations to bring them into full conformance with both IDA and Big Cypress National Preserve lighting standards. Within 3 years, the preserve will bring 100% of its outdoor lighting into conformance with these guidelines. Total number of non-compliant fixtures is 18 (9%). The preserve will bring 6 fixtures per year into compliance with guidelines over the 3 year period. Funding to bring these fixtures into compliance will be from the existing accounts, which are intended to maintain the facilities where some of the fixtures are located, and from our Preserve base account funds for those fixtures that are located at operations support facilities. The lighting retrofits will take place by geographical area i.e., Oasis area, Ochopee area etc.

This lighting plan will help ensure that the location, duration, and intensity of all artificial lighting will be limited to only that which is needed to achieve a basic level of safety, security, and convenience for NPS employees, residents, and visitors. Additionally, Big Cypress National Preserve has delineated a *Standard Lighting Zone (LZ1)*, *Minimal Lighting Zone (LZ0)*, *Natural Darkness Zone (LZ00)*, and *Private Lighting Zone (PLZ)* within the preserve. Standards for outdoor lighting are provided for each zone below.

As of April 8, 2015, 21 counties and 64 municipalities in the state of Florida have a lighting ordinance prohibiting light from reaching beaches at night to reduce sea turtle disorientation (http://myfwc.com/conservation/you-conserve/lighting/ordinances/). Big Cypress National Preserve does not contain any locations known to be utilized as a nesting area for sea turtles.

All exterior lighting owned by, or on land leased from, Big Cypress National Preserve shall be designed to eliminate light trespass, minimize glare, and use an intensity, color, and duration that will preserve the natural darkness as much as possible. In addition, regardless of lighting zones under our control, no unshielded light source above 500 initial lumens will be utilized within Big Cypress National Preserve. This includes all light sources used for security for Preserve facilities.

Existing Standards and Codes

A Royal Astronomical Society of Canada (RASC) Dark Sky Park is defined as an area whose night sky has little or no sky glow and minimal lighting within the DSP. As such, Big Cypress National Preserve has created and adapted a lighting guideline outline that minimizes the lighting within the preserve.

National Park Service Guidance

NPS Management Policies direct NPS units to use artificial light on an "only as needed" basis and to minimize impact whenever possible. Merely shielding a light does not necessarily constitute lightscape, wildlife, or night-sky friendliness; especially if that light is unnecessary in the first place. Even when a light is necessary, the incorporation of a timer, motion sensor, or switch can greatly reduce its impact.

The National Park Service Night Skies Program has developed draft outdoor lighting guidelines based on the International Engineering Society's Outdoor Lighting Standards (Interim Guidance for Outdoor Lighting in National Parks, 2013). The draft guidelines include extensive information on the reasons for protecting dark night skies, the science of artificial light, human vision, and the role of the National Park Service in providing leadership in lighting science and policy. The guidelines outline principles for exterior lighting in park settings, as well as mitigation approaches for designing, selecting and operating exterior lighting. A goal of these guidelines is to help park's realize effective lighting solutions while minimizing light pollution.

The following principles, adapted from the Interim Guidance for Outdoor Lighting in National Parks (2013) and other sources, provide the basic foundation for lightscape management decisions at Big Cypress National Preserve.

Permanent outdoor lighting should only be installed and operated for specific needs
The need for illumination must be warranted.

Delineate areas where no permanent outdoor lighting is allowed
Parks with sensitive natural resources should designate a natural darkness zone.

Outdoor environments in parks are not lighted for maximum safety
Visitors, employees, and residents of national parks assume a certain level of risk.

Lighting for physical security should be reasonable and practical
Security lighting should not outweigh resource preservation and visitor enjoyment.

Lighting industry recommended practices are seldom appropriate for parks
Industry standards lack the environmental sensitivity required for dark sky parks.

The darker the environment, the less illumination is necessary
Reduced (low-level) lighting provides adequate contrast in darker settings.

Energy efficiency is not enough
Energy efficiency alone does not make a light fixture appropriate and sustainable.

Keep lighting impacts on-site
Lighting should be limited to intended areas and should not be visible elsewhere.

More recently, the National Park Service Natural Sounds & Night Skies Division has released its Sustainable Outdoor Lighting Principles (Sustainable Outdoor Lighting Principles, 2015).

Big Cypress National Preserve's Outdoor Lighting Principles (below) draw heavily from these NPS documents, as well as similar documents included within other National Park Units that have already been designated as International Dark-Sky Parks by the International Dark-Sky Association.

Outdoor Lighting Principles

7. Light only if you need it
    - Consider if a light is really necessary (both new and existing)

- Select other means of enhancing visibility and wayfinding such as reflective surfaces, signage, lighter paint colors, removal of hazards, and flashlights
- Lighting installations should be placed only where uses dictate

8. Light only when you need it
    - Control lighting through devices such as timers, motion sensors, remote controls, other smart sensors, and dimmable lamps
    - Turn off lights when leaving an area
    - Rather than defaulting to a dusk-til-dawn operational cycle, lighting controls should be designed to minimize the amount of time the light is on while still fulfilling the need met by installing the light at that spot in the first place
9. Light only where you need it
    - Direct the light downward where it is needed to accomplish a task or activity
    - Shield or retrofit fixtures so they cast no light upward (full cut-off fixture)
    - Avoid fixtures with globes or diffusers that hang below the light fixture
    - Avoid lights that are aimed laterally
    - No fixture should emit light above the horizontal. In most cases, beams of light should be restricted even further
10. Use appropriate color spectra for needs and conditions
    - Humans and many other animals are most sensitive to blue/white light. Most evening lighting goals can be achieved using warmer temperature lighting, which decreases the disruption to wildlife (including insects), maintains the human ability to adapt to low light conditions, and decreases sky glow
    - The color tint of white light is measured in Kelvins (K) on a Color Correlated Temperature (CCT) scale in which warm-toned white light has smaller values (1800-3000 K) and cold-toned light has larger values (5000 K and higher). Between 3000 and 5000 K, light is said to be "neutral" in tone. The common incandescent lamp is 2700 K.
    - Traditional incandescent lighting is about 2700 K, a warm toned light considered normal for residential and hospitality lighting in North America. For reasons of consistency and appearance, light sources should be 2700-3000 K with a minimum Color Rendering Index of 70. Amber or yellow light sources are preferable, both to limit attraction by insects and to reduce sky glow. Light sources should be chosen for energy efficiency, long life and low maintenance. Because some locations in the park experience extremes of temperature, moisture, and exposure, light sources must be suitable for all expected operating conditions. The following light sources are acceptable for outside use:
        i. LED 2700 K "warm" white lamps, yellow, or amber colored, 1, 3, or 7 watt. LED's superior 54 life, energy efficiency, instant starting and low temperature performance are superior but some capabilities of the source are limited. Use with caution in hot climates. Use amber LEDs in most environmentally sensitive areas.
        ii. Compact fluorescent, 9 watt, twin tube and 13 watt double twin tube or Edison base spiral 3, &, 10, 13, or 26 watt (2700 K only or yellow "bug lamps"). Because of low starting temperature and low cost components, this light source can be used for many basic outdoor lighting applications.
        iii. Halogen IR, 20 watt, 12 volt MR16 lamp. Uses are generally limited to temporary (presence detector activated) lighting applications. Because of their low luminous efficacy they should not be used in continuous duty applications.
        iv. Ceramic metal halide lamps, 20 watts, T4.5 and 39 watt, T6, 3000 K only. In general, these are the most powerful light source to be used outdoors, but warm up and restrike time preclude use where frequent switching or power quality issues are present.
11. Use the minimum amount of light necessary
    - Provide adequate visual contrast for a specific task
    - Relatively little light is necessary in typically dark environments
12. Choose energy efficient lamps and fixtures
    - True energy efficiency incorporates multiple factors (not only efficiency of lamp or light bulb)
    - Consider all design constraints and objectives, activity area, spacing of lights, timing of lights, directionality
    - Examine the luminous efficacy, typically stated in lumens per watt, for suitable lamp types
    - Following principles of sustainable outdoor lighting will improve overall energy efficiency

Lighting Zones

In accordance with the NPS Interim Guidance on Outdoor Lighting Zones, 4th revision (2013), Big Cypress National Preserve has assigned all park areas to one of four designated lighting management zones (see figure **4**).

A. Standard Lighting Zone (LZ1). The Big Cypress Swamp Welcome Center, Oasis Visitor Center, Big Cypress Headquarters, housing areas, and maintenance yard are in this zone, which supports the basic operational needs of the park. This also includes lands occupied, currently and in the future, by oil and gas operations. Lighting here exists on a level dictated by necessity only, and should be restricted temporally and spatially.

***Standards*:** Exterior lighting exists solely for security and convenience. Lights shall remain on only in minimum capacity, and with the aim of safety and security. Permanent fixtures are allowed in this zone, provided they are limited to immediate task area. Artificial lighting is used only when necessary for safety, as in lights around fee stations, maintenance facilities, residential porches, and visitor centers. Any future buildings or projects will conform to these standards. In order to alleviate light trespass, the following basic principles are observed:

- Light fixtures should exist only where needed for specific tasks
- Light should only exist when necessary. Lights should operate on manual switches or motion sensors/timers.
- Light should only exist in the minimum amount necessary. Individual fixtures should be limited to 600 lumens, whether shielded or unshielded, with exceptions for specific safety and special uses based on need.
- Lights should be selected with warm colors, such as amber (≤2500 K color temperature).
- Energy efficiency should be considered when choosing lighting. Standard bulbs should be compact fluorescent (CFL), which are low-wattage, or light-emitting diodes (LED).
- Lights should be directed downward and shielded.
- Dedicated pathway lighting may be utilized for evening programs. Ranger-led and other public programs concentrate visitors, which may require additional lighting to ensure safe conditions. Permanent, low-wattage pathway lights will be installed; these will be shielded and manually controlled.
- In conformance with NPS Management Policies 9.3.1.4, any stage lighting during ranger-led activities will be kept to a minimum and carefully directed to either to the presenters, podium, or other necessary locations.
- To preserve the park's natural lightscape, all permanent and temporary housing residents will be encouraged to limit their use of artificial exterior lighting after nightfall and adhere to Big Cypress National Preserve's park-wide lighting curfew (from approximately 10:00PM to 6:00AM).
- The park will provide light-blocking window shades or other coverings that minimize light trespass from interior sources into the outdoors. Privately-owned RVs will provide their own window shades when stationed in the housing area.
- Security and safety alarms may have unshielded lights due to their infrequent, emergency use and need to be seen from distances; light output may exceed other standards.
- Frequently-used permanent buildings (e.g., curation facility, maintenance offices, workshops, wood shed, well house) should have fully-shielded motion-activated convenience lights at primary exterior doorways.
- Fixtures will be added, removed, or relocated as needed to reflect actual needs and uses.
- Portable high-intensity lighting can be used as needed for immediate work tasks. These lights will be fully-shielded and aimed down to reduce glare.
- Minimal temporary lighting may be utilized as needed for specific after-hours operations. These lights will be fully-shielded and aimed down to reduce glare.

B. Minimal Lighting Zone (LZ0). All campgrounds (Bear Island, Burns Lake, Gator Head, Midway, Mitchell Landing, Monument Lake, Pinecrest and Pink Jeep) and ORV access points (Monroe Station, Skillet Strand, Paces Dike, etc.) fall in this zone. Lighting here exists on a level dictated by necessity only, and should be restricted temporally and spatially.

Standards: There is minimal expectation of artificial lighting. Permanent artificial light fixtures exist only where critical for safety or mandated by codes and are generally isolated. Lighting duration at night is considered for minimum impact to lightscapes. Indoor lighting is contained either with blinds or valences. There is a negligible to minor impact to human dark adaptation and the experience of a natural lightscape. There is a presumed minimal impact to nocturnal Nighttime activities are oriented to a basic level of darkness and there is minimal expectation of night lighting other than essential, isolated spots such as restroom facilities. In order to alleviate light trespass, the following basic principles are observed:

- Light fixtures should exist only where needed for specific tasks
- Light should only exist when necessary. Lights should operate on manual switches or motion sensors/timers.
- Light should only exist in the minimum amount necessary. Individual fixtures should be limited to 600 lumens, with exceptions for specific safety and special uses based on need.
- Lights should be selected with warm colors, such as amber (≤2500 K color temperature).
- Energy efficiency should be considered when choosing lighting. Standard bulbs should be compact fluorescent (CFL), which are low-wattage, or light-emitting diodes (LED).
- Lights should be directed downward and shielded.
- Fully-shielded, motion-activated, amber-colored, low-level lighting (600 lumens maximum) should be provided at each bathroom doorway.
- Campers will be encouraged to manage their use of artificial light in concert with the voluntary park-wide lighting curfew which will be in effect approximately between the hours of 10:00PM and 6:00AM (ideally mirroring quiet hours). The park will discourage the use of bright lanterns and exterior lights on campers, trailers and RVs during this period. Campers will be reminded to turn down interior lights or close window and door shades during these hours to minimize light trespass into the outdoor environment. Personal light sources such as flashlights and headlamps are appropriate at any time, though park staff or volunteers may ask visitors to limit their use during programs.
- If desired, the on-duty campground host may utilize a shielded amber exterior light no greater than 600 lumens between nightfall and curfew to provide visitor orientation.
- Campers will be informed of the expectation of darkness in the campground and will be encouraged to limit their use of artificial lights in order to reduce their visual footprint. This will not only promote a naturally dark sky for other campers, but will also help to minimize the effect of artificial lighting on park wildlife.
- Campfires are not considered artificial lighting and are not covered in these guidelines.

C. **Natural Darkness Zone (LZ00)**. All areas of the park not listed above are in this zone (with the exception of private land holdings); this primarily includes backcountry areas. This zone is managed to maintain the naturally dark environment and is generally closed after sunset except for Law Enforcement patrols, special park-led programs, infrequent resource management work, and permitted special uses. There is currently no electrical service in this zone and no permanent lighting currently exists or is allowed in this area. Light trespass from outside sources and Standard and Minimal Lighting Zones is minimal and all attempts are made to eliminate any excess light pollution. This area makes up the large majority of the preserve.

There is the potential that oil and gas production may expand operations into areas currently designated as a Natural Darkness Zone. As this is a private property right, we are legally unable to restrict such access. However, any future oil and gas operation within the preserve will be limited to the standards listed above.

Standards: No permanent exterior or interior light fixtures are currently allowed. Temporary, portable lighting is considered on a case-by-case basis with an emphasis on avoiding, minimizing, and mitigating artificial light use. Vehicle lights are not used for illumination other than what is required for normal vehicle operation. All efforts are made to eliminate light trespass into this zone from other lighting zones within the preserve or from sources outside the preserve.

- No permanent lighting is currently allowed in this zone. This zone currently does not have electrical service, and the park does not plan to introduce electrical service in the future.
- Use of portable artificial lights will be considered on a case-by-case basis. For all proposed lighting, effects on natural darkness will be considered. The preference will first be to avoid, then minimize, then mitigate effects on the natural lightscape.
- Activities that may require temporary lighting include interpretive programs, special park uses, facilities maintenance, research, resource management, search and rescue, and law enforcement activities.

D. Private Lighting Zone (PLZ) – Lights on privately owned property are exempt from Guidelines within this document. However, private landowners are recommended by park staff to follow standards of the Standard Lighting Zone (LZ1).

Restrictions on artificial lighting do not apply in emergency situations.

Outdoor Lighting Curfew

• A voluntary park-wide lighting curfew will be established approximately between the hours of 10:00PM and 6:00AM. Continuous use of exterior lights should be avoided during these hours, though limited use of exterior lighting for immediate needs is to be expected. Big Cypress National Preserve's lighting curfew is a tangible way for all park visitors, residents, and employees to contribute to the park's night sky preservation goals.

• During the curfew period, all interior lights should either be turned off, or window and door blinds should be closed to prevent light trespass outdoors. All park-owned facilities will be furnished with light-blocking window shades or other coverings that minimize light trespass into the outdoor environment.

Lighting Replacement and Maintenance

• Bulbs and fixtures will be replaced as needed in accordance with these guidelines.

• To the extent possible, bulbs will be standardized to ensure appropriate light intensity, color, quality, visual uniformity, and ease of replacement.

• Unnecessary light fixtures will be either removed or relocated.

• Except for lights that are part of an emergency alarm system, all exterior lights will be controlled by manual switches or motion sensors.

• A label specifying the appropriate replacement bulb will be affixed to exterior lights.

Employee and Visitor Education

• Through its website, information kiosks, and other sources, the park will inform visitors of the expectation of natural darkness and the need to provide personal lighting (e.g., flashlights) after dark. Park staff will provide information on Big Cypress National Preserve's park-wide lighting curfew, including etiquette for use of bright lanterns and other exterior lighting, as well as the benefits of controlling light trespass from interior sources (i.e., from RVs, camping trailers, or similar structures).

• Visitors to evening ranger-led activities will be instructed on the use of red lamps to facilitate the transition to scotopic (night) vision. Visitors will also be reminded of the impacts that vehicle headlights have on the park's Night Sky program activities.

• Through a variety of methods, park employees, residents, and visitors will be reminded that many people come to Big Cypress National Preserve to experience its dark night sky, and that unnecessary nighttime lighting can negatively affect their experience. The importance of protecting park wildlife from the effects of light pollution and the preservation of natural ecological processes will also be part of Big Cypress National Preserve's night sky preservation education messaging.

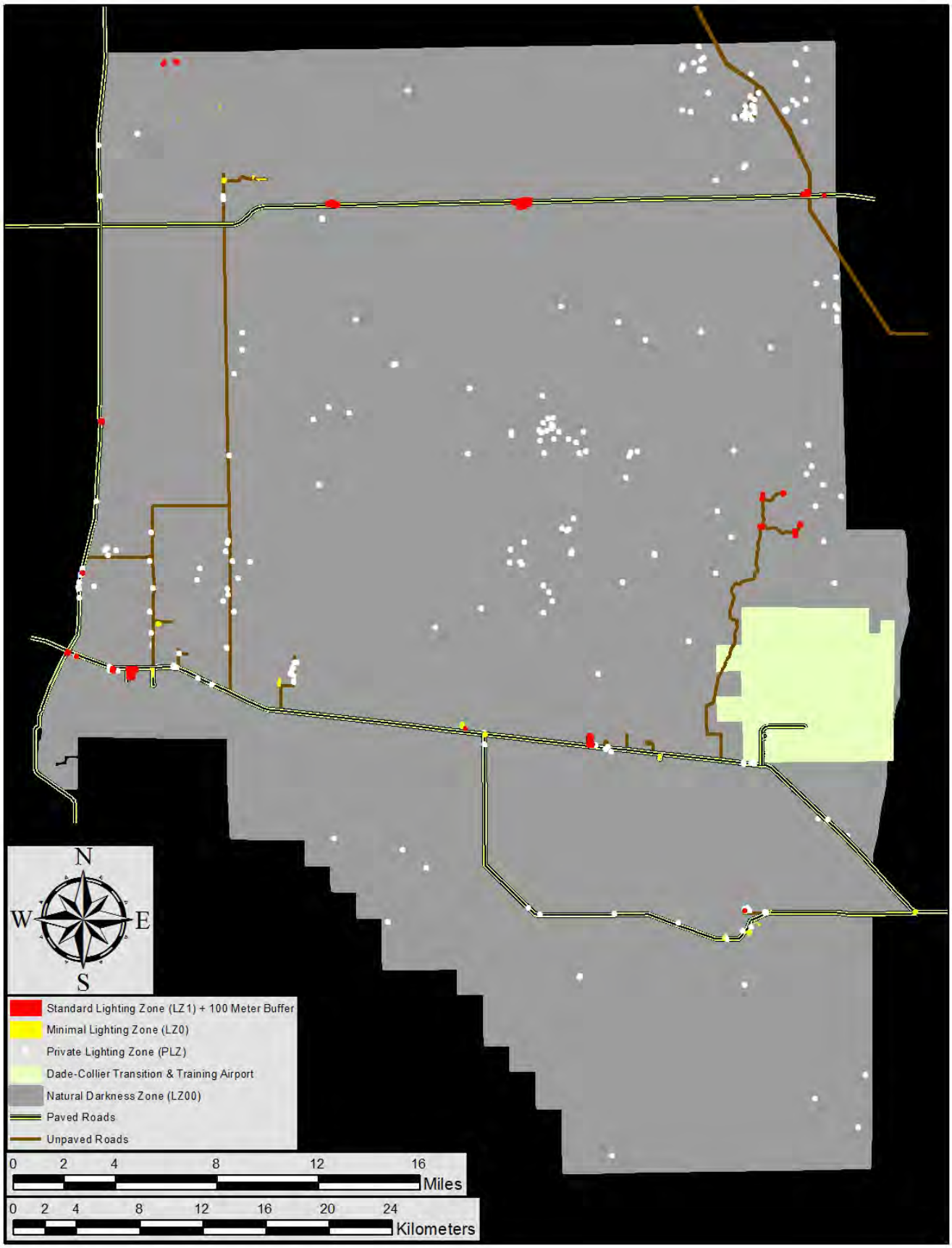


Figure 4. Big Cypress National Preserve Lighting Zones, March, 2016

NPS Night Skies Program Data Night Report Explanation

D Duriscoe
February 2015

Introduction

This document provides a quick explanation of so-called "Data Night Reports" generated automatically from the Night Skies Program master database. A brief description of each table, and each attribute reported within them, is included. For the theoretical basis and methods of computation the reader is referred to a more complete document (Duriscoe 2015).

A "Data Night" is a unique combination of date and location representing when and where sky brightness data was collected. The Night Skies Program uses a code, usually a combination of 4 letters and 6 numbers, that describe the park or other area and date. The date is defined at the start of data collection in Universal Time (UT). Hence it's often one day later than Local Time, either Standard, Daylight, or Local Mean Time (LMT), for locations in North America if data collection is begun in the evening. A "Data Set" is one complete set of 45 images that cover the entire sky. Multiple data sets are often taken over the course of the night to detect changes in artificial sky glow from evening to early morning.

The NPS Night Skies Program Data Night Report contains three main sections: 1) general attributes of the data night and each data set, 2) a list of populated places that may contribute to sky glow observed, and 3) the sky brightness and estimated artificial sky glow mosaics for each data set, illustrated in false color in panoramic equal-area projection, with a table of derived statistics and indicators of the impact of light pollution. The report provides a "snapshot" of the photic environment at the time of the observations as well as an estimate of the impact from artificial sources.

Photometric units of measure used include *SI* units of luminance (candela per square meter) and illuminance (lux), as well as astronomical units of luminance (magnitudes per square arc second) and illuminance (magnitudes) in the V, or visual, band. *SI* units are linear, astronomical units are inverse logarithmic, that is, smaller values indicate brighter objects, and negative values are possible.

Page 1. Metadata and visual observations

First line: Data Night Code, Park or other area, Location name, and Date (UT)

Data Night Attributes Table

Longitude: Longitude in decimal degrees (west is negative), Datum WGS 84, taken with GPS receiver, typical horizontal positional accuracy 5 meters

Latitude: Latitude in decimal degrees (north is positive), Datum WGS 84, taken with GPS receiver, typical horizontal positional accuracy 5 meters

Elevation (m): Elevation above mean sea level in meters, taken with GPS receiver, typical vertical positional accuracy 15 meters

Camera: Short description of the camera used. The camera name is usually the manufacturer, such as SBIG (Santa Barbara Instruments Group), followed by a number separating multiple cameras used with the same manufacturer.

# of sets: A count of the number of individual data sets collected over the night at this location.

Exposure (secs): Exposure (or integration) time of each image in seconds.

Air Temp (C): Air temperature at start of image acquisition as measured by a portable weather meter in degrees Celsius. Typical accuracy is 3 degrees.

R.H. (%): Relative humidity at start of image acquisition as measured by a portable weather meter. Typical accuracy is 5%.

Wind Speed (mph): Average wind speed at the start of image acquisition as measured by a portable weather meter held at eye level. Typical accuracy is 3 mph.

ZLM: Zenith limiting magnitude, or the faintest stars than can be observed visually without optical aid (naked eye) near the zenith, or darkest part of the sky. This observation varies somewhat from observer to observer, but all observers are instructed to practice the same methods. 6.6 is considered near pristine under average conditions. 7.0 is achievable under good seeing conditions and with proper dark adaptation of the eye. 7.4 is excellent, just about the faintest attainable, although some observers have confirmed seeing stars as faint as magnitude 8.2 with the naked eye. A number lower than 6.3 usually indicates significantly degraded sky quality.

BORTLE: A semi-quantitative measure of the sky quality observed visually, as developed by astronomer John Bortle. Classes are whole numbers 1-9, with 1 the very best and 9 the poorest.

SQM: A measurement taken with the Unihedron Sky Quality Meter, in magnitudes per square arc-second (mag arcsec^{-2}), aimed at the zenith.

OBS-1, OBS_2, OBS_3: Name(s) of the observer(s).

NARRATIVE: A descriptive narrative of the conditions observed visually during the night of data collection. This usually includes seeing (a measure of atmospheric steadiness), and transparency (a measure of atmospheric clarity) in semi-quantitative terms. Also may include characteristics of the site, the appearance of certain astronomical features, and the suitability of the site for visual astronomy by park visitors.

Data Set Attributes Table

Data Set: Data set number

Quality Flags: *Useable*--Y or N (yes or no), a determination as to whether or not the data should be included or rejected based upon inspection of the mosaic; *Collection*--(1-5, 1 poorest, 5 best) a semi-quantitative judgment as to the quality of data collection, including such factors as camera and mount performance, accuracy of mount setup, presence of stray light; *Processing*--(1-5, 1 poorest, 5 best) a semi-quantitative judgment as to the quality of data processing, including image calibration, atmospheric extinction calculation, instrument zeropoint calculation; *Atmosphere*--(1-5, 1 poorest, 5 best) a semi-quantitative judgment as to the quality of atmospheric conditions, where excellent transparency and steadiness, low relative humidity, and the complete absence of clouds or smoke plumes is best.

Natural Sky Model: A report of the amount of natural *airglow* used at the *zenith* in micro-candela per meter squared (µcd m^{-2}), the *Fit Quality* of the model (1-5, 1 poorest, 5 best), a semi-quantitative judgment as to the quality of natural sky model fit based upon inspection of the artificial sky glow mosaic as compared to the natural sky model mosiac, and

Natural sky model fit notes, which explain why the operator assigned the zenith airglow intensity and fit quality reported.

Extinction: A report of calculated all-sky atmospheric extinction for each data set. Extinction is a measure of the opacity of the air, the units are astronomical magnitudes per airmass. Airmass depends on its zenith angle and the relationship is not linear. A star viewed at the exact zenith is by definition view through one airmass. This value is computed for each data set from measurements of 50-150 standard stars on the images over the entire sky.
Attributes reported in the table include: *Extinction coefficient* in V magnitudes per airmass, *Standard error of Y*, in V magnitudes, a measure of the fit of the observed data to a regression line (0.03 or smaller is excellent while 0.06 and larger is poor), and the *Number of* reference *Stars used* and *rejected* in the regression equation. Rejected stars are outliers of greater than 0.1 magnitude, presumably because they were partially masked by horizon obstructions or clouds, measured incorrectly because of scintillation, or measured incorrectly because of within-pixel variations in the sensitivity of the CCD detector.

Collection Properties: A report of the observed *percentage of clouds* in the entire sky, the *Average Pointing Error* of the camera mount system in degrees (less than 0.25 is excellent, more than 0.5 is poor), the Maximum Pointing Error of the camera mount system in degrees (less than 0.4 is excellent, more than 1.0 is poor), and the *total bias drift* of the camera over the course of the 45 images in each data set in raw camera ADUs (more than 10 ADU drift may indicate a camera problem).

Page 2(-3). Populated Places Table

A table of places within 300 km of the observing site is displayed ordered with decreasing potential to produce artificial sky glow. The places name (*Place*) and *Population* are given from the 2010 U.S. Census. The *Distance* in kilometers, apparent *Azimuth* , and *Apparent Half-Width* in degrees as seen from the observer's location are given based upon the longitude and latitude of the place's centroid and assuming a circular area whose diameter is computed based upon the land area of the populated place given in the Census database. Finally, each place is ordered according to *Walker's* Law, a formula which predicts sky glow intensity of a populated place as a function of its population and distance from the observer. The numbers shown in the table for this attribute are a unitless ratio with linear scaling. An arbitrary cutoff is made for the lower limit of this value that includes a reasonable number of populated places (less than 50).

Pages 3(4) +. All-sky Photometry Report

The all-sky photometry report is scaled so that one data set fits on one page, and multiple data sets are reported on succeeding pages.

First Line: The *Data Night* Code, the *Date* in Local Mean Time (LMT), the *Time* of the middle of image collection in LMT in decimal hours, whether or not (Y or N) the data set is the *Reference* set for the night, and the *Data Set Number*. Local Mean Time is used for comparison between locations and data nights, with local midnight being 0.0 hours. Local midnight is the time when the sun is at its maximum position below the horizon.

First Figure -- Full Resolution Mosaic

The full resolution mosaic of the data set's images rendered in false color. Each individual image is placed in the mosaic after correction for pointing errors, and projected into a Hammer-Aitoff equal area projection with the horizon at the center vertically and a fixed azimuth at the center horizontally. The false color scheme reveals a wide dynamic range of sky brightness values in a logarithmic scale from 14 to 23 mag arcsec^{-2}. The all-sky image mosaic (zenith to 6 degrees below the level horizon) contains about 34 million pixels. Land features and individual light trespass sources are often visible in this rendering.

Photometry of all sources Table

A table of summary measures from the sky brightness mosaic is given. The sky brightness mosaic is derived from the full resolution mosaic by applying a strong median filter to screen out stars, then resampling to 0.05 degrees per pixel resolution, for a total of about 8 million pixels covering the entire sky in an equal-area projection. Bright unshielded lights in the land portion of the mosaic will not be accurately measured for two reasons: they commonly are so bright their recorded luminance exceeds the dynamic range of the detector so they become clipped or saturated at the maximum ADU value, and the median filter will remove most of the light from these sources since they resemble stars or point sources. Therefore "all sources" should not be interpreted to include accurate measures of light tresspass from visible individual lights, even if they appear in the full resolution mosaic. Very bright sources such as this will often cause vertical lines or "column bleeds" in the full resolution image; these are removed by the median filter technique before statistics are calculated. A graphic of the sky brightness mosaic is not shown in the report.

Average Sky Luminance is an important statistic describing the photic environment. It is reported in logarithmic units of mag arcsec^{-2} and linear units µcd m^{-2}. The natural moonless reference condition is set at 21.6 mag arcsec^{-2} or 250 µcd m^{-2}. This is an unbiased measure of the amount of light reaching the observer from sky luminance.

Zenith Luminance is often reported as a sky quality indicator in the astronomical literature. This measure is calculated from the median pixel value of an approximately one degree diameter circle centered on the zenith. 22.0 mag arcsec^{-2} or 172 µcd m^{-2} is generally considered to represent the darkest part of pristine skies, any value lower (brighter) than 21.3 mag arcsec^{-2} usually indicates significantly degraded sky quality, unless the measurement falls in the Milky Way, the natural airglow, or bright portions of the Zodiacal Light.

Brightest Luminance is an important value because the human eye's ability to dark adapt will be impaired by the brightest part of the visual scene, and because bright parts of the sky may cast shadows from 3D objects on the land surface, giving depth to an otherwise uniformly lit natural landscape. The brightest part of the Milky Way is 19.6 mag arcsec^{-2} or 1500 µcd m^{-2}. Brighter values will begin to impair dark adaptation, values brighter than 17.0 mag arcsec^{-2} can cast shadows.

The *Synthetic SQM* value is given for comparison to a measure with the Unihedron Sky Quality Meter. It is considered to be more accurate than the actual measure, since it is computed from the sky brightness mosaic based upon accurate alignment to zenith and accurately calibrated CCD camera data. The sky brightness values in the data set are subjected to an algorithm that matches the SQM response curve with zenith angle. The units are mag arcsec^{-2}. Values of 21.3 and greater (darker) fall within the range of "natural" skies (Bortle Class 1-3), 19.5-21.3 may be considered significantly degraded skies (Bortle Class 4-6), while values less than 19.5 may be considered severely degraded (Bortle Class 7-9). The SQM is only sensitive to areas of the sky 30 degrees above the horizon and higher, so will not measure bright sources of artificial sky glow along the horizon.

Total luminous emittance exactly correlates with average sky luminance, but in units of illuminance. It represents the total luminous flux from the sky if all the light were collected into a point or source of small angular diameter, like the moon. This summary value excludes the light from individual stars and planets and glare from unshielded lights but includes the Milky Way, Airglow, Zodiacal Light, and artificial sky glow. When expressed in astronomical magnitudes it can be compared with the moon at various phases (-8 at crescent, -11 at half phase, and -12.5 at full phase). A value larger (darker) than -7.0 is exceptionally dark; between -7.5 and -7.0 is typical for near pristine locations. A value smaller (brighter) than -8.0 usually indicates significantly degraded sky quality.

Horizontal and Maximum Vertical Illuminance are important measures of the amount of light striking the ground (horizontal) or a vertical plane (vertical). The units are milli-lux (mlux). The natural reference condition for moonless

nights is 0.8 mlux for horizontal and 0.4 mlux for vertical. The maximum vertical illuminance is for a plane facing the brightest part of the sky near the horizon.

Second Figure -- Estimated Artificial Sky Glow

The sky glow mosaic is the sky brightness mosaic subjected to pixel by pixel subtraction of a registered natural sky model mosaic (the natural sky model is not shown as a graphic in the report) rendered in the same false color scale as the full resolution mosaic. The resolution is 0.05 degrees per pixel. Land features and individual light trespass sources are masked out so that only sky luminance from artificial sky glow is shown. This is an at-a-glance representation of the amount of light pollution from sky glow observed at the site. Artificial sky glow will always be brighter near the horizon than at the zenith and its impact on the natural lightscape substantial.

Photometry of Artificial Sky Glow Table

This table includes indicators of sky quality based upon the estimated artificial sky glow mosaic in absolute, relative, and index units.

The *Sky Quality Index* is a synthetic index derived from the distribution of sky luminance values in the artificial sky glow mosaic. Its range is 0-100, where 100 is a sky free of artificial sky glow. Values of 80-100 may be considered to represent skies that retain all of the natural characteristics throughout most of the sky, 60-80 retaining most of the natural sky features, but only in areas within 40 degrees of the zenith, 40-60 represents skies where the Milky Way is not visible or only the brightest parts are visible near the zenith, 20-40 represents skies only stars and planets remaining and the land is illuminated at a level of moonlight, and 0-20 indicates only the brightest stars remain, and the land is in perpetual twilight.

The *Average Sky Luminance, Zenith Luminance,* and the *Brightest Luminance* are reported as in the all sources table, but in linear units only. The whole sky mosaic is clipped at 80 degrees zenith angle and 70 degrees and an average sky luminance computed for each in order to provide a more unbiased comparison to areas that may have blocked horizons.

The *All-sky Light Pollution Ratio* (ALR) is the most important indicator of light pollution from artificial sky glow. It is merely the ratio of the all-sky average luminance from artificial sources to the natural reference condition of 250 µcd m^{-2}. This unit-less ratio may be easily interpreted is a linear measure of the amount of light from sky brightness above the natural background. For example an ALR of 1.0 indicates there is 100% more light in the environment than natural conditions, 2.0 = 200%, 0.5 = 50%, etc.

The *Total Luminous Emittance* from artificial sky glow express in magnitudes may be compared to astronomical objects such as Sirius or Jupiter (-2), Venus (-4), a thin crescent moon (-7), or the moon at other phases as described above.

Horizontal and *Maximum Vertical Illuminance* are reported as in the all sources table. These values may also be compared to the reference condition of 0.8 mlux and 0.4 mlux, respectively.

References

Duriscoe, D.M. (in preparation) Assessing night sky quality with all-sky broadband photmetric imaging. NRSS, Fort Collins, CO.

NPS NIGHT SKIES PROGRAM DATA NIGHT REPORT

BICY140224 Big Cypress NP **Kirby Storter Roadside Park** **24-Feb-14**

Data Night Attributes

Longitude:	-81.15461	Camera:	ML 4	Air temp. (C):	22.2	ZLM:	6.80	OBS_1:	B Meadows
Latitude:	25.86827	# of sets:	4	R. H. (%):	85.9	BORTLE:	4	OBS_2:	M Nelson
Elevation (m):	1	Exposure (secs):	12	Wind Speed (mph):	0	SQM:	21.35	OBS_3:	

NARRATIVE: Probably one of the darkest sites in the Preserve for night sky viewing (along with easy access). Miami/Ft Lauderdale is easily visible to the east and Naples less so to the west. Very good detail in the Milky Way, with the Prancing Horse visible and a width of almost 15°. Initially cloud free, then clouds and ground fog moved into the area. Stars visible to <5° in the south

Data Set Attributes

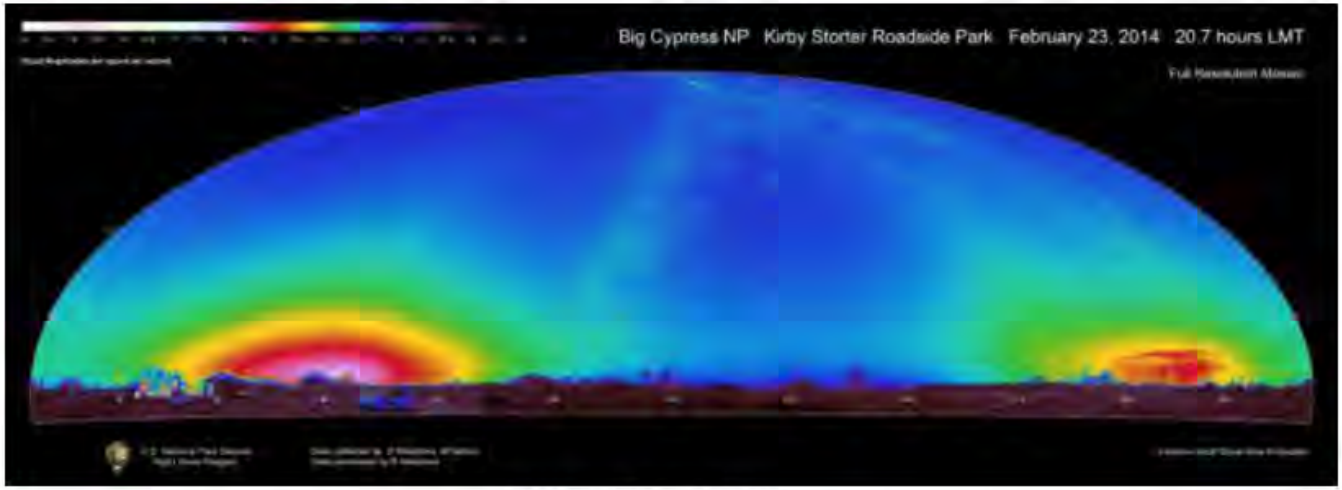
	Quality Flags						Natural Sky Model	Extinction				Collection Properties			
Data Set	Use-able	Col-lection	Pro-cessing	Atmo-sphere:	Zenith airglow (µcd/m²)	Fit quality	Natural sky model fit notes	Ext. coeff. (mag/ airmass)	Std err Y	# stars used	# stars reject	% Clouds	Ave. Point Error	Max Point Error	total bias drift
1	Y	4	4	4	143	4	Good subtraction	0.245	0.04	128	9	4	0.28	0.46	1.4
2	Y	3	3	4	143	4	Good subtraction	0.242	0.04	130	6	4	0.26	0.45	1.1
3	N	2	3	3	143	2	Clouds	0.276	0.06	107	15	10	0.24	0.42	0.9
4	N	3	3	3	159	3	few clouds	0.349	0.13	114	25	15	0.22	0.40	1.1

Populated Places

Place	Population (2010)	Distance (km)	Azimuth	Walker's	Apparent Half-Width (degrees)
Miami city	399,457	95.2	96	0.452	3.3
Hialeah city	224,669	85.2	90	0.336	2.8
Pembroke Pines city	154,750	83.1	78	0.246	3.6
Miramar city	122,041	82.7	81	0.196	3.4
Fort Lauderdale city	165,521	105.4	73	0.145	2.9
Hollywood city	140,768	100.6	79	0.139	2.7
Miami Gardens city	107,167	91.5	84	0.134	2.4
Coral Springs city	121,096	99.9	63	0.121	2.5
Kendall CDP	75,371	83.0	105	0.120	2.5
Davie town	91,992	90.0	75	0.120	3.4
Weston city	65,333	79.5	71	0.116	3.3
Kendale Lakes CDP	56,148	76.7	103	0.109	1.9
Tamiami CDP	55,271	76.3	99	0.109	1.8
The Hammocks CDP	51,003	74.0	107	0.108	2.0
Fountainebleau CDP	59,764	81.2	97	0.101	1.3
Plantation city	84,955	93.6	72	0.100	2.6
Cape Coral city	154,305	120.3	316	0.097	4.4
Lehigh Acres CDP	86,784	95.8	330	0.097	5.2
Sunrise city	84,439	95.5	69	0.095	2.3
Homestead city	60,512	83.8	122	0.094	2.4
Miami Beach city	87,779	101.7	93	0.084	1.4
Doral city	45,704	79.9	94	0.080	2.4
Pompano Beach city	99,845	110.5	68	0.078	2.3
Kendall West CDP	36,154	73.6	104	0.078	1.2
Marco Island city	16,413	55.1	278	0.073	3.3
Country Club CDP	47,105	84.7	84	0.071	1.2
Golden Gate CDP	23,961	65.1	303	0.070	1.6
Lauderhill city	66,887	98.5	71	0.069	1.5
Bonita Springs city	43,914	83.3	311	0.069	3.9
Immokalee CDP	24,154	67.3	337	0.065	3.7
Tamarac city	60,427	97.2	67	0.065	1.8
North Miami city	58,786	98.7	88	0.061	1.5
Richmond West CDP	31,973	78.1	111	0.059	1.4

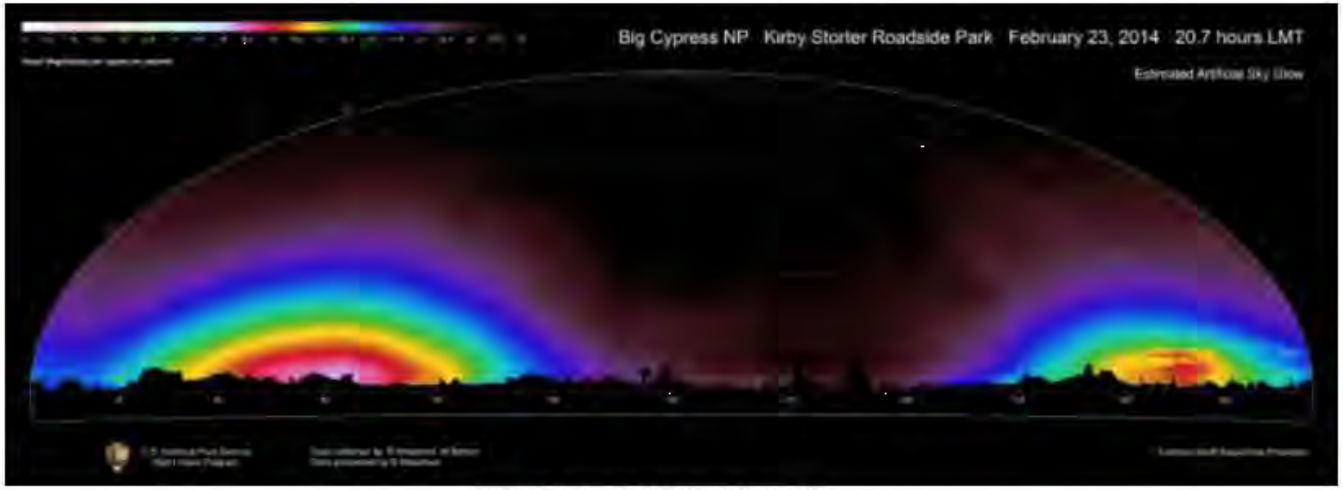
Coral Gables city	46,780	92.2	103	0.057	2.0
South Miami Heights CDP	35,696	83.0	112	0.057	1.4
Boca Raton city	84,392	118.7	62	0.055	2.4
Cutler Bay town	40,286	88.3	111	0.055	1.8
Deerfield Beach city	75,018	113.9	64	0.054	1.8
Fort Myers city	62,298	107.3	321	0.052	3.1

BICY140224 Date (LMT) 23-Feb-14 Time (LMT): 20.71 Reference: Y Data Set: **1**



PHOTOMETRY OF ALL SOURCES

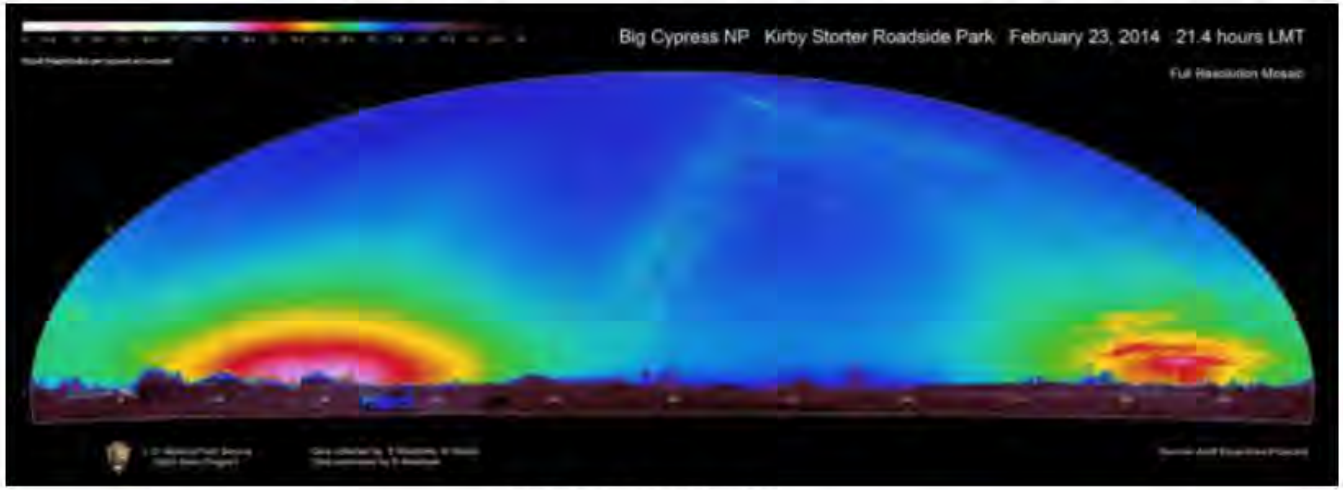
Average Sky Luminance (mag arcsec^{-2})	Average Sky Luminance (µcd/m^2)	Zenith Luminance (mag arcsec^{-2})	Zenith Luminance (µcd/m^2)	Brightest luminance (mag arcsec^{-2})	Brightest luminiinance	Synthetic SQM (mag arcsec^{-2})	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
20.72	561	21.35	312	17.44	11,502	21.24	-7.84	1.318	1.311



PHOTOMETRY OF ARTIFICIAL SKYGLOW

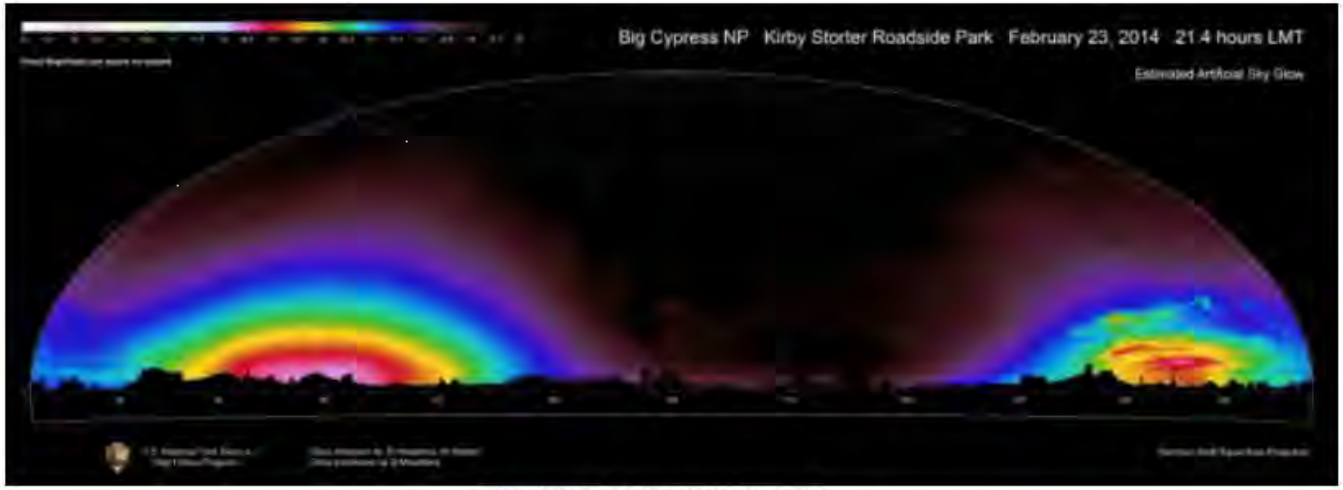
Sky Quality Index (SQI)	Average Sky Luminance (µcd/m^2)	Average Sky Luminance to zenith angle 80°	Average Sky Luminance to zenith angle 70°	Zenith Luminance	Brightest luminiinance (µcd/m^2)	All-sky light pollution ratio (ALR)	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
73.7	226	125.2	65.4	4	6,050	0.91	-6.81	0.307	0.773

BICY140224 Date (LMT) 23-Feb-14 Time (LMT): 21.36 Reference: N Data Set: **2**



PHOTOMETRY OF ALL SOURCES

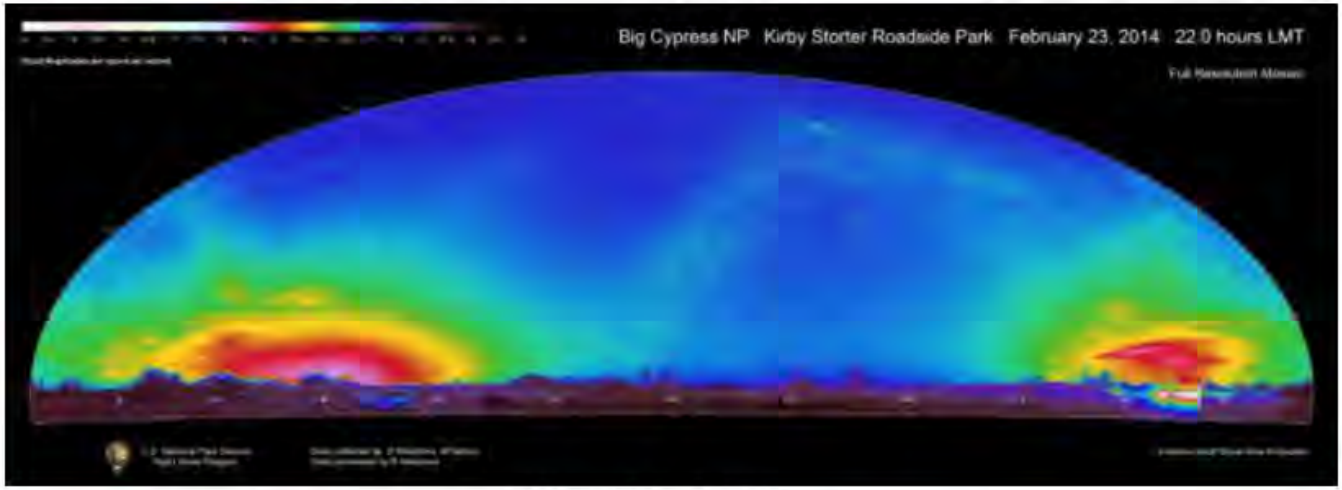
Average Sky Luminance (mag arcsec^{-2})	Average Sky Luminance (µcd/m^2)	Zenith Luminance (mag arcsec^{-2})	Zenith Luminance (µcd/m^2)	Brightest luminance (mag arcsec^{-2})	Brightest lumininance	Synthetic SQM (mag arcsec^{-2})	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
20.71	564	21.47	280	18.20	5,697	21.27	-7.84	1.304	1.298



PHOTOMETRY OF ARTIFICIAL SKYGLOW

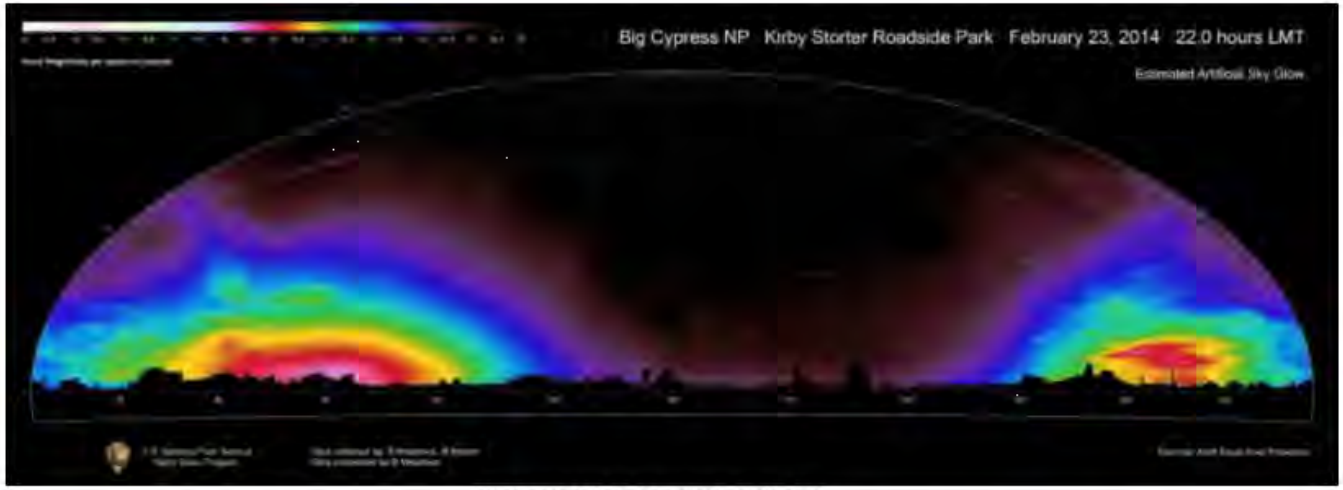
Sky Quality Index (SQI)	Average Sky Luminance (µcd/m^2)	Average Sky Luminance to zenith angle 80°	Average Sky Luminance to zenith angle 70°	Zenith Luminance	Brightest lumininance (µcd/m^2)	All-sky light pollution ratio (ALR)	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
74.6	232	125.4	61.4	-4	5,441	0.93	-6.84	0.304	0.778

BICY140224 Date (LMT) 23-Feb-14 Time (LMT): 22.01 Reference: N **Data Set: 3**



PHOTOMETRY OF ALL SOURCES

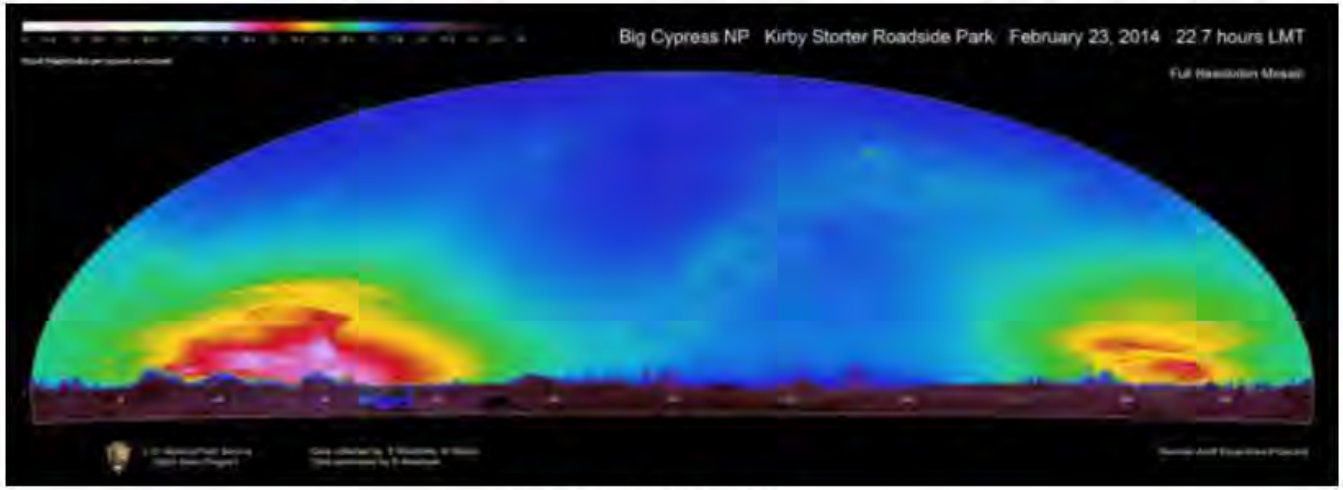
Average Sky Luminance (mag arcsec^{-2})	Average Sky Luminance (µcd/m^2)	Zenith Luminance (mag arcsec^{-2})	Zenith Luminance (µcd/m^2)	Brightest luminance (mag arcsec^{-2})	Brightest lumininance	Synthetic SQM (mag arcsec^{-2})	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
20.68	578	21.52	268	16.17	36,867	21.29	-7.90	1.326	1.325



PHOTOMETRY OF ARTIFICIAL SKYGLOW

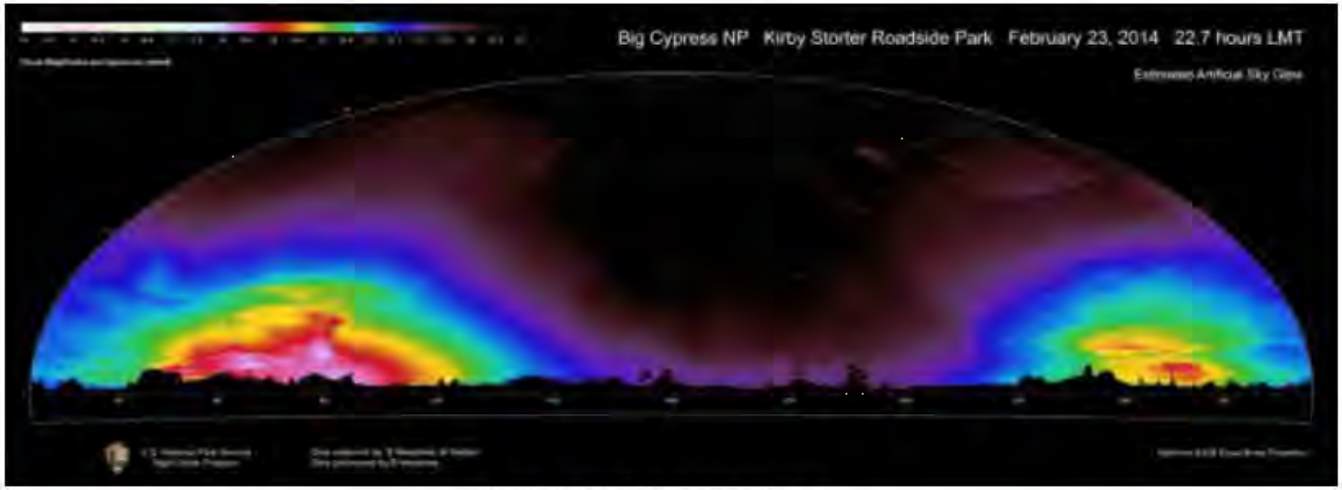
Sky Quality Index (SQI)	Average Sky Luminance (µcd/m^2)	Average Sky Luminance to zenith angle 80°	Average Sky Luminance to zenith angle 70°	Zenith Luminance	Brightest lumininance (µcd/m^2)	All-sky light pollution ratio (ALR)	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
71.6	266	156.3	83.8	2	4,926	1.07	-6.99	0.373	0.836

BICY140224 Date (LMT) 23-Feb-14 Time (LMT): 22.65 Reference: N Data Set: **4**



PHOTOMETRY OF ALL SOURCES

Average Sky Luminance (mag arcsec^{-2})	Average Sky Luminance (µcd/m^2)	Zenith Luminance (mag arcsec^{-2})	Zenith Luminance (µcd/m^2)	Brightest luminance (mag arcsec^{-2})	Brightest luminiinance	Synthetic SQM (mag arcsec^{-2})	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
20.62	612	21.51	271	18.06	6,452	21.28	-7.93	1.396	1.545



PHOTOMETRY OF ARTIFICIAL SKYGLOW

Sky Quality Index (SQI)	Average Sky Luminance (µcd/m^2)	Average Sky Luminance to zenith angle 80°	Average Sky Luminance to zenith angle 70°	Zenith Luminance	Brightest luminiinance (µcd/m^2)	All-sky light pollution ratio (ALR)	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
68.2	315	202.2	106.5	10	6,152	1.27	-7.18	0.468	1.080

NPS NIGHT SKIES PROGRAM DATA NIGHT REPORT

BICY140226 Big Cypress NP **Levee 28, 4 miles N of I75** **26-Feb-14**

Data Night Attributes

Longitude:	-80.92052	Camera:	ML 4	Air temp. (C):	22.2	ZLM:	6.50	OBS_1:	B Meadows
Latitude:	26.22796	# of sets:	4	R. H. (%):	79.6	BORTLE:	4	OBS_2:	M Nelson
Elevation (m):	6	Exposure (secs):	12	Wind Speed (mph):	1	SQM:		OBS_3:	C Moore

NARRATIVE: Clouds never completely cleared through the night, especially to the east and southeast. Stars only visible to 15° in the north and maybe 10° in the south. The light dome from Miami/Fort Lauderdale area is visible to about 25° in the east. The light dome from the Big Cypress Indian Reservation development about 10 miles NNW is easily visible. Not much detail seen in the sky.

Data Set Attributes

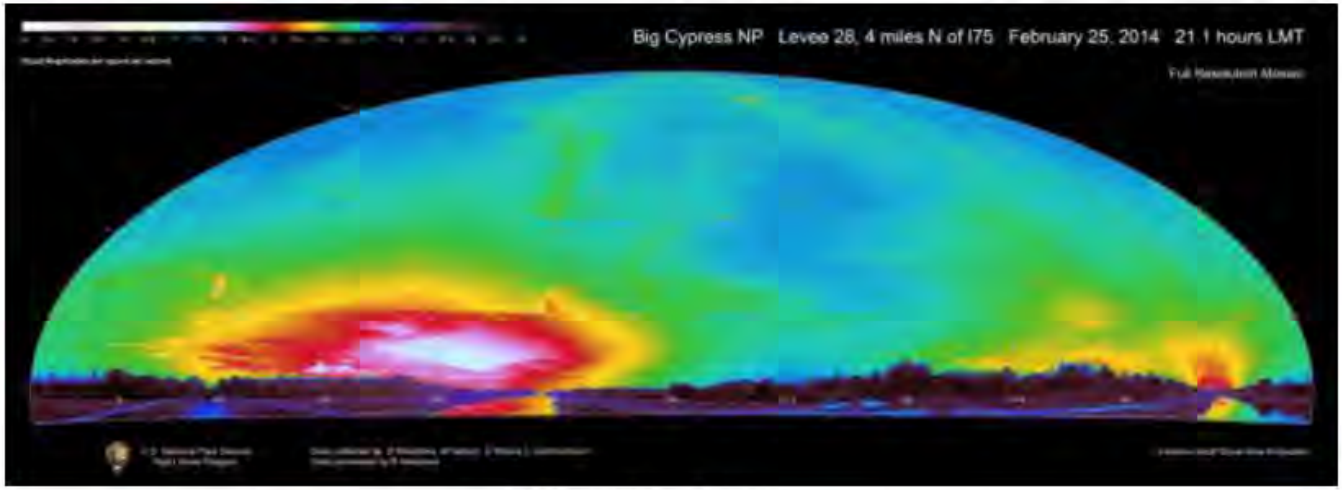
	Quality Flags						Natural Sky Model	Extinction				Collection Properties			
Data Set	Use-able	Col-lection	Pro-cessing	Atmo-sphere:	Zenith airglow (ucd/m²)	Fit quality	Natural sky model fit notes	Ext. coeff. (mag/ airmass)	Std err Y	# stars used	# stars reject	% Clouds	Ave. Point Error	Max Point Error	total bias drift
1	N	3	3	3	95	2	Clouds	0.557	0.22	89	52	10	0.20	0.24	1.4
2	Y	3	3	3	95	3	Clouds	0.468	0.06	108	18	5	0.23	0.27	0.8
3	Y	3	3	3	95	2	Clouds	0.470	0.12	102	32	5	0.24	0.27	1.0
4	Y	3	3	3	95	2	Clouds	0.610	0.20	101	39	5	0.23	0.27	1.0

Populated Places

Place	Population (2010)	Distance (km)	Azimuth	Walker's	Apparent Half-Width (degrees)
Miami city	399,457	87.1	125	0.564	3.6
Pembroke Pines city	154,750	62.3	112	0.506	4.8
Hialeah city	224,669	73.4	123	0.487	3.3
Miramar city	122,041	64.7	115	0.363	4.4
Coral Springs city	121,096	66.1	86	0.341	3.8
Weston city	65,333	53.6	105	0.311	4.9
Fort Lauderdale city	165,521	78.0	97	0.308	3.9
Davie town	91,992	65.5	104	0.265	4.7
Hollywood city	140,768	78.5	106	0.258	3.5
Sunrise city	84,439	66.2	95	0.237	3.3
Plantation city	84,955	66.7	100	0.234	3.6
Miami Gardens city	107,167	74.3	115	0.225	3.0
Pompano Beach city	99,845	78.9	89	0.181	3.2
Tamarac city	60,427	66.4	92	0.168	2.7
Lauderhill city	66,887	69.9	96	0.164	2.2
Lehigh Acres CDP	86,784	83.3	301	0.137	6.0
Boca Raton city	84,392	82.7	79	0.136	3.4
Deerfield Beach city	75,018	79.8	83	0.132	2.5
Margate city	53,284	70.7	88	0.127	2.2
Country Club CDP	47,105	68.7	118	0.120	1.5
Tamiami CDP	55,271	73.6	135	0.119	1.9
Fountainebleau CDP	59,764	76.1	131	0.118	1.4
Kendall CDP	75,371	83.9	138	0.117	2.5
Coconut Creek city	52,909	73.5	85	0.114	2.4
Miami Beach city	87,779	90.5	120	0.113	1.6
Immokalee CDP	24,154	54.4	294	0.110	4.5
Kendale Lakes CDP	56,148	77.2	138	0.107	1.9
West Palm Beach city	99,919	97.9	54	0.105	3.9
Cape Coral city	154,305	116.7	294	0.105	4.6
Doral city	45,704	72.5	129	0.102	2.7
North Lauderdale city	41,023	69.8	91	0.101	1.6
Wellington village	56,508	79.4	54	0.101	4.4
The Hammocks CDP	51,003	77.8	143	0.095	1.9

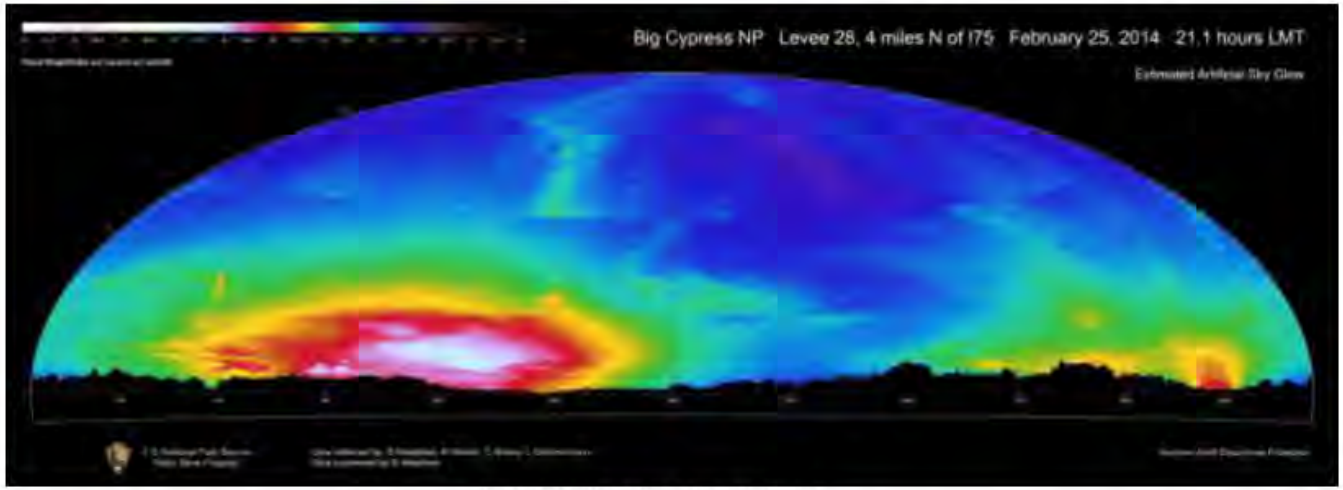
North Miami city	58,786	83.4	116	0.093	1.8
Boynton Beach city	68,217	90.0	68	0.089	2.3
Port St. Lucie city	164,603	128.6	24	0.088	4.3
Delray Beach city	60,522	86.5	73	0.087	2.4
Oakland Park city	41,363	76.8	94	0.080	1.9
Cooper City city	28,547	66.4	107	0.079	2.2
Miami Lakes town	29,361	69.1	120	0.074	1.8
Lauderdale Lakes city	32,593	72.1	95	0.074	1.4
Kendall West CDP	36,154	75.2	140	0.074	1.1
Belle Glade city	17,467	56.9	26	0.072	2.2
North Miami Beach city	41,523	82.3	114	0.067	1.4
Homestead city	60,512	96.9	151	0.065	2.1
Parkland city	23,962	67.8	82	0.063	2.7
Fort Myers city	62,298	100.6	296	0.061	3.3
Bonita Springs city	43,914	87.5	280	0.061	3.7
West Little River CDP	34,699	79.7	121	0.061	1.4

BICY140226 Date (LMT) 25-Feb-14 Time (LMT): 21.13 Reference: N Data Set: **1**



PHOTOMETRY OF ALL SOURCES

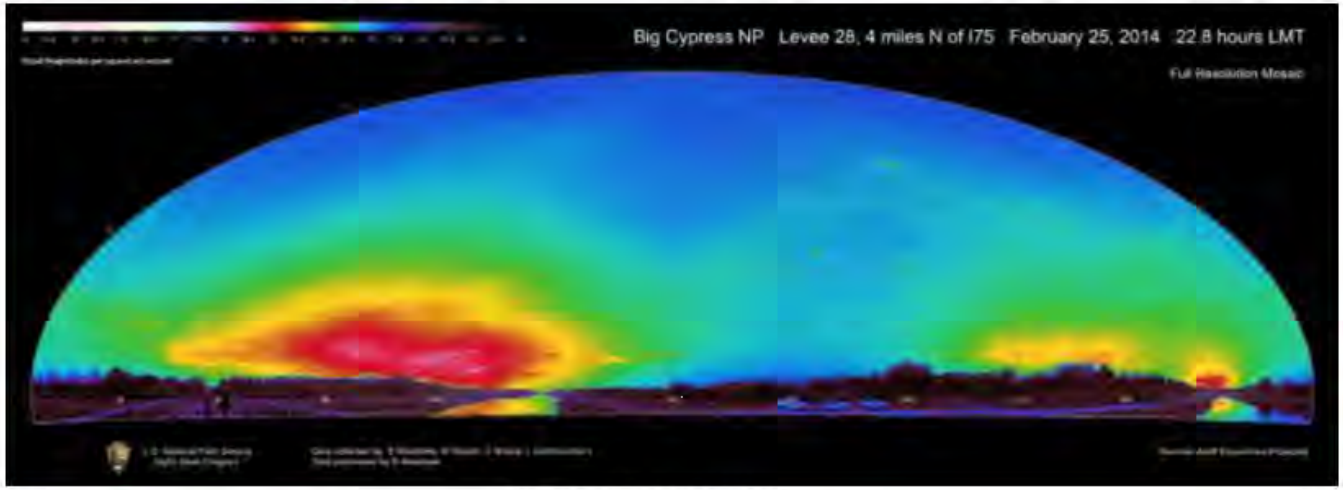
Average Sky Luminance (mag arcsec^{-2})	Average Sky Luminance (µcd/m^2)	Zenith Luminance (mag arcsec^{-2})	Zenith Luminance (µcd/m^2)	Brightest luminance (mag arcsec^{-2})	Brightest lumininance	Synthetic SQM (mag arcsec^{-2})	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
20.17	929	20.97	442	17.33	12,731	20.81	-8.38	2.140	2.621



PHOTOMETRY OF ARTIFICIAL SKYGLOW

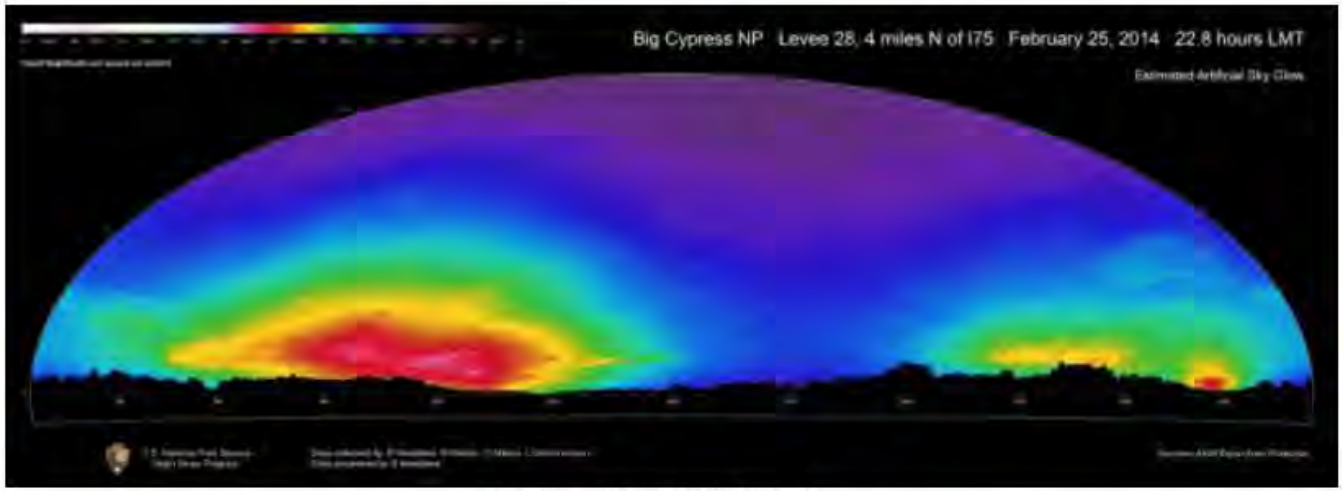
Sky Quality Index (SQI)	Average Sky Luminance (µcd/m^2)	Average Sky Luminance to zenith angle 80°	Average Sky Luminance to zenith angle 70°	Zenith Luminance	Brightest lumininance (µcd/m^2)	All-sky light pollution ratio (ALR)	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
41.9	751	597.5	414.1	294	12,615	3.03	-8.11	1.542	2.274

BICY140226 Date (LMT) 25-Feb-14 Time (LMT): 22.76 Reference: Y Data Set: **2**



PHOTOMETRY OF ALL SOURCES

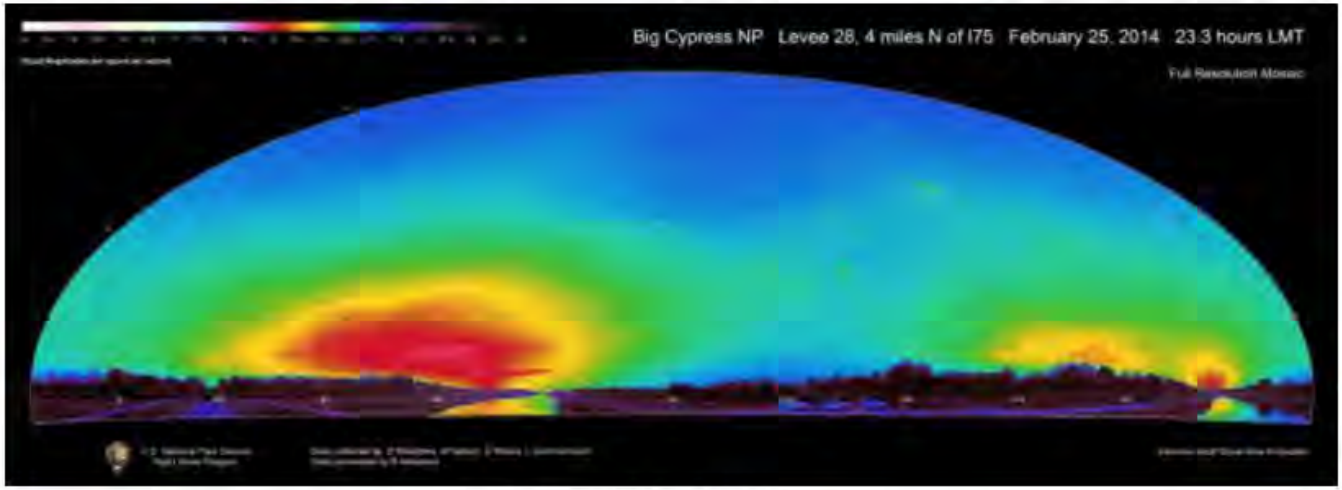
Average Sky Luminance (mag arcsec^{-2})	Average Sky Luminance (µcd/m^2)	Zenith Luminance (mag arcsec^{-2})	Zenith Luminance (µcd/m^2)	Brightest luminance (mag arcsec^{-2})	Brightest luminiinance	Synthetic SQM (mag arcsec^{-2})	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
20.47	703	21.31	324	18.16	5,931	21.05	-8.07	1.700	1.750



PHOTOMETRY OF ARTIFICIAL SKYGLOW

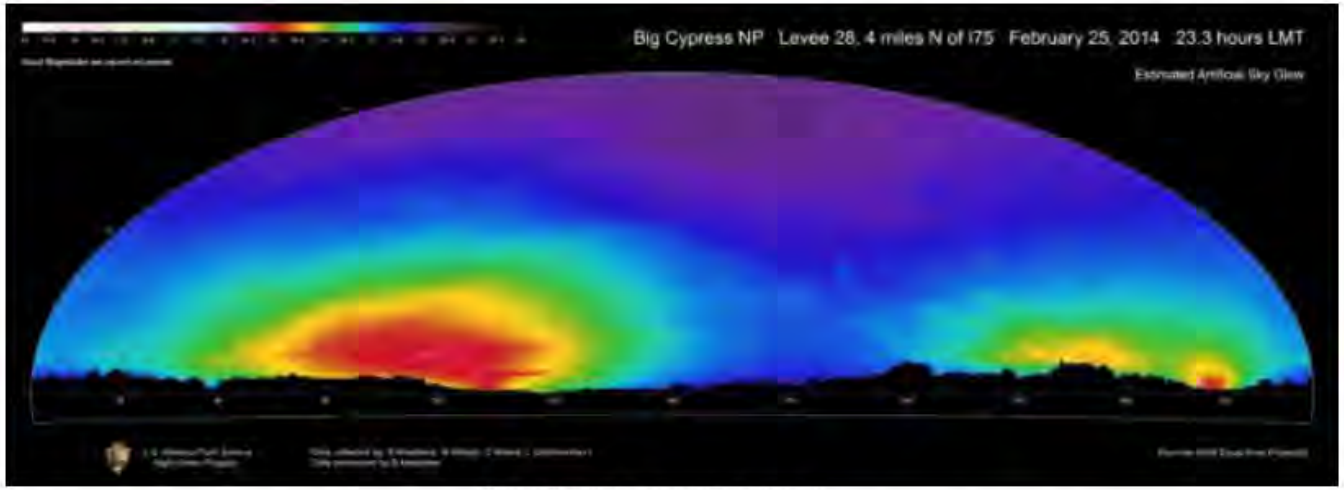
Sky Quality Index (SQI)	Average Sky Luminance (µcd/m^2)	Average Sky Luminance to zenith angle 80°	Average Sky Luminance to zenith angle 70°	Zenith Luminance	Brightest luminiinance (µcd/m^2)	All-sky light pollution ratio (ALR)	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
47.5	511	424.1	307.1	133	5,800	2.06	-7.69	1.075	1.422

BICY140226 Date (LMT) 25-Feb-14 Time (LMT): 23.27 Reference: N Data Set: **3**



PHOTOMETRY OF ALL SOURCES

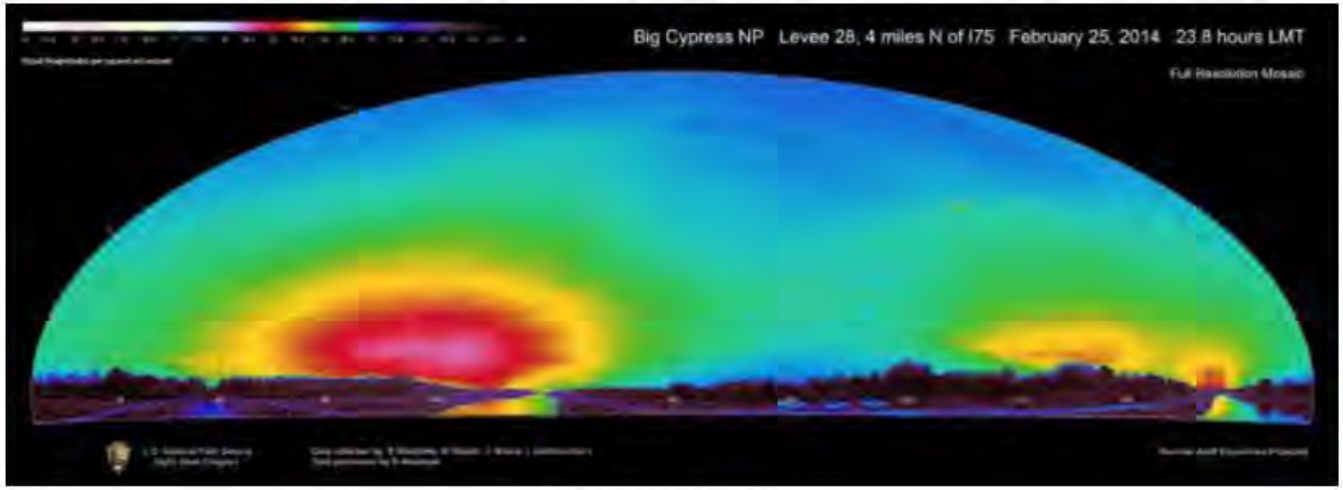
Average Sky Luminance (mag arcsec^{-2})	Average Sky Luminance (µcd/m^2)	Zenith Luminance (mag arcsec^{-2})	Zenith Luminance (µcd/m^2)	Brightest luminance (mag arcsec^{-2})	Brightest luminincance	Synthetic SQM (mag arcsec^{-2})	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
20.48	696	21.26	340	18.58	3,995	21.04	-8.06	1.718	1.687



PHOTOMETRY OF ARTIFICIAL SKYGLOW

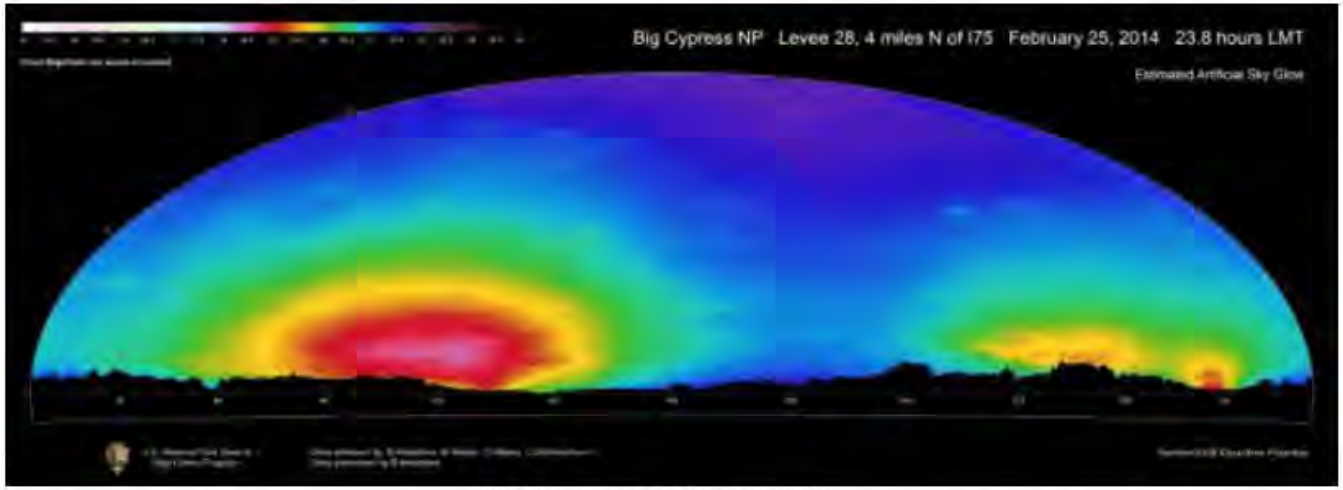
Sky Quality Index (SQI)	Average Sky Luminance (µcd/m^2)	Average Sky Luminance to zenith angle 80°	Average Sky Luminance to zenith angle 70°	Zenith Luminance	Brightest luminincance (µcd/m^2)	All-sky light pollution ratio (ALR)	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
47.8	507	433.1	324.2	144	3,865	2.04	-7.68	1.102	1.357

BICY140226 Date (LMT) 25-Feb-14 Time (LMT): 23.78 Reference: N Data Set: **4**



PHOTOMETRY OF ALL SOURCES

Average Sky Luminance (mag arcsec^{-2})	Average Sky Luminance (µcd/m^2)	Zenith Luminance (mag arcsec^{-2})	Zenith Luminance (µcd/m^2)	Brightest luminance (mag arcsec^{-2})	Brightest lumininance	Synthetic SQM (mag arcsec^{-2})	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
20.32	806	21.14	378	18.46	4,500	20.88	-8.22	2.001	2.029



PHOTOMETRY OF ARTIFICIAL SKYGLOW

Sky Quality Index (SQI)	Average Sky Luminance (µcd/m^2)	Average Sky Luminance to zenith angle 80°	Average Sky Luminance to zenith angle 70°	Zenith Luminance	Brightest lumininance (µcd/m^2)	All-sky light pollution ratio (ALR)	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
43.8	646	568.6	435.8	203	4,376	2.60	-7.94	1.467	1.740

NPS NIGHT SKIES PROGRAM DATA NIGHT REPORT

BICY140221_ML3 Big Cypress NP **Kirby Storter Roadside Park** **21-Feb-14**

Data Night Attributes

Longitude:	-81.15480	Camera:	ML 3	Air temp. (C):	21.9	ZLM:		OBS_1:	M Nelson
Latitude:	25.86822	# of sets:	4	R. H. (%):	94.0	BORTLE:	4	OBS_2:	
Elevation (m):	2	Exposure (secs):	12	Wind Speed (mph):	3	SQM:		OBS_3:	

NARRATIVE: *These notes are based upon observations from Fire Prairie Trail (17 miles NNW) taken the same night by Bob Meadows. Very nice night with almost all clouds clearing out shortly after sunset. Good detail in the Milky Way, with the prancing horse easily visibly along with the great rift. the light dome from the SE coast is easily visible, as is the dome from Naples/Fort Meyers. Transparency was good and stars could be seen in the southern horizon to about 5 degrees. This is a pretty good site for night sky viewing.

Data Set Attributes

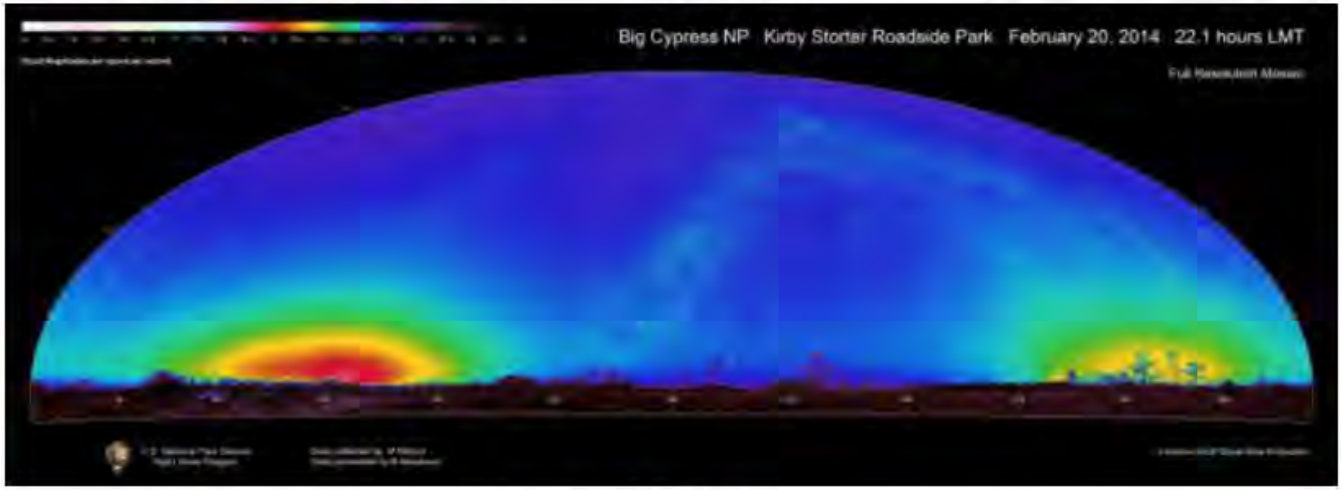
	Quality Flags				Natural Sky Model			Extinction				Collection Properties			
Data Set	Use-able	Col-lection	Pro-cessing	Atmo-sphere	Zenith airglow (µcd/m²)	Fit quality	Natural sky model fit notes	Ext. coeff. (mag/ airmass)	Std err Y	# stars used	# stars reject	% Clouds	Ave. Point Error	Max Point Error	total bias drift
1	Y	4	4	4	92	3	Flat issues, otherwise good night	0.239	0.04	97	8	1	0.76	1.37	1.3
2	Y	4	4	4	99	3	Flat issues, otherwise good night	0.234	0.05	102	7	0	0.75	1.33	0.9
3	Y	4	4	4	99	3	Flat issues, otherwise good night	0.229	0.04	102	10	0	0.73	1.31	1.1
4	Y	4	4	4	134	3	Flat issues, otherwise good night	0.236	0.05	89	9	0	0.73	1.30	1.1

Populated Places

Place	Population (2010)	Distance (km)	Azimuth	Walker's	Apparent Half-Width (degrees)
Miami city	399,457	95.2	96	0.452	3.3
Hialeah city	224,669	85.2	90	0.336	2.8
Pembroke Pines city	154,750	83.1	78	0.246	3.6
Miramar city	122,041	82.7	81	0.196	3.4
Fort Lauderdale city	165,521	105.4	73	0.145	2.9
Hollywood city	140,768	100.6	79	0.139	2.7
Miami Gardens city	107,167	91.5	84	0.134	2.4
Coral Springs city	121,096	100.0	63	0.121	2.5
Kendall CDP	75,371	83.0	105	0.120	2.5
Davie town	91,992	90.0	75	0.120	3.4
Weston city	65,333	79.5	71	0.116	3.3
Kendale Lakes CDP	56,148	76.7	103	0.109	1.9
Tamiami CDP	55,271	76.3	99	0.109	1.8
The Hammocks CDP	51,003	74.0	107	0.108	2.0
Fountainebleau CDP	59,764	81.2	97	0.101	1.3
Plantation city	84,955	93.7	72	0.100	2.6
Cape Coral city	154,305	120.3	316	0.097	4.4
Lehigh Acres CDP	86,784	95.8	330	0.097	5.2
Sunrise city	84,439	95.5	69	0.095	2.3
Homestead city	60,512	83.8	122	0.094	2.4
Miami Beach city	87,779	101.7	93	0.084	1.4
Doral city	45,704	79.9	94	0.080	2.4
Pompano Beach city	99,845	110.5	68	0.078	2.3
Kendall West CDP	36,154	73.7	104	0.078	1.2
Marco Island city	16,413	55.1	278	0.073	3.3
Country Club CDP	47,105	84.7	84	0.071	1.2
Golden Gate CDP	23,961	65.1	303	0.070	1.6
Lauderhill city	66,887	98.5	71	0.069	1.5
Bonita Springs city	43,914	83.3	311	0.069	3.9
Immokalee CDP	24,154	67.2	337	0.065	3.7
Tamarac city	60,427	97.2	67	0.065	1.8
North Miami city	58,786	98.7	88	0.061	1.5
Richmond West CDP	31,973	78.1	111	0.059	1.4

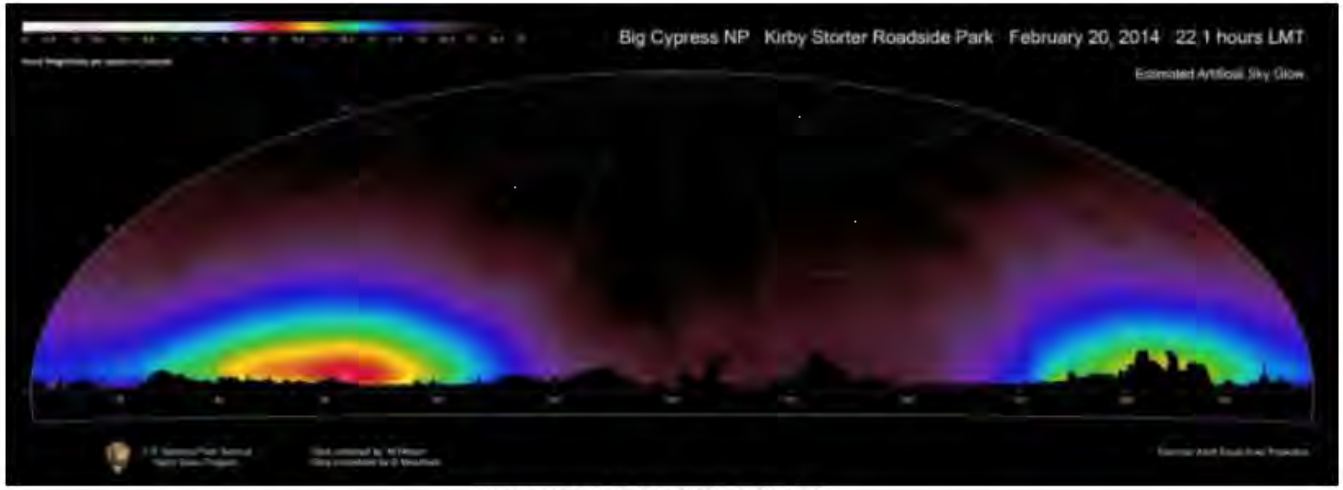
Coral Gables city	46,780	92.2	103	0.057	2.0
South Miami Heights CDP	35,696	83.0	112	0.057	1.4
Boca Raton city	84,392	118.7	62	0.055	2.4
Cutler Bay town	40,286	88.3	111	0.055	1.8
Deerfield Beach city	75,018	113.9	64	0.054	1.8
Fort Myers city	62,298	107.3	321	0.052	3.1

BICY140221_ML3 Date (LMT) 20-Feb-14 Time (LMT): 22.11 Reference: Y Data Set: **1**



PHOTOMETRY OF ALL SOURCES

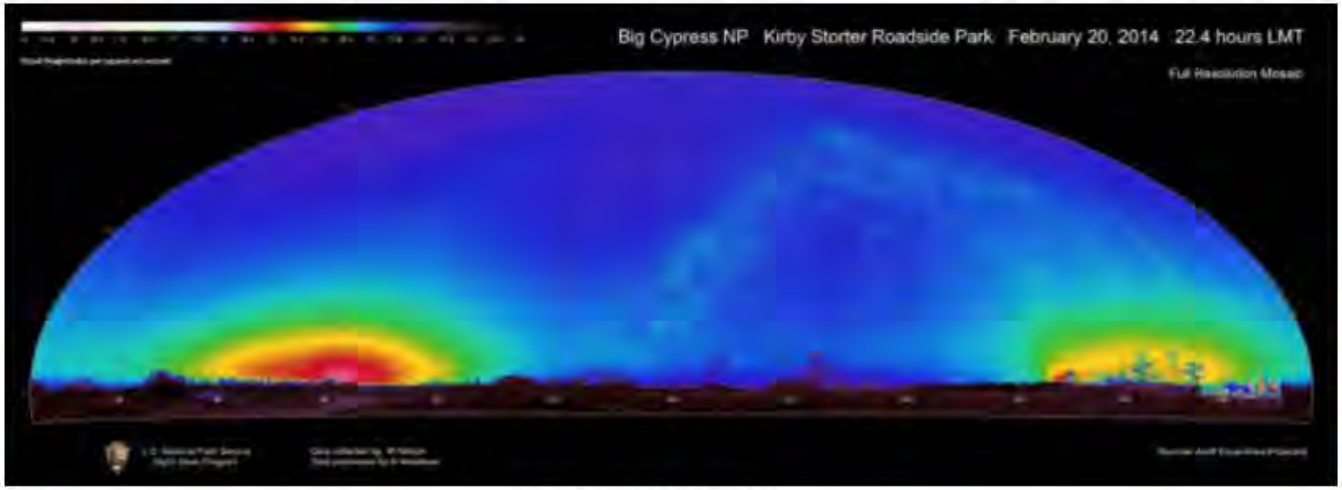
Average Sky Luminance (mag arcsec^{-2})	Average Sky Luminance (µcd/m^2)	Zenith Luminance (mag arcsec^{-2})	Zenith Luminance (µcd/m^2)	Brightest luminance (mag arcsec^{-2})	Brightest lumininance	Synthetic SQM (mag arcsec^{-2})	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
21.04	415	21.69	229	18.68	3,662	21.46	-7.51	1.022	0.880



PHOTOMETRY OF ARTIFICIAL SKYGLOW

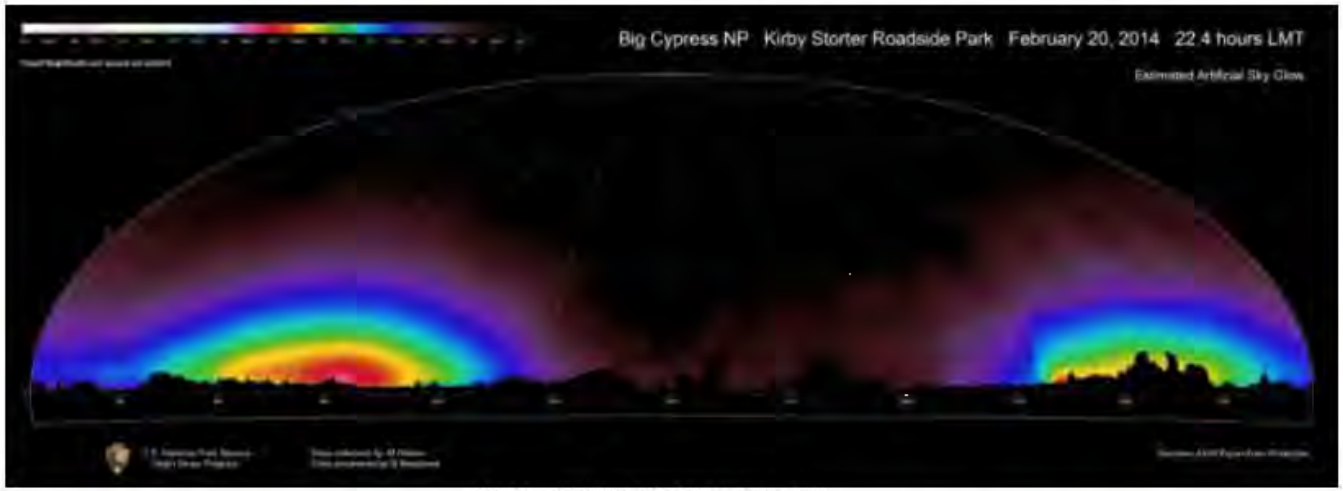
Sky Quality Index (SQI)	Average Sky Luminance (µcd/m^2)	Average Sky Luminance to zenith angle 80°	Average Sky Luminance to zenith angle 70°	Zenith Luminance	Brightest lumininance (µcd/m^2)	All-sky light pollution ratio (ALR)	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
77.9	157	96.9	53.7	3	3,468	0.63	-6.40	0.230	0.491

BICY140221_ML3 Date (LMT) 20-Feb-14 Time (LMT): 22.44 Reference: N Data Set: **2**



PHOTOMETRY OF ALL SOURCES

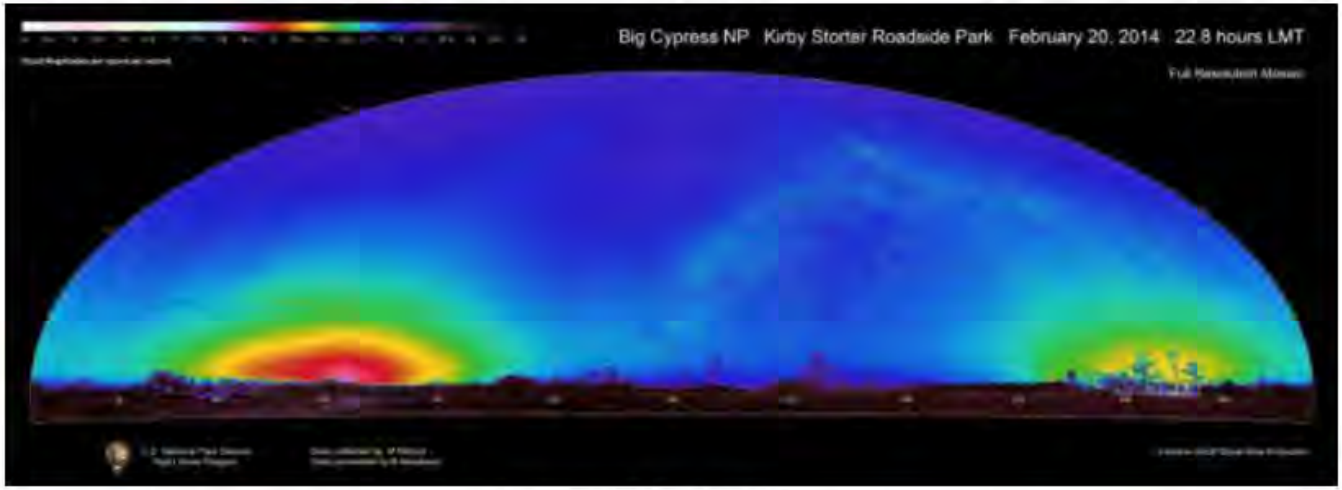
Average Sky Luminance (mag arcsec^{-2})	Average Sky Luminance (µcd/m^2)	Zenith Luminance (mag arcsec^{-2})	Zenith Luminance (µcd/m^2)	Brightest luminance (mag arcsec^{-2})	Brightest luminiinance	Synthetic SQM (mag arcsec^{-2})	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
21.03	420	21.67	233	18.02	6,703	21.47	-7.53	1.022	0.893



PHOTOMETRY OF ARTIFICIAL SKYGLOW

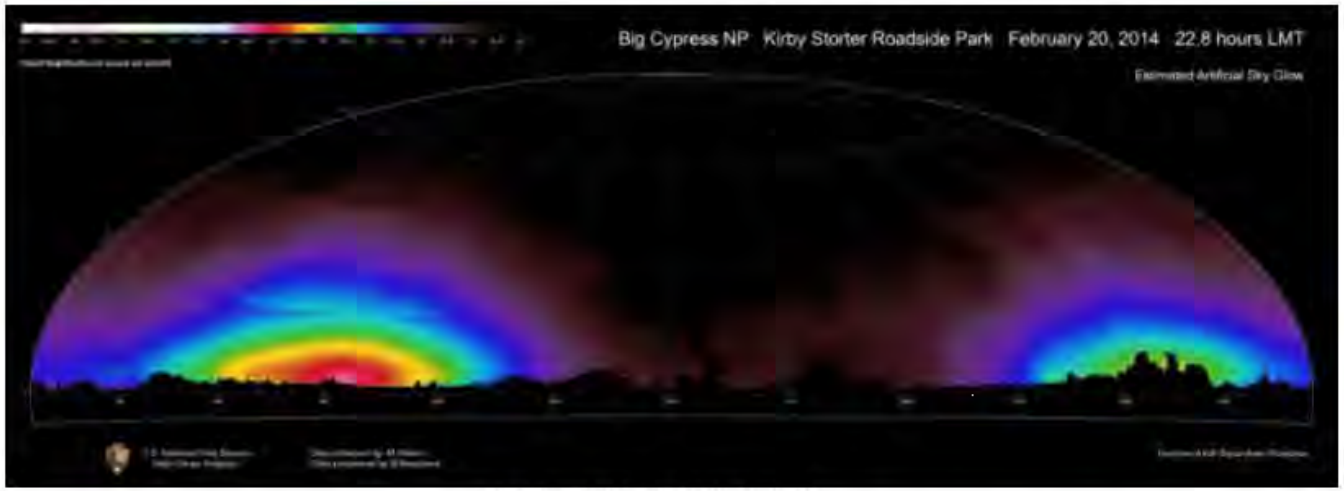
Sky Quality Index (SQI)	Average Sky Luminance (µcd/m^2)	Average Sky Luminance to zenith angle 80°	Average Sky Luminance to zenith angle 70°	Zenith Luminance	Brightest luminiinance (µcd/m^2)	All-sky light pollution ratio (ALR)	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
79.9	152	87.4	44.0	2	4,167	0.61	-6.37	0.206	0.487

BICY140221_ML3 Date (LMT) 20-Feb-14 Time (LMT): 22.77 Reference: N Data Set: **3**



PHOTOMETRY OF ALL SOURCES

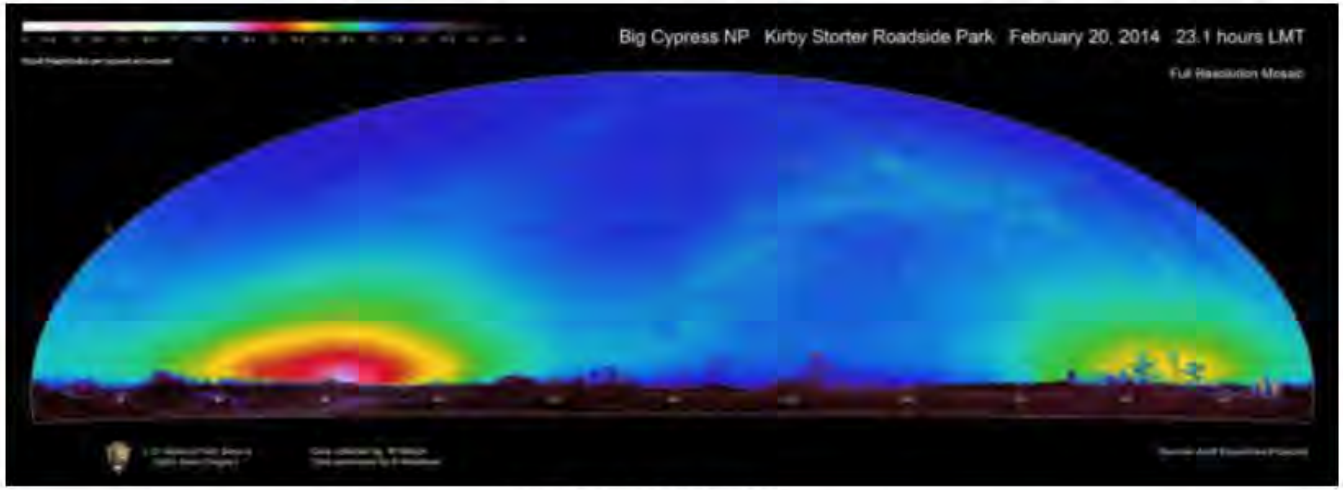
Average Sky Luminance (mag arcsec^{-2})	Average Sky Luminance (µcd/m^2)	Zenith Luminance (mag arcsec^{-2})	Zenith Luminance (µcd/m^2)	Brightest luminance (mag arcsec^{-2})	Brightest luminiinance	Synthetic SQM (mag arcsec^{-2})	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
21.01	428	21.68	232	18.46	4,469	21.46	-7.54	1.048	0.956



PHOTOMETRY OF ARTIFICIAL SKYGLOW

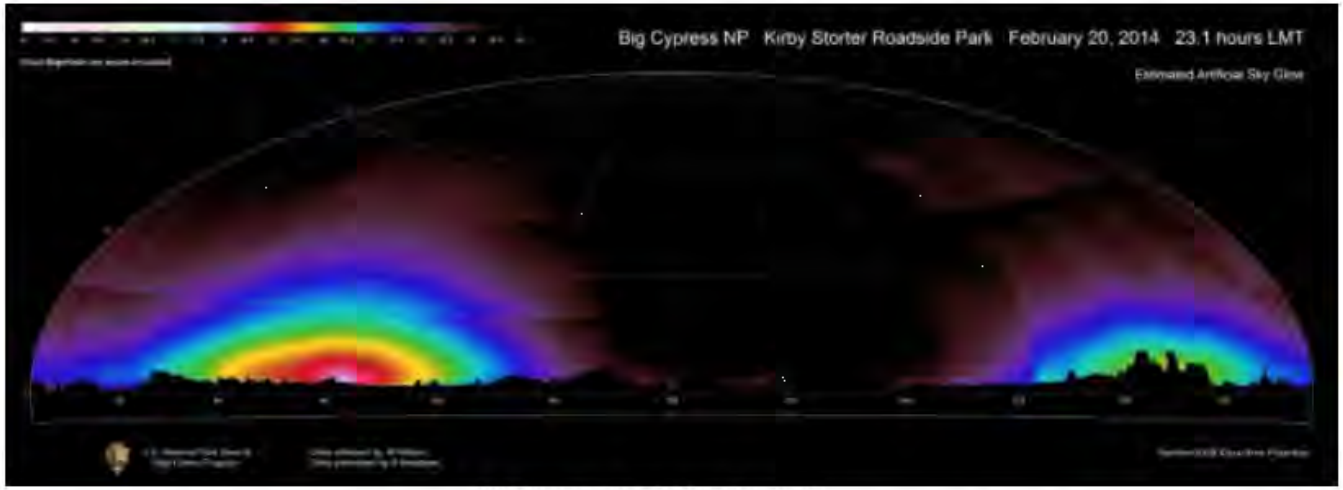
Sky Quality Index (SQI)	Average Sky Luminance (µcd/m^2)	Average Sky Luminance to zenith angle 80°	Average Sky Luminance to zenith angle 70°	Zenith Luminance	Brightest luminiinance (µcd/m^2)	All-sky light pollution ratio (ALR)	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
78.1	159	97.8	56.2	2	4,262	0.64	-6.42	0.234	0.546

BICY140221_ML3 Date (LMT) 20-Feb-14 Time (LMT): 23.11 Reference: N **Data Set: 4**



PHOTOMETRY OF ALL SOURCES

Average Sky Luminance (mag arcsec^{-2})	Average Sky Luminance (µcd/m^2)	Zenith Luminance (mag arcsec^{-2})	Zenith Luminance (µcd/m^2)	Brightest luminance (mag arcsec^{-2})	Brightest lumininance	Synthetic SQM (mag arcsec^{-2})	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
20.91	469	21.48	277	17.85	7,873	21.34	-7.64	1.167	1.059



PHOTOMETRY OF ARTIFICIAL SKYGLOW

Sky Quality Index (SQI)	Average Sky Luminance (µcd/m^2)	Average Sky Luminance to zenith angle 80°	Average Sky Luminance to zenith angle 70°	Zenith Luminance	Brightest lumininance (µcd/m^2)	All-sky light pollution ratio (ALR)	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
79.9	155	90.3	52.1	15	5,880	0.62	-6.39	0.227	0.577

NPS NIGHT SKIES PROGRAM DATA NIGHT REPORT

BICY140221_ML4 Big Cypress NP **Fire Prairie Trail** **21-Feb-14**

Data Night Attributes

Longitude:	-81.27950	Camera:	ML 4	Air temp. (C):	22.4	ZLM:	6.80	OBS_1:	B Meadows
Latitude:	26.09262	# of sets:	1	R. H. (%):	86.7	BORTLE:	4	OBS_2:	L Gommermann
Elevation (m):	3	Exposure (secs):	12	Wind Speed (mph):	2	SQM:	21.56	OBS_3:	

NARRATIVE: Excellent site for night sky observing. The light dome from Naples/Fort Meyers is easily visible to about 20° above horizon, but does not significantly impact the detail in the sky above. Miami/Ft Lauderdale light dome visible in the east to about 15°. Almost totally clear skies with good transparency and seeing. Fairly good detail in the Milky Way.

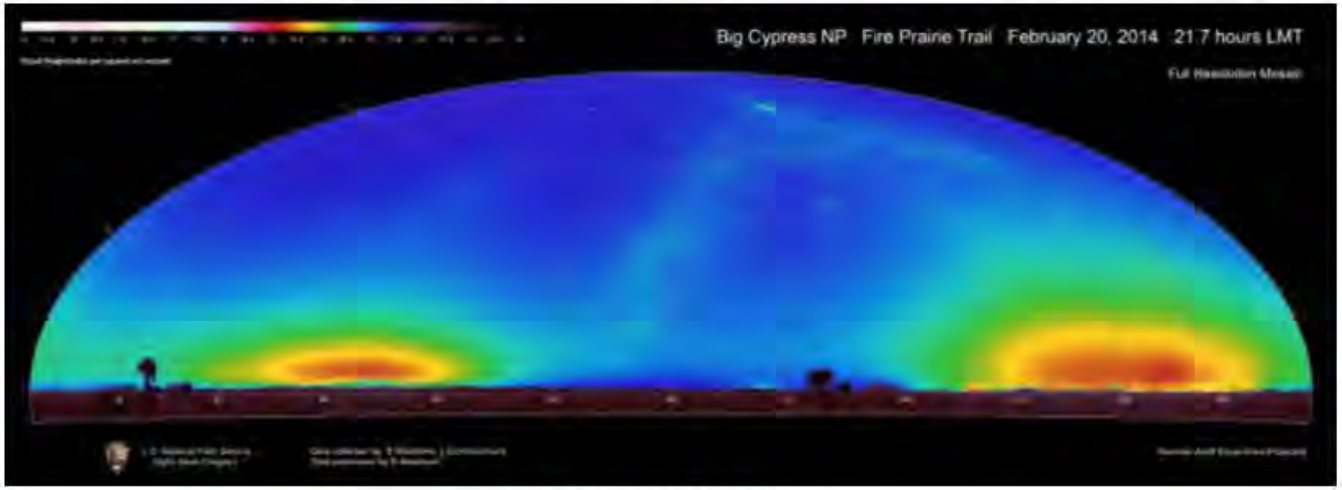
Data Set Attributes

	Quality Flags						Natural Sky Model	Extinction				Collection Properties			
Data Set	Use-able	Col-lection	Pro-cessing	Atmo-sphere:	Zenith airglow (µcd/m²)	Fit quality	Natural sky model fit notes	Ext. coeff. (mag/ airmass)	Std err Y	# stars used	# stars reject	% Clouds	Ave. Point Error	Max Point Error	total bias drift
1	Y	5	5	4	127	4	clear skies with some lingering haze/low clouds to the west	0.280	0.04	136	6	2	0.26	0.88	1.0

Populated Places

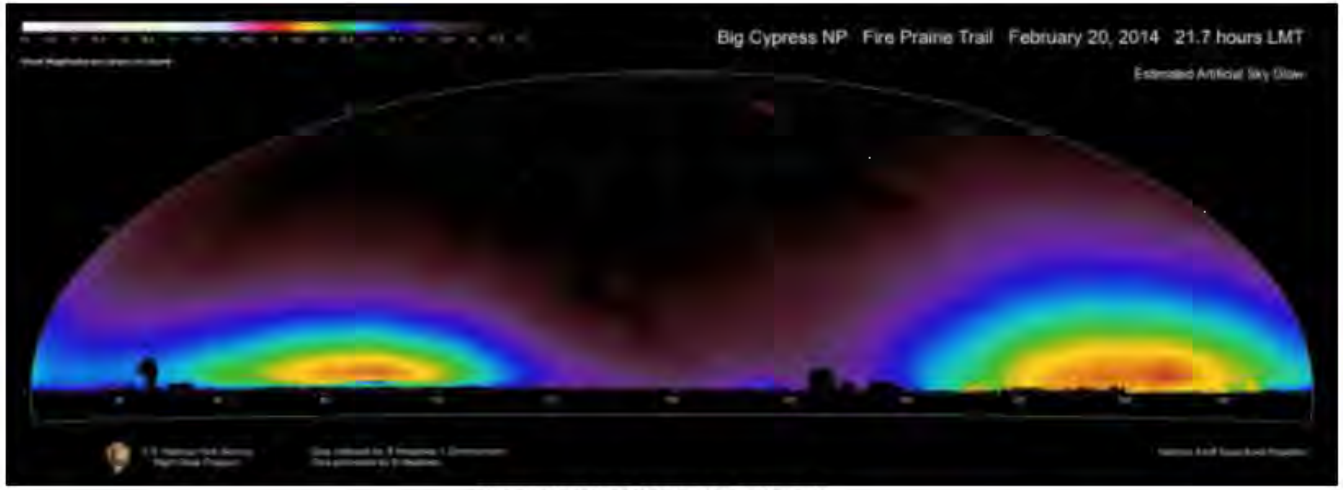
Place	Population (2010)	Distance (km)	Azimuth	Walker's	Apparent Half-Width (degrees)
Miami city	399,457	112.7	108	0.296	2.8
Immokalee CDP	24,154	39.5	339	0.247	6.3
Lehigh Acres CDP	86,784	68.0	328	0.228	7.3
Hialeah city	224,669	100.6	104	0.221	2.4
Golden Gate CDP	23,961	43.5	284	0.192	2.4
Pembroke Pines city	154,750	94.1	95	0.180	3.2
Cape Coral city	154,305	94.1	311	0.180	5.7
Bonita Springs city	43,914	58.5	300	0.168	5.5
Miramar city	122,041	95.1	98	0.138	3.0
Fort Lauderdale city	165,521	113.4	87	0.121	2.7
Marco Island city	16,413	45.7	247	0.116	4.0
Coral Springs city	121,096	103.6	79	0.111	2.4
Fort Myers city	62,298	80.3	317	0.108	4.1
Hollywood city	140,768	111.5	93	0.107	2.4
Naples city	19,537	51.8	277	0.101	3.5
Miami Gardens city	107,167	104.7	99	0.096	2.1
Davie town	91,992	99.3	91	0.094	3.1
Weston city	65,333	87.5	89	0.091	3.0
Plantation city	84,955	101.6	88	0.082	2.4
Sunrise city	84,439	102.1	85	0.080	2.2
Estero CDP	22,612	63.7	305	0.070	3.6
Pompano Beach city	99,845	115.9	81	0.069	2.2
Kendall CDP	75,371	103.7	117	0.069	2.0
Tamiami CDP	55,271	95.3	113	0.062	1.5
Kendale Lakes CDP	56,148	96.9	116	0.061	1.5
Fountainebleau CDP	59,764	99.4	111	0.061	1.1
Lauderhill city	66,887	105.6	86	0.058	1.4
Miami Beach city	87,779	118.0	105	0.058	1.2
The Hammocks CDP	51,003	95.4	119	0.057	1.5
Tamarac city	60,427	102.9	83	0.056	1.7
Orangetree CDP	4,406	36.8	307	0.054	2.8
Boca Raton city	84,392	121.0	75	0.052	2.3
Port St. Lucie city	164,603	159.2	34	0.051	3.5

BICY140221_ML4 Date (LMT) 20-Feb-14 Time (LMT): 21.66 Reference: Y Data Set: **1**



PHOTOMETRY OF ALL SOURCES

Average Sky Luminance (mag arcsec^{-2})	Average Sky Luminance (µcd/m^2)	Zenith Luminance (mag arcsec^{-2})	Zenith Luminance (µcd/m^2)	Brightest luminance (mag arcsec^{-2})	Brightest luminiinance	Synthetic SQM (mag arcsec^{-2})	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
20.85	498	21.53	266	18.77	3,364	21.34	-7.72	1.180	1.131



PHOTOMETRY OF ARTIFICIAL SKYGLOW

Sky Quality Index (SQI)	Average Sky Luminance (µcd/m^2)	Average Sky Luminance to zenith angle 80°	Average Sky Luminance to zenith angle 70°	Zenith Luminance	Brightest luminiinance (µcd/m^2)	All-sky light pollution ratio (ALR)	Total luminous emittance (mags)	Illuminance (mlux) Horizontal	Max Vert
74.5	210	116.7	63.8	6	3,212	0.85	-6.76	0.285	0.638

INTERNATIONAL DARK-SKY ASSOCIATION

INTERNATIONAL DARK-SKY ASSOCIATION
FLORIDA CHAPTER

defending Florida's natural night sky environment

May 11, 2016

Christine Clark
Management Assistant
Big Cypress National Preserve
33100 Tamiami Trail East
Ochopee, FL 34141

SUBJ: Sky Quality Monitoring for Big Cypress National Preserve

Dear Ms. Clark,

The purpose of this letter is to let you know that IDA Florida Chapter volunteers, together with other volunteers from supportive groups in South Florida (i.e. astronomy clubs, photography clubs and others), plan to collect sky quality monitoring information on a yearly basis at Big Cypress National Preserve ("Preserve") using IDA's accepted practices for sky quality surveys. Via this letter, we are also including the first set of monitoring data we collected a week ago (May 6 and 7, 2016).

We will encourage our volunteers and partners to collect the data using Sky Quality Meters (SQM) during clear moonless nights. Since the preserve has large predators that could be active at night (e.g. alligators, bears and panthers), measurements will be collected from areas that are deemed safe and easily accessible to volunteers at night (such as public rest stops, campgrounds, etc). As weather in South FL tends to be cloudy and humid for most of the year, it may not always be practical to collect SQM data. When that's the case, we will employ other methods that IDA deems acceptable, such as collecting night sky photos with a digital SLR camera, to help document the visibiliy of stars, the Milky Way and urban skyglow. We'll recommend our volunteers to take the photos from a common location (such as Kirby Storter Roadside Park) and use consistent camera settings year to year. Besides documenting the visibility of starlight, these photos will help us monitor the effects of skyglow from the closest large urban regions (Broward/Miami-Dade, Everglades City/ Naples/ Ft Myers).

We are also using this opportunity to submit the SQM monitoring data we collected in May 5 and 6, 2016, which provides evidence of "Silver"-tier night sky quality over the Preserve. A total of 9 readings were collected across the north and south sections of the preserve. Those nights we had mostly clear to clear skies, lower than usual humidity and moonless conditions. We also plan to submit these readings to the Globe at Night citizen science project so the data can be publicly accessible and used to advance the science of night sky monitoring. You are also encouraged to use these data during public outreach at the Preserve.

We hope this information is helpful and, needless to say, we are all looking forward to celebrating with you the designation of Big Cypress National Preserve as an International Dark-Sky Park.

Sincerely,

Diana Umpierre

Diana Umpierre, AICP, GISP
IDA Florida Chapter, Chair

NightSkyConservancy@gmail.com
https://www.facebook.com/NightSkyConservancy

Big Cypress National Preserve
Night Sky Quality Monitoring – May 2016

During the course of 2 nights, a total of 9 readings were collected using a Unihedron sky quality meter (SQM-L). The readings were taken from rest stops, parking lots and road shoulders along US 41, I-75 and SR29. During those nights, the Moon was not present. We experienced mostly clear to clear skies and lower than usual humidity. It is worth noting that both nights, the bulge of the Milky Way was nicely visible and we also saw several meteors from the Eta Aquarids meteor shower that was near peak early morning on 5/6.

ObsID	LocalDate	LocalTime	Latitude	Longitude	SQMReading	SQMSerial	CloudCover	Moon?	CollectedBy
1	5/6/2016	1:05 AM	26.1736	-80.8958	20.90	7815	mostly clear	No	D. Umpierre (IDA-FL)
2	5/6/2016	1:35 AM	26.1697	-81.0729	21.10	7815	clear	No	D. Umpierre (IDA-FL)
3	5/6/2016	1:48 AM	26.1683	-81.1979	21.50	7815	mostly clear	No	D. Umpierre (IDA-FL)
4	5/6/2016	2:23 AM	26.2344	-81.3414	21.42	7815	clear	No	D. Umpierre (IDA-FL)
5	5/6/2016	3:00 AM	25.8929	-81.3264	21.55	7815	mostly clear	No	D. Umpierre (IDA-FL)
6	5/6/2016	11:00 PM	25.8914	-81.2300	21.48	7815	clear	No	D. Umpierre (IDA-FL)
7	5/6/2016	11:45 PM	25.8682	-81.1543	21.50	7815	clear	No	D. Umpierre (IDA-FL)
8	5/7/2016	12:05 AM	25.8576	-81.0322	21.28	7815	mostly clear	No	D. Umpierre (IDA-FL)
9	5/7/2016	12:49 AM	25.8612	-80.9251	21.17	7815	mostly clear	No	D. Umpierre (IDA-FL)
				Average	21.32				
				Median	21.42				

ObsID	LocalDate	LocalTime	Latitude	Longitude	SQMReading	SQMSerial	CloudCover	Moon?	CollectedBy
1	5/6/2016	1:05 AM	26.1736	-80.8958	20.90	7815	mostly clear	No	D. Umpierre (IDA-FL)
2	5/6/2016	1:35 AM	26.1697	-81.0729	21.10	7815	clear	No	D. Umpierre (IDA-FL)
3	5/6/2016	1:48 AM	26.1683	-81.1979	21.50	7815	mostly clear	No	D. Umpierre (IDA-FL)
4	5/6/2016	2:23 AM	26.2344	-81.3414	21.42	7815	clear	No	D. Umpierre (IDA-FL)
5	5/6/2016	3:00 AM	25.8929	-81.3264	21.55	7815	mostly clear	No	D. Umpierre (IDA-FL)
6	5/6/2016	11:00 PM	25.8914	-81.2300	21.48	7815	clear	No	D. Umpierre (IDA-FL)
7	5/6/2016	11:45 PM	25.8682	-81.1543	21.50	7815	clear	No	D. Umpierre (IDA-FL)
8	5/7/2016	12:05 AM	25.8576	-81.0322	21.28	7815	mostly clear	No	D. Umpierre (IDA-FL)
9	5/7/2016	12:49 AM	25.8612	-80.9251	21.17	7815	mostly clear	No	D. Umpierre (IDA-FL)
				Average	21.32				
				Median	21.42				

Private Land Ownership

Within the preserve, approximately 270 private landowners cumulatively possess less than 1,000 acres, together comprising ~0.1% of Big Cypress National Preserve's total area.

On February 14, 2015 staff from Big Cypress National Preserve addressed approximately 70 private landowners and their families at an annual landowner meeting regarding Big Cypress National Preserve's application to become a Dark Sky Park. Private landowners were explained the requirements of a Dark Sky Park, were provided an introduction to different types and sources of light pollution, and were informed of efforts Big Cypress National Preserve was making (e.g. establish outdoor lighting guidelines, complete outdoor lighting inventory, conduct education programs, etc.) to achieve an International Dark Sky Place designation.

Landowners were provided with a brochure (see following pages) including a summary of this information and, for those interested in making voluntary changes to outdoor lighting on their private land, guidelines to consider when making lighting changes.

Staff from Big Cypress will continue to work with private landowners to ensure protection of the night sky. We are excited to participate in the International Dark-Sky Association's Parks and Protected Areas program that has the potential to provide Fixture Seal of Approval lighting options to private landowners within Big Cypress National Preserve at reduced cost.

National Park Service
U.S. Department of the Interior

Big Cypress National Preserve
Florida

A Timeless View...

There are few places left in the Eastern United States where the Milky Way Galaxy can still be seen stretching across the night sky from horizon to horizon. These sights above your private land within Big Cypress National Preserve are exceptional, and we intend to keep them this way.

Above: The Milky Way above Highway 29 along Big Cypress National Preserve's western boundary.

Please join us for our evening ranger-led astronomy programs and telescope viewings. Dates and times are available on our website: www.nps.gov/bicy.

The International Dark-Sky Association's Fixture Seal of Approval Program includes a registry of dark-sky friendly products. For more information, please visit www.darksky.org.

Big Cypress Seeking Dark Sky Park Designation

Information for Private Landowners Within Big Cypress

Why a Dark Sky Park?

By seeking Dark Sky Park designation through the International Dark-Sky Association, Big Cypress National Preserve is making a commitment to protect a resource that is rapidly disappearing all around us—the ability to see a natural night sky, unobscured by light pollution.

Left: While light pollution obscures night skies over the east and west coasts, little light pollution is emitted from lands within Big Cypress National Preserve (NASA, 2012).

How Can You Help?

All outdoor lights located on land operated by the Preserve are being inventoried. **Please note this does not include any outdoor lights on private land.** We have undertaken several lighting projects to mitigate or eliminate lights that are sources of light pollution and will continue to do so until all outdoor lights conform to night-sky friendly guidelines.

As a private landowner, **you are not obligated to make any changes** to outdoor lighting on your property. If you would like to make voluntary changes to your lights, please consider the following guidelines.

Above Left: A long-time exposure photograph of star tracks taken from Mile Marker 63 comfort station along I-75.
Above Right: A park ranger points to night sky objects during a ranger-led astronomy program at Seagrape Drive.

What Can You Do to Protect the Night Skies Over Big Cypress National Preserve?

1. Light Only Where & When You Need It

Remove lights from areas that do not need to be illuminated. Use motion sensors to illuminate lights only when necessary.

Left: A maintenance building equipped with motion sensors. Light pollution from Naples visible in background.

2. Direct Light Down With Shielding

Use lights with a solid barrier on top to direct light down and prevent glare. Light should not be emitted above the horizontal.

Left: Placing lights below roof overhangs can act as a shield.

3. Use Warm Amber Over Cool Blue Colors

Our eyes are less disturbed by (and wildlife is less attracted to) "warm" amber lights compared to "cool" blue-white lights.

Right: Amber lights illuminate hallways at headquarters.

4. Use Low-Watt & Energy-Efficient Lights

Use lights only as bright as needed. Find dimmable LEDs and CFLs. Remember, the most energy-efficient light is no light at all.

Right: Shielded LED lights illuminate a parking lot at headquarters.

If you replace any lighting on your property to protect the night sky, please contact Bob DeGross (bob_degross@nps.gov). If possible, provide photos of your old and new lights. This will help us achieve Dark Sky Park designation.

Leased Lands

Big Cypress has minimal leasing available within its boundaries. Two previously private properties were purchased with a life lease possessory interest attached to the lease. These lands total approximately 18 acres, and neither has public utility power at the property.

Big Cypress National Preserve allows for the customary use and occupancy of the two recognized tribes, the Miccosukee Tribe of Indians of Florida, and the Seminole Tribe of Florida. Twenty-two small family villages and three ceremonial sites are located on or adjacent to NPS lands. Of the NPS lands that are used by tribal entities, families, or clans, wildlife nuisance and night sky preservation are now part of the special use permit agreement that allows them to occupy the land.

Big Cypress is in the process of converting one lease that was inherited by the NPS when the Big Cypress Addition was created by act of Congress into three distinct lease instruments for the existing facilities – one for the Everglades Area Chamber of Commerce, one for the Collier County Sheriff, and one for an existing 240 foot communications tower. All three of these lease documents will have specific language to ensure the preservation of night sky quality.

Dade-Collier Training and Transition Airport

The Dade-Collier JetPort (now called the Miami Dade Training and Transition Airport, or TNT) was designed and building was begun before the Preserve was created. Although all of the area of the TNT Airport is within Collier County, Miami-Dade County owns the Airport and surrounding land, which is entirely within the boundaries of the Preserve. The following website gives the local history surrounding the TNT. https://www.nps.gov/bicy/learn/historyculture/miami-jetport.htm. The TNT encompasses 24, 850 acres, of which approximately 15% is minimally developed, with 2 runways, access runways, access roads from the adjacent US 41, and a small facility for air traffic control. Other than the 1000 square foot air traffic control building (which is staffed by a single air traffic controller 24 hours a day) and two storage sheds, it does not have any public facilities, terminals, parking, or public transportation and is not "open" to the public. It is used for approximately 70 low level approaches and landings or "touch-and-go" training landings per week during daylight hours. The runway was to be a back-up for NASA's space shuttle program, but now that the shuttle is no longer being used by NASA, the runway is no longer considered an optional landing location. The only night use for the jetport would be emergency landings; in which case the installed runway lights would be illuminated for as long as necessary for the landing to take place. In the last 25 years, there has not been a case where the JetPort has been used for emergency landings at night. There is a shielded light fixture above the door to the air traffic control building, but there is no illumination along the 2 mile road that leads to the JetPort air traffic control building. There are no plans to expand or change the layout or usage of the TNT airport.

Breitburn Oil and Gas Operations

Within Big Cypress National Preserve, two well fields have existed since the Preserve was created. The NPS does not own its subsurface rights, but has worked well with the Collier Mineral owner to provide reasonable access and resource protection since 1974. While the facility has always been oriented towards crew safety, the protection of resources and maximum energy efficiency has always been of paramount importance to the mineral owners and their operators during drilling, production, and extraction of minerals. Besides keeping lighting at production pads at minimal levels, Flaring of excess natural gas is also kept at a minimum (very infrequent) to reduce resource impacts.

Outdoor Lighting Survey

The attached lighting survey, begun in 2014, was conducted by Big Cypress National Preserve staff.

When reviewing our current outdoor lighting inventory, please consider the following information regarding the CCT rating of lighting currently installed within Big Cypress National Preserve:

Since the preserve began pursuing the IDA Dark Sky Places designation, the Color Correlated Temperature requirements considered as compliant with the IDA Dark Sky Park program has changed from having no guidelines (Dark Sky Park Program, Version 1.31) to recommendations ("it is recommended that only lighting under 3100K correlated color temperature (CCT) be used as this will minimize the impact on most wildlife…", International Dark-Sky Association Dark Sky Park Program Criteria, May 2013), to increasing restrictions ("correlated color temperature (CCT) of lamps installed in the Park shall not exceed 4000 K, and a CCT of 2500 K or less is recommended to minimize the impact on most wildlife", International Dark-Sky Association Dark Sky Park Program Guidelines, October 2014; "correlated color temperature (CCT) of lamps installed in the Park shall not exceed 3000 K, and a CCT of 2000 K or less is recommended to minimize the impact on most wildlife", October 2015).

Currently, there are installed within Big Cypress National Preserve a number of LED lighting documented in our outdoor lighting inventory that, when purchased (all before 2013), were approved by the International Dark-Sky Association. These lamps have CCT ratings of 5000 or higher. An example of such lighting is the RAB Lighting LPack WPLED 26 Bronze streetlight, rated at 5169 K, which are installed at parking lots at Big Cypress Swamp Welcome Center, Big Cypress Headquarters, and the Oasis Visitor Center.

Staff at Big Cypress National Preserve recognizes the documented detrimental effect of lamps with elevated CCT ratings on both wildlife and human health. Staff is seeking filters or alternative bulbs for these fixtures of elevated CCT ratings and expects to replace them with 3000 K or less equivalents over the next year. These retrofits will be documented and included in our upcoming annual report.

Outdoor lighting inventory is attached as excel file on enclosed flash drive due to margin and orientation issue associated with attaching in this document.

The following columns are required: Location (column A in our current online inventory), Picture of Fixture (column C in our current online inventory), Application (column J in our current online inventory), Fully-Shielded status (column K in our current online inventory), Alterntaive Mitigation status (column L in our current online inventory), Special Purpose <500 Lumens status (column M in our current online inventory), Conformity with LMP (column N in our current online inventory), Plan if not in conformity (column O in our current online inventory).

Outdoor Lighting Removal and Retrofits

Maintenance staff of Big Cypress National Preserve have undertaken both removal of outdoor lighting deemed unnecessary, and retrofitting of outdoor lighting to comply with night-sky friendly standards as stated in the Big Cypress National Preserve Policy on outdoor lighting. Examples of retrofitting lights include installation of motion sensors and shielding lights from above and to the horizontal.

The following table summarizes the location and number of lights that have been removed or disconnected to date.

Location	**Number of Lights Removed/Disconnected**
Big Cypress National Preserve Headquarters	9
Big Cypress Swamp Welcome Center	7
Environmental Education House	1
Fire Operations Center	2
Loop Road Education Center	4
Loop Road Ranger Station	4
Mile Marker 51 Recreation Parking	17
Mile Marker 63 Recreation Parking	24
Mile Marker 70 Recreation Parking	93
Quarters #16	2

The following pages provide examples of lighting removal and retrofits within Big Cypress National Preserve.

Photo taken of west parking lot lighting at Big Cypress Headquarters on February 24, 2014 (1 second exposure).

Photo taken of west parking lot lighting at Big Cypress Headquarters on January 11, 2015 (30 second exposure). Linear streak of light in background are headlights of cars on U.S. Hwy. 41.

Photo taken of first floor lighting along the west hallway of the Big Cypress Headquarters on January 11, 2015 (1/10 second exposure).

Photo taken of first floor lighting along the west hallway of the Big Cypress Headquarters on March 9, 2016 (1/10 second exposure).

Photo taken of north side of Big Cypress Water Plant on January 11, 2015 (2.5 second exposure).

Photo taken of first floor lighting along the west hallway of the Big Cypress Headquarters on January 11, 2015 (25 second exposure). Note distant sky glow of Naples, Florida as well as the flickering of a yellow-green firefly near the middle of the right side of the photo.

Night Sky Interpretation and Publications

Interpretation staff at Big Cypress National Preserve has utilized a broad range of formats to raise awareness of the significance and threat night sky resources protected within Big Cypress face, not only among visitors of Big Cypress, but also to nearby communities and organizations. Provided here are examples of this effort, which includes evening and daytime ranger-led night sky programs (taking place both inside and outside of the preserve), in addition to website features, social media platforms, press releases, newspaper publications, an article published in a state-wide environmental educator newsletter, and an interview with a local National Public Radio station.

Evening Ranger-Led Interpretive Programs

During the fall of 2009, the Big Cypress National Preserve Environmental Education and Outreach program purchased an Orion Skyquest™ XT8 Dobsonian telescope for use during ranger-led evening astronomy programs. Two ranger-led interpretive programs were delivered that year.

During the Winter 2012-2013 season, interpretation staff began delivering ranger-led evening astronomy programs on a regular basis – at least four each winter season (October – April). Additionally, interpretation staff reached out to local amateur astronomy groups including the South Florida Amateur Astronomers Association of Fort Lauderdale, the Everglades Astronomical Association of Naples, and the International Dark Sky Association Palm Beach Chapter of Boynton Beach to bring additional viewing equipment for visitors to utilize following evening night sky interpretive programs.

Strong partnerships have since developed between staff from Big Cypress National Preserve and these local amateur astronomy organizations whose assistance has proved crucial, particularly on evenings were participant numbers have exceed two hundred visitors. A table displaying the season, date, and number of participants in attendance for our evening ranger-led night sky interpretive programs is provided below.

Big Cypress National Preserve Evening Ranger-Led Night Sky Interpretive Programs		
Season	**Date**	**Number of Participants**
Winter 2009-2010	December 12, 2009	30
	March 27, 2010	18
Winter 2012-2013	January 4, 2013	50
	February 8, 2013	25
	February 22, 2013*	42
	March 13, 2013†	44
	March 15, 2013	80
Winter 2013-2014	December 7, 2013	60
	January 3, 2014	85
	February 1, 2014	130
	March 7, 2014	101
	March 22, 2014†	80
	April 5, 2014	240
Winter 2014-2015	December 6, 2014	50
	January 17, 2015‡	11
	January 23, 2015	94
	February 21, 2015	262
	March 20, 2015	TBD
Winter 2015-2016	December 5, 2015	20
	December 12, 2015	40
	January 9, 2016	85
	February 6, 2016	18
	March 5, 2015	151

* Program delivered within Big Cypress National Preserve to AMI Boys Camp

† Program delivered outside of Big Cypress National Preserve at one of the following locations: Collier County South Regional Library (3/13/13), Collier-Seminole State Park (3/22/14), League of Environmental Educators in Florida Annual Conference (3/27/10).

‡ Evening interpretive night ecology and night sky viewing canoe program limited to 12 participants.

The evening ranger-led programs are delivered (weather permitting) by park rangers outside without the use of a projector or PowerPoint slides. Visitors gather around rangers using the night sky as their only visual guide. These interpretive programs provide opportunities for visitors to consider and appreciate the rich cultural, natural, scientific, and aesthetic resources of the night sky and carry strong themes of night sky protection.

Prior to the Winter 2014-2015 season, when overcast conditions were present, the same themed, interpretive program was presented inside the nearby Big Cypress Swamp Welcome Center Auditorium utilizing a PowerPoint presentation. This presentation provided visitors with visual references to night sky objects discussed during the program. Due to the limited seating within the auditorium (approximately 75 seats), the Big Cypress National Preserve Interpretation Brach purchased a portable, inflatable projector screen in the Winter 2014-2015 season, allowing programs to be delivered to larger audiences even when overcast conditions are present.

Programs have been well-received by visitors and amateur astronomers alike. Following the interpretive program, a small number of participants were asked to complete a brief survey discussing their thoughts on the interpretive program and the night sky of Big Cypress National Preserve. Here is a sampling of the comments we have received:

"The rangers were awesome. The night sky should be protected. I especially loved the moons and bands of Jupiter and the Orion Nebula. Viva Big Cypress National Preserve…" – Christopher, Miami, FL

"Amazing sky – easy access from where I live to get here…With a crazy hectic lifestyle Big Cypress is my favorite respite to escape to!" – Melissa, Boca Raton, FL

"I have always loved the night sky. I remember, as a child growing up in Ohio, my parents showing me the Big Dipper and 'The Man on the Moon.' Then living my adult life in the Seattle area and not seeing the night sky – mainly due to cloud cover. But, cherishing those few clear nights and seeing great meteor showers, etc. Now, we have the opportunity to see a beautiful dark sky here in Ochopee. It is unique and a treasure and must be protected. A dark sky, like we see here in Big Cypress National Preserve, seems to be a rare thing and must be protected. PLUS, the word about this place must be shared so everyone knows to come and witness a dark sky filled with stars." – Kim, Ochopee, FL

"Living south of Boston, I don't see much – I can usually pick out Orion's belt clearly but not much else…The sky here is INCREADIBLE." – Dana, Easton, MA

"The show on Friday night was amazing! Both my soon to be 5 year old and I enjoyed it…The night sky, especially toward the east was bright and clear, and the viewing with the cooler air was outstanding. Of course, our viewing site had such superior conditions to the over lit city we live in. I would appreciate knowing anything we can do to support the Dark Skies initiative, especially at the park units, as we must work to preserve the ever fewer dark sites to view the historical sky I so well remember was awe-inspiring as a boy growing up in western New York state, where every clear summer night the Milky Way was so much more than just a candy bar. Thanks so much for your leadership in engaging our citizens, even the young ones, on such a critically important concern!" – Patrick, Naples, FL

Daytime Ranger-Led Interpretive Programs

Beginning during the Winter 2013-2014 season, seasonal park rangers with the Big Cypress National Preserve Environmental Education and Outreach Branch additionally researched, developed, and presented interpretive programs with themes focusing on the night sky of Big Cypress National Preserve. Primarily delivered to audiences outside of Big Cypress National Preserve, these programs are intended for broad audiences and include discussions of the threat of light pollution to South Florida's night skies. Program summaries are provided for the three interpretive programs developed to date, entitled "Stars Above, Swamp Below", "Night Moves", and "Get Firefly-ed Up!", followed by a table displaying the season, date, program, and number of participants in attendance.

Stars Above, Swamp Below

From the colossal furnaces of a star's core to the ancient precession of the zodiac, join a park range to explore the heavens that glisten above the Big Cypress Swamp. Understanding the nature of the night sky is much like discovering the nature of tl swamp itself. In this stellar program, we compare the structure of both these systems, learn about their "inhabitants", explore what threatens them, and finally uncover the profound connections we share with both Big Cypress National Preserve an the starry skies.

Night Moves

The chorus of crickets crescendos while the deep red sun drops below the horizon. The land and its inhabitants seem to have gone to rest, but the tranquility is suddenly broken by flourishes and flashes of noise and motion. It is an unfamiliar place of dark shapes and moonlit shadows, of strange sounds and shifting stars. Join a park ranger and explore the hidden realm of the nocturnal at Big Cypress National Preserve. Alor the way, learn of the importance of the night-time environment – not only for the wild flora and faur of southwest Florida – but also for ourselves.

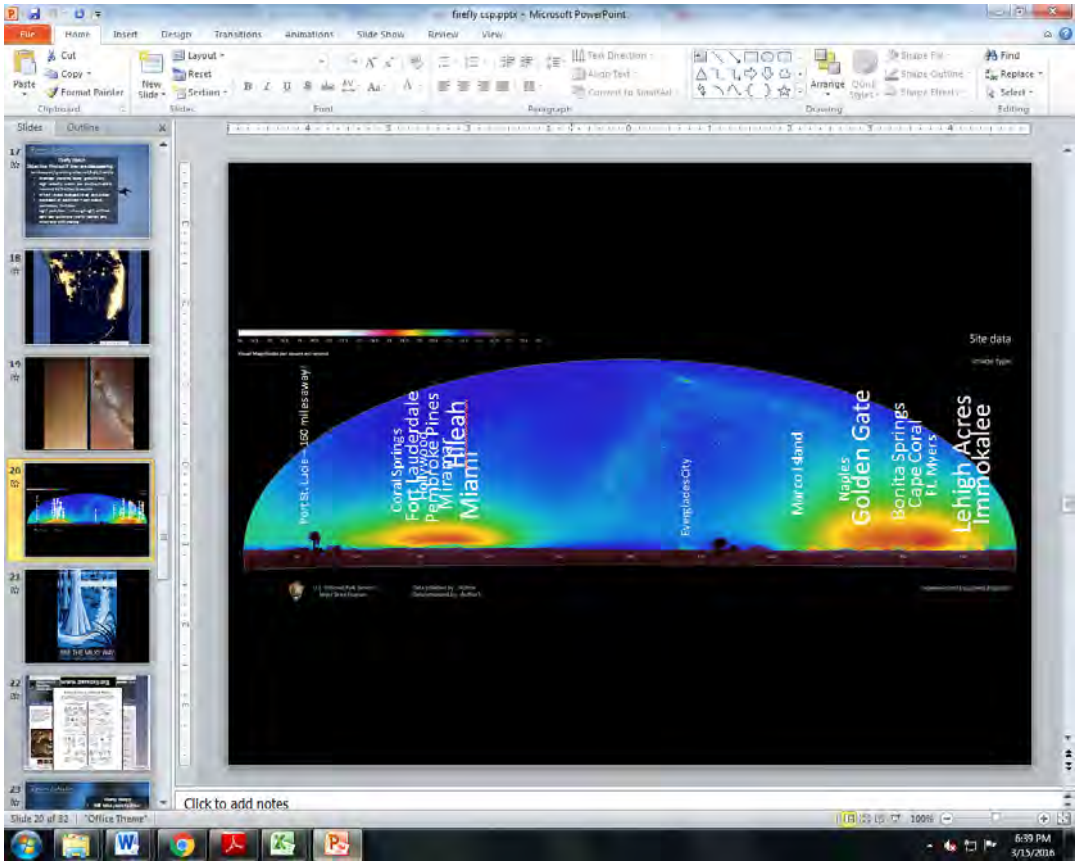
Get Firefly-ed Up!

Once a common sight during twilight hours, the flashing beacons of fireflies (a.k.a. lightening bugs) have become increasingly difficult to spot, suggesting widespread population declines. Gain insights on firefly biology and ecology while learning how recording observations of fireflies from your own backyard can help scientists studying firefly population trends across North America through the citizen science project "Firefly Watch."

Big Cypress National Preserve Daytime Ranger-Led Night Sky Interpretive Programs			
Season	**Date**	**Program**	**Number of Participants**
Winter 2013-2014	December 18, 2013†	Stars Above, Swamp Below	15
	February 5, 2014	Stars Above, Swamp Below	13
	February 22, 2014†	Stars Above, Swamp Below	40
Winter 2014-2015	January 20, 2015†	Night Moves	38
	February 24, 2015	Night Moves	22
	February 28, 2015†	Night Moves	55
	March 7, 2015†	Night Moves	51
Winter 2015-2016	January 12, 2016	Night Moves	40
	January 15, 2016	Get Firefly-ed Up!	11
	March 1, 2016	Get Firefly-ed Up!	18
	March 2, 2016†	Night Moves	40

† Program delivered outside of Big Cypress National Preserve at one of the following locations: Collier-Seminole State Park (12/18/13), Collier County Museum of the Everglades (2/22/14, 2/28/15), The Naples Preserve (1/20/15), Friends of Barefoot Beach Lecture Series (3/21/15), North Collier Government Center (3/2/16)

All interpretive night sky programs conducted by Big Cypress National Preserve include a strong message regarding the threat of light pollution to the resources of the preserve and night sky. Images depicting light pollution in South Florida are combined with false-color models of light pollution collected by the National Park Service Night Sky Team during a sampling trip to Big Cypress National Preserve in the spring of 2014 to illustrate our responsibilities of night sky stewardship.



The above example highlights a slide from the interpretive program "Get Firefly-ed Up!" that utilizes NPS Night Sky Team images.

Website

The Big Cypress National Preserve website features a "Lightscape / Night Sky" webpage (below left) highlighting the dark skies of the preserve wildlife, such as migrating birds and nocturnal moths, whose ecology is dependent on naturally dark habitats. Light pollution is addressed as both a threat and a waste of economic and energy resources. Also included are links to the National Park Service Night Sky webpage, the International Dark-Sky Association webpage, the International Dark-Sky Association's Multimedia webpage featuring videos on numerous night sky protection topics, and the "Losing the Dark" YouTube video.

Additionally, the Big Cypress National Preserve website also features a "Night Sky & Astronomy Programs" webpage (below right). Here web surfers can find our latest evening ranger-led interpretive program schedule as well as tips for attending these programs. Links to the South Florida Amateur Astronomers Association, the Everglades Astronomical Society, and the International Dark-Sky Association South Florida Chapter websites are also provided.


National Park Service
Find a Park
Discover History
Explore Nature
Get Involved
Working with Communities
Teachers
Kids
About Us
Big Cypress
National Preserve
Florida
Explore This Park
There are park alerts in effect.
Park Home
Plan Your Visit
Photos & Multimedia
History & Culture
Nature & Science
For Teachers
For Kids
News
Management
Support Your Park
Bookstore
Park Tools
View Park Map
Find Us On
Facebook
Twitter
YouTube
Flickr
More
Lightscape / Night Sky
Big Cypress National Preserve has a resource that many take for granted, or may not even be aware of - our natural "darkness." Even with widespread development on the east and west coasts of Florida the Preserve remains one of the darkest areas east of the Mississippi River. In the heart of the swamp it's still possible to view the Milky Way, something that many who have only been in urban or suburban settings have never seen.
The quality of the night sky (its relative darkness) throughout the United States, and the World for that matter, has come under siege. The widespread and rapid rate of development and the associated installation of lights, without thought to the impact those lights have on the night sky is lighting the night sky worldwide. Lighting associated with advertising, building and street illumination, and grounds security all contribute to what is referred to as "light pollution."
One estimate indicates that about 30 percent of all light generated in the United States is wasted, costing billions of dollars. Outdoor lights provide many benefits, but improved consideration of night sky concerns in their design and application would be highly beneficial in reducing light pollution and the associated production of unneeded energy.
In addition to interfering with our ability to see celestial bodies and astronomical events, light pollution has a detrimental environmental impact. Some bird species depend on stars for navigation. Light pollution interferes with their travels. Some believe that declines in moth populations are linked to attraction to lights and subsequent death.
HALF THE PARK IS AFTER DARK
SEE THE MILKY WAY
BIG CYPRESS NATIONAL PRESERVE
Astronomy Programs
View one of the darkest night skies in the eastern United States by attending ranger-led astronomy programs at Big Cypress National Preserve. The National Park Service, along with partners, will be conducting night sky outings. For dates and more information click here.
The National Park Service is concerned about our contribution to light pollution and has set policy that seeks to reduce or eliminate the adverse impacts of light pollution. At Big Cypress National Preserve, staff members are working to reduce light pollution.
To learn more about the efforts to "Save the night" click on the links below.
National Park Service's Night Sky Program
International Dark-Sky Association
Videos on the importance of the night sky
Losing the Dark. Starry skies are a vanishing treasure because light pollution is washing away our view of the cosmos. It not only threatens astronomy, it disrupts wildlife, and affects human health.
Click here for a though-provoking video.
Did You Know?
Big Cypress National Preserve was one of the first national preserves within the National Park System. As a preserve, Big Cypress manages for a broader range of recreational activities, including hunting and off-road vehicle access.

The following page highlights a poster developed by Big Cypress staff entitled “Change Your Lights, Save the Nights.” **This poster describes and provides examples of efforts that were undertaken at Big Cypress to comply with the Sustainable Outdoor Lighting Principles** (developed by the NPS Night Sky Team).

National Park Service

Find a Park | Discover History | Explore Nature | Get Involved | Working with Communities | Teachers | Kids | About Us

Big Cypress
National Preserve
Florida

Explore This Park

- Park Home
- Plan Your Visit
- Learn About the Park
- Get Involved

Park Tools

- View Park Map
- FAQs
- Contact Us
- Site Index
- Español
- Bookstore

Find Us On

- Facebook
- Twitter
- YouTube
- Flickr
- Instagram
- More

FIND YOUR PARK
SHARE YOUR STORY

There are park alerts in effect. SHOW ALERTS »

A A A

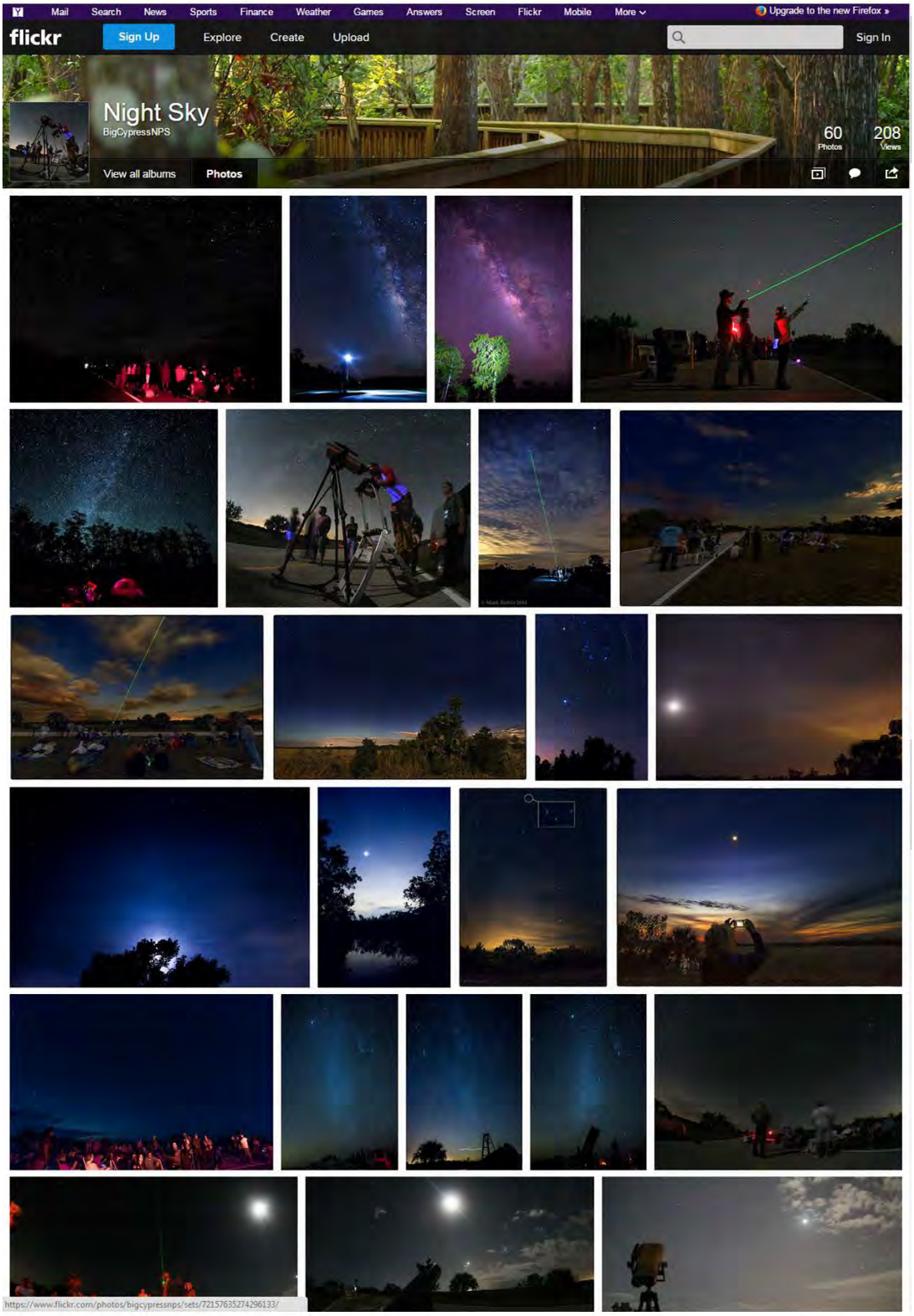
Change Your Lights, Save the Nights

Did You Know?

HP Williams and Oasis Visitor Center are popular places to see alligators. The best time to see large congregations of alligators is typically January-May. Do not feed or approach wildlife.

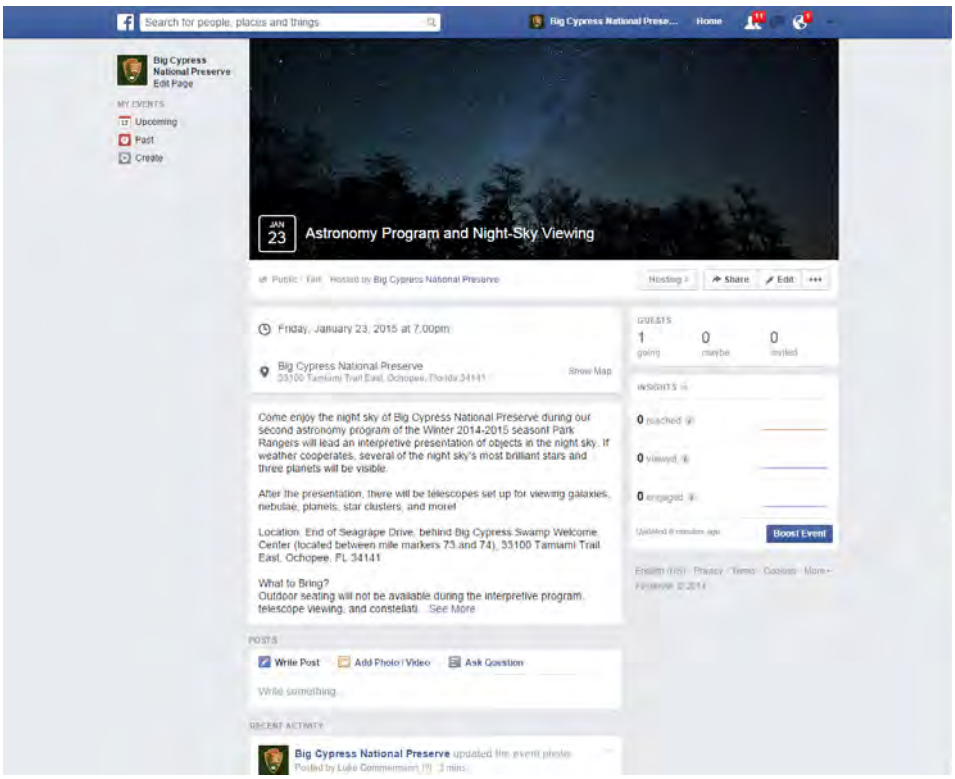
Flickr Night Sky Album

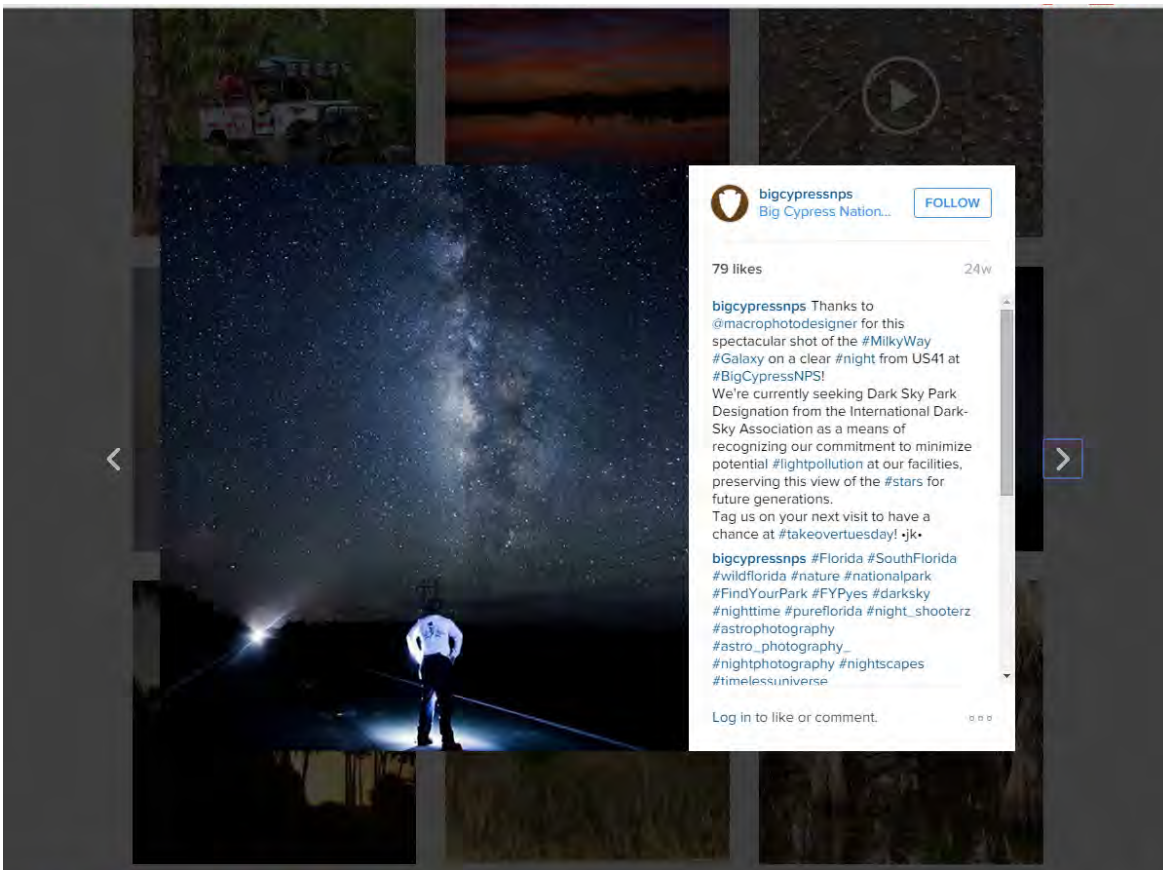
Big Cypress National Preserve staff maintains a Flickr Night Sky album (see below) featuring photos highlighting the beauty of night sky features observed by amateur astronomers, visitors, and park rangers. As of March 2016, eleven individuals have contributed to the album of 60 photos, several of which have been viewed over 3,000 times.



Social Media

Big Cypress National Preserve staff maintains Facebook, Twitter, and Instagram accounts to notify potential visitors of night sky programs occurring within the preserve (see below).




bigcypressnps
Big Cypress Nation...
FOLLOW
79 likes
24w
bigcypressnps Thanks to @macrophotodesigner for this spectacular shot of the #MilkyWay #Galaxy on a clear #night from US41 at #BigCypressNPS!
We're currently seeking Dark Sky Park Designation from the International Dark-Sky Association as a means of recognizing our commitment to minimize potential #lightpollution at our facilities, preserving this view of the #stars for future generations.
Tag us on your next visit to have a chance at #takeovertuesday! •jk•
bigcypressnps #Florida #SouthFlorida #wildflorida #nature #nationalpark #FindYourPark #FYPyes #darksky #nighttime #pureflorida #night_shooterz #astrophotography #astro_photography_ #nightphotography #nightscapes #timelessuniverse
Log in to like or comment.

Press Release

On December 20, 2013, staff from Big Cypress National Preserve released a press release entitled, "Starry, Starry Nights – Big Cypress Announces Winter 2014 Astronomy Programs" (below). The press release announced the schedule of evening ranger-led night sky programs, described where night sky programs were taking place, and included special considerations for visitors, including what to wear and bring for a comfortable viewing experience.

This press release was created in concert with the National Park Service's A Call to Action Goal #27: Starry, Starry Night, recognizing the agency's stewardship in protecting the night sky resource.

Newspaper Publications

In January 2014, staff from Big Cypress National Preserve was asked to provide a Valentine's Day-inspired article for an upcoming issue of the *South Dade News Leader*. This publication has been serving the community of South Dade county for over 100 years and has a weekly distribution of 24,000.

The article, "Star-Crossed Love at Big Cypress National Preserve", was published on February 14, 2014 and highlighted both the interpretive night sky programs at Big Cypress National Preserve and efforts for Big Cypress National Preserve to become an International Dark Sky Park (next page).

Included in the article was a sidebar introducing the International Dark-Sky Association, its mission to protect the natural night sky, and recommendations citizens can take to minimize light pollution.

Star-Crossed Love at Big Cypress National Preserve

Just Minutes Away: Big Cypress National Preserve, Biscayne National Park, Dry Tortugas National Park, Everglades National Park

By Luke Gommermann

Looking for a new activity to do with the one you love this Valentine's Day? All you need to do is take an evening walk outside and look up! What could be more romantic than a stroll beneath a night sky strewn with stars stretching from horizon to horizon? It may come as a surprise to learn that the splendor of the night sky is becoming harder and harder to see. The National Park Service at Big Cypress National Preserve is working to ensure this romantic opportunity will remain a part of the south Florida landscape for generations to come.

Over the past two winter seasons, park rangers from Big Cypress National Preserve have presented free evening astronomy programs to the general public highlighting cultural connections, historical perspectives, and modern scientific findings surrounding objects in the night sky. These events are made possible through partnerships with local astronomical societies, including the South Florida Amateur Astronomers Association (Fort Lauderdale) and the Everglades Astronomical Society (Naples), as well as the International Dark-Sky Association South Florida Chapter. These enthusiastic amateur astronomers and night-sky enthusiasts volunteer their time and equipment, such as telescopes, night-sky cameras, and night-sky quality meters, to enhance visitor's night sky experience.

Big Cypress National Preserve provides residents and visitors alike with one of the best night sky viewing locations in the eastern United States. Due to its location – approximately half-way between the dense populations of Florida's east and west coasts – Big Cypress National Preserve protects more than plants, animals, and water - it also protects the night sky.

While we may not think it is possible to lose our view of the stars, it is happening before our eyes. Try spotting the majestic Milky Way galaxy in Miami or Naples, and you may have some difficulty. This is because less than half of the light emitted from artificial outdoor lighting is directed toward the ground below. The remaining light is directed at our eyes, creating unsafe glare, at the surrounding landscape, causing light trespass, or at the night sky above. The flooding of the night sky with excessive artificial outdoor lighting, also known as light pollution, dims night-sky objects to the point where they are less and less visible.

The negative effects of light pollution extend beyond diminishing our view of the stars. Scientific research has linked decreased immune systems in people exposed to bright light at night. Light pollution also affects the health of plants and disrupts the behavior of wildlife, including nesting sea turtles, migrating birds, and nocturnal amphibians and insects. The wasted light in light pollution also squanders large amounts of energy, costing billions of dollars to generate in the United States each year.

In order to protect the night skies over Big Cypress National Preserve, the National Park Service is seeking an International Dark-Sky Park designation through the International Dark-Sky Association. If successful, this effort will ensure that the National Park Service considers the night-sky environment and its preservation in future actions and management decisions at the national preserve. This will include developing lighting standards for federally-owned structures, installing night-sky meters to measure light pollution, and developing interpretive and educational programming to night-sky topics.

While we often take it for granted, the night sky is an invaluable resource. The night sky is recognized, and often holds important roles, in every human culture on earth. Scientists utilize the night sky to better understand our place in the universe, and the behavior of wildlife is intimately shaped by the daily setting of the sun and the appearance of the night sky. This Valentine's Day, be sure to keep the stars in mind.

For more information on night-sky programs at Big Cypress National Preserve, please visit http://www.nps.gov/bicy/naturescience/lightscape.htm.

Luke Gommermann is a Park Ranger at Big Cypress National Preserve.

What is the International Dark-Sky Association?

The International Dark-Sky Association (IDA) is an educational organization committed to the protection of the natural night sky by bringing attention to the hazards of light pollution. The IDA promotes a simple philosophy – "Light what you need, when you need it" – and collaborates with individuals, organizations and governments to raise awareness of the value of the night sky.

Through its International Dark-Sky Places program, the IDA provides designation to areas and communities around the world committed to preserving the night sky. These locations assess all light sources and install dark sky friendly lights, saving energy, reducing light pollution, and protecting wildlife. In addition, International Dark Sky Places sponsor outreach events to educate and promote dark sky conservation in nearby communities. Today, the IDA has designated 25 International Dark Sky Places that are found across eight countries and three continents.

Via their websites IDA (www.ida.org) and its local chapter (www.idasouthflorida.org) provide educational resources to help individuals and communities looking to minimize light pollution. Recommendations include:

- Installing lighting only when and where needed and in the right amount
- Shielding and directing light fixtures toward the ground
- Using energy saving timers, dimmers, and motion sensors
- Choosing amber-colored lights versus harmful blue-rich white lights
- Using a friendly approach when educating friends, families, and neighbors about the benefits of good outdoor lighting

In January 2015, Big Cypress National Preserve's ranger-led astronomy programs were featured in the Coastal Life section of the Fort Myers News-Press. The article, "Special Nighttime Programs at Parks and Preserves" also highlighted fellow agencies across Southwest Florida featuring night sky education programs, including Collier-Seminole State Park, Audubon Corkscrew Swamp Sanctuary, and Fakahatchee Strand Preserve State Park.

The article (copied below) also recognized the efforts of the Everglades Astronomical Society for their support of three agencies night sky programs, including those taking place in Big Cypress National Preserve.

Special nighttime programs at parks and preserves

Laura Tichy-Smith, Special to Coastal Life*8:09 p.m. EST January 7, 2015*

(Photo: Special to Coastal Life)

Night in the swamps — the idea sounds mysterious or possibly foreboding. After all, the local swamps are the home of bears, panthers, alligators and other creatures that slip about in the shadows.

It seems as if the only time we hear about a person in the swamps at night is when the story involves a missing hunter lost in the wilds. But several recreational programs recently started at Southwest Florida's parks and preserves prove there's a lot to enjoy and experience in these special wilderness areas where the night returns to the dark and quiet reality of its ancient, starry self.

While Collier-Seminole State Park and Big Cypress Swamp National Preserve already allow night visitors because of camping, the programs provide additional knowledge for enjoying the parks at night. The special hosted events at Audubon Corkscrew Swamp Sanctuary and Fakahatchee Strand Preserve State Park are the only times that visitors are permitted to enter the properties after they close for the night.

Stargazing figures prominently among many of the programs but is not the only activity. The Everglades Astronomical Society assists with events at Big Cypress, Collier-Seminole and Corkscrew. Club members bring about half a dozen telescopes to provide guided tours of the star-filled sky on nights when clouds and the moon are absent. The big, open sky over the swamps that makes for such stunning cloud photographs during the day provides ample room for viewing the stars at night. Away from the pollution of city lights, it's actually possible to see the Milky Way in the dark sky with the naked eye. Bob DeGross, chief of interpretation and public affairs for Big Cypress, said one of his favorite places for viewing the Milky Way is through an opening in the cypress trees at the preserve's Kirby Storter Boardwalk.

"So many people haven't experienced the unpolluted night sky," said DeGross. "In South Florida, the wild places have the darkest skies east of the Mississippi. The International Dark Sky Association certifies night-sky parks. We're seeking certification, and we'll be the first park in the East."

Big Cypress offers its night sky and astronomy programs once a month during season. The free, ranger-led programs feature an educational presentation about the night sky in the welcome center's auditorium followed by outdoor stargazing with the Everglades Astronomical Society, if the weather permits. An additional educational program is presented if weather is not conducive to outdoor stargazing.

The Friends of Collier-Seminole State Park also sponsor stargazing parties with the astronomical society once a month (weather permitting; call park before 5:30 p.m. to check that the event is taking place). Entrance to the park requires an admission fee, but the star party is free after entering the park. Friends volunteer Darlene Smith said that a society member presents a talk using a laser to point out constellations, and then the group opens its telescopes for viewing.

"We've got a beautiful view of the sky by the boat basin and salt marsh, and it's wonderful being able to view the stars with no city lights around and enjoy the quiet," she said.

A highly unique experience that Collier-Seminole State Park offers is its guided moonlight canoe trips on the Blackwater River. The canoes have backrests and accommodate two people, and the guides use glow sticks to facilitate the tour.

"You'll hear stuff jumping in the water and feel like you're in a different time," Smith said. "It's so awesome."

The Friends of Fakahatchee Strand Preserve State Park has added a new “Boardwalk After Dark Adventure” to augment the highly popular moonlight tram tours that sold out for the season about a month after they were announced in the fall. The moonlit, naturalist-guided tour of the half-mile-long Big Cypress Bend Boardwalk, which passes through a virgin stand of cypress on the way to a gator pond, is limited to 14 participants and tickets must be purchased in advance.

“People so far who have attended have been dedicated nature people, but being on the boardwalk at night is a new experience and much quieter than during the day,” said Fakahatchee Friends volunteer Bruce Bunch. “You can’t see as much but you hear a lot and you smell the night-blooming smells. A highlight of the day is the eagles nest next to the boardwalk, but one of the surprises was the eagles chattering to each other after dark in the nest. Even the naturalist was surprised and had expected to hear owls. We heard a bear growling under the boardwalk. People get used to so many lights, and this is a chance to enjoy the peaceful environment and learn new things.”

A guided boardwalk tour is just one of the activities featured at the Corkscrew Sanctuary “After Hours” events. Visitors also have the option of walking the more than two-mile-long boardwalk on their own to experience the deep quiet and solitude of night in the sanctuary. Several activities take place around the Blair Audubon Center, including live music, stargazing through the astronomical society’s telescopes, children’s craft activities and classroom lectures on topics such as the Calusa Indians or local toads and frogs. Catered sandwiches and teas are available for purchase at the event.

“It’s so special here at night, and we wanted to give the public a chance to experience the sounds that only the staff and volunteers experience amid the 500-year-old trees,” said sanctuary Director Jason Lauritsen. “The evening is also very social and laid back with the live music and the food in the tea room. You’ll remember this special trip even if you’ve been here before because you haven’t seen Corkscrew this way. It’s a chance to step back in time.”

Connect with this writer: @LauraTichySmith (Twitter)

IF YOU GO

•**What to bring:** Long pants, long-sleeve shirt, light jacket, closed-toe shoes, insect repellent, water bottle, beach chair for stargazing events. If you bring a flashlight, it must have a red lens cover to dim it in order to not interfere with night vision.

•**What:** Camping in the swamps

•**Where:** Both Collier-Seminole State Park and Big Cypress Swamp National Preserve offer camping. Contact for locations and prices.

•**Info:** 394-3397, floridastateparks.org/collierseminole; 695-4758; nps.gov/bicy

•**What:** Corkscrew “After Hours”

•**Where:** Audubon Corkscrew Swamp Sanctuary,375 Sanctuary Road West, Naples

•**When:** 5:30-9 p.m. Fridays, Jan. 23, Feb. 20 and March 27

•**Cost:** $12 adult; $6 Audubon Society members or full-time college student with ID; $4 ages 6-18; free age 6 and under

•**Info:** 348-9151, corkscrew.audubon.org

•**What:** Night sky and astronomy programs

•**Where:** Big Cypress Swamp National Preserve Welcome Center, 33000 Tamiami Trail East, Ochopee

•**When:** 7 p.m. Friday, Jan. 23; 7:30 p.m. Saturday, Feb. 21; 8 p.m. Friday, March 20

(indoor program takes place if weather is unsuitable for stargazing)

•**Cost:** Free

•**Info:** 695-4758; nps.gov/bicy/planyourvisit/winter-2014-astronomy-programs.htm

•**What:** Guided moonlight canoe trips

•**Where:** Collier-Seminole State Park, 20200 Tamiami Trail East, Naples

•**When:** 7:30-9:30 p.m. Sunday, Feb. 1 and Monday, Feb. 2; Tuesday, March 3 and Wednesday, March 4

•**Cost:** $50 per person plus $5 per vehicle park admission

•**Info:** 394-3397, floridastateparks.org/collierseminole

•**What:** Stargazing party

•**Where:** Collier-Seminole State Park, 20200 Tamiami Trail East, Naples

•**When:** 7 p.m. Saturdays January 17 and March 14; 7:30 p.m. Saturday April 11 (weather permitting; call park before 5:30 p.m. to check that the event is taking place)

•**Cost:** $5 per vehicle park admission

•**Info:** 394-3397, floridastateparks.org/collierseminole

•**What:** Fakahatchee “Boardwalk After Dark Adventure”

•**Where:** Big Cypress Bend Boardwalk in Fakahatchee Strand Preserve State Park, located on the north side of U.S. 41 about 17 miles east of the Naples intersection of U.S. 41 and Collier Boulevard (no address; sign on south side of road points to small parking area when you arrive)

•**When:** 6-7:30 p.m. Monday, Feb. 2 and Wednesday, March 4

•**Cost:** $25 (must prepurchase tickets; reservations close one day prior to event)

•**Info:** orchidswamp.org, 695-4593

Environmental Educator Newsletter Publication

The League of Environmental Educators in Florida is a non-profit organization established in 1981 to promote education and the environment in Florida. Membership includes classroom teachers, environmental educators, businesses, collegiate students and faculty, and agency personnel.

Staff from Big Cypress National Preserve submitted an article (following pages) to the League of Environmental Educators in Florida LEEFlet newsletter, "Sharing Values of the Night Sky." This article provides educators with interdisciplinary scholastic connections to the night sky, including cultural, historical, scientific, natural, and conservation values.

The LEEFLET Spring 2014

LEEF

The League of Environmental Educators in Florida

Conference Highlights 2014

More conference photos available at: https://www.facebook.com/LEEF.Florida

Sharing Values of the Night Sky

By Luke Gommermann, Seasonal Park Ranger of Environmental Education and Outreach, Big Cypress National Preserve

Looking upon a night sky strewn with innumerable stars, what do you see? A cast of characters and the stories they tell? A natural work of art? A reminder of our place in the universe? A look back in time? Night sky viewing provides learners of all ages and backgrounds with opportunities for discovery, creativity, and conservation. By incorporating elements of the night sky into your existing programs or developing new programs focused on the night sky, we will help continue a tradition of astronomical education that has been in existence for thousands of years.

Cultural Values

When early cultures needed to predict the time for planting and harvesting or when travelers found themselves lost and in need of direction, where did they turn? Regardless of their location on our planet, they found answers to their most pressing questions by looking up to the night sky. Over the course of a year, shifting motions of night-sky objects provided civilizations with the earliest calendars. Special night-sky objects were revered as deities whose paths held powerful influence over their lives. Today, we tell their ancient tales by connecting dots of starlight overhead to outline constellations.

After reading lore surrounding one or more constellations, consider taking students on a constellation scavenger hunt. Additionally, students can learn to distinguish an officially-designated constellation (e.g., Ursa Major) from an asterism (e.g., the Big Dipper). Students can create their own asterisms using actual stars or created star patterns and can then compose a legend about their asterism.

Historical Values

In addition to cultural history preserved in the night sky, realize that a look into the heavens is also a look back in time. While traveling incredibly fast – approximately 671,000,000 million miles per hour – it takes time for light to travel the immense distances of space separating our eyes from night-sky objects. Because of this, when we look at planets and stars, we are not looking at them as they are, but rather, as they were. For example, light emitted from distant stars takes years to travel through space before falling upon our eyes. Polaris, the North Star, lies 433 light-years away from Earth. Hence, when we look at Polaris, the light now reaching us was emitted from this star 433 years ago. For a historical perspective, 433 years ago an English sea captain and pirate named Sir Francis Drake was knighted by Queen Elizabeth I following his voyage circumnavigating the globe in 1581.

Consider providing students with a list of easy to find stars. Allow students to research how far a star is located from Earth in light-years, calculate the year this star's light originated, and research what was occurring on our planet at this time.

Scientific Values

It takes only a pair of binoculars and steady hands to observe Jupiter's four Galilean moons. This revolutionary sight spotted by Galileo in 1610 was the first definitive evidence disproving the geocentric theory, which stated Earth was the center of the

Continued on Page 11

Continued from Page 10

universe. By observing the night sky, astronomers have discovered our home planet is only one of several masses of rock and gas orbiting around a star that is only average amongst hundreds of millions of stars found within the Milky Way Galaxy. Further, it is now estimated that our home galaxy is only one of billions of galaxies found in the universe.

Visions in the night sky provide us with opportunities to watch scientific wonders, including the birth and death of stars, the processes and products of nuclear fusion, and the extremes of weather and climate present on distant worlds, just to name a few. Additionally, night-sky viewing underscores the relationship between science and society. Several modern technologies, including solar panels and safety grooving on highways, were first designed for space exploration, while technologies that rely on satellites (e.g. cell phones, Global Positioning Systems, and television broadcasts) are completely dependent on technology orbiting around our planet.

Consider providing students with a schedule of satellite passes over night skies in your area (available for free online at heavens-above.com). After spotting one or more satellites, search the skies for shooting meteors. Ask students to compare and contrast their motions across the night sky and research the science behind both types of objects.

Natural Values

Approximately half of all organisms on our planet are active at night and have developed adaptations to survive in a dark world. All nocturnal creatures are dependent on the night for their survival, from moths pollinating moon-lit flowers and sea turtles crawling ashore to lay their eggs to panthers searching for prey under the cover of darkness and dung beetles orienting themselves as they roll prized finds along the ground. National Park Service units across the country are sharing this nocturnal ecological perspective, along with the natural beauty of the night, with its visitors through the message "Half the Park is After Dark" by providing moon-lit walks, bike rides, and paddling trips.

Consider conducting a moon-lit walk as part of your education program. Collect short passages of writing that express both the uplifting beauty and inspiration of the night sky and the importance of darkness to your area's natural ecology.

Conservation Values

While insightful in many respects, opportunities to experience dark night skies are becoming increasingly rare. Alarmingly, a majority of people born today will never see the Milky Way, our home galaxy, stretching gracefully overhead. Light pollution, created when artificial human lighting is directed into the atmosphere and reflects off clouds and particles, is often much brighter than light from night sky objects – as a result, they are lost in the glow.

Provide students with an opportunity to compare the night sky in areas with different amounts of light pollution. Have students compare and contrast light pollution with other types of pollution, such as air or water. Ask them to consider causes, effects, and costs associated with each type of pollution.

Nature's Ultimate Educational Resource

There exist few educational resources in nature that are as well-rounded and easily available as the night sky. Wandering planets, glowing comets, dazzling star clusters – even our distant neighbor, the Andromeda Galaxy, can be witnessed over 2.5 million light-years away through the naked eye alone. The night sky instills a sense of exploration and discovery, of wonder and inspiration, while at the same time humbling and grounding us and our lives. For those who have an opportunity to share the wonders of the night sky with others, please don't allow it to pass by. While a meteor's dazzling streak may only last a few seconds, a viewer's memory of that brilliant moment may last a lifetime.

Radio Interview

Following a ranger-led evening night sky program on February 21, 2015, interpretive park rangers were asked by a freelance journalist to conduct a radio interview regarding Big Cypress National Preserve's application to become an International Dark Sky Park. The following is a transcript of the interview, which aired on February 25, 2015.

5:16 PM
WED FEBRUARY 25, 2015

Big Cypress Preserve Applying To Be International "Dark Sky Park"

BY JESSICA MESZAROS

Big Cypress National Preserve runs over 729,000 acres in Collier County and bits of Monroe and Miami Dade counties. The preserve is applying to be an international"dark sky park." There are only 20 in the world. A "dark sky park" is a place where humans get clear, starry scenery, and nocturnal animals, like the endangered Florida Panther, see better.

Hear the audio version of this story: http://wlrn.org/post/big-cypress-preserve-applying-be-international-dark-sky-park

View of the night sky from Big Cypress National Preserve.

Credit Stephen Meszaros

"Those animals, if they're not able to see a dark night sky, that's disrupting parts of their natural ecology, their natural behaviors," says Luke Gommermann, Big Cypress park ranger.

Gommermann is helping to prepare the "dark sky park" application. He says the national park service has a "night sky team" that goes around all the national park units of the United States to monitor their night sky quality.

"They determined that Big Cypress is one of the darker locations east of the Mississippi river," he said.

He says that on a moonless night in Big Cypress, you can see the Milky Way.

"We can also pick up a lot of the fainter night sky objects like even the Andromeda Galaxy two and a half million light years away," says Gommermann. "You don't even need a telescope or binoculars to pick it out."

He says people go out seeking these dark areas to recreate and to camp in.

"We would expect that visitation would increase, and hopefully that will improve local economies as well," he said.

Big Cypress would also start to monitor and control artificial light within the preserve. But there's some light pollution they can't get away from.

The brownish-yellow color on the lower horizon is called "sky glow." It's a type of light pollution that comes from large cities. This is Miami and Fort Lauderdale "sky glow" as seen from Big Cypress National Preserve.

Credit Stephen Meszaros

"When we look to the east, we can easily make out Miami and Fort Lauderdale. It's a brownish-yellow glow in our lower horizon in that direction," says Gommermann. "Also looking to the northwest, we can see the lights of Naples and Fort Myers, Cape Coral."

If the application gets approved, the rangers plan to reach out to neighboring communities for help in minimizing light pollution.

Gommermann hopes to complete the application requirements by this year's deadline, March 23.

Kirby Storter Wayside Exhibit

Approximately halfway along a drive across Big Cypress National Preserve on U.S. Hwy. 41 (the Tamiami Trail), visitors can experience the Kirby Storter Roadside Park in this free, public use area. The most popular attraction here is the Kirby Storter boardwalk, featuring a one-mile, round-trip stroll that offers visitors an excellent opportunity to explore a mature cypress strand without getting their feet wet. The boardwalk ends at an open cypress dome where visitors can find a variety of wildlife enjoying the oasis and an opportunity to view the night sky.

A wayside exhibit entitled "Pollution of Another Kind" was installed along the boardwalk during the summer of 2015. Both a description of the threats of light pollution – from sources both inside and beyond our boundaries – as well as the importance of Big Cypress National Preserve's role as a dark-sky viewing area, are prominently featured.

4th Grade Night Sky Curriculum

During the Winter 2015-2016 season, staff at Big Cypress National Preserve created a 4th grade classroom activity to supplement classroom teacher's curriculum resources relating to the night sky. The resulting activity, "Create A Constellation", was designed to meet the following three Sunshine State Curriculum Standards:

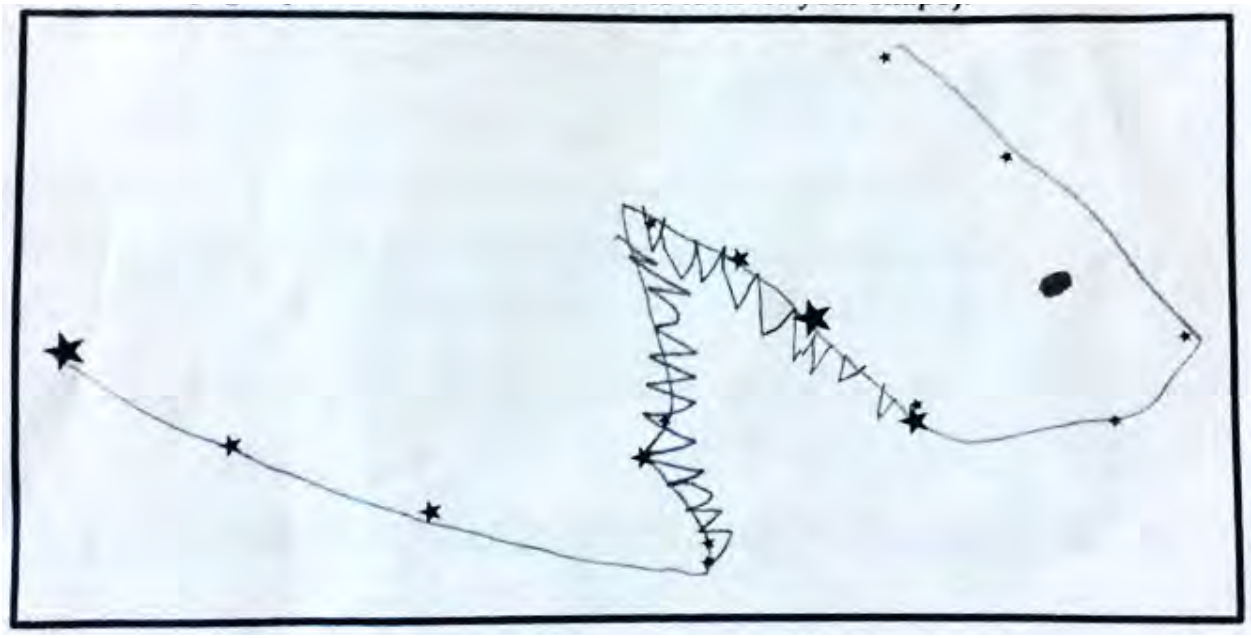
SC.4.E.5.1 Observe that the patterns of stars in the sky stay the same although they appear to shift across the sky nightly and different stars can be seen in different seasons.

SC.4.E.5.3 Recognize that Earth revolves around the Sun in a year and rotates on its axis in a 24-hour day.

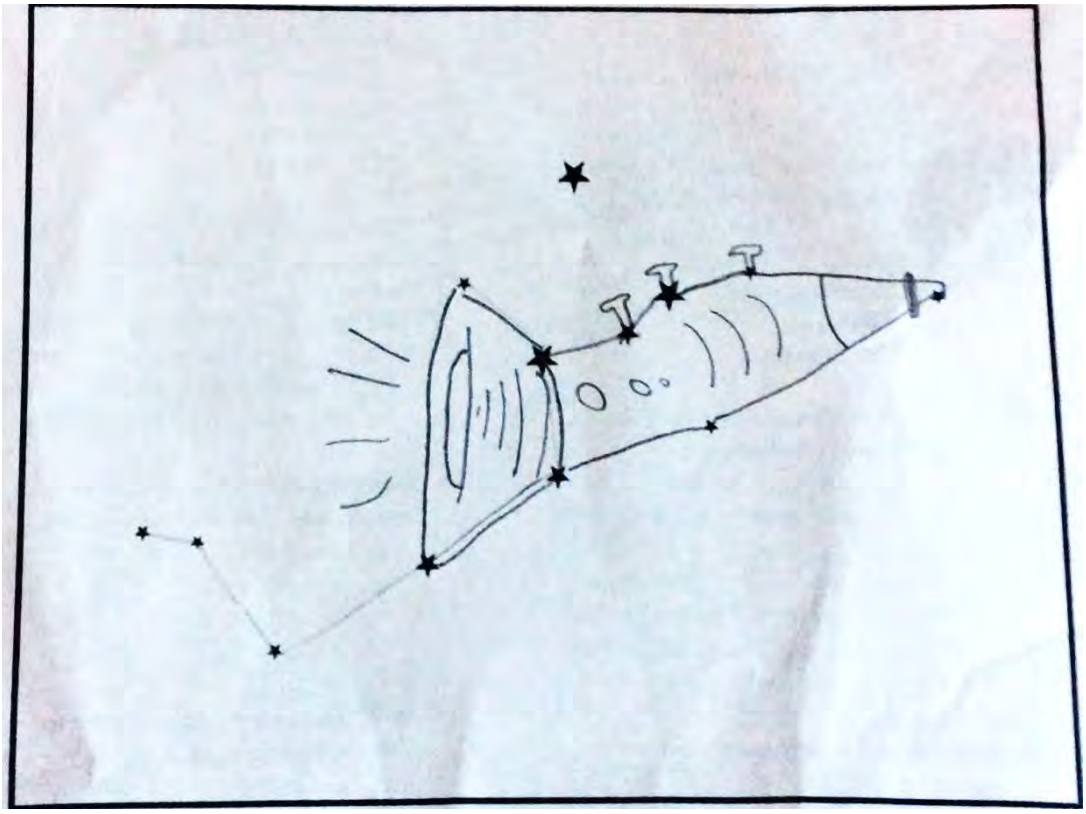
SC.4.E.5.4 Relate that the rotation of Earth (day and night) and apparent movements of the Sun, Moon, and stars are connected.

"Create A Constellation" was pilot tested with twenty-one 4th grade students from Golden Terrace Elementary School in Naples, Florida. The activity takes approximately 75 minutes to complete, and consists of note-taking guided by a PowerPoint interspersed by drawing activities and hands-on demonstrations. The activity introduces basic astronomical concepts of stars, constellations, the sun and moon, Earth's rotation on its axis, Earth's seasons, and Earth's revolution around the sun while striving to inspire student creativity and imagination utilizing actual constellations found in the night sky.

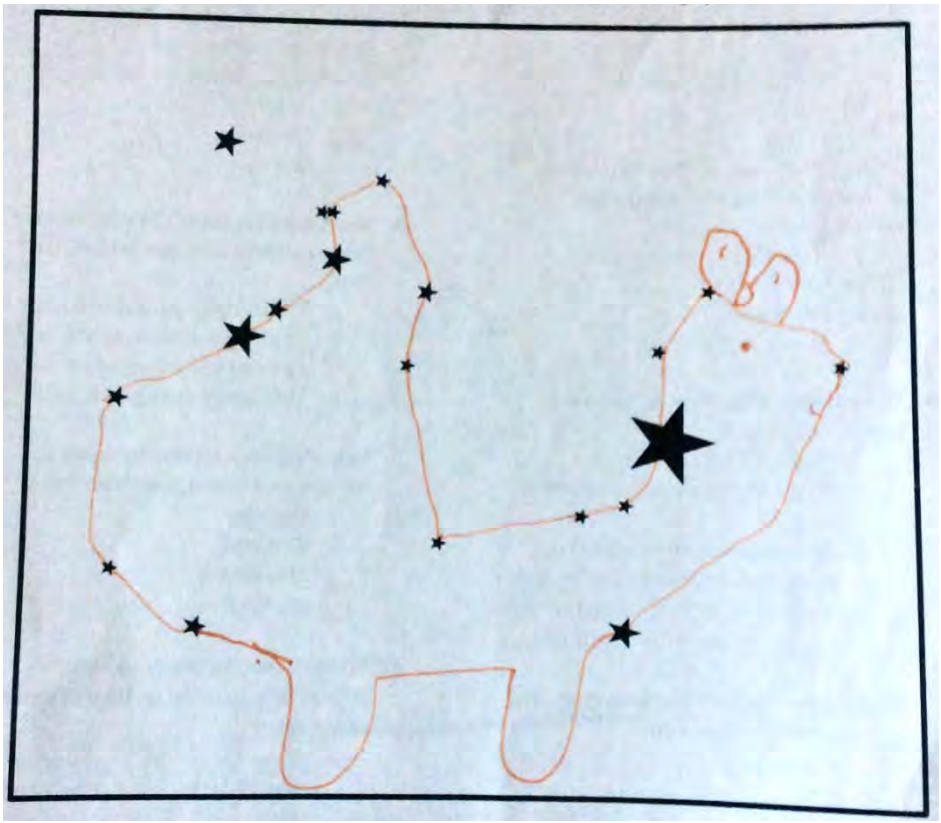
This and future curriculum developed by preserve staff relating to the night sky will be freely available through the Big Cypress National Preserve website.



Ursa minor as "a shark".



Cassiopeia as “a clarinet”.



Canis major as “a camel”.

Visitor Brochure

Modeled after our brochure for private land owners within the preserve, staff from Big Cypress National Preserve created an informational brochure to be provided for visitors at visitor centers and campgrounds. This brochure illustrates both the beauty of the scenic night sky over Big Cypress National Preserve and the threat it faces from light pollution. Additionally, it explain Big Cypress National Preserve's effort to become a Dark Sky Park that explains the concept of a Dark Sky Park, lists the voluntary lighting curfew guidelines, and provides examples of steps staff at Big Cypress have taken to remediate outdoor lighting and minimize light pollution created within our boundaries.

National Park Service
U.S. Department of the Interior

Big Cypress National Preserve
Florida

A Timeless View...

There are few places left in the Eastern United States where the Milky Way Galaxy can still be seen stretching across the night sky from horizon to horizon. These sights above Big Cypress National Preserve are exceptional, and we intend to keep them this way.

Above: The Milky Way above Highway 29 along Big Cypress National Preserve's western boundary.

Please join us for our evening ranger-led astronomy programs and telescope viewings. Dates and times are available on our website: www.nps.gov/bicy.

The International Dark-Sky Association's Fixture Seal of Approval Program includes a registry of dark-sky friendly products. For more information, please visit www.darksky.org.

Big Cypress Seeking Dark Sky Park Designation

Information for Visitors of Big Cypress

Why a Dark Sky Park?

By seeking Dark Sky Park designation through the International Dark-Sky Association, Big Cypress National Preserve is making a commitment to protect a resource that is rapidly disappearing all around us—the ability to see a natural night sky, unobscured by light pollution.

Left: While light pollution obscures night skies over the east and west coasts, little light pollution is emitted from lands within Big Cypress National Preserve (NASA, 2012).

How Can You Help During Your Visit?

As a visitor, **please follow our voluntary lighting curfew.** Between 10 pm and 6 am,

- continuous use of exterior lights should be avoided and bright lanterns and exterior lights are discouraged,
- all interior lights should either be turned off, or window and door blinds should be closed,
- personal light sources (e.g. flashlights and headlamps) are appropriate at any time but limit their use to reduce your visual footprint,
- Campfires are not considered artificial lighting and are allowed.

Above Left: A long-time exposure photograph of star tracks taken from Mile Marker 63 comfort station along I-75.
Above Right: A park ranger points to night sky objects during a ranger-led astronomy program at Seagrape Drive.

What Can You Do to Protect the Night Skies Where You Live?

1. Light Only Where & When You Need It

Remove lights from areas that do not need to be illuminated. Use motion sensors to illuminate lights only when necessary.

Left: A maintenance building equipped with motion sensors. Light pollution from Naples visible in background.

2. Direct Light Down With Shielding

Use lights with a solid barrier on top to direct light down and prevent glare. Light should not be emitted above the horizontal.

Left: Placing lights below roof overhangs can act as a shield.

3. Use Warm Amber Over Cool Blue Colors

Our eyes are less disturbed by (and wildlife is less attracted to) "warm" amber lights compared to "cool" blue-white lights.

Right: Amber lights illuminate hallways at headquarters.

4. Use Low-Watt & Energy-Efficient Lights

Use lights only as bright as needed. Find dimmable LEDs and CFLs. Remember, the most energy-efficient light is no light at all.

Right: Shielded LED lights illuminate a parking lot at headquarters.

If you replace any lighting on your property to protect the night sky, please contact Bob DeGross (bob_degross@nps.gov). If possible, provide photos of your old and new lights. This will help us achieve Dark Sky Park designation.

Future Work

Describe any work planned for future night sky interpretation programs, may be formatted as five-year plan with goals stated – important to show location's dedication to dark sky awareness education, important for reporting IDA annual report

- If accepted, BICY will need to erect an "International Dark Sky Preserve" sign along a roadway entrance with the DSP text and logo.
- Submit annual reports by 1 October each year.
- Continue removing unnecessary lighting and retrofitting non-compliant lighting to meet 5 and 10 year goals
- Continue providing interpretive programs on-site (and if possible, off site) that highlight the importance of dark nights/natural darkness. Dark skies should be one of central themes communicated through on-site interpretation, with dedicated programming at least 4 times each year.
- Continue to work with local astronomy societies/volunteers/campground hosts to maintaining independent measurement program of light pollution. BICY will be purchasing one night sky quality meters by October 1, 2016, and will work with Diana Umpierre for specific meter details, and future purchases.
- Continue producing a "night sky friendly" lighting project that is publicly visible and interpreted- intendend completion: October, 2017.
- Consider involving additional external partners in dark sky restoration efforts (e.g. chamber of commerce, power utility, university research, tribal nations, environmental groups, conservation groups, natural history association),
    - Gulf Coast VC (EVER)
    - LCEC
    - FDOT
    - Jetport (if not done so already)
    - Tribes (if not done so already)
    - Burnett O&G (if necessary?)
- Consider cooperation with nearby municipalities that results in adoption of lighting codes that improve sky conditions in the park
    - Everglades City
    - Carnestown Corner
    - Port of the Islands
- Develop additional 4th grade curriculm meeting the following standard: **SC.4.E.5.5 (HIGH) – Investigate and report the effects of space research and exploration on the economy and culture of Florida.**

References

93rd United States Congress. 1974. "An Act to Establish Big Cypress National Preserve." (88 Stat. 1255) (P.L. 93-440).

Big Bend National Park & the NPS Night Sky Team. 2013. "Interim Outdoor Lighting Guidelines (DRAFT)". http://www.ida.darksky.org/assets/Night_Sky_Conservation/Parks/Big_Bend/Big_Bend_Lighting_Plan.pdf

Big Cypress National Preserve General Management Plan/Final Environmental Impact Statement, 1991

Big Cypress National Preserve – Addition: Final General Management Plan/Wilderness Study/Off-Road Vehicle Management Plan/Environmental Impact Statement, 2010

Dick, Robert. Guidelines for Outdoor Lighting in RASC Dark-sky Preserves and IDA Dark Sky Places. 2012.

Duever, M. J., J. E. Carlson, J. F. Meeder, L. C. Duever, L. H. Gunderson, L. A. Riopelle, T. R. Alexander, R. F. Myers, and D. P. Spangler. 1986. The Big Cypress National Preserve. New York: National Audubon Society. 455 pgs.

Duriscoe, Dan. NPS Night Skies Program Data Night Report Explanation. 2015.

Florida Fish and Wildlife Conservation Commission. 2015. "Sea Turtle Protection Ordinances". http://myfwc.com/conservation/you-conserve/lighting/ordinances/

Gommermann, Luke. Sharing Values of the Night Sky. The LEEFlet. The League of Environmental Educators in Florida. Spring 2014.

Gommermann, Luke. Star-Crossed Love at Big Cypress National Preserve. South Dade News Leader. Vol. 101, No. 49. Pg. 8.

International Dark-Sky Association. "Dark-Sky Park Program (Version 1.31)". 2006.

International Dark-Sky Association. "Dark Sky Park Program Criteria." 2013.

International Dark-Sky Association. "Dark Sky Park Program Guidelines." 2014.

International Dark-Sky Association. "Dark Sky Park Program Guidelines." 2015.

Meszaros, Jessica. "Big Cypress Preserve Applying to be International 'Dark Sky Park'". 2015.

National Aeronautics and Space Administration (NASA). "City Lights of the United States 2012". *Earth at Night*. [http://earthobservatory.nasa.gov/Features/NightLights/page3.php]. December 9, 2013.

National Park Service. 1916. "Organic Act" Vol. 16, §1-4.

National Park Service. 2006. "Management Policies".

National Park Service. 2012. "A Call to Action: Preparing for a Second Century of Stewardship and Engagement".

National Park Service. 2012. "Green Parks Plan".

National Park Service Natural Sounds & Night Skies Division. 2015. "Sustainable Outdoor Lighting Principles".

Tichy-Smith, Laura. Special Nighttime Programs at Parks and Preserves. Fort Myers News-Press. Special to Coastal Life. January 7, 2015. http://www.news-press.com/story/life/coastal-life/2015/01/07/special-nighttime-programs-parks-preserves/21417507/

Contributors

Dennis Bartalino, Chief of Maintenance, Big Cypress National Preserve
Christine Clark, Management Assistant, Big Cypress National Preserve
Ron Clark, Chief of Natural Resources, Big Cypress National Preserve
Bob DeGross, Chief of Interpretation, Big Cypress National Preserve
Dan Duriscoe, Lead Physical Scientist, NPS Night Sky Team
Luke Gommermann, Seasonal Park Ranger of Interpretation, Big Cypress National Preserve
Bob Meadows, Physical Scientist, NPS Night Sky Team

Special Thanks

Lisa Andrews, Education Specialist, Big Cypress National Preserve
Maintenance Division, Big Cypress National Preserve
Membership of the Everglades Astronomical Society
Membership of the International Dark-Sky Association – South Florida Chapter
Membership of the International Dark-Sky Association – Palm Beach Chapter
Membership of the South Florida Amateur Astronomers Association
Membership of the Southern Cross Astronomical Society
NPS Night Sky Team

Acknowledgements

In compiling our nomination package to become an International Dark-Sky Place as recognized by the International Dark-Sky Association, Big Cypress National Preserve staff modeled their application after, and at times directly utilized materials from, the applications of previously designated National Park Service units. We hope this provides us with the best opportunity to conform with outdoor lighting policies in place at the following NPS units already designated by the International Dark-Sky Association: Natural Bridges National Monument (2007), Big Bend National Park (2011), Death Valley National Park (2012), Chaco Culture National Historical Park (2013), Hovenweep National Monument (2014), Grand Canyon-Parashant National Monument (2014), Capital Reef National Park (2015), Canyonlands National Park (2015), and Black Canyon of the Gunnison National Park (2015).

United States Department of the Interior

NATIONAL PARK SERVICE
Big Cypress National Preserve
33100 Tamiami Trail, East
Ochopee, Florida 34141-9710

IN REPLY REFER TO:
BICY N16-Night Sky

August 31, 2016

Scott Feierabend
International Dark-Sky Association
3223 N. First Avenue
Tucson, Arizona 85719

Mr. Feierabend:

The purpose of this letter to address questions raised by IDA staff after our July 2016 application submittal. Please, consider this letter as a minor amendment to the July submittal.

LMP's Compliance Level

We have updated our lighting inventory spreadsheet to better identify our level of compliance with Outdoor Lighting Management Plan (LMP). We updated columns J through N to make compliance parameters more clear. We are currently at 85.6% compliance (not 91% as reported in p.24 of our July submittal). Our current inventory has 209 exterior lights: 179 of these fixtures already conform with our LMP as they are either fully-shielded, have been mitigated, or were de-activated.

Within 3 years, the preserve has committed to bring 100% of its outdoor lighting into compliance with our LMP. The total number of non-compliant fixtures is 30 (14.4%, not 9% as reported in p.24 of our July submittal). The preserve will convert or replace an estimated 10 fixtures per year to comply with the LMP over this 3 year period.

Lumen Levels

As stated on p.24 of our July submittal, and in accordance with IDA's Dark Sky Park Program guidelines dated October 2014, *regardless of lighting zones under our control, no unshielded light source above 500 initial lumens* will be utilized within Big Cypress

National Preserve. Also, as stated in the description of our lighting zones (pp. 27-28), we plan to limit all fixtures to 600 lumens, whether shielded or unshielded. This should clarify any confusion that may have occurred due to mention of 600 lumen max in that section.

Please feel free to contact Christine Clark, Management Assistant for the Preserve if you have any more questions or need further clarification regarding our application to the Dark Sky Park Program. We look forward to your review of our application, and our continued positive relationship.

Sincerely,

For Tamara Whittington
Superintendent

Attachment: Lighting Inventory, provided digitally in Excel format